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Dwarfing Peach Trees and Fruit Quality Development by Using Summer Pruning as Physiological Changed Dwarfing Component

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Abstract: Slender spindle bush type summer pruning was used as physiological changed dwarfing component in this experiment. Summer pruning was performed in late July after fruit harvest from 2000-2004, and winter pruning (control) was performed in mid February 2001-2005. Pruned branch weight was lower in summer pruned than in winter pruned trees. Declining trend was found both summer and winter pruned trees from 2001-2005. Percent flower bud was less in summer pruned than winter-pruned trees. However, percent fruit set was a little higher in summer-pruned than in winter-pruned trees. Fruit yield (fruit size and weight) and quality (soluble solids content, acid content and maturity index) was better in summer pruned than in winter pruned trees. The result showed that summer pruning as dwarfing component was a useful practice for controlling small sized peach trees and development of fruit quality by changing tree physiology.

Key words: dwarfing, fruit quality, peach, summer pruning.

INTRODUCTION

Dwarfing fruit trees play an important role in fruit growth, development and quality. Large vigorous fruit trees are a problem to the fruit growers, because ladders have to be used during fruit thinning, bagging and harvesting. If trees are small sized, then it is easy to pick fruit from the ground. Small, compact, dwarf or size controlled fruit trees provide for easier pruning, thinning, spraying and harvesting and could lead to production of high-grade fruit at lower production cost (Tukey 1964). To induce dwarfing, fruit growers can use dwarfing rootstocks. However, dwarfing rootstocks are not yet available for peaches like apple (Erez, 1984). Peach trees grafted on *Prunus tomentosa* and *Prunus japonica* rootstocks could be dwarfed but showed graft incompatibilities after a certain period (Andrews and Serrano, 1992). The primary factor limiting the use of size controlling rootstocks in stone fruit production is the lack of suitable rootstocks with a wide range of compatibility among cultivars (De Jong *et al.*, 2001). Therefore, dwarfing techniques other than dwarfing rootstocks need to be developed to control peach tree growth. Summer pruning has been reported to suppress vegetative growth and enhance fruit quality. Light distribution and penetration within canopies were also improved by summer pruning. (Ferree *et al.* 1984; Marini and Barden 1987; Rom and Ferree 1984; Marini 1984).

Greene and Lord (1983) found that there was no difference of fruit set between summer-pruned and control trees in apple. They also reported that summer pruning reduced apple fruit weight in 1978 and 1980 and increased in 1979 as well as (SSC) increased. The number of fruit per vine of kiwifruit was slightly greater on central leader summer pruned vines and soluble solids content (SSC) was higher in summer-pruned trees (Miller *et al.* 2001). Taylor and Ferree (1984) observed that apple fruit yield reduced and increased after summer and winter pruning in different years. They also found that SSC was higher in summer pruned than in control trees. Erez (1984) reported that peach fruit yield was lower by pruning treatments in 1983.

This study was undertaken to develop dwarfing technique for maintaining slender spindle bush type of peach trees grafted on vigorous rootstock and improvement of fruit yield and quality (SSC and TA) in the following years after summer pruning.

MATERIALS AND METHODS

Site:

The experiment was carried out in an orchard in the Ehime University Farm located in southern Japan.

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Plant materials;

Nine-year-old peach cv.'Akatsuki' x unknown Banto trees grafted on wild form vigorous rootstocks and planted at a spacing of 2 x 3m and were used.

Intercultural operation:

Since the peach trees were planted in a field where grapevines had been grown and received adequate fertilization, no fertilizer was applied during the course of this experiment. Before the experiment, winter pruning (control) had been adopted as tree training method. Weeding was done at 30 days interval. Irrigation and pesticide were applied as required.

Treatment setting:

Treatments were assigned in a completely randomized design and summer pruning was done after harvesting fruit on July 24, 2000-2004 and consisted of heading back and removal of vigorous shoots (Fig.1). Winter pruning was done in mid February 2001-2005. Slender spindle central leader were about 2m tall. Twelve trees were used in the experiment. Six trees for summer pruning and remaining for winter pruning.

Data collection:

Pruned branched weight was measured after pruning (both summer and winter) in late July and mid January from 2001-2005. Percent flower bud and fruit set were measured in January and May 2005, respectively.

Design and Statistical analysis:

Treatments were set following completely randomized design repeated in different trees. Mean seperation was done by SE (standard error bar).

Fruit thinning and harvesting:

Fruit thinning was conducted by hand in early May as commonly practiced in commercial orchards. During thinning, 1 to 3 fruit per long bearing shoot, 1 per medium-sized shoot, and 1 per 3 to 5 short shoots were retained. Fruit was harvested in mid July 2001-2005 and data on number of fruit per tree and harvested fruit weight were recorded immediately after harvest.

