WALNUT HEDGEROW PRUNING AND TRAINING TRIAL

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ABSTRACT

Hedgerow walnut orchards have been studied since the 1970s as a high density system to reduce pruning costs and to benefit early production. At present, the common pruning methods are similar to the methods used to establish conventionally spaced orchards with some differences in height of the first scaffold and the amount of wood removed in the early years. This trial will look at ways to improve on this pruning method to gain a better structured tree for the life of the orchard, improve the amount of fruit wood, decrease wind damage and potentially reduce the need for early hedging of the orchard.

OBJECTIVES

The objective of this trial is to consider different training styles in the early years for hedgerow planted Chandler walnuts. This trial will also evaluate two new varieties, Gillet and Forde, and compare them to the older variety of Tulare for their ability to be trained in a hedgerow planting and note any differences in tree structure or growth habit. A secondary aspect of this experiment is to see if reducing vigor with deficit irrigation in the 3-6th year would postpone the need for early hedging and help maintain a smaller sized tree without negative impacts on yield.

PROCEDURES

The trial is located within the Nickels Soil Lab hedgerow planting of Chandler that also contains three rows of other varieties; one row each of Tulare, Forde and Gillet. The trees were planted in March 2008 on a one foot berm, at a spacing of 15 ft. x 22 ft. (132 trees per acre). The trees were nursery budded on Paradox rootstock. The orchard is irrigated with double line drip with inline emitters spaced 22 inches apart.

Training systems for this trial began at the end of the first growing season (figure 1 and 2). Four training systems were applied in a randomized block experimental design containing 6 replicated plots of each treatment. Each plot is three rows across with 5 trees in each row. Data was collected from the three interior trees. The training systems include:

1. **Traditional hedgerow** training (T1). Heading the one year old trees at a height of 6 feet. Second year, select and head a central leader and scaffolds. Leave smaller fruiting wood for early cropping. Third year, head all main scaffolds and leader. Fourth year, minimal pruning, head leader and main scaffolds if needed. Third and fourth year, thin out scaffolds that are too low, crossing each other, or growing into the drive row.
2. **Traditional hedgerow/ low vigor** training (T2). Follow traditional training hedgerow (T 1) with restricted irrigation from year 3 on to create lower vigor.
3. **Minimal hedgerow** training (T3). Following much of the traditional style but with no heading cuts after the first year. First year, head main scaffold at 6 feet. Second

year select scaffolds and main leader. No heading. Third and fourth year, thin out scaffolds that are too low, crossing each other, or growing into row.

4. **No heading hedgerow** training (T4). First year, remove lower branches and select one main trunk. No heading. Second year select scaffolds and main leader. No heading. Third and fourth year, thin out scaffolds that are too low, crossing each other, or growing into row.

The variety training trial was restricted due to the fact that only one row of trees were planted of Tulare, Forde and Gillet. Within each variety, 7 plots of 5 trees were randomly chosen for one of three training treatments: 2 plots of traditional (T1), 2 plots minimal (T3) and 3 plots no heading (T4). Traditional/low vigor training (T2) was not included in the variety trial
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Data collected in the growing season of 2009 for all varieties included, diameter (mm) at 2 and 6 feet of height in March and again at 2 feet at the end of the season in December, height of main trunk after pruning in March and in December, total number of emerging shoots in May, and number of emerging shoots above 3 feet from the ground in May. Midday stem water potential was measured in June, July, and September on the Chandler variety. Number of shoots per 10 centimeters of main trunk was calculated. Analysis using ANOVA and Duncan's multiple range test was performed using SAS (GLM procedure).

During the first year, limbs below three feet were removed (July 21) from all treatments. Limbs that had grown in a problematic position (in tractor row or bent down) were also removed at the same time.

RESULTS AND DISCUSSION

The results of the diameter measurements at 2 and 6 feet show no significant difference between treatments at the beginning of the trial for any variety (Table 1). Differences found in the future may be attributed to the differences caused by treatments.

Treatments 1, 2, and 3 had no differences in training/pruning treatment in 2009. All the trees had the lower suckers removed, a single main trunk selected, and then were headed at 6 feet. (Note: The heading cut was made one foot higher than the traditional training style which states heading of the main trunk should be between 4-5 feet. The authors believe this higher cut will create better scaffold placement and reduce lower limb breakage in the first few years of harvest.) There were no significant differences between these treatments for height of main trunk after pruning, total number of emerging shoots, number of emerging shoots above 3 feet from the ground, and number of shoots per 10 centimeters of main trunk (Table 2). This result is the same for all varieties.

