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Postharvest and Preharvest Summer Pruning of 'Firebrite' Nectarine Trees

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Abstract. **The effect of postharvest and preharvest summer pruning techniques on photosynthetic photon flux densities (PPFD) and yield characteristics were studied in mature 'Firebrite' nectarine [*Prunus persica* (L.) Batsch] trees. Treatments 14 days after harvest included unpruned control, hand-topping, interior watersprout removal (WSR), and combination of hand-topping and WSR. All pruning treatments initially increased PPFD within the canopies. Forty-five days after pruning, the topped trees had PPFD similar to unpruned controls, while PPFD in the other treatments remained higher. PPFD were similar for all treatments 90 days after treatment. No significant effects of postharvest pruning on flowering or fruit set were observed during the following year. Preharvest summer pruning (23 and 28 days before harvest), imposed on the same set of trees the following year and consisting of WSR, increased fruit size, weight, and redness relative to unpruned trees.**

Summer pruning has long been used as a management method for fruit trees crops (2, 5), and has been shown to be of value as a method of controlling tree growth (7–9), increasing flowering (3, 11), and increasing fruit color (6, 8, 12). Disadvantages of summer pruning are reported to include decreased soluble solids concentration (1, 12) and fruit size (10). Such differences in results can probably be attributed to differences in timing and severity of pruning, and because, in some cases, summer pruning was used as a replacement for dormant pruning rather than as a supplement.

Peach growers use summer pruning as a management technique to help reduce excessive tree growth and shading. Some growers mechanically top, summer-prune by hand, or do both after harvest.

Due to limited data on summer pruning effects on stone fruit, a study was undertaken to compare summer hand-pruning and topping effects on: a) light penetration within the tree and b) return bloom and fruit set the season following treatment. The second part of this research addresses the practice of preharvest summer pruning that has been implemented in attempts to maintain canopy light environment and intensify fruit color (6). However, some growers believe that the removal of leaves negatively affects tree vigor and fruit quality. Therefore, we also determined tree and fruit responses to preharvest summer pruning.

Summer-pruning experiments were conducted on mature trees of a mid-season nectarine 'Firebrite' on 'Nemaguard' rootstock growing at the California State Univ., Fresno, orchard. Trees were planted at standard density (272 trees/ha), trained to an open-vase configuration, furrow-irrigated, and they received routine horticultural care.

Postharvest summer-pruning treatments were imposed on 16 July 1984, 14 days after harvest. The treatments included a) no pruning (control); b) hand-topping to a height of ≈3.5 m to simulate mechanical topping; c) removal of upright, interior watersprouts originating below 2 m from the ground (WSR); and d) a combination of b and c (WSR/topping). In addition, all trees received normal dormant hand-pruning during Dec. 1984. Six trees of each treatment were arranged in a randomized complete block design for a total of 24 treatment trees.

Following each treatment, interior light readings of PPFD between 400 and 700 nm were taken at 1200 HR on 18 July, 30 Aug., and 7 Oct. using a LI-COR LI-188B inte-

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Table 1. Effect of postharvest summer pruning treatments on photosynthetic photon flux density (PPFD; $\mu mol \cdot s^{-1} \cdot m^{-2}$) penetrating into the center of the canopy of 'Firebrite' nectarine trees at solar noon. Data are mean values of solar noon measurements 2, 45, and 90 days after pruning, respectively.

	PPFD[y]		
	Date		
Treatment[z]	18 July	30 Aug.	7 Oct.
Control	52 a	43 a	51 a
WSR	239 b	264 b	65 ab
Topping	168 ab	63 a	48 a
WSR + topping	248 b	308 b	88 b

[z]WSR = waterspout removal.
[y]Mean separation within columns by Duncan's multiple range test, $P = 0.05$.

grating quantum radiometer/photometer with a LI-COR LI-1915 line quantum sensor. The quantum sensor was positioned in the crotch of a tree at a height of ≈40 to 50 cm. Two readings were taken for each tree, one with the sensor positioned in a north–south orientation and one with an east–west orientation. The two readings were integrated over 10 sec and then averaged.

Four healthy fruit bearing shoots located on the periphery of the canopy were measured and tagged in each tree on 18 July 1984, one located in each quadrant. On 1 Mar. 1985, at ≈5% to 10% bloom, the flower buds on these tagged shoots were counted. Then, on 20 Apr., fruit was counted to determine fruit set.

