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Eight-Year Performance of 19 Peach Rootstocks at 20 Locations in North America

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Abstract

Nineteen *Prunus* rootstock cultivars and selections budded with 'Redhaven' peach were planted at 20 locations in North America in 1994 as an uniform planting of the NC-140 Cooperative Regional Rootstock Project. The rootstocks included peach seedlings from 'Lovell', 'Nemaguard', 'Bailey', 'Tennessee Natural 281-1', 'Stark's Redleaf', 'GF 305', 'Higama', 'Montclar', 'Rubira', 'Chui Lum Tao', 'Tzim Pee Tao', 'H7338013', 'H7338019', 'BY520-8', and 'Guardian™ BY520-9'. Clonal rootstocks included 'Ishtara', 'Myran', 'S.2729', and 'Ta Tao 5' interstem on 'Lovell'. Data were summarized across the 20 sites in 18 states and provinces over eight years. Tree survival was lowest in the Michigan, Indiana and southeastern Missouri plantings and best in Arkansas, Kansas, Maryland, New York, South Carolina, and Utah. Trunk circumference was largest in southern Illinois, central Tennessee, southeastern Missouri, and central New Jersey. 'Myran' was the most vigorous rootstock followed by 'S.2729' and 'Guardian™ BY520-9'. 'Ishtara', 'Tzim Pee Tao', and 'Chui Lum Tao' produced the smallest trees. Full bloom date was significantly advanced (< 1 day) on 'Myran' rootstock and delayed (1-5 days) on the 'Ta Tao 5' interstem. Fruit maturity was advanced <1 day on 'Myran' and 'Tennessee Natural 281-1' and delayed 1-4 days on 'Ta Tao 5' interstems when compared to 'Lovell'. The effect of 'Ta Tao 5' on bloom and ripening delay in days was more prolonged in the South (i.e., Georgia, South Carolina). Fruit weight was significantly influenced by rootstock as 'Redhaven' fruit from 'BY520-8' and 'Ta Tao 5' interstem trees were smaller (~10 g) and fruit from 'Ishtara' and 'H7338013' were larger (6-7 g) than fruit from trees on 'Lovell'. Cumulative fruit yield (1996-2001) significantly varied among rootstocks, and yield differences were evident between locations as the highest cumulative fruit yields were from Ohio, north central New Jersey, Maryland, and South Carolina. No rootstock yielded significantly more than 'Lovell'. However, 'GF 305', 'Montclar', 'Guardian™ BY520-9' and 'H7338019' yielded equivalent to 'Lovell'. In contrast, 'Ishtara', 'Chui Lum Tao', 'Tzim Pee Tao', 'Bailey', 'Higama', and 'Rubira' and the 'Ta Tao 5' interstem trees often had significantly lower yields than 'Lovell'. Relative ranking of cumulative yields according to rootstocks and geographic locations tended to remain unchanged after the fifth year.

Introduction

Peach production in North America has relied on peach seedling rootstocks since the mid-1800s. Today, peach growers face severe replant problems, the loss of soil fumigants and agricultural chemicals, increased production costs, and reduced yields due to shortened tree longevity. To increase orchard productivity and efficiency, growers are looking for solutions in the form of new rootstocks that are more resistant to abiotic (winter cold damage, drought stress, soil anaerobic conditions, etc.) and biotic stresses (root pathogens, soil nematodes, bacterial and fungal cankers, etc.). The NC-140 committee, a United States and Canadian group of cooperating researchers, was organized to test new rootstocks over a wide range of sites in North America. Previous reports (1,2,3,7,8,9,10,11,12,14,15,20,23,24)

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from this group have provided information on performance of new peach, apple, and cherry rootstocks in a wide range of environments, thus shortening evaluation period for the fruit grower and the fruit industry.

In the 1980s, new peach seedling and clonal rootstocks were reported to be productive ('Montclar', 'GF 305', and 'Rubira'), tolerant of replant sites ('BY520-8', 'Guardian™ BY520-9', and Tennessee Natural 281-1'), tolerant to nematodes ('BY520-8', 'Guardian™ BY520-9', 'Higama', 'Rubira', Tzim Pee Tao'), tolerant of *Armillaria spp.* ('Ishtara' and 'Myran') or *Agrobacterium tumifaciens* ('Rubira'), and cold hardy ('H7338013', 'H338019', 'Chui Lum Tao', 'Tzim Pee Tao' and 'Ta Tao 5') (5,6,13,17,22). These rootstocks had limited testing in North America, and thus were good candidates for an NC-140 rootstock trial. To determine the merits of these rootstocks under North American edaphic and climatic conditions, rootstock material such as seeds and cuttings were collected in 1992 for nursery propagation and budding. The objectives of this field trial were to evaluate the performance of new rootstocks for survival, tree vigor, yield, fruit quality, cold hardiness, nematode or disease tolerance and replant performance.

Materials and Methods

New peach rootstocks from foreign and domestic breeding programs were either propagated via hardwood cuttings or collected as seed at Clemson University (Clemson, South Carolina). The rootstocks were *Prunus* selections or cultivars from France ('GF 305', 'Montclar', 'Rubira', 'Ishtara', 'Myran', and 'S.2729'), Canada ('H7338013' and 'H7338019'), China ('Chui Lum Tao', 'Tzim Pee Tao', and 'Ta Tao 5'), Japan/France ('Higama'), and the United States ('BY520-8', 'Guardian™ BY520-9', 'Stark's Redleaf', and Tennessee Natural 281-1'). Peach seedling rootstocks 'Lovell', 'Nemaguard' and 'Bailey' were included as the commercial standards. All rootstock materials used were open-pollinated peach seedlings except three peach x plum hybrids, 'Myran', a cross of 'Belsiana' (*P. cerasifera* Ehrh. x *P. salicina* Lindl.) and 'Yunnan' peach, 'Ishtara', a cross of 'Belsiana' and a *P. persica* x *P. cerasifera* hybrid, and 'S.2729', a cross of *P. cerasifera* with an unidentified natural peach hybrid. 'Ta Tao 5' peach was tested as a 20-40 cm interstem piece grafted between a 'Lovell' seedling rootstock and the 'Redhaven' scion.

Adams County Nursery (ACN) in Aspers, Pennsylvania received rootstock seed in 1991 to produce seedlings for budding in Aug. 1992. Seed from virus-indexed rootstock clones was obtained from ACN, Ag Canada at Harrow, Canada, and Clemson University, Clemson, South Carolina and planted at ACN in November 1991. Rooted hardwood cuttings of the clonal rootstocks were propagated at the Musser Fruit Research Center near Clemson, South Carolina and sent to ACN for outplanting in April 1992 and later budding in Aug. 1992. The commercial cultivar for this trial was ACN's virus-indexed 'Redhaven'. Some other 'Redhaven' (ACN clone) on 'Guardian™ BY520-9', 'Myran', 'Ishtara', and 'Tao Tao 5' were 1993 June-budded trees from Clemson University that were shipped to ACN in Nov. 1993 to fill out cooperator's allotments. ACN 'Redhaven' trees were lifted Nov. 1993 for Spring 1994 delivery. 'Redhaven' on 'Bailey' rootstock was propagated by Hilltop Nursery, Hartford, Michigan. 'Redhaven' on 'Stark's Redleaf' rootstock was propagated by Stark's Bro's Nursery, Louisiana, Missouri. These trees were shipped separately to cooperators. Cooperators and the locations of their sites are listed in Table 1.

Test plantings were established in 1994 at 20 locations in 17 states and Ontario, Canada. Two other plantings, both on fruit growers' land in Texas and Washington, failed early and no data were collected. Eight replicate trees of each of the 19 rootstocks were planted at each site in a randomized complete block design. Each replicate was planted in a single row, and border rows were planted on the outside of rows 1 and 8. Not all rootstocks were available for all sites. Trees were spaced 5 m within rows and 6 m between rows and planted in Spring 1994. Trees were headed at planting at a height of approximately 70-80 cm and trained to an open center or vase system except for

Table 1. Cooperators, affiliations, and locations of the 1994 NC-140 peach rootstock test planting

State	Location	Cooperator	Current Institution
Arkansas	Clarksville	Curt R. Rom	University of Arkansas
Colorado	Grand Junction	Ron Godin	Colorado State University
		Harold Larsen	Colorado State University
		Alvan Gaus	Michigan State University
Georgia	Byron	Kathryn Taylor	University of Georgia
		Thomas Beckman	ARS-USDA, Byron
		Stephen Myers	Ohio State University
Illinois	Carbondale	Bradley H. Taylor	Southern Illinois University
Indiana	Vincennes	Peter Hirst	Purdue University
		Richard A. Hayden	Purdue University (retired)
Kansas	Wichita	Frank Morrison	Kansas State University (retired)
		Alan Erb	Cornell University
		Sorkel Kadir	Kansas State University
Kentucky	Princeton	Gerald R. Brown	University of Kentucky (retired)
Maryland	Wye Mills	Christopher S. Walsh	University of Maryland
Massachusetts	Belchertown	Wesley R. Autio	University of Massachusetts
Michigan	Benton Harbor	William Shane	Michigan State University
Missouri	Campbell	Martin L. Kaps	SW Missouri State University
		Patrick L. Byers	SW Missouri State University
		Timothy P. Baker	University of Missouri
Missouri	New Franklin	Michele Warmund	University of Missouri
New Jersey	Cream Ridge	Robert D. Belding	Rutgers University
		Edward Durner	Rutgers University
New Jersey	Pittstown	Winfred P. Cowgill, Jr.	Rutgers University
New York	Geneva	Robert L. Andersen	Cornell University
Ohio	Wooster	David C. Ferree	Ohio State University
Ontario	Vineland	Neil W. Miles	University of Guelph (retired)
South Carolina	Clemson	Gregory L. Reighard	Clemson University
		David R. Ouellette	Clemson University
Tennessee	Crossville	Dennis Deyton	University of Tennessee
Utah	Kaysville	J. LaMar Anderson	Utah State University (retired)
		Thor Lindstrom	Utah State University

Ontario, which used a modified central leader system. Irrigation, weed control and rate of fertilizer were applied according to local recommendations.

