

Application – 2015 ESS Award for Excellence in Multistate Research

Nominating Region: North Central Region Association

Nominator: Ronald Perry (perryr@anr.msu.edu)

Project Number and Title: *NC-140 Improving economic and environmental sustainability in tree fruit production through changes in rootstock use*

Technical Committee Chair: Richard Marini (rpm12@psu.edu)

Administrative Advisor: Ronald Perry (perryr@anr.msu.edu)

Historical context and evidence of sustained productive activity of the NC-140 project:

This multistate project was established in 1967 to evaluate apple rootstocks under diverse conditions. At that time, there was conflicting rootstock information from different states due to many differences in experimental procedures and tree management practices. Protocols established by NC-140 for uniform multi-state trials have greatly reduced the time to evaluate rootstocks. Over the years, the focus of the project has expanded to evaluate rootstocks for peach, plum, pear, and cherry. Other multi-state trials include evaluation of apple orchard systems and the effect of apple rootstocks on fruit size and replant disease. NC-140 is the only scientific group in the world to work with rootstock breeders and nurserymen around the world to obtain new rootstocks and collaborate with commercial nurseries to propagate trees for multi-location evaluation. NC-140 is recognized as the primary source of fruit tree rootstock information in North America. In the late 1990s, when results from several projects were disseminated to the fruit industry by NC-140 members, the U.S. apple industry went through a rapid transition from orchards with about 200 trees/acre that required more than 12 years to become profitable, to orchards with 800 to 1,400 trees per acre that require less than 8 years to become profitable. NC-140 members were the first to report that the Russian rootstock B. 9 imparted fireblight resistance to the scion in uniform trials, which is now widely planted in North America. As a result of these orchard observations, NC-140 members are working with plant molecular geneticists and breeders to understand the complex interactions between rootstocks and scions for other traits such as water use efficiency, cold hardiness, fruit size, and bloom delay. NC-140 led a similar transition for sweet cherry by hosting the first replicated trial in North America of some of the Gisela® series German dwarfing cherry rootstocks that promote early high yields and require less labor to manage the orchards. The top performing rootstocks in this trial, established in 1987, are now commercially propagated and adopted by industry. Dwarfing rootstocks also led to the expansion of sweet cherry production to nontraditional locations because the small trees can be grown under the protection of high tunnels. Some of the new research currently being planned includes dwarfing rootstocks for peach and pear and evaluating new apple rootstock selections from North American breeding programs that are highly productive and resistant to several diseases. During the past 30 years, 38 trials have been conducted by NC-140. After the first five years and upon completion of a project, the data are published in peer-reviewed and trade journals. Approximately 125 peer-reviewed articles have resulted directly from NC-140 trials, and more than 1,500 related articles have been published by NC-140 cooperators.

Project objectives: 1) To evaluate the influence of rootstocks on temperate-zone fruit tree characteristics grown under varying environments using sustainable management systems; 2) To develop improved rootstocks for temperate-zone fruit trees using state-of-the-art genomic tools in breeding programs; 3) To accelerate adoption of new rootstocks (a) by improving propagation techniques and (b) by acquiring new rootstocks from worldwide sources; 4) To better understand the impacts of biotic and abiotic stresses on scion/rootstock combinations in

temperate-zone fruit trees; 5) To enhance the sustainability of temperate fruit farming through development and distribution of research-based information utilizing eXtension.

Major research outcomes: Uniform multi-location trials exposed new rootstocks to a wide range of biotic and abiotic stresses and reduced the time to evaluate rootstocks from more than 50 years to just 10 years. New protocols for screening rootstocks for susceptibility to fireblight, a major bacterial disease of apple, have been developed. Studies were conducted by a sub-set of NC-140 researchers, resulting in publications clarifying the characteristics of rootstocks and their impacts on scions regarding abiotic and biotic stress associated with uniform trials. Examples of these contributions were made on cold hardiness, tolerance to high pH and calcareous soils, tolerance to soil pathogens, and tolerance to replant disease. NC-140 participants collected critical information from uniform trials regarding characteristics such as propensity for burrknot development in apple, rootstock anchorage, influence on post-harvest storage of fruit of scion varieties among many other parameters of interest to scientists and industry. Results from testing a number of clones of M.9 rootstock reduced confusion in the industry which had been dominated by one clone, NAKB 337, and identified M.9 clones to replace M.26 which had high mortality at many locations. In some trials, certain cultivar/rootstock combinations broke at the bud union which led to research on bud union strength and grower recommendations for enhanced tree support to reduce tree breakage. NC-140 data were used to develop more efficient experimental designs and protocols for future research. Cultivar selection for rootstock trials need not be limited to cultivars grown in specific regions because the cultivar-by-rootstock interaction was found to be minimal.

