EVALUATION OF SIZE CONTROLLING ROOTSTOCKS FOR CALIFORNIA PEACH, PLUM AND NECTARINE PRODUCTION

Ted M. DeJong, R.S. Johnson D. Ramming
James F. Doyle and Kevin R. Day

This project is a continuation of a research project that was initially funded by USDA-ARS as a special four-year cooperative research project between the USDA Horticultural Crops Research Laboratory in Fresno and the University of California, Davis/Kearney. Hardwood cuttings from more than 100 different Prunus genotypes were planted in a commercial California nursery in November, 1986 (Table 1). In May, 1987, all of the living cuttings were budded with either a peach (Prunus persica cv. 'O'Henry') or plum (Prunus salicina cv. 'Santa Rosa') scion cultivar. In January 1988, 80 rootstock genotypes budded with peach and 70 rootstock genotypes budded with plum were transplanted into an orchard site at the University of California's Kearney Agricultural Center. By October, 1989, 63 and 70 rootstocks were still living with the peach and plum scions, respectively.

In addition to the original trees in this block, 5 and 6 additional rootstock genotypes budded with peach and plum, respectively, were transplanted into the Kearney plot in January, 1989. These trees were mostly the result of a second attempt to propagate 44 of the hard-to-root genotypes from the first rooting trial in 1986-87.

Most of the trees from the first propagation produced some fruit in 1989 but there was not enough fruit to adequately assess rootstock effects on fruit size and quality. In 1990 most of the peach trees produced enough fruit to begin selecting rootstocks on the basis of tree size and vigor, fruit set, yield and fruit size. Based on data from 1990 and 1991 nineteen peach rootstocks and 41 plum rootstocks were selected for continued evaluation. All of the remaining rootstocks, except for Nemaguard and Nemared, were eliminated from the rootstock trial. The rootstocks selected for further evaluation represent a wide range of genetic backgrounds and exhibit large differences in tree size.

In 1990 through 1993 all rootstocks in the 'O'Henry' peach part of the experiment were evaluated on the basis of tree size and vigor, fruit set, yield and fruit size. The difference in tree sizes makes it difficult to evaluate fruit yield and size data because in a commercial planting of semi-dwarfed trees, tree densities and crop loads would need to be adjusted for particular tree size or rootstock/scion combinations. Nevertheless, this year we have summarized the data from the 21 rootstocks remaining in the peach trial (Table 2) and have selected 8 rootstocks for further evaluation along with Nemaguard and Citation for comparison. These rootstocks range from being less vigorous than Nemaguard but about the same size and vigor as Citation to substantially smaller and less vigorous than either Nemaguard or Citation. P-30-135 is a plum x peach hybrid that produced an 'O'Henry' tree of about the same size and vigor (as measured by pruning weights) as Citation. K-119-50 is a plum x almond hybrid with a tree size slightly larger than Citation but with a tendency toward lower pruning weights. Hiawatha (seedling of a P. besseyi x P. salicina hybrid) appears to be a little smaller and less vigorous than K-119-50. K-

145-5, K-146-43 (two plum x peach hybrids) and Sapalta (OP seedling of a P. besseyi x P. salicina hybrid) all appear to be similar but slightly smaller and less vigorous than Hiawatha. Two additional genotypes (K-146-44, a plum x peach hybrid, and Alace, an OP seedling of a P. besseyi x P. salicina hybrid) are the smallest and least vigorous rootstocks selected for further evaluation. They produce 'O'Henry' trees less than half the size of Nemaguard.

All of the rootstocks selected for a second round of evaluation produced reasonable crops for their size but some of the smallest genotypes tended to produce small fruit (eg. K-146-44). It is difficult to determine if the tendency toward small fruit is inherent to the rootstock or was a function of over-cropping relative to tree size. In 1994, we intend to test this by thinning two trees of each of the remaining rootstocks in the test to minimal crop loads (i.e., 20-30 fruit per tree) to determine if the rootstocks influence the maximum potential size of the fruit or if the size differences are strictly a function of crop load.