The following data were collected annually at each site and summarized at Clemson University: tree survival, trunk circumference, root sprouts, full bloom date, 10% maturity date, total yield / tree, and average weight of 20 fruit/tree. The Michigan, Missouri (New Franklin), and Kansas orchards were pulled before the final 2001 season, and some cooperators did not or could not collect all requested data.

Due to unequal rootstock numbers among locations, data from seven rootstocks that were common to the 20 sites were analyzed by PROC MIXED (SAS, Cary, NC) to detect rootstock differences between sites for 'Redhaven' survival, trunk circumference, root suckers, bloom date, maturity date, fruit weight, cumulative yield, and yield efficiency. In addition, data for each location were analyzed by PROC MIXED to determine differences among the rootstocks present at that site. The SAS macro, PDMIX612, was used to convert pair-wise differences between least squares means to letter groupings using Fisher's LSD. All data presented in tables were least squares means adjusted for missing cells.

Results and Discussion

Seven rootstocks common to all locations

Seven rootstocks common to all 20 locations were 'GF 305', 'Montclar',

'Higama', 'Guardian™ BY520-9', Tennessee Natural 281-1', 'Lovell', and 'Bailey'. Tree survival (Table 2) differed significantly among rootstocks. These differences could partly be attributed to some rootstocks either suffering ethylene-damage in storage (e.g., 'Lovell' and 'Tennessee Natural') or being planted as small trees due to late propagation (e.g., June-budded 'Guardian™ BY520-9'). However, there was less than a 13% difference between the highest ('Bailey') and poorest surviving rootstocks ('Lovell' and 'Higama'). Root suckers were few (< 1) but significantly more were produced on 'Guardian™ BY520-9' than on 'GF 305'.

'Redhaven' phenology and fruit maturity were significantly influenced by rootstock, but the differences were probably biologically and economically insignificant (Table 2). 'Redhaven' on 'Higama' and 'Montclar' rootstocks bloomed significantly later (0.4 day) than on 'Guardian™ BY520-9', 'GF 305', and 'Tennessee Natural 281-1'. 'Redhaven' fruit ripened earliest on 'Tennessee Natural 281-1' and latest on 'Montclar' with the difference between these rootstocks of only 0.8 day.

After 8 years, 'Redhaven' trunk circumference (i.e., radial growth) across all sites was statistically different among rootstocks (Table 2). 'Guardian™ BY520-9' and 'Lovell' produced the largest trees, whereas 'Bailey' and 'Tennessee Natural 281-1' produced the smallest trees. These small numerical differences would appear to be biologically insignificant. However, tree height and crown width were also significantly different with trees on 'Lovell', 'GF 305', 'Montclar' and 'Guardian™ BY520-9' rootstocks being taller with wider canopies. These parameters could be economically significant if fruit production is correlated with bearing shoot number. The 'Redhaven' cumulative fruit yields were in fact highest on these four rootstocks with significantly less fruit produced by 'Bailey', 'Higama', and 'Tennessee Natural 281-1' than 'Guardian™ BY520-9' rootstocks. Trees on 'Lovell' also produced significantly more fruit than on 'Bailey' and 'Higama' rootstocks.

In contrast, mean fruit weight was significantly larger by 1-6 grams on the 'Bailey' and 'Higama' rootstocks, which may be due to a crop load effect (Table 2). Cumulative yield efficiency was also highest on the lower yielding rootstocks, 'Bailey' and 'Tennessee Natural 281-1', and lowest on the higher yielding rootstocks, 'Guardian™ BY520-9' and 'Lovell'. The data show that tree size was influenced by the seven *P. persica* seedling rootstocks, and this had a small but positive effect on yield through eight growing seasons.

All rootstocks and locations

Tree survival (Tables 3-22) differed significantly among rootstocks at individual sites. These differences could partly be attributed to factors listed for the seven common rootstocks above. In addition, some rootstocks were planted on fewer and colder test sites (e.g., 'Myran', 'Tzim Pee Tao', 'Chui Lum Tao', and 'H338019') and others had smaller caliper trees at planting (e.g., 'Myran', 'Ishtara' and 'Ta Tao 5'). Rootstocks with the lowest survival across all sites were 'Ishtara', 'Myran' and the 'Ta Tao 5' interstem. Rootstocks with the best survival were 'Rubira' and 'S.2729'. Tree survival was less than 70% for the Michigan, Indiana, and southeastern Missouri plantings, but better than 90% for the Arkansas, Kansas, Maryland, New York, South Carolina, and Utah locations. Propagation procedures of clonal rootstocks for peach were not well refined by the U. S. fruit tree nurseries at the time this test was begun. Personal observations from organizing the 2001 and 2002 NC-140 peach rootstock trials and comments from cooperators on variation in tree size and quality, suggested that there is still room for improvement in producing uniform peach trees on clonal rootstocks. These production glitches could hinder or slow introduction of new clonal rootstocks for peach growers in North America.

After eight years, tree growth within sites was statistically different among rootstocks (Tables 3-22). 'Myran' when present was often the most vigorous rootstock followed by 'S.2729' and 'Guardian™ BY520-9'.

Table 2. Eight-year performance of Redhaven peach on 7 rootstocks planted at 20 NC-140 testing locations.

Rootstock cultivar	Survival[Z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	75.4 c	45.5 ab	3.67 a	5.13 a	0.2 bc	95.7 bcd	203.1 cd	165 b	246.2 ab	1.60 d
Bailey	88.1 a	40.3 e	3.46 b	4.88 c	0.2 bc	95.8 abc	203.3 bc	169 a	223.9 cd	1.87 a
Tennessee Natural 281-1	83.0 abc	41.1 e	3.50 b	4.91 bc	0.3 b	95.6 cd	202.8 d	165 b	236.4 bc	1.88 a
GF 305	85.0 ab	44.0 cd	3.63 a	5.02 ab	0.1 c	95.6 cd	203.5 ab	164 b	249.0 ab	1.74 b
Higama	75.7 c	43.3 d	3.48 b	4.75 d	0.3 b	96.0 a	203.1 c	166 ab	216.9 d	1.54 d
Montclar	86.9 ab	44.5 bc	3.61 a	4.96 bc	0.2 bc	96.0 ab	203.6 a	165 b	244.8 ab	1.70 bc
BY520-9 (Guardian)	79.8 bc	45.7 a	3.60 a	4.96 bc	0.6 a	95.6 d	203.4 abc	163 b	252.5 a	1.63 cd
No. of locations in analysis	20	17[1]	14[1,2]	14[1,2]	20	12[3]	15[4]	17[5]	16[1,6]	16[1,6]
Rootstock X location	***	***	**	**	***	***	**	**	*	***

[Z] Mean separation within columns using Fisher's LSD, $P < 0.05$

*,**,*** Significant at $P < 0.05$, 0.01, and 0.001, respectively.

[1] KS, MI, U of MO removed trees early, thus no 2001 or 6-year cumulative data

[2] GA, IL, IN, and TN did not record data; Fall 2000 data used for KS

[3] Only locations with ≥3 years of data used in analysis; IL, IN, MA, MD, MI, U of MO, NY, and OH with < 3 years of data

[4] Only locations with ≥3 years of data used in analysis; GA, IL, MI, OH, and TN with < 3 years of data

[5] Only locations with ≥3 years of data used in analysis; MI, U of MO, and NY with < 3 years of data

[6] IL had complete crop loss due to brown rot in 2000

The standards 'Lovell' and 'Nemaguard' were statistically similar in vigor to 'Guardian™ BY520-9', 'S.2729' and 'Montclar'. 'Ishtara', 'Tzim Pee Tao', and 'Chui Lum Tao' produced the smallest trees, but the latter two rootstocks were planted mostly in cold regions (i.e., shorter growing season). It should be noted, however, that in South Carolina they also produced smaller trees. The origin of these two stocks is from northeastern China, a very cold region with a short growing season. 'Rubira' and 'Bailey' also produced slightly smaller trees on average. 'Ishtara', 'Rubira' and 'Bailey' have been reported to be slightly dwarfing with peach cultivars (16,18,19,22).

Among locations (Tables 3-22), trees grew larger in southern Illinois, central Tennessee, southeastern Missouri, and central New Jersey. All of these locations are in minor peach production areas in the United States where annual cropping is uncertain. The high tree vigor at these sites could be partly attributed to good soils and growing conditions or to low annual cropping due to freezes. The smallest trees were in Arkansas, New York, Ontario, and Utah. Climate, soils, diseases, replant land or other factors such as herbicide toxicity (e.g., Arkansas) may have limited tree growth at these sites. Lastly, variations in cultural practices such as crop load adjustment, irrigation frequency, or fertilization at each site could have influenced tree vigor.

Suckers originating at or below the root collar were recorded (Tables 3-22). 'Nemaguard' had significantly more suckers than all other rootstocks, whereas 'Ishtara' and 'Myran', which are clonal hybrids, did not produce suckers. After the first 2 years, very little suckering occurred.

Infestation from peach tree borer (*Synanthedon exitiosa* (Say)) occurred at the Tennessee, Massachusetts, and New York sites, and borer damage data (not shown) were collected in 1994, 1997, and 1999, respectively for these test locations. There were no differences in infestation among rootstocks in Tennessee, which only had peach seedling rootstocks at its site. At least 50% or more of the trees on each rootstock were infested. Likewise, all peach seedling rootstocks were attacked by the peach tree borer at the Massachusetts location with damage ratings of 1.0 or greater out of a 0 (low) to a 4 (high) scale. However, 'Ishtara', the only peach x plum hybrid at this site had a very low infestation rating of 0.1. Similar findings were reported from the New York site, where peach rootstocks had ratings from 4.4 to 8.8 on a 1 (none) to a 9 (severe) scale for level of borer infestation; whereas the two peach x plum hybrids, 'Ishtara' and 'S.2729', had ratings of 1.75 and 2.3, respectively. These data suggest that there is some genetic resistance to peach tree borer in the peach x plum rootstocks, especially 'Ishtara'.

