

EVALUATION OF ‘CHANDLER’ WALNUT ON ITS OWN ROOTS AND GRAFTED TO VARIOUS ROOTSTOCKS – 2007

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ABSTRACT

Reports that “own rooted” ‘Chandler’ walnuts out performed grafted trees stimulated the creation of this replicated trial. The performance of own rooted ‘Chandler’ trees, ‘Chandler’ grafted to own rooted ‘Chandler’, and ‘Chandler’ grafted to three paradox selections and to a vigorous English selection is investigated in this trial. Rootstock trees were planted in March 1999 at the California State University Farm in Chico. Scions were grafted using wood collected from mature ‘Chandler’ trees in the spring of 2000. Initial survival, yield and trunk cross sectional area (TCSA) data collection began in 2001. Catkin abundance, tree yield, nut quality, trunk circumference, and crown gall severity data was collected in 2007 and is reported here.

OBJECTIVES

The objectives of this trial are to investigate the following questions:

- a) Does a graft union have a limiting effect on tree growth and productivity?
- b) Is ‘Chandler’ a superior English rootstock?
- c) Do trees on clonal paradox show less variation than those on paradox seedling rootstocks?
- d) Are own rooted ‘Chandler’ trees superior to ‘Chandler’ on paradox?

PROCEDURES

The following six treatments are being evaluated:

1. ‘Chandler’ own rooted via tissue culture (not grafted).
2. ‘Chandler’ grafted on own rooted ‘Chandler’ rootstock.
3. ‘Chandler’ grafted on English ‘Waterloo’ rootstock.
4. ‘Chandler’ grafted on common paradox rootstock.
5. ‘Chandler’ grafted on ‘Trinta’ paradox rootstock.
6. ‘Chandler’ grafted on ‘Px1’ paradox rootstock tissue cultured from the “Rawlins” tree.

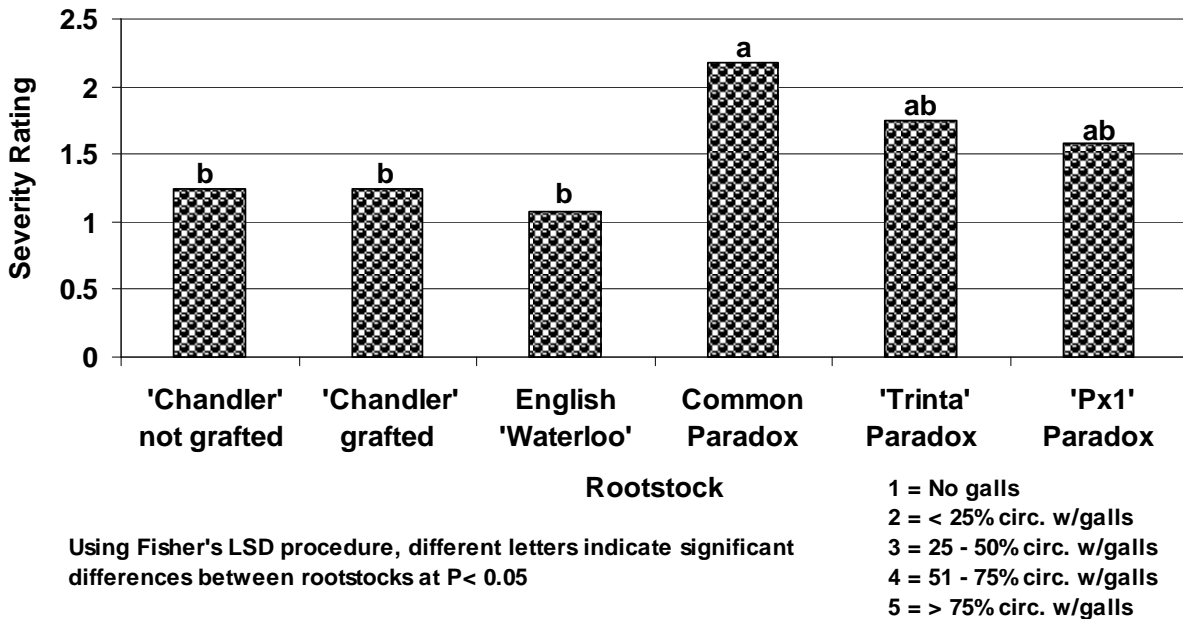
Small (3/8” diameter) rootstocks for these six treatments were planted on March 19, 1999 in a randomized block design with six replicates made up of two trees per replicate. Top working (grafting) took place in the spring of 2000 with wood collected from mature ‘Chandler’ trees. Initial tree survival has been reported previously. In 2007, observations on catkin abundance, severity of crown gall, measurements of tree growth expressed as trunk cross sectional area (TCSA), and yield and quality data was collected. Yield efficiency was calculated and is also presented.

