

ANNUAL REPORT OF THE COOPERATIVE REGIONAL RESEARCH PROJECT

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Hatch Act, as Amended August 11, 1995

January 1 to December 31, 2001

Project: NC-140 Rootstock and Interstem Effects on Pome and Stone Fruit Trees

(Revised October 1, 1997)

COOPERATING AGENCIES AND PRINCIPAL REPRESENTATIVES:

Station	Cooperator	Station	Cooperator	Station	Cooperator
AR	C. Rom	MN	E. Hoover	VT	E. Garcia
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IN	P. Hirst	NC	M. Parker		
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KY	G. Brown	PA	G. Green	NB	J. Prive
ME	J. Schupp	SC	G. Reighard	NS	C. Embree
MA	W. Autio	SD	A. Fennell	ON	J. Cline
MD	C. Walsh	TN	C. Mullins	QU	R. Granger
MI	R. Perry	UT	J.L. Anderson	Mexico	R.P. Quesada

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CSREES Representative: Tom Bewick

PROGRESS OF THE WORK AND PRINCIPAL ACCOMPLISHMENTS

Uniform rootstock and training system trials (Objective 1) are planned and coordinated by the technical committees at multiple sites for ten-year periods. Publications are prepared following the fifth and tenth years. Other objectives are researched at one or more locations.

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

1988 Pear Rootstock Trial: Anita Azarenko

A brief report was presented at an international meeting in Italy in the summer of 2000. This trial is completed and a manuscript is still in preparation.

1990 Plum Rootstock Trial: Bob Anderson

This trial is completed and a manuscript is being prepared.

1990 Gala Apple Rootstock Trial: Rich Marini

The performance of 8 dwarf rootstocks were evaluated for 10 years and the trial was terminated after the 1999 harvest. Tree survival was not influenced by rootstock. Trees on P.1 had the largest trunks, lowest yield, lowest yield efficiency, and smallest fruit. Trees on O.3 and M.26 EMLA had similar trunk size, but M.26 EMLA was the least productive of the two. Mark, MAC.39, B.9 and M.9 EMLA produced trees with similar trunk size, yields and yield efficiencies. M.27 produced trees with the smallest trunks and relatively low yields. A paper summarizing this 10-year study was published in the Journal of the American Pomological Society in October 2001 (see publication list). Data from this trial are being used to evaluate the influence of rootstock on average fruit weight after adjusting the means for crop load. The manuscript will be submitted to HortScience by March 2002. The data were also used to evaluate the relative efficiency of blocking rootstock experiments and using multiple trees per block, and to estimate the number of replications needed to detect differences between rootstocks at the 5% level of significance. This manuscript is in preparation and should be ready for internal review by March 2002.

1990 Systems Trial: Rich Marini

Ten orchard systems, comprised of three training systems and several rootstocks, were compared with two cultivars at nine locations for ten years. The trial was terminated after the 1999 harvest. Training systems included slender spindle (SS) with 2,400 trees/ha, vertical axis (VA) with 1,561 trees/ha, and central leader (CL) with 1,111 trees/ha. Trunk size was negatively related to tree density: trunks were largest for CL trees, smallest for SS and intermediate for VA. Cumulative yield per ha varied greatly with location and cultivar, but the relative performance of orchard system was fairly consistent across locations and cultivars. CL trees on M.26 or Mark rootstock tended to be least productive, whereas SS trees on M.9, Mark, and B.9 rootstocks were most productive. VA/M.9 was the most productive of the VA systems and at some locations it was as productive as SS. A paper summarizing this 10-year trial was published in the Journal of the American Pomological Society in October 2001 (see publication list). At two locations trees were cut off at ground level and were weighted. Data are being summarized to compare the amount of fruit produced relative to the amount of wood produced for the 10 systems.

1992-1993 Liberty/CG Rootstock Trial: Terence Robinson

The 1992 planting was terminated following the 2000 season. The 9 years of data for this trial is currently being summarized for publication. In the dwarf group of rootstocks G.11 and CG.202 have had high yield efficiency while G.65 has had low yields and small fruit size. In the semi-dwarf group G.30 and CG.210 have had high yield efficiency.

The 1993 planting is being terminated following the 2001 season. Data will be summarized in 2002 for a 9-year summary of this trial. In this trial among the dwarf stocks CG.007 and CG.29

have had superior yield efficiency while CG.13 has been too vigorous and non productive. Among the semidwarf stocks G.30, G.202 and CG.29 have been superior stock.

