

COMPARISON OF GROWTH AND PRODUCTIVITY OF PRUNED AND UNPRUNED YOUNG ‘HOWARD’ WALNUT TREES AS IMPACTED BY CROP LOAD

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ABSTRACT

In 2004, terminal shoot growth in ‘Howard’ walnut trees was significantly greater in pruned than in unpruned trees. However, because the pruned trees need to regrow the amount of shoot that was pruned off during the dormant season, overall tree height was not significantly different in the pruned versus unpruned trees. Unpruned trees had significantly more shoots that broke below the terminal than pruned trees. Fruit load was significantly higher on unpruned trees.

In 2005 and in 2006, there were significantly more shoots growing in the pruned treatment trees compared to the unpruned. Unpruned trees tended to be shorter at the end of the growing season, except for the unpruned with fruit removal treatment. However, this relationship changes after pruned treatment trees are pruned during the winter. In 2005, the greatest numbers of nuts were on the treatment that was pruned in 2004 but not pruned in 2005, but in 2006, there were no significant differences in the numbers of nuts on pruned versus unpruned trees.

Trees formed by pruning have a different structure than unpruned trees. In pruned trees, less shoots break below the terminal but those that do grow more aggressively than the shoots that break below the terminal in unpruned trees. This tends to give a more dense canopy with more branches crossing over and intertwining than in the pruned trees.

Midday stem water potential was similar in all treatments early and late in season when trees were fully watered. However, during midseason when all treatments became somewhat stressed, the level of stress tended to be greater in pruned trees compared to unpruned trees in 2005. In 2006, late in the season, trees with fruit removed tended to be more stressed than those with fruit left on the tree.

INTRODUCTION

A study was set up on two year old Howard walnut trees at the Nickels Soil Lab in Colusa County to look at the impact of the following pruning and fruit removal treatments

Treatment 1- unpruned, no fruit removal

Treatment 2- unpruned, with fruit removal

Treatment 3- pruned (1/3 of previous years growth removed each year until tree fills allotted space, no fruit removal)

Treatment 4- pruned as in treatment 3 with fruit removal.

Treatment 5- pruned as treatment 3 in winter 2003-4, otherwise, unpruned

PROCEDURES

In the spring of 2004, 2005 and 2006, all nuts were removed from Treatments 2 and 4 when they were approximately ¼” in diameter. Terminal shoot growth was measured approximately every 2-3 weeks during the growing season in 2004 and at the end of the growing season in 2005 and 2006 (not yet completed). The number (in 2004 and 2005) and timing (in 2004) of in-season branching points formed (syllaptic shoots) were assessed as well. The number and length of preformed and neoformed leaves were measured late in the season in all years. Preformed leaves are leaves that are formed in the bud during the previous summer. Neoformed leaves are formed during the current growing season. The number of shoots that broke below each terminal were counted late in the season in 2004 and 2005. The number and the percentage of minor and major sunburned nuts on each tree were counted in early September in 2004, 2005 and 2006. Midday stem water potential was measured approximately every other week on 10 trees per treatment. Leaves were bagged at least 15 minutes before measurements were taken with a plant pressure chamber. In 2004, nuts were counted on the tree. In 2005 and 2006, trees were harvested by hand shaking and all nuts were collected, counted and weighed. Sub-samples were taken for drying from each tree. Samples for leaf nitrogen analysis were collected in mid-July in 2005.

RESULTS AND DISCUSSION

Pruning resulted in significantly more actively growing shoots per tree in 2004 (data not shown) and in 2005 and 2006 (Fig. 1). In general, shoots on the pruned trees tended to stop growing earlier in the summer than did those on the unpruned trees (Fig. 1). Fruit removal led to lead more growing shoots and a tendency towards longer growth although the effect was not significant in 2006 (Fig. 1). After 3 years of treatment imposition, none of the treatments had a significant impact on trunk circumference, tree width or tree height (Fig.2). Similarly, midday canopy light interception was also not significantly impacted by midsummer of the second or third season of treatment imposition (Fig. 3).

