Improved Rootstocks for Peach and Nectarine

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ABSTRACT

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. Fifty rootstocks were planted, in replicated trials, at the Kearney Agricultural Center (KAC) in 2003 through 2007. 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 by 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 sixth-leaf O'Henry trees on the HBOK 32 and HBOK10 rootstocks had significantly less height, dormant and summer pruning weights and suckers than Nemaguard and many other tested rootstocks. HBOK32 had significantly higher cropping efficiency than Nemaguard. Yield efficiency (crop divided by TCA) takes the size of the tree into account. When the early nectarine Mayfire was used as the top, trees on both HBOK32 and HBOK10 had significantly less height, dormant pruning weight, TCA (Trunk Cross-sectional Area) and suckers than trees on Nemaguard. When the early peach Springcrest was used as the top on HBOK10 and HBOK32, the trees had smaller heights, dormant and summer pruning weights, TCA and number of suckers. These trees also had higher cropping efficiency than trees on Nemaguard. When Summer Fire nectarine was used as the top on HBOK10 and HBOK32, the trees behaved similar to the ones when Springcrest peach was used but in addition they had lower summer pruning weights.

Replicated trials of different rootstocks from our program and others, 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 values of the majority of trees on the tested rootstocks, planted in 2003 and 2004, were significantly higher than trees on the control, Nemaguard.

Among the rootstocks tested with O'Henry in the 2004 trial are HBOK27 and HBOK28. Trees on these two rootstocks had significantly less height, dormant and summer pruning weights, and higher cropping efficiency than trees on Nemaguard and the majority of the other tested rootstocks.

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 orchards. Also as the future availability of soil fumigants becomes increasingly uncertain, there is 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 without resultant loss of yield per acre or reduction in fruit quality while using current scion cultivars.

Several peach varieties and inter-specific hybrids have been reported to have growth controlling ability (e.g., Layne and Jui, 1994), but the inheritance of this trait 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 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 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) 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 2008

- ***Plantings***

  A total of 50 rootstocks with various scions are being tested in this project at Kearney Ag Center. The majority of these rootstocks have been developed by this project, have root-knot nematode resistance and have the potential for size-controlling. Tables 1, 2, 3, and 4 list the rootstocks and tops that are being tested in replicated trials planted in 2007, 2005, 2004 and 2003, respectively.

- ***Data from the 2003 replicated trial***

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

  A. Vegetative Data (Table 5)

  Height: Trees on Barrier rootstock were similar to the control (Nemaguard). Trees on the rest of the tested rootstocks were shorter than the control.

  Dormant Pruning Weight: Pruning weights of trees on HBOK50 and Barrier rootstocks were similar to that of the trees on the control. Trees

on the rest of the tested rootstocks had significantly lower dormant pruning weights than trees on the control (ranging from 15% to 86%).
Summer Pruning Weight: Pruning weights of trees on HBOK2, HBOK50, HBOK1, HBOK10, HBOK18, HBOK 32, Ishtara, Adesoto, Sapalta-OP-3, and Sapalta-OP-24 were all significantly less (ranging between 13.5% to 79.8%) than trees on the control Nemaguard.
Number of Suckers **(Table 6)**: Trees on Adesoto, Cadaman and Nemaguard rootstocks produced the greatest number of suckers (6.6, 4.1, and 4.1 per tree, respectively). The rest of the rootstocks had fewer suckers than the control. HBOK 32 had no suckers. It is worth-while mentioning that Adesoto had suckers arising from the roots. Suckering may indicate possible incompatibility with other varieties of peach and nectarine, especially since one or more of the parents of some of the rootstocks are of plum origin (Table 6 – see parents column).

B. Fruit production characteristics (Table 7):
Crop: Trees on HBOK1, Barrier, Cadaman, HBOK2, and HBOK50 rootstocks were similar to that of the control.
Weight (size) of fruit: Trees on all of the tested rootstocks, except for Saplata-OP-3 and Sapalta-OP-24 had similar fruit size to that of the control.
Cropping efficiency: HBOK32, HBOK1, Ishtara, HBOK10 and HBOK2 had the highest efficiency values (ranging from 139.6 to 122.9%) compared to the control Nemaguard. Trees on the rest of the rootstocks were similar to Nemaguard.