July leaf samples were taken for nutrient analysis from the 'O'Henry' scions on all 19 rootstocks remaining in the trial in both 1992 and 1993. Although there was substantial variability, all of the trees appeared to be within the optimum range for most of the major and minor elements of concern to fruit growers. However, trees on 5 rootstocks (Alace, K-119-50, K-144-100, K-145-75, K-146-44) were on the borderline between deficient and optimal for N. Three rootstocks (K-119-50, K-146-43, Sapa) appeared to be marginally deficient for K. The plot has received no fertilizer supplements since the beginning of the trial except for fall foliar sprays of Zn SO_4. Since this trial only involves small numbers of trees in localized areas of the field, it is impossible to determine at this time if the differences in N and K nutrient are due to rootstock or location. Further testing in replicated trials are necessary to learn more about the nutritional aspects of these rootstocks.

The rootstocks not selected for further test were rejected because of excessive vigor (eg. Opata, St. Anthony, K-62-68), signs of incompatibility, poor tree health (such as leaf boating and early leaf senescence), poor overall performance compared to others that appear to have promise, or difficulties in propagating from hardwood cuttings. In 1993, we attempted to root the most promising rootstocks in the trial from dormant cuttings and also grafted them on to established rootstocks so that by Fall 1994 enough wood for hardwood cuttings will be available to begin a second round of testing. This multiplication of cutting material will continue during 1994-95.

In summary, we believe that we have identified 8 new potential size-controlling rootstocks for California peach production. Barring the unexpected collapse of any of the eight selections in 1994, we plan to begin a second round of evaluations of these rootstocks with additional scion cultivars in a semi-commercial setting in 1995.

Table 1. Prunus species and hybrids tested as potential rootstocks for peach and plum.

Species background/ Accession name	% Rooting	% Bud take w/peach[b]	% Peach survival in nursery[c]	Peach vigor rating[d]	% Bud take w/plum[b]	% Plum survival in nursery
P. americana						
Surprise	0	-	-	-	-	-
Weaver	(0)[a]	-	-	-	-	-
Twilight	76	100	20	8[e]	74	100
P. armeniaca						
Goff	(0)[a]	-	-	-	-	-
P. besseyi						
Brooks	(0)[a]	-	-	-	-	-
Convoy	39	100	100	7	80	100
P. blirieana						
GA	(32)[a]	-	-	-	-	-
WA	(4)[a]	-	-	-	-	-
P. cerasifera						
Myro 29C	100	40	0	dead	54	100
P. cistena						
species	94	100	100	4[e]	63	100
P. ferganensis						
species	96	72	100	1	65	100
P. insititia						
Damas 1869	81	68	80	3	58	100
GF 655-2	98	79	100	7	40	100
P. japonica						
GA	(92)[a]	-	-	-	-	-
WA	(0)[a]	-	-	-	-	-
P. maritima						
species	84	91	100	5[e]	100	100
P. mira						
species	91	88	100	2	60	100
P. persica						
Chi Lum Tao	(0)[a]	-	-	-	-	-
K-62-68	86	84	100	2	50	100
Lovell	92	64	100	2	35	100
Nemaguard	100	83	100	2	88	100
Nemared	76	88	100	2	53	100
Okinawa	73	89	100	2	60	100
S-2535	27	88	100	3	71	60

a. Date of propagation attempt in the second year (1988) are given in parentheses.
b. Budded in June 24, rated August 25.
c. Survival until nursery digging January 1988.
d. Rated in October 1989. Scale of 1 (most vigorous) to 9 (least vigorous).
e. Showed signs of leaf boating, leaf discoloration or general unhealthy appearance.