RESULTS

Presence of crown gall:

In 2006, Janine Hasey surveyed this trial for crown gall as part of her sabbatical leave project but those data are not reported here. In November 2007 we did an additional survey and rated the trial for crown gall severity using a scale of: 1=no crown gall visible; 2=crown gall affecting <25% of the circumference; 3=crown gall affecting 25 to 50% of the circumference; 4=crown gall affecting 51 to 75% of the circumference; and 5= >75% of the circumference affected. Ratings in the trial ranged from 1 to 5 with treatment means and significance presented in figure 1. Rootstock contributes to the degree of crown gall but tree source is almost certainly a factor as well.

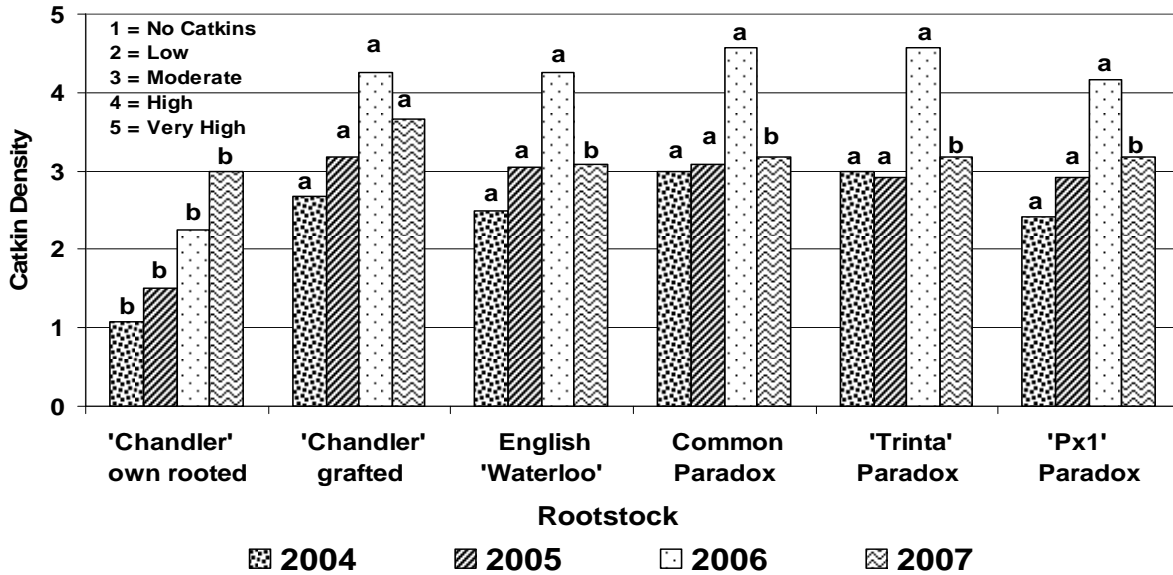
Figure 1. Severity of crown gall by rootstock, Nov. 2007



Catkin abundance:

Our subjective rating system is: 1 = no catkins; 2 = low number of catkins; 3 = moderate number of catkins; 4 = high catkin abundance; and 5 = very high catkin abundance. In observations from 2003 through 2006 own rooted 'Chandler' trees were consistent in having significantly fewer catkins than all other grafted treatments. In 2007 this changed in that own rooted 'Chandler' had the same catkin abundance as most treatments with the exception that 'Chandler' grafted on 'Chandler' had significantly more catkins than the other treatments (Figure 2).

Figure 2. Catkin Abundance



Using Fisher's LSD procedure, different letters indicate significant differences by year between rootstocks at $P < 0.05$

Tree growth - trunk cross sectional area (TCSA):

Trunk circumference measurements are made on all trees approximately 36 inches above the ground. Prior to 2006, own rooted 'Chandler' not grafted had a significantly larger TCSA than all other treatments. This year 'Px1' and common paradox gained on the own rooted 'Chandler' and the trees on these stocks were not significantly smaller than own rooted 'Chandler'. Trees on 'Trinta' paradox rootstock are numerically smaller than all other treatments (Table 1) but they have not been significantly smaller than trees on 'Waterloo' or the grafted 'Chandler' for the past three years.

Table 1. Mean trunk cross-sectional area (cm²)

<u>Treatment</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>
'Chandler' own rooted	150.7 a	253.1 a	348.4 a	421.5 a	528.7 a	583.7 a
'Chandler' grafted	82.8 b	163.7 bc	252.7 b	316.7 bc	402.9 bc	449.6 bcd
English 'Waterloo'	76.8 b	148.4 cd	225.6 bc	299.2 bc	388.5 bc	439.5 cd
Common Paradox	89.4 b	177.5 bc	263.9 b	337.7 b	445.1 b	495.5 abc
'Trinta' Paradox	47.4 c	111.8 d	187.2 c	259.3 c	337.6 c	390.0 d
'Px1' Paradox	93.4 b	197.6 b	257.7 b	354.4 b	460.3 ab	531.7 ab

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at $P < 0.05$

Harvest timing:

Husk split ratings for comparative maturity were not made this season. Rain occurred in September and October this year and the actual harvest date was October 18, 2007.

