

Economic impact of extensive pollination through honey bee in peach orchard

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ABSTRACT

A field experiment was conducted to find out the effect of bee foraging in peach crop during 2006 to 2010 under agro-climatic conditions of Doon Valley. The two treatments (with honey bee and without honey bee boxes) were imposed to Sanpedro peach orchard at pink bud stage. The higher number of fruit set per tree (527.50), number of fruits at harvest (464.08), yield (22.03 kg/tree) and minimum fruit drop per tree (14.38%) were observed with bees which were significantly better as compare to without bees. The per hectare return with higher B: C ratio was also observed in peach cultivation in with bee's treatment.

Key words: Peach, honey bees *Prunus persica*, cost of cultivation.

INTRODUCTION

Peach (*Prunus persica*) is a popular fruit crop of temperate region. In India, it is commercially grown in the mid hill zones of Himalayas. Low chilling peaches are grown in subtropical regions, particularly in Uttarakhand, Western Uttar Pradesh, Haryana and Punjab. There is a wide diversity in peach cultivars prevailing in these regions (Saran *et al.*, 3). In the recent past, some exotic peach cultivars were also introduced, which are thriving very well under subtropical fringes of Doon Valley, Uttarakhand. The cultivar (Sanpedro) was around 30-40 days early than the temperate peaches and thus provided high returns to growers (Krishna *et al.*, 2).

Most of the peach cultivars are self-fertile and a few are self-sterile. Many self-sterile cultivars have been largely or completely eliminated from the market regardless their good traits, because insect pollination and inter-planting of cultivars are necessary. Bees are more effective as pollinator in cultivars with rosaceous flowers. The extent of pollination actually accomplished by wind as compared to insects is unknown. The evidence indicates that their presence in the orchard is important as a pollinator for peaches. Both yield and quality of the fruit are dependent upon the intensity and diversity of pollination. The growers are fortunate enough to have in that the peach flowers attractive hence ample pollination is obtained free of cost when conditions are favourable. Insufficient and inferior pollen transfer can lead to poor fertilization of ovules, non-symmetrical fruit, and high rates of fruit drop. Many of these problems can be avoided by placing honey bee colonies in the orchard during the bloom period

(Ferrari, 1). The proper use and placement of honey bee colonies may help to insure maximum benefits. The present study was undertaken to quantify the effect of bees in term of fruit yield.

MATERIALS AND METHODS

The present investigations were carried out during 2007 to 2010 at G.B. Pant University of Agriculture & Technology, Horticulture Research and Extension Centre, Dhakrani, Dehradun, Uttarakhand, (elev. 600 m; lat. 28°42' N and long. 77°35' - 81°5' E). The selected genotypes of eighteen-year-old trees budded on Kabul Greengage rootstock planted at 6 m × 6 m spacing received uniform training and pruning contributed as experimental plant material. The trees selected were of uniform age (26 years) in the orchard.

The observations on fruit yield and yield attributing traits were recorded during 2007 and 2010. In these years, 60 bee boxes were kept in orchard. During 2008 and 2009 the experimental orchards were kept without bee boxes (6 km periphery) to compare the yield. The twelve trees in each year were randomly chosen for observations from pink bud to fruit maturity stage. Each tree represented a replication. The observations were recorded in twelve trees to estimate the effect of bees. The quantitative traits *viz.*, number of flowers per tree, number of fruit set per tree, number of fruits at harvest, fruit weight (g), yield (kg/tree) and fruit drop per tree (%) were observed. The statistical analysis of the data was carried out using standard statistical procedures.

The cost of cultivation of peach orchard (one hectare) was calculated from 2007 to 2010 and data were pooled as with (2007 & 2010) and without bees (2008 & 2009), separately. Primary data were collected

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personally as per cost & returns during the period and analyzed as following procedures.

$$\text{Depreciation} = \frac{\text{Purchase price of asset} - \text{Junk value}}{\text{Number of expected useful years of life}}$$

After calculating total annual depreciation of the farm, the depreciation for a peach was worked out.

$$\text{Depreciation for crop 'X'} = \frac{\text{Total annual depreciation}}{\text{Total cropped area}} \times \text{Area under peach}$$

Since the structure of cost for the cultivation of henna is quite different to the traditional crop farming, the Establishment Cost and Maintenance (Fixed and Variable) Cost concepts are devised.

$$\text{Cost of production} = \frac{\text{Cost of cultivation per unit area} - \text{Value of by-product per unit area}}{\text{Quantity of main product produced per unit area}}$$

In case of peach the value of by-product was considered as zero.