Impacts of project activity: NC-140 activities have beneficially impacted every state where temperate tree fruit are grown, the southern Canadian provinces and some areas in Mexico. NC-140 is a major source of rootstock information worldwide, resulting in recommendations and educational programs that guided planting 170,000 acres of fruit trees over the past 5 years in the U.S. Utilization of NC-140 recommendations has increased yields by 20% per acre in mature orchards, improved fruit size by 10%, increased the percentage of fruit meeting the highest grade category by 20%, shortened the time to pay-back on orchards from more than 12 years to less than 8 years, and the financial benefit to U.S. fruit growers was \$200,000,000 over the last 5 years. Transition to compact canopies and high density orchards, generated by dwarfing rootstocks tested in uniform trials, has made pesticide use more efficient by reducing chemical cost and application by nearly 40%, with associated environmental benefit plus \$100,000,000 saved over the past 5 years.

Extent of links to extension that have been formed: Most of the technical committee members have extension appointments and provide information to stakeholders in their states and provinces. In 2013 alone, NC-140 members presented information related to the project at more than 140 grower meetings (<http://www.nc140.org/2013/annualreport.pdf>). NC-140 has had a long-standing close association with the International Fruit Tree Association (formerly International Dwarf Fruit Tree Association). Many members of NC-140 have not only given updates on rootstock performance at annual IFTA meetings, but have also received funding for uniform trials (tree costs) and support of critical research regarding independent studies on rootstock issues. NC-140 developed a website (<http://www.nc140.org/>) more than 15 years ago to make results from the project widely available. The eXtension website (eapples.org or <http://www.extension.org/apples>) was developed by NC-140 members to archive information from NC-140 and apple cultivar trials to make research-based apple information available to the general public. NC-140 was the vehicle behind member collaboration and acquisition of nearly

\$500,000 in funding to create the eXtension Apples CoP. The web site makes peer-reviewed and scientifically accurate apple rootstock and variety information even more readily available to a wide audience.

Added value from the NC140 project's interdependency: Data beyond the original objectives are often obtained from trials. Information on the effect of rootstocks on cold injury, fruit size, fruit maturity, graft union strength, return bloom and blocking efficiency and sample size for future experiments was generated and published. In addition, several smaller groups of NC-140 member researchers, in collaboration with colleagues in allied sciences, have investigated aspects of rootstocks that were not addressed in the uniform multi-location trials, such as low temperature tolerance of rootstocks, burrknot development, and evaluation of new rootstocks in specific regions. Some NC-140 members were also involved in two newer regional projects (NE-183 <http://www.ne183.org/> and NE-1020 http://nimss.umd.edu/lgu_v2/homepages/home.cfm?trackID=4034) that were modelled after NC-140 with uniform multi-location trials. Data generated by NC-140 and NE-183 were used to develop the eApple website, making information available nationally and providing research-based information for extension workers to make local recommendations. Members also obtained a planning grant from the SCRI called "Root2Fruit SCRI" and NC-140 maintains the website <http://root2fruit.org>.

Extent of multi-disciplinary activity: The project includes collaborations with researchers from several disciplines including soil science, plant physiology, plant breeding, entomology, plant pathology, statistics, and agricultural economics. NC-140 members introduced molecular approaches to rootstock breeding programs, enhancing the efficiency of development and selection of the next generations of tree-fruit rootstocks. Members have worked with commercial nurseries to hasten the introduction of new rootstocks into commercial channels. Extensive trials have been performed in commercial nurseries on scions propagated on dwarfing rootstocks to produce superior nursery trees for orchardists.

Amount of integrated activities (multi-functionality): NC-140 members advanced the science associated with rootstock development and evaluation through refereed journal articles and presentations at scientific meetings. In 2013, members published 17 peer-reviewed publications and 36 non-reviewed papers and made more than 140 presentations at extension meetings related to the project. In 2014, results related to NC-140 objectives were presented at 5 international symposia. Since many members have extension appointments, research information is disseminated at many grower educational meetings, demonstrations, and newsletter articles. The NC-140 project has maintained its own website for more than 15 years. Technical committee meetings are also a training ground for future tree fruit workers specifically graduates students, young extension workers, and young fruit researchers who attend the annual meeting. Uniform trials have served as replicated testing sites for studies by allied scientists and their graduate students such as nematodes, fireblight in apple, post-harvest, cold hardiness, mycorrhizae, nutrition, "peach tree short life decline", etc.

