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Performance of the 1984 NC-140 Cooperative Peach Rootstock Planting

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Abstract

In 1984, trees of 'Redhaven' peach [*Prunus persica* (L.) Batsch] on 9 rootstocks were planted at 16 sites in North America according to guidelines established for cooperative testing by the North Central Regional Cooperative Project (NC-140). After 7 years, tree loss was greatest on 'Citation' (52%) and 'Damas 1869' (32%). Survival was greatest for trees on 'Bailey,' 'Halford' and own-rooted 'Redhaven.' Tree loss was greatest at the Ohio and Kentucky sites, due primarily to winter damage and heavy soil conditions, respectively. Trees on 'GF 677' were the most vigorous and those on 'Citation,' 'GF 655-2' and 'Damas 1869' were the least vigorous. Greatest cumulative yield was experienced on 'GF 677,' 'Halford,' 'Bailey,' 'Siberian C' and own-rooted 'Redhaven.'

Peach growers across North America are faced with the challenge of finding rootstocks that induce productivity over as long a period as possible. Except for California, peach orchards have a tendency to be short lived, in comparison to apple orchards. Longevity is a function of the interactions of scion and rootstock with abiotic (winter cold damage, drought stress, soil anaerobic conditions, etc) and /or biotic stresses (root pathogens, soil nematodes, bacterial and fungal cankers, etc) (5, 6, 9, 10, 11). The NC-140 committee, an international group of cooperating researchers, is organized to test new rootstock candidates over a wide range of sites. Previous reports (1, 7, 8) from this group have provided growers and researchers with information on performance of new apple rootstocks in a wide range of environments, thus shortening the evaluation period.

Test plantings reported here were established in 1984 in 16 areas of North America to compare relatively untested *Prunus* selections from France ('Damas 1869,' 'GF 677' and 'GF 655-2') and California ('Citation') with *Prunus persica* seedling rootstocks 'Halford,' 'Lovell,' 'Nemaguard' (CA only), 'Siberian C' and 'Bailey.' Additionally, softwood cuttings of 'Redhaven' were included as own-rooted trees.

Materials and Methods

Trees for the cooperative planting were propagated by Hilltop Nursery, Hartford, Michigan using virus-free 'Redhaven' as the scion. 'Redhaven' own-rooted (i.e., 'Own-root') trees were propagated by Gary Couvillon from the University of Georgia and sent in 1983 to Hilltop Nursery for inclusion with the other NC-140 rootstocks in the nursery. Nursery liners of 'Citation' were provided by Dave Wilson Nursery, Modesto, California for planting at Hilltop Nursery and subsequent budding in 1983. Cooperators and the locations of their sites are listed in Table 1. Ten replicate trees of each of the 9 rootstocks (Table 2) were planted at each site in a randomized complete block design. 'Nemaguard' was added as a tenth rootstock treatment in California and not included in this report. Trees were spaced 6.1 X 6.1 m apart and planted in Spring 1984. Trees were headed at planting at a standard 70 cm height and trained to an open center system. Irrigation, weed control and rate of fertilizer were applied according to local recom-

[1]Current or former members of the North Central Regional Research Project NC-140 Committee for Rootstock and Interstem Effects on Pome and Stone Fruit Trees.

Table 1. NC-140 1984 Peach Rootstock Trial Cooperators.

State/Province	Cooperator	Institution	Site
AR	Roy Rom	Univ of Arkansas	Clarksville
	Curt Rom	Univ of Arkansas	Clarksville
CA	Scott Johnson	Univ of California	Parlier
GA	Stephen Meyers	Univ of Georgia	Byron
	Tom Beckman	USDA	Byron
	W. R. Okie		
IL	Brad Taylor	Southern Illinois	Carbondale
KS	Frank Morrison	Kansas State Univ	Manhattan
KY	Gerald Brown	Univ of Kentucky	Princeton
MI	Ron Perry	Mich State Univ	Clarksville
NY	Jim Cummins	New York AES	Geneva
OH	Dave Ferree	Ohio State Univ	Wooster
ONT	R.E.C. Layne	Ag Canada	Harrow, Ont
PA	George Green	Penn State Univ	Biglerville
VA	John Barden	Virginia Tech Univ	Blacksburg
MO	Michelle Warmund	Univ of Missouri	Columbia
UT	Lamar Anderson	Utah State Univ	Logan
CO	Ken Yu	Colorado State Univ	Hotchkiss
NJ	Ed Durner	Rutgers Univ	Cream Ridge

mendations. The following data were collected annually at each site and summarized at a central location (Ohio): survival, trunk circumference, total yield/tree, average weight of 50 fruit, and bloom date. Each site also submitted monthly air and soil temperature averages and extremes, and rainfall (not presented).