Species background/ Accession name	% Rooting	% Bud take w/peach[b]	% Peach survival in nursery[c]	Peach vigor rating[d]	% Bud take w/plum[b]	% Plum survival in nursery
P. pumila						
Mondo	38	90	0	dead	100	100
P. salicina						
Abundance	12	100	100	6[e]	100	0
K-41-10	100	71	100	6[e]	64	100
P. simonii						
species	84	86	100	6[e]	57	100
P. spinosa						
species	78	100	0	dead	72	100
P. subhirtella						
species	27	100	0	4	83	100
P. tomentosa						
species	90	96	60	8[e]	85	100
Orient	8	100	0	dead	50	100
P. umbellata						
species	(8)	-	-	-	-	-
P. americana x P. simonii						
Toka	6(8)	100	100	7[e]	100	100
(P. americana x P. salicina) x P. americana						
La Cresent	8(1)[a]	100	0	-	-	-
P. armeniaca x P. dulcis						
10A x 14A	2(0)[a]	100	100	6	-	-
10A x 14AP	(0)	-	-	-	-	-
P. besseyi x P. americana						
Compass	6(5)	100	100	7[e]	100	100
P. besseyi x P. armeniaca						
Yuksa	50	92	100	9[e]	83	100
P. besseyi x P. persica						
S-3400	74	100	100	2	81	100
P. besseyi x P. salicina						
Deep Purple	0(4)[a]	-	-	-	-	-
Oka	49	93	80	dead	89	100
Opata	4(6)[a]	100	100	4	-	-
Sapa	4(35)[a]	100	100	dead	-	-
Skinner's Favorite	0(0)[a]	-	-	-	-	-
Winered	8(11)[a]	50	100	9	100	0
P. besseyi x P. tomentosa						
B5-13	12	100	75	8[e]	100	100

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Species background/ Accession name	% Rooting	% Bud take w/peach[b]	% Peach survival in nursery[c]	Peach vigor rating[d]	% Bud take w/plum[b]	% Plum survival in nursery
(P. besseyi x P. salicina) op						
Alace	54	69	100	4	40	100
Hiawatha	30	100	100	3	100	100
Manor	42	91	100	4	90	100
Sapalta	82	95	100	3	85	100
St. Anthony	5	100	100	6	-	-
(P. besseyi x P. salicina) x P. armeniaca						
Alf 46-44	0	-	-	-	-	-
Alf 46-57	33(0)[a]	50	50	dead	100	100
([P. besseyi x P. salicina] op) x P. americana						
Alf 38-12	62	100	0	dead	87	100
P. cerasifera x P. munsoniana						
M 2624	98	86	40	dead	90	100
P. cerasifera x P. persica						
S 2729	82	100	100	2	67	100
P. davidiana x P. persica						
F #1	41	100	100	1	67	40
F #2	94	92	100	1	60	100
P. dulcis x P. persica						
GF 53-7	100	100	100	4	88	100
GF-677	76	75	100	1	61	100
P115-1R	92	78	83	2	30	100
C844-1	30	100	100	1	43	100
P. dulcis x (P. armeniaca x P. dulcis)						
R8.5 #1	8(0)[a]	100	100	5[e]	100	100
R8.5 #4	28	100	100	2	71	67
R8.5 #5	16	100	100	3	100	25
R8.5 #6	42	100	100	4	82	60
R8.5 #8	10(0)[a]	100	0	-	50	0
R9.5	82	91	100	2	26	80
P. maritima x P. armeniaca						
ALF 44-14	48	100	100	6[e]	27	100
ALF 46-16	2	100	0	-	-	-
ALF 46-17	26	71	60	dead	60	67
ALF 46-19	28	100	100	5[e]	86	100
P. maritima x P. salicina						
ALF 44-18	12(7)[a]	100	0	-	-	-

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Species background/ Accession name	% Rooting	% Bud take w/peach[b]	% Peach survival in nursery[c]	Peach vigor rating[d]	% Bud take w/plum[b]	% Plum survival in nursery
P. salicina x P. americana						
Monitor*	0	-	-	-	-	-
Redwig	0	-	-	-	-	-
P. salicina x P. armeniaca						
Lantz	94	60	100	dead	32	100
P. salicina x P. dulcis						
K-119-50	44	92	100	4	90	100
K-187-1	8	100	0	-	100	100
P. salicina x P. persica						
Citation	44	92	80	5[e]	75	100
K-144-100	86	95	100	4	77	100
K-145-5	38	92	100	5	90	100
K-145-55	39	80	100	4[e]	70	100
K-145-65	86	90	100	4	62	100
K-145-75	100	77	100	4	15	100
K-146-408	94	96	100	4	95	100
K-146-43	80	95	100	5	70	100
K-146-44	38	45	100	4	70	100
P-30-135	96	96	100	6	83	100
Unknowns?						
Alf 47-46	22	67	75	5[e]	100	80
Alf 47-65	2(0)[a]	100	100	7[e]	-	-
Kahinta	2(3)[a]	100	0	-	-	-
GF-43	10(0)[a]	100	33	4	50	100
Minn 416	0	-	-	-	-	-
P1-60-G	100	96	100	5[e]	88	100
8-2	16(0)[a]	25	0	-	0	-
PI-304928	0					
Brompton	(4)[a]					
Bruce GA	(84)[a]					
Bruce WA	(20)[a]					
BY 7901-1	(0)[a]					
BY82-P6083	(0)[a]					
BY82-P6165	(0)[aCG*]					
Edible Sloe	(0)[a]					
Higama	(0)[a]					
Mohawk	(0)[a]					
Montclar	(84)[aCG*]					
PI-101-686	(0)[a]					
Red Glow	(0)[a]					

