

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 in San Joaquin County is 100 percent; in Sutter County, a few own-rooted Vina trees were diagnosed with branch wilt disease in 2007 and one severely affected tree was removed in 2008. The Paradox rooted Vina trees in Sutter County have remained the largest trees since planting. In 2006, 2007, and 2008, the Paradox rooted Vina were significantly larger than the own-rooted Vina, own-rooted Chandler and Chandler on Paradox. In 2008, the Paradox rooted Vina trees had significantly higher yields than the Chandler on Paradox and the own-rooted trees for both varieties. The Paradox rooted Chandler and Vina trees had significantly more cumulative yield than the own-rooted trees. Paradox rooted Vina trees had significantly higher yield efficiency expressed as pounds per cm of trunk circumference compared to other treatments, whereas Paradox rooted Chandler had significantly higher yield efficiency in 2007. 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 in 2008 continued to leaf out and flower later although not quite as pronounced as in previous years and to produce far fewer catkins than Paradox rooted trees. Summer stem water potential samples showed own-rooted trees to be significantly more stressed than Paradox rooted trees as in 2007. The water stress and poorer performance of the own-rooted trees suggest that these English rooted trees are not well adapted to soils that are predominately sandy. In San Joaquin County there has been no significant size difference between Paradox rooted and own-rooted Chandler trees since planting although nut production has been much greater from Paradox rooted trees. Salt toxicity symptoms were observed by late summer as in previous years with severe defoliation in own-rooted trees by harvest. Own-rooted English walnut trees appear to be as sensitive to salinity as are English seedling rootstocks.

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 2008, pruning was mainly to remove branch wilt diseased and broken branches. In March and April, leafing and flowering phenology data was taken. Leaves were sampled on July 22, 2008 and analyzed for N, K, Ca, Zn, and Mn. Midday stem water potential was taken on July 29 after own-rooted trees were observed to be wilting on shoot tips. Trees were harvested on October 29, 2008 and nut samples were submitted for quality. Tree trunk circumference was measured on November 13, 2008 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. Observations for salt toxicity were taken in late summer. Tree trunk circumference was measured at 30 cm above the ground and yield data was taken in October, 2008.

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 2008. Own-rooted Chandler trees have had the greatest percent change in trunk circumference since planting.

Yield is shown in Table 2. In 2008, the Paradox rooted Vina trees had significantly higher yields than the Paradox rooted Chandler and the own-rooted trees for both varieties. Own-rooted Chandler had the lowest yield in 2008 whereas own-rooted Vina had the lowest yield in 2007. Paradox rooted Vina trees had significantly higher yield efficiency expressed as pounds per cm of trunk circumference; own-rooted Chandler had the lowest yield efficiency in 2008 (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. Both Chandler treatments had significantly higher percent edible yields. The own-rooted Vina had the lowest percent edible yield.

Several of the own-rooted Vina trees that had low vigor and branch wilt that was diagnosed in 2007, continued to decline in 2008. One of the Vina trees with branch wilt so severe that the main trunk was infected in 2007 was removed in 2008 and the roots were examined. No root rot was found. This was the first tree mortality. Several of the own-rooted Chandler had low vigor in 2008 which was reflected in the poorer yields than in the past.

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 later leafing and flowering was not as pronounced in 2008 as in previous years. 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 July as in the previous year. Midday stem water potential (SWP) was subsequently measured in July. Own-rooted Vina and Chandler had significantly lower stem water potential (more stressed) than did Paradox rooted trees (Table 6). The soil at this site is very sandy throughout the profile. The water stress and poorer performance of the own-rooted trees suggest that these English rooted trees are not well adapted to soils that are predominately sandy and not loamier. 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). Nut production was much greater from Paradox rooted trees in 2005, 2006, and 2008. Yields were not measured in 2007, but appeared visually to follow the same pattern as in previous years (Table 8).

As in previous years, 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. Own-rooted trees were almost completely defoliated by harvest, Paradox rooted trees around 10-30% defoliated.

There were 4/40 dead Paradox trees in 2002 and zero dead in 2003-2008; zero dead own-rooted trees any year.

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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 from planting |
|---------------------|---|---------|---------|----------|----------|----------|----------|------------------------|
| | 12/4/02 | 12/3/03 | 12/2/04 | 11/21/05 | 11/17/06 | 11/30/07 | 11/13/08 | |
| Chandler/PDX | 9.9 b | 19.7 b | 32.4 b | 42.7 b | 48.1 b | 53.8 b | 59.4 b | 1244 |
| Chandler/OR | 8.9 c | 17.9 c | 32.1 b | 43.4 b | 48.6 b | 53.9 b | 59.1 b | 1431 |
| Vina/PDX | 11.7 a | 21.8 a | 35.1 a | 46.7 a | 53.3 a | 59.5 a | 64.0 a | 891 |
| Vina/OR | 9.3 c | 18.9 bc | 32.9 ab | 44.7 ab | 48.9 b | 54.3 b | 58.8 b | 1181 |

Means followed by the same letter in a column are not significantly different ($P \leq 0.05$).