The diameter of the main trunk 2 feet from the ground in December 2009 showed no differences between treatments within each variety except for Gillet. Gillet had a significantly smaller diameter at the end of the season in the unheaded treatment (T4) compared to the other two treatments (Table 1).

There was a significant difference between these three treatments and Treatment 4 (no heading of selected main trunk) in all the varieties for height of main trunk in March, total number of emerging shoots, and number of emerging shoots above 3 feet. Treatment 4 was significantly

taller in March and grew more shoots for all varieties (Table 2). In the Chandler variety, the calculated number of shoots per 10 cm. of main trunk was significantly different from the minimal pruning (T4) but not significantly different from Treatment 1 and 2. In the other varieties, Treatment 4 showed a significantly higher number of shoots per 10 cm. of main trunk than treatment 1 and 3.

The height of the trees in December showed significantly taller trees in the unheaded treatment (T4) in Chandler and Forde. In Chandler, the headed trees were only 80% of the height of the unheaded trees (Table 2; Figure 3). Tulare showed no difference in height between headed and unheaded. While Gillet showed a significant reduction of height in the unheaded treatment compared to the headed treatment. However, this was likely due to a large amount of broken shoots due to wind damage in the Gillet.

An unexpected result was the amount of bud break from the side buds along the main trunk in the unheaded trees. It has been understood that the apical dominance of the growing tip would diminish the ability of the side buds to break and it was hypothesized that a tall but poorly branched tree would result. This trial shows that this is not always the case and that more buds can break along the trunk if left unheaded compared to a tree that was headed. Figure 3 shows a typical unheaded Chandler tree next to a headed tree in September. The fact that the unheaded tree filled out equal to the headed comparison trees may lead to a larger canopy size earlier in the life of the orchard. The opposite effect seems to have happened in Gillet where the unheaded trees are shorter and also smaller in diameter in December. Though there are a lower number of trees and replicated plots in the variety test, the different growing pattern of Gillet may indicate that the effects of unheaded versus headed pruning may be different between varieties.

The midday stem water potential of the Chandlers showed no significant differences between treatments but did show a trend through the first half of the season for the unpruned trees to be less stressed (Figure 4). This has been observed in other pruning trials (Lampinen, unpublished). In September, all treatments show moderate levels of stress.

Figure 1. Example of tree before training, March 2009.

Figure 2. Example of first year training of treatment 4: no heading, March 2009.

Figure 3. Example of unheaded Chandler tree (on the left) and headed Chandler tree on the right, (photo on Sept. 19, 2009). Headed Chandlers averaged 80% of height of unheaded trees on Sept. 19, 2009.

Table 1. Average diameter of the tree in each treatment in March and December 2009. No significant differences between the treatments.

Variety	Treatment	Average Diameter at 2 feet above ground March 2009 (mm)	Average Diameter at 6 feet above ground March 2009 (mm)	Average Diameter at 2 feet above ground Dec. 2009 (mm)
Chandler	Traditional (1)	26.26 a	17.67 a	65.1 a
	Traditional/low vigor (2)	26.25 a	17.42 a	69.1 a
	Minimal (3)	25.12 a	16.88 a	64.7 a
	No heading/pruning (4)	26.00 a	17.42 a	66.6 a
Tulare	Traditional (1)	27.23 a	18.20 a	71.0 a
	Minimal (3)	29.35 a	21.03 a	69.3 a
	No heading/pruning (4)	27.99 a	19.54 a	61.4 a
Forde	Traditional (1)	29.55 a	19.83 a	75.6 a
	Minimal (3)	28.53 a	18.75 a	75.4 a
	No heading/pruning (4)	30.03 a	18.66 a	74.2 a
Gillet	Traditional (1)	29.28 a	20.72 a	74.3 a
	Minimal (3)	28.73 a	21.53 a	75.6 a
	No heading/ pruning (4)	26.76 a	18.14 a	63.0 b

Table 2. The average height of the main trunk after the heading cut was made in March and December 2009. In May, measurements were made of the average number of shoots that broke from the main trunk, and the average number shoots that broke above 3 feet. The average number of shoots per 10 cm of main trunk was calculated from the measurements.

