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Cost and return analysis of different treatments of mulching and herbicide application on Peach (*Prunus persica* (L.) Batsch) cv. Shan-e-Punjab

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ABSTRACT

The trees of peach cv. Shan-e-Punjab were treated with different orchard floor management practices (mulching and herbicidal treatment) in the month of February 2014. In all, there were 14 treatments including mulches viz., black polythene, paddy straw, saw dust, white polythene and herbicides viz., atrazine 50 WP (1.0, 1.5 and 2.0 Kg a.i. per hectare), oxyflurofen 23.5 EC (0.5, 0.75 and 1.0 l a.i. per ha) and pendimethalin 30 EC (1.0, 1.5 and 2.0 l a.i. per ha) and control which were replicated thrice. The total cost of cultivation per hectare was found to be highest (₹ 207480.00) in treatments T1 and T2 i.e. black polythene mulch and white polythene mulch, respectively whereas, it was found to be lowest of ₹ 185240.00 in the treatment (T14) i.e. control. Among all the treatments, the benefit: cost ratio was found highest with black polythene mulch (1:1.89) followed by atrazine 2.0 kg a.i/ha (1:1.86) and lowest in control (1:1.55). Thus, for improving growth, yield and fruit quality of peach cv Shan-e-Punjab, black polythene mulch and atrazine 2.0 kg a.i/ha are found to be most suitable and economically feasible under the Jammu sub- tropics.

Keywords: Peach, mulches, herbicides, yield, cost, returns, benefit-cost ratio

Peach (*Prunus persica* (L.) Batsch) belongs to the family Rosaceae and is one of the high ranking stone fruit grown in temperate zones of the world. The main peach producing countries are Italy, USA, Greece, Spain, France, Russia and China. Introduction of cultivated peaches into India, probably, took place in later half of 19th century. Today, it is being grown in the mid hill zone of Himalaya (1000-2000 m above mean sea level) extending from Jammu and Kashmir to Khasi hills. It is also being grown to a limited scale in the hills of South India and in the North eastern region of the country. Low chilling cultivars of peach are also grown in the sub-mountainous regions of Punjab, Haryana, Delhi and Western U.P. In India, the total area under peach is estimated to be 18,000 ha with an estimated annual

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production of 93,000 metric tonnes (Anonymous, 2015 a).

In Jammu and Kashmir, peach cultivation is confined to a limited acreage, mainly in temperate zones. However, with the introduction of low chilling, high quality, prolific bearing exotic cultivars such as Flordasun, Shan-e-Punjab, Florda Red, Sun Red, Florda Prince etc. into India and their subsequent recommendation for cultivation in the sub-tropical regions of J&K state, the area under peach cultivation is increasing year after year. Total area under peach in Jammu province is estimated to be about 1,808.82 hectare with estimated production of about 2,131.37 metric tonnes (Anonymous, 2015 b).

Orchard floor management is one of the most important operations for successful orcharding and influence the growth and overall development of fruit trees. Different orchard floor management systems not only suppress the growth and development of weeds but also improve soil conditions, structure and soil nutrient status as a consequence of their biomass (Haynes and Goh, 1980). The peach orchard faces a number of production hindrances and the competition offered by weed growth is one of them. The subtropical climatic zones of Jammu division of the state are quite favourable for rapid growth of different weed plants, hence, peach trees face severe weed competition (Chanan *et al.*, 1983). Mulching has been reported to be a beneficial practice for obtaining higher yield (Patra *et al.*, 2004) which resulted in more income from orchards (Prakash *et al.*, 2007). The practice of mulching in fruit trees impart manifold beneficial effects, like, stabilization of soil temperature, reduced water loss through evaporation, resulting more stored soil moisture (Shirgure *et al.*, 2003), maintenance of soil fertility (Thakur *et al.*, 1997), suppression of weed growth (Bhutani and Bhatia, 1994), improvement in growth and yield (Pande *et al.*, 2005), reduces erosion by wind or water, checks surface run-off and suppress the weed growth (Merwin *et al.*, 1994).

In the recent years, greater emphasis is also being laid on use of herbicides for control of weeds in the orchards of stone fruits because it is reported to be convenient, economical and feasible (Bhutani *et al.*, 1983; Kumar, 1984 and Sharma, 1985). The present investigation was therefore, under taken to study benefit cost ratio of different treatments of mulching and herbicide application on peach.

Materials and Methods

The present investigation entitled was carried out at Government orchard Maralia, Jammu during 2014-15. The details about the experimental site, material used and the methodology adopted during the course of investigation are presented under following sub-heads.

