

GROWTH AND PERFORMANCE OF OWN-ROOTED ‘CHANDLER’ AND ‘VINA’ COMPARED TO PARADOX ROOTED TREES

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ABSTRACT

Two studies comparing own-rooted Chandler to nursery grafted Chandler on seedling Paradox rootstock were planted in Sutter and San Joaquin Counties in 2002. Additionally, own-rooted Vina is being compared to Paradox rooted Vina in Sutter County. The survival rate of own-rooted trees at both sites is 100 percent. The Paradox rooted Vina trees in Sutter County have remained the largest trees since planting. In 2006 and 2007, the Paradox rooted Vina were significantly larger than the own-rooted Vina, own-rooted Chandler and Chandler on Paradox. In 2007, the Paradox rooted Chandler trees had significantly higher yields than the own-rooted trees for both varieties. Paradox rooted Chandler trees had significantly higher yield efficiency expressed as pounds per cm of trunk circumference compared to other treatments. Both Chandler treatments had significantly more light nuts compared to the Vina treatments; the delayed harvest timing for Vina probably contributed to poorer kernel color. The own-rooted trees continue to leaf out later and produce far fewer catkins than Paradox rooted trees. Several own-rooted Vina trees had low vigor and branch wilt disease was diagnosed on some trees. Summer stem water potential samples showed own-rooted trees to be significantly more stressed than Paradox rooted trees. In San Joaquin County, since planting there has been no significant size difference between Paradox rooted and own-rooted Chandler trees. Yield data was not taken in 2007. Salt toxicity symptoms were observed by late summer as in 2005 and 2006. Leaf chloride concentrations were significantly higher in own-rooted than in Paradox trees.

OBJECTIVES

Compare long-term growth and yield performance of own-rooted Chandler and Vina (Sutter County only) with trees on seedling Paradox rootstock in two locations.

PROCEDURES

Sutter County - The study site is on Holillipah loamy sand. The site was previously planted in pistachios but had been fallow for several years. There were zero nematodes from a random sample of soil taken from the top foot in October 2000 prior to methyl bromide (MB) treatment. Soil was again sampled in 12” increments to 60” in April 2001 following a fall MB treatment. There were no nematodes found in soil or root samples.

The treatments compare own-rooted Chandler and Vina to nursery grafted Chandler and Vina on seedling Paradox rootstock. Six 6-tree replications of each rootstock were planted on March 12, 2002 in a randomized complete block design spaced at 25’ x 25’ and surrounded by buffer trees. Most of the nursery trees were ½” or 5/8” except the Vina on Paradox were ¾”. Trees were sprinkler irrigated. In 2007, pruning was confined to lower limbs for orchard access. In March and April, leafing and flowering phenology data was taken. Leaves were sampled on July 25,

2007 and analyzed for N, K, Ca, Zn, Mn, and Cl. Midday stem water potential was taken on June 13 after own-rooted trees were observed to be wilting on shoot tips and again on July 20. Trees were harvested on October 23, 2007 and nut samples were submitted for quality. Tree trunk circumference was measured at leaf fall on November 30, 2007 at 14 inches above the ground.

San Joaquin County - The study site is on Columbia fine sandy loam. The treatments compare own-rooted Chandler to nursery grafted Chandler on seedling Paradox rootstock. Five 8-tree replications of each rootstock, arranged in a single row within a newly planted commercial block, were planted on March 15, 2002 in a randomized complete block design. The planting is an 11' x 25' hedgerow with rows oriented E-W. Trees are furrow irrigated. Irrigation water at the site contains elevated levels of sodium, chloride, and boron. The orchard has a high water table and a tile drainage system is installed six feet below the soil surface. Leaves were sampled and analyzed for sodium and chloride in July. Tree trunk circumference was measured at 30 cm above the ground. Trees were harvested in 2007 before yield data could be taken.