Evidence of additional leveraged funding to further the goals of the NC140 project: Data are not available before 2012, but NC-140 members have written research proposals and attracted extramural funding associated with 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 (<http://www.nc140.org:8000/2013/annualreport.pdf>).

Appendix

I. List of Participating Institutions

Annual meeting venues have included states and provinces within and outside the North Central Region boundaries including Canada and Mexico. Each year, the annual meeting attracts members and non-members and openly welcomes 50-65 people interested in the topics on agendas covered by project objectives.

In November, 2014, 40 active participants from 28 universities, 2 USDA-ARS laboratories, 3 Canadian provinces, one Mexican state and Chile attended NC-140 technical committee meeting.

Auburn University
University of Arkansas
University of California, Davis
University of Colorado
Cornell University
University of Georgia
University of Idaho
University of Illinois
Iowa State University
University of Kentucky
University of Maine
University of Massachusetts
University of Maryland
Michigan State University
University of Minnesota
University of Missouri
New Mexico State University
North Carolina State University
The Ohio State University
Oregon State University
The Pennsylvania State University
Purdue University
Rutgers University
University of Tennessee
Utah State University
Virginia Tech
Washington State University
University of Wisconsin
University of Guelph, Ontario, Canada
Agriculture & Agri-Food Canada, Summerland, BC, Canada
Agriculture & Agri-Food Canada, Nova Scotia, Canada
University of Chihuahua, Mexico
University of Chile
USDA-ARS, Geneva, NY

USDA-ARS, Kearneysville, WV

Supporting URLs Referenced in the Text

<http://www.nc140.org:8000/2013/annualreport.pdf> (NC-140 Annual report for 2013)

<http://www.nc140.org/> (NC-140 website)

<http://www.extension.org/pages/60760/apples-community-information#.VG4snckXLlg> (eapple website)

<http://www.ne183.org/> (NE-183 website)

http://nimss.umd.edu/lgu_v2/homepages/home.cfm?trackID=4034 (NE-1020 project)

<http://root2fruit.org> (root2shoot project)

II. Selected Letters of Industry Support

- 1. International Fruit Tree Association (IFTA), Chesterfield, MO**
- 2. Adams County Nursery, Aspers, PA**
- 3. Summerland Varieties Corporation, Summerland, BC, Canada**
- 4. New Jersey State Horticulture Society, Hackettstown, NJ**

***Additional letters may be found at <http://nc140.org/award>**



January 5, 2015

Dear Friend,

The International Fruit Tree Association (IFTA) is an international grower association that promotes the education of tree fruit growers concerning adoption of new production technologies. Our main emphasis is on planting and training new orchards. The NC-140 research project tests new and promising rootstocks tree fruit growers are eager to plant but rely heavily on good non-bias rootstock research. This NC-140 multi-state project evaluates new rootstocks on a wide scale basis and thus quickly discovers the strengths and weaknesses before grower invest their time and money into new highly expensive planting. It provides growers with vital research information to make proper selection of rootstocks. It in my opinion is the finest tree-fruit testing project we have had for many years.

I understand that NC-140 project is being considered for the Excellence in Multistate Research Award. I believe this is exactly what NC-140 is, "Excellence". I greatly encourage you to select this project for that award. Thank you for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read 'Phil Schwallier', with a long horizontal flourish extending to the right.

Phil Schwallier
IFTA President



Adams County Nursery, Inc.
P.O. Box 108
26 Nursery Road
Aspers, PA 17304-0108

Dec.22, 2014

Phone: 717-677-8105

Fax: 717-677-4124

e-mail: acn@acnursery.com

website: www.acnursery.com

Dr. Jeff Jacobsen
North Central Regional Association, Director
446 west Circle, room 408
Justin S. Morrill hall of Agriculture
Michigan State University
East Lansing, MI 48824

Dear Dr. Jacobsen,

I am writing in support of the NC-140 Regional Research Project nomination for the "Excellence in Multistate Research Award" I believe my comments would be echoed by many of my colleagues in the commercial tree fruit industry.

