Multistate Research Activity Accomplishments Reported

Project Number: NC-140

Project Title: Rootstock and Interstem Effects on Pome-and Stone-Fruit Trees

Period Covered: October 1, 2005-September 30, 2006

Date of This Report: December 15, 2006

Annual Meeting Dates: November 6-7, 2006

Participants: Please see annual meeting minutes, available on the NC-140 web-site: Http://www.nc140.org.
The address of the listserv for participants is: Http://www.nc140@virtualorchard.net.

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

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/plantings.html for more details on planting design, rootstocks and locations). Several widely planted trials have been concluded in the last few years and some conclude in 2006, and data from these plantings have either been published or are being prepared for publication. Currently there are 17 multi-state coordinated plantings from which data are being collected. These comprise seven apple, four cherry, three peach and three pear plantings. A brief summary of each as follows:

1998 Apple (Coordinated by Terence Robinson, NY).

T. Robinson told the group that 2006 would be the final year for this study. He requested final data be sent to him by March 1, 2007 and that the death of trees in the study be explained where possible.

1999 Dwarf and Semi-dwarf Fuji/McIntosh Apple (coordinated by W. Autio, MA).

1999-Apple – Annual report and a data collection protocol for 2007 were distributed by W. Autio. Cooperators were asked to measure tree leaning (as degrees from vertical) in the Semi-dwarf trial. These data should be reported for 2006 as well as 2007. The 2006 data should be sent to Wes by Jan. 15, 2007.

In the dwarf rootstock trial, rootstock did not affect fruit yield or yield efficiency for Fuji, but did so for McIntosh. Rootstock did affect fruit size in Fuji, but not McIntosh in 2005. Root suckering was much more prominent with Fuji as the scion cultivar than with McIntosh as the scion. Interactions of rootstock and site were significant for trunk crossectional area (TCA), cumulative fruit yield/tree, cumulative yield efficiency, and average fruit weight; interactions for survival were not analyzed but are expected to be the most notable.

In the semidwarf trial, data for Fuji were available only from three states, compared to seven states for McIntosh. Semidwarfing rootstocks did affect fruit yield for both Fuji and McIntosh, but did not affect yield efficiency or average fruit weight for Fuji. Semidwarfing rootstocks did affect yield efficiency, but not average fruit weight, for McIntosh.

2001 Redtop/Redhaven Peach Rootstock (coordinated by G. Reighard, SC).

Fourteen Prunus rootstock cultivars and selections were budded with 'Redhaven', 'Cresthaven', and 'Redtop'. Vigorous rootstocks included 'BH-4' and 'SLAP' (peach x almond hybrids), as well as 'Cadaman' and peach seedling SC-17. Standard sized rootstocks were Lovell and Bailey seedlings. Semi-dwarfing rootstocks included 'Jaspi', 'Pumiselect', 'Hiawatha', 'Julior', 'P30135', 'K146-43', 'K146-44', and 'VVA-1'. 'Redhaven' was planted in Indiana, Missouri, New Jersey, Ontario, and Utah; 'Cresthaven' in Colorado, Texas, and Washington; and 'Redtop' in California, Georgia, Maryland, and South Carolina. For Colorado, Washington, and probably Texas, 'Redhaven', not 'Cresthaven', is the cultivar budded on 'Jaspi'. Tree spacing was 5.0 m within rows and 6.0 m between rows.

A 5-year report was distributed by G. Reighard; cooperators were asked to check their data & report errors to him ASAP. A paper will be submitted in January, 2007 to the Journal of Am. Pom. Soc. All data for 2006 should be sent to him by Feb. 1, 2007.

2002 Cresthaven/Redhaven Peach Rootstock (coordinated by S. Johnson, CA).

Eight different peach rootstocks were planted at 18 different sites in 2002; the scion was either Redhaven or Cresthaven. Much variability was found among the different sites with regard to production yield. Adesto 101, MRS 2/5, Penta and Cadaman all had slightly larger fruit weight than the Lovell control; VVA-1 and Pumiselect had slightly smaller fruit weight, and VSV-1 had the smallest fruit weight in the trial. All the rootstocks had more suckering than the control rootstock (Lovell, 0.4/tree); Cadaman had the least and VSV-1 the most suckers/tree (2.6 and 17.5, respectively). Only Cadaman (94%) survived as well as the control rootstock, Lovell (93%); Pumiselect had the worst survival rate (64%).

S. Johnson reminded participants that it is time to prepare the 5-year report and asked participants to measure canopy height & spread, to explain why any tree failed, and to note any obvious reason for suckering (winter damage to the scion, incompatibility with scion, genetic issues, etc.). Data is to be submitted to him by Jan. 15, 2007.

2002 Cresthaven Peach Physiology (coordinated by S. Johnson, CA).

Cresthaven/Lovell trees were planted in eight locations in 2002; five of the locations collected data in 2004 and 2005, and six locations collected data in 2006. The purpose of the study was to determine environmental factors affecting harvest date, fruit weight, and soluble solids content. Considerable variation was found in all parameters measured. Preliminary evaluations indicated strong relationships between some of the parameters; average fruit weight increased with days between bloom and harvest, but average fruit weight and soluble solids content decreased with average temperature for the 60 days after bloom. Also, the days from bloom to harvest decreased with the average temperature for 60 days after bloom. Further work is planned to confirm these relationships.

2002 Buckeye Gala Apple (coordinated by W. Autio, MA).

This report presents data from the 2005 (fourth) growing season of this trial. Over all sites in the core data set (Arkansas, British Columbia, Kentucky, Massachusetts, Michigan, New Jersey, and New York), rootstock significantly affected trunk cross-sectional area after three seasons. Specifically, P.14 resulted in the largest trees, followed by Supporter & M.26 NAKB. The smallest trees were on B.9 Europe and B.9 Treco. After four seasons, trees on M.26 NAKB and M.26 EMLA had similar trunk cross-sectional area. Trees on the two B.9 strains likewise had similar trunk cross-sectional area. The three M.9 strains resulted in trees of similar trunk cross-sectional area. Yield efficiency was highest for the two B.9 strains and lowest for P.14. In 2005, M.9 Burgmer 756 resulted in larger fruit than did B.9 Europe; the largest fruit was from trees on M.9 Burgmer 756 and the smallest from trees on P.14. No differences were found in fruit size for trees on B.9 strains, the M.26 strains, and the other M.9 strains of rootstock. Of particular interest are the JM, the PiAu, and the CG rootstocks. After four seasons, G.41, CG.5935, JM.1, JM.7, and PiAu 51-11 appear to be in the M.9-size category; whereas, CG.3007, JM.2, PiAu 51-4, and PiAu 56-83 appear to be in the M.26 or larger category.

This year completes 5 years for this trial and additional data on tree height, spread, and burrknots should be collected according to the protocol. Cooperators were asked by T. Robinson to carefully review the data for each tree on JM1, JM2, JM7, CG.3007, G.935, and P.14 to determine if there are any super-dwarfing trees (all should be semidwarfing or semivigorous); there appears to be some mislabeling for some of these. Once data are corrected for mistaken rootstocks, they should be sent to W. Autio by Jan. 1, 2007 with a note explaining which trees were identified with the wrong rootstock.

2002 Cameo apple trial (coordinated by J. Clements, ME & W. Cowgill, NJ)

A semi-formal NC-140 planting of Cameo apple on three dwarfing rootstocks (G.16, M.9-337, and B.9) was established in 2002 in Massachusetts and New Jersey. All trees are trickle irrigated and trained to a vertical axis. Annual measurements of trunk circumference, tree height & spread (2006 only), suckering, fruit yield (beginning 2003), and fruit size (NJ only 2004-2005) have been made. The study is projected to continue for another five growing seasons. A 5-year summary of the trial will be published this winter (2006-07).