RESULTS AND DISCUSSION

Sutter County - The Vina on Paradox trees were larger at planting and have remained the largest trees. They were not significantly larger than own-rooted Vina in 2004 and 2005 but were significantly larger in 2006 and 2007 (Table 1). Both own-rooted cultivars and the Chandler on Paradox were not significantly different in size from 2004 through 2007. The growth rate was similar for all treatments in 2007. Own-rooted Chandler trees have had the greatest percent change in trunk circumference since planting. There has been no tree mortality but several of the own-rooted Vina in particular have had low vigor and continued to decline in 2007. Several own-rooted Vina had limb dieback in the summer that was later diagnosed as branch wilt (*Nattrassia mangiferae*). Two of the trees had branch wilt so severe it was actually in the main trunk.

Yield is shown in Table 2. In 2007, the Paradox rooted Chandler trees had significantly higher yields than the own-rooted trees for both varieties. Paradox rooted Vina yields were not significantly different than own-rooted Chandler yields. Own-rooted Vina had the lowest yield in 2007. Paradox rooted Chandler trees had significantly higher yield efficiency expressed as pounds per cm of trunk circumference; own-rooted Vina had the lowest yield efficiency (Table 3). Figure 1 shows the block by block variability for trunk circumference versus yield.

Walnut quality varied for percent light nuts between the treatments; both Chandler own-rooted and Paradox rooted trees had substantially more light nuts compared to the Vina treatments (Table 4). The delayed harvest timing for Vina probably contributed to poorer kernel color in addition to its inherent darker kernel color than Chandler. Own-rooted Chandler also had reduced percent large sound nuts compared to the other treatments for unknown reasons.

Leafing and flowering phenology was observed on several dates in the spring (Table 5). Both own-rooted cultivars were later leafing and produced far fewer catkins than Paradox rooted trees, as has been observed in other trials with own-rooted trees. The growth habit of own-rooted trees is more open with fewer branches whereas the Paradox rooted trees have more secondary and fruiting branches where the catkins are located.

Wilting on shoot tips of own-rooted trees was observed in mid-June. Midday stem water potential (SWP) was subsequently measured in June and July. Own-rooted Vina and Chandler had significantly lower stem water potential (more stressed) than did Paradox rooted trees at both sampling dates (Table 6). From July leaf samples, all nutrients analyzed were in the adequate or normal range for all treatments.

San Joaquin County - The trunk circumference of own-rooted Chandler trees was not significantly different compared to Paradox rooted trees (Table 7). Paradox rooted trees had significantly more yield than did the own-rooted trees in 2005 and 2006 (Table 8). Four of the Paradox rooted trees died the first year and one in 2005 but all the own-rooted trees have survived.

As in 2005 and 2006, leaf marginal burn symptomatic of salt toxicity was noted by late summer, with minor symptoms on Paradox rooted trees and severe symptoms on own-rooted trees. July 6, 2007 leaf analyses showed average leaf sodium concentrations similar and below toxic levels in leaves from the two rootstocks (Paradox = 72 ppm, own-rooted = 70 ppm). Leaf chloride concentrations were higher in own-rooted (1.8%) than Paradox trees (1.0%) (ANOVA P=0.001).

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Table 1. Trunk circumference of own-rooted (OR) Chandler and Vina compared to Paradox rooted (PDX) Chandler and Vina in Sutter County

Rootstock	Trunk circumference (cm) 14 inches above ground						% change 06-07	% change from planting
	12/4/02	12/3/03	12/2/04	11/21/05	11/17/06	11/30/07		
Chandler/PDX	9.9 b	19.7 b	32.4 b	42.7 b	48.1 b	53.8 b	11.9	1117
Chandler/OR	8.9 c	17.9 c	32.1 b	43.4 b	48.6 b	53.9 b	10.9	1296
Vina/PDX	11.7 a	21.8 a	35.1 a	46.7 a	53.3 a	59.5 a	11.6	821
Vina/OR	9.3 c	18.9 bc	32.9 ab	44.7 ab	48.9 b	54.3 b	11.0	1083

Means followed by the same letter in a column are not significantly different (based on 95% confidence intervals).

