SAES-422 Multistate Research Activity Accomplishments Report

Project No. NC 140 and Title: Improving Economic and Environmental Sustainability in Tree-Fruit Production Through Changes in Rootstock Use


Annual Meeting Dates: November 6-9, 2013

Brief Summary of Minutes of Annual Meeting

The 2013 meeting was coordinated, hosted and chaired by Dr. Essie Fallahi, University of Idaho, Meridian (Boise), ID November 6-9, 2013. The meeting included a conference day long tour of commercial orchards and research plots at the Parma, ID research station. A report on each cooperative trial was given by planting coordinators. Current status of eight existing or recently terminated plantings and four future plantings were shared with the group. Sites for future meetings were confirmed. Next year’s meeting will be coordinated by Greg Reighard and will be located in Clemson, SC. The following year’s meeting will be in Northern California, organized by Rachel Elkins and in 2016 by Greg Peck, Virginia. Accomplishments report and minutes prepared by Essie Fallahi, ID and Rachel Elkins, CA.

Accomplishments

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

Projects which are in various stages of data collection and evaluation include the following in association with years of plot establishment:

2003 Dwarf Apple Rootstock trial completed with publications forthcoming.
2004 Pear rootstock trial compares 3 rootstocks at 3 locations in North America.
2005 Pear rootstock trial at 6 locations in North America.
2005 Cherry high tunnel systems in MI.
2006 Cherry physiology trial compares the yield and fruit size of a dwarfing cherry rootstock at 4 locations in North America.
2009 Peach rootstock and physiology trials at 13 sites.
2009 Peach physiology study led by Johnson transferred to Marini following Johnson retirement.
2010 Apple rootstock trial.
2010 Cherry rootstock and training systems.
2014 Apple rootstock trial coordinated by Cline
2014 Apple organic rootstock trial coordinated by Robinson
2015 Sweet Cherry rootstock trial coordinated by Lang

The following projects are in their final stage of conclusion and wrap-up. The 2003 Apple Physiology study was completed with one paper published, one in press and two potential papers to be prepared. The 2003 Apple rootstock trial data collection is in its final year. Data will be summarized for writing and submitting a paper.

Apple Sub-Committee (Chair, Robinson, NY)

The 2014 Apple planting will be coordinated by John Cline who has also agreed to analyze the data. This trial has two semi dwarfing rootstocks that may be too large for a 3-foot spacing. The group voted in favor of extending this to 4 feet in the row and 12 feet between rows with the cultivar Honeycrisp, but keeping the tall spindle system. For Fuji, it was agreed to extend the spacing to 5 feet in the row, 13 feet between rows and a vertical axe training system. Each site will select a pollinizer variety since some sites are very limited in adapted varieties. Another trial is being organized by Robinson for expected planting of 2019. Potential rootstocks are from the East Malling series and New Zealand selections.
Cherry Sub-Committee (Chair, Lang, MI)

The 2010 Sweet Cherry Rootstock x Canopy Training System Coordinated Trial began with 13 sites; these have dwindled to 5-6 due to diseases, cooperator retirements or transitions, deer damage, etc. Work has begun on the first trial paper (Training Systems Establishment, Years 1-3) with adequate data expected from CA, MI, NY-Geneva, NY-New Paltz, NS, and BC. Of this group, CA likely will drop out for the next phase (Initial-Maturation Yields – Years 4-6) due to excessive mortality from Armillaria. Greg Lang will send out a call for missing data sets, as well as a draft of 2014 training and data protocols for subcommittee input, during January. Results from the project thus far have been presented at several international scientific conferences (ISHS-Canopy Physiology, Rootstocks, and Training Systems 2012; ISHS-Cherry 2013) and regional/international grower meetings (MI, MO, PA, WA, IFTA, Chile, New Zealand). The initial fruiting results from 2013 are limited, but interesting in that certain canopy architectures appear to have a potential influence on fruit quality traits such as soluble solids and firmness.

Two 2010 Tart Cherry Rootstock x Canopy Training System Independent Trials were established in UT (Brent Black) and MI-Traverse City (Greg Lang/Nikki Rothwell/Ron Perry). The focus is on examining rootstock x canopy training interactions to develop hedgerow-type trees for over-the-row mechanical harvest. Both sites remain on track; an initial paper on establishment has yet to be discussed.

