

EFFECT OF HEDGING AND TOPPING ON PISTACHIO ALTERNATE BEARING

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INTRODUCTION

Although mechanical side hedging of pistachios has become a common industry practice, there are still questions about how hedging might be best employed to mitigate alternate bearing. Research conducted between 1988-91 by Ferguson et al, in two locations prior to both on and off-years showed no difference in yield between single and double-sided **moderate hedging** and the hand-pruned controls. It also did not impact alternate bearing in either location. An earlier trial also conducted by Ferguson et al, from 1985-91 in Kern County showed that **severe side hedging and topping** of mature Kerman trees on *P. atlantica* rootstock reduced alternate bearing. After seven years, the cumulative yield per tree was very similar between the severely mechanically pruned trees and the hand pruned control. However, during the first four years, the strongly alternate bearing hand pruned treatment still produced up to 32% more inshell split nuts than the severely side hedged trees. This data set has been referenced in recommending that growers with strongly alternate bearing orchards hedge and top prior to an off-year, rather than an on-year. Such a recommendation seems counter intuitive to the bearing habit of pistachio, since the yield loss from heavy pruning prior to an on-year is known to be partially compensated for by a higher set percentage in the remaining flower clusters. The capacity for compensation is also dependent upon the severity of pruning. The higher crop load associated with on-trees also appears to reduce the total seasonal growth compared to trees severely pruned prior to an off-year.

A long-term hedging trial by Beede in 1996 on 15 year-old 'Kerman' trees in southern Kings County attempted to test the off-year hypothesis by initiating multiple hedging and topping treatments over two seasons, with the expectation that the heavy bearing 1997 year would be followed by a low bearing on-year. This did not prove to be the case. Thus, the only replicated experiment currently available to support the off-year hedging recommendation for reducing alternate bearing is the early trial in Kern County. Although the cumulative yield after seven years was similar in the Kern trial between the severely hedged and topped trees and the hand-pruned controls, hedging and topping suppressed yield during the first four years. Growers question if this is in their best financial interest.

Confirmation of the effects of hedging and topping prior to the off-year is therefore important, considering the fact that mechanical pruning is a widely accepted practice in pistachio, and some growers with older blocks are now expressing concern that their revenue stream in strongly alternate bearing orchards is insufficient to cover expenses during the off-year.

To address this question, a randomized complete block, split-plot experiment was established in the rootstock trial at the Kearney Agricultural Center in Parlier during the winter of 2011-12, an off-year for this orchard. This trial consists of 400 trees (cv. Kerman) which are divided into 100, four-tree plots. Each plot contains one of the four following rootstocks: *P. atlantica*, *P. integerrima*, (Pioneer Gold I), *P. integerrima* x *P. atlantica* (Pioneer Gold II), and *P. atlantica* x *P. integerrima* (UCB-1). Ten of these four-tree plots are then grouped into a single 40-tree block to create five uniform replications for experimentation. Male trees (cv. Peters) are also replicated on each rootstock and placed every third tree within the row and every third row. During the winter of 2011-12, this east-west planted orchard was divided down the middle from north to south to create two identically designed experimental halves. The east half was mechanically side hedged and topped, and the west half was hand pruned. Side hedging consisted of cutting every other middle at six feet from the tree trunk. Topping was then performed at 14.5 feet. Hedging and topping severity varied by the effect that rootstock has on tree size. UCB-1 and PGII were more severely pruned than PGI and *P. atlantica* because of their documented larger tree size. Up to five feet of growth was removed from topping the largest trees. Topping was performed by a four-bladed rotating star machine mounted upon a four-wheel drive tractor. Due to the severity of the side hedging, a large, fixed-boom hedger was employed with five, 48-inch diameter stationary blades to prevent splitting of the large structural limbs. Minimal hand pruning was also performed on the non-hedged side to insure efficient nut removal at harvest. Each data tree in the mechanically pruned half was rated light, medium, or heavy in pruning severity.

During the winter of 2012-13, the same side-hedging and topping method was applied to the west half of the trial (hand pruned the previous year), using the same tree middles as the previous year. Observations of fruit wood and flower bud density confirmed that this half of the orchard was going into a pronounced on-year.

Following shredding of the abundant brush, hand pruning was then performed on both halves of the trial in the non-hedged rows. Tipping of the one-year-old growth on the sides and tops of the trees mechanically pruned last year was also performed according to commercial practices. The west-side trees were then rated for hedging severity by counting the number of cuts per tree for five size categories, ranging from less than one-half inch to greater than two inches. This procedure attempted to quantify any differential in side-hedging severity related to rootstock vigor.

Individual tree yields were collected September 11-12 in 2012, and September 4-6, 2013. Thirty pound, composite samples were taken for each rootstock in each of the five replications within each half of the trial. They were then submitted to Paramount Farms for commercial evaluation. The grade sheet data was then used to calculate the total dry yield, as well as the pounds of split nuts, closed shell nuts, and blank nuts.