Juice collection:

Ten fruit per tree were randomly selected and used to determine soluble solids content (SSC). Fruit juice was collected immediately after harvest manually using sieve and preserved in the freezer to determine SSC and TA.

Soluble solids conternt determination (SSC):

Soluble solids content was measured with a refractometer (Atago PR-1). One drop of juice was taken on the refractometer and reading was recorded.

Titratable acidity determination (TA):

TA was determined by titration with 0.1N NaOH using phenolphthalein as an indicator. Titration was done using juice until color was developed and recorded the reading.

RESULTS AND DISCUSSION

Fig. 1 was shown the pruning treatment as slender spindle bush shape. Pruned branch weight was less in summer pruned than in winter-pruned trees in the following years. Pruned branch weight decreased gradually over the years from 2001- 2005 in both summer and winter-pruned trees (Fig. 2). Percent flower bud was less in summer-pruned than in winter -pruned trees whereas, Percent fruit set was a little higher in summer-pruned trees (Fig. 3).

From 2001-2005, fruit number/tree, mean fruit weight and yield fluctuated in summer-pruned and in winter-pruned trees (Table 1). Similar trends were also observed in 2001, 2003 and 2005 for fruit diameter, and the maturity degree were higher in summer-pruned trees in 2002, 2003 and 2005. This indicates that summer pruning promotes fruit maturation in the following years. Soluble solids content of harvested fruit in the was higher in summer-pruned than in winter-pruned trees from 2001-2005 with a gradual increase in SSC

over the years. The inverse was true for TA that was lower in summer-pruned than in winter-pruned trees from 2001-2005 (Fig. 4). Fig. 5 shows the effect of treatment on fruit color (maturity). Fruit color (maturity) was higher in summer pruned than winter pruned trees.

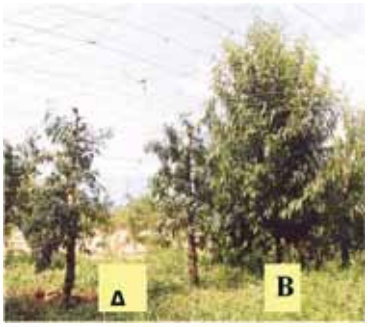

Fig. 1: Peach tree shape after summer pruning on July 24, 2001 (A: trees just after summer pruning, B: trees without summer pruning).

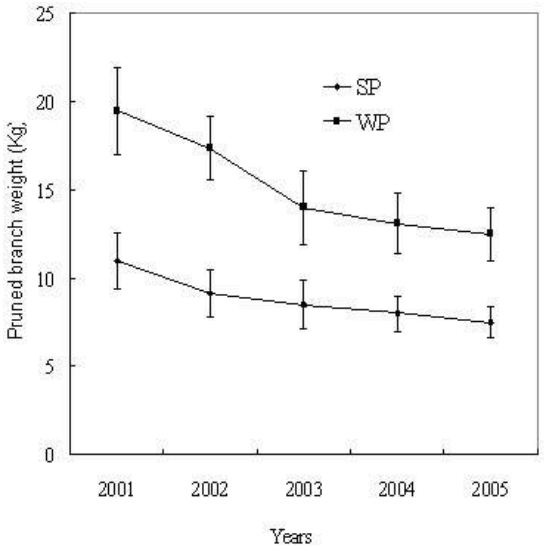

Fig. 2: Effect of summer pruning on pruned shoot weight pf peach trees. Vertical bars represent SE (n=6).

Table 1: Peach fruit yield and quality in different years as affected by summer pruning.

Year	Treatment	Fruit/tree (no)	Yield (kg)/tree	Fruit weight (g)	Maturity degree	Fruit diameter (mm)
2001	SP	136.0±36.7	13.0±3.1	102.2±5.3	----	62.2±0.7
	WP	86.2±5.3	8.7±0.8	102.0±4.0	----	60.7±0.5
2002	SP	76.8±15.0	8.3±2.1	108.9±4.4	3.8±0.4	----
	WP	66.4 ±8.0	6.6±1.0	103.5±3.5	2.4±0.3	----
2003	SP	28.1±4.5	4.2±0.3	104.1±5.0	4.0±0.5	62.5±0.8
	WP	21.1±4.0	3.1±0.2	104.0±4.0	2.9±0.4	60.9±0.5
2004	SP	41.4±7.1	4.9±0.3	121.1±6.3	----	----
	WP	56.6±7.8	5.8±0.8	102.1±4.2	----	----
2005	SP	68.4±9.0	7.7±0.9	112.2±4.7	4.4±0.4	62.8±0.9
	WP	75.5 ±11	7.9±1.1	105.1±4.2	3.1±0.3	61.0±0.7

Mean ± SE (n =6), SP = Summer pruning, WP = Winter pruning.