Three new rootstock genotype evaluation trials are being discussed (Matt Stasiak and Greg Lang, organizers), probably for 2017 planting. Rootstocks up for testing are from MSU, several from Krymsk, several from Gisela, and perhaps one or more MxM stocks. Greg Lang initiated discussion of a new potential (2015) trial focused on trellised sweet cherry systems, i.e., single and dual (“V”) fruiting wall canopy architectures, if there is interest from other subcommittee members.

Pear Sub-Committee (Chair, Einhorn, OR)

The 2002 trial was published in JAPS. The 2004 trial is completed and Terence Robinson and Suzanne Blatt will collaborate on writing this up and presenting at the ISHS Pear Symposium in Belgium in July 2014. The 2005 trial will finish after the 2014 season; data to date will be presented in Belgium, but the final harvest data will not be available until Fall 2014. Rachel will prepare the JAPS article. The 2013 training/rootstock/spacing trial just completed its first season. Cooperators are OR (2 sites; Bartlett and Anjou), NY (Bosc), and CA (Bartlett). Trees were grown by Willow Drive Nursery in WA.

Einhorn suggested a new trial of quince selections from the ones he had tested for freezing tolerance. In addition to OR, there was interest from: CA (not for cold hardiness; Bartlett, Bosc), CO (Bartlett), NY (Bartlett, Bosc), Nova Scotia (Bartlett, Bosc), and WA (Bartlett, Anjou). The group suggested: a Beurre Hardy interstem done in the nursery to ensure compatibility for Bartlett; Terence described an apple example: Golden Delicious is budded onto the rootstock, then when the trees were knipped (i.e. the 1-year-old stem headed after the first growing season), the desired scion bud was inserted. Suggested spacing was 1-1.5 m x 3.5 - 4 m. Standards would be all commercially available Quince (A, C, BA29, another) and OHF87. Projected planting is for 2016 or 2017, presuming material is available (tissue culture plants of the quince selections are being grown by North American Plant in Oregon).

Peach Sub-Committee (Chair, Reighard, SC)

A five year paper will be prepared for ISHS presentation. Johnson (CA) has retired and coordination will be assumed by Marini (PA). There will be a change in focus to fruit size measurements across climates with early/mid/late season; high to low crop load in 2014. Cooperators will collect temperature data during the growing season up to harvest date using an onsite data logger.
Objective 2. To develop improved rootstocks for temperate-zone fruit trees using state-of-the-art genomic tools in breeding programs.

Rootstocks from the California peach breeding program have been patented and released with an additional rootstocks to be released at a future date. Quince selections in OR are being screened as potential size-controlling pear rootstocks. Pyrus germplasm was established in a collection in WA to evaluate for size control, disease resistance and abiotic stress tolerances of pear trees. Germplasm will also be used for future pear breeding. Efforts to transform Gisela cherry rootstocks with genetic resistance to Prunus necrotic ringspot virus were successful. Field testing of elite cherry genotypes continued in WA and MI. Tissue culture propagation has enhanced rooting of Geneva apple rootstocks and increased the number of stock plants. Efficient methods for existing pear, cherry and apple rootstock micropropagation have been developed in WA for rapid multiplication of new rootstocks. A series of micropropagation experiments were conducted to test different methods to promote shoot proliferation of G.30, B.9 and G.41 apple rootstocks in ME. Peach rootstocks are being developed to reduce impact of Peach Tree Short Life decline for the South Eastern U.S. (GA).

Objective 3. To accelerate adoption of new rootstocks (a) by improving propagation techniques and (b) by acquiring new rootstocks from worldwide sources.

In WA, genomics and transcriptomics approaches are being tested to understand rootstock/scion interactions to ensure the compatibility of new rootstocks. The propagation of several Geneva rootstocks has been improved significantly by the use of tissue culture plants as mother plants for stoolbeds, especially with G.41 in NY. This has resulted in a mini-boom of planting of Geneva 41 stoolbeds. NY found that this research accelerated production in stool beds and resulted in a production of 800,000 liners of G.11 in 2012 and 600,000 liners of G.41. This process boosted availability of rootstock liners to 1.2million liners of G.41, 800,000 liners of G.11 and 300,000 liners of G.935, which will be harvested fall 2013. Mussachi (WA) offered that he was introducing 13 out of 32 dwarfing pear genotypes from the breeding program at the University of Bologna, IT. They would be released after 2 years (2016).