Terminal shoots on unpruned trees had more preformed leaves (Fig. 7a) and the neoformed growth was longer (Fig. 7d) compared to pruned trees. However, unpruned trees had less neoformed leaves (Fig. 7b), shorter neoformed growth (7e) and less overall growth (Fig. 7f) compared to pruned trees. Fruit removal resulted in more preformed leaves in the unpruned trees (Fig. 7a). This was likely not because there were more preformed leaves in the bud but rather because more preformed leaves stayed on through the season. The preformed growth was also shorter on unpruned trees with fruit removed (Fig. 7d). For unpruned trees, fruit removal had a large effect on the number (7b) and length (7e) of neoformed leaves. For pruned trees, fruit removal did not have a significant impact on number (7b) or length (7e) of neoformed leaves. Overall number of leaves (7c) and length (7f) followed the same pattern as neoformed growth.

Pruning and fruit removal treatments had small impacts on midday stem water potential. In 2005, the pruned treatments tended to be slightly more water stressed in mid to late summer compared to the unpruned treatments (Fig. 4). In 2006, the treatments that had their fruit removed tended to be slightly more stressed than the unthinned treatments in mid to late summer (Fig. 4).

In 2004 and 2005, the unpruned treatment had significantly higher yields than the pruned treatment (Fig. 5). However, by 2006 these early differences no longer resulted in a significantly higher cumulative yield compared to the pruned treatment (Fig. 5). Trees with a lower midday stem water (more stressed) tended to have slightly higher yields and lighter colored nuts as measured by the reflected light index (RLI; Fig. 8).

Fruit removal tended to result in more shoot growth although the effect on overall tree height was not significant (Fig. 2). Fruit removal also tended to result in higher weight of pruning removed on both the March 2005 and March 2006 pruning dates but again, again the effect was not significant (Fig. 6).

PRELIMINARY CONCLUSIONS

Three years after initiating pruned and unpruned treatments, it appears that in terms of trunk circumference (Fig. 2), tree height (Fig. 2), tree width (Fig. 2), canopy volume (Fig. 2) and midday canopy light interception (Fig. 3), the unpruned trees are performing similarly to the pruned trees. Unpruned trees tended to have more fruit the first two years of the study but by the third year fruit load (Table 1) and cumulative yields were similar for all treatments with fruit left on tree (Fig. 5). Fruit removal had little effect on overall vegetative growth in the first and second year of the trial when numbers of fruit per tree were few, but by the third year, growth tended to be more extensive on trees with fruit removed, both in terms of number and length of shoots. Impacts of the pruning treatments on midday stem water potential deserve further investigation.

Pruned trees tended to have less neoformed leaves compared to unpruned trees (Fig. 7b). This is because the terminal bud, which tends to be larger and have 2-3 more preformed leaves than lateral buds, is removed with pruning. Pruning, resulted in more neoformed leaf growth and more overall shoot growth during the season. However, after pruning, shoot length and overall tree height (Fig. 2) tended to be comparable on unpruned and pruned trees. Fruit removal led to more neoformed leaves (Fig. 7b) and longer overall shoots (Fig. 7f) in unpruned but not in pruned trees. Tree structure for pruned versus unpruned trees is quite different with the unpruned trees tending to have a more open canopy structure while the pruned trees tend to be bushier. Fruit removal treatments exacerbated these differences.

Acknowledgements

Thanks to the Walnut Marketing Board, Nickels Soil Laboratory and Diamond Foods Incorporated for supporting this work.

Table 1. Effects of treatments on number of fruit per tree and sunburn in 2004 and 2005.