'Redhaven' bloom date over 6 years was generally affected little by rootstock (Tables 3-16, 19-22). Except for New Franklin, Missouri where the bloom data were approximately opposite the other sites, data were relatively consistent for order of bloom on different rootstocks across years. However, these data were not collected annually at many locations, thus eight sites were omitted from the statistical analyses. From the data that were analyzed, significant differences were an earlier 'Redhaven' bloom (< 1 day) on 'Myran' and a later bloom date on 'Ta Tao 5' interstem trees. Differences in bloom delay were most pronounced at the southern locations where trees on 'Ta Tao 5' interstems bloomed an average of 2.4 to 4.9 days later than trees on 'Lovell' in South Carolina and Georgia, respectively (Tables 5, 20). Trees on the 'Ta Tao 5' interstem bloomed more than 1 day later in Arkansas, Colorado, Illinois, southeastern Missouri, and Tennessee (Tables 3,4,6,14,21). Bloom delay from 'Ta Tao 5' has been shown to be due largely to the peach latent mosaic viroid, and the interstem is not necessary to obtain the delay in phenology (4,21). For all other rootstocks, however, the bloom date was less than a day different from 'Lovell'. Four rootstocks ('H7338013', 'H7338019', 'Chui Lum Tao', 'Tzim Pee Tao') tended to delay 'Redhaven' bloom about 1 day later than 'Lovell'. 'Redhaven' full bloom averaged as early as March 20 in central Georgia and as late as May 16 in Massachusetts (Tables 5, 11).

Fruit maturity also was little affected by rootstock between (Table 2) and within locations (Tables 3-22). Fruit from trees on 'Myran' and 'Tennessee Natural 281-1' tended to ripen less than a day earlier on average than on 'Lovell'. 'Redhaven' fruit on 'Montclar' rootstock ripened about 0.5 day later than fruit on 'Lovell'. Fruit from trees on 'Ta Tao 5' interstems ripened 1.5 to 2 days later on average. Once again, the delay in fruit maturity was more extended at the southern locations where delays averaged 3.3 and 3.9 days for South Carolina and Georgia, respectively (Tables 5, 20). 'Redhaven' fruit ripened on average as early as June 22 in mid-Georgia and as late as August 16 in eastern Ontario.

Fruit weight was significantly influenced within some locations by rootstock (Tables 3-16, 18-22). 'Redhaven' fruit from 'BY520-8' and 'Ta Tao 5' interstem trees were slightly but significantly smaller (~10 g); whereas fruit from trees on 'Ishtara' and 'H7338013' ('H7338019' was borderline) were significantly larger (6-7 g) than fruit from trees on 'Lovell'. 'Rubira' produced slightly larger fruit and 'Myran' slightly smaller fruit than did 'Lovell' rootstock at some sites (Tables 3-5, 12, 20). Crop load (i.e., fruit number) effects were not factored into the fruit weight analyses.

Fruit weight was noticeably different (not statistically analyzed) between locations. Climate and cultural practices would influence fruit size via indirect and direct factors. The Massachusetts and southeastern Missouri locations had the largest average fruit weight of 206 and 196 g, respectively. Indiana, Kansas, Arkansas and Michigan had the smallest fruit, which averaged 132, 137, 140 and 140 g, respectively. The Missouri site happened to be the only one at a grower farm where timely attention to thinning, irrigation, and weed and pest control would be expected and therefore fruit size maximized.

Cumulative fruit yields (1996-2001) were significantly different among rootstocks within locations (Tables 3-22), and yield differences were evident between locations. Highest cumulative fruit yields were from Ohio, north central New Jersey, Maryland, and South Carolina, which had average cumulative yields of 414, 391, 320, and 318 kg/tree, respectively. These same locations also had the highest yields after the first 3 fruiting years (20). The Maryland site is located on the Delmarva peninsula and has deep fertile soil and a mild climate. The New Jersey and Ohio sites are fertile, heavier textured soils; whereas the South Carolina site was gravelly sand previously planted to *Prunus sp.* The first three locations had favorable soil conditions for tree growth while the latter location had a warmer climate favorable for tree and fruit growth.

The lowest mean cumulative fruit yields were from Michigan (30 kg/tree after 6 yrs), New Franklin, Missouri (138 kg/tree after 7 yrs), and after 8 years, New York, Colorado, and Arkansas with 102, 103, and 142 kg/tree, respectively (data not shown). The first 4 locations are regions with cold winters, whereas in Arkansas trees grew poorly for about three years after a herbicide overdose and lost a crop from a spring frost in 1998 (Rom, pers. comm.). Some of the low yields at the northern sites could be attributed to cold damage to flower buds or cambial tissue. In the 1984 NC-140 peach rootstock planting (15), 'Redhaven' cumulative yields were also very low in Missouri and Colorado, but were average to good in Arkansas, New York, and Michigan. This suggested that poor weather events will influence fruit production in marginal peach production areas, but might or might not occur during a rootstock's testing period.

In this large test, no rootstock yielded significantly more than the commercial standard 'Lovell'. However, 'GF 305', 'Montclar', 'Guardian™ BY520-9' and 'H7338019' yielded equivalent to 'Lovell' at many sites (Tables 3-22). Once again, yield data for these rootstocks were similar to the findings in the 5-yr report for this trial (20) suggesting a consistent yield potential for a rootstock and possibly a geographic location once trees come into full production at approximately years 4 or 5. Other rootstocks such as 'Ishtara', 'Chui Lum Tao', 'Tzim Pee Tao', 'Bailey', 'Higama', and 'Rubira' plus the 'Ta Tao 5' interstem tended to yield less than 'Lovell' at many locations in this test at

both the 5-year (20) and 8-year reporting periods.

The 'Redhaven' yield data for each rootstock at each location showed that the rootstocks that yielded as well as or numerically better than 'Lovell' and the ones that yielded less than 'Lovell' were often consistent in their relative yield ranking among rootstocks at different locations. 'Guardian™ BY520-9', 'Lovell', 'GF 305', and 'Montclar' were planted at all 20 sites and had some of the highest cumulative yields at many locations and overall. An argument might be made that it appeared that the rootstocks that yielded less than average were generally not as well represented (i.e., fewer sites) in the trial. However, 'H7338019' was one of the best yielding rootstocks, yet was only planted at 11 sites; whereas, low yielding 'Ishtara', 'Ta Tao 5' interstem, and 'Bailey' were planted at 17, 17 and 20 locations, respectively. Rootstock productivity in relation to other rootstocks tended to be consistent across sites.

Cumulative yield efficiency was expressed as cumulative fruit yield over final tree trunk cross-sectional area to give an approximate estimate of rootstock efficiency (Tables 3-22). All trees had sufficient orchard space for much of the test period and thus vigorous rootstocks were not restricted in canopy expansion until maybe the final few years. The most efficient rootstocks were 'Rubira', 'Ishtara', 'Bailey', 'H7338019', and 'Tennessee Natural 281-1'. All of these rootstocks, as well as 'GF 305', were significantly more yield efficient and smaller in size than 'Lovell'. However, the first three yielded significantly less than 'Lovell', while the rest were similar to 'Lovell'. Despite their higher yield efficiency, none of these rootstocks were considered dwarfing types and thus would not likely be planted in a high density system to increase production on a per-hectare basis.

In contrast, significantly lower cumulative yield efficiencies were found for the peach x plum hybrid rootstocks, 'Myran' and 'S.2729', as well as 'Higama' peach seedling. Only Higama had yields significantly less than 'Lovell' at many sites but all three of these rootstocks are reported to be very vigorous (5,18,19), which can negatively affect yield efficiency such as was found with GF 677 in the 1984 rootstock trial (15). Since effective vigor control was not found within this group of rootstocks, yield efficiency may have little significance in this trial.

Even though all but three of the rootstocks in this trial were peach seedlings, significant differences among rootstocks were found for all characters measured. Since most of the locations were not difficult replant sites, many of the differences noted might be attributed more to the effects of climate and cultural practices and less so to environmental stresses such as drought, waterlogging, nematodes, soil fungi, and other factors. Therefore, it is not surprising that 'Lovell' performed as well as or better than the other rootstocks at many of the test locations throughout North America. The consistency of yield over time for rootstocks at each location suggested that long term testing (>5 yrs.) may not be necessary for peach seedling rootstocks unless some mortality-related factor like a once in a decade winter freeze event is desired. However, if dwarfing rootstocks are needed or site conditions/pathogens require rootstocks with more tolerance or resistance than a peach seedling like 'Lovell' then clonal rootstocks of complex *Prunus* hybrids may prove to be a better choice. Therefore, additional NC-140 peach rootstock trials were organized and planted in 2001 and 2002 for the purpose of evaluating interspecific *Prunus* rootstocks compatible to peach so that growers will eventually have options other than peach seedlings for the future.