Table 2. 2005-07 yield of own-rooted (OR) Chandler and Vina compared to Paradox rooted (PDX) Chandler and Vina in Sutter County Trial

Rootstock	2005 (dry ton/acre)	2006 (dry ton/acre)	2007 (dry ton/acre)
Chandler/PDX	0.29 a	1.18 a	1.27 a
Chandler/OR	0.11 c	0.47 c	0.91 b
Vina/PDX	0.22 b	1.21 a	1.04 ab
Vina/OR	0.08 c	0.75 b	0.59 c

Means followed by the same letter in a column are not significantly different (based on 95% confidence intervals).

Table 3. 2007 yield efficiency (YE) expressed as pounds per cm of trunk circumference (not tcsa).

Rootstock	YE
Chandler/PDX	0.68 a
Chandler/OR	0.50 b
Vina/PDX	0.49 b
Vina/OR	0.31 c

Table 4. 2007 walnut quality of own-rooted (OR) Chandler and Vina compared to Paradox rooted (PDX) Chandler and Vina in Sutter County Trial

Rootstock	% Large Sound	% Edible Yield	% Extra Light	% Light	% Total Light
Chandler/PDX	87.9 a	53.5 b	47.1 a	42.3 a	89.5 a
Chandler/OR	68.3 b	57.7 a	40.6 a	45.0 a	85.6 a
Vina/PDX	89.2 a	50.8 c	10.0 b	53.9 a	63.9 b
Vina/OR	84.2 a	49.9 c	1.9 b	51.1 a	53.0 b

Table 5. 2007 phenology observations of own-rooted (OR) Chandler and Vina compared to Paradox rooted (PDX) Chandler and Vina in Sutter County Trial

Rootstock	Leaf Date	1 st Male	Peak Male	Last Male	1 st Female	Peak Female	Last Female	Catkin Abundance
Chandler/PDX	3/25	3/28	4/6	4/15	4/8	4/14	4/22	7
Chandler/OR	3/30	4/2	4/10	4/18	4/11	4/18	4/25	3
Vina/PDX	3/18	3/24	3/29	4/7	4/1	4/6	4/12	7
Vina/OR	3/22	3/28	4/2	4/10	4/4	4/10	4/16	4

Table 6. Stem water potential data on two dates in 2007

Rootstock	Midday stem water potential (bars)	
	6/13/2007	7/20/2007
Chandler/PDX	-7.80 a	-6.32 a
Chandler/OR	-10.92 b	-7.63 b
Vina/PDX	-7.36 a	-6.26 a
Vina/OR	-11.93 c	-8.11 b

Table 7. Trunk circumference of own-rooted Chandler compared to Paradox rooted Chandler in San Joaquin County. (Note: this table contains corrected 2006 data).

Rootstock	Trunk circumference (cm) 30 cm above ground							
	11/25/02	12/8/03	11/15/04	11/1/05	10/27/06	% change '05 to '06	10/31/07	% change '06 to '07
Paradox	9.6	18.5	26.3	33.7	39.1	15.9 %	42.8	9.6 %
Own-rooted	8.4	17.3	26.3	34.5	40.3	16.8 %	43.9	9.0 %

Significance¹ NS NS
0.001 (*0.06*) (*0.91*) NS (*0.29*) NS (*0.09*) NS (*0.70*) NS (*0.15*) NS (*0.26*)

¹Probability of a significant difference, 2-way ANOVA

²Change since prior year measurement

Table 8. 2005 and 2006 yield of own-rooted Chandler compared to Paradox rooted Chandler in San Joaquin County.

Rootstock	Number nuts/tree	lbs/tree
	10/7/05	10/27/06
Paradox	72.7	4.4
Own-rooted	12.0	1.2

Significance¹ *0.0002* *0.0002*

¹Probability of a significant difference, 2-way ANOVA

Figure 1. Block by block results for trunk circumference versus yield in Sutter County Trial.