<i>Treatment</i>	<i>#nuts per tree</i>	<i>Percent minor sunburn</i>	<i>Percent major sunburn</i>
2004			
1 (unpruned)	78 a	4.6 a	2.1 a
2 (unpruned w/fruit removed)			
3 (pruned)	48 b	2.9 a	3.1 a
4 (pruned w/fruit removed)			
5 (pruned 2004, unpruned 2005)	44 b	1.0 a	0.1 a
2005			
1 (unpruned)	266 b	6.4 b	1.9 bc
2 (unpruned w/fruit removed)			
3 (pruned)	237 b	6.3 b	2.6 a
4 (pruned w/fruit removed)			
5 (pruned 2004, unpruned 2005)	350 a	15.7 a	4.7 a
2006			
1 (unpruned)	848 a	0.7 a	1.3 a
2 (unpruned w/fruit removed)			
3 (pruned)	879 a	0.6 a	0.8 a
4 (pruned w/fruit removed)			
5 (pruned 2004, unpruned 2005)	796 a	0.6 a	0.7 a

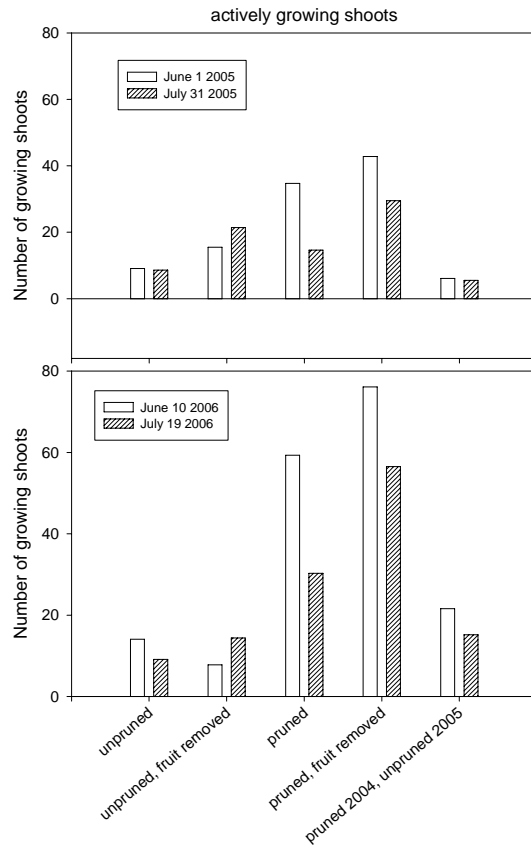


Fig. 1. Growing shoots per tree on June 1 & July 31, 2005 and June 10 & July 19, 2006 by treatment.

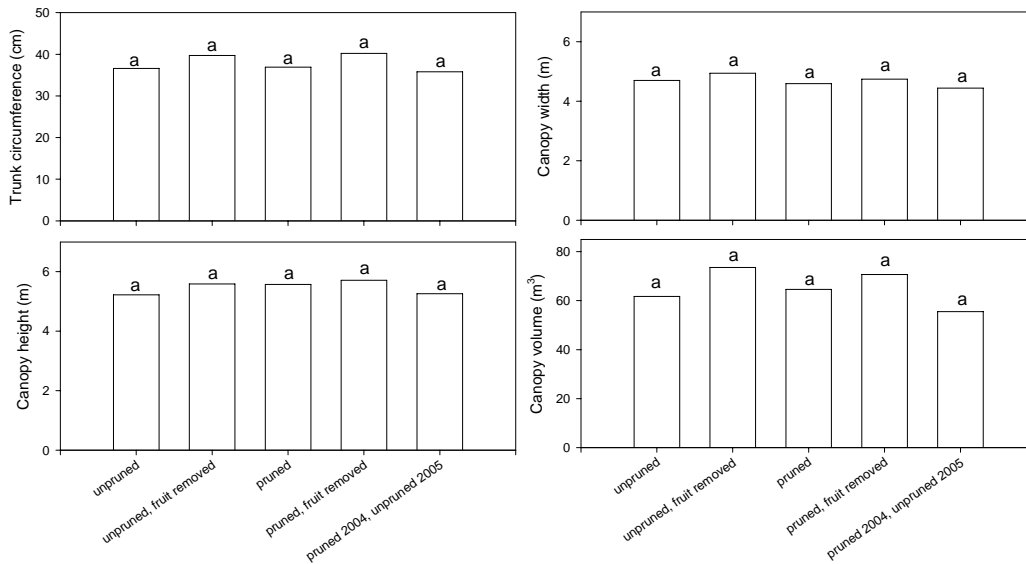


Fig. 2. Trunk circumference, canopy width, canopy height and canopy volume by treatment. Measurements were made after dormant season pruning was completed in March 2006.

