IMPROVED ROOTSTOCKS FOR PEACH AND NECTARINE

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Summary

The objective of this project is to develop genetically improved rootstocks for peach and nectarine that combine tree size control and resistance to important diseases and pests including nematodes. Thirty-nine rootstocks were planted, in replicated trials, at the Kearney Agricultural Center (KAC) in 2003, through 2005. All of these rootstocks are root-knot nematode resistant and have the potential for tree size control.

Data from a previous replicated trial at (KAC) identified three rootstocks from crosses of Harrow Blood peach x Okinawa peach, made in our program, that had significant size-controlling potential (selections HBOK32, HBOK10 and HBOK50, in descending order of apparent size-controlling effect). These rootstocks were also shown to be resistant to root knot nematode. Selections HBOK32 and HBOK10 were re-replicated at KAC in Spring, 2003, with O'Henry peach and the early nectarine, Mayfire. They were also grafted with Springcrest peach and Summer Fire nectarine and planted in a replicated trial at KAC in February, 2004. Selection HBOK50 was re-replicated at KAC with O'Henry peach only, in Spring, 2003.

Data from the 2003 planting indicated that the fourth-leaf O'Henry trees on the HBOK 32 rootstock had significantly less height, TCA (Trunk Cross-sectional Area), dormant and summer pruning weights, and suckers; and significantly higher yield efficiency than the control trees grafted on Nemaguard. Yield efficiency (crop divided by TCA) takes the size of the tree into account. Similar results where obtained with the fourth-leaf Mayfire nectarine trees of HBOK 32. Also, the fruits of Mayfire trees on HBOK 32 trees were significantly larger than that on trees of the control Nemaguard. The third-leaf trees of HBOK 32, grafted with Springcrest peach and Summer Fire nectarine also had significantly less height, dormant pruning weights, TCA and suckers than the control trees on Nemaguard. Crop efficiency for Summer Fire nectarine on HBOK32 trees was significantly higher than trees on Nemaguard but similar for Springcrest peach.

Replicated trials of different rootstocks from our program and other programs grafted with O'Henry, and planted at KAC in 2003 and 2004, showed that the majority of the trees on the tested rootstocks had significantly less height, TCA, dormant and summer pruning weights and suckers than trees on the control, Nemaguard. Yield efficiency and weight per fruit from the

majority of trees on the tested rootstocks, planted in 2003, were either similar or larger than from trees on the control, Nemaguard.

Six hundred and eighty new seedlings resulting from crosses made in the springs of 2000 and 2001 were budded with O'Henry and planted, at UC Davis in 2003. Evaluation of these trees started at the beginning of 2005. Twenty-seven selections of these seedling rootstocks showed promise for size control and good yield efficiency (Table 16). Nineteen of these selected rootstocks are being tested for their reaction (resistance/susceptibility) to root-knot nematodes.

Problem and its Significance:

Many high quality scion varieties of peach and nectarine are available to producers, but relatively few rootstocks have been developed for the changing demands of the industry. In recent years there has been increasing interest in the development of size-reducing rootstocks for peaches and nectarines to reduce the labor costs involved in management and harvest of the orchard. As the future availability of soil fumigants becomes increasingly uncertain, there is also increased need for rootstocks with resistance/tolerance to soil borne pests and diseases. To develop improved rootstocks that combine several elite traits, hybridization followed by selection is required. Within segregating seedling populations, it is possible to identify individuals that can be clonally propagated, thus developing considerable flexibility in rootstock options for growers.

The control of tree growth of peach and nectarine is usually accomplished by judicious use of management practices, i.e., planting density and pruning. However, even with the best management practices, the resultant large trees usually require large amounts of hand labor for tree care and the use of ladders for pruning, fruit thinning and harvest. An attractive alternative would be the management of tree growth by size-controlling rootstocks, such as are available for apple. This would allow trees to be managed from ground level with no resultant loss of yield per acre or reduction in fruit quality while using current scion cultivars.

Several peach varieties and inter-specific hybrids are reported to have growth controlling ability (e.g., Layne and Jui, 1994), but its inheritance is unknown. Some peach cultivars, including Harrow Blood, Siberian C, and Rubira, have shown growth controlling ability but these rootstocks are either not well adapted to California or are nematode susceptible. Concomitant with growth control in improved rootstocks is the need for resistance to nematodes and important diseases since the diminished availability of approved chemical control agents is likely to continue. New rootstocks should have nematode resistance similar to the levels found in current rootstocks, i.e., Nemaguard and Nemared. Additionally, resistance to bacterial canker and crown gall would be desirable. None of the rootstocks currently in wide use has these combined attributes.

For each of the desired traits, there are several available sources of genetic materials that are potentially valuable for rootstock improvement. Resistance to root knot nematode is well defined and materials such as Okinawa, Nemared, Nemaguard, Flordaguard, etc. can be used as parents for hybridization (Sharpe, 1957; Sherman et al., 1991). However, genetic variability for growth control, crown gall and bacterial canker resistance is less well defined. Therefore, systematic screening is needed to identify the most useful materials. We have done an extensive

screening of *Prunus* germplasm and have identified candidate genotypes to be used as sources of resistance to crown gall disease (Bliss et al, 1999). We also have screened a large number of *Prunus* genotypes for their resistance/susceptibility to the bacterial canker disease and root knot nematode.