2002 Pear Trial - (no coordinator)

The study was planted in CA, OR, WA, and WV and is not a uniform trial. Each state had different varieties and rootstocks. There has been no coordination of data yet, but Steve Castognoli (OR) has agreed to take over coordination of data and will bring a report next year.

2003 Golden Delicious Physiology (coordinated by R. Marini, VA).

In 2006 all sites had good tree survival (at least 80%); survival was not influenced by site or rootstock. The interaction of site * rootstock was significant for TCA, but TCA was affected significantly by rootstock only at IA, MA, ME, NJ, and ONT; at all those locations, trees on T337 had the smallest trunks. In 2006 crop load was adjusted to specific levels for each tree; fruit was harvested at only eight sites, but yield was reported only for six locations. Both site and rootstock affected yield, but the interaction was not significant. In general, G16 produced the most fruit and had the highest yields; NJ

harvested the most fruit. Crops were quite light, so average fruit weight was not considered to be very meaningful. The largest fruit were reported for UT.

R. Marini distributed a report for 2006 and protocol for 2007. Sites that were not able to impose different croploads in 2006 due to light bloom and set should impose the range on croploads on their trees in 2007. Sites that imposed different croploads in 2006 should measure return bloom on each tree according to the specified protocol and then thin all of the trees to a low cropload (3 fruits/cm^2 TCA) soon after bloom. All 2006 data still outstanding should be forwarded to R. Marini by Mar. 1, 2007.

2003 Dwarf Apple Rootstock (coordinated by R. Marini, VA).

Data were analyzed as a repeated generalized randomized block design with SAS's Mixed Procedure. Block and tree (tree within a block) were designated as random effects. TCA was significantly influenced by rootstock at all locations. All locations except AR and possibly KY had good tree survival. Rootstock G.16 had the poorest survival. Number of fruit / tree and yield varied with site and with rootstock.

2004 Pear Trial - (no coordinator)

Steve Castognoli (OR) has agreed to take over coordination of data and will bring a report next year. The study was planted in OR, NY, and NS and is a uniform trial.

2005 Pear Trial - (no coordinator)

Steve Castognoli (OR) has agreed to take over coordination of data and will bring a report next year. The trial was planted in OR, WA, and NY.

1998 Cherry (coordinated by G. Lang, MI)

Sweet cherry – the eastern and western sweet cherry studies will be terminated at the end of this year (2006). All data for the western study should be sent to Frank Kappel by Jan. 15, 2007, and all data for the eastern study should be sent to Greg Lang by the same date.

Tart cherry – the eastern tart cherry study will continue for one more year (until the end of 2007). All data for 2006 should be sent to Greg Lang by Jan. 15, 2007.

2006 Apple Replant Study (coordinated by T. Robinson, NY)

This trial was planted in 10 locations and includes 12 rootstocks. T. Robinson distributed the protocol for 2007 and requested that cooperators measure total lateral shoot growth on all trees (the earlier protocol only requested shoot length of five laterals) to enable calculation of total shoot growth per tree. Trees are to be left unpruned or minimally pruned; however, if leader growth is more than 1 m, then the leader can be headed by 1/3. The protocol was amended (by agreement) to allow cropping of the trees in the second year, but they should be thinned to no more than five fruits/cm^2 TCA. Final data for 2006 is to be sent to T. Robinson by March 1, 2007.

2006 Cherry Physiology Study (coordinated by G. Lang, MI)

This trial, planted in four locations (CA, MI, NY, & WA), has Rainer on Gi.5 and will study the effect of management (pruning & thinning) on fruit size in four distinct climates. Other locations were

also interested, but trees could only be found for four locations. Trees for additional sites will be planted in 2007 or 2008. A protocol will be developed for 2007 and distributed to participants.

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

New York State, in cooperation with the USDA, continues to work on techniques for the improved propagation of apple.

NJ was to investigate improving softwood and hardwood tissue cutting techniques (contact Joe Gofredda).

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

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 roostocks through breeding and genetic engineering.

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

-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.

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

Geneva has released three M9 clones:

G16-susceptable to latent viruses, vigorous early, settles down by year 6, grows late, may have winter freeze issues, but survived better than B9 in midwinter freeze

G11-M9 size, excellent productivity, excellent in Europe, not immune from fire blight, but rather resistant.

G41 – one of the tops in yield efficiency, not a great rooter in stool bed, the solution is tissue culture.

Field Tour

Win Cowgill led an excellent and interesting tour of his plots at the Snyder Research Farm. The tour also included an overview and exhibit of equipment used in the "Sprayer Application Technology Training" workshops presented by John Grande, Director of the Snyder Research & Extension Farm.

COMMITTEE REPORTS:

Rewrite Committee -- Current project to expire September 2007. Wes Autio, Chair. The new proposal must be uploaded to NIMMS website by Dec. 1, 2006. The name for the project has been revised per suggestions in the midterm review; the new name is *"Economic and Environmental Sustainability and Fruit Tree Production Through Changes in Rootstock Use*."

Any changes need to be forwarded to Wes by Nov. 15, 2006. Changes suggested by meeting participants included:

1. Addition of plum rootstock work to Objective
2. Addition of propagation work to Objective
3. Inclusion of work by USDA cooperating scientist under planned work, especially in Objectives 1 – 3.

The new proposal draft (with the above changes) was agreed to by meeting participants and the committee chair and participants were commended unanimously for their work.

Administrative Advisor Report

Dr. Wendy Weatherspoon-administrator advisor reported to the group via conference call and discussed the new NC-140 proposal. She made several suggestions earlier to the Rewrite Committee Chair, Wes Autio, that included strengthening the impact section. She outlined the procedures for review and approval of the new proposal once it is submitted.

Future Plans – WORK PLANNED FOR NEXT YEAR

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. Technical committees will develop schedules of new promising rootstocks that merit broad testing, then prepare for trees to be propagated for future plantings.

Apple Planting Committee Report (T. Robinson, Ch.)

Plans were made to proceed with propagation of a smaller rootstock planting in 2009 (six new rootstocks, primarily new Russian stocks and four controls) with Honeycrisp and Auvil Early Fuji as the scions. Those who want to plant this trial must commit before Feb.1, 2007 (those not at the meeting must contact T. Robinson before that date and indicate which scion variety they want). W. Autio will coordinate the data for this trial.

Plans also were made to proceed with propagation of a larger rootstock planting in 2010 (15 new rootstocks, primarily new Geneva and Malling stocks and four controls) with Honeycrisp and Golden Delicious as the scions. Those who waht to plant this trial must commit before Feb. 1, 2008 (those not at the meeting must contact T. Robinson before that date and indicate which scion variety they want).

Cherry Committee Report (G. Lang, Ch.)

The 1998 tart cherry trial will end in 2007 (tenth season).

The trees from the 1998 sweet cherry trial that ended in 2006 will be used for a study to determine the interaction of pruning and rootstock on fruit size. A new rootstock trial being planned to look at interactions between dwarfing rootstocks and management; proposed stocks would include Gi.5, Gi.6, Edabriz and Wi72.

A second new rootstock trial also is being looked at for the PiKu stocks, Gi.12 and the best stocks from the 1998 trial. No date for planting this trial has been set yet.

Peach Committee Report (G. Reighard, Ch.)

A 2009 planting with 10 new rootstocks (to include Kuban86, Tetra, UC-Davis clones and, if possible, Zaiger clones) is being planned.

Pear Committee Report (S. Castagnoli, Ch.)

The Pear Committee restructured itself to have two coordinators: an accession/acquisition coordinator (still to be identified) and a trial/data coordinator (S. Castagnoli, OR, agreed to serve for the European pears) for each trial. The group will work on both European and Asian pears (coordinator for Asian pears still to be identified). Inclusion of Asian pears is hoped to attract new cooperators in the future.

