MECHANICAL PRUNING OF TULARE COUNTY DRIED PLUMS

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ABSTRACT

Prune trees are typically pruned by hand; however, a recent study conducted in the northern Sacramento Valley suggested that mechanical pruning techniques may be implemented without adversely affecting yield or fruit size. In 2010 and 2011, a similar study was conducted in Tulare County to determine the impact of mechanical pruning on tree height, light absorption, yield and fruit size. In 2010 four pruning techniques (standard hand prune, mechanical topping, mechanical V-Cut, and use of pruning towers) were established in a randomized complete block design. In 2011, rows pruned with the pruning tower in 2010 were instead hand pruned, for a total of three treatments in the second year of the project. Approximately one month prior to harvest, a light bar was run through the orchard to determine adsorption of photosynthetically active radiation (PAR). Fresh weight was determined at harvest, and dry weight was estimated by running 5 lb subsamples from each treatment through the dehydrator and calculating a wet-dry weight conversion factor. The influence of pruning treatment on fruit size was determined by weighing individual fruit in subsamples. Pruning treatment did not affect adsorption of photosynthetically active radiation (PAR) in either year. Neither fresh nor dry yield was affected by pruning treatment in either year; however, one block yielded significantly higher than the other two blocks. The high yielding block also exhibited significantly higher percent absorption of PAR. In 2010 implementation of pruning towers plus a cursory follow-up with hand pruning resulted in significant increase in fruit size as estimated by fruit weight. The pruning tower treatment was more expensive than hand pruning, and was therefore discontinued in 2011. The results suggest that mechanized pruning techniques may be employed without adverse affect on yield or fruit size.

INTRODUCTION

In Tulare County, dried plum trees are typically pruned by hand with loppers and ladders; however, growers have expressed interest in the potential to employ mechanical pruning treatments as an alternative to hand pruning. A study conducted in Glenn County by B. Krueger, et al suggests that mechanical pruning may be used in combination with less detailed pruning from the ground without detrimental effect on yield or fruit size. In the Glenn County study, mechanical pruning to create a "V" in the top of prune trees, followed by dormant pole pruning from the ground, resulted in increased yields over standard hand-pruned trees. Additionally, the "V" cut plus dormant pole prune treatment cost over 50% less per acre than the standard hand-pruned plots. The incorporation of mechanical pruning costs approximately $40/acre; however, the mechanical pruning expense is in addition to some ground work. Consequently, the economic savings of adding a mechanical pruning component is still determined largely by the cost of the subsequent hand labor.

The effects of mechanical pruning on dried plum production in the southern San Joaquin Valley (SSJV) is yet unknown. Because of the climatic dissimilarity between Glenn County and Tulare

County, a regional trial based in the SSJV is necessary to evaluate the potential impacts of mechanical pruning techniques on yield, fruit size, and long-term tree health. Additionally, a comparative assessment of the economic benefits of mechanical pruning between orchards in the northern Sacramento Valley the SSJV is necessitated by the disparity in labor costs between the two regions.

OBJECTIVES

The objective of this study is to compare the impacts pruning treatments on fresh yield, dry yield, and fruit size of dried plums. The study included four pruning treatments in 2010 and three treatments in 2011. Additionally, to assess the impact of pruning treatments on tree size, post-pruning tree height and percent adsorption of photosynthetically active radiation (PAR) was assessed across pruning treatments.

METHODS

A 22 acre block of French prunes on Mariana rootstock was utilized for the study. The block was planted in 2001 with 20 ft x 16 ft spacing and rows running east/west. In 2010 four pruning treatments were employed in a randomized complete block design (RCBD), with entire rows serving as replicates. Only three pruning treatments were implemented in 2011. Within each of three blocks, each pruning treatment was exacted over three consecutive rows, thereby minimizing interplot interference by enabling data collection from the middle of three identically-treated rows. Each row contained 75 trees and represents approximately 0.53 acres. Upon plot establishment, an orchard map was created to illustrate locations of both weak and missing trees.

Trees were pruned with four different treatments in 2010: i). standard/hand prune, ii) mechanical "V" top, iii) mechanical flat top, and iv) pruning towers. In 2011, the rows that had been pruned with pruning towers in 2010 were instead hand pruned in 2011. All mechanized treatments were followed with hand crews to make select cuts.

Assessment of tree size. Two techniques were employed to determine the effect of pruning treatments on overall tree size. Tree height was assessed in March 2010 and 2011 and percent absorption of PAR was measured in July 2010 and August 2011. To measure tree height, five trees were selected at random from each test row and two measurements were taken from each selected tree, one on the north side and the other on the south. Using a telescoping measuring stick, the total height from the top of the burm to the visibly-tallest branch was recorded. The average height per tree was calculated, resulting in 5 subsamples of tree height within each test row. Percent PAR was determined by running light sensors under the orchard canopy within approximately 40 minutes of solar noon (1 pm due to daylight savings time).