Goal and Objectives

The goal of this project is to develop new rootstocks with pest resistance and tree size controlling ability that can be propagated economically by commercial nurseries for use with a wide range of California peach and nectarine varieties.

The specific objectives of this project were to:

1) Screen *Prunus* populations for i) compatibility and growth controlling potential with peach and nectarine, ii) nematode resistance, initially root knot nematode race 1, iii) crown gall resistance and iv) bacterial canker resistance,

2) Develop elite individual plants that can be used for clonal rootstocks; and

3) Assess the potential of the best materials for commercial peach and nectarine production in California.

Progress during 2006

Data from the 2003 replicated trial:

1. Rootstocks grafted with **O'Henry** peach:

Table 4 shows the mean values (and % compared to the control trees on Nemaguard) for height, Trunk Cross-sectional Area (TCA), dormant and summer pruning weights of the O'Henry peach trees grafted on fourteen rootstock selections, plus the control.

A. Height: Trees on HBOK2, Barrier, Cadaman and HBOK1 were similar to the control (Nemaguard). Trees on the rest of the tested rootstocks were shorter than the control.
B. TCA (Trunk Sectional Area): Trees on Barrier, Cadaman and HBOK50 rootstocks were similar to that of the control. Trees on the Sapalta-OP-3, HBOK18, HBOK10, Ishtara, Adesoto and HBOK32 rootstocks were smaller than the control and the rest of the tested rootstocks (with TCA ranging from 55.7% to 66.1% of the Nemaguard control). The smallest among all of the tested rootstocks was HBOK 32 (55.79%).
C. Dormant Pruning Weight: Pruning weights of trees on Barrier and Cadaman rootstock were similar to that of the trees on the control. Weights from trees on HBOK 18, HBOK 32, Saplata-OP-3 Pumiselect, Ishtara, Adesoto and Saplata-OP-24 rootstocks (with dormant pruning weight ranging from 18.8% to 43.8%) were significantly less than from trees on Nemaguard and the rest of the tested rootstocks.
D. Summer Pruning Weight: Pruning weights of trees on Cadaman and Nemaguard were the greatest. The weights of trees on HBOK32, HBOK18, Adesoto and Ishtara rootstocks were significantly less than the control and the rest of the tested rootstocks (ranging 38.1% to 54%).

Trees on Adesoto and Cadaman , followed by Nemaguard rootsocks produced the greatest number of suckers (5.8, 4.4, and 3.8, respectively) (Table 5). The rest of the rootstocks had fewer suckers than the control. HBOK 32 had no suckers. It is worth-while mentioning that

Adesoto and Pumiselect had suckers arising from the roots. This may indicate possible incompatibility with other varieties of peach and nectarine, especially since one or more of their parents are of plum origin (Table 5 – see parents column).

Fruit production characteristics (Table 6):

A. Crop : Trees on HBOK2, HBOK1, Barrier, Cadaman, HBOK8, HBOK50 and Ishtara rootstocks were similar to that of the control
B. Weight (size) of Fruit: .Trees on the majority of the rootstocks, except for Pumiselect and HBOK18, had similar weight of fruits to that of the control.
C. Crop Efficiency: HBOK32, HBOK18 and Ishtara had the largest efficiency. Trees on the Nemaguard rootstocks had the lowest efficiency.

2. Rootstocks grafted with the early nectarine, **Mayfire**:
Table 7 shows that Mayfire trees on HBOK 32 and HBOK 10 rootstocks were significantly shorter and had smaller TCA and dormant and summer pruning weights than trees on the control, Nemaguard. No significant difference was found between the number of suckers on the two rootstocks and that of the control (0.3, 0 and 0, respectively).
Mayfire trees on the HBOK 32 and HBOK 10 rootstocks had similar yield efficiencies as trees on Nemaguard (Table 8). Mayfire fruit weight (fruit size) was also significantly larger for trees on the rootstock HBOK32 than from trees on Nemaguard.

Data from the 2004 replicated trial:

1. Rootstocks grafted with **O'Henry** peach

Trees on Nemaguard were significantly taller and had largest dormant and summer pruning weights than trees on the rest of the tested rootstocks (Table 9). Nemaguard and HBOK123 had larger TCA than trees on the other rootstocks.

Fruit production characteristics (Table 10):

A. Crop: Trees on Nemaguard and HBOK122, HBOK138, KV84068-s, HBOK121,HBOK123 HBOK36, HBOK27,HBOK160 and Rubira had the highest fruit yield.
B. Weight per Fruit (size): Trees on the rootstocks HBOK122, HBOK28, HBOK123, HBOK27, and HBOK9 had the largest fruits. The rest of the rootstocks yielded the same size of fruits as the control Nemaguard.
C. Crop Efficiency: Trees on the HBOK122 and HBOK138 rootstocks had the highest crop efficiency. Trees on the rest of the rootstocks had similar efficiency as trees on the control, Nemaguard.