A new European trial is being planned for 2009. Potential cooperators include BC, CHIH, MA, MD, NJ, NS, NY, ONT, OR, WA, & CO. Scion cultivars will vary with location; OR & WA will use Anjou, CA will use Bartlett, and eastern locations will use Blakes Pride. The trial will be propagated at Adams County Nursery or Fowler Nursery.

Plum and Apricot Committees – did not meet, looking for a new cooperators to take the lead.

USEFULNESS OF FINDING AND IMPACT OF COOPERATIVE RESEARCH PROJECTS

From uniform trials planted across sites in North America that differ greatly in terms of environmental conditions and biotic and abiotic stresses, unbiased data is gathered to quickly assess new rootstocks in a timely fashion. These rootstocks are compared with industry standards, and from these comparisons, recommendations to growers can be made that are independent and backed by solid data. In developing such recommendations, consideration is given to not only productivity, but also to survival, cold tolerance, disease resistance, graft union integrity, and ease of management. The NC-140 project is recognized internationally as a leading source of comprehensive, unbiased data on field performance of tree fruit rootstocks.

Website – We continue to maintain our Internet registration for our website at http://www.NC14.org/. The web site was hosted and maintained by Win Cowgill, NJ and Jon Clements, UMASS. An online Filemaker database that is self-editing contains the cooperator contact information. Requirements for web page design for regional projects have been met as outlined by the Cooperative State Research, Education, and Extension Service (CSREES) and the North Central Regional Association of Agricultural Experiment Station Directors (NCRA). Articles, photographs and reports were archived throughout the year.

E-Mail Distribution List – The projects Email distribution list is maintained by Win Cowgill, NJ and Jon Clements, UMASS. The posting e-mail address is <nc140@virtualorchard.net>

Web Based – The NC140 website has become a significant tool for extension outreach and dissemination of research results. In 2006 over 28,905 page hits were received an increase of over 10% from the previous year. Visitors from over 73 countries were logged, an increase of 5%. Ninety percentage of page hits originated in the US.

PUBLICATIONS

Refereed Journal articles:

Autio, W., T. Robinson, L. Anderson, B. Barritt, J. Cline, R. Crassweller, C. Embree, D. Ferree, E. Garcia, G. Greene, E. Hoover, S. Johnson, K. Kosola, J. Masabni, M. Parker, R. Perry, G. Reighard, 2005. Performance of 'Fuji' and 'McIntosh' apple trees after 5 years as affected by several dwarf rootstocks in the 1999 NC-140 rootstock trial. J. Amer. Pom. Soc. 59(4):202-214.

Autio, W., T. Robinson, B. Barritt, J. Cline, R. Crassweller, C. Embree, D. Ferree, E. Garcia, G. Greene, E. Hoover, S. Johnson, K. Kosola, J. Masabni, M. Parker, R. Perry, G. Reighard, S. Seeley and M. Warmund. 2005. Performance of 'Fuji' and 'McIntosh' apple trees after 5 years as affected by several semidwarf rootstocks in the 1999 NC-140 rootstock trial. J. Amer. Pom. Soc. 59(4):192-201.

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L. Perry, G.L. Reighard, S.D. Seeley, and M. Warmund. 2005. Fuji and McIntosh apple tree performance after 5 years as affected by several dwarfing rootstocks in the 1999 NC-140 Rootstock Trial. Journal of the American Pomological Society 59: 202-214.

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L. Perry, G.L. Reighard, S.D. Seeley, and M. Warmund. 2005. Fuji and McIntosh apple tree performance after 5 years as affected by several semidwarfing rootstocks in the 1999 NC-140 Rootstock Trial. Journal of the American Pomological Society 59:192-201.

Autio, W.R., J.M. Clements, and J. Krupa. 2006. G.16 versus M.9 in the 1998 NC-140 Apple Rootstock Trial. Fruit Notes 71(1):7-8.

Autio, W.R., J.M. Clements, and J. Krupa. 2006. New CG rootstocks, G.16, and Supporter 1, 2, and 3 versus M.9 and M.26 EMLA in the 1999 NC-140 Dwarf Apple Rootstock Trial. Fruit Notes 71(1):9-10.

Autio, W.R., J.M. Clements, and J. Krupa. 2006. CG.4814, CG.7707, G.30, and Supporter 4 versus M.26 EMLA and M.7 EMLA in the 1999 NC-140 Semidwarf Apple Rootstock Trial. Fruit Notes 71(1):12-13.

Autio, W.R. and J. Krupa. 2006. B.9, M.9, and M.26 strains and new Polish and PiAu rootstocks in the 2002 NC-140 Apple Rootstock Trial. Fruit Notes 71(1):14-15.

Autio, W.R. and J. Krupa. 2006. Several new dwarfing rootstocks compared to Lovell in the 2002 NC-140 Peach Rootstock Trial. Fruit Notes 71(1):16-17.

Autio, W.R., J. Krupa, and J.M. Clements. 2006. A comparison of Vineland Apple Rootstocks and M.26 EMLA in the 1996 McIntosh Rootstock Trials. Fruit Notes 71(1):5-6.

Clements, J.M and W.R. Autio. 2006. G.16 versus M.9 and B.9 in the 2002 Massachusetts-New Jersey Cameo Rootstock Trial. Fruit Notes 71(1):11.

Fazio, G., Aldwinckle, H.S., McQuinn, R.P. and Robinson, T.L. 2006. Differential susceptibility to fire blight in commercial and experimental apple rootstock cultivars. Acta Hort. 704:527-530

Gut, L.J., P.H. McGhee and R.L. Perry. 2005 Soil mounding as a control for Dogwood borer in apple. HortScience 40(7):2066-2070.

Lang, G.A. 2006. Cherry rootstock. Pp. 1109-1110 in Clark, J.R. and C.E. Finn. Register of New Fruit and Nut Cultivars: List 43. HortScience 41(5):1101-1133.

LoGiudice, N., Aldwinckle, H.S., Robinson, T.L. and Fazio, G. 2006. The nature of resistance of the ´B.9´ apple rootstock to fire blight. Acta Hort. 704:515-520.

Marini, R.P., J.L. Anderson, J.A. Barden, B.H. Barritt, G.R. Brown, J. Cline, W.P. Cowgill, Jr., P.A. Domoto, D.C. Ferree, R.M. Garner, G.M. Greene, C. Hampson, P. Hirst, M.M. Kushad, J. Masabni, E. Mielke, R. Moran, C.A. Mullins, M. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T. Robinson, C.R. Rom, T. Roper, J.R. Schupp, E. Stover, and R. Unrath. 2006. Performance of 'Gala' on four semi-dwarf rootstocks: A ten-year summary of the 1994 NC-140 semi-dwarf rootstock trial. Journal of the American Pomological Society 60:58-68.

Marini, R.P., J.L. Anderson, W.R. Autio, B.H. Barritt, J.A. Cline, W.P. Cowgill, Jr., R.M. Crassweller, P.A. Domoto, D.C. Ferree, J. Garner, A. Gaus, G.M. Greene, C. Hampson, P. Hirst, M.M. Kushad, E. Mielke, C.A. Mullins, M. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T. Robinson, C.R. Rom, T.R. Roper, J.R. Schupp, E. Stover, and R. Unrath. 2006. Performance of Gala apple on 18 dwarf rootstocks: Ten-year summary of the 1994 NC-140 Dwarf Rootstock Trial. Journal of the American Pomological Society 60:69-83.

Moran, R.E. 2006. Growth and yield improvement of newly planted 'Honeycrisp' apple trees with preplant soil amendments and rootstocks. HortScience 41:983 (abstract).

Pernice, F., L. Solari, and T.M. DeJong. 2006. Comparison of growth potentials of epicormic shoots of nectarine trees grown on size-controlling and vigorous rootstocks. J. Hort. Sci. and Biotechnology 81:211-218.