Table 2. 2005-08 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) | 2008 (dry ton/acre) | Cumulative yield (dry ton/acre) |
|---------------------|------------------------|------------------------|------------------------|------------------------|------------------------------------|
| Chandler/PDX | 0.29 a | 1.22 a | 1.27 a | 2.49 b | 5.26 a |
| Chandler/OR | 0.10 c | 0.47 c | 0.91 b | 1.24 d | 2.73 b |
| Vina/PDX | 0.21 b | 1.21 a | 1.04 ab | 3.36 a | 5.82 a |
| Vina/OR | 0.08 c | 0.79 b | 0.57 c | 1.90 c | 3.33 b |

Means followed by the same letter in a column are not significantly different ($P \leq 0.05$).

Table 3. 2007-08 yield efficiency (YE) expressed as pounds per cm of trunk circumference (not tcsa).

| Rootstock | 2007 YE | 2008 YE |
|---------------------|---------|---------|
| Chandler/PDX | 0.68 a | 1.20 b |
| Chandler/OR | 0.50 b | 0.60 d |
| Vina/PDX | 0.49 b | 1.51 a |
| Vina/OR | 0.31 c | 0.93 c |

Means followed by the same letter in a column are not significantly different ($P \leq 0.05$).

Table 4. 2008 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 | 96.8 a | 51.7 a | 81.1 a | 11.5 b | 92.5 a |
| Chandler/OR | 93.9 ab | 52.9 a | 78.7 a | 14.9 b | 93.6 a |
| Vina/PDX | 92.8 b | 48.8 b | 14.1 b | 48.1 a | 62.3 b |
| Vina/OR | 92.9 b | 46.7 c | 11.2 b | 52.7 a | 63.9 b |

Means followed by the same letter in a column are not significantly different ($P \leq 0.05$).

Table 5. 2008 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 | 3/31 | 3/29 | 4/8 | 4/13 | 4/12 | 4/17 | 4/25 | 7 |
| Chandler/OR | 4/5 | 4/3 | 4/12 | 4/16 | 4/14 | 4/20 | 4/26 | 3 |
| Vina/PDX | 3/22 | 3/24 | 4/1 | 4/12 | 3/31 | 4/10 | 4/17 | 7 |
| Vina/OR | 3/23 | 3/24 | 4/2 | 4/14 | 4/1 | 4/12 | 4/15 | 4 |

Table 6. Stem water potential data on two dates in 2007 and one date in 2008.

| Rootstock | Midday stem water potential (bars) | | |
|--------------|------------------------------------|-----------|-----------|
| | 6/13/2007 | 7/20/2007 | 7/29/2008 |
| Chandler/PDX | -7.80 a | -6.32 a | -5.68 a |
| Chandler/OR | -10.92 b | -7.63 b | -8.08 c. |
| Vina/PDX | -7.36 a | -6.26 a | -7.02 b |
| Vina/OR | -11.93 c | -8.11 b | -10.5 d |

Means followed by the same letter in a column are not significantly different ($P \leq 0.05$).

Table 7. Trunk circumference of own-rooted Chandler compared to Paradox rooted Chandler in San Joaquin County.

| Rootstock | Trunk circumference (cm) 30 cm above ground | | | | | | | |
|---------------------------|---|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 3/18/02 | 11/25/02 | 12/8/03 | 11/15/04 | 11/1/05 | 10/27/06 | 10/31/07 | 10/31/08 |
| Paradox | 4.9 | 9.6 | 18.5 | 26.3 | 33.7 | 39.1 | 42.8 | 45.4 |
| Self-rooted | 3.9 | 8.4 | 17.3 | 26.3 | 34.5 | 40.3 | 43.9 | 44.2 |
| Significance ¹ | 0.006 | 0.001 | NS (0.06) | NS (0.91) | NS (0.29) | NS (0.09) | NS (0.15) | NS (0.55) |

¹ Probability of a significant difference, 2-way ANOVA

Table 8. 2005, 2006, and 2008 yield of own-rooted Chandler compared to Paradox rooted Chandler in San Joaquin County.

| Rootstock | Number nuts/tree | lbs/tree | lbs/tree |
|------------|------------------|----------|----------|
| | 10/7/05 | 10/27/06 | 10/24/08 |
| Paradox | 72.7 | 4.4 | 14.6 |
| Own-rooted | 12.0 | 1.2 | 4.8 |

Significance¹ *0.0002* *0.0002* *0.003*

¹Probability of a significant difference, 2-way ANOVA

Figure 1. 2008 trunk circumference versus yield by block for Sutter County Trial.

