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Effect of pruning and fruit thinning on yield and fruit weight of peach (*Prunus Persica* (L) Batsch) cv. Shan-i-Punjab in sub-mountain zone of Punjab—An on-farm study

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Abstract

Fruit and shoot management in peaches (*Prunus persica* L.) is an important intervention to improve fruit quality and its yield . Studies were conducted through on-farm trials at farmer's fields in Ropar (Punjab) district during 2006-2009 to evaluate the technology of pruning and fruit thinning and its effects on crop yield and fruit quality in six-year-old peach cv. *Shan-i-Punjab* trees with three treatments *viz.*, T_1=50% pruning of fruitful shoots + cutting of dead and diseased wood in early-January, T_2=T_1+ Fruit thinning during mid-March and T_3=No pruning and no fruit thinning (Farmer Practice-FP). The pruning treatments caused the development of an abundant number of long shoots, which are valuable for fruiting. Mean fruit yield was 50 kg per plant in T_1; 48 kg per plant in T_2 and 32 kg per plant in T_3 (FP). Mean fruit yield was 56.25 % higher in T_1 over T_3 (FP) and by 50.00% higher in T_2 over T_3 (FP). Results revealed that mean fruit weights were 55.10, 70.10 and 41.00 grams in T_1, T_2 and T_3 respectively during 2006-07. Mean fruit weight was 34.39 % higher in T_1 over T_3 (FP) and it was 70.97 % higher in T_2 over T_3 . Similar trend was observed during the following years 2008 & 2009 at all the locations except in 2009 where non-significant reduction in fruit yield was noticed in T_2 over T_3 . The highest benefit cost ratio was obtained in T_2 (3.31) followed by T_1 (3.20) and T_3 (2.32). It was concluded that economic fruit yield can significantly be obtained by imposing 50% pruning of fruited shoots and cutting of dead and diseased wood during early January followed by fruit thinning in mid- March in peaches cv. Shan-i- Punjab in sub mountain zone of Punjab.

Key words: *Prunus persica,* pruning, fruit thinning, fruit yield, fruit weight, farmer practice

Introduction

The Ropar district of Punjab has an immense scope for cultivation of fruit crops. Fruit production is one of the potential alternatives to rice-wheat cropping system particularly in this region. Farmers are growing peach through traditional techniques to supplement their income. They are not aware regarding the utility of pruning and fruit thinning technology and do not follow the recommended practice in peaches. Peach tree differ from most other kind of fruit trees because they bear fruits only on shoots that grew the previous season and never on spurs. Because of this, it is necessary to keep the tree in a high state of vigour through adequate pruning and through proper fertilizer application so that plenty of new wood is formed in each year. In the bearing peach trees, the weight of fruit and tendency of tree to grow toward light lead to an upward and outward shift of fruiting wood. Unless counteracted, this trend by pruning, the tree will develop only thin layer of fruiting wood in the upper, outer portion leading to lower yield of poor quality fruit. According to Miller (1995) excessive vigor is often a significant problem in deciduous fruit tree orchards, particularly in apple and peach trees, and implied a diminution in light penetration, yield and fruit quality and an increase in pruning and pest control cost. Numerous methods are available for regulating vegetative growth in deciduous fruit tree species (Miller and Tworkoski, 2003). Pruning is an essential cultural practice in the production of peaches. Norton (2002) reported that intensive pruning stimulates the regeneration processes as well as modifies the size of tree crowns, particularly decreasing the excessive tree height. Pruning establishes the structure of the tree, its shape and form, provides a framework to support the crop and facilitate mechanical operations. As trees age, pruning removes broken and diseased wood, stimulates new growth, and provides essential light distribution throughout the tree for the formation of strong fruit buds and acceptable fruit quality with appropriate fruit color, soluble solids, and ripeness. In addition, since peaches are extremely fruitful, pruning can be used to judiciously remove a significant portion of the unwanted potential crop at a lower cost than hand thinning. Pruning contributes to an increase in young shoot and peach growth, as it limits shade and improves the nutrient supply to shoots by the roots (Cannell and Kimeu, 1985). However, severe pruning applied in every year resulted in low tree vigour and subsequently poor fruit quality and yield. Crop load has been considered as the main factor of fruit size variations in apple (*Malus domestica)* and peach (Blanco *et al.*, 1995; Marini, 1995). Different factors may influence fruit size and quality in peaches. Light environment in the peach tree canopy appears determinant, since shade contributes to decreased fruit growth (Chartzoulakis *et al.*, 1993). Tree pruning, one of the most important techniques in orchard management, influences the balance between vegetative growth and cropping. Peach trees (*Prunus persica* L.) in most countries are often pruned by the traditional "short pruning" method. On the north China plain, excessive tree vigour, especially on the top parts of the tree canopy, encouraged by hard pruning and a deep fertile soil, results in death of some branches and reduction of light transmission in the middle, basal, or inner parts of tree canopy.