Reighard, G.L., T. Beckman, R. Belding, B. Black, J. Cline, W. Cowgill, R. Godin, M. Kaps, T. Lindstrom, D. Ouellette, L. Stein, K. Taylor, C. Walsh, M. Whiting and T. Robinson. 2006. Performance of Prunus Rootstocks in the 2001 NC-140 Peach Trial. Sodininkyste Ir Darzinninkyste. 25 (3):327-333.

Robinson, T.L. 2006. Interaction of fertilization, rootstock and irrigation on growth, thinning efficiency, yield and fruit quality of 'Empire' apple. Acta Hort. 721:41-48.

Robinson, T.L., R.L. Andersen and S.A. Hoying. 2006. Performance of six high-density peach training systems in the northeastern United States. Acta Hort. 713:311-320.

Robinson, T.L., S.A. Hoying, and R.L. Andersen. 2006. Performance of dwarfing cherry rootstocks in the Northeastern United States. Sodininkyste Ir Darzinninkyste. 25 (3):113-122.

Robinson, T.L., G. Fazio, H.S. Aldwinckle, S.A. Hoying, and N. Russo. 2006. Field performance of Geneva® apple rootstocks in the USA. Sodininkyste Ir Darzinninkyste. 25 (3):181-191.

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. Johnson, M. Parker, G. Reighard, R. Perry, J.P. Privé, C. Rom, T. Roper, J. Schupp, M. Warmund, W. Autio, W. Cowgill, K. Taylor, D. Wolfe. 2004. Performance Of Cornell-Geneva Rootstocks in Multi-Location NC-140 Rootstock Trials Across North America. Acta Hort. 658:241-245.

Solari, L.I. and T.M. DeJong. 2006. The effect of root pressurization on water relations, shoot growth, and leaf gas exchanges of peach (Prunus persica) trees on rootstocks with differing growth potential and hydraulic conductance. J. Experimental Botany 57:1981-1989.

Solari, L.I., S. Johnson, and T.M. DeJong. 2006. Relationship of water status to vegetative growth and leaf gas exchange of peach (Prunus persica) trees on different rootstocks. Tree Physiology 26:1333-1341.

Solari, L.I., S. Johnson, and T.M. DeJong. 2006. Hydraulic conductance characteristics of peach (Prunus persica) trees on different rootstocks are related to biomass production and distribution. Tree Physiology 26:1343-1350.

Song, G.-Q. and Sink, K.C. 2006. Transformation of Montmorency sour cherry (Prunus cerasus L.) and Gisela 6 (P. cerasus × P. canescens) cherry rootstock mediated by Agrobacterium tumefaciens. Plant Cell Reports 25:117-23.

Non-Refereed Journal Articles:

Agnello, A.M., A. Landers, D.A. Rosenberger, T.L. Robinson, J.E. Carroll, L. Cheng, P.D. Curtis, D.I. Breth, and S.A Hoying. 2006. Pest management guidelines for commercial tree-fruit production 2006. Cornell University, Ithaca NY

Andersen, R.L., J. Freer and T.L., Robinson. 2006. Plum Rootstocks Trials At Geneva: A Progress Report. NY Fruit Quarterly 14(1):27-28

Autio, W.R. and R.P. Marini. 2005. NC-140 Trial coordination, data analysis, and results summary. Compact Fruit Tree 38(3):26-27.

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L Perry, G.L. Reighard, S.D. Seeley, and M. Warmund. 2006. Comparison of several semi dwarf rootstocks with Fuji and McIntosh as cultivars: 1999 NC140 semi dwarf apple rootstock trials. Compact Fruit Tree 39(3):24-27.

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L, Perry, G.L. Reighard, S.D. Seeley, and M. Warmund. 2006. Comparison of several dwarf rootstocks with Fuji and McIntosh as cultivars: 1999 NC140 semi dwarf apple rootstock trials. Compact Fruit Tree 39(3):28-32.

Carroll, J.E., T.L. Robinson, D.I. Breth, S.A. Hoying, A.N. Lakso, A.M. Agnello, A.J. Landers, J.P. Nyrop, W.H. Reissig, R.W. Straub, M.J. Fargione, P.D. Curtis, D.A. Rosenberger, K.A. Iungerman, L. Cheng, I. A. Merwin, C.B. Watkins. 2006. New York integrated fruit production protocol for apples. New York Food and Life Sciences Bulletin 158, Cornell University, Geneva, NY

Cheng, L., T.L. Robinson. 2006. Zonal chlorosis of Honeycrisp leaves: Causes and Implications. Compact Fruit Tree 39(1):28-29.

Lang, G. 2006. Will VCHERRY be the sharpest pruning tool in your shed? Compact Fruit Tree 39(2):7-9.

Robinson, T.. L. Anderson, W. Autio, B. Barritt, J. Cline, R. Crassweller, W. Cowgill, C. Embree, D. Ferree, E. Garcia, G. Greene, C. Hampson, K. Kosola, M. Parker, R. Perry, T. Roper and M. Warmund 2006. A multi-location comparison of Geneva® 16, Geneva® 41 and M.9 apple rootstocks across North America. Compact Fruit Tree 39(2):22-23

Robinson, T.L., S.A. Hoying and R.L. Andersen. 2006. High-density peach training systems for NY fruit growers. Proc. of the 2006 Empire State Fruit and Veg. Expo. p 32-35.

Robinson, T.L., S.A. Hoying and R.L. Andersen. 2006. The integrated system of growing high quality sweet cherries in the east. Compact Fruit Tree 39(3):6-10.

Robinson. T.L., S.A. Hoying and G.L. Reginato. 2006. The Tall Spindle apple planting system. NY Fruit Quarterly 14(2)21-28.

Russo, N.L., T. Robinson, G. Fazio and H. Aldwinckle. 2006. Rootstock blight in apple. NY Fruit Quarterly 14(3):11-15.

Abstracts:

Fazio, G., H.S. Aldwinckle, T.L. Robinson, and J. Cummins. 2005. Geneva 41: A new fire blight resistant, dwarf apple rootstock. HortScience 40:1027 (Abstr.).

Lopez-Cuevas, S. and T.L. Robinson 2006. Effect of crop load, irrigation, and fertilization on yield and postharvest bitter pit incidence of 'Honeycrisp' Apple. HortScience 41: 1030 (Abstr.)

Osborne, J.L. and T.L. Robinson 2006. Chemical blossom thinning on Prunus in New York. HortScience 41: 995 (Abstr.)

Reginato, G.H., T.L. Robinson and V. Garcia de Cortazar. 2006. Predicted crop value for a cling peach and three nectarines of different harvest seasons as a function of crop load. HortScience 41: 995 (Abstr.)

Robinson, T.L. 2006. Optimum fruit size and yield to maximize crop value of Gala apple. HortScience 41: 982 (Abstr.)

Robinson, T.L. 2006. The evolution towards more competitive apple orchard systems in the USA. 27th International Horticulture Congress Program p73

Robinson, T.L. 2006. Effect of pruning, fertilization, chemical thinning and irrigation on ‘Gala’ apple fruit size, color and crop value. 27th International Horticulture Congress Abstracts p106.

Robinson, T.L., R.L. Andersen and S.A. Hoying. 2006. Performance of dwarfing cherry rootstocks in the Northeastern United States. International scientific conference on fruit tree rootstocks for temperate zone: Biological, ecological and technological aspects, Abstracts p.28.

Robinson, T.L., G. Fazio, H.S. Aldwinckle, and S.A. Hoying. 2006. Field performance of Geneva® apple rootstocks in the USA. International scientific conference on fruit tree rootstocks for temperate zone: Biological, ecological and technological aspects, Abstracts p.38.