In our study, shoot growth (by measuring branch weight) was lower in summer-pruned than in winter-pruned trees (Fig. 2) and fruit quality (SSC and TA) was better in summer pruned than in winter pruned trees. It might due to more light penetration into the branches. Hossain *et al.* (2006) found that shoot growth was lower in summer pruned than in control (winter pruned) trees. They also found that percent flower bud was lower and fruit set was higher in summer pruned than winter pruned trees. In our research we also found similar result to their result. Marini (1985) observed that light levels were very low at the tree center in mid

July, prior to pruning. After pruning in July, light penetration up to 70% photosynthetically available radiation (PAR) was observed at the tree center, whereas light penetration was only 6% PAR for winter-pruned trees. The rate of photosynthesis in leaves remaining after summer pruning increased by 6% in peach and 11-39% in apple (Taylor and Ferree, 1981; Myers and Ferree, 1983a; Marini and Barden, 1982c; Rom and Ferree, 1985). Generally, leaf photosynthesis increases to an early maximum and then gradually declines over the season. It was inferred that summer pruning reduced tree vigor because new shoot growth, especially leaves utilize reserves that cannot be replaced if removed during the growing season.

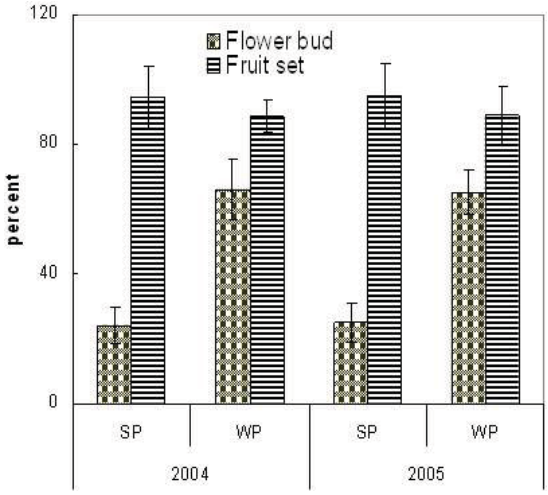

Fig. 3: Effect of summer pruning on flower bud and fruit set of peach trees. Vertical bars represent SE (n=6).

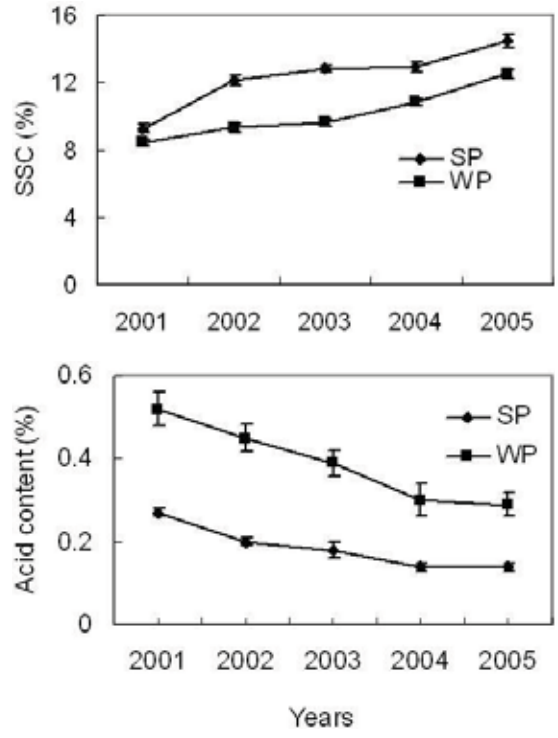

Fig. 4: Effect of summer and winter pruning on soluble solids content acid content of peach fruit. Mean ± SE (n = 6).

Fig. 5: Photo was taken after harvesting fruit. Grade was determined by visual observation of colour. Grade 1: Higher color and maturity. Grade II: lower color and maturity.

Flower bud formation per cluster and fruit set percent were lower in summer-pruned trees than in the control (Taylor and Ferree, 1984). Greene and Lord (1983) found that there was no difference in fruit set between summer-pruned and control trees.

It is generally believed that the quality of fruit inside the trees is worse than that of fruit in the outer parts of the trees due to penetrating less light which causes less photosynthesis. This is supported by results from our experiment where fruit quality in winter-pruned trees was lower that in summer-pruned trees even when compared at the full maturity stage. Data from our five-year study show that fruit yield was much less in 2003 and 2004 compared with 2001 and 2002. This might be due to diseases and pest occurred over the years (2003 and 2004).

Conclusion:

In conclusion, it seems difficult to maintain small sized peach trees and develop fruit quality grafted on vigorous rootstocks by winter pruning (as usual method). However, summer pruning (as slender spindle bush type) in mid-late July after harvest may be a useful practice to reduce tree size and improve peach fruit quality. This practice can be used for other fruit species where dwarfing rootstock is not available.

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