Returns

i) Gross returns: $GR = QP \times PP$

Where, GR = Gross return, QP = Quantity of Produce, PP = Price of Produce

ii) Net Return: It is the residue after deducting all cost items *i.e.*, total costs from the gross returns.

iii) Return over maintenance cost = Gross return – Total maintenance cost

For the present analysis, present value of future cash flow has been worked out by discounting the estimated returns and costs at 12 per cent rate of interest, the rate of borrowing money from the financial institutions in the study area.

RESULTS AND DISCUSSION

The pooled mean for yield and contributing traits indicated that the bee foraging had significant effect as given in Table 1. The number of fruit set per tree (527.50), number of fruits at harvest (464.08), yield (22.03 kg/tree) and minimum fruit drop per tree (14.38

%) were observed significantly higher with bees as compared to without bees. This may be due to adequate pollination by bees as reported by Ferrari (1) in nut fruits. Non-significant impact of bee pollination was observed in case of number of flowers per tree and fruit weight due to lack of influence on both the traits. The higher fruit weight (52.87 g) observed in orchards without bees as compared to with bee may be due to higher fruit setting. In case of better fruit set, thinning is recommended to improve the fruit size in peaches as reported by Ferrari (1). Similarly, Ying *et al.* (5) also reported that the *Apis mellifera* L. was important vectors for pollen transfer, fruit set and yield improvement in avocado.

The data recorded in Table 2 showed that, on an average, the total fixed cost per hectare for peach crop with bees was Rs. 5,329 and without bees Rs. 5,299. Under this cost interest on fixed capital (Rs. 525) was higher in the treatment with bee while depreciation (Rs. 612) was higher in the orchard without bees. On an average the total variable cost per hectare with bees and without bees of peach crop was estimated to be Rs. 31,390 and Rs. 28,654, respectively. Under total variable cost, cultural practices, human labour and harvesting & transporting involved higher investment in orchard with bees while tractor labour, manure & fertilizers, plant protection measures and interest on working capital was high in orchard without bees. The total cost was calculated to be Rs. 36,719 in orchard with bees and Rs. 33,953 in case of orchard without bees. The average cost of production in orchard with bees and without bees was Rs. 13.35 kg⁻¹ and Rs. 15.09 kg⁻¹ respectively.

The higher yield (2,750 kg ha⁻¹), gross return (Rs.52,250 ha⁻¹), net return (Rs. 15,531 ha⁻¹) was observed in orchard with bees as compare to without bees. The higher B: C ratio (1.42) was also observed with bee case. Overall the better results were observed with bee cases as compared to without bees in peach crop. Honey bees has major role in apple and peach pollination and has also improve B: C ratio (Westwood, 4).

Table 1. Effect of bee pollination on yield and yield contributing traits of peach cv. Sanpedro.

Parameter	With bees (Pooled mean)	Without bees (Pooled mean)	C.D. (P=0.05)
No. of flowers/tree	579.50	568.33	76.27
No. of fruit set /tree	527.50	381.17	95.22
No. of fruits at harvest	464.08	223.83	134.77
Fruit weight (g)	49.39	52.87	5.52
Yield (kg/tree)	22.03	10.15	4.65
Fruit drop (%)	14.38	37.98	17.18

Table 2. Cost of cultivation (Rs.) in peach cv. Sanpedro.

S. No.	Particulars	With bees (2007 & 2010)	Without bees (2008 & 2009)
Fixed cost items			
1.	Interest on fixed capital	525	457
2.	Deprecation	574	612
3.	Land revenue	30	30
4.	Rental value of owned land	4,200	4,200
A.	Total fixed cost	5,329	5,299
Variable cost items			
1.	Cultural practices	2,880	2,688
2.	Human labour	12,384	11,520
3.	Tractor labour	4,020	4,190
4.	Manures & fertilizers	2,496	2,600
5.	Irrigation charges	4,200	4,100
6.	Plant protection measures	1,064	1,200
7.	Harvesting & transporting	3,920	1,692
8.	Interest on working capital	426	664
B.	Total variable cost	31,390	28,654
	Total cost (A + B)	36,719	33,953
Returns			
1.	Yield (kg/ha)	2,750	2,250
2.	Gross return	52,250	42,750
3.	Net return	15,531	8,797
4.	Cost of production (Rs./kg)	13.35	15.09
	B:C ratio	1.42	1.25

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