An analysis of variance (ANOVA) was utilized to assess influence of block and pruning treatment on tree height and percent PAR and differences between means were determined with a Waller-Duncan K ratio test (K=100). All statistical analyses were conducted using SAS (Cary, NC).

Determination of yield. The day prior to harvest of test plots, all weak trees occupying test rows were harvested by hand. Consequently, all yield data was adjusted to reflect numbers associated with a full compliment of 75 trees per row. Test rows were harvested independently, and two 5 lb subsamples of fresh prunes were collected from each row. Subsamples were weighed in the field and then independently run through the dehydrator. Total fresh yield was determined by weighing each bin prior to dehydration. Total dry yield from each row was determined by multiplication by a conversion factor based on fresh:dry weight of subsamples.

An ANOVA was utilized to assess influence of block and pruning treatment on fresh and dry yield and differences between means were determined with a Waller-Duncan K ratio test (K=100).

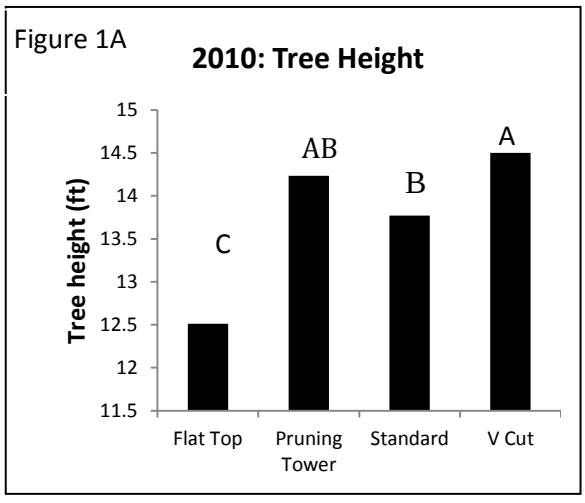
Assessment of fruit size. After dehydration, subsamples were utilized for determination of size distribution. For assessment of size as a continuous variable, individual dried fruit weights were recorded for the first 50 pieces of fruit randomly selected from subsample bags. The average fruit weight per subsample was calculated. For assessment of size as a categorical variable, subsamples were run through a series of nested screens (38,36,34,30,28,26,25). The number of fruit and weight of fruit caught in each screen was recorded and the proportion of fruit in each category was calculated by weight.

The influence of block and pruning treatment on individual fruit weight was determined by ANOVA and differences between means were determined with a Waller-Duncan K ratio test (K=100). Categorical data was analyzed by ANOVA comparing proportions of fruit in size categories with respect to block and treatment.

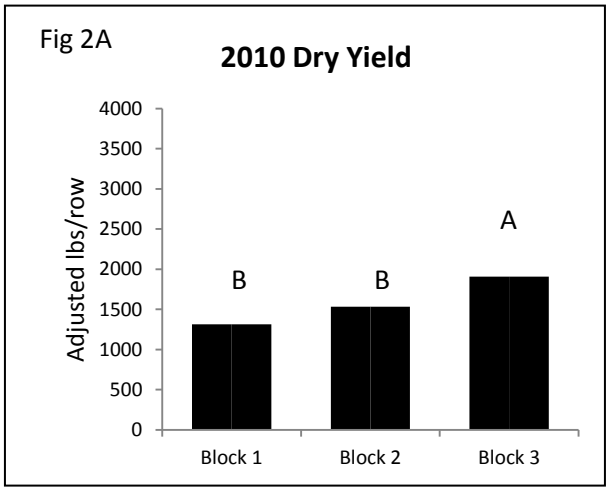
RESULTS

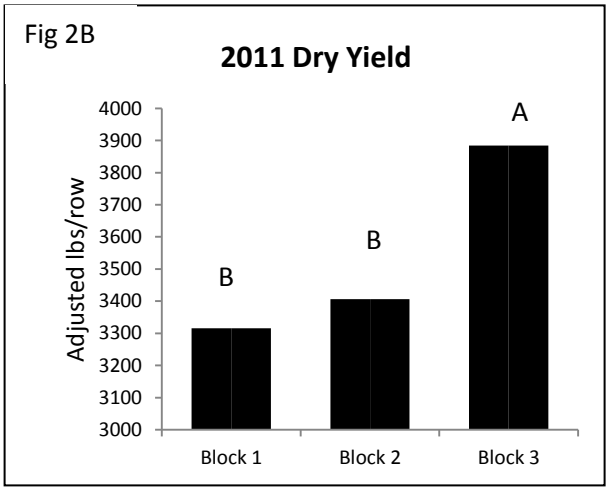
Assessment of tree size. In 2010, pruning treatment significantly affected tree height ($P \leq 0.0001$) (Fig 1A). Flat topped trees were significantly shorter than all other pruning treatments. In 2011, pruning treatment had no influence on tree height. In both years percent PAR varied significantly between blocks ($P \leq 0.05$), with block 3 (north side of orchard) exhibiting higher light absorption than either block 1 or 2. Pruning treatment had no statistical affect on light absorption in either year.