2. Rootstocks grafted with the early nectarine, **Mayfire**:

A. Vegetative Data (Table 8):
Trees on HBOK 32 and HBOK 10 rootstocks were significantly shorter, had fewer suckers and had smaller dormant and summer pruning weights than trees on the control, Nemaguard.

B. Fruit production characteristics (Table 9):
Trees on the HBOK 32 had similar fruit size to those on Nemaguard.

- ***Data from the 2004 replicated trial***

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

A. Vegetative Data (Table 10):
Heights of trees on the rootstocks HBOK144, HBOK123, HBOK121 and HBOK160 were similar to Nemaguard. Trees on Nemaguard had TCAs and dormant and summer pruning weights significantly higher than trees on the other tested rootstocks.

B. Fruit production characteristics (Table 11):

Crop: Trees on HBOK36, HBOK160, HBOK123, HBOK122 and HBOK9 had similar crop weights as trees on Nemaguard.
Weight per Fruit (size): Trees on the rootstock HBOK 123 had fruit sizes larger than the control. Trees on the rootstocks HBOK121, HBOK28, HBOK144, HBOK122, HBOK9, HBOK138, HBOK 29, HBOK36 and HBOK27 had fruit sizes similar to the control.
Crop Efficiency: Trees on HBOK29, HBOK27, HBOK9, HBOK28 and HBOK122 rootstocks had higher crop efficiencies than Nemaguard.

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

A. Vegetative Data (Table 12):
Similar to the results obtained from the trial with the early Mayfire nectarine (Table 8), trees on the HBOK 32 and HBOK 10 rootstocks were significantly shorter, and had less dormant pruning weight, fewer suckers and smaller TCA than trees on the control, Nemaguard. Summer pruning weights were similar to the control.

B. Fruit production characteristics (Table 13):
Crop efficiency (similar to Mayfire results- Table 9) was significantly higher for the two rootstocks than the control Nemaguard.

3. Rootstocks grafted with the early peach, **Summer Fire nectarine**

A. Vegetative Data (Table 14):
Trees on HBOK10 and HBOK32 rootstocks were shorter and had smaller TCA, fewer suckers and less dormant and summer prunings than trees on Nemaguard.

C. Fruit production characteristics (Table 15):
Trees on HBOK32 had larger crop than on Nemaguard. Crop efficiencies of trees on HBOK10 and HBOK32 were higher than on Nemaguard. Fruit size of trees on the two rootstocks was similar to trees on Nemaguard.

References

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Table 1. List of eleven rootstocks that have size-controlling potential being tested in a replicated trial. The trees were grafted with O'Henry peach and planted, at Kearney Ag. Center, in January and September, **2007**.

Rootstock	Parents	Date Planted	Description*
95-153-141	Harrow Blood x Okinawa-141	Jan07	Size controlling; RKN resist.
94 94 17	Harrow Blood x Okinawa-17	Jan07	Size controlling; RKN resist.
KV-1	KV84068(3-6) selfed	Sept07	Size controlling; RKN resist.
(FL X KV)-1	Flordaguard (R16, T22) x KV84068 (CBR3, T4)-19-44	Sept07	Size controlling; RKN resist.
KV-2	KV77015(3-3) selfed(15-4)	Sept07	Size controlling; RKN resist.
KV-3	KV84068(3-12) selfed	Sept07	Size controlling; RKN resist.
FL X Weep	FlordagxWeep. p.(31-19)	Sept07	Size controlling; RKN resist.
(FL X KV)-2	Flordaguard (R16, T20) x KV84068 (CBR3, T4)-15-32	Sept07	Size controlling; RKN resist.
KV-4	KV77015(3-3) selfed(17-76)	Sept07	Size controlling; RKN resist.
KV-5	KV77015(3-3) selfed(5-1)	Sept07	Size controlling; RKN resist.
KV-6	KV84068(3-4) selfed	Sept07	Size controlling; RKN resist.
Nemaguard	control	Jan07 & Sept07	Vigorous; resistant to RKN l

**RKN = Root Knot Nematode.

Table 2. List of eight rootstocks planted in **2005** that have size-controlling potential and are being tested in a replicated trial. The trees were grafted with O'Henry and

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 3. List of twenty rootstocks that have size-controlling potential being tested in a replicated trial. The trees were grafted with the designated 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 4. List of fourteen rootstocks that have size-controlling potential being tested in a replicated trial. The trees were grafted with the designated 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;. 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.
Sapalta 3	Sapalta-OP (P. bessyi x P. salicina)	O'Henry	Size controlling; resistant to RKN.
Sapalta 24	Sapalta-OP (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 5. Mean values and % of the control of height, dormant and summer pruning weights, and TCA of the rootstocks grafted with O'Henry for 2008. The trees were planted in a replicated trial, in 2003.