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Table 3. Eight-year performance of Redhaven peach on 15 rootstocks at Clarksville, Arkansas.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	87.5 ab	32.2 de	3.1 bc	4.9 ab	0.0 c	87.1 b-e	180.9 bc	147 ab	143.0 bc	1.74 a-d
Bailey	75.0 ab	32.7 de	3.1 bc	4.6 a-d	0.0 c	87.8 bc	181.0 bc	151 a	134.0 bcd	1.61 a-e
Tennessee Natural 281-1	87.5 ab	34.3 cde	3.0 cd	4.7 abc	0.0 c	87.1 b-e	180.5 c	135 bcd	166.4 ab	1.75 a-d
Nemaguard	87.5 ab	33.6 de	3.0 c	4.6 abc	0.5 abc	87.3 b-e	180.1 c	135 bcd	164.6 ab	1.81 abc
Stark's Redleaf	87.5 ab	33.7 de	2.9 cd	4.5 bcd	0.4 abc	87.7 bcd	180.9 bc	139 a-d	166.8 ab	1.89 a
GF 305	87.5 ab	35.9 bcd	3.1 bc	4.6 a-d	0.0 c	87.5 b-e	180.8 bc	145 abc	149.0 abc	1.47 de
Higama	100.0 a	33.5 de	3.2 abc	4.3 cd	0.1 c	87.0 de	180.7 bc	139 a-d	125.7 cd	1.46 e
Montclar	100.0 a	38.6 abc	3.5 a	5.0 a	0.3 abc	87.1 b-e	180.9 bc	144 abc	180.3 a	1.54 cde
Rubira	100.0 a	31.6 e	3.1 bc	4.5 bcd	0.2 bc	87.9 b	180.8 bc	146 ab	143.2 bc	1.81 abc
Ishtara	75.0 ab	24.9 f	2.3 e	3.4 e	0.0 c	87.0 b-e	180.4 c	134 bcd	68.9 e	1.45 de
Myran	100.0 a	39.0 ab	3.3 abc	4.4 bcd	0.1 c	87.4 b-e	180.1 c	133 cd	128.6 cd	1.05 f
S.2729	100.1 ab	34.9 b-e	3.2 abc	4.6 a-d	1.2 a	87.2 b-e	181.7 ab	137 bcd	155.4 abc	1.58 b-e
BY520-8	100.0 a	35.5 b-e	3.1 bc	4.5 bcd	0.0 c	87.1 cde	180.7 c	129 d	157.4 abc	1.57 cde
BY520-9 (Guardian)	87.5 ab	41.6 a	3.4 ab	5.1 a	1.1 ab	86.7 e	180.7 bc	139 a-d	153.4 abc	1.15 f
Ta Tao 5 interstem	67.1 b	25.8 f	2.5 de	4.0 d	0.0 bc	89.2 a	182.8 a	132 bcd	100.3 de	1.92 ab
No. years of data	--	--	--	--	8	5	4	5	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 4. Eight-year performance of Redhaven peach on 17 rootstocks at Grand Junction, Colorado.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	25.0 cd	46.3 ab	3.7 a-e	5.3 a-d	0.1 abc	96.1 g	202.0 d	165 d-g	100.2 b-f	0.57 cde
Bailey	100.0 a	40.1 efg	3.7 bcd	5.1 bcd	0.1 c	98.3 a-e	204.4 a-d	183 bcd	75.7 f	0.59 de
Tennessee Natural 281-1	75.0 ab	42.6 b-e	3.7 a-d	5.0 bcd	0.0 c	98.3 a-e	204.0 a-d	189 bc	108.9 bcd	0.74 bc
GF 305	75.0 ab	42.7 b-e	3.7 a-d	5.4 ab	0.2 abc	97.0 fg	203.5 cd	175 c-f	113.6 bc	0.78 b
Higama	87.5 ab	42.6 b-e	3.5 de	4.9 d	0.0 c	98.5 a-e	204.2 a-d	165 f	83.2 ef	0.58 de
Montclar	100.0 a	43.5 bcd	3.7 abc	5.2 bcd	0.0 c	97.2 fg	205.0 a-d	181 b-e	112.4 bc	0.75 b
Rubira	87.5 ab	38.7 fg	3.6 cd	4.8 d	0.1 bc	97.9 def	205.9 a	187 bcg	86.9 ef	0.72 bc
Ishtara	62.5 abc	38.6 fg	3.7 a-d	5.2 a-d	0.0 c	97.7 d-g	204.8 a-d	186 bcg	124.5 ab	1.04 a
Myran	12.5 d	52.1 a	3.9 a-d	5.8 abc	0.0 abc	97.0 b-g	202.8 a-d	192 a-f	118.7 a-e	0.56 b-e
S.2729	87.5 ab	44.7 b	3.9 ab	5.0 bcd	0.0 c	97.9 c-f	203.8 bcd	183 bcd	83.7 ef	0.53 e
Chui Lum Tao	50.0 bcd	36.8 g	3.5 cde	4.9 cd	0.2 abc	98.5 a-e	205.2 a-d	196 ab	85.5 def	0.78 b
Tzim Pee Tao	50.0 bcd	41.0 c-f	3.7 a-d	5.0 bcd	0.0 c	99.4 a	205.6 abc	192 bc	93.0 c-f	0.70 bcd
H7338013	100.0 a	43.9 bcd	3.9 a	5.6 a	0.3 a	98.9 abc	204.4 a-d	194 b	89.8 def	0.59 de
H7338019	50.0 bcd	42.8 b-e	3.8 abc	5.2 a-d	0.3 ab	99.3 ab	206.1 ab	213 a	146.3 a	1.02 a
BY520-8	75.0 ab	44.9 b	3.6 cd	5.3 abc	0.1 bc	98.4 a-e	204.7 a-d	166 ef	113.6 bc	0.70 bc
BY520-9 (Guardian)	100.0 a	44.3 bc	3.7 bcd	5.3 abc	0.1 bc	97.5 efg	205.7 ab	191 b	121.5 b	0.78 b
Ta Tao 5 interstem	75.0 ab	41.2 def	3.3 e	4.8 d	0.0 c	98.7 a-d	204.7 a-d	168 def	103.1 b-e	0.77 b
No. years of data	--	--	--	--	8	5	4	4	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 5. Eight-year performance of Redhaven peach on 14 rootstocks at Byron, Georgia.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	87.5 a	44.8 de	0.2 b	79.1 b	169.3 b	147 abc	162.0 abc	1.02 bc
Bailey	87.5 a	41.6 efg	0.0 b	78.5 bcd	168.7 b	143 bcd	139.8 bcd	1.02 abc
Tennessee Natural 281-1	100.0 a	39.8 fg	0.4 b	78.3 bcd	167.4 bcd	135 cd	166.1 abc	1.31 a
Nemaguard	62.5 ab	46.3 bcd	0.9 ab	79.9 b	167.9 bc	134 cd	134.0 bcd	0.77 cde
GF 305	100.0 a	44.9 de	0.2 b	77.2 cde	166.5 cd	143 bcd	196.8 a	1.21 ab
Higama	37.5 b	51.8 a	0.4 ab	78.2 b-e	168.6 bc	168 ab	197.1 ab	0.93 a-e
Montclar	62.5 ab	45.4 cde	0.5 ab	79.3 b	169.2 b	144 bcd	151.4 a-d	0.92 bcd
Rubira	87.5 a	43.1 def	0.7 ab	78.5 bcd	168.0 bc	152 abc	171.3 abc	1.15 ab
Ishtara	37.5 b	38.4 g	0.0 b	79.6 bc	164.6 d	173 a	110.0 cde	0.95 a-d
Myran	62.5 ab	43.4 d-g	0.0 b	76.4 de	166.9 bcd	134 cd	112.0 cde	0.70 cde
S.2729	87.5 a	40.3 fg	0.0 b	79.1 b	167.9 bc	133 cd	73.2 e	0.55 e
BY520-8	75.0 ab	50.0 ab	1.6 a	75.8 e	167.1 bcd	125 d	202.4 a	1.01 abc
BY520-9 (Guardian)	62.5 ab	49.6 abc	0.0 b	77.8 b-e	169.3 b	139 cd	206.1 a	1.03 abc
Ta Tao 5 interstem	68.4 ab	44.6 de	0.2 b	83.9 a	172.5 a	138 cd	95.6 de	0.60 de
No. years of data	--	--	8	6	2	5	6	6

Table 6. Eight-year performance of Redhaven peach on 17 rootstocks at Carbondale, Illinois.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	62.5 abc	59.1 a	0.0 c	88.4 e-h	194.5 bc	174 b-e	157.5 cde	0.56 g
Bailey	87.5 ab	54.6 a-e	0.1 c	89.7 b-e	193.9 bcd	190 a	166.0 bcd	0.71 d-g
Tennessee Natural 281-1	62.5 abc	54.9 a-e	0.2 bc	87.0 h	192.8 cd	162 e	161.0 bcd	0.68 fg
Stark's Redleaf	75.0 ab	52.6 c-f	0.0 c	89.0 c-f	193.6 bcd	174 b-e	196.5 ab	0.89 a-e
GF 305	75.0 ab	58.1 abc	0.0 c	88.7 d-g	193.9 bcd	177 bcd	176.6 a-d	0.66 fg
Higama	75.0 ab	52.5 c-f	0.5 ab	88.1 fgh	193.6 cd	177 bcd	193.7 abc	0.90 ab
Montclar	100.0 a	58.8 a	0.0 c	88.7 def	194.1 bc	173 b-e	187.6 a-d	0.68 fg
Rubira	100.0 a	52.3 def	0.0 c	88.6 d-g	193.1 cd	183 ab	201.9 a	0.93 a
Ishtara	25.0 c	43.2 g	0.0 bc	91.2 ab	192.4 cd	187 ab	106.1 e	0.70 a-g
S.2729	100.0 a	58.2 ab	0.1 c	87.5 gh	194.1 bc	178 bc	182.6 a-d	0.69 fg
Chui Lum Tao	75.0 ab	53.4 a-f	0.0 bc	90.4 abc	193.4 bcd	187 ab	195.7 a-d	0.91 a-d
Tzim Pee Tao	100.0 a	47.5 fg	0.3 abc	90.9 ab	192.1 d	178 a-d	164.7 a-d	0.90 abc
H7338013	100.0 a	53.1 b-f	0.1 bc	88.2 fgh	194.1 bc	177 bcd	165.0 bcd	0.76 b-f
H7338019	100.0 a	56.1 a-e	0.0 c	89.7 b-e	193.4 cd	173 b-e	159.0 b-e	0.65 fg
BY520-8	87.5 ab	55.3 a-e	0.1 c	88.5 d-g	194.4 bc	167 de	175.1 a-d	0.72 c-g
BY520-9 (Guardian)	50.0 bc	58.2 a-d	0.7 a	90.0 a-d	195.6 ab	165 cde	184.0 a-d	0.71 c-g
Ta Tao 5 interstem	66.7 ab	50.5 efg	0.0 c	91.4 a	197.6 a	167 cde	152.7 de	0.75 b-g
No. years data	--	--	7	2	2	4	5	5

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 7. Eight-year performance of Redhaven peach on 18 rootstocks at Vincennes, Indiana.