1994 Gala Semi-Dwarf Apple Rootstock Trial: Rich Marini

Little additional tree loss was reported in 2000. Tree mortality is greatest on G.30 and M.26 EMLA and relatively low for P.1 and V.2. The interaction between location and rootstock is extreme. At 10 of the 19 locations rootstock did not significantly influence TCSA. Locations with the largest trees include NJ, TN, and VA. At locations where rootstock is significant, the smaller trees were on V.2 and G.30. Response variables related to yield are difficult to interpret from a single year's data, because there seems to be extreme alternate bearing at some locations. Yield was significantly affected by rootstock at only 5 of the 19 locations. For those locations, G.30 tended to have the highest yields.

1994 Gala Dwarf Apple Rootstock Trial: Rich Marini

Marini noted that some data are still missing. Tree survival varies with location and rootstock. Survival is good at BC, NJ, NY-Highland, ONT, PA-Biglerville, PA-Rocksprings, WA, and WI, but tree mortality is high at GA, NC, SC, and TN. Rootstocks with high survival include V.1, B.491, and B.9, but rootstocks with poor survival include Mark, M.9 EMLA, and O.3. There is a strong location x rootstock interaction for every response variable. However, at most locations, the largest trees are on M.26 EMLA and V.1. At some locations, M.9 RN29 and M.9 Pajam 2 also produced large trees. M.27 EMLA and P.22 produced the smallest trees at most locations. Indices related to yield cannot be evaluated with one year's data, because some locations are in alternate bearing patterns.

1994 Peach Rootstock Trial: Greg Reighard

The 5-year results were published in *Acta Hort.* A manuscript will be prepared for *Compact Fruit Tree*. The trial will be terminated in 2001. Trees have survived well and the rootstocks have generally performed similarly to each other. Some sites may choose to keep the planting, and Reighard will coordinate further research within the remaining trials.

1998 Cherry Rootstock Trial: Frank Kappel

Yield data has been good and has highlighted differences between rootstocks. Preliminary summaries were presented at the international cherry symposium in June 2001.

1998 G.16 Rootstock Trial: Terence Robinson

Sites with Gala will terminate the planting after the 2002 growing season. Jonagold trials will be maintained for another five years. With Gala, the G.16 trees have grown significantly larger than M.9 trees. Gala trees were produced with tissue cultured liners that had not grown in a stoolbed. It appears tissue culture induces significantly greater vigor than trees on non-tissue cultured liners.

1999 Dwarf Apple Rootstock Trial: Wes Autio

Autio reported that there was a significant interaction of rootstock and location; however, generally the largest trees were on CG.4013, and the smallest were on M.9 NAKBT337. Greatest yields were harvested from Supporter 1 (Fuji) and Supporter 3 (McIntosh) where rootstock differences existed.

1999 Semi-dwarf Apple Rootstock Trial: Wes Autio

For Fuji, largest trees were on G.30N, and for McIntosh they were on Supporter 4. Trees on M.7 EMLA yielded the most in 2000.

2001 Peach: Greg Reighard

There were some problems with tree loss related to tree propagation. Rooting occurred only at the base of the hardwood/semihardwood cuttings. Newly planted finished trees were moved in moderate wind and this tore roots from these rootstock shanks. Many trees were very weak.

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

Two states are working on techniques for the improved propagation of apple (NY) and pear (OR) rootstocks.

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

Extensive testing of elite Cornell-Geneva rootstocks was done this past summer to look for possible identity problems. Stocks tested in 2001 include Geneva 16, Geneva 11, 3041, 4202, 5202, and 6210. The testing was useful for comparing older stoolbeds in Geneva with several trees in orchard sites and modern stoolbeds at commercial nurseries. This work is continuing and will become a routine operation in the program to aid genotype distribution and identity in the future (NY).

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

AR – An ongoing breeding program for both apple and peach rootstocks is being carried out in Arkansas. Twelve apple selections were budded to Smoothie Golden Delicious in 1999 and will be planted in a replicated trial in 2001. For peach rootstocks, 24 in 1997 and another 20 in 2000 were selected for further evaluations.

CA – A peach rootstock breeding program is being conducted to combine disease resistance with dwarfism and other desirable horticultural traits.

NY – Two rootstocks will be released in 2003 and one in 2002 to New Zealand. In addition, new rootstocks from around the world are being gathered. In 1999, 16 rootstocks from 3 European breeding programs were established.

OH – Five selections of the Morioka series of rootstocks have been obtained and are being cloned for further evaluations.

Ontario – Rootstocks V.1, V.2, and V.3 will all be commercialized and licensed to a nursery.