Results and Discussion

After 7 years, tree loss was greatest on 'Citation' (52%) and 'Damas 1869' (32%) (Table 2). Survival was greatest for trees on 'Bailey,' 'Halford' and 'Own-root.' An assay for Prunus Necrotic Ringspot Virus was performed in Fall 1985 by W. R. Okie from Byron, GA on trees at his site. He reported that PNRSV was positive for all trees on the 'Citation' and 'Redhaven' own-rooted treatments. Plots at the Ohio and Kentucky sites suffered heavy losses due primarily to a combination of heavy soil conditions and winter low temperatures (Table 3). These plots were prema-

Table 2. Percent mortality of Redhaven on 9 rootstocks at 14 cooperator sites over 7 years in the 1984 NC-140 trial.

Rootstock	1984	1985	1986	1987	1988	1989	1990
Own-root	12.0	14.6					14.6
Halford	0.0	5.3	9.3	9.2	10.0	10.0	14.6
Sib C	0.8	5.3	13.6	13.6	15.0	18.5	22.3
Bailey	0.0	5.3	9.3	5.4	10.7	10.8	13.8
GF 677	3.1	11.3	12.9	18.5	20.7	20.7	25.4
GF 655-2	0.0	2.7	2.9	5.4	15.0		
Damas 1869	0.0	4.0	4.3	9.2	22.9	26.9	32.3
Lovell	1.7	8.5	11.4	11.5	14.3	16.2	23.8
Citation	6.9	14.7	15.0	20.0	32.9	45.4	52.3
LSD @ .05			5.3	6.4	7.4	8.2	8.5

Mean separation within columns by LSD @ .05 level.
Blanks are missing data unavailable for respective years.

Table 3. Percent mortality of Redhaven on 9 rootstocks at 14 cooperator sites over 7 years in the 1984 NC-140 trial.

	1984	1985	1986	1987	1988	1989	1990
AR	1.0	5.6	5.6	14.4	21.1	23.8	25.0
CA	1.1	1.1	1.1		2.2	5.0	5.0
GA	0.0	0.0	0.0	4.4	14.4	20.0	20.0
IL	1.1	3.3	3.3	10.0	12.2	13.8	16.3
KS	0.0	0.0	3.3	5.6	18.9	27.5	37.5
KY	4.4	50.0	55.6	56.7	61.1		
MI	2.2	4.4		13.3	22.2	23.8	28.8
NY	0.0	8.9	8.9			11.3	11.3
OH	7.8	12.2	47.8				
ONT	3.0	3.0	3.0				
PA		16.7		18.9	21.1	23.0	23.8
VA	0.0	0.0	0.0	2.2	15.6	47.5	58.8
MO	2.2	2.2	6.7	7.8	20.0	32.5	65.0
UT	0.0	1.3	1.1	3.3	4.4	8.8	8.8
CO	1.0	1.0	1.0	1.0	1.0	2.5	3.8
NJ		3.3	5.6	5.6	12.2	16.3	20.0
LSD @ .05			9.2	9.6	11.4	10.8	11.4

Mean separation within columns by LSD @ .05 level.
Blanks are missing data unavailable for respective years.

turely terminated in 1987 (Ohio) and 1989 (Kentucky).

The most vigorous trees were those on GF 677 (now trademarked 'Paramount CV') followed by those on 'Halford' and 'Own-root' (Table 4). Trees on 'Citation' were comparatively small and averaged 30% of the trunk cross-sectional area of those on 'GF 677.' Trees on 'Citation' appeared unhealthy in many plots as well as those on 'Damas 1869.' Suckering was profuse on 'Damas 1869' (data not shown) and interfered with cultural practices at many sites. Cropping was greatest on 'GF 677' and lowest on 'Citation,' 'Damas 1869' and 'GF 655-2' (Table 4). Cumulative yields did not differ significantly among 'GF 677,' 'Halford,' 'Own-root,' 'Siberian C,' 'Bailey' and 'Lovell' (Table 5). Yields were largest in California and smallest at the Colorado, Missouri and Kansas sites. The most variable rootstock

Table 4. Annual yield/tree and trunk cross-sectional area (TCA) of Redhaven on 9 rootstocks at 14 sites in the1984 NC-140 trial.