Yield:

The 2007 season was the eighth growing season for scions in this trial. Although TCSA is still significantly different between treatments there was only a significant difference in yield in 2004 with the smaller ‘Trinta’ paradox trees having a significantly lower yield than all other treatments that year. In all other years the differences seen between treatments are not significant at the 5% level (Table 2).

Table 2. Mean yield per tree (pounds inshell), 3rd through 8th scion growing season.

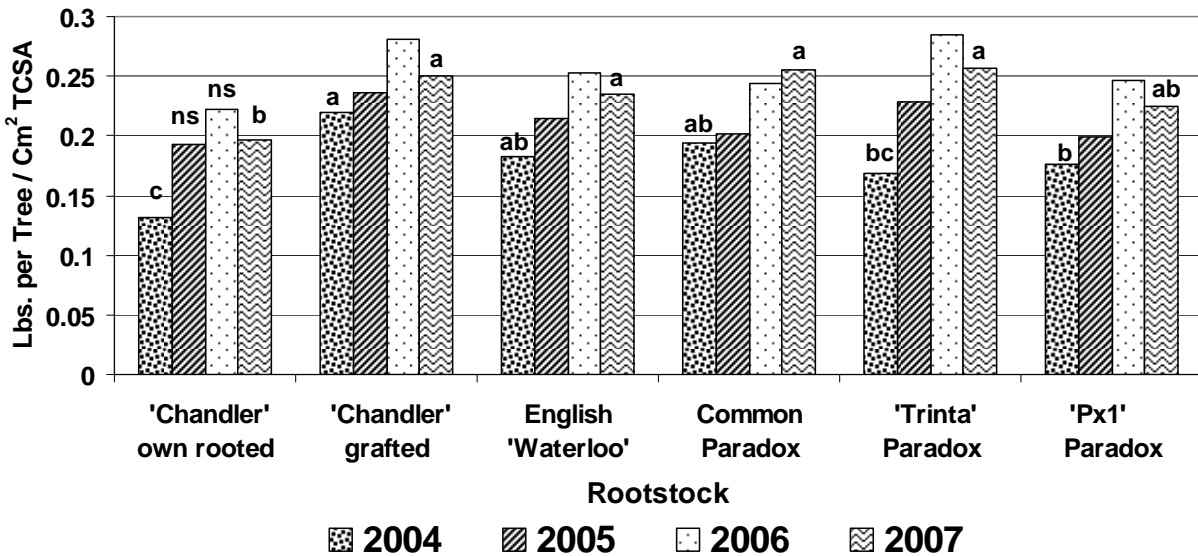
<u>Treatment</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>	<u>Cumulative Yield</u>
'Chandler' own rooted	3.34 ns	16.74 ns	46.05 a	82.02 ns	117.54 ns	115.31 ns	381.00
'Chandler' grafted	2.77	14.93	52.12 a	72.32	112.55	112.16	366.85
English 'Waterloo'	3.23	12.64	41.77 a	62.06	98.23	102.38	320.30
Common Paradox	3.51	13.75	52.02 a	70.43	107.55	124.82	372.07
'Trinta' Paradox	2.70	14.24	29.77 b	58.61	96.53	100.18	302.03
'Px1' Paradox	2.42	13.75	45.73 a	70.21	113.55	118.60	364.26

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at P < 0.05

Yield efficiency:

Yield efficiency is tree yield divided by TCSA. Despite significant differences each year in TCSA, there were no significant differences in yield efficiencies in 2005 and 2006. Where significant differences did occur, yield efficiency was often lowest on treatments with the largest trees (Figure 3 & Table 1).

Figure 3. Mean Yield Efficiency



Using Fisher's LSD procedure, different letters indicate significant differences by year between rootstocks at P < 0.05

Nut quality -- % edible kernel, % large, % extra light, and relative value

Edible kernel:

The percentage of edible kernel has shown no significant differences between rootstocks in two out of the past three years. In 2006 differences were significant between rootstocks with the not grafted 'Chandler' treatment having the highest percentage of edible kernel and the 'Trinta' paradox the lowest percentage edible (Table 3).