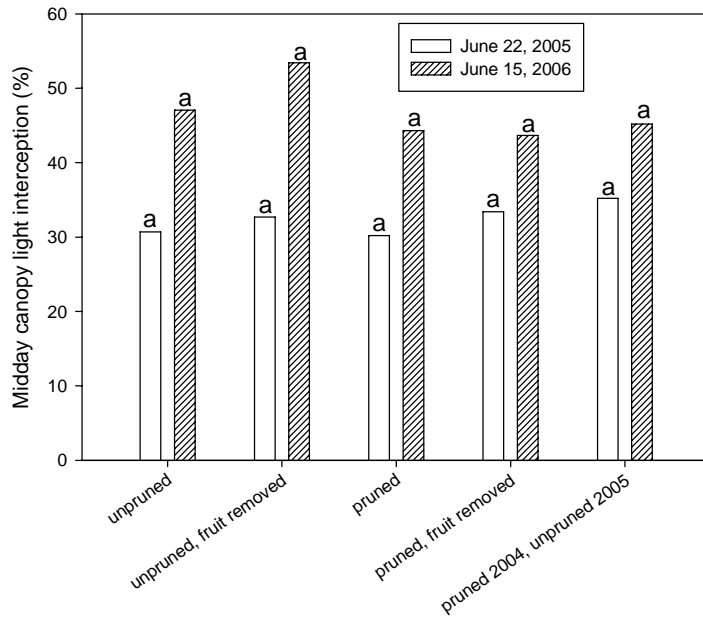


Fig. 3. Midday light interception measured on June 22, 2005 and June 15, 2006. Letters indicate significant difference among treatments within a given year..

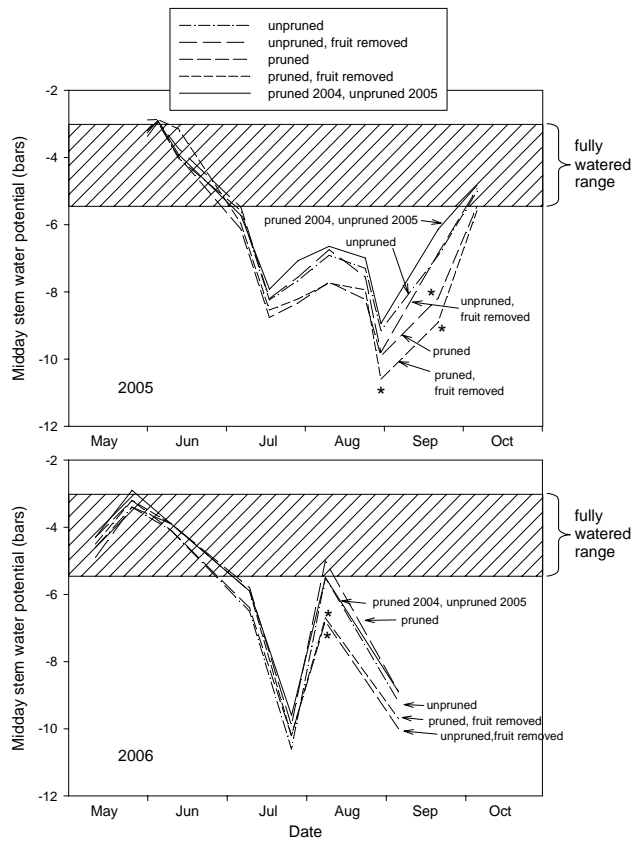


Fig. 4. Midday stem water potential by treatment for 2005 and 2006 seasons. Cross-hatched area marks range for fully watered tree.