Genotype	Height (cm)*	% Control	
Nemaguard	490.9	100	a
Barrier	483.8	98.6	ab
Cadaman	462.7	94.3	bc
HBOK 2	458.2	93.3	c
HBOK 1	455.8	92.8	c
HBOK 50	450.0	91.7	c
HBOK 10	425.6	86.7	d
HBOK 18	416.0	84.7	ed
Ishtara(P)	394.8	80.4	ef
HBOK 32	383.6	78.1	gf
Adesoto	368.8	75.1	gf
Sapalta-OP-3	350.0	71.3	ih
Sapalta-OP-24	337.3	68.7	I

Genotype	Dormant Pruning (Kg)	% Control	
Nemaguard	8.9	100	a
Barrier	8.6	96.6	a
Cadaman	8.5	95.5	a
HBOK 2	7.1	79.8	b
HBOK 50	7.0	78.7	b
HBOK 1	6.3	70.8	bc
HBOK 10	5.8	65.2	cd
HBOK 18	4.9	55.1	ed
HBOK 32	4.4	49.4	e
Ishtara(P)	2.1	23.6	f
Adesoto	2.0	22.5	f
Sapalta-OP-3	1.4	15.7	f
Sapalta-OP-24	1.2	13.5	f

Genotype	Summer Pruning (Kg)	% Control	
HBOK 50	0.81	124.6	a
Barrier	0.8	123.1	a
Nemaguard	0.7	100.0	ab
Cadaman	0.6	98.5	ab
HBOK 2	0.5	81.5	bc
HBOK 10	0.5	76.9	bc
HBOK 18	0.4	66.2	cd
HBOK 1	0.4	64.6	cd
HBOK 32	0.3	46.2	de
Sapalta-OP-3	0.1	21.5	ef
Ishtara(P)	0.1	20.0	ef
Adesoto	0.1	15.4	ef
Sapalta-OP-24	0.0	3.1	f

Genotype	TCA (cm2)	% Control	
Barrier	130.2	108.6	a
Nemaguard	119.9	100.0	ab
Cadaman	112.9	94.2	bc
HBOK 50	111.6	93.1	bc
HBOK 1	98.3	82.0	dc
HBOK 2	97.7	81.5	dc
HBOK 10	83.5	69.6	de
HBOK 18	79.3	66.1	e
Sapalta-OP-3	74.6	62.2	e
HBOK 32	73.2	61.1	e
Ishtara(P)	71.2	59.4	e
Adesoto	69.7	58.1	e
Sapalta-OP-24	67.6	56.4	e

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 6. Mean values and % of the control of the number of suckers for the rootstocks grafted with O'Henry for 2008. The trees were planted, in a replicated trial, in 2003.

Genotype	No. Suckers	% Control		Parents	Notes
Adesoto	6.6	161.0	a	P. isititia selection	root suckers
Cadaman	4.3	104.9	ab	(P. persica x P. dulcis) x P. dividiana	
Nemaguard	4.1	100.0	b	P. persica x P. dividiana	
Sapalta-OP-24	1.4	34.1	c	Sapalta-OP 24 (P. bessyi x P. salicina)	
HBOK 8	0.6	14.6	c	Harrow Blood x Okinawa-8	
HBOK 10	0.3	7.3	c	Harrow Blood x Okinawa-8	
HBOK 50	0.1	2.4	c	Harrow Blood x Okinawa-8	
HBOK 1	0.1	2.4	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)	
Sapalta-OP-3	0.0	0.0	c	Sapalta-OP 3 (P. bessyi x P. salicina)	

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 7. Mean values and % of the control of crop weight, weight per fruit (size), and cropping efficiency of the rootstocks grafted with O'Henry for 2008. The trees were planted in 2003.

