

Review

## Summer pruning in fruit trees

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Pruning has been practiced for ages in controlling tree size because it has much less stimulating effect on shoot re-growth. The pruning is done to restrict excessive vegetative growth and to maintain a balance between leaf/fruit ratio, fruit size, fruit colour and other quality attributes. Excessive tree vigour can reduce flower bud formation, fruit set and result in reduced fruit quality. Summer pruning by removing the vigorous growing shoots increase the light intensity in cropping zone and colour intensity. Late summer pruning also reduce the growth due to reduction in photosynthetic capacity and ultimately carbohydrate reserve by reducing the leaf area index and the spread of the canopy.

**Key words:** Pruning, fruit trees, growth, yield.

### INTRODUCTION

Pruning may be defined as the removal of plant parts to achieve a desirable architecture of the canopy and also using the foliage density by removing the unproductive branches of fruit trees. Summer pruning in apple orchards can be traced back to the 17th century and has scientific attention since 1903 (Marini and Barden, 1987). For vigour control, pruning is the most important operation conducted in dormant season, when the leaf fall takes place. This operation requires skilled labour, which is time consuming and costly. It is the means of diverting a portion of plant water and nutrients from one part of growing point to another. The pruning is done to restrict excessive vegetative growth and to maintain a balance between leaf/fruit ratio, fruit size, fruit colour and other quality attributes. Excessive tree vigour can reduce flower bud formation, fruit set and result in reduced fruit quality. It increases auxin activity by about 60%, gibberellin by 90% and cytokinin by 90% (Grochowska et al., 1984). Pruning increases photosynthetic translocation to fruits and roots which regulates flower bud formation. With the increase in knowledge of the importance of light interception and apple orchard management (Jackson, 1980), the interest in the effects of summer pruning has

been revived.

By removing the part of the extension shoots and leaves, summer pruning improves light penetration and distribution within the canopy (Lakso et al., 1989) and improves fruit colour. Removal of apical portions of shoots by pruning changes the hormonal status between the meristems which results in stimulation of lateral buds, induction of branching and increment in photosynthesis of basal leaves (Mika, 1986). The relationship between vegetative and reproductive growth influences the amount and quality of fruits produced by an apple tree.

### EFFECT OF SUMMER PRUNING ON VEGETATIVE GROWTH CHARACTERISTICS

Pruning has been practiced for ages in controlling tree size because it has much less stimulating effect on shoot re-growth (Mika and Krzewinska, 1995). Mizutani et al. (2000) reported that the earlier summer pruning resulted in the greater shoot length and shoot numbers in apple trees. Bruno and Evelyn (2001) reported that shoot tipping in cherimoya significantly decreased shoot length

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according to the date it was done. In Shimizuhakuto cultivar of peach, the shoot growth in light pruned trees ceased by end of May, while in heavy pruned trees, the shoots continued to elongate until the end of June (Fukuda et al., 2002). Zamani et al. (2006) observed that by conducting summer pruning on apple cultivars Golab and Shafi-Abadi on M9 rootstock, trunk cross sectional area was positively correlated with annual shoot number, total length of annual shoots, tree volume and dormant pruning weight. Summer pruning treatments effectively reduced the measured vegetative characters. They further reported that the treatment was most effective when conducted 90 days after full bloom. Hassani and Rezaee (2007) conducted field studies on the peach cultivars, Anjiri and Mahalli. Three pruning intensities namely, one half, one third and one fourth cutting back of the bearing shoots were applied on the trees, it was found that there was a significant increase in vegetative growth with the heavy pruning. Melouk (2007) stimulated vegetative growth of Succary Abiad mango cv. by pruning. Salem et al. (2008) showed that the vegetative growth of Baldy mandarin trees was improved by pruning.

Demirtas et al. (2010) reported that the pruning applications significantly affected both shoot diameter and length. The highest shoot diameter and length were obtained from pre-harvest summer + winter pruning application as 8.52 mm and 77.84 cm, respectively. The highest leaf area was determined as 39.43 cm<sup>2</sup> in post harvest pruning treatment. Depending upon pruning severity, stage of plant development and environmental conditions like nutrient supply, soil moisture and light, summer pruning may have a dwarfing or an invigorating influence on fruit trees as compared to winter pruning. Summer pruning suppresses shoot growth and shoots were shorter on summer pruned trees than control.