Figure 1A

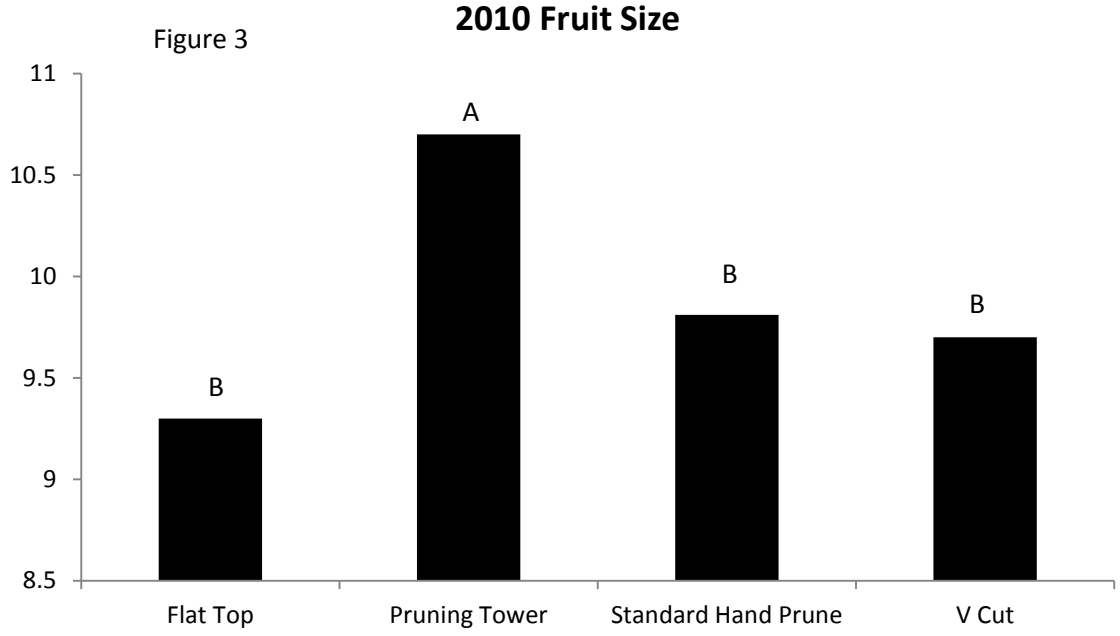


Yield. Pruning treatment had no significant effect on either fresh or dry yield in 2010 or 2011; however, yield varied significantly by block (P≤0.02) (Fig 2 A and B), with block 3 (northern block) exhibiting higher fresh and dry yield than either block 1 or 2.





Fruit size. In 2010, fruit size was affected by pruning treatment (P≤0.0001) (Figure 3). The use of pruning-towers followed by hand crews resulted in significantly larger fruit than the three other treatments, and fruit weight was 9% higher in pruning-tower plots than in the standard hand-pruned plots in 2010. Fruit size was not influenced by pruning treatment in 2011. Fruit size did not vary by block. When fruit sized was assessed as a categorical variable, no statistical differences were observed in proportions of fruit captured in each size category over both years.



DISCUSSION

The results suggest that mechanical pruning techniques may be incorporated in prune culture without adverse effect on yield or fruit size. The main factor affecting yield was block, or geographic region of the orchard. Interestingly, the block exhibiting the highest yield also demonstrated a significantly higher adsorption of PAR. These results suggest that further studies should be developed to investigate the association of light absorption with yield in dried plums.

The implementation of mechanical pruning techniques on dried plums will likely vary based on labor costs. The cost of standard-hand pruning in the Glenn County trial was approximately $600/acre, whereas the standard-hand pruning in the Tulare County trial was approximately $350/acre. This difference in hand-pruning costs may reflect differing labor costs in northern Sacramento Valley and the SSJV, and perhaps also a reflection of the economic times during the implementation of pruning trials at either location. If hand-labor costs only $350/acre, there is little financial incentive to incorporate mechanical pruning into an orchard management plan. However, in years when labor is scarce and/or expensive, mechanical pruning may offer a cost-saving option without adverse affect on yield or fruit size.