Genotype	**Crop (Kg)**	**% Control**	
HBOK 1	63.5	112.4	a
Barrier	62.3	110.3	a
Cadaman	62.2	110.1	a
Nemaguard	56.5	100.0	ab
HBOK 2	56.0	99.1	ab
HBOK 50	50.4	89.2	bc
HBOK 32	47.7	84.4	cd
HBOK 10	45.7	80.9	cd
Ishtara(P)	41.2	72.9	de
HBOK 18	40.5	71.7	de
Adesoto	34.2	60.5	fe
Sapalta-OP-3	32.5	57.5	f
Sapalta-OP-24	26.5	46.9	f

Genotype	**Wt. per fruit (g)**	**% Control**	
Cadaman	235.2	106.1	a
Nemaguard	221.7	100.0	ab
Barrier	221.1	99.7	ab
HBOK 1	219.9	99.2	ab
HBOK 32	218.7	98.6	ab
HBOK 50	216.4	97.6	b
Adesoto	211.7	95.5	bc
HBOK 18	211.1	95.2	bc
Ishtara(P)	207.5	93.6	bc
HBOK 2	207.0	93.4	bc
HBOK 10	205.0	92.5	bc
Sapalta-OP-3	196.9	88.8	c
Sapalta-OP-24	180.9	81.6	d

Genotype	**Crop Efficiency ***	**% Control**	
HBOK 32	0.7	139.6	a
HBOK 1	0.6	131.3	ab
Ishtara(P)	0.6	125.0	abc
HBOK 10	0.6	122.9	abc
HBOK 2	0.6	122.9	abc
Cadaman	0.6	116.7	bcd
HBOK 18	0.5	108.3	cde
Adesoto	0.5	106.3	cde
Barrier	0.5	104.2	cde
Nemaguard	0.5	100.0	def
HBOK 50	0.5	95.8	ef
Sapalta-OP-3	0.5	95.8	ef
Sapalta-OP-24	0.4	83.3	f

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 8. Mean values and % of the control of height, dormant pruning weight, summer pruning weight, number of suckers and TCA of the rootstocks grafted with the early nectarine Mayfire for 2008. The trees were planted in a replicated trial, in 2003

Genotype	**Height (cm)***	**% Control**	
Nemaguard	626.0	100.0	a
HBOK 10	579.0	92.5	b
HBOK 32	500.0	79.9	c

Genotype	**Dormant Pruning (Kg)***	**% Control**	
Nemaguard	26.4	100.0	a
HBOK 10	19.0	72.0	b
HBOK 32	11.3	42.8	c

Genotype	**Summer Pruning (Kg)***	**% Control**	
Nemaguard	1.33	100.0	a
HBOK 32	1.23	92.5	a
HBOK 10	1.09	82.0	a

Genotype	**No. Suckers***	**% Control**	
Nemaguard	1.8	100.0	a
HBOK 32	0.0	0.0	b
HBOK 10	0.0	0.0	b

Genotype	**TCA (cm2)**	**% Control**	
Nemaguard	186.0	100.0	a
HBOK 10	109.0	58.6	b
HBOK 32	85.0	45.7	b

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 9. Mean values and % of the control of crop weight, weight per fruit (size), and cropping efficiency of the rootstocks grafted with the early nectarine Mayfire for 2008. The trees were planted in 2003.

Genotype	**Crop (Kg)**	**% Control**	
Nemaguard	76.3	100	a
HBOK 10	27.6	36	b
HBOK 32	19.6	26	b

Genotype	**Wt. per fruit (g)**	**% Control**	
HBOK 32	76	102.4	a
Nemaguard	74	100.0	ab
HBOK 10	65	87.8	c

Genotype	**Crop Efficiency (Kg/cm2)***	**% Control**	
Nemaguard	0.44	100	a
HBOK 10	0.29	66	b
HBOK 32	0.23	52	b

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 10. Mean values and % of the control of height, dormant pruning weight and summer pruning weight and TCA of the rootstocks grafted with O'Henry for 2008.The trees were planted in a replicated trial, in 2004.