Robinson T.L. 2006. Optimum fruit size and yield to maximize crop value. 2006 Great Lakes Fruit Workers Meeting. Abstracts pp.19-20.

Other Publications:

Agnello, A.M., A. Landers, D.A. Rosenberger. T.L. Robinson, J.E. Carroll, L. Cheng, P.D. Curtis, D.I. Breth, and S.A. Hoying. 2005. Pest Management Guidelines for Commercial Tree-Fruit Production 2005. Cornell University, Ithaca NY.

Andersen, R.L., T.L. Robinson, and J. Freer. 2005. Sweet cherry rootstock trials at Geneva. Proceedings of the Robert L. Andersen Stone Fruit Symposium. Cornell University, Geneva, NY pp18.1-18.2.

Domoto, P. 2006. Iowa planting of the 2003 NC-140 dwarf apple rootstock trial. Hort. Res. Sta. Ann. Prog. Rept. – 2005, ISRF05-36:43-44.

Godin, R. 2006. NC-140 Fruit Tree Rootstock Trials 2005 Reports. 1998 Sweet Cherry Rootstock Trial. pages 23-24 in: Caspari, H. W. (Editor). Western Colorado Research Center 2005 Annual Report. 2007. Technical Report TR06-06. Colorado Agricultural Experiment Station. 38 pp.

Godin, R. 2006. NC-140 Fruit Tree Rootstock Trials 2005 Reports. 2001 Peach Rootstock Trial. pages 25-26 in: Caspari, H. W. (Editor). Western Colorado Research Center 2005 Annual Report. 2007. Technical Report TR06-06. Colorado Agricultural Experiment Station. 38 pp.

Godin, R. 2006. NC-140 Fruit Tree Rootstock Trials 2005 Reports. 2002 Peach Rootstock Trial. page 27 in: Caspari, H. W. (Editor). Western Colorado Research Center 2005 Annual Report. 2007. Technical Report TR06-06. Colorado Agricultural Experiment Station. 38 pp.

Extension publications:

omoto, P. 2006. “Apple rootstock research update.” Iowa Fruit and Vegetable Growers Conference. Jan. 27 2006, Marshalltown, IA. (Attendance 90).

Domoto, P. 2006. “Apple rootstock research and training systems.” Iowa Fruit and Vegetable Growers Field Day. Jun. 19, 2006, ISU Horticulture Farm, Ames, IA. (Attendance 70).

Kosola, K.R. 2006. Options for managing apple replant disease. Wisconsin Fresh Fruit and Vegetable Conference, 1/10/06, Oconomowoc, WI.

Lokaj, G, 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. 2007. "New Jersey Commercial Tree Fruit Production Guide." Rutgers Cooperative Extension Bulletin E001.

Moran, R. 2006. “Horticultural Requirements of Apple Trees.” Waterville, ME, March 28, 2006.

Newell, M. J. 2006. “NC140 Peach Rootstock Update.” Presented at: 2006 Annual Bay Area Fruit Meeting, Queenstown, MD (attn. 40).

Stasiak, M.J. 2006. “Apple rootstocks for Wisconsin.” Wisconsin Fresh Fruit and Vegetable Conference, 1/10/06, Oconomowoc, WI.

In Press:

Autio W., T. Robinson, L. Anderson, B. Barritt, J. Cline, R. Crassweller, C. Embree, D. Ferree, E. Garcia, G. Greene, E, Hoover, S. Johnson, K. Kosola, J. Masabni, M. Parker, R. Perry, G. Reighard. 2006. Early performance of ‘ Fuji’ and ‘McIntosh’ apple trees on several dwarf rootstocks in the 1999 NC-140 rootstock trial. Acta Hort. (in press)

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L. Perry,

G.L. Reighard, S.D. Seeley, and M. Warmund. 2006. Early performance of Fuji and McIntosh apple trees on several dwarf rootstocks in the 1999 NC-140 Rootstock Trial. Acta Hort. In press.

Autio, W.R., T.L. Robinson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, R.S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L. Perry, G.L. Reighard, S.D. Seeley, and M. Warmund. 2006. Early performance of Fuji and McIntosh apple trees on several semi dwarf rootstocks in the 1999 NC-140 Rootstock Trial. Acta Hort. In press.

Kosola, K.R., J.H. Gilman, B.A.A. Workmaster, J.S. Busse. 200X. Sampling damage to tree fine roots: comparing air excavation and hydropneumatic elutriation. Submitted to HortScience.

Robinson, T., L. Anderson, W. Autio, B. Barritt, J. Cline, R. Crassweller, W. Cowgill, C. Embree, D. Ferree, E. Garcia, G. Greene, C. Hampson, K. Kosola, M. Parker, R. Perry, T. Roper, and M. Warmund. 2006. A multi-location comparison of Geneva 16, Geneva 41, and M.9 apple rootstocks across North America. Acta Hort. In press.

Song, G-Q., G.A. Lang, S.V. Dolgov, and K.C. Sink. 2006. Cherries. in R. Scorza and T.C. Hall (eds.), The transgenics: encyclopedia of biotech plants, Vol. 5, Blackwell Publishing (in press).

Presentations:

Autio, W.R., J.L. Anderson, B.H. Barritt, J.A. Cline, R.M. Crassweller, C.G. Embree, D.C. Ferree, M.E. Garcia, G.M. Greene, E.E. Hoover, S. Johnson, K. Kosola, J. Masabni, M.L. Parker, R.L. Perry, G.L. Reighard, T.L. Robinson, and M. Warmund. 2004. Early performance of 'Fuji' and 'McIntosh' apple on several dwarf rootstocks in the 1999 NC-140 Rootstock Trial. VIII International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems, ISHS, Hungary.

Extension Presentations:

Annual Peach Grower's Meeting, Malden, Missouri. February 23, 2005. Presented a grower update the rootstock trials in MO.

New Jersey Extension Meetings and Field Days included the following:

- •North Jersey Fruit Meeting, March 2006; Broadway, NJ. 82 attendees (growers).
- •North Jersey Twilight Fruit Meeting, April, 2006; Rutgers Snyder Farm, Pittstown, NJ. 42 attendees (growers).
- •North Jersey Horticultural Research Twilight Mtg., September, 2006; Snyder Farm, Pittstown, NJ. 78 attendees (organic and conventional growers).
- •South Jersey Field Day and Tour, August 2006; RAREC, Upper-Deerfield, NJ. 160 attendees (growers, industry and Extension personnel).

Other Outreach Activities:

Lang, G. & Flore, J. (Symposium organizers). 2006. The 2006 Art Mitchell Symposium: Tree Growth and Development in Modern Cherry Production, held 19-21 January 2006 at the MSU Northwest Horticultural Research Station, Traverse City, MI. Participants included growers and more than 45 invited speakers, panelists, and moderators from nine countries.

Grants:

Moran, R., and D. Zhang. 2006. Cold Temperature Tolerance of Apple Rootstocks. Prepared for the Maine Ag. Center. Received $1500.

Moran, R., and D. Zhang. 2006. Cold Temperature Tolerance of Apple Rootstocks. Prepared for the New England Tree Fruit Research Committee. Requested and received $570.

Project NC-140
Multistate Research Activity Accomplishments Reported – 2006 (State Summaries, supplement)

California: Both the 2001 and 2002 peach rootstock trials have been established in California. The VVA-1 rootstock is the most promising item in both these plantings. It is a thrifty looking dwarf tree with generally good fruit size. For the 2002 trial it had the largest fruit size of all the rootstocks, although it did have some root suckers. In the 2001 trial, fruit size was not as good and the trees seemed a little weak. Thus, there is some concern about its long-term vitality. The 2003 Golden Delicious apple rootstock trial has also been planted in California. This planting has a large number of items that so far look promising. They range from extremely dwarfing to quite vigorous rootstocks. Of particular interest is the apparent resistance to fireblight of many of the rootstocks. In the past 2 years, about half the trees on the standard stocks M26 and M9 have died from this disease. Three trees on PiAu 56-83, one on PiAu 51-11 and one on Bud 62-396 have all died. So far, none of the CG or JM series rootstocks have succumbed to this disease.