2. Rootstocks grafted with the early peach, **Springcrest**

Similar to the results obtained from the trial with the early Mayfire nectarine (Table 7), trees on the HBOK 32 and HBOK 10 rootstocks were shorter, and had smaller TCA, dormant and summer pruning weights, and numbers of suckers than trees on the control, Nemaguard (Table 11).
Yield and crop efficiency were not significantly different for the two rootstocks versus the Nemaguard control.

3. Rootstocks grafted with **Summer Fire** nectarine.

Similar to the results obtained from the trial with the early nectarine, Mayfire (Table 7) and the early peach, Springcrest (Table 11), trees on the HBOK 32 and HBOK 10 rootstocks were significantly shorter, and had less TCA, dormant and summer pruning weights, and suckers than trees on the control, Nemaguard (Table 13). Dormant pruning weights for trees on HBOK 32 were significantly less than for trees on HBOK 10 (Table 13).

Table 14 shows that the yield for the trees on the two rootstocks HBOK10 and 32 were similar to that of the Nemaguard control. Weight per fruit (size) of trees on HBOK10 and HBOK32 rootstocks was higher than for trees on Nemaguard. Crop efficiency for HBOK32 was higher than that of either HBOK10 or Nemaguard.

New rootstock seedling crosses:

Six hundred and eighty new seedlings resulting from crosses made in the springs of 2000 and 2001 were previously budded with O'Henry and planted, at UC Davis. Each of these seedlings were also budded onto Nemared rootstock for preservation until field evaluations are complete. The budded trees were planted in the field in 2003. Evaluation of these trees started at the beginning of 2005. Twenty-seven selections from these seedling rootstocks that show promise for size control and yield efficiency are listed in Table 15. The dormant pruning weights for these selections ranges from 21% to 78% of the control (Nemaguard) and the yield efficiency ranges from 70% to 240.4% of the control. The parents for these crosses are:

1. Flordaguard: This rootstock, originally from Florida, is root-knot nematode resistant, red-leafed, vigorous and requires low amounts of chilling. It has been shown by us, in *an in vitro* study, to be resistant to the canker disease. It appears to have conveyed this resistance to Ross peach trees in a replicated trial at Escalon, CA. This rootstock was crossed with Weeping peach and several different rootstock selections (KV#'s).
2. Weeping peach: This peach is an ornamental peach with resistance to root-knot nematode and is size controlling. The original plant from which seeds were collected was at KAC. It has been reported that the green peach aphid, that transmits Sharka (Plum Pox) virus, does not feed on it. This genotype was crossed with Flordaguard.
3. KV #s: These rootstock selections (with names starting with the letters KV) were acquired from a USDA research station in the east coast of the US. They have the genes for tree size control and root-knot nematode resistance. They also have some tolerance to crown gall disease. They were crossed with Flordaguard and selfed.

References

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Table 1. List of rootstocks that have size-controlling potential being tested in replicated trials. The trees were grafted with O'Henry and planted, at Kearney Ag. Center, in 2005.

Rootstock	Description*
Harrow Blood x Okinawa-155	Size controlling; resistant to RKN.
Harrow Blood x Okinawa-162	Size controlling; resistant to RKN.
Bl 19,T110	Size controlling; resistant to RKN.
Bl19,T71	Size controlling; resistant to RKN.
Flordaguard x KV84068	Size controlling; resistant to RKN.
FlordagxKV77015	Size controlling; resistant to RKN.
Sm weeping	Size controlling; resistant to RKN.
Lg weeping	Size controlling; resistant to RKN.
Nemaguard (control)	Vigorous; resistant to RKN

*RKN = Root Knot Nematode.

Table 2. List of rootstocks that have size-controlling potential being tested in the 2004 replicated trial. The trees were grafted with the appropriate scion and planted, at the Kearney Ag. Center, in February 2004.

Rootstock	Scion	Description*
HBOK5	O'Henry	Size controlling; resistant to RKN.
HBOK9	O'Henry	Size controlling; resistant to RKN.
HBOK10	Summer Fire	Size controlling; resistant to RKN.
HBOK10	Springcrest	Size controlling; resistant to RKN.
HBOK27	O'Henry	Size controlling; resistant to RKN.
HBOK28	O'Henry	Size controlling; resistant to RKN.
HBOK 29	O'Henry	Size controlling; resistant to RKN.
HBOK32	Summer Fire	Size controlling; resistant to RKN.
HBOK32	Springcrest	Size controlling; resistant to RKN.
HBOK36	O'Henry	Size controlling; resistant to RKN.
HBOK121	O'Henry	Size controlling; resistant to RKN.
HBOK122	O'Henry	Size controlling; resistant to RKN.
HBOK123	O'Henry	Size controlling; resistant to RKN.
HBOK138	O'Henry	Size controlling; resistant to RKN.
HBOK144	O'Henry	Size controlling; resistant to RKN.
HBOK160	O'Henry	Size controlling; resistant to RKN.
Hiawatha	O'Henry	Size controlling; resistant to RKN.
K146-43	O'Henry	Size controlling; resistant to RKN.
KV84068-S	O'Henry	Size controlling; resistant to RKN.
Nemaguard (control)	O'Henry	Vigorous; resistant to RKN
Nemaguard (control)	Summer Fire	Vigorous; resistant to RKN
Nemaguard (control)	Springcrest	Vigorous; resistant to RKN
Rubira	O'Henry	Size controlling; resistant to RKN.
Weeping peach 31	O'Henry	Size controlling; resistant to RKN.
Weeping peach 3	O'Henry	Size controlling; resistant to RKN.