Experimental Details

Treatment details

The experimental details with respect to mulch material and herbicide treatment adopted during the current investigation are given below:

T_1: Black polythene mulch, 100 μm; T_2: White polythene mulch, 100 μm; T_3: Paddy straw mulch, 10 cm thick; T_4: Saw dust mulch, 10 cm thick; T_5: Atrazine @ 1.0 kg a.i/ha (pre-emergence); T_6: Atrazine @ 1.5 kg a.i/ha (pre-emergence); T_7: Atrazine @ 2.0 kg a.i/ha (pre-emergence); T_8: Oxyflurofen @ 0.5 l a.i/ha (pre-emergence) T_9: Oxyflurofen @ 0.75 l a.i/ha (pre-emergence); T_{10}: Oxyflurofen @ 1.0 l a.i/ha (pre-emergence); T_{11}: Pendimethalin @ 1.0 l a.i/ha (pre-emergence); T_{12}: Pendimethalin @ 1.5 l a.i/ha (pre-emergence); T_{13}: Pendimethalin @ 2.0 l a.i/ha (pre-emergence); T_{14}: Control

Layout plan of the experiment

Name of cultivar : Shan-e-Punjab

Number of treatments : 14

Number of replications : 3

Total number of plants : 14 × 3 = 42

Experimental design : Randomized Block Design (RBD)

Application of treatments was done during the spring season *viz.*, 6th February, 2014. During the course of study, all the trees were given uniform cultural operations as per the package of practices for fruit crops of SKUAST-Jammu.

Yield Attributes

Fruit set (%)

During fruit development, the numbers of fruit on the tagged branches were counted to determine per cent fruit set. Per cent of fruit set was computed by using following formula suggested by Westwood (1978):

$$\text{Fruit set (\%)} = \frac{\text{Total Number of fruit set}}{\text{Total Number of flowers}} \times 100$$

Fruit drop (%)

Number of fruits present on the randomly selected branches of the trees at the time of fruit set was recorded and number of fruits retained on these branches till maturity was recorded. The data recorded was expressed as percent fruit drop.

$$\text{Fruit drop (\%)} = \frac{\text{Initial fruit set} - \text{Final fruit retention}}{\text{Initial fruit set}} \times 100$$

Yield per plant

Total numbers of fruits in each replication were counted. The counting was made two to three times for minimizing the counting error. The fruits harvested from each tree were weighed on electronic balance. The crop load removed from the tree during harvesting season of 2015 was recorded as yield per tree and expressed in kg/plant.

Economic analysis

The economics of using different orchard floor management practices in peach orchard of cv. Shan-e-Punjab have been worked out by calculating net returns for each treatment. The net returns obtained from different treatments have also been compared with control. In this analysis, only the cost of treatments for different mulching materials and cultural management practices has been considered for estimating the cost. This cost includes material as well as labour cost of the treatment. Thus, the net returns are based on the following components.

(i) Cost of treatment

The cost incurred on each treatment per hectare was worked out by taking into consideration the cost of variable inputs only *viz.*, fertilizer, basin preparation, mulching, irrigation, plant protection measures, harvesting, labour cost etc.

Variable cost (V.C) = $C_1 + C_2 +$ ………………… C_n

(ii) Gross income

Gross income was calculated by multiplying the fruit yield per hectare for a given treatment by the sale price of the fruit.

Gross income (GI) = Fruit yield × sale price

In order to evaluate the most profitable treatment, economic analysis of treatments was worked out in terms of net returns and benefit cost (B:C) ratio. The net returns and B:C ratio was calculated as follows:

Net returns were calculated by deducting the cost of cultivation from the gross income.

Net income = Gross income – Cost of treatment

$$\text{B : C ratio} = \frac{\text{Gross present value of income (B)}}{\text{Gross present value of cost (C)}}$$

RESULTS AND DISCUSSION

The data on the cost of cultivation of peach cv. Shan-e-Punjab with different mulching materials and herbicides presented in Table 1 revealed that the total cost of cultivation per hectare was found to be highest (₹ 207480.00) in treatments T_1 and T_2 i.e. black polythene mulch and white polythene mulch, respectively whereas, it was found to be lowest of ₹ 185240.00 in the treatment (T_{14}) i.e. control. The costs incurred on preparation of basin (₹ 120.00), labour charges (₹ 360.00), FYM (₹420.00), fertilizers i.e. urea, DAP and MOP (₹ 98.94), irrigation, plant protection, harvesting charges, loading/unloading, transporting (₹ 1000.00) were found to be the same in all the treatments because it was pre-requisite for analyzing the effect of mulching and herbicides. The only difference in the cost was due to variation in the cost of mulching material and herbicides. It was observed that cost incurred on herbicides application was much

Table 1: Average cost of cultivation of peach cv. Shan-e-Punjab using different mulching materials and herbicides

Items	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}
Cost of basin preparation (₹)	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00
Cost of FYM (₹)	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00
Cost of Urea (₹)	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80	13.80
Cost of DAP (₹)	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14	22.14
Cost of MOP (₹)	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00	63.00
Cost of mulching material (₹)	240.00	240.00	180.00	165.00	—	—	—	—	—	—	—	—	—	—
Cost of herbicide (₹)	—	—	—	—	1.80	2.70	3.60	10.00	15.00	20.00	3.00	4.73	6.30	—
Cost of labour (₹)	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
Miscellaneous (₹)	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
Total cost (₹) for 3 plants	2239.00	2239.00	2179.00	2164.00	2001.00	2002.00	2003.00	2009.00	2014.00	2019.00	2002.00	2004.00	2005.00	1999.00
Total cost/Plant (₹)	746.33	746.33	726.33	721.33	667.00	667.33	667.66	669.66	671.33	673.00	667.33	668.00	668.33	666.33
Total cost /ha (₹)	207480.00	207480.00	201920.00	200530.00	185426.00	185518.00	185611.00	186167.00	186630.00	187094.00	185518.00	185704.00	185796.00	185240.00