Colorado: Severe spring frost at or near bloom at the two locations with NC-140 plantings affected fruit production data for 2006. Pumiselect, Cadaman, and SLAP peach rootstocks grew best and tended to have the best fruit production at the included locations, although Pumiselect had poor survival. Final growth data was collected for the 1998 western sweet cherry study in 2006, and opportunity was taken to examine phytoparasitic nematode populations associated with the roots of the sweet cherry rootstocks. This preliminary assessment of the nematode taxa and populations found potential relationships between rootstocks and observed nematode taxa and populations. Further studies on these relationships are planned for 2007.

Illinois: Two NC.140 experimental trials are planted at University of Illinois Urbana-Champaign Campus. The oldest trial is the 2002 'Buckeye Gala' apple on nine rootstocks. Tree size as a function of TCSA showed that Bud-9 Europe and Bud-9 Treco continued to be the smallest, while P.14 is the largest. Yield per tree was adequate with the highest (28.7 Kg) on M.26NAKB and the lowest (12.3 Kg) on B.9Treco. Fruit sizes were largest on M.9nic29 and smallest on Supporter 4. Rootstocks differed in their suckering capacity with Bud-9Erurop producing more than 5 suckers per tree, while M.26NAKB and P.14 did not produce rootsuckers. Fireblight has been a major problem in Illinois in the last three years. The nine rootstocks responded differently to fireblight infection. The most serious tree mortality occurred on M.9 T337 (100), M.26 EMLA (71%), and Supporter 4 (71%). Trees on M.26NAKB suffered 57% loss, trees on M.9 nic29 and M.9 B756 suffered 43% loss, and trees on Bud-9 Treco and Bud-9 Europe suffered only 14% loss. However, trees on P.14 did not suffer any loss to fireblight. Interestingly, Honeycrisp trees on B.9 Treco planted at the same time but not part of the trial were not affected by fireblight. The second and most recent trial was established in the spring of 2006 involves testing the interaction of rootstock genotype and replant disease using 'Mitchell Gala' as scion wood grafted on 12 rootstocks. Trees have grown very nicely but it is too early to report any data.

Kentucky: All of the NC-140 trials in Kentucky are located at the Research and Education Center in Princeton, KY. One is the 1999 dwarf and semi-dwarf apple plantings. Among the dwarf rootstocks, trees on CG.3041 and CG.4013 have yielded the most fruit, while trees on G.30N have yielded the most fruit among the semi-dwarf trees. Below to normal temperatures throughout the growing season resulted in fair to good color of our Fuji apples. In the 2002 rootstock trial, trees on the M.9 Burg 756 stock have yielded the most fruit over the past three seasons. Trunk cross-sectional area is highest for P.14 followed by M.9 Burg 756 and M.26 NAKBT337. Yield data was taken for the second time from two trials planted in 2003. Trees on PiAu56-83 yielded the most fruit over the past two years, and are the biggest trees in this trial. Trees in the physiology trial were thinned differentially to crop loads of 2, 5, 8, 11, and 14 fruit per

square centimeter of trunk cross sectional area. No significant differences were observed among the three rootstocks (G.16, M.9 NAKBT337, and M.26 EMLA)in mortality, cumulative yield, yield in 2006, fruit size (as measured by average weight per fruit), number of flower clusters, number of fruit harvested, crop density, or trunk cross-sectional area. Neither rootstock nor the covariate, crop density, was significant in the analysis of covariance for fruit weight.

Maine: Maine has three rootstock plantings. The 2003 NC-140 Golden Delicious rootstock and physiology plantings were maintained according to NC-140 protocol. Trees in the physiology study were not cropped due to insufficient fruit set. A local trial established in 2002 with Honeycrisp on M.26 EMLA and G.16 is being maintained until 2011. Data measurements included trunk circumference, tree height, number of flower clusters and yield. Growth and yield of G.16 trees was generally greater than M.26. Tree survival was similar for both rootstocks.

Impacts: Planting superior rootstocks can increase yield and tree survival. Impacts will be measured as changes in the industry and will be documented through grower surveys.

Maryland: All current NC-140 peach trials are located on the Eastern Shore of Maryland at the Wye Research and Education Center (WREC) outside of Queenstown. The current trials consist of the 2001 Redtop planting on fourteen different rootstocks, the 2002 Redhaven planting on eight different rootstocks and the 2002 Cresthaven /Lovell physiology study. All trees continue to be maintained using local commercial recommendations for pruning, fertility, pest control and irrigations. All established protocol for data collection have been accomplished and reported to the trial coordinators through the 2006 season. Rootstocks Controller 5 and Controller 9 have exhibited good tolerance to wet soils and some size-controlling attributes.

Massachusetts: In the 1998 NC-140 Apple Rootstock Trial in 2006, largest trees with the smallest average fruit size (1999-2006) were on G.16. Cumulative yield per tree (1999-2006) and yield efficiency (1999-2006) were similar for trees on M.9 and M.9 EMLA, but both resulted in less yield per tree and similar yield efficiency than did G.16. In the 1999 NC-140 Dwarf Apple Rootstock Trial (McIntosh), largest trees were on CG.4013 and the smallest were on M.9 NAKBT337, Supporter 1, and Supporter 2. Cumulative yield (2001-06) was greatest from trees on CG.4013, CG.5179, and G.202 and smallest from trees on M.9 NAKBT337, G.16N, and Supporter 1. Cumulative yield efficiency was greatest for trees on Supporter 2 and least for trees on G.16N and M.26 EMLA. Average fruit size (2001-06) was greatest for trees on M.9 NAKBT337 and least for trees on Supporter 2 and Supporter 3. In the 1999 NC-140 Semidwarf Apple Rootstock Trial (McIntosh), largest trees were on G.30N, M.7 EMLA, and Supporter 4 and the smallest were on CG.4814, M.26 EMLA, and CG.7707. Cumulative yield (2001-06) was greatest from trees on G.30N. Cumulative yield efficiency was greatest for trees on CG.4814 and least for those on M.7 EMLA. Average fruit size (2001-06) was unaffected by rootstock. In the 2002 NC-140 Apple Rootstock Trial, the largest trees were on PiAu51-4, and the smallest were on the two B.9 strains. Greatest cumulative (2004-06) yield was harvest from trees on the B.9 strains and M.26 NAKB and the least from those on Supporter 4. The most yield efficient trees were on the B.9 strains. The M.9 strains, B.9 (Treco), and PiAu51-4 resulted in the greatest average (2004-06) fruit size, and M.26 NAKB and Supporter 4 resulted in the smallest. In the 2002, NC-140 Peach Rootstock Trial, trees on Cadaman and Lovell were the largest, and those on VSV-1, Pumiselect, and VVA-1 were the smallest. Greatest cumulative yield (2005-06) and yield efficiency (2005-06) resulted from Cadaman and Lovell and the lowest from Pumiselect and VSV-1. Average fruit size (2005-06) was not affected by rootstock. Pumiselect has experienced the greatest tree loss (50%), followed by Penta (25%), MRS 2/5 (12.5%), and VVA-1 (12.5%). In the 2002 NJ/MA Apple Rootstock Trial (Cameo), trees on G.16 were larger than those on B.9 or M.9 NAKBT337. Trees on G.16 had the greatest cumulative yield (2003-06), and those on B.9 were the most yield efficient. Average fruit size (2003-06) was unaffected by rootstock.