### **EFFECT OF SUMMER PRUNING ON FRUIT SET AND YIELD**

Summer pruning resulted in favourable influence in relation to better fruit set and yield in pruned mango trees (Lal et al., 2000; Sharma and Singh, 2006). Ingle et al. (2001) reported that medium pruning recorded the highest value for the number of flowers per shoot of acid lime trees. Sharma and Chauhan (2004) recorded the highest fruit yield in lightly pruned trees where 25% of current season's growth was removed than the moderate and severely pruned trees where 50 and 75% of the current season's growth were removed, respectively in peach. Kumar et al. (2005) reported in Sharbati, Flordasun and Prabhat cvs. of peach that among the three pruning intensities namely, light, medium and severe; light pruning induced early flowering and also increased the number of flowers as compared to other pruning treatments. Rather (2006) reported that strong pruning delayed flowering by 6 to 9 days, increased fruit

set (64.75 and 60.21%) as compared to 36.95 and 25.16% in control during 2004 and 2005, respectively. However, maximum fruit yield (117.07 and 132.47 kg tree<sup>-1</sup>) was attained by medium pruning regime as compared to 93.63 and 98.93 kg tree<sup>-1</sup> fruit yield in control during 2004 and 2005 in Red Delicious apple. Robinson et al. (2006) reported that the yield per tree was largely affected by the severity of pruning and the yield was greatest in the least pruned peach trees. Shaban (2009) observed that moderate pruning and GA<sub>3</sub> at 50 ppm proved to be the most effective treatment for improving yield of Zebda mango trees in the off-year season. Demirtas et al. (2010) reported that the highest average yield considering trunk cross-sectional area was obtained as 0.34 kg cm<sup>-2</sup> from pre-harvest summer pruning treatment and the highest share of flower bud was observed as 68.29% in pre-harvest summer + winter pruning treatment in apricot.

Mohamed et al. (2011) reported that shortening 1/3 branches level treatment gave the highest yield (33.62 kg/tree) followed by tipping (31.47 kg/tree), shortening 1/2 branches level (21.72 kg/tree) than control trees (19.41 kg/tree) in plum. Summer pruning increased light penetration within the tree canopy which strengthen spurs and increase flower bud formation. Also, buds break at the base of pruned shoots and develop into fruiting spurs due to summer pruning. Summer pruning performed on growing shoots removed apical dominance, released lateral buds from correlative inhibition and changed tree form and construction which in turn, increased flower bud initiation from lateral buds and increased the yield.

### **EFFECT OF SUMMER PRUNING ON RETURN BLOOM**

Miller and Byers (2000) reported in peach cv. Balke that the return bloom was lowest in trees which were left unpruned or were severely pruned than the light and heavily pruned trees. Li et al. (2003) reported that summer pruning in apple alone did not affect the return bloom or root growth within commercial canopy ranges. Li and Lakso (2004) reported that within commercial cropping ranges, light and moderate summer pruning alone in apple did not affect return bloom or root growth, however, the potential negative effect of summer pruning on fruit growth, return bloom and fine root survival can be predicted through their relationships with physiological factors. Maas (2005) noticed that summer regrowth caused the loss of terminal flower buds in 'Conference' and 'Doyenne du Comice' pears.

### **EFFECT OF SUMMER PRUNING ON FRUIT PHYSICAL CHARACTERISTICS**

Severely pruned trees produced heavier and large sized fruit, with a higher percentage of fruit in 80 mm diameter of large category (Bound and Summers, 2001). Bruno

and Evelyn (2001) noticed that shoot tipping in cherimoya at 10 buds and its combination with bark girdling resulted in an increase of 25% in fruit weight. Sonali et al. (2001) found that different levels of pruning increased fruit weight in litchi. Kaundal et al. (2002) also reported the enhanced fruit size with ascending pruning severities in Pratap peach trees. Rather (2006) reported that highest fruit volume (280.57 and 305.06 cm<sup>3</sup>) was attained by medium pruning regime as compared to 102.30 and 111.17 cm<sup>3</sup> fruit volume in control during the years 2004 and 2005, respectively in 'Delicious' apple. Firmness was recorded more in light pruning whereas organoleptic rating was found superior by medium pruning in both years of study in Red Delicious apple. Hossain et al. (2006) observed that fruit maturation was accelerated in summer-pruned peach trees. Mohamed et al. (2011) reported that the highest values of weight, size, length, diameter, shape and flesh thickness were recorded by shortening 1/3 branches level followed by shortening 1/2 branches level, tipping than control trees in both seasons in plum.

Fruit size, weight and volume were similarly increased by summer pruning. Pruning decreased the fruit load and as the number of fruits was less, the available food material reached the individual fruit in sufficient quantity.