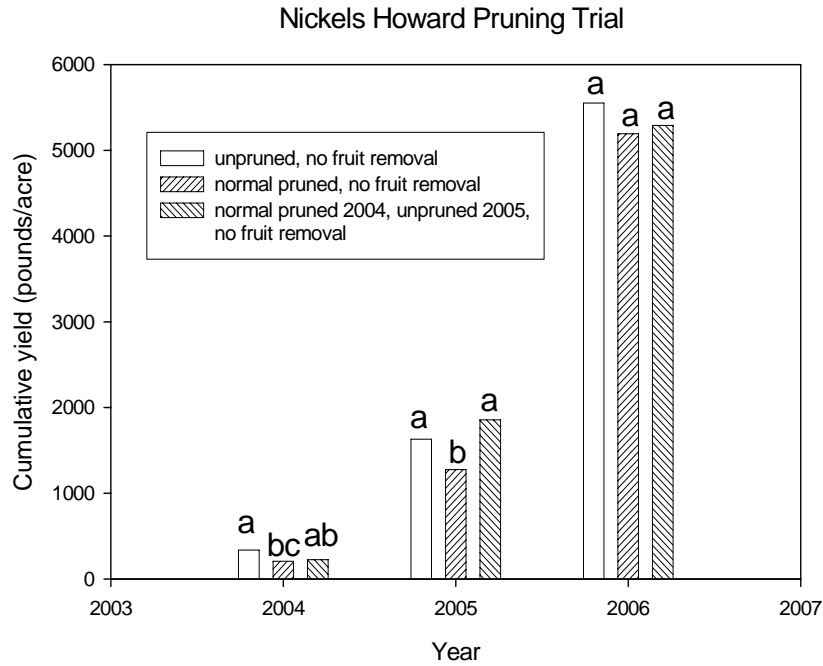


Fig. 5. Cumulative yield by year and treatment.

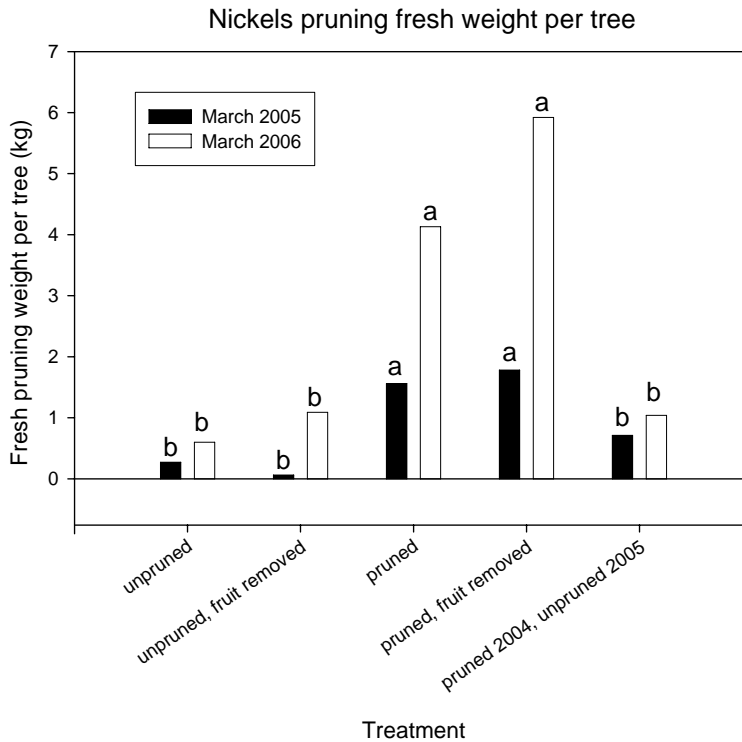


Fig. 6. Fresh pruning weight by treatment and year. Letters indicate significant difference within year. Pruning weights for unpruned treatments are branches that either broke off or were removed because they were too close to the ground or in the way of the shaker.