All pruning cuts can be classified as either heading or thinning. Heading cuts are those made into the previous year's shoots or branch at branch point wood. Thinning cuts remove all of a shoot or branch at branch point. Fruit thinning is usually performed in peach orchards in order to improve fruit size (Corelli-Grappadelli and Coston, 1991; Pavel and Dejong, 1993). Sansavini *et al.* (1985) reported that the principal aim of thinning is to optimize the leaf-to-fruit ratio.

Our objective was to test the effects of pruning and fruit thinning intensity on fruit yield and quality in peach trees. In the present investigation different treatments of pruning and fruit thinning were evaluated in comparison to the farmer practice generally followed in peach orchards in the district so as to assess and refine the technology at the farmer's fields for better adoption rate.

Materials and methods

Studies were conducted at farmer's fields through on-farm trials on six years old peach cv. Shan-i-Punjab trees most commonly grown in Punjab. The selected plants were of uniform in size, age and vigour. The trees were trained in a modified leader system. The experiment involved five replications at each location in each treatment during the years 2006 to 2009. Each block consisted of five trees arrayed in the same row. Three treatments were applied to the examined trees during 2006-07. The treatments *viz.*, T_1=50% pruning of fruitful shoots + cutting of dead and diseased wood in early January, T_2=T_1+ Fruit thinning during mid-March, and T_3=No pruning and no fruit thinning (farmer practice-FP) were applied. In pruning, heading cuts were made into last year wood to shorten or stiffen shoots and thinning cuts were made to remove entire limbs and fruitful shoots. Pruning was done in first week of January. Fruit thinning was done in mid-March at all the locations. Only one healthy fruit was kept with 10 to 15 centimeter shoot length during the period under report. The treated trees were managed in accordance with recommendations of Punjab Agricultural University, Ludhiana. All the trees received routine horticultural care except for pruning and thinning, which varied according to the treatments. The experiment was repeated in 2007-08 and 2008-09. Fruit yields were recorded in each treatment and fruit weights were recorded on randomly selected fifty fruits from each treatment in every year. The obtained results were statistically analysed in complete randomized block design of experiments. The significance of differences was estimated at the confidence level of $P = 0.05$.

Climate and soil characteristics: In general, the climate of the area is sub-tropical and is characterized with hot summer with mean maximum temperature of 41 ± 3°C in June and cool winter with mean minimum temperature of around 4° ± 2°C in December. The average annual rainfall in the study area varied from 900-1300 mm of which about 75-80% was received during *kharif* season and rest (20-25%) during *rabi* season. The physical properties of the soil are however, favorable for fruit production. The pH of the soils was in the range of 7.23 to 8.19 and the organic carbon was 0.325-0.555 percent.

Results and discussion

The data in the Table 1 show that in 2006-07, the mean fruit yield in T_1 was 50.00 kg per plant followed by 48.00 kg per plant in T_2 and 32.00 kg per plant in T_3 (Farmer Practice-FP). The difference in fruit yield in T_1 and T_2 was not significant. However, the differences in fruit yields in T_1 and T_3 (FP); T_2 and T_3 (FP) were significant. The mean fruit weight in T_2 was 70.10 g followed by 55.10 g in T_1 and 41.00 g in T_3 (FP). These differences in fruit weight was significant in all treatments.