Impacts: Approximately 250 acres were planted to dwarfing rootstocks during the last year. All rootstock recommendations are based on the results of this project, and growers rely heavily on those recommendations when selecting the proper scion/rootstock combinations. These rootstocks, will reduce pruning and harvest labor by 50%, increase fruit quality, increase size by 10-20%, and enhance the economic return on this acreage by as much as 50%. Further, smaller trees require 70% less pesticide because of reduced canopy volume. The net effect of the planting in 2006 is to reduce the amount of spray material in total by about 250,000 gallons per year in Massachusetts. The beneficiaries of this year's research are tree-fruit growers and the citizens of the Commonwealth.

Michigan: For the 'McIntosh' apple trials planted in 1999, the G.30 clone appears to be the only semi-dwarfing rootstock performing well in sandy infertile soil of northern Michigan (Traverse City), suggesting commercial promise for this region. CG.5087 warrants further testing due to productivity and vigor. On the better soil of central west Michigan (Clarksville), 'McIntosh' on the dwarfing CG series 4013, 5202 and 5935 show commercial potential at this time. For the 'Montmorency' tart cherry trial planted in 1998, no rootstock has performed as well as standard mahaleb seedling for trunk-shaker mechanical harvest. However, for alternative mechanical harvest methods that would utilize smaller trees at higher densities, the semi-dwarfing W158 and more dwarfing W72 have higher yield efficiencies than mahaleb. The sweet-tart varieties Balaton™ and Danube™ on the vigorous Hungarian mahaleb seedling rootstocks have been yielding better than on standard mahaleb seedling. For mechanically-harvested processing sweet cherries (e.g., Hedelfingen), standard mahaleb and the Hungarian mahaleb rootstocks (Erdi V, CT.2753, and CT.500) have been much more yield efficient than Mazzard, yet fruit quality (size) has been similar. In genetic studies, an efficient adventitious shoot regeneration protocol has been established for successful and stable Agrobacterium-mediated genetic transformation of sour cherry and hybrid cherry rootstock genotypes. Studies of high tunnel sweet cherry production on dwarfing rootstocks have demonstrated yields of 4.0 to 5.4 tons/acre of fruit averaging 12.5 g in weight and 97% 10-Row and larger in size, with projected net (gross value – harvest labor cost) values of $18,650 to $24,500 per acre and reduced needs for chemical pesticide inputs.

Minnesota: In the NC140 1999 planting, tree size ranking has not changed significantly. In the dwarf planting, Supporter 1 is the smallest tree and CG.4013 the largest. In the semidwarf planting there are no significant differences among the rootstocks in TCA. Yield for the Cornell-Geneva rootstocks was significantly higher in the dwarf planting than the others under evaluation. Fruit produced on trees grafted onto CG.5202 and CG.4013, on average, produced 28 kg/tree without much of a reduction in fruit size. Fruit produced on trees grafted onto G.30N and CG6210 averaged about 31 kg/tree again without a reduction in fruit size. We established a rootstock trial in the spring of 2003 with a Minnesota breeding selection MN1797, now named SnowSweet™ (with limited number of trees available for spring 2006 and 2007 planting). Tree growth was excellent during the 2006 growing season even though moisture was limiting during the summer. SnowSweet™ is a late cultivar for Minnesota with fruit harvested October 12 and has a droopy growth habit. The trend in tree size for Zestar! is for Bud 9 and M.9 trees to be smallest followed by M. 26 and then EMLA. 7. Suckering was evident on almost all EMLA.7 trees. Ranking of tree size after the 2006 growing season is the same as after the 2005 with M.26, Bud. 9 and EMLA 9 being of equal tree size and EMLA 7 being significantly larger. Fruit was harvested August 24th.

New Jersey: The two peach plantings were terminated at the end of the 2006 growing season due to virus concerns. The 2001 peach planting ('Redhaven' cv) had 7 rootstocks with significantly smaller mean trunk crossectional areas than 'Lovell' (VVA-1, Jaspi, K146-43, Julior, 'Bailey', K146-44, and P30-135). Of these 7 smaller rootstocks 'Bailey' had significantly higher cumulative yield efficiency than 'Lovell' (0.90 vs. 0.63 kg fruit/cm2 TCA) but, the others were not different from 'Lovell'. As of 2006 the 2002 peach planting ('Cresthaven' cv) had four rootstocks with significantly smaller mean trunk cross sectional areas

than ‘Lovell’ (VSV-1, VVA-1, Penta, MRS 2/5, and Adesoto 101). Cumulative yield efficiency was not significantly different among rootstocks in the 2002 planting.

The 1998 NC140 CG-16 Jonagold Rootstock trial compares CG 16 to the standard M9 EMLA. In 2006 there were no significant differences in yield, yield efficiency, or Trunk Cross Sectional Area. The were no cumulative yield and yield efficiency differences for 2000-2006 between these stocks. This trial will be terminated after this growing season.

In the New Jersey/UMASS G16 Cameo NC140 Rootstock Trial, B9 was the smallest stock by TCSA, G16 the largest. B9 was the most yield efficient stock in 2006 and had the largest cumulative yield efficiency (2003-2006). B9 and M9337 had significantly higher average fruit weight over G16 in 2006.

2002-NC-140 Gala Apple Rootstock Trial consists of 11 rootstocks. Tree growth was excellent in 2006. There was no significant difference in average fruit size, yield or yield efficiency between stocks. Rootstocks affected TCSA, cumulative yield and cumulative yield efficiency at the end of the 5th growing season. The largest trees at the end of 2006 were PiAu51-4 and P. 14 and the smallest trees were B.9Europe followed B.9Treco. B.9Europe and B.9 Treco stocks had the highest cumulative yield and efficiency. There were no significant differences in average fruit size.

2003 NC-140 Apple Physiology Trial- This year was our first opportunity to evaluate the effect of crop load and its interaction with rootstock in this planting. Trees had adequate bloom and fruit set to establish nearly the full complement of crop loads requested by the protocol. There was a significant interaction effect of crop load and rootstock on average fruit weight (P=0.0040). Fruit weight decreased linearly with increasing crop load on the G16 and M26 but not on R337 (Fig 1). There was also a significant interaction effect of crop load and rootstock on TCA growth from 2005 to 2006 (P=0.0019). TCA growth decreased linearly with increasing crop load on G16 and R337 but not on M26.

2006 NC140 Apple Replant Trial NJ and MA Cooperating- Twelve rootstocks from the Cornell breeding program including standard stocks were utilized. At the end of the 2006 growing season G.4210 was the smallest stock and G.5935 was the largest. G.4210 had the largest increase in circumference from spring to fall in 2006. B.9 had the smallest increase in circumference.

New York: Several apple rootstock trials showed G.41 was the most yield efficient dwarf stock we are evaluating. G.16 was also highly efficient. A field trial conducted jointly by Cornell University and USDA-ARS showed that almost all of the CG rootstocks showed no rootstock death to fire blight when the scion was inoculated. Exceptions were G.11, G.65, G.935, CG.4288 CG.6006 and CG.6210 which each had a low percentage of trees infected. B.9 also had a low level of trees infected in this trial. Low levels of infection were also shown for P.14 P.22, PiAU56-83, Vineland 3 and M7. New rootstocks from Japan (JM series) showed no infections except JM.2. The Vineland series of rootstocks showed no infection except Vineland 3. All of the Malling stocks except M.7 showed a high level of infection as did Ottawa3, and Supporter 4. A pruning study overlaid on the 1998 sweet cherry rootstock trial showed a trend toward larger fruit size from spur extinction pruning or stubbing back pruning even of dwarfing stocks. Nevertheless the dwarfing stocks continued to produce smaller fruit size. Analysis of covariance showed that the difference in fruit size was largely the result of high crop loads with the dwarfing stocks. Peach experiments showed that Controller 5 and Krymsk-1 (VVA-1) survived much better in NY state than any other stocks. These have high potential as improved peach rootstocks for northern growing areas.