As a fruit tree nursery, we are asked by our clients to advise them in the decision on rootstock selection for new orchard plantings. Growers generally know the varieties they will plant but many times struggle with the decision on what rootstock to use. The rootstock selection is a difficult decision because it has such critical impact on the success of the new planting. Reliable information on rootstock performance was difficult to access prior to the NC-140 Project. Many costly mistakes were made due to the lack of this knowledge.

The NC-140 Project is a well-designed, multi-state project involving research institutions across a wide range of climatic/geographical conditions. The data has been analyzed over a long period of time using consistent analytical methods. The research plots have been well managed by many talented horticulturists with a common goal and this information has been made available by the stakeholders throughout the country and internationally.

As Chair of the State Horticultural of PA Research Committee, I can attest to the fact that our board has reviewed and funded at least one project annually in support of the NC-140 project at Penn State University. This has been ongoing for at least 20 years. Our committee recently visited the research site at Rock Springs, PA with Dr. Rob Crassweller and as always, there is something interesting to observe.

This program has provided valuable information to the industry for many years and continues to provide our standard base of knowledge on rootstock performance.

My regards,

Phillip D. Baugher, President
Adams County Nursery, Inc.

Growing with you™ ...



SUMMERLAND VARIETIES CORP
105 – 13677 Rosedale Avenue
Summerland, British Columbia
Canada V0H 1Z5

www.summerlandvarieties.com

December 15, 2014

Dr. Jeff Jacobsen

North Central Regional Association, Director
446 West Circle, room 408
Justin S. Morrill Hall of Agriculture
Michigan State University
East Lansing, MI 48824

Dear Dr. Jeff Jacobsen,

RE: Support for the Excellence in Multistate Research Award to NC-140 Regional Rootstock Research Project.

Summerland Varieties Corp (SVC) (formerly Okanagan Plant Improvement Corporation) is a variety rights management company that tests and licenses new varieties of tree fruits. Given SVC's emphasis on the successful introduction of new fruit varieties, particularly apples and cherries, we strongly support the research efforts of the NC-140 Regional Rootstock Research Project. We believe that this work ensures the horticultural success of our new varieties and contributes to the vitality and sustainability of the BC fruit tree industry.

NC-140 provides a means of sourcing new rootstocks from breeding programs. Those rootstocks are then tested over a wide geography and the most promising selections are rapidly introduced to the tree fruit industry. The major advantages of this process for SVC and the BC Tree Fruit Industry is that the rootstocks are tested in BC and, in that way, we gain access to product and information that we would have difficulty obtaining given our relatively small and fragmented industry. Additionally, NC-140's professional team is invaluable because they have the expertise to evaluate the bewildering array of rootstock options, focus industry on the best choices, and thereby make more efficient use of our limited research funding.

From the perspective of new variety introductions, the results from the NC-140 trials offer SVC horticultural options for varieties that may otherwise prove too difficult to grow. For example, SVC has a number of non-selfing cherry varieties with excellent eating qualities; however, growing these selections in a conventional widely spaced planting system with high-vigour rootstocks would result in lower yields compared to selfing varieties. The semi-dwarfing rootstocks that are locally tested in the NC-140 trials offer an alternative because we know they are suitable for the BC climate and soils and that they will encourage a better balanced tree with more fully developed flowers that will ultimately produce more fruit. Likewise, we have an

to grow in areas with replant disease complex. Since fumigation is seldom an option in BC, this new variety will require a rootstock that is resistant to the soil pathogens that cause replant disease. The NC-140 trial will be the only proven source of reliable local information for this type of rootstock.

We support the NC-140's application for the Excellence in Multistate Research Award and look forward to the results of the current and future rootstock trials. Our vision is to use the NC-140 information to make informed decisions about rootstock selections that will improve our varieties' performance and support the vitality of the BC apple and cherry industries.

Yours truly,
Summerland Varieties Corp.

A handwritten signature in black ink, appearing to read 'Nick Ibuki', with a stylized, flowing script.

Nick Ibuki
Acting General Manager
Email: nick@summerlandvarieties.com
Direct Line: (250) 494-5167

/ew
Encl.