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

Biotic stresses. Apple rootstock tolerance to replant disease continues in NY to categorize 36 genotypes as resistant, intermediate or susceptible. The 2006 apple replant trial continued in some sites. A 2006 apple fumigation trial in NJ and MA continued. A 2009 peach replant study continued in NC. Russian and Geneva apple rootstocks were evaluated for fireblight tolerance in NY. In VA, 10 rootstocks showed differing susceptibility when inoculated with fireblight bacteria. Studies to determine the performance of Fire blight resistance in Asian pears AL. Colonization with root lesion nematodes (Pratylenchus penetrans) was much higher for G13 than for Gi5 and Gi6 cherry rootstocks with no effects of training system on root health and no bacterial canker in BC. CA will begin studies in cherry rootstock resistance to Armillaria mellea. Studies are being conducted to determine incidence and interaction of Bacterial canker and metal wire trellising and rootstocks and varieties in MI. Research is being conducted on regional and rootstock differences in apple cultivar volatiles and their impact on apple maggot and apple sawfly host selection at NS, CAN. Studies are beginning in WV to plant a test of rootstock susceptibility to Tomato Ring Spot Virus. Peach Tree Short Life decline can be attenuated using rootstocks which can prolong tree and orchard life in GA.

Abiotic stresses. Evaluation of peach rootstock tolerance to soil alkalinity continued in Utah. Apple rootstock tolerance to soil pH is also being evaluated in NY. Cold Hardiness Testing of Apple Rootstock Cultivars and Selections (Collaboration with USDA ARS Geneva and the Univ. of Guelph) is continuing in ME. Cold hardiness of quince selections for pear continued in OR. In IA and MO, a study to determine the relationship of blackheart and tree performance continued. Rootstock treatments had little effect on
bud survival in the 2009 peach rootstock trial in SC, MO and UT despite warm winter temperatures. Nutritional studies are finding differences among cherry rootstocks in BC. Mineral nutrient absorption is being studied in ID among apple rootstocks. Studies being conducted on UT on iron deficiency in peaches utilizing the 2009 NC 140 peach rootstock trial to see if rootstocks influence iron levels in plant tissue of Redhaven scion.

Objective 5. To enhance the sustainability of temperate fruit farming through development and distribution of research-based information utilizing eXtension. Members of our research group have been working on making research-based information available to any one who would like to use it through eXtension (MN, PA, MA, NY, NC, MO, OH, WV, IN, VA). In 2013, we completed our databases for apple rootstocks and cultivars and can be viewed at at http://www.extension.org/apples. This project was funded through the USDA-SCRI program and will be completed in August 2014. We have linked to the primary website for the research group, www.nc140.org. This site continues to be our primary outreach component serving as an important collaboration tool for cooperators. Members of the research group communicate through a list serve, and upload/download project files to password-protected directories (NJ, MA). We have used the site to allow for easier collaboration and comparison of replicated rootstock trials.

Impacts

Official Statement SAES-422: Over the last 30 years, fruit growers in North America have steadily transitioned from large canopied orchards to newer higher density orchards that use less land surface, increased production efficiency, and accommodate automation utilizing new technology in management. New rootstocks have largely been the impetus behind this transition as identified by NC-140 research in identifying superior performing rootstocks, their propagation and commercialization. The outcome of this work has given consumers supplies of sustainably grown quality fresh and processed fruit.

The NC-140 plantings are regularly used as demonstration plots of new rootstocks for growers, nurserymen, visiting scientists, and graduate students. Rootstock trials have also been conducted on grower’s farms, which has yielded invaluable information on adaptability that was not known from experiment station trials. Over the last 16 years, there has been a large change in rootstock use in the United States and Canada.

Results from NC-140 research continue to accelerate the process of identifying superior performing tree rootstocks and of their propagation and commercialization. Growers in various regions of the North America have benefited by having these rootstocks made available earlier by nursery companies. The NC-140 cooperative plantings have identified the benefits of the disease resistant CG rootstocks for North American sites.

Documents have been uploaded in eXtension associated with rootstocks and apple varieties have become a very popular resource for information for growers throughout the eastern United States (MN, NC) found at www.extension.org/apples.

Apple and peach rootstocks with tolerance to replant disease are being identified to improve survival and productivity without the use of fumigants in CA, SC, NC, ID, WA, MI, PA, IN, WI, MN, IA, OR, CO, NY, NJ, NC and MA.