*RKN = Root Knot Nematode

Table 3. List of rootstocks that have size-controlling potential being tested in replicated trials. The trees were grafted with the appropriate scion and planted, at Kearney Ag. Center, in 2003.

Rootstock	Parents	Scion	Description
Adesoto	P. isititia selection	O'Henry	From NAP*; suckers from the roots; 80% of the standard size of peach; early entry in production; productive; induces larger fruit size and earlier ripening in peaches; good adaptation to poor or saline soils.
Barrier	P. persica x P. davidiana	O'Henry	From NAP; adaptive to a wide array of soils, was selected for longevity and performance on replant sites.
Cadaman	(P. persica x P. dulcis) x P. dividiana	O'Henry	From NAP; high becoming less vigorous with age; has a high yield efficiency. Resistant to RKN** and LN***.
HBOK 1	Harrow Blood x Okinawa-1	O'Henry	Size controlling; resistant to RKN.
HBOK 2	Harrow Blood x Okinawa-2	O'Henry	Size controlling; resistant to RKN.
HBOK 8	Harrow Blood x Okinawa-8	O'Henry	Size controlling; resistant to RKN.
HBOK 10	Harrow Blood x Okinawa-10	Mayfire	Size controlling; resistant to RKN.
HBOK 10	Harrow Blood x Okinawa-10	O'Henry	Size controlling; resistant to RKN.
HBOK 18	Harrow Blood x Okinawa-18	O'Henry	Size controlling; resistant to RKN.
HBOK 32	Harrow Blood x Okinawa-32	Mayfire	Size controlling; resistant to RKN.
HBOK 32	Harrow Blood x Okinawa-32	O'Henry	Size controlling; resistant to RKN.
HBOK 50	Harrow Blood x Okinawa-50	O'Henry	Size controlling; resistant to RKN and LN.
Ishtara	Belsiana plum (P. cerasifera x P. salicina) x (natural hybrid of P. ceracifera x P. persica)	O'Henry	From NAP; semi dwarfing to slightly smaller than peach seedling; shows high productivity; rapid entry in production and induces larger fruit size in peach. Resistant to RKN and LN but susceptible to LN if both RKN and LN are present in the soil.
Pumiselect	P. pumila selection	O'Henry	From NAP; dwarfing to semi-dwarfing (70% of 'Nemaguard'); high resistance to plum pox (sharka) virus; precocious and very cold hardy. Resistant to RKN and moderately susceptible LN.
Spalta 3	Spalta-OP 3 (P. bessyi x P. salicina)	O'Henry	Size controlling; resistant to RKN.
Spalta 24	Spalta-OP 24 (P. bessyi x P. salicina)	O'Henry	Size controlling; resistant to RKN.
Nemaguard	Control	Mayfire	Vigorous; resistant to RKN
Nemaguard	Control	O'Henry	Vigorous; resistant to RKN

*NAP = North American Plant
**RKN = Root Knot Nematode.
LN*** = Lesion nematode.

Table 4. Mean values and % of the control of height, Trunk Cross-sectional Area (TCA), dormant pruning weight, and summer pruning weight weight of the rootstocks grafted with O'Henry for 2006. The trees were planted in a replicated trial, in 2003.