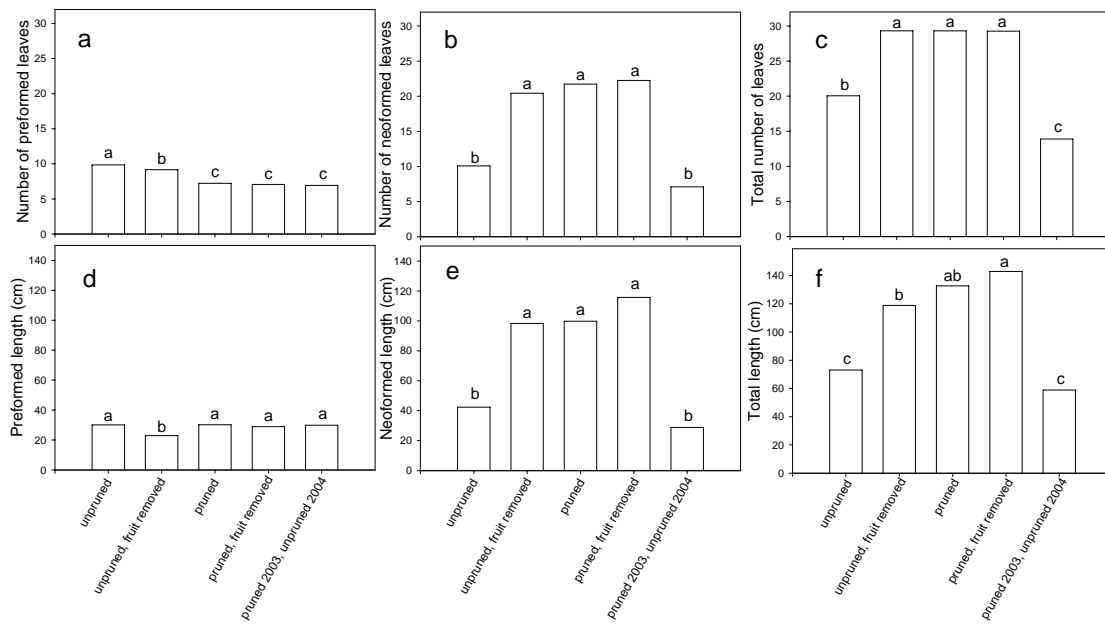


Fig. 7. Number of preformed leaves (a), number of neoformed leaves (b), total number of leaves (c), length of preformed growth (d), length of neoformed growth (e) and total shoot length (f) by treatment. Measurements were made at the end of the 2005 growing season. Letters indicate a significant difference at the 5% level of significance.

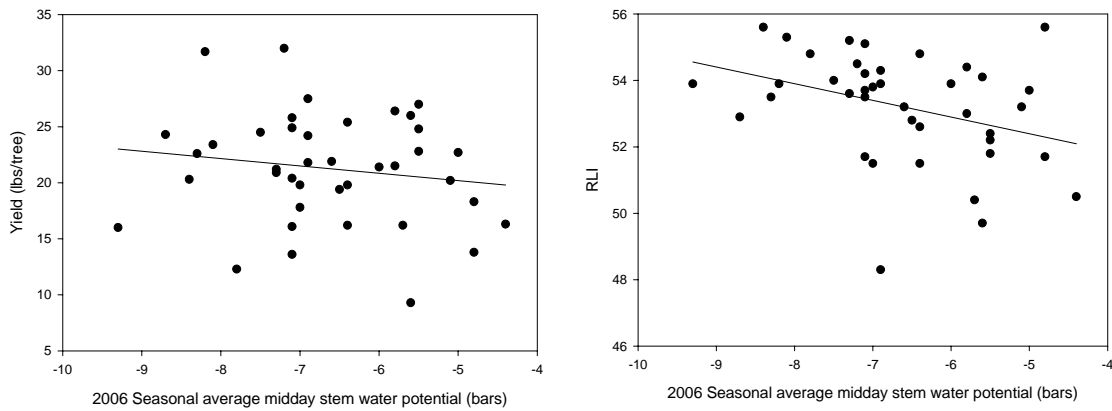


Fig. 8. 2006 seasonal average midday stem water potential versus yield and reflected light index. Lighter kernels give a higher RLI.