**NEW JERSEY
STATE HORTICULTURAL SOCIETY**
176 Airport Road, Hackettstown, New Jersey 07840

Dr. Jeff Jacobsen
North Central Regional Association, Director
446 west Circle, room 408
Justin S. Morrill hall of Agriculture
Michigan State University
East Lansing, MI 48824

Dear Dr. Jacobson;

I am writing to you on behalf of the NJ State Horticultural Society and the three hundred plus tree fruit growers farming in New Jersey. We represent the tree fruit industry in New Jersey that has directly benefitted from the work of NC-140.

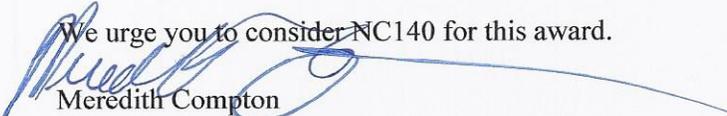
This is a letter of support for the nomination of the project *NC-140 Improving economic and environmental sustainability in tree fruit production through changes in rootstock use for the 2015 ESS Award for Excellence in Multistate Research.*

Some of the highlights and impacts of NC140 in NJ include the following:

1. NC-140 trials in NJ have been the primary source of research based recommendations in NJ. Guidance in the Rutgers Commercial Tree Fruit Production Guide comes directly from NC 140 trial results in NJ and pooled knowledge from the other NC140 cooperators. In addition the NC140 trials located at Rutgers Snyder Farm have been toured by hundreds of growers on multiple occasions in order to make decisions on what to plant on their own farms.
2. NC140 has given the ability of NJ growers to see first hand rootstock materials from around the world.
3. The systematic approach of NC140 across multiple states has shortened the time of rootstock evaluation from 40 to ten years.
4. B9 apple rootstock from Russia, first trialed by NC140 in the US and NJ has given our growers the first fire blight resistant rootstock for use. It is been commercial adopted and widely planted in NJ based on the observations by growers of the NC140 plots.
5. Peach, cherry and apple rootstock trials have all been done in NJ and have greatly impacted the tree fruit industry in NJ in a positive way. Numerous NJ orchards have now planted extensive dwarf cherry plantings for direct sales on Gisela Rootstocks trialed by NC140 at Rutgers in NJ.
6. Since 1992 over 99% of the new apple trees planted in NJ have been on dwarfing rootstock.
7. The financial benefit to NJ fruit growers from earlier returns, greater yield, and higher fruit quality was \$2,000,000 over the past 10 year period

Please note that the NJ State Horticultural Society has provided extensive financial support to NC140 since 1992. We have provided \$3000-\$5000 a year to establish and Maintain NC140 trial plots at Rutgers Snyder Farm by Win Cowgill, our NJ State leader for NC-140.

We urge you to consider NC140 for this award.


Meredith Compton
President

c. Dean Robert Goodman, Dean Carol Harvey
NJ Farm Bureau
NJSHS Board Members

PRESIDENT
Meredith Compton
150 Pittstown Road
Pittstown, NJ 08867
908-713-1705
peacefulvalleyorchards1@gmail.com

VICE-PRESIDENT
Dale Davis IV
8 Route 24
Chester, NJ 07930
908-879-2696
Dale4stonyhill@gmail.com

SECRETARY
Peter Nitzsche
RCE Morris County
P.O. Box 900
Morristown, NJ
07963-0900
973-285-8300
nitzsche@njaes.rutgers.edu

TREASURER
Gary Mount
330 Cold Soil Road
Princeton, NJ 08540
609-924-2310
gbmount@alumni.princeton.edu

PAST PRESIDENT
David G. Duffield
324 Chapel Hts. Rd.
Sewell, NJ 08080
856-589-0158
duff4020@gmail.com

BOARD OF DIRECTORS

Greg Donaldson 2011-2016
176 Airport Road
Hackettstown, NJ 07840
908-852-9122
greg@donaldsonfarms.net

Jim Giamarese 2012-2014
155 Fresh Ponds Road
East Brunswick, NJ 08816
732-599-3988
giamarese@comcast.net

John Hauser 2013-2015
336 Ticetown Road
Oldbridge, NJ 08857
732-591-1966
hauserhillfarms@verizon.net

James Bourgeois 2013-2016
122 Oakdale Road
Chester, NJ 07930
609-364-8005
jamesbourgeois@yahoo.com

Ken Wightman 2014-2016
1111 Mt. Kimble Ave.
Morristown, NJ 07960
973-425-9819
wightmansfarms@yahoo.com

Anthony Yula 2014
500 University Boulevard
Glassboro, NJ 08028
856-217-3636
summitcityfarms@yahoo.com