Rootstock cultivar	Survival[Z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	75.0 a	44.6 ab	0.1 b	101.9 a	196.8 a	136 ab	250.8 a-d	1.58 d
Bailey	87.5 a	39.3 bc	0.0 b	101.0 a	197.4 a	135 ab	260.8 a-d	2.18 ab
Tennessee Natural 281-1	87.5 a	40.2 abc	0.0 b	100.8 a	196.7 a	133 ab	240.4 bcd	2.08 abc
Stark's Redleaf	62.5 ab	43.8 ab	0.0 b	102.4 a	196.8 a	128 a-d	270.2 a-d	1.73 cd
GF 305	62.5 ab	46.0 a	0.0 b	101.5 a	197.5 a	135 ab	323.0 ab	1.85 a-d
Higama	87.5 a	43.2 ab	0.0 b	102.0 a	196.6 a	133 ab	257.7 a-d	1.89 a-d
Montclar	75.0 a	45.9 a	0.0 b	102.8 a	196.9 a	127 bcd	288.4 a-d	1.89 a-d
Rubira	75.0 a	39.2 bc	0.0 b	100.8 a	196.7 a	136 ab	272.4 a-d	2.24 a
Ishtara	0.0 b							
Myran	47.5 ab	47.0 ab	0.0 b	97.3 a	197.3 a	132 a-d	280.5 a-d	1.58 a-d
S.2729	87.5 a	46.3 ab	0.7 a	100.8 a	196.7 a	137 ab	336.3 ab	1.98 a-d
Chui Lum Tao	98.6 a	38.4 abc	0.0 b	104.0 a	196.2 a	120 cd	185.5 cd	1.60 cd
Tzim Pee Tao	99.2 a	34.1 c	0.0 b	103.4 a	196.3 a	117 d	174.2 d	1.66 bcd
H7338013	50.8 ab	36.2 abc	0.0 b	96.7 a	195.8 a	119 bcd	178.9 a-d	1.78 a-d
H7338019	0.0 b							
BY520-8	62.5 ab	43.3 ab	0.0 b	102.4 a	197.1 a	132 abc	296.3 abc	2.09 abc
BY520-9 (Guardian)	62.5 ab	45.5 a	0.0 b	102.8 a	196.8 a	138 a	333.2 a	2.08 abc
Ta Tao 5 interstem	0.0 b							
No. years of data	--	--	3	1	5	5	6	6

[Z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 8. Seven-year performance of Redhaven peach on 8 rootstocks at Wichita, Kansas.

Rootstock cultivar	Survival[z] (%) 1994-2000	Trunk circumference (cm) Fall 2000	Tree height (m) Fall 2000	Crown width (m) Fall 2000	No. of rootsuckers 1994-2000	90% Full bloom (Julian date) 1996-2000	10% Fruit mature (Julian date) 1996-2000	Mean fruit weight (g) 1996-2000	Cumulative fruit yield (kg) 1996-2000	Cumulative yield efficiency (kg/cm^2) 1996-2000
Lovell	100.0 a	41.7 bc	4.1 a	5.4 ab	0.0 a	91.4 ab	196.3 bc	134 bc	183.7 abc	1.32 ab
Bailey	100.0 a	39.5 cd	3.7 b	5.3 ab	0.0 a	91.5 ab	195.9 c	145 a	172.2 c	1.37 ab
Tennessee Natural 281-1	100.0 a	39.1 d	3.9 ab	5.2 b	0.0 a	91.0 b	195.6 c	138 abc	176.8 bc	1.44 a
GF 305	100.0 a	40.7 bcd	3.9 ab	5.2 ab	0.0 a	90.9 b	196.2 bc	132 c	162.9 c	1.22 b
Higama	100.0 a	42.9 ab	4.0 a	5.5 a	0.0 a	91.5 ab	195.8 c	135 bc	180.1 bc	1.22 b
Montclar	100.0 a	41.2 bcd	4.0 a	5.3 ab	0.0 a	91.6 a	196.9 ab	142 ab	184.8 abc	1.37 ab
BY520-8	87.5 a	43.0 ab	3.9 ab	5.4 ab	0.0 a	91.4 ab	197.4 a	131 c	203.7 ab	1.37 ab
BY520-9 (Guardian)	100.0 a	44.7 a	3.9 ab	5.4 a	0.0 a	91.0 b	196.3 bc	130 c	209.0 a	1.30 ab
No. years of data	--	--	--	--	7	4	3	4	5	5

[z] Mean separation within columns using Fisher's LSD, $P< 0.05$

Table 9. Eight-year performance of Redhaven peach on 12 rootstocks at Princeton, Kentucky.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	37.5 b	47.3 a	4.1 abc	5.1 a-d	0.0 ab	91.9 b	190.1 b-e	171 a	228.8 ab	1.28 bcd
Bailey	100.0 a	39.0 cd	3.8 d	4.9 bcd	0.0 b	91.5 bcd	189.4 e	172 a	185.6 bc	1.52 ab
Tennessee Natural 281-1	75.0 ab	40.7 c	3.8 cd	5.0 abc	0.2 ab	91.2 bcd	189.4 de	169 a	194.0 abc	1.48 abc
Stark's Redleaf	87.5 a	47.6 a	4.1 abc	5.3 ab	0.1 ab	91.3 bcd	189.8 b-e	180 a	201.3 abc	1.13 d
GF 305	100.0 a	46.8 a	4.4 a	5.3 a	0.2 ab	91.0 d	190.2 bc	173 a	230.4 a	1.33 bcd
Higama	62.5 ab	41.8 bc	4.0 bcd	4.5 d	0.5 a	91.7 bc	190.4 b	170 a	171.0 c	1.23 cd
Montclar	87.5 a	47.0 a	4.2 ab	5.1 abc	0.2 ab	91.7 bc	190.0 bcd	168 a	210.6 abc	1.19 d
Rubira	87.5 a	45.5 ab	4.1 ab	5.0 abc	0.2 ab	91.1 bcd	190.0 bcd	171 a	206.1 abc	1.27 bcd
Ishtara	62.5 ab	36.2 d	3.4 e	4.7 cd	0.0 ab	91.0 cd	189.9 b-e	154 b	180.9 bc	1.78 a
BY520-8	75.0 ab	45.7 ab	4.1 ab	5.2 abc	0.2 ab	91.3 bcd	189.6 cde	174 a	197.5 abc	1.20 cd
BY520-9 (Guardian)	87.5 a	46.6 a	4.0 bcd	5.3 ab	0.2 ab	91.4 bcd	189.7 b-e	177 a	228.1 a	1.34 bcd
Ta Tao 5 interstem	100.0 a	40.4 c	3.5 e	5.0 abc	0.3 ab	92.9 a	193.1 a	154 b	201.9 abc	1.53 ab
No. years of data	--	--	--	--	8	5	5	5	6	6

[z] Mean separation within columns using Fisher's LSD, $P< 0.05$

Table 10. Eight-year performance of Redhaven peach on 12 rootstocks at Wye Mills, Maryland.

Rootstock cultivar	Survival[Z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	56.4 a	4.2 a	5.1 a	0.5 c	200.3 a-d	153 bc	340.9 abc	1.83 d
Bailey	100.0 a	44.6 def	3.8 a-e	4.8 ab	0.9 bc	200.7 abc	156 abc	336.5 abc	2.85 a
Tennessee Natural 281-1	100.0 a	42.1 f	3.6 de	4.8 ab	2.9 a	200.2 bcd	158 abc	275.0 cd	2.71 ab
GF 305	100.0 a	52.3 abc	4.0 abc	5.0 ab	0.2 c	201.7 ab	159 ab	331.0 abc	2.03 cd
Higama	75.0 a	45.5 def	3.5 e	4.9 ab	1.7 b	200.3 a-d	157 abc	303.6 bcd	2.41 bc
Montclar	100.0 a	48.7 cd	4.1 ab	4.7 ab	0.5 c	201.2 abc	162 a	345.7 abc	2.41 bc
Rubira	100.0 a	43.2 ef	3.7 b-e	4.5 b	0.4 c	200.0 cd	155 abc	304.9 bcd	2.73 ab
Ishtara	25.0 b	42.3 def	3.3 e	4.3 abc	0.6 c	198.5 d	146 c	314.2 a-d	3.24 a
S.2729	100.0 a	50.6 bc	4.0 a-d	4.7 ab	0.5 c	200.8 abc	164 a	362.7 ab	2.29 c
BY520-8	100.0 a	48.5 cd	3.7 cde	4.7 ab	0.6 c	200.5 a-d	155 abc	303.9 bcd	2.19 cd
BY520-9 (Guardian)	100.0 a	53.5 ab	3.8 a-e	4.8 ab	1.1 bc	200.5 a-d	150 bc	402.5 a	2.17 cd
Ta Tao 5 interstem	98.7 a	48.6 b-e	4.3 a	3.8 c	0.1 c	201.9 a	150 bc	233.9 d	2.12 cd
No. years of data	--	--	--	--	7	4	6	6	6

[Z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 11. Eight-year performance of Redhaven peach on 13 rootstocks at Belchertown, Massachusetts.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	75.0 a-d	42.4 a	3.2 a	4.7 a	0.0 b	135.5 abc	223.4 cd	207 abc	250.3 a	1.78 bcd
Bailey	50.0 d	39.2 abc	2.8 a-d	4.5 ab	0.0 b	136.0 ab	223.4 cd	209 abc	214.3 a-d	1.78 bcd
Tennessee Natural 281-1	100.0 a	40.3 ab	3.1 ab	4.7 a	0.0 b	135.1 abc	222.9 d	213 ab	244.2 ab	1.88 bcd
Stark's Redleaf	100.0 ab	38.5 abc	3.0 a-d	4.6 ab	0.0 b	135.3 abc	222.6 d	220 a	231.8 abc	1.97 abc
GF 305	62.5 bcd	39.4 abc	2.9 a-d	4.5 ab	0.0 b	136.6 a	223.6 cd	200 bc	218.9 a-d	1.75 bcd
Higama	50.0 cd	40.0 abc	2.8 a-d	4.2 abc	0.0 ab	137.7 a	225.5 ab	197 bc	203.7 a-e	1.56 cd
Montclar	87.5 abc	39.7 ab	3.0 abc	4.5 ab	0.0 b	135.6 ab	224.3 abc	199 c	203.8 bcd	1.64 cd
Rubira	87.5 abc	33.3 d	3.0 ab	4.2 bc	0.0 b	133.9 bc	224.0 bcd	209 abc	181.5 cde	2.05 ab
Ishtara	100.0 a	28.7 e	2.8 bcd	3.8 c	0.0 b	133.3 c	223.1 d	198 c	149.7 e	2.27 a
H7338019	100.0 ab	34.9 cd	2.5 d	4.1 bc	0.1 ab	136.5 ab	222.8 d	210 abc	194.6 b-e	2.00 abc
BY520-8	75.0 a-d	38.9 abc	3.2 ab	4.7 a	0.2 a	136.0 ab	224.0 bcd	209 abc	217.9 abc	1.81 bcd
BY520-9 (Guardian)	100.0 a	43.0 a	3.2 ab	4.7 a	0.0 ab	134.0 bc	223.6 cd	198 c	246.1 a	1.69 cd
Ta Tao 5 interstem	83.3 a-d	36.9 bcd	2.5 cd	4.1 bc	0.0 b	136.0 ab	225.5 a	199 bc	167.5 de	1.54 d
No. years of data	--	--	--	==	7	1	4	6	6	6

[z] Mean separation within columns using Fisher's LSD, $P< 0.05$

Table 12. Six-year performance of Redhaven peach on 18 rootstocks at Benton Harbor, Michigan.