Table 2: Benefit: cost ratio analysis of peach cv. Shan-e-Punjab under different mulching materials and herbicide applications

Treatments	Average yield of peach (kg/tree)	Rate/kg fruit (₹)	Gross returns/ha (₹)	Cost of cultivation/ha (₹)	Net return/ha (₹)	Benefit: cost ratio
T_1 : Black polythene mulch, 100 μm	56.40	25.00	391980.00	207480.00	184500.00	1:1.89
T_2 : White polythene mulch, 100 μm	48.80	24.00	325593.00	207480.00	118113.00	1:1.57
T_3 : Paddy straw mulch, 10 cm thick	50.07	24.00	334067.00	201920.00	132147.00	1:1.65
T_4 :Saw dust mulch, 10 cm thick	50.15	23.00	320659.00	200530.00	120129.00	1:1.60
T_5 : Atrazine @ 1.0 kg a.i/ha (pre-emergence)	53.20	22.50	332766.00	185426.00	147340.00	1:1.79
T_6 : Atrazine @ 1.5 kg a.i/ha (pre-emergence)	54.90	22.50	343399.00	185518.00	157881.00	1:1.85
T_7 : Atrazine @ 2.0 kg a.i/ha (pre-emergence)	55.10	22.50	344650.00	185611.00	159039.00	1:1.86
T_8 : Oxyflurofen @ 0.5 l a.i/ha (pre-emergence)	49.94	23.00	319316.00	186167.00	133149.00	1:1.71
T_9 : Oxyflurofen @ 0.75 l a.i/ha (pre-emergence)	49.96	23.00	319444.00	186630.00	132814.00	1:1.71
T_{10} : Oxyflurofen @ 1.0 l a.i/ha (pre-emergence)	51.10	23.00	326733.00	187094.00	139639.00	1:1.74
T_{11} : Pendimethalin @ 1.0 l a.i/ha (pre-emergence)	49.35	23.00	315543.00	185518.00	130025.00	1:1.70
T_{12} : Pendimethalin @ 1.5 l a.i/ha (pre-emergence)	49.38	23.00	315735.00	185704.00	130031.00	1:1.70
T_{13} :Pendimethalin @ 2.0 l a.i/ha (pre-emergence)	49.45	23.00	316183.00	185796.00	130387.00	1:1.70
T_{14} : Control	47.10	22.00	288063.00	185240.00	102823.00	1:1.55

lower than the mulching material and it was found to be highest of ₹ 20.00 in T_{10} whereas in case of mulching, highest cost of ₹ 240.00 was incurred in treatments T_1 and T_2.

The data pertaining to the net returns is presented in Table 2. It is evident from the data that different mulching treatments influenced the net returns as compared to control. The black polythene gave highest net returns of ₹ 184500.00 per hectare and followed by ₹ 159039.00 with atrazine 2.0 kg a.i/ha. The lowest net returns of ₹ 102823.00 were observed in control treatment. The table further revealed that benefit: cost ratio (B: C ratio) was highest in the treatment black polythene mulch (1:1.89), followed by atrazine 2.0 kg a.i/ha (1:1.86) and lowest of 1:1.55 was recorded in control treatment. Gross returns/ha were found to be highest (₹ 3,91980.00) in black polythene mulch whereas, lowest of ₹ 2,88063.00 were found in control. This may be attributed to higher yields and superior quality of fruits with different mulching treatments. Similar estimates for gross income were reported by Kotze and Joubert (1992) where the increase was 24% and 79% under mulch treatments in apricot trees. Higher gross and net returns per hectare were calculated by Raina (1991) in apple, Sharma (2003) in

plum and Sharma (2004) in strawberry. These findings are in agreement with the work of Khokhar *et al*. (2001) who found maximum B: C ratio in grass mulch as compared to hand weeding in olive. These results are also in association with the results obtained by Prakash *et al*. (2007) in litchi and Iqbal (2014) in aonla.

Conclusion

From the present study, it can be concluded that among the different mulching and herbicidal treatments the application of black polythene mulch and atrazine 2.0 kg a.i/ha resulted in significant reduction in weed population and weed index and significant increase in weed control efficiency. The application of black polythene mulch recorded maximum net returns and benefit : cost ratio. On the basis of vegetative growth, flowering, yield and fruit quality characters, black polythene mulch and atrazine 2.0 kg a.i/ha is the ideal choice of mulch and herbicide. Therefore, from the present study it can be concluded that for improving growth, yield and fruit quality of peach cv. Shan-e-Punjab, black polythene mulch and atrazine 2.0 kg a.i/ha are found to be most suitable and economically feasible mulch and herbicide under sub tropical conditions of Jammu.

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