Preharvest pruning treatments were imposed on 3 and 8 June 1985. The treatments included a) no pruning (control) and b)WSR. The 3 June WSR treatments were imposed on trees used in the postharvest pruning study described above. Trees previously receiving only topping were not used, while trees that received WSR and the WSR/Topping treatments were analyzed separately. No differences in response to preharvest pruning were detected between trees from the two treatments and results were pooled. On 8 June, WSR treatments were imposed on trees that had received no previous summer pruning. Immediately before and after each treatment, PPFD was measured as outlined above.

On July 1985, all fruit below 1.3 m in the canopy were harvested and then transported to the Univ. of California, Kearney Agricultural Center, Parlier for analysis.

A 40-fruit random sample from each replication was analyzed for weight, diameter, color, and soluble solids concentration (SSC). Individual fruit size was determined from lateral transverse diameter measurements using an electronic caliper. Each fruit was then visually rated for percentage of the surface that was red. SSC were determined with a temperature-compensated hand-held refractometer on juice samples obtained by mascerating two, one-eighth sections from each fruit. Data were analyzed by analysis of variance, and, when applicable, means were separated by Duncan's multiple range test ($P = 0.05$).

Postharvest summer topping alone did not significantly increase PPFD, while WSR alone, or in combination with topping, increased PPFD initially and for at least 45 days after pruning (Table 1). Ninety days after treatment, only WSR/topping produced significantly greater PPFD than the control.

The lack of increase of PPFD in trees receiving only topping can be attributed to shading caused by remaining interior watersprouts. Heading cuts from the topping treatment resulted in initiation of growth from these shoots, further exacerbating the problem. Since these shoots were removed in trees receiving the WSR/topping treatment, no such regrowth occurred and PPFD remained constant over a longer period.

Flower and fruit counts on 1 Mar. and 20 Apr. 1985 indicated no differences between treatments. This may be due to the use of young, well-cared for trees that had not yet developed severe shading problems common in older trees.

Preharvest WSR increased PPFD over unpruned controls (Table 2). While prepruning PPFD was significantly different between 3 June WSR ($128\ \mu mol \cdot s^{-1} \cdot m^{-2}$) and 8 June WSR ($20\ \mu mol \cdot s^{-1} \cdot m^{-2}$), postpruning PPFD was similar for both treatments. These initial differences did not affect tree and fruit quality responses to summer pruning, and appeared to be overcome by the benefits of increased PPFD.

Increased solar radiation has been shown to increase redness of fruit (4), consistent with results presented here (Table 2). This improvement is important as it increases the marketability of fruit and allows for easier and more uniform harvesting. Observations of similar summer-pruning methods support such increases in fruit color without a negative impact on fruit size (6). Watersprout removal on both dates increased size and weight, reduced cullage of undersize, and did not affect SSC of fruit in the lower portion of the canopy (Table 2).

Other summer-pruning experiments have indicated decreases in fruit size (1, 10), possibly due to excessive removal of photosynthetic tissue. In the present study, relatively little leaf area was removed, and, since all of it was non-fruiting watersprouts rather than fruit-bearing shoots, there was probably little reduction in photosynthate availability to fruits. Rather, there may have been an increase in photosynthate available to fruit of pruned trees due to an increase in PPFD and/or the removal of competitive sinks—i.e., watersprouts. Also, improved light exposure may have strengthened fruit sink activity, thus increasing fruit size (4).

It appears that watersprout removal, both preharvest and postharvest, is a simple, effective method for increasing light flux densities under California conditions, while postharvest summer topping appears to be of little value. Further research needs to be done to determine how preharvest summer pruning affects fruit size.

Table 2. Effect of preharvest summer pruning treatments on photosynthetic photon flux density (PPFD; $\mu mol \cdot s^{-1} \cdot m^{-2}$) at solar noon, soluble solids concentration (SSC), proportion of surface that is red, weight, diameter, and percentage of undersize fruit.

	Treatment[z,y]		
Characteristic	Control	WSR 3 June	WSR 8 June
PPFD before treatment[x]	60 a	128 a	20 b
PPFD after treatment	60 a	386 b	452 b
SSC (%)[w]	10.4 a	10.3 a	10.1 a
Surface red (%)	61 a	71 b	71 b
Fruit weight (g/fruit)	92 a	112 b	113 b
Fruit diameter (mm)	54 a	58 b	58 b
Undersize fruit, <97 g (%)	59 a	31 b	35 b

[z]WSR = watersprout removal.
[y]Mean separation within rows by Duncan's multiple range test, $P = 0.05$.
[x]PPFD readings made 3 and 8 June 1985.
[w]Fruit quality measurements made 1 July 1985.

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