Rootstock cultivar	Survival[z] (%) 1994-1999	Trunk circumference (cm) Fall 1999	No. of rootsuckers 1994-1999	90% Full bloom (Julian date) 1996-1999	10% Fruit mature (Julian date) 1996-1999	Mean fruit weight (g) 1996-1999	Cumulative fruit yield (kg) 1996-1999	Cumulative yield efficiency (kg/cm^2) 1996-1999
Lovell	87.5 a	32.4 ab	0.3 b	116.5 a	220.8 bc	150 ab	34.2 ab	0.40 a-d
Bailey	62.5 ab	27.6 ab	1.5 b	116.5 a	220.4 c	145 abc	26.3 bcd	0.43 a-d
Tennessee Natural 281-1	50.0 ab	27.1 ab	0.6 b	116.5 a	220.5 bc	143 abc	29.0 a-d	0.53 abc
Stark's Redleaf	87.5 a	25.7 b	0.4 b	116.5 a	220.5 bc	127 bc	22.2 cd	0.47 abc
GF 305	62.5 ab	32.1 ab	0.1 b	116.5 a	220.9 bc	145 abc	35.7 ab	0.45 a-d
Higama	37.5 b	36.3 a	0.2 b	116.5 a	221.2 ab	117 c	36.9 ab	0.42 a-d
Montclar	50.0 ab	32.7 ab	1.4 b	116.5 a	220.5 bc	146 abc	27.2 a-d	0.32 bcd
Rubira	87.5 a	31.5 ab	0.7 b	116.5 a	220.5 bc	138 abc	34.9 ab	0.47 abc
Ishtara	87.5 a	30.2 ab	0.0 b	116.5 a	220.5 bc	142 abc	29.7 a-d	0.55 ab
Myran	75.0 ab	33.3 a	0.0 b	116.5 a	220.8 bc	122 c	20.7 d	0.24 d
S.2729	75.0 ab	34.7 a	0.0 b	116.5 a	220.5 bc	163 a	26.4 bcd	0.30 cd
Chui Lum Tao	100.0 a	29.2 ab	1.3 b	116.5 a	220.4 c	142 abc	40.1 a	0.61 a
Tzim Pee Tao	49.7 ab	26.4 ab	2.5 ab	116.5 a	220.5 bc	148 abc	35.5 a-d	0.58 abc
H7338013	62.5 ab	29.6 ab	1.2 b	116.5 a	220.5 bc	155 ab	26.7 a-d	0.37 a-d
H7338019	24.7 b	32.2 ab	0.3 b	116.5 a	220.5 bc	109 bc	34.8 a-d	0.41 a-d
BY520-8	75.0 ab	30.7 ab	0.2 b	116.5 a	220.9 bc	128 bc	31.7 a-d	0.44 a-d
BY520-9 (Guardian)	62.5 ab	31.8 ab	6.0 a	116.5 a	220.9 bc	139 abc	33.3 abc	0.55 ab
Ta Tao 5 interstem	50.5 ab	26.2 ab	0.2 b	116.5 a	221.8 a	134 abc	26.366 a-d	0.50 a-d
No. years of data	--	--	6	2	2	2	4	4

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 13. Seven-year performance of Redhaven on 17 rootstocks at New Franklin, Missouri.

Rootstock cultivar	Survival[z] (%) 1994-2000	Trunk circumference (cm) Fall 1998	No. of rootsuckers 1994-2000	90% Full bloom (Julian date) 1996-2000	10% Fruit mature (Julian date) 1996-2000	Mean fruit weight (g) 1996-2000	Cumulative fruit yield (kg) 1996-2000	Cumulative yield efficiency (kg/cm^2) 1996-2000
Lovell	37.5 b	36.0 abc	0.0 b	93.7 f	196.3 def	145 a	122.6 c-h	1.16 bcd
Bailey	62.5 ab	30.3 def	0.2 b	96.2 d	196.8 c-f	147 a	127.1 c-g	1.75 abc
Tennessee Natural 281-1	62.5 ab	29.9 ef	0.8 ab	94.0 f	194.6 g	147 a	88.7 fgh	1.25 bcd
Stark's Redleaf	87.5 a	35.4 abc	0.4 b	97.4 abc	199.3 a	153 a	198.0 ab	1.98 a
GF 305	37.5 b	34.1 a-e	0.1 b	97.3 abc	197.7 bcd	150 a	148.1 b-f	1.59 abc
Higama	87.5 a	33.3 cde	0.8 ab	94.4 f	194.7 g	142 a	108.7 d-h	1.22 bcd
Montclar	100.0 a	32.9 cde	0.5 b	97.4 abc	197.3 bcd	137 a	133.5 c-f	1.54 abc
Rubira	100.0 a	33.6 cd	0.3 b	97.4 abc	198.1 b	141 a	175.5 abc	1.99 a
Ishtara	62.5 ab	28.5 f	0.0 b	94.4 f	195.5 fg	137 a	82.0 gh	1.15 cd
S.2729	87.5 a	37.0 ab	0.1 b	95.2 e	196.1 ef	142 a	210.4 a	1.92 a
Chui Lum Tao	75.2 ab	33.3 b-e	0.3 b	97.7 ab	197.7 bcd	137 a	152.4 a-f	1.74 abc
Tzim Pee Tao	100.0 a	33.2 b-e	0.4 b	96.8 cd	197.7 bcd	153 a	158.2 a-d	1.76 abc
H7338013	87.5 a	32.9 cde	0.5 b	96.3 d	197.7 bcd	140 a	162.5 abc	1.91 a
H7338019	100.0 a	34.3 a-d	0.6 b	97.5 abc	197.3 b-e	150 a	170.9 abc	1.84 ab
BY520-8	75.0 ab	31.2 def	1.7 a	97.0 bc	197.6 bcd	148 a	99.3 e-h	1.30 bcd
BY520-9 (Guardian)	87.5 a	37.7 a	0.5 b	97.7 a	198.0 bc	139 a	148.3 cde	1.28 bcd
Ta Tao 5 interstem	33.1 b	31.7 c-f	0.0 b	94.5 ef	198.1 a-d	138 a	40.1 h	0.51 d
No. years of data	--	--	5	1	3	2	5	5