Table 3. Walnut quality -- percentage of edible kernel by rootstock

Treatment	2004 % Edible Kernels	2006 % Edible Kernels	2007 % Edible Kernels
1) 'Chandler' not grafted	50.7 NS	46.6 a	49.0 NS
2) 'Chandler' grafted	50.6	45.9 ab	49.1
3) English 'Waterloo'	51.6	44.9 bc	48.7
4) Common Paradox	49.6	44.2 cd	48.6
5) 'Trinta' Paradox	49.6	43.6 d	47.9
6) 'Px1' Paradox	50.3	45.7 ab	48.5

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at P < 0.05

Nut size:

Nut size does not appear to be affected consistently by rootstock treatment. Although there have been statistically significant results in individual years the significance seems to be contradictory when comparing treatments across years. Rootstock has shown no consistent effects on the percentage of large and jumbo nuts (Table 4).

Table 4. Walnut quality -- percentage of large and jumbo nuts by rootstock.

Treatment	2004 % Large Nuts	2006 % Large Nuts	2007 % Large Nuts
1) 'Chandler' not grafted	99.8 a	91.4 NS	88.2 b
2) 'Chandler' grafted	98.2 bc	92.6	93.4 a
3) English 'Waterloo'	98.0 c	93.5	93.9 a
4) Common Paradox	98.8 abc	97.0	94.6 a
5) 'Trinta' Paradox	100.0 a	93.4	91.4 ab
6) 'Px1' Paradox	99.7 ab	95.6	94.2 a

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at P < 0.05

Kernel color:

Rootstock has had a significant effect on kernel color in two of the past three years. All three paradox rootstock treatments have tend to have a lower percentage of extra light colored kernels while the three treatments on English roots have a higher percentage of light colored kernels. There were no significant kernel color differences between treatments in 2007 (Table 5).

Table 5. Walnut quality -- percentage of extra light kernels by rootstock.

<u>Treatment</u>	2004 % Extra <u>Light</u>	2006 % Extra <u>Light</u>	2007 % Extra <u>Light</u>
1) 'Chandler' not grafted	23.7 a	10.91 a	50.8 NS
2) 'Chandler' grafted	22.3 a	6.41 ab	43.0
3) English 'Waterloo'	24.3 a	6.97 ab	55.5
4) Common Paradox	14.2 b	0 b	44.6
5) 'Trinta' Paradox	14 b	0 b	43.1
6) 'Px1' Paradox	17.3 ab	0 b	41.2

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at P< 0.05

Relative value:

The relative nut value tends to be greater in treatments on English roots than in treatments on paradox roots. Differences between treatments in relative value have been statistically significant in each of the past three years (Table 6).

Table 6. Walnut quality -- relative value by rootstock.

<u>Treatment</u>	2004 Relative <u>Value</u>	2006 Relative <u>Value</u>	2007 Relative <u>Value</u>
1) 'Chandler' not grafted	0.970 ab	0.939 a	0.987 a
2) 'Chandler' grafted	0.965 ab	0.923 ab	0.979 ab
3) English 'Waterloo'	0.996 a	0.904 bc	0.979 ab
4) Common Paradox	0.931 b	0.882 cd	0.957 bc
5) 'Trinta' Paradox	0.922 b	0.855 d	0.945 c
6) 'Px1' Paradox	0.934 b	0.899 bc	0.958 bc

Using Fisher's LSD procedure, different letters indicate significant differences between rootstocks at P< 0.05

DISCUSSION

The tissue cultured own rooted 'Chandler' not grafted trees are now nine years old and for the first time the catkin abundance in these trees was similar to most other treatments. These trees tend to be larger and their yield efficiency tends to be lower. Nut quality and value from trees in this treatment has been good. Differences between treatments have been diminishing most recently and in all but one year there have been no significant yield differences between treatments.

In all parameters measured there is no evidence that the English 'Chandler' rootstock is superior to the English 'Waterloo' rootstock used in this trial. 'Px1' paradox appears to be similar to the common paradox rootstock in nearly all respects. Common and 'Trinta' paradox rootstocks had greater initial mortality compared to the 'Px1' paradox. Both common and 'Px1' paradox rootstocks produced larger tree size (TCSA) than the 'Trinta' paradox rootstock.

There has been no tree mortality in 'Chandler' on its own roots either in grafted or not grafted trees or in trees on 'Px1' paradox rootstock. In a 2007 evaluation, rootstock contributed to the severity of crown gall but tree source is almost certainly a factor as well.

Fewer catkins and larger trees at a young age is a possible advantage for own rooted 'Chandler' trees. Since an over abundance of pollen contributes to pistillate flower abscission (PFA), cultivars having significant PFA such as 'Serr' might benefit from being own rooted although this benefit disappeared by the ninth growing season. Another advantage might be usefulness in areas with a high incidence of blackline virus. Without a graft union, English walnut would tolerate the disease.