	Yield/tree (kg)					Cumu. yield (kg) (1986-90)	TCA cm^2) 1990
Rootstock	1986	1987[z]	1988	1989	1990		
Own-root	5.8	28.0a	37.1ab	32.3a	35.5	143.2ab	122.4abc
Halford	5.3	30.4a	41.0a	37.7a	41.1	164.2a	145.3a
Siberian C	7.1	29.4a	36.1ab	29.2a	33.6	143.7ab	122.6abc
Bailey	5.4	28.4a	35.1ab	33.0a	36.2	143.7ab	126.2ab
GF 677	6.6	33.1a	45.9a	37.1a	39.7	162.6a	154.5a
GH 655-2	2.9	17.1ab	19.2cd	16.4ab	15.6	73.8c	83.9c
Damas 1869	5.6	19.2ab	22.9bc	19.0ab	22.3	95.5bc	94.4bc
Lovell	5.6	29.4a	37.7ab	30.8a	38.8	148.6ab	120.9abc
Citation	2.3	6.5b	7.3d	6.4b	10.5	38.9c	44.1d

[z]Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 5. Cumulative yield efficiency (kg/cm² TCA) of Redhaven on 9 rootstocks at 14 sites over 7 years in the1984 NC-140 trial.

	Rootstock										
Site	Own	Halford	Siberian C	Bailey	GF 677	GF 655-2	Damas 1869	Lovell	Citation	LSD	Cv
Arkansas	1.21	1.46	1.49	1.19	1.38	1.35	1.11	.93	1.25	.32	25.5
California	2.12	1.68	1.88	1.83	1.59	1.76	1.80	1.82	1.95	.33	21.2
Georgia	1.81	1.59	1.27	1.57	1.62	1.00	1.11	1.38	——	.31	24.6
Illinois	1.11	1.18	1.42	1.12	1.13	1.05	1.15	1.34	.64	.22	19.5
Kansas	.22	.31	.35	.31	.20	.24	.38	.44	——	.09	31.6
Michigan	1.30	1.32	1.33	1.38	1.41	1.36	1.05	1.49	1.03	.34	26.5
New York	.99	1.05	.98	1.02	1.00	1.19	.96	1.28	1.21	——	——
Ontario	1.21	1.37	1.41	1.33	1.32	——	1.11	1.32	.94	.24	21.7
Pennsylvania	1.31	1.08	1.20	1.29	.93	1.28	.89	1.09	1.12	.32	29.8
Virginia	.98	.83	1.02	1.09	.81	1.13	.67	1.26	.79	.17	19.7
Missouri	.44	.29	.36	.39	.22	.13	——	.30	.32	.13	35.6
Colorado	.19	.33	.49	.37	.31	.43	.50	.60	.36	.08	23.3
New Jersey	1.18	.99	1.48	.98	.95	.75	.76	1.53	.79	.23	22.1
LSD@.05	.20	.21	.22	.22	.18	.23	.17	.19	.34		
Cv	23.0	26.1	25.4	25.9	23.1	31.4	23.3	21.3	46.8		

treatment regarding yield was 'Citation' (Table 5). 'Lovell' and other seedling rootstocks were found to be just as uniform in performance across all sites (Table 5). Cumulative yield efficiency as expressed as a ratio of cumulative yield per tree to trunk cross-sectional area for 1990 indicated that rootstock performance was greatest at the California site (Table 6). While 'GF 677' had large cumulative yields at many sites, yield efficiency was low in California, Virginia and in Pennsylvania, where tree

Table 6. Cumulative yield/tree (kg) of Redhaven on 9 rootstocks at 14 sites over 7 years in the 1984 NC-140 trial.