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 14. Eight-year performance of Redhaven peach on 15 rootstocks at Campbell, Missouri.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	50.0 bc	52.7 ab	4.1 a	5.5 a	0.0 b	89.3 b-f	189.9 ab	197 abc	303.8 ab	1.38 a-e
Bailey	87.5 ab	45.2 c	3.8 ab	4.9 ab	0.0 b	89.3 c-f	189.7 b	206 a	250.8 c-f	1.54 ab
Tennessee Natural 281-1	75.0 ab	51.3 b	4.2 a	5.1 ab	0.0 b	89.1 fg	189.8 b	188 bcd	278.9 a-d	1.36 b-e
Stark's Redleaf	87.5 ab	51.4 b	4.2 a	5.4 a	0.0 b	89.5 b-e	190.2 ab	198 abc	305.4 a	1.46 a-d
GF 305	100.0 a	51.6 b	4.3 a	5.2 ab	0.0 b	89.2 ef	189.9 ab	197 abc	274.4 a-d	1.29 cde
Higama	50.0 bc	50.7 b	3.9 ab	4.6 bc	0.0 b	89.7 bc	190.2 ab	205 ab	245.0 b-g	1.20 def
Montclar	62.5 ab	51.0 b	3.9 ab	5.2 ab	0.0 b	89.6 bcd	189.9 ab	200 abc	288.8 a-d	1.41 a-e
Ishtara	62.5 ab	47.9 bc	3.4 bc	4.0 c	0.0 b	89.7 b	189.8 b	195 abc	201.4 g	1.11 ef
Myran	57.2 ab	57.8 a	4.1 a	5.1 ab	0.0 b	88.4 h	189.7 b	188 a-d	234.7 d-g	0.90 f
S.2729	88.8 ab	56.4 a	4.3 a	5.4 a	0.6 a	88.9 gh	190.0 ab	200 abc	308.4 a	1.24 de
Chui Lum Tao	87.5 ab	39.2 d	3.3 c	4.3 c	0.0 b	89.4 b-f	189.6 b	186 cd	209.0 fg	1.66 a
H7338013	87.5 ab	50.6 b	4.2 a	5.2 ab	0.0 b	89.4 b-f	189.8 b	205 a	270.4 a-e	1.35 b-e
H7338019	75.0 ab	49.5 bc	3.8 ab	5.0 ab	0.1 b	89.2 def	189.7 b	203 ab	296.9 abc	1.52 abc
BY520-9 (Guardian)	62.5 ab	53.0 ab	4.1 a	5.0 ab	0.0 b	89.4 b-f	190.4 ab	196 abc	280.4 a-d	1.27 b-e
Ta Tao 5 interstem	12.5 c	44.1 bcd	2.7 c	4.9 abc	0.0 b	90.9 a	191.6 a	161 d	182.2 efg	1.15 b-f
No. years of data	--	--	--	--	8	6	6	4	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 15. Eight-year performance of Redhaven peach on 15 rootstocks at Cream Ridge, New Jersey.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	45.4 a	3.6 ab	5.8 a	0.1 b	97.8 ab	209.2 a-d	144 bcd	216.3 ab	1.33 e
Bailey	87.5 ab	39.7 bcd	3.4 a-d	5.6 abc	0.3 b	97.6 bc	209.1 a-e	147 a-d	197.6 bc	1.58 b-e
Tennessee Natural 281-1	87.5 ab	38.2 d	3.4 a-d	5.5 a-d	0.1 b	97.8 b	208.5 def	153 ab	201.3 bc	1.70 bc
Nemaguard	100.0 a	42.0 abc	3.6 a	5.6 a-d	2.4 a	97.7 b	209.8 abc	144 a-d	215.3 ab	1.54 cde
Stark's Redleaf	100.0 a	42.5 ab	3.6 ab	5.6 a-d	0.6 b	97.7 bc	209.0 b-f	143 bcd	209.0 abd	1.47 cde
GF 305	100.0 a	42.7 ab	3.5 abc	5.7 ab	0.3 b	98.1 ab	209.9 ab	145 a-d	231.7 ab	1.62 bcd
Higama	62.5 bc	38.5 cd	3.0 e	4.7 f	0.2 b	97.8 ab	208.7 b-f	149 abc	165.2 ce	1.37 de
Montclar	87.5 ab	40.3 bcd	3.3 bcd	5.3 b-e	0.1 b	97.5 bc	209.2 a-d	147 abc	219.8 ab	1.72 bc
Rubira	100.0 a	38.8 cd	3.4 a-d	5.5 a-d	0.3 b	98.3 ab	209.3 a-d	154 a	245.3 a	2.05 a
Ishtara	0.0 d									
Myran	12.5 d	45.9 ab	3.2 a-e	4.9 b-f	0.4 b	97.7 abc	208.8 a-f	127 d	128.3 cde	0.74 f
S.2729	50.0 c	41.5 a-d	3.4 a-d	5.1 def	0.5 b	96.8 c	207.7 f	146 a-d	149.7 e	1.01 f
BY520-8	87.5 ab	40.8 bcd	3.5 abc	5.5 a-d	0.5 b	97.8 ab	208.0 ef	146 a-d	241.4 a	1.84 ab
BY520-9 (Guardian)	75.0 abc	39.4 bcd	3.3 cd	5.0 ef	0.1 b	97.5 bc	208.6 c-f	140 cd	210.2 abc	1.70 bc
Ta Tao 5 interstem	50.0 c	43.3 ab	3.2 de	5.1 c-f	0.0 b	98.7 a	210.4 a	142 bcd	225.8 ab	1.52 b-e
No. years of data	--	--	--	--	7	3	3	6	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 16. Eight-year performance of Redhaven peach on 9 rootstocks at Pittstown, New Jersey.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	56.7 a	3.6 a	6.0 a	0.0 a	112.7 bcd	215.7 bc	176 abc	421.1 a	1.70 d
Bailey	100.0 a	44.6 e	3.5 ab	5.7 ab	0.0 a	112.8 a-d	216.0 abc	179 abc	408.6 a	2.60 a
Tennessee Natural 281-1	87.5 ab	46.4 e	3.3 b	5.5 b	0.1 a	112.1 d	215.2 c	178 abc	365.9 a	2.18 b
Nemaguard	75.0 ab	54.0 a-d	3.5 ab	6.1 a	0.0 a	113.1 ab	216.6 ab	183 a	428.4 a	1.85 bcd
Stark's Redleaf	75.0 ab	47.7 de	3.6 ab	5.6 ab	0.0 a	113.0 ab	215.8 abc	181 ab	393.1 a	2.17 b
GF 305	100.0 a	49.0 cde	3.6 a	5.9 ab	0.0 a	113.4 a	215.9 abc	176 bc	398.2 a	2.10 bc
Higama	75.0 ab	50.0 b-e	3.7 a	6.0 ab	0.0 a	112.9 abc	215.6 bc	172 c	364.4 a	1.87 bcd
Montclar	100.0 a	55.6 ab	3.6 ab	5.7 ab	0.0 a	112.7 a-d	216.9 a	177 abc	397.0 a	1.70 d
BY520-9 (Guardian)	62.5 b	54.9 abc	3.7 a	5.7 ab	0.1 a	112.1 cd	215.8 abc	173 bc	382.9 a	1.66 cd
No. years of data	--	--	--	--	8	6	6	4	6	6

[z]Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 17. Eight-year performance of Redhaven peach on 15 rootstocks at Geneva, New York.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	10% Fruit mature (Julian date) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	71.4 ab	33.0 bcd	3.2 abc	4.3 ab	0.4 bc	221.7 ab	102.0 c-f	1.19 b-e
Bailey	100.0 a	30.3 d-g	3.2 a-d	4.2 ab	0.3 c	221.2 b	90.6 c-f	1.27 bcd
Tennessee Natural 281-1	85.7 a	29.1 efg	3.0 cde	4.1 b	0.6 bc	221.3 b	86.6 def	1.26 b-e
GF 305	100.0 a	33.7 bc	3.3 ab	4.4 ab	0.3 c	221.5 ab	131.3 a	1.46 ab
Higama	100.0 a	32.7 b-e	3.2 a-e	4.1 ab	0.3 c	220.6 b	75.7 ef	0.89 e
Montclar	100.0 a	32.5 b-e	3.2 abc	4.5 ab	0.3 c	221.6 ab	110.3 abc	1.36 abc
Rubira	100.0 a	28.2 g	2.9 e	4.2 ab	0.3 c	221.1 b	94.2 c-f	1.44 ab
Ishtara	80.0 ab	30.1 c-g	3.4 a	4.4 ab	0.3 c	221.4 ab	106.3 a-e	1.50 ab
S.2729	100.0 a	37.2 a	3.3 a	4.6 a	0.3 c	221.4 ab	131.0 ab	1.20 b-e
Tzim Pee Tao	50.0 b	26.9 fg	3.1 a-e	4.0 ab	1.6 a	220.8 b	91.4 c-f	1.58 ab
H7338013	85.7 a	31.9 b-f	3.0 b-e	4.5 ab	0.3 c	221.1 b	103.4 cde	1.29 bcd
H7338019	100.0 a	29.3 d-g	3.1 a-e	4.2 ab	0.9 ab	221.3 ab	114.0 abc	1.68 a
BY520-8	100.0 a	32.6 b-e	3.1 a-e	4.2 ab	0.4 c	221.4 ab	108.5 bcd	1.28 bcd
BY520-9 (Guardian)	83.3 ab	35.1 ab	3.1 a-e	4.2 ab	0.5 bc	221.7 ab	106.5 cd	1.09 cde
Ta Tao 5 interstem	100.0 a	31.5 b-g	2.9 de	4.4 ab	0.3 c	222.4 a	75.9 f	0.98 de
No. years of data	--	--	--	--	4	5	6	6

Table 18. Eight-year performance of Redhaven peach on 11 rootstocks at Wooster, Ohio.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	44.8 a	3.9 a	5.0 a	0.3 a	182 bc	458.7 a	2.87 bc
Bailey	100.0 a	39.3 bc	3.7 abc	4.7 ab	0.0 a	189 ab	439.9 abc	3.56 a
Tennessee Natural 281-1	100.0 a	42.3 ab	3.7 abc	4.9 ab	0.1 a	184 bc	460.6 a	3.27 ab
Stark's Redleaf	75.0 a	40.7 ab	3.7 abc	4.5 b	0.0 a	178 bc	364.2 bcd	2.86 bc
GF 305	87.5 a	42.7 ab	3.6 abc	4.6 b	0.0 a	180 bc	448.8 ab	3.09 abc
Higama	87.5 a	41.2 ab	3.7 abc	4.6 b	0.0 a	176 bc	353.9 cd	2.57 c
Montclar	75.0 a	42.2 ab	3.9 ab	4.6 b	0.0 a	180 bc	467.9 a	3.26 ab
Rubira	87.5 a	38.4 bc	3.7 abc	4.7 ab	0.0 a	175 bc	416.4 a-d	3.54 a
Ishtara	75.0 a	35.4 c	3.4 c	4.6 b	0.1 a	203 a	339.4 d	3.43 ab
BY520-8	100.0 a	40.2 b	3.5 bc	4.6 b	0.5 a	170 c	401.1 a-d	3.17 ab
BY520-9 (Guardian)	87.5 a	42.0 ab	3.8 ab	4.7 ab	0.1 a	174 bc	429.1 a-d	3.09 abc
No. years of data	--	--	--	--	6	6	6	6