RESULTS

Table 1 shows the results of canopy size assessment conducted in 2009 using aerial thermal imagery. Although performed two seasons before establishment of this experiment, the maturity of the orchard (22 years at the time of the imagery) and accuracy of measurement still makes relative comparison of tree size valid. Trees on UCB-1 and PGII are very similar in size and significantly larger than the other two rootstocks. *P. atlantica* was significantly smaller than the other rootstocks. Documentation of the rootstock effect on tree size was important for this experiment, because the topping and hedging could not be applied proportional to it. Consequently, the trees on UCB-1 and PGII were more severely pruned than the trees on the other two rootstocks.

Chart 1 compares the effect of severe side hedging and topping to hand pruning by rootstock prior to an off-year (2012). Trees on UCB-1 suffered the greatest yield reduction during the first year of the trial. They also were the most severely pruned. The yield of mechanically pruned trees on PGII was about half that of the hand pruned treatment. Although PGII rooted trees showed less reduction in total dry yield compared to trees on UCB-1, the difference was not significant. The yield of trees on PGI and *P. atlantica* was not affected by the mechanical pruning. Trees on these two rootstocks were also significantly smaller than UCB-1 and PGII, and thus suffered less flower bud removal.

Chart 2 shows the results of hedging and topping prior to an on-year (2013) in comparison to the recovery of trees receiving the same pruning the previous off-year. Again, the largest trees on UCB-1 and PGII suffered the greatest reduction in total dry yield, due to the greater severity of pruning documented by counting the cut number and size. However, the total dry yield for trees on UCB-1 and PGII was not statistically less than the trees grown on either PGI or *P. atlantica*. The effect of severe hedging and topping before the on-year on edible split nut production was substantially different from the previous off-year results. Unlike the off-treatment, edible split nut yield differed less than two pounds per tree between rootstocks for the on-year treatment. It is also notable that the trees hedged and topped last year recovered sufficiently to yield the same edible split nuts as the on-year treatment. However, edible closed inshell nut production was significantly higher over all the rootstocks hedged and topped prior to the off-year. The greater closed inshell production also caused the total dry yield for the off-year treatment to be significantly greater than that of the on-year. Blank nut production was not significantly affected by severe hedging and topping performed prior to either bearing cycle.

Chart 3 shows that severe hedging and topping prior to the off-year significantly reduced the percent edible split nuts compared to applying the same treatment prior to the on-year. The percentage of edible closed inshell nuts was also significantly greater in the trees severely pruned during the off-year. This suggests that the canopy had not possibly recovered sufficiently from the previous season's pruning to provide adequate photosynthates for a crop equal in size to the trees severely pruned this season. Differences in the percentage of blank nuts were related more to the rootstock than the time in which severe hedging and pruning was performed. The more vigorous rootstocks

(UCB-1 and PGII) had significantly less percent blank nuts than trees grown on P. *atlantica* or PGI.

CONCLUSIONS AND PRACTICAL APPLICATION

Results thus far show that, within the year performed, side hedging and topping severely prior to an off-year depresses yield more than the same treatment applied before an on-year. Trees severely topped and hedged on one side prior to the 2013 on-year still averaged 36.8 pounds of edible split and closed inshell nuts, the equivalent of 4710 pounds of edible nuts per acre (128 females per acre). However, the average edible nut yield from the trees severely pruned last year was 43.7 pounds this season, the equivalent of 5597 pounds per acre. This was highly statistically different from the on-year treatment. The additional pounds of edible nuts produced this season by the off-year treatment compensates for much of the crop lost last year from the most severely pruned trees. Continued data collection will hopefully reveal when to impose reconstructive hedging and topping to reduce alternate bearing with minimal crop loss. The tree size difference created by the four rootstocks may also allow an assessment of how pruning severity affects changes in alternate bearing. For example, P. *atlantica*, due its significantly smaller tree size, has received minimal pruning thus far, and may therefore maintain the same alternate bearing index. In contrast, UCB-1 and PGII should show the greatest correction, since trees on these stocks have been the most severely pruned.

Data collected this season supports the hypothesis that the yield superiority of individual Kerman trees within the rootstock trials is more a function of tree size, and not greater fruiting efficiency imparted by the stock. The data supporting this hypothesis is the absence of significant differences in edible nut yield between the rootstocks, now that their canopy size has been largely standardized.

Table 1. Relative rootstock canopy size based on aerial thermal imagery performed in August of 2009. P=0.05.

Rootstock	Canopy Area (ft ²)
UCB-1	254.5a
PGII	252.6a
PGI	216.9 b
ATL	185.4 c

Chart 1. Effect of severe side hedging and topping prior to an off-year on the yield and nut quality of Kerman pistachio grown on four commercial rootstocks. Averages based on five replications, each containing nine trees on each rootstock. Harvested 9/11-12/12.