Variety	Treatment	3/23/2009 Average Height (cm)	12/4/2009 Average Height (cm)	Average Number of Total Shoots	Shoots above 3 ft.	Shoots per 10 cm of main trunk
Chandler	Traditional (1)	192.2 b	389.4 c	19.13 b	15.13 b	0.99 ab
	Traditional/low vigor (2)	197.2 b	421.1 b	20.50 b	16.00 b	1.04 ab
	Minimal (3)	190.6 b	389.6 c	18.17 b	15.00 b	0.95 b
	No heading/pruning (4)	280.4 a	481.6 a	30.17 a	26.22 a	1.08 a
Tulare	Traditional (1)	204.8 b	460.8 a	16.17 b	15.50 b	0.79 b
	Minimal (3)	205.7 b	489.2 a	15.00 b	13.83 b	0.73 b
	No heading/pruning (4)	326.3 a	513.9 a	29.11 a	28.67 a	0.90 a
Forde	Traditional (1)	191.0 b	466.3 b	21.17 b	17.83 b	1.12 b
	Minimal (3)	192.5 b	452.3 b	19.83 b	16.83 b	1.03 b
	No heading/pruning (4)	288.7 a	529.3 a	38.44 a	36.33 a	1.32 a
Gillet	Traditional (1)	191.3 b	490.3 a	16.17 b	14.00 b	0.85 b
	Minimal (3)	204.7 b	492.8 a	16.00 b	14.83 b	0.78 b
	No heading/pruning (4)	294.1 a	425.2 b*	35.00 a	32.00 a	1.22 a

*Shorter height in Gillet likely due to extensive breakage early in season.

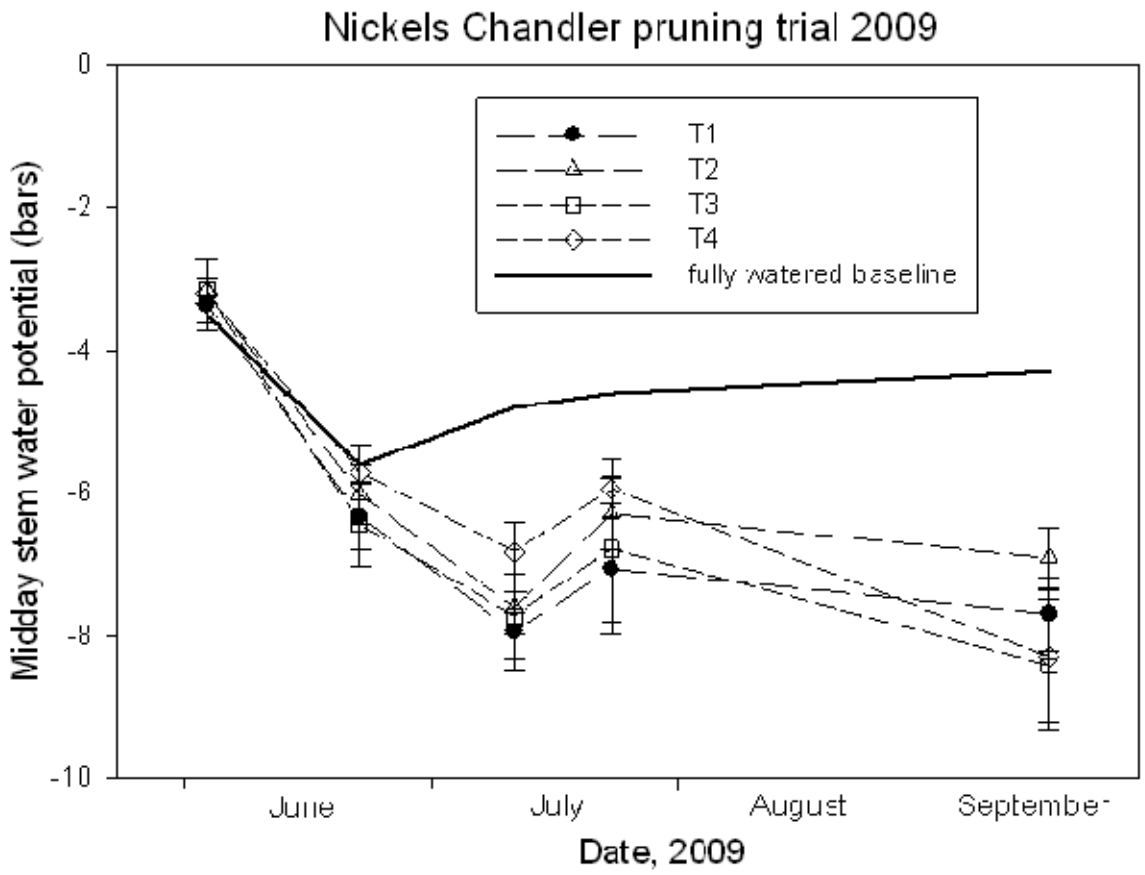

Figure 4. Midday stem water potential (bars) for the four pruning treatments throughout the 2009 season.