Given the increasing labor costs and emphasis on labor safety, some Californian peach growers are very interested in shifting to pedestrian orchard systems. The peach rootstock research associated with this cooperative research project are providing growers with options for reducing peach tree vigor that are required to meet their objectives.

Dwarfing apple rootstocks are critical to growers transitioning to training systems which accommodate the use of labor saving automation, such as mobile platforms and overhead water and chemical delivery regarding pruning, training, harvesting and pest control.
Apple and pear (quince) rootstocks with superior cold temperature tolerance are being identified to improve survival and productivity.

High density apple, pear and sweet cherry orchards that employ several dwarfing rootstocks have stimulated growers to expand commercial acreage. New peach rootstocks are motivating growers to transition to rootstocks tolerant of high pH calcareous soils which avoids use of chelating compounds to correct iron deficiency.

Yields, fruit quality, and labor efficiencies realized with the intensive high density cherry canopy architectures on dwarfing rootstocks are already stimulating grower experimentation with these new training and production concepts.

Changes in rootstock use were documented in Indiana. Previously, approximately 80% of apple orchards in the state were planted on more vigorous rootstocks. In plantings made in the last 15 years, use of the superior performing rootstocks in NC-140 trials in this state has increased 660%. The use of recommended rootstocks can increase crop value by more than $12,000 per acre. On a state-wide basis, this is an increase of $8.8 m per year.

The NC-140 web site, www.nc140.org continues to be an important outreach component satisfying the needs of growers. In 2012 we began using Google Analytics to track our web traffic. We had 2,064 visits with 5,551 page views The NC-140 web site also serves as an important collaboration tool for cooperators who can communicate via an e-mail list, and upload/download project files to password-protected directories.

Grants

NC140 members have written research proposals and attracted extramural funding associated or directly related to the five objectives of this project from local, regional, national and international funding sources. For fiscal year 2012/2013, funding reported by members amounted to $1,182,250 from primarily commodity groups and state sources. Additionally, funding from competitive grants associated with this project amounted to $3.2 million.

Publications

Collaborative research directed by members of this group led to 28 peer-reviewed publications, 41 non peer-reviewed publications, and numerous Extension articles and presentations that reached fruit growers throughout North America. Two articles in trade journals highlighted the impact of rootstock research on tree fruit production.

Peer Reviewed


Other Publications (Abstracts, Fact Sheets, Newsletters, Reports)


http://www2.ca.uky.edu/agc/pubs/pr/pr656/pr656.pdf


Articles in Trade Publications


**Presentations:**


Cowgill, W.P.,JR. 2013. North Jersey Twilight Fruit Meeting, April, 11; Rutgers Snyder Farm, Pittstown, NJ 44 attendees, growers


Einhorn, T. August 8, 2013. An update on pear horticultural research at MCAREC. 2013 MCAREC Annual Field day, Hood River, OR. Members of the Oregon tree fruit industry. Estimated attendance 70.

Einhorn, T. February 6, 2013. New and continuing research on improving pear production efficiency. 2013 Hood River Winter Horticulture Meeting, Hood River, OR. Members of the regional fruit industry. Estimated attendance 85.


Einhorn, T. July 11, 2013. The Mid-Columbia pear horticulture research program. 2013 SOREC annual field day, Medford, OR. Members of the Rogue Valley tree fruit industry. Estimated attendance 25.


Ingels, C. and B. Kirkpatrick. Visit by UC Davis Fruit Pathology Class to discuss training systems, rootstocks, and oak root fungus. April 18, 2013, 16 attendees.

Ingels, C. and R. Elkins. UC European Pear Workgroup and pear & cherry tour, including cherry trial site. June 27, 13 attendees.


ISU Fruit & Vegetable Field Day, Hort Res. Sta., Ames, IA NC-140 dwarf apple rootstock trial, 90 attendees.


Meeting. Kelowna, BC grower audience.


Moran, R. 2013. Update on Research at the Experiment Station, Maine Agricultural Trades Show, Augusta, ME, January 9, 2013. Attended by 60 growers.


Parker, M.L. February 2013. Mike’s “Crystal Ball” for Apple Varieties and Rootstocks for Western NC. Western District Apple School, Hendersonville, NC. Commercial grower audience. Attendance 100.