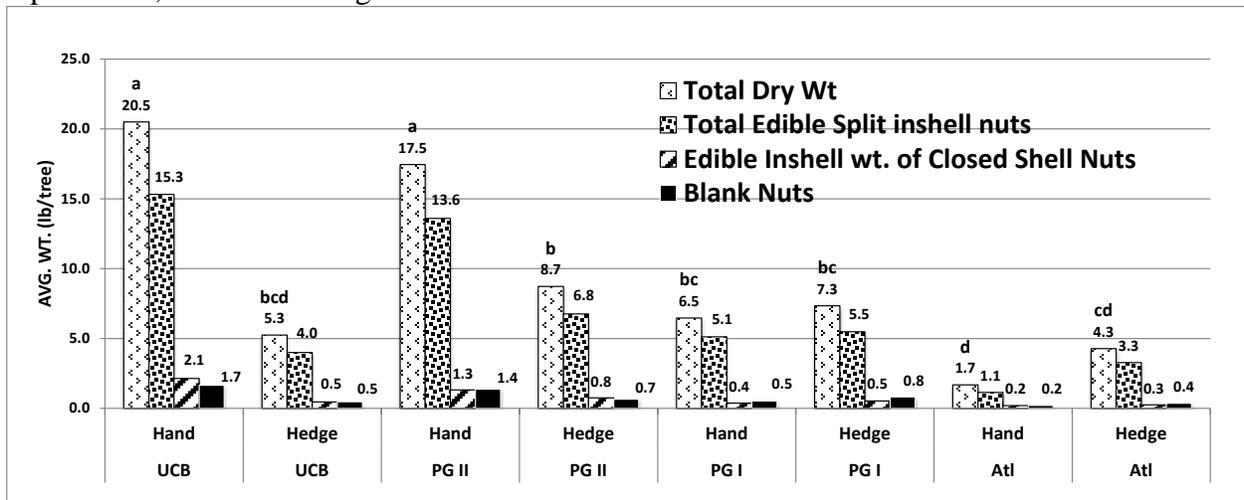


Chart 2. Effect of severe mechanical side hedging and topping prior to an on and off-bearing year on mature Kerman pistachio yield grown on four different rootstocks. Averages based on five replications, each containing nine trees on each rootstock. Harvested 9/4-6/13.

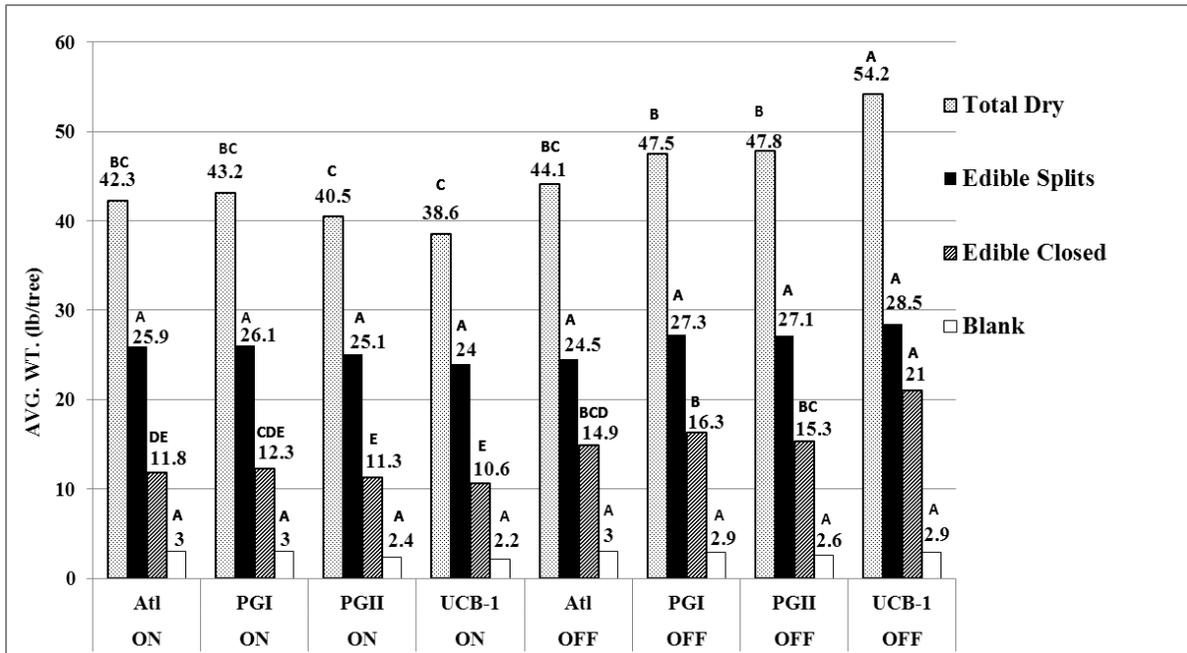


Chart 3. Effect of severe mechanical side hedging and topping prior to an on and off-bearing year on the nut quality of mature Kerman pistachio grown on four different rootstocks. Averages based on five replications, each containing nine trees per rootstock. Harvested 9/4-6/13.