Genotype	Height (cm)	% Control	*	Genotype	TCA (cm2)	% Control	*
Nemaguard	502.3	100.0	a	Nemaguard	82.9	100.0	a
HBOK 2	483.1	96.2	ab	Barrier	74.4	89.7	ab
Barrier	481.3	95.8	abc	Cadaman	73.5	88.7	abc
Cadaman	478.9	95.3	abc	HBOK 50	73.4	88.5	abc
HBOK 1	476.6	94.9	abc	HBOK 1	66.2	79.9	bcd
HBOK 50	459.0	91.4	bc	HBOK 8	64.2	77.4	cde
HBOK 8	455.0	90.6	c	HBOK 2	63.5	76.6	de
HBOK 10	427.8	85.2	d	Pumiselect	61.1	73.7	def
HBOK 32	420.6	83.7	d	Spalta-OP-24	56.4	68.0	defg
Ishtara	415.6	82.7	d	Spalta-OP-3	54.8	66.1	efgh
HBOK 18	411.3	81.9	d	HBOK 18	53.7	64.8	fgh
Pumiselect	406.5	80.9	ed	HBOK 10	52.7	63.6	fgh
Adesoto	405.1	80.7	ed	Ishtara	49.7	60.0	gh
Spalta-OP-3	400.0	79.6	ed	Adesoto	46.8	56.5	gh
Spalta-OP-24	380.6	75.8	e	HBOK 32	46.2	55.7	h
Genotype	**Dormant Pruning (Kg)**	**% Control**	*	**Genotype**	**Summer Pruning (Kg)**	**% Control**	*
Barrier	8.2	102.5	a	Cadaman	0.7	103.2	a
Nemaguard	8.0	100.0	a	Nemaguard	0.6	100.0	ab
Cadaman	7.9	98.8	a	Barrier	0.5	85.7	bc
HBOK 50	6.4	80.0	b	HBOK 10	0.5	84.1	cd
HBOK 1	6.3	78.8	b	HBOK 50	0.5	81.0	cd
HBOK 10	5.7	71.3	cb	HBOK 8	0.5	74.6	cde
HBOK 2	5.6	70.0	cb	Pumiselect	0.5	74.6	cde
HBOK 8	5.3	66.3	c	Spalta-OP-3	0.4	68.3	def
HBOK 18	3.5	43.8	d	HBOK 2	0.4	61.9	efg
HBOK 32	3.4	42.5	d	HBOK 1	0.4	58.7	efg
Spalta-OP-3	3.4	42.5	d	HBOK 32	0.3	54.0	fgh
Pumiselect	3.1	38.8	d	HBOK 18	0.3	47.6	gh
Ishtara	2.9	36.3	d	Adesoto	0.3	39.7	h
Adesoto	2.5	31.3	d	Ishtara	0.2	38.1	h
Spalta-OP-24	1.5	18.8	e				

* = numbers followed by the same letter(s) are not significantly different.

Table 5. Mean values and % of the control of the number of suckers for the rootstocks grafted with O'Henry for 2006. The trees were planted in 2003 in a replicated trial.

Genotype	No. Suckers	% Control	*	Parents	Notes
Adesoto	5.8	152.6	a	P. isititia selection	root suckers
Cadaman	4.4	115.8	ab	(P. persica x P. dulcis) x P. dividiana	
Nemaguard	3.8	100.0	b	P. persica x P. dividiana	
Spalta-OP-24	1.4	36.8	c	Spalta-OP 24 (P. bessyi x P. salicina)	
Pumiselect	1.2	31.6	c	P. pumila selection	root suckers
HBOK 8	0.6	15.8	c	Harrow Blood x Okinawa-8	
HBOK 10	0.3	7.9	c	Harrow Blood x Okinawa-8	
HBOK 50	0.1	2.6	c	Harrow Blood x Okinawa-8	
HBOK 1	0.1	2.6	c	Harrow Blood x Okinawa-8	
Barrier	0.0	0.0	c	P. persica x P. davidiana	
HBOK 2	0.0	0.0	c	Harrow Blood x Okinawa-8	
HBOK 32	0.0	0.0	c	Harrow Blood x Okinawa-8	
Ishtara	0.0	0.0	c	Belsiana plum (P. cerasifera x P. salicina) x (natural hybrid of P. ceracifera x P. persica)	
HBOK 18	0.0	0.0	c	Harrow Blood x Okinawa-8	
Spalta-OP-3	0.0	0.0	c	Spalta-OP 3 (P. bessyi x P. salicina)	

* = numbers followed by the same letter(s) are not significantly different.

Table 6. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency (crop weight divided by TCA) of the rootstocks grafted with O'Henry for 2006. The trees were planted in 2003.

Genotype	Crop (Kg)	% Control	*	Genotype	Wt. per fruit (g)	% Control	*	Genotype	Crop Efficiency	% Control	*
HBOK 2	37.0	109.1	a	Cadaman	206.1	107.9	a	Ishtara	0.6	155.0	a
Nemaguard	33.9	100.0	ab	Ishtara	206.1	107.9	a	HBOK 18	0.6	140.0	ab
HBOK 1	33.5	98.8	ab	HBOK 1	201.4	105.4	ab	HBOK 32	0.6	137.5	abc
Barrier	33.1	97.6	abc	HBOK 50	192.0	100.5	abc	HBOK 2	0.5	130.0	bcd
Cadaman	33.0	97.3	abc	HBOK 8	191.8	100.4	abc	HBOK 1	0.5	130.0	bcd
HBOK 8	31.0	91.4	bc	Nemaguard	191.0	100.0	abcd	Adesoto	0.5	127.5	bcde
HBOK 50	30.2	89.1	bc	HBOK 10	190.6	99.8	abcd	HBOK 8	0.5	125.0	bcdef
Ishtara	29.5	87.0	bcd	HBOK 32	188.1	98.5	bcd	HBOK 10	0.5	122.5	bcdef
HBOK 18	28.9	85.3	cde	Spalta-OP-3	186.4	97.6	bcd	Spalta-OP-3	0.5	122.5	bcdef
Pumiselect	25.7	75.8	def	Spalta-OP-24	185.6	97.2	bcd	Barrier	0.5	122.5	bcdef
Spalta-OP-3	25.0	73.7	ef	Adesoto	182.5	95.5	cde	Cadaman	0.5	115.0	cdef
HBOK 32	24.5	72.3	ef	Barrier	177.1	92.7	cdef	Pumiselect	0.4	107.5	def
HBOK 10	24.1	71.1	f	HBOK 2	174.4	91.3	def	Spalta-OP-24	0.4	107.5	def
Spalta-OP-24	22.8	67.3	f	Pumiselect	168.9	88.4	ef	HBOK 50	0.4	105.0	ef
Adesoto	2.4	66.1	f	HBOK 18	161.6	84.6	f	Nemaguard	0.4	100.0	f

* = numbers followed by the same letter(s) are not significantly different.