The perusal of the data in Table 2 shows that in 2007-08, the mean fruit yield in T_1 was 42.00 kg per plant followed by 38.00 kg per plant in T_2 and 30.00 kg per plant in T_3 (FP). The difference in fruit yield in T_1 and T_2 was not significant. However, the differences in fruit yields in T_1 and T_3 (FP); T_2 and T_3 (FP) were significant. Mean fruit weight of 78.20 g was recorded in T_2 followed by 62.10 g in T_1 and 44.00 g in T_3 (FP). These differences were significant in all treatments.

Table 1. Effect of pruning and fruit thinning on fruit yield in peach cv. Shan-i-Punjab at different locations in Ropar district during 2006-07

Treatment	Fruit yield (kg per plant)						Fruit weight (g)					
	*L_1	L_2	L_3	L_4	L_5	Mean	L_1	L_2	L_3	L_4	L_5	Mean
T_1	58.00	42.00	55.00	45.00	50.00	50.00	60.50	49.70	55.80	58.20	51.30	55.10
T_2	44.00	42.00	49.00	53.00	54.00	48.00	65.00	70.10	74.10	71.00	70.50	70.10
T_3 **(FP)	28.00	36.00	36.00	28.00	32.00	32.00	38.00	44.00	45.00	42.00	36.00	41.00
LSD(0.05)						8.50						5.75

Table 2. Effect of pruning and fruit thinning on fruit yield in peach cv. Shan-i-Punjab at different locations in Ropar district during 2007-08

Treatment	Fruit yield (kg per plant)						Fruit weight (g)					
	*L_1	L_2	L_3	L_4	L_5	Mean	L_1	L_2	L_3	L_4	L_5	Mean
T_1	44.00	46.00	36.00	40.00	44.00	42.00	66.00	58.20	65.00	59.00	62.30	62.10
T_2	35.00	32.00	43.00	42.00	38.00	38.00	80.00	75.00	73.00	82.00	82.00	78.20
T_3 **(FP)	26.00	33.00	31.00	28.00	32.00	30.00	48.00	46.00	38.00	43.00	45.00	44.00
LSD(0.05)						6.72						5.27

Table 3. Effect of pruning and fruit thinning on fruit yield in peach cv. Shan-i-Punjab at different locations in Ropar district during 2008-09

Treatment	Fruit yield (kg per plant)						Fruit weight (g)					
	*L_1	L_2	L_3	L_4	L_5	Mean	L_1	L_2	L_3	L_4	L_5	Mean
T_1	58.00	54.00	55.00	59.00	49.00	55.00	60.00	62.00	54.00	52.00	62.00	58.00
T_2	45.00	48.00	52.00	54.00	46.00	49.00	63.00	58.00	62.00	56.00	61.00	60.00
T_3 **(FP)	46.00	52.00	48.00	51.00	53.00	50.00	28.00	32.00	37.00	38.00	40.00	35.00
LSD(0.05)						NS						6.66

*L-Location **FP-Farmer Practice

Table 4. Effect of pruning and fruit thinning on % increase in yield and fruit weight and in peach cv. Shan-i-Punjab in Ropar district

Treatment	2006-07				2007-08				2008-09			
	Yield (kg per plant)	Increase in yield over T_3 (%)	Fruit weight (g)	Increase in fruit weight over T_3 (%)	Yield (kg per plant)	Increase in yield over T_3 (%)	Fruit weight (g)	Increase in fruit weight over T_3 (%)	Yield (kg per plant)	Increase in yield over T_3 (%)	Fruit weight (g)	Increase in fruit weight over T_3 (%)
T_1	50.00	56.25	55.10	34.39	42.00	40.00	62.10	41.13	55.00	10.00	58.00	65.71
T_2	48.00	50.00	70.10	70.97	38.00	20.00	78.20	77.72	49.00	-2.0	60.00	71.42
T_3 *(FP)	32.00	-	41.00	-	30.00	-	44.00	-	50.00	-	35.00	-

*FP-Farmer Practice

Table 5. Effect of pruning and fruit thinning on benefit cost (B:C) ratio in peach cv. Shan-i-Punjab in Ropar district

Treatment	Mean yield (kg per plant)	Mean Fruit weight (g)	Average cost of cash inputs (Rs. per plant)	Average gross returns (Rs. per plant)	Average net returns (Rs. per plant)	B:C Ratio
T_1	49.00	58.40	275.00	882.00	607.00	3.20
T_2	45.00	69.40	339.00	1125.00	786.00	3.31
T_3*(FP)	37.30	40.00	241.00	559.50	318.00	2.32