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

New Brunswick – The Cornell-Geneva apple rootstocks are being screened for cold hardiness.

KY – In the 1994 peach planting percent survival of trees on Lovell (38%) was significantly lower than trees on other rootstocks (84%).

NY – The Cornell-Geneva rootstocks, as well as many others from around the world, are being screened for tolerance to such biotic and abiotic factors as replant disease, late winter cold temperatures, Phytophthora root rots and fire blight.

OR – Over-cropping pears is correlated with tree failure.

Ontario – Studies are continuing to evaluate the fireblight sensitivity and cold hardiness of the Vineland series of apple rootstocks compared to several known standard rootstocks.

UT – Bud hardiness of Montmorency cherry has been followed for three years. Buds on trees on Mahaleb rootstocks are more hardy than buds growing on trees on Colt or MXM2 in the late fall. Buds growing on trees on Colt or MXM2 rootstocks are more hardy than buds growing on trees on Mahaleb in late winter. Additional data will be collected in 2002.

USEFULNESS OF FINDINGS AND IMPACT OF COOPERATIVE RESEARCH PROJECT

Uniform trials continue to suggest superior rootstock selections in an unbiased manner. Nearly all states indicate the importance of the results from these trials as the primary source of information for recommendations made by research and Extension personnel. Fire blight continues to be a major limiting factor for apple rootstock selection and several sites are actively involved in screening and other studies to determine sensitivity and reduce tree losses. State surveys of tree planting indicate a dramatic shift to trees on more dwarfing rootstocks in recent years. Growers and industry recognize the importance of unbiased information from broad uniform trials and more than \$1,000,000 is given to support these trials and related rootstock projects.

WORK PLANNED FOR NEXT YEAR

The current project (renewed October 1997) will continue through September 2002. The rewrite committee produced a draft that will be submitted for the next four-year funding cycle. Existing trials will be maintained following the protocols developed by the respective technical committees. Current (and supplemental) data will continue to be collected and summarized by the planting coordinator, who will prepare the five- and ten-year reports for publication. Individual state project leaders will, wherever possible, expand the data collection on a particular planting beyond that of the uniform data set so as to gain further information on rootstock performance, or how the rootstocks respond to training and local conditions. As new, not as yet commercially available, rootstocks are wanted for the trials, plantings must be planned three to five years prior to the actual planting being made. The following new trials are in the planning stage:

2002 Peach Rootstock Trial: Greg Reighard

A new peach rootstock planting will be established in 2002 in 16 to 18 sites. Eight sites will have Cresthaven as the scion and 8 to 10 sites will have Redhaven. There will be eight single-tree replications of each rootstock at each site. All sites will include eight rootstock selections including VVA-1, Pumiselect, Cadaman, Lovell (repeats from 2001 planting), Adesoto 101, MRS 2/5, Penta and VSV-1. Two other rootstocks will be included as border trees in some of the plantings but will not be evaluated officially. These are K146-43 that grew poorly in the nursery and Monegro that never grew large enough to bud.

2002 Apple Trial: Wes Autio

A number of Buckeye Gala trees were finished, but there is not enough for as large a trial as originally planned. It was decided that five rootstocks (B.9Tresco, B.9Europe, M.9Burgmer 756, M.9 RN29, and M.9 NAKBT337) will be included in a trial with four replications with two trees of each rootstock within each replication. Eight locations (MA, IL, BC, MI, NY, NJ, IN, PA) will be included. Additional finished trees will be distributed to cooperators interested in them.

2002/2003 Pear Rootstock Trial: Gene Mielke

There will be eight rootstocks in this trial. Planting sites will be the Wenatchee area, Yakima area, Okanagan area, Hood River area, and Kearneysville, WV. Cultivars will include Bartlett and Bosc. Mielke will coordinate this trial

2003 Apple rootstock trial: Rich Marini

Twenty-two rootstocks will be included at approximately 20 sites. Some trees will be in short supply.

2004 Pear rootstock trial: Gene Mielke

This trial will include three California and two New York sites with the eight rootstocks used in 2002 plus eight additional stocks. The eight additional stocks also will be planted at the sites used in the 2002.

2004 Tart Cherry rootstock trial: Greg Lang

Six to eight rootstocks with two cultivars will be included in this trial.

2005 Sweet Cherry rootstock trial Frank Kappel

Lang reported that efforts are beginning regarding the establishment of a new trial of sweet cherry. Kappel will coordinate this trial.