Table 7. Mean values and % of the control of height, Trunk Cross-sectional Area (TCA), dormant pruning weight, summer pruning weight and number of suckers of the rootstocks grafted with Mayfire for 2006. The trees were planted in a replicated trial, in 2003.

Genotype	Height (cm)	Height % Control	*	TCA (cm2)	TCA % Control	*	Dormant Pruning (Kg)	Dormant Pruning % Control	*	Summer Pruning (Kg)	Summer Pruning % Control	*	No. Suckers	Suckers % Control	*
Nemaguard	678.5	115.0	a	138.3	100.0	a	21.3	121.7	a	3.0	100.0	a	0.3	100.0	a
HBOK 10	526.4	89.2	b	71.5	51.7	b	9.8	56.0	b	1.4	46.7	b	0.0	0.0	a
HBOK 32	414.0	70.2	c	54.3	39.3	b	8.1	46.3	b	0.9	30.0	c	0.0	0.0	a

* = numbers followed by the same letter(s) are not significantly different.

Table 8. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency (crop weight divided by TCA) of the rootstocks grafted with the early nectarine Mayfire for 2006.The trees were planted in 2003.

Genotype	Crop (Kg)	% Control	*	Genotype	Wt. per fruit (g)	% Control	*	Genotype	Crop Efficiency (Kg/cm2)	% Control	*
Nemaguard	11.6	100.0	a	HBOK 32	78.0	103.6	a	HBOK 10	0.1	110.0	a
HBOK 10	8.0	69.0	b	Nemaguard	75.3	100.0	b	Nemaguard	0.1	100.0	a
HBOK 32	5.5	47.4	c	HBOK 10	62.2	82.6	b	HBOK 32	0.1	100.0	a

* = numbers followed by the same letter(s) are not significantly different.

Table 9. Mean values and % of the control of height, Trunk Cross-sectional Area (TCA), dormant pruning weight, and summer pruning of the rootstocks grafted with O'Henry for 2006.The trees were planted in a replicated trial in 2004.

Genotype	Height (cm)	% Control	*	Genotype	TCA (cm2)	% Control	*
Nemaguard	404.3	100.0	a	Nemaguard	73.2	100.0	a
HBOK138	375.5	92.9	b	HBOK123	65.8	89.9	ab
HBOK36	361.7	89.5	cb	HBOK36	64.4	88.0	bc
KV84068-S	359.1	88.8	cbd	KV84068-S	63.4	86.6	bc
HBOK160	355.9	88.0	cebd	HBOK138	61.0	83.3	bcd
HBOK121	354.2	87.6	cebd	HBOK160	60.0	82.0	bcd
HBOK123	353.1	87.3	cebd	HBOK121	58.2	79.5	bcde
Rubira	336.5	83.2	cefd	HBOK122	56.4	77.0	cde
Weeping peach 31	334.1	82.6	cefd	Weeping peach 31	54.3	74.2	efd
HBOK122	334.2	82.7	efd	HBOK144	53.7	73.4	efd
HBOK144	331.2	81.9	ef	Rubira	50.8	69.4	ef
HBOK27	320.9	79.4	f	HBOK28	47.2	64.5	f
HBOK9	319.7	79.1	f	HBOK9	47.1	64.3	f
HBOK28	310.5	76.8	f	HBOK27	46.1	63.0	f
Tetra	286.4	70.8	g	Weeping peach3	38.2	52.2	g
Hiawatha	278.3	68.8	g	Hiawatha	36.4	49.7	gh
Weeping peach3	276.6	68.4	g	Tetra	32.5	44.4	gh
HBOK29	273.5	67.6	g	HBOK29	29.0	39.6	h
Genotype	**Dormant Pruning (Kg)**	**% Control**	*	**Genotype**	**Summer Pruning (Kg)**	**% Control**	*
Nemaguard	8.4	100.0	a	Nemaguard	2.6	100.0	a
HBOK123	7.0	83.3	b	HBOK122	2.0	76.3	b
HBOK122	6.6	78.6	bc	HBOK123	2.0	76.3	bc
HBOK138	6.5	77.4	bcd	HBOK36	1.9	72.5	bcd
HBOK36	6.2	73.8	bcde	HBOK28	1.8	68.7	cde
HBOK160	6.2	73.8	bcde	HBOK144	1.8	68.7	cde
HBOK121	5.9	70.2	cdef	HBOK138	1.8	68.7	cdef
HBOK144	5.8	69.0	cdef	HBOK121	1.8	68.7	cdef
KV84068-S	5.8	69.0	defg	HBOK9	1.8	68.7	def
HBOK28	5.4	64.3	efg	KV84068-S	1.7	64.9	ef
HBOK9	5.2	61.9	fg	HBOK160	1.6	61.1	f
Rubira	4.7	56.0	gh	Rubira	1.5	57.3	f
HBOK27	3.9	46.4	hi	Weeping peach 31	1.1	42.0	g
Weeping peach 31	3.5	41.7	iJ	Hiawatha	1.0	38.2	g
HBOK29	3.0	35.7	kJ	HBOK27	0.9	34.4	g
Weeping peach3	3.0	35.7	kJ	Tetra	0.6	22.9	h
Hiawatha	2.4	28.6	kl	Weeping peach3	0.6	22.9	h
Tetra	2.0	23.8	l	HBOK29	0.6	22.9	h