*FP-Farmer Practice; Market rate-Rs 18 to 25 per kg (Larger fruits fetched more price)

The data in Table 3 indicate that non-significant higher fruit yield of 55.00 kg per plant was obtained in T_1 followed by 50.00 kg per plant in T_3 and 49.00 kg per plant in T_2 in 2008-09. Mean fruit weight of 60.00 g was recorded in T_2 followed by 58.00 g in T_1 and 35.00 g in T_3. The difference in fruit weight in T_1 and T_2 was non-significant. However, the differences in fruit weights in T_1 and T_3; T_2 and T_3 were significant.

It is evident from the data in Table 4 that there was 56.25 % increase in mean fruit yield in T_1 and 34.39 % in T_2 over T_3 (FP) in 2006-07. Increase in mean fruit yield was 40 % in T_1 and 20 % in T_2 over the T_3 in 2007-08. In 2008-09, the increase in fruit yield was 10 % in T_1 over the T_3. However, non-significant reduction in fruit yield was noticed in T_2 over the T_3. Percent increase in mean fruit weight was 70.97 in T_2; 34.39 in T_1 over the T_3 in 2006-07. Similar trend in mean fruit weights was also observed during the year 2007-08 and 2008-09 as shown in the table 4.

Economic returns: The comparison of economics related to different shoot and fruit management practices adopted in different treatments has been given in Table 5. Average cost of cash inputs incurred for the different treatments was different, because of different pruning and thinning treatments. However, because of variation in average fruit yield and fruit weight in different treatments, average gross returns to the growers were higher from T_2 as compared to other treatments (Table 5). Average gross returns were linearly related to the average fruit yield and its weight obtained from specific treatments. Additionally, average net returns in specific treatments was worked out by subtracting the average cost incurred also reflects positive effect of applying treatments of fruit thinning in addition to pruning in T_2. Average net returns was highest in T_2 (Rs. 786 per plant) followed by T_1 (Rs. 607 per plant) and T_3 (Rs. 318 per plant). Furthermore, highest benefit cost (B:C) ratio of 3.31 obtained (average gross returns / average cost of cash inputs) in T_2 followed by T_1 (3.20) and T_3 (FP) (2.32), demonstrates the superiority of applying T_2=50% pruning of fruitful shoots + cutting of dead and diseased wood in early January + fruit thinning during mid-March.

The experimental results indicated that 50 % pruning of fruitful shoots and removal of dead and diseased wood along with fruit thinning stimulates new growth and provides essential light distribution throughout the tree for formation of strong fruit buds and acceptable fruit quality and yield. The results were similar to the findings of Ferree and Palmer (1982) and Norton (2002) who reported that the amounts of photosynthates available for fruit growth should be increased with severe pruning, which probably explains the higher fruit growth observed during the period under report. Vegetative growth enhancement caused by pruning was likely to stimulate leaf-to-fruit ratio compared to light pruning for a same fruit load on the trees. The main source of newly synthesized carbohydrates for peach growth seems to be lateral shoots, however, when extension shoots are actively growing they preferentially support their vegetative growth before fruit growth. Cultural practices which limit shade and promote lateral shoot growth in the canopy may improve peach quality. The hypothesis was advanced that for a given crop load of peach trees (*i.e.*, a constant thinning level for the whole tree), reducing the number of shoots bearing fruit by pruning would modulate fruit growth and quality. The tree crown fruit bearing zone decreased by pruning was compensated by the more valuable and productive thick, long and vigorous shoots.

It was observed that properly performed intensive pruning of trees did not decrease the yield in the third year, in comparison with the non-pruned control trees. It is concluded that 50% pruning of fruitful shoots + cutting of dead and diseased wood in early January + fruit thinning during mid-March resulted in higher fruit yield of better quality as compared to the Farmer Practice. Therefore, it is proposed that shoot and fruit management should be so designed as to produce vigorous growth of shoots to obtain economic yield of high quality fruits in peaches under sub-mountain conditions of Punjab.

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