#### **EFFECT OF SUMMER PRUNING ON FRUIT COLOUR**

Prakash and Nautiyal (1994) also noticed greater red colour from the severely pruned peach trees than the moderately and lightly pruned ones. Francisconi et al. (1996) observed in peach cultivar Marli that removal of more than 50% of current shoots significantly increased fruit surface colouration. Singh et al. (1997) also reported significant effect of pruning on colour development in peach fruits. Thinning cuts and heading cuts made it possible to pick a large number of total and highly coloured fruits earlier than following heading cuts in 'Yataka Figi' (Yongkoo et al., 2000). Li et al. (2003) reported that by conducting summer pruning, the canopy size can be controlled and light availability to fruit for red colour development can be improved without undesirable post pruning regrowth by summer pruning. Dussi et al. (2004) when conducted summer pruning in Red Delicious apple tree noticed an increase in red colour. Rather (2006) noticed that fruit colour was superior in medium pruned in Red Delicious apple. By conducting summer pruning, the canopy size can be controlled and light availability to fruits for red colour development can be improved without undesirable post pruning regrowth by summer pruning.

#### **EFFECT OF SUMMER PRUNING ON FRUIT CHEMICAL CHARACTERISTICS AND STORAGE**

Sonali et al. (2001) revealed that 5 levels of pruning in

litchi trees increased T.S.S. and total sugars and ascorbic acid content. In Redhavan peach trees, the buds of pruned plants had higher soluble sugars and starch content than the unpruned ones (Vitagliano et al., 2001). Kaundal et al. (2002) reported that the TSS acid ratio and total sugar in peach was enhanced with increase in pruning severity. Mahajan and Dhillon (2002) observed that the pruning at 75% produced the highest TSS; whereas, the highest acid content was noticed in unpruned plants of Shan-e-Punjab peach. Singh and Chauhan (2002) reported in July Elberta peach that the total soluble solids content increased with increasing pruning severity. Sharma and Chauhan (2004) further reported that heavy pruning where cutting back the annual shoots to 75% of their original length was done in July Elberta peach produced higher TSS, acidity and total sugars as compared to pruning treatment where cutting back of annual shoots to 25 and 50% was performed. Rather (2006) reported that TSS and total sugar was found superior by medium pruning and acidity was noticed more in control in both years of study in 'Red Delicious' apple. Hossain et al. (2006) observed that fruit maturation was accelerated in summer-pruned peach trees, which resulted in higher soluble solids content (SSC) and lower titratable acidity (TA) in the fruit. Qing et al. (2006) reported in Kyolea cultivar of peach that the fruit soluble solids content of 15 cm branch was slightly higher than that of branches with 35 to 60 cm and more than 60 cm in length.

Hassani and Rezaee (2007) reported an increase in fruit TSS of peach with the increase in the pruning severity. Mercier et al. (2008) reported that manual pruning enhanced the fruit quality measured in terms of increased total soluble solids in peach. The increased rate of photosynthesis led by more light penetration into the interior tree canopy increased the soluble solids in fruits harvested from pruned trees. Summer pruning accelerates fruit maturation which resulted in higher soluble solid content and lower titratable acidity. Summer pruning significantly enhanced fruit calcium which resulted in decrease in incidence of calcium related disorders like bitter pit, cork spot, thereby extending the shelf life of fruits. Summer pruning has the potential to reduce the competition between shoot growth and fruit for available calcium which increased calcium levels in fruits.

#### **EFFECT OF SUMMER PRUNING ON EVAPOTRANSPIRATION**

There may be other advantages of summer pruning beyond fruit colour and tree size control. Removing leaves by summer pruning can be expected to reduce total canopy water loss (transpiration), and consequently improve tree water status. In Washington State, heavy summer pruning has been used to help pear and peach orchards survive in severe drought seasons (Li et al., 2001). Therefore, in dry years or areas, summer pruning

might help relieve drought-induced reductions in fruit growth.

## EFFECT OF SUMMER PRUNING ON CANOPY WATER LOSS AND WATER STATUS

Summer pruning reduced canopy transpiration rate which indicates that less water is lost through the leaves after summer pruning. Tree water status for fruit expansion is improved after summer pruning (Li et al., 2001). Therefore, for overall fruit growth, improved tree water status might compensate for the shortage of carbohydrate supply in drought years. The reduction in canopy transpiration after summer pruning, however, might affect the impact of carbohydrate imbalance by improving tree water status.

## CONCLUSION

Summer pruning caused minimum vegetative growth which increased fruit yield by way of increasing flower bud formation and return bloom as well. Growth has been suppressed, the year of pruning due to reduced supplies of photosynthates or growth regulators from tree top during the late summer. Growth might also be suppressed due to the restricted root system following summer pruning. Summer pruning increased the light exposure of spur leaves in the interior apple canopy. Previous canopy shade reduced the apparent photosynthetic ability of the interior leaves. If summer pruning is done correctly, fruit colour development could be significantly improved without any other losses of yield or quality. The fruits retained better quality characteristics in terms of size, weight, volume, colour change, firmness, organoleptic rating, physiological loss in weight, spoilage, acid content, total soluble solids, sugars (total, reducing and non-reducing sugars) and calcium content due to summer pruning.

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