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e. Showed signs of leaf boating, leaf discoloration or general unhealthy appearance.

Table 2. Summary of rootstock performance characteristics with 'O'Henry' peach as the scion cultivar. The first 10 rootstocks have been selected for further tests.

Rootstock	Size Rating Vigorous (1) to Dwarfed (9)			Pruning Weights (kg/tree)				Trunk Circum-ference	Fruit Yield / Fruit Size (kg/tree) / (g/fruit)				Ave. Fruit Size
	1990	1991	1993	1991	1992		1993	1993	1990	1991	1992	1993	(g/fruit)
				(Winter)	(Summer)	(Winter)	(Summer)						
Nemaguard	2	2	2	13.8	2.3	17.2	4.6	49.2	28.0/204	57.3/226	65.2/226	74.5/231	222
P-30-135	6	4	3	5.8	1.2	6.8	2.3	41.4	17.0/250	43.4/201	40.9/194	56.0/226	218
Citation	6	4	4	5.7	1.6	6.2	1.9	37.3	21.0/199	53.2/217	53.0/222	57.2/234	218
K-119-50	4	3	4	5.2	1.2	5.5	1.3	36.5	22.0/220	52.3/192	50.7/205	61.7/225	211
Hiawatha	5	4	5	4.5	1.2	5.1	0.7	38.9	25.0/190	46.0/184	49.9/207	56.1/199	195
K-145-5	6	4	5	4.8	0.5	4.5	0.5	35.9	14.0/193	44.5/194	46.1/187	43.8/198	193
Sapalta	5	5	6	4.1	0.2	4.4	0.8	37.0	26.0/219	39.3/175	32.4/198	40.9/215	202
K-146-43	6	5	5	3.9	0.3	4.7	0.3	36.4	21.0/179	38.0/184	48.2/183	52.1/200	187
K-146-44	7	6	6	2.5	0.4	2.7	0.5	29.8	20.0/164	32.9/140	35.7/160	38.2/180	161
Alace	6	6	6	2.8	0.3	3.2	0.3	35.1	28.0/225	41.4/169	58.5/232	65.4/233	215
Nemared	2	2	2	11.2	2.1	14.8	5.2	49.8	27.0/197	60.7/228	58.5/232	65.4/233	223
Opata	4	3	3	11.0	2.1	14.1	3.9	54.5	26.0/216	48.4/249	63.6/229	79.8/230	231
10A x 14A	6	5	5	10.0	1.8	2.5	2.7	44.6	18.0/224	15.7/336	35.2/278	69.5/220	265
St. Anthony	5	4	4	7.4	1.3	11.6	3.5	47.1	13.0/198	30.5/161	47.7/224	59.4/219	201
K-62-68	4	3	3	7.1	1.0	10.1	1.5	44.3	28.0/206	65.6/186	58.4/193	70.7/200	196
Winered	7	5	6	4.0	0.5	7.6	0.6	37.9	5.0/216	38.6/188	20.2/245	40.7/192	210
Sapa	-	5	6	4.1	0.2	3.6	0.4	37.3	-	23.4/257	31.4/170	30.9/185	204
K-144-100	5	4	7	3.8	0.8	3.1	0.3	30.7	21.0/202	39.5/174	46.1/160	45.2/162	175
Manor	6	4	6	3.4	1.1	3.6	0.5	36.7	22.0/155	36.8/163	37.0/174	48.6/180	168
K-145-75	6	6	7	2.5	0.3	2.2	0.1	28.7	30.0/196	37.9/163	35.9/160	35.6/151	168
Yuksa	9	9	9	0.7	-	1.5	-	23.7	2.0/122	6.2/233	4.2/214	5.2/245	204