Table 19. Eight-year performance of Redhaven peach on 17 rootstocks at Vineland, Ontario.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001
Lovell	25.0 d	37.4 bc	3.8 abc	4.5 bc	0.0 b	129.8 ef	226.5 d	134 c-h	245.0 a
Bailey	100.0 a	33.8 c	3.5 bc	4.2 c	0.0 b	130.6 cde	226.5 d	144 b-h	195.0 abc
Tennessee Natural 281-1	37.5 cd	34.6 bc	3.5 bc	4.4 bc	0.0 b	130.2 c-f	227.2 bc	136 d-h	210.0 abc
GF 305	87.5 ab	36.6 bc	3.5 bc	4.1 c	0.0 b	130.4 def	227.2 b	136 e-h	209.7 ab
Higama	50.0 bcd	39.4 b	3.4 bc	4.1 bc	0.0 b	130.9 a-e	226.5 d	145 b-h	210.9 abc
Montclar	87.5 ab	36.2 bc	3.5 bc	4.4 bc	0.0 b	131.1 a-d	226.5 d	144 b-h	216.6 ab
Rubira	100.0 a	34.3 c	3.4 c	4.2 c	0.0 b	130.6 cde	227.2 b	144 b-g	205.0 ab
Ishtara	50.0 bcd	34.0 c	3.3 cd	4.2 bc	0.0 b	129.7 f	227.2 b	149 b-f	197.8 abc
Myran	75.0 abc	37.5 bc	3.7 ab	4.6 b	0.0 b	130.6 cde	226.5 d	148 b-e	181.0 abc
S.2729	100.0 a	45.0 a	4.0 a	5.3 a	0.0 b	131.1 a-d	227.3 b	166 a	219.4 a
Chui Lum Tao	98.7 ab	34.4 bc	3.5 bc	4.2 bc	0.0 b	131.3 abc	227.2 b	154 ab	192.4 abc
Tzim Pee Tao	73.7 a-d	36.6 bc	3.5 bc	4.6 bc	0.0 b	130.8 a-e	227.4 b	153 abc	202.2 abc
H7338013	75.0 abc	35.3 bc	3.5 bc	4.3 bc	0.0 b	131.5 ab	226.9 c	150 bcd	175.2 bc
H7338019	98.7 ab	38.2 bc	3.4 bc	4.0 c	0.0 b	131.8 a	226.5 d	143 b-h	221.7 ab
BY520-8	50.0 bcd	35.4 bc	3.4 bc	4.2 bc	0.1 a	130.1 ef	226.5 d	133 gh	181.9 abc
BY520-9 (Guardian)	62.5 a-d	34.5 c	3.4 bc	4.0 c	0.0 b	130.5 c-f	226.5 d	134 fgh	194.0 abc
Ta Tao 5 interstem	80.5 abc	37.0 bc	2.9 d	4.0 c	0.0 b	130.7 b-e	227.8 a	131 h	156.4 c
No. years of data	--	--	--	--	8	3	6	3	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 20. Eight-year performance of Redhaven peach on 18 rootstocks at Clemson, South Carolina.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	43.7 bcd	3.4 ab	5.1 bcd	1.0 b	77.8 ef	176.6 b-e	155 fgh	334.8 a-d	2.21 cde
Bailey	100.0 a	36.3 gh	3.1 cde	5.1 bcd	0.1 b	77.9 ef	177.1 b	164 c-g	281.0 def	2.67 a
Tennessee Natural 281-1	100.0 a	41.6 def	3.4 b	5.0 d	0.2 b	76.5 h	175.7 h	156 fgh	353.0 abc	2.57 ab
Stark's Redleaf	100.0 a	41.3 def	3.4 b	5.0 d	0.9 b	77.6 fg	177.0 bc	159 e-h	327.2 a-e	2.43 abc
GF 305	87.5 a	39.4 efg	3.4 ab	5.1 bcd	0.7 b	77.4 fg	176.9 bcd	158 fgh	301.0 cde	2.45 abc
Higama	87.5 a	44.3 bcd	3.4 b	5.0 cd	1.0 b	77.7 fg	176.4 d-g	165 c-f	322.3 a-e	2.06 de
Montclar	87.5 a	42.8 b-e	3.3 bc	5.1 bcd	0.3 b	77.8 efg	177.0 bc	157 fgh	354.5 abc	2.44 abc
Rubira	87.5 a	38.9 fg	3.1 b-e	5.1 bcd	1.2 ab	77.7 efg	176.1 e-h	170 b-e	267.1 ef	2.21 b-e
Ishtara	87.5 a	35.0 h	2.9 def	5.0 d	0.1 b	78.3 de	175.9 gh	190 a	219.6 f	2.25 b-e
Myran	100.0 a	52.6 a	3.7 a	5.6 a	0.1 b	77.2 g	176.0 gh	163 d-h	365.1 ab	1.66 f
S.2729	100.0 a	46.1 b	3.2 bcd	5.0 d	0.7 b	77.9 ef	176.1 fgh	179 ab	374.6 a	2.22 cde
Chui Lum Tao	84.6 a	38.5 fgh	2.7 f	4.9 d	0.1 b	79.6 ab	176.4 d-g	173 bcd	273.7 def	2.33 a-d
Tzim Pee Tao	98.9 a	38.6 fgh	2.8 ef	4.9 d	0.1 b	79.1 bc	176.6 b-f	162 d-h	290.5 cde	2.43 a-d
H7338013	98.9 a	45.3 bc	3.2 bcd	5.3 ab	0.1 b	79.4 bc	176.1 e-h	174 bc	308.8 b-e	1.87 ef
H7338019	56.1 b	45.8 bc	3.4 abc	5.1 bcd	0.4 b	78.7 cd	176.3 d-h	168 b-f	343.2 a-e	2.07 c-f
BY520-8	100.0 a	43.9 bcd	3.4 ab	5.3 bc	2.6 a	77.6 fg	176.8 bcd	158 fgh	354.7 abc	2.31 bcd
BY520-9 (Guardian)	100.0 a	42.6 cde	3.3 bc	5.0 d	0.4 b	77.5 fg	176.5 c-f	153 gh	332.1 a-d	2.31 bcd
Ta Tao 5 interstem	100.0 a	43.3 bcd	3.1 cde	5.1 bcd	0.3 b	80.2 a	179.7 a	152 h	322.31 a-e	2.13 cde
No. years of data	--	--	--	--	8	6	6	6	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$

Table 21. Eight-year performance of Redhaven peach on 9 rootstocks at Crossville, Tennessee.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001	Cumulative yield efficiency (kg/cm^2) 1996-2001
Lovell	100.0 a	52.0 a	0.4 b	87.9 bc	190.0 b	186 ab	187.8 b	0.87 bc
Bailey	87.5 a	52.3 a	0.2 b	86.6 d	190.2 ab	178 bc	192.1 ab	0.89 bc
Tennessee Natural 281-1	87.5 a	46.0 b	0.4 b	87.6 cd	190.0 b	198 a	223.4 a	1.37 a
Nemaguard	100.0 a	53.0 a	2.7 a	87.5 cd	193.4 a	182 bc	164.5 b	0.74 c
GF 305	87.5 a	51.8 a	0.3 b	87.6 cd	193.2 ab	183 bc	186.6 b	0.88 bc
Higama	100.0 a	50.8 a	0.8 b	88.9 b	191.0 ab	187 ab	170.9 b	0.84 bc
Montclar	75.0 a	52.3 a	0.4 b	88.4 bc	190.7 ab	184 abc	169.3 b	0.78 bc
BY520-9 (Guardian)	87.5 a	51.3 a	0.7 b	87.8 bc	190.3 ab	186 ab	194.1 ab	0.92 bc
Ta Tao 5 interstem	75.0 a	47.0 b	0.1 b	90.0 a	190.8 ab	170 c	177.0 b	1.01 b
No. years of data	--	--	5	3	1	4	6	6

[z] Mean separation within columns using Fisher's LSD, $P< 0.05$

Table 22. Eight-year performance of Redhaven peach on 15 rootstocks at Kaysville, Utah.

Rootstock cultivar	Survival[z] (%) 1994-2001	Trunk circumference (cm) Fall 2001	Tree height (m) Fall 2001	Crown width (m) Fall 2001	No. of rootsuckers 1994-2001	90% Full bloom (Julian date) 1996-2001	10% Fruit mature (Julian date) 1996-2001	Mean fruit weight (g) 1996-2001	Cumulative fruit yield (kg) 1996-2001
Lovell	87.5 ab	35.5 bcd	3.5 b-e	5.1 a-d	0.2 b	107.8 cde	220.3 bcd	193 bcd	205.6 c-f
Bailey	87.5 ab	33.1 def	3.4 cde	4.8 de	0.3 ab	107.9 a-e	220.3 bcd	186 cde	187.9 efg
Tennessee Natural 281-1	100.0 a	33.4 def	3.5 a-e	5.0 cde	0.5 ab	107.9 a-d	219.8 de	184 de	195.2 def
GF 305	87.5 ab	34.6 b-e	3.6 abc	5.2 abc	0.3 ab	107.9 b-e	220.0 cde	180 e	233.6 abc
Higama	100.0 a	37.1 bc	3.7 ab	5.0 cde	0.5 ab	107.9 a-d	220.0 cde	185 de	218.4 a-e
Montclar	100.0 a	35.1 b-e	3.5 b-e	4.9 cde	0.3 ab	107.8 de	220.4 bc	179 e	210.9 b-f
Rubira	100.0 a	31.1 f	3.3 e	4.7 e	0.9 a	108.1 a	220.0 cde	193 bcd	179.6 fg
Ishtara	100.0 a	34.1 def	3.3 de	5.0 b-e	0.0 b	107.9 a-d	220.0 cde	205 a	214.4 a-f
S.2729	87.5 ab	41.8 a	3.7 abc	5.4 a	0.0 b	107.9 b-e	219.5 e	200 ab	240.4 abc
Tzim Pee Tao	100.0 ab	31.7 ef	3.4 cde	4.7 de	0.6 ab	108.0 abc	219.7 cde	197 abc	185.2 efg
H7338013	100.0 a	37.4 b	3.6 a-d	5.4 ab	0.9 a	108.0 abc	220.2 bcd	193 bcd	246.1 ab
H7338019	100.0 ab	33.7 b-f	3.4 b-e	5.0 a-e	0.8 ab	107.8 cde	220.1 b-e	184 cde	257.2 a
BY520-8	100.0 a	35.6 bcd	3.5 a-e	4.9 cde	0.6 ab	108.0 abc	220.8 ab	183 de	231.0 a-d
BY520-9 (Guardian)	75.0 b	41.6 a	3.7 a	5.2 a-d	0.5 ab	107.7 e	219.7 de	183 de	235.5 abc
Ta Tao 5 interstem	83.3 ab	34.0 c-f	3.0 f	4.6 e	0.0 b	108.1 ab	221.3 a	180 e	151.2 g
No. years of data	--	--	---	---	8	6	6	6	6

[z] Mean separation within columns using Fisher's LSD, $P < 0.05$