* = numbers followed by the same letter(s) are not significantly different.

Table 10. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency (crop weight divided by TCA) of the rootstocks grafted with O'Henry for 2006. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	*	Genotype	Wt. per fruit (g)	% Control	*	Genotype	Crop Efficiency	% Control	*
HBOK122	18.3	107.6	a	HBOK122	263.9	116.4	a	HBOK122	0.33	143.5	a
HBOK138	18.1	106.5	a	HBOK28	252.5	111.3	ab	HBOK138	0.31	134.8	ab
KV84068-S	18	105.9	a	HBOK123	251.3	110.8	ab	KV84068-S	0.3	130.4	abc
HBOK121	17.3	101.8	ab	HBOK27	250.9	110.6	ab	HBOK121	0.3	130.4	abc
Nemaguard	17	100.0	ab	HBOK9	244.6	107.8	ab	HBOK27	0.29	126.1	abc
HBOK123	16.8	98.8	ab	HBOK121	239.6	105.6	bc	Rubira	0.28	121.7	abc
HBOK36	16.2	95.3	abc	HBOK29	237.1	104.5	bcd	HBOK9	0.28	121.7	abc
HBOK27	13.8	81.2	bcd	HBOK138	228.8	100.9	bcde	HBOK36	0.26	113.0	abc
HBOK160	13.5	79.4	bcd	Nemaguard	226.8	100.0	cdef	Hiawatha	0.25	108.7	bc
Rubira	13.4	78.8	bcd	HBOK160	222.7	98.2	cdef	HBOK123	0.25	108.7	bc
HBOK144	12.8	75.3	cd	Rubira	219.4	96.7	defg	HBOK29	0.24	104.3	bc
HBOK9	11.9	70.0	d	HBOK144	218.4	96.3	efg	Weeping peach 3	0.24	104.3	c
Weeping peach 31	11.6	68.2	d	Weeping peach 31	217.3	95.8	efg	HBOK144	0.24	104.3	c
HBOK28	11.4	67.1	ed	Weeping peach 3	214.2	94.4	fg	HBOK160	0.24	104.3	c
Hiawatha	8	47.1	ef	HBOK36	212.6	93.7	fg	Nemaguard	0.23	100.0	c
Weeping peach 3	7.9	46.5	ef	KV84068-S	204.6	90.2	fg	Tetra	0.23	100.0	c
Tetra	7.1	41.8	f	Tetra	185.9	82.0	g	HBOK28	0.23	100.0	c
HBOK29	6.4	37.6	f	Hiawatha	183.6	81.0	h	Weeping peach 31	0.22	95.7	c

* = numbers followed by the same letter(s) are not significantly different.

Table 11. Mean values and % of the control of height, Trunk Cross-sectional Area (TCA), dormant pruning weight, and summer pruning of the rootstocks grafted with the early peach Springcrest for 2006.The trees were planted, in a replicated trial, in 2004.

Genotype	Height (cm)	% Control	*
Nemaguard	457.9	100.0	a
HBOK32	364.4	79.6	b
HBOK10	344.4	75.2	b

Genotype	TCA (cm2)	% Control	*
Nemaguard	89.0	100.0	a
HBOK32	55.4	62.2	b
HBOK10	48.4	54.4	b

Genotype	Dormant Pruning (Kg)	% Control	*
Nemaguard	11.6	100.0	a
HBOK10	7.3	62.9	b
HBOK32	5.7	49.1	b

Genotype	Summer Pruning (Kg)	% Control	*
Nemaguard	3.1	100.0	a
HBOK10	1.4	45.2	b
HBOK32	1.3	41.9	b

Genotype	No. Suckers	% Control	*
Nemaguard	2.5	100.0	a
HBOK32	0.3	12.0	b
HBOK10	0.1	4.0	b

* = numbers followed by the same letter(s) are not significantly different.