2006 Apple rootstock trial: Terence Robinson

Efforts have begun to assemble a 2006 planting. He also expressed concerns about current interpretation of plant patent laws. If this interpretation persists, this planting may not occur. NC-140 voted to make political contacts to express our concerns.

PUBLICATIONS

Refereed Publications:

Autio, W. R., J. L. Anderson, J. A. Barden, G. R. Brown, R. M. Crassweller, P. A. Domoto, A. Erb, D. C. Ferree, A. Gaus, P. M. Hirst, C. A. Mullins, J. R. Schupp. 2001. Location affects performance of Golden Delicious, Jonagold, Empire, and Rome Beauty apple trees on five rootstocks over ten years in the 1990 NC-140 cultivar-rootstock trial. *J. Amer. Pom. Soc.* 55:138-145.

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- Gutzwiler, J. and G.A. Lang. 2001. Sweet cherry crop load and vigor management on Gisela rootstocks. *Acta Hort.* 557:321-325.
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Meetings:

Meeting	Date	Location	Attendance	Audience
Illinois Specialty Crops Conference	January 17,18, 2001	Champaign, IL	220	growers and marketers
Mid-America Fruit Growers Conference	Jan. 24 and 25, 2001	Olathe, KS	130	Growers
Master Gardener training	Various, 25 dates	Missouri	200	Master Gardeners
South Central Illinois Fruit School	January 6, 2001	Centralia, IL	50	growers
Southern Illinois Fruit School	January 7, 2001	Cobden, IL	55	Growers
East Central Illinois Fruit School	January 8, 2001	Hardin, IL	40	growers
Southeastern Apple Growers Meeting	January 11, 2001	Asheville, NC	200	growers
California Apple Day	January 16, 2001	Fresno, CA	150	Growers & shippers
Northeastern PA Regional Fruit Growers Meeting	Feb. 13, 2001	Pittston, PA	90	Growers
Appalachian Area Fruit Growers Meeting	Feb. 13, 2001	Bedford, PA	40	Growers
Southeastern Regional Fruit Growers Meeting	Feb. 14, 2001	Leesport, PA	120	Growers and home owners
Western Fruit Growers Meeting	Feb. 14, 2001	Wexford, PA	56	Growers
Schuylkill Co. Regional Fruit Growers Meeting	Feb. 15, 2001	Pottsville, PA	40	Growers
Erie Co. (PA)/Western NY Fruit Growers Meeting	Feb. 15, 2001	North East, PA	30	Growers
Central Coast Counties Apple Institute	Feb 16, 2001	Watsonville, CA	20	Growers
Adams Co. Fruit Growers Meeting	Feb. 19, 2001	Biglerville, PA	150	Growers
Franklin Co. Fruit Growers Meeting	Feb. 20, 2001	Waynesboro, PA	40	Growers
York/Lancaster Co. Fruit Growers Meeting	Feb. 21, 2001	York, PA	30	Growers
2001 IDFTA Annual Meeting NC-140 Peach Rootstocks	February 22, 2001	Grand Rapids, MI	200	Growers
Iowa Fruit and Vegetable Growers Conference, "New apple training systems - How its done and rootstocks that work"	February 23, 2001	Cedar Rapids, IA	80 registered	Growers
Brushy Mountain Fruit School	March 1, 2001	Wilkesboro, NC	30	growers
Stone Fruit Workgroup	April 18, 2001	Parlier, CA	10	County agents

Orchard Twilight meeting	April 26, 2001	Jerseyville, IL	25	growers
Snyder Co. Twilight Fruit Growers Meeting	May 17, 2001	Sunbury, PA	35	Growers
Western PA Regional Twilight Fruit Growers Meeting	May 24, 2001	New Castle, PA	60	Growers
Orchard Twilight meeting	May 24, 2001	Edwardsville, Illinois	35	growers
Research Comm., State Hort. Assoc. of PA	June 12, 2001	University Park, PA	15	Growers
Illinois State Horticultural Society Summer Field Day	June 21, 2001	Peoria, Illinois	85	growers and marketers
Wisconsin Apple Field Day	June 26, 2001	Racine, WI	150	Growers
Henderson County Winter Fruit School	February 7, 2001	Hendersonville, NC	100	growers
Kearney Field Day	July 13, 2001	Parlier, CA	80	International scientists and growers
Highmoor Farm Summer Tour	July 20, 2001	Monmouth, ME	40	Growers
County Extension Education Directors in-service training.	Sept. 14, 2001	Ames, IA	35	County agents
Southeastern Professional Fruit Workers Conference	September 18, 2001	Fletcher, NC	40	University personnel and county agents