	Rootstock										
Site	Own	Halford	Siberian C	Bailey	GF 677	GF 655-2	Damas 1869	Lovell	Citation	LSD	Cv
Arkansas	181.3	197.4	246.3	154.9	173.8	207.4	106.2	101.3	——	41.4	24.8
California	346.2	332.1	298.4	278.2	330.5	57.5	158.7	306.7	52.2	47.0	21.3
Georgia	209.5	206.1	155.7	188.0	232.3	52.1	98.6	143.7	——	36.9	25.6
Illinois	191.4	233.4	227.5	211.5	206.5	143.3	186.9	231.0	37.6	47.6	25.3
Kansas	46.8	59.3	63.5	51.7	46.9	33.0	53.6	85.6	——	16.2	31.6
Michigan	193.6	212.9	160.9	222.5	197.0	108.3	116.0	216.8	59.3	38.9	23.3
New York	110.5	150.5	102.6	127.8	145.1	102.8	92.1	152.4	52.3	——	——
Ontario	143.5	225.6	191.4	165.2	253.2	——	140.0	175.5	41.2	35.8	23.1
Pennsylvania	143.6	171.6	156.5	171.3	158.0	114.3	82.8	174.6	48.8	28.0	20.6
Virginia	125.3	147.0	119.8	116.3	130.2	41.7	59.5	144.4	35.4	33.4	24.1
Missouri	72.3	54.6	62.9	57.6	47.9	23.2	——	25.2	38.1	24.8	41.0
Utah	65.4	90.2	99.2	75.8	142.9	66.0	63.8	24.3	6.2	17.4	25.6
Colorado	6.9	25.5	34.9	23.9	25.4	26.0	27.6	41.2	15.3	6.0	26.8
New Jersey	143.9	135.3	169.7	138.3	147.8	84.1	80.3	180.6	25.7	28.9	23.0
LSD @.05	28.3	36.3	29.4	33.7	38.1	17.4	23.9	28.6	17.5		
Cv	24.8	28.6	26.2	29.6	29.5	31.9	32.9	23.8	54.4		

vigor was high. Yield efficiency among rootstocks differed little in Michigan, Ontario and Illinois. The least efficient rootstock treatment was 'Citation' (Table 6).

The fact that two treatments, 'Citation' and 'Own-root,' were found to be contaminated with Prunus Necrotic Ringspot Virus (PNRSV), compromises the evaluation for at least the 'Citation' treatment. 'Citation,' being a complex *Prunus* hybrid, is very sensitive to some viruses. These were the only rootstocks provided by non-Hilltop Nursery sources. Bud wood for the budded trees had been vigorously monitored for viruses at Hilltop Nursery. Cuttings for the 'Own-root' treatment did not originate at Hilltop Nursery. Therefore, due to the lack of a rootstock/scion union, the virus contamination in the 'Own-root' treatment did not appear to affect field performance at most sites. Trees on 'GF 655-2' did not appear healthy at many sites which might be attributed to PNRSV or a potential genetic incompatibility, since 'GF 655-2' is a plum rootstock (St Julian clone). 'GF 677,' a peach x almond hybrid, was promoted by the C.T.I.F.L. in France as a vigorous, productive rootstock (3). The performance of it in this trial substantiates observations from France and Italy (2, 4).

Bloom date over 4 years (1987 through 1990) did not appear to be affected much by rootstock (data not shown). Data were inconsistent and suggested only a one to two day average differential among the rootstock treatments and was not significant among all sites for each year. Yield efficiency for individual years among the 9 rootstocks and across all sites was not found to be statistically significant (data not shown). Fruit size and yield expressed as a ratio to trunk cross-sectional area among all rootstocks and across all sites was not found statistically significant for each year from 1987 through 1990 (data not shown).

The data from these rootstocks suggest that plum hybrid rootstocks were not as good for orchard productivity and health as the commercial standards, which were peach seedlings. The one peach-almond hybrid rootstock, 'GF 677,' was more vigorous than the standard peach seedling rootstocks. However, yield efficiency on this hybrid was not as good as peach. Thus, no new rootstock appeared to be superior to peach seedling rootstocks on more than a few sites in this test. New rootstocks that are more resistant than peach to biotic and abiotic stresses such soil diseases, fine soil texture, and cold temperatures still need to be found and evaluated.

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