Table 12. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency (crop weight divided by TCA) of the rootstocks grafted with the earl y peach Springcrest for 2006. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	
Nemaguard	8.2	100.0	a
HBOK32	6.4	78.0	a
HBOK10	4.8	58.5	a

Genotype	Wt. per fruit (g)	% Control	
Nemaguard	43.8	100.0	a
HBOK10	42.8	97.7	a
HBOK32	41.3	94.3	b

Genotype	Crop Efficiency	% Control	
HBOK10	0.1	100.0	a
HBOK32	0.1	100.0	a
Nemaguard	0.1	100.0	a

* = numbers followed by the same letter(s) are not significantly different.

Table 13. Mean values and % of the control of height, Trunk Cross-sectional Area (TCA), dormant pruning weight, and summer pruning of the rootstocks grafted with nectarine Summer Fire for 2006.The trees were planted, in a replicated trial, in 2004.

Genotype	Height (cm)	% Control	*
Nemaguard	406.0	100.0	a
HBOK10	329.8	81.2	b
HBOK32	329.5	81.2	b

Genotype	TCA (cm2)	% Control	*
Nemaguard	84.4	100.0	a
HBOK32	51.6	61.1	b
HBOK10	47.1	55.8	b

Genotype	Dormant Pruning (Kg)	% Control	*
Nemaguard	11.1	100.0	a
HBOK10	7.2	64.9	b
HBOK32	5.3	47.7	c

Genotype	Summer Pruning (Kg)	% Control	*
Nemaguard	2.9	100.0	a
HBOK32	1.5	51.7	b
HBOK10	1.2	41.4	c

Genotype	No. Suckers	% Control	*
Nemaguard	2.4	100.0	a
HBOK32	0.4	16.7	b
HBOK10	0.2	8.3	b

* = numbers followed by the same letter(s) are not significantly different.

Table 14. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency (crop weight divided by TCA) of the rootstocks grafted with nectarine Summer Fire for 2006. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	*
HBOK32	2.0	105.3	a
Nemaguard	1.9	100.0	a
HBOK10	1.6	84.2	a

Genotype	Wt. per fruit (g)	% Control	*
HBOK10	180.0	138.5	a
HBOK32	170.0	130.8	a
Nemaguard	130.0	100.0	b

Genotype	Crop Efficiency	% Control	*
HBOK32	0.038	190.0	a
HBOK10	0.020	100.0	b
Nemaguard	0.020	100.0	b

* = numbers followed by the same letter(s) are not significantly different.

Table 15. Twenty seven selections from crosses made in 2000.

No.	Cross	TCA % control	Dormant Pruning %Control	Summer Pruning %Control	Weight per Fruit (Size) % Control	Efficiency %Control
1	Flordag x KV84068(CBR3,T4)	42.6	36.4	5.4	111.2	146.9
2	Flordag (R16,T20) x KV84068(CBR3,T4)	52.3	27.3	7.7	118.3	127.2
3	Flordag (R16,T22) x KV84068(CBR3,T4)	81.0	41.2	17.7	88.4	118.4
4	Flordag (R16,T22) x KV84068(CBR3,T4)	71.7	36.4	70.0	111.7	112.3
5	FlordagxKV77015(R1,T14)	71.7	69.7	50.0	111.7	113.3
6	FlordagxKV77015(R1,T14)	71.7	54.5	46.9	111.7	125.3
7	FlordagxKV77015(R1,T14)	61.9	78.8	38.5	100.8	160.2
8	FlordagxKV77015(R1,T14)	65.3	75.8	70.0	101.8	188.6
9	FlordagxWeep. p.(31-19)	63.0	51.5	48.5	98.6	146.8
10	KV77015(3-3) selfed	37.3	45.5	28.5	85.4	194.7
11	KV77015(3-3) selfed	31.9	24.2	21.5	97.9	102.4
12	KV77015(3-3) selfed	37.3	24.2	26.9	95.1	141.1
13	KV77015(3-3) selfed	35.1	21.2	18.5	95.8	125.0
14	KV77015(3-3) selfed	47.8	42.4	66.9	103.3	122.5
15	KV84068(3-4) selfed	29.9	27.3	16.9	109.5	240.4
16	KV84068(3-4) selfed	60.3	36.4	26.2	98.9	122.6
17	KV77119(3-8) selfed	65.9	45.5	38.5	81.6	120.9
18	KV77119(3-8) selfed	45.4	24.2	73.1	101.8	70.4
19	KV77119(3-8) selfed	44.0	39.4	51.5	97.0	89.3
20	KV77119(3-8) selfed	54.9	36.4	57.7	92.3	71.5
21	KV84068(3-12) selfed	40.3	39.4	19.2	92.3	112.2
22	KV84068(3-12) selfed	52.3	42.4	42.3	91.6	151.4
23	KV84068(3-12) selfed	51.8	33.3	60.0	87.5	116.9
24	KV84068(3-12) selfed	39.9	30.3	30.8	92.0	105.1
25	KV84068(3-12) selfed	41.3	24.2	41.5	98.6	98.5
26	KV84068(3-12) selfed	52.3	36.4	67.7	95.5	105.6
27	KV84068(3-12) selfed	31.9	27.3	43.8	89.5	100.3