Genotype	Height (cm)*	% Control		Genotype	Dormant Pruning (Kg)	% Control	
HBOK144	463.0	100.1	a	Nemaguard	6.3	100.0	a
Nemaguard	462.6	100.0	a	HBOK123	5.8	92.1	b
HBOK123	452.0	97.7	ab	HBOK160	5.3	84.1	bc
HBOK121	449.5	97.2	abc	HBOK9	5.1	81.0	cd
HBOK160	444.0	96.0	abcd	HBOK144	4.7	74.6	de
HBOK138	439.0	94.9	bcd	HBOK122	4.7	74.6	de
HBOK122	431.1	93.2	cde	HBOK36	4.6	73.0	de
HBOK36	429.0	92.7	cde	HBOK138	4.3	68.3	e
HBOK9	424.0	91.7	de	HBOK121	4.3	68.3	e
KV84068-S	416.5	90.0	ef	HBOK28	4.3	68.3	e
HBOK28	416.5	90.0	ef	KV84068-S	3.5	55.6	f
Rubira	412.6	89.2	ef	Rubira	3.0	47.6	g
Weeping peach-31	397.0	85.8	fg	HBOK27	2.8	44.4	g
HBOK27	379.5	82.0	g	Weeping peach-31	2.2	34.9	h
Tetra	350.7	75.8	h	HBOK29	1.9	30.2	hi
Weeping peach-3	346.5	74.9	h	Weeping peach-3	1.8	28.6	hi
HBOK29	344.4	74.4	h	Tetra	1.7	27.0	i

Genotype	Summer Pruning (Kg)	% Control		Genotype	TCA (cm2)*	% Control	
Nemaguard	0.9	100.0	a	Nemaguard	108.2	100.0	a
HBOK123	0.7	82.8	b	HBOK123	100.1	92.5	ab
HBOK9	0.7	75.9	bc	HBOK36	93.8	86.7	bc
HBOK144	0.6	73.6	bcd	KV84068-S	91.3	84.4	bc
HBOK28	0.6	72.4	bcd	HBOK160	89.8	83.0	bcd
HBOK36	0.6	70.1	bcd	HBOK138	88.1	81.4	cd
HBOK160	0.6	69.0	bcd	HBOK121	86.9	80.3	cde
HBOK138	0.6	63.2	cde	HBOK144	86.1	79.6	cde
HBOK121	0.5	62.1	cde	HBOK122	85.4	78.9	cde
HBOK122	0.5	60.9	de	Weeping peach-31	78.7	72.7	def
KV84068-S	0.4	49.4	ef	HBOK9	76.3	70.5	ef
Tetra	0.4	43.7	fg	Rubira	74.0	68.4	gf
Rubira	0.4	40.2	fg	HBOK28	73.4	67.8	gf
HBOK27	0.3	34.5	gh	HBOK27	64.1	59.2	gh
Weeping peach-31	0.2	24.1	hi	Weeping peach-3	59.8	55.3	h
Weeping peach-3	0.2	18.4	i	Tetra	55.5	51.3	hi
HBOK29	0.1	16.1	i	HBOK29	45.8	42.3	i

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 11. Mean values and % of the control of crop, weight per fruit (size), and crop efficiency of the rootstocks grafted with O'Henry for 2008. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	
HBOK36	48.7	100.6	a
HBOK160	48.7	100.6	a
HBOK123	48.4	100.0	ab
Nemaguard	48.4	100.0	ab
HBOK122	47.6	98.3	ab
HBOK9	46.1	95.2	bc
HBOK28	45.1	93.2	cd
HBOK138	43.8	90.5	cde
HBOK144	43.5	89.9	de
HBOK121	43.1	89.0	de
KV84068-S	41.7	86.2	ef
HBOK27	39.6	81.8	fg
Rubira	39.1	80.8	g
Weeping peach-31	32.7	67.6	h
HBOK29	31.9	65.9	h
Weeping peach-3	26.9	55.6	i
Tetra	26.2	54.1	i

Genotype	Wt. per fruit (g)	% Control	
HBOK123	230.6	109.5	a
HBOK121	218.4	103.7	b
HBOK28	217.0	103.0	bc
Nemaguard	210.6	100.0	bcd
HBOK144	206.3	98.0	cde
HBOK122	205.2	97.4	cde
HBOK9	203.6	96.7	ed
HBOK138	202.5	96.2	def
HBOK29	199.5	94.7	def
HBOK36	199.2	94.6	def
HBOK27	198.6	94.3	def
HBOK160	195.5	92.8	efg
KV84068-S	190.9	90.6	fgh
Rubira	184.3	87.5	gh
Weeping peach-31	182.4	86.6	h
Tetra	180.3	85.6	h
Weeping peach-3	160.9	76.4	i