NY Outreach Activities

A grower field day was held in July to highlight high density sweet cherry orchards on several dwarfing rootstocks which stimulated grower interest to expand sweet cherry acreage in NY State. A grower field day was held in Northern NY to highlight high density apple orchards on various dwarfing rootstocks to improve the productivity and profitability of new apple orchards in the Northern production areas of the state.

North Carolina: North Carolina has four of the NC-140 cooperative apple plantings. The trials that are currently under investigation in North Carolina are the 1998 gala planting, both the 1999 fuji dwarf and semi-dwarf plantings and the 2006 apple replant trial. Growing conditions in 2006 were ideal with adequate rainfall during the summer and no significant frost/freeze conditions in the spring during bloom. In the 1998 gala planting the trunk cross-sectional area (TCSA) of trees on G.16, M.9 EMLA and M.9NAKBT337 were not significantly different, however trees on G.16 were numerically larger and those on M.9NAKBT337 were the smallest . Trees on G.16 had the greatest cumulative yield which was significantly greater than that of trees on M.9EMLA which had the least. In the dwarf fuji planting, trees on CG.4013 had the largest TCSA and trees on M.9 NAKBT337, Supporter1, 2, and 3 had the smallest. Trees on CG.5935 had the greatest cumulative yield and trees on Supporter 1 the lowest. In the semi-dwarf planting, there were no significant differences in TCSA, although trees on CG. 6210 were the largest and those on CG.4814 the smallest. Cumulative yield was greatest for trees on CG.6210 followed by G.30T and CG. 7707 and the lowest yield was for trees on M.7 EMLA and M.26EMLA . Following the tropical storm damage received in 2004, several rootstocks of interest that may have brittle or shallower roots are CG.5179, Supp.4, CG. 7707, G.30N and G.30T. Data from the 2006 apple replant study will not be collected until mid-winter 2007. The information generated in this project is given at grower meetings and orchard tours are held in the plantings to help educate our clientele in the southeast about apple rootstocks.

Nova Scotia: Season and Crop: The winter was considered generally mild. The lowest temperature was on February 12 at -19.4oC. The season started very dry and ten days to two weeks earlier than usual. McIntosh full bloom was May 24th which was almost two weeks earlier than usual. Immediately following the bloom period and during bloom for the late varieties, cloudy overcast wet weather moved in and persisted for about two weeks. The lack of sunshine, we believe, increased the efficiency of thinners and confirms earlier work by Ross Byers. Cortland appeared to be especially sensitive, and there were reports of over thinning with Sevin. All this led us to predict a lower crop than usual, however fruit size was larger than normal, and the late varieties preformed well, so there was only a slight reduction in the region's crop.

Status of the Current and Previous Trials at Kentville, Nova Scotia and Bouctouche, New Brunswick: The following trials are currently in place at Kentville: the 2006 Replant Study; the 2005 Pyro-Dwarf Pear Rootstock Trial; the 1999 Cornell Geneva dwarf and semi-dwarf rootstock planting; and the 1998 Cornell/Geneva G. 16 and G. 41 mini planting

The 2006 replant trial was not planted until very late so growth has been minimal this year. This was planted by David Baldwin under the direction of dr. Privé who had planed to combine the Bouctouche and Kentville trials. Since that time, he has accepted a acting position in administration and will not be available for the next six months, it is not known how this will impact on the long term plans. In the mean time, C. Embree is continuing to supervise the research. For the 1998 JonaGold trial, the rootstock G.16 is 27% larger than M.9, G.41 is slightly smaller than G.16. In 2006 fruit size was smaller on M.9.

The 1984, 1989, and 1992 plantings are still in place, but are being used for other studies.

Pennsylvania: Sudden cold temperatures in early December 2005 killed all but two of the Redhaven/ MRS 2/5 trees in the 2002 peach trial. This suggests that trees on MRS 2/5 may harden off more slowly than is desired. Tree mortality is high for G.41 in the 1998 apple planting. Our preliminary diagnosis for the tree loss is graft union necrosis (ToRSV). G.16 and M.9 have 100% survival in this planting, and trees on these two stocks are very comparable in growth and performance. Further diagnostic study is planned to confirm the preliminary conclusion. Tree mortality is very high for all three Supporter rootstocks in the 1999 dwarf Fuji planting in Biglerville. Fuji trees on Supporter rootstocks at Rock Springs are also growing and performing poorly, while McIntosh trees on Supporter rootstocks have growth and productivity similar the other rootstocks in the trial. The 2006 replant X rootstock planting grew well, although initial tree quality, caliper, and number of feathers were highly variable. Data collection for 2006 is underway for all

plantings. Research results will form the basis for making rootstock recommendations to Mid-Atlantic fruit growers.

South Carolina: In the 2001 peach trial, 'Redtop' on BH-4, K146-43, and K146-44 rootstocks had 100% survival after 6 years in the orchard. SLAP and SC-17 continued to be the most vigorous rootstocks. No rootstock produced fruit significantly larger than Lovell. SC-17 and Bailey have been the most productive rootstocks over the last 4 years, with cumulative yields ~270 kg/tree. Bailey, Hiawatha, K146-43, VVA-1, and Lovell have the highest cumulative yield efficiencies. Julior, Jaspi, and VVA-1 continue to produce trees with low vigor and fruit yields. There was a 3-day range in bloom date and a 4.5-day range in maturity date. In the 2002 peach trial, 'Redhaven' on Lovell and K146-43 have 100% survival after 5 years in the orchard. Cadaman and Lovell continue to be the most vigorous rootstocks, and Mr.S. 2/5, VSV-1, and VSA-1 continue to be the least vigorous. Fruit of trees on VVA-1, Cadaman, and Lovell were largest, and fruit of trees on Mr.S. 2/5 were smallest. Cadaman and Lovell had the highest fruit yields in 2006, and were the most productive rootstocks over the last 3 years, with cumulative fruit yields >150 kg/tree. Adesoto 101, Mr.S. 2/5, VSV-1, and VVA-1 had the lowest yields. Low-yielding rootstocks (< 20 kg/tree) also had low yield efficiencies, except for VSV-1. There was a 2.5-day range in bloom date and a 9-day range in maturity date. In the 1998 Cherry trial, 'Hedelfingen' on GI 148-8 has 100% survival after 9 years in the field. Trees on GI 195-20, GI 209-1, and Weiroot 53 have the poorest survival. Mazzard and Weiroot 10 continue to be the most vigorous rootstocks, and GI 148-2 the least vigorous. There were 1.5-day bloom date and 6.5-day maturity date differences among rootstocks. Fruit size was largest with Weiroot 10 rootstocks and smallest with Mahaleb. Trees on G195-20, Edabriz, Weiroot 10, Weiroot 13, and Weiroot 158 had the highest yields in 2006 (> 20 kg/tree), and highest cumulative yields (> 45 kg/tree). GI 195-20 had the highest yield efficiency in 2006 and highest cumulative yield efficiency. Mahaleb and Mazzard continue to be the least yield efficient rootstocks. In the 1999 Fuji dwarf apple trial, trees on Geneva 16N rootstocks continued to be the most vigorous, and trees on Supporter #3 rootstocks were the least vigorous. Fruit size was largest with Geneva 16N and M.9T337 rootstocks and smallest with Supporter #2 and Supporter #3. There were no significant differences in fruit yield in 2006. CG.179, Supporter #2, and Supporter #3 rootstocks had the highest yield efficiency in 2006 and also over the last 6 years. In the 1999 Fuji semi-dwarf apple trial, M.26 rootstocks continued to be the most vigorous. There were no significant differences in fruit size, total fruit yield, or cumulative fruit yield. Yield efficiencies were highest with CG.814 in 2006. Cumulative yield efficiency was much higher with CG.814 and Supporter #4 than with M.26.