Genotype	Crop Efficiency*	% Control	
HBOK29	0.7	153.2	a
HBOK27	0.7	138.3	ab
HBOK9	0.6	136.2	bc
HBOK28	0.6	134.0	bc
HBOK122	0.6	123.4	bcd
HBOK160	0.6	119.1	bcde
Rubira	0.5	114.9	cdef
HBOK36	0.5	112.8	def
HBOK144	0.5	110.6	defg
HBOK138	0.5	110.6	defg
HBOK121	0.5	110.6	defg
HBOK123	0.5	108.5	defg
Weeping peach-3	0.5	106.4	defg
Tetra	0.5	104.3	defg
Nemaguard	0.5	100.0	efg
KV84068-S	0.5	97.9	fg
Weeping peach-31	0.4	91.5	g

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 12. Mean values and % of the control of height, summer pruning weight, dormant pruning weight, number of suckers and TCA of the rootstocks grafted with the early peach Springcrest for 2008. The trees were planted, in a replicated trial, in 2004.

Genotype	Height (cm)*	% Control		Genotype	Summer Pruning (Kg)	% Control	
Nemaguard	554.0	100.0	a	Nemaguard	1.6	100.0	a
HBOK32	502.0	90.6	b	HBOK10	1.3	81.3	a
HBOK10	485.0	87.5	b	HBOK32	1.3	81.3	a

Genotype	Dormant Pruning (Kg)	% Control		Genotype	No. Suckers	% Control	
Nemaguard	16.7	100.0	a	Nemaguard	2.8	100.0	a
HBOK10	9.8	58.7	b	HBOK32	0.3	10.7	b
HBOK32	9.4	56.3	b	HBOk10	0.1	3.6	b

Genotype	TCA (cm2)*	% Control	
Nemaguard	146.5	100.0	a
HBOK32	97.8	66.8	b
HBOk10	88.2	60.2	b

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 13. Mean values and % of the control of crop, weight per fruit (size), and cropping efficiency (crop weight divided by TCA) of the rootstocks grafted with early peach Springcrest for 2008. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	
Nemaguard	27.2	100.0	a
HBOK32	23.9	87.9	b
HBOK10	19.5	71.7	c

Genotype	Wt. per fruit (g)	% Control	
Nemaguard	101.0	100.0	a
HBOK32	94.0	93.1	b
HBOK10	88.0	87.1	c

Genotype	Crop Efficiency*	% Control	
HBOK32	0.25	132.3	a
HBOK10	0.23	121.7	a
Nemaguard	0.19	100.0	b

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 14. 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 2008. The trees were planted, in a replicated trial, in 2004.

Genotype	Height (cm)*	% Control		Genotype	TCA (cm2)*	% Control	
Nemaguard	514.0	100.0	a	Nemaguard	145.4	100.0	a
HBOK10	481.0	93.6	b	HBOK10	101.2	69.6	b
HBOK32	446.0	86.8	c	HBOK32	87.1	59.9	c
Genotype	**Drormant Pruning (Kg)**	**% Control**		**Genotype**	**Summer Pruning (Kg)**	**% Control**	
Nemaguard	9.8	100.0	a	Nemaguard	0.9	100.0	a
HBOK10	7.3	74.5	b	HBOK10	0.6	64.0	b
HBOK32	4.7	48.0	c	HBOK32	0.3	37.1	c
Genotype	**No. Suckers**	**% Control**					
Nemaguard	3.3	100.0	a				
HBOK32	0.6	18.2	b				
HBOK10	0.4	12.1	b				

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

Table 15. Mean values and % of the control of crop weight, weight per fruit (size), and cropping efficiency (crop weight divided by TCA) of the rootstocks grafted with nectarine Summer Fire for 2008. The trees were planted in 2004.

Genotype	Crop (Kg)	% Control	-
HBOK32	37.2	111.4	a
Nemaguard	33.4	100.0	b
HBOK10	32.1	96.1	b

Genotype	Wt. per fruit (g)	% Control	-
Nemaguard	214.1	100.0	a
HBOK10	210.4	98.3	a
HBOK32	206.2	96.3	a

Genotype	Crop Efficiency*	% Control	-
HBOK32	0.440	183.3	a
HBOK10	0.330	137.5	b
Nemaguard	0.240	100.0	c

* = numbers followed by the same letter(s) are not significantly different at the 0.05 probability level.

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