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Mulching and herbicidal treatment impact on weed growth and performance of low chilling peach under sub-tropical condition

P. GUPTA, D. J. BHAT, P. BAKSHI, V. K. WALI, *N. SHARMA, [1]V. M. ARYA, [2]K. K. SOOD AND A. JASROTIA

Division of Fruit Science, [1]Division of Soil Science and Agricultural Chemistry, [2]Division of Agro-Forestry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Faculty of Agriculture, Main Campus, Chatha, Jammu, J & K 180009

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ABSTRACT

Mulching and herbicidal treatment response was studied for two consecutive years to check their effect on weed growth, flowering behavior, fruit characteristics and yield of low chilling peach cultivar Shan-e-Punjab under sub-tropical conditions. Among fourteen treatments including different mulches and herbicidal concentrations, black polythene mulch recorded zero population of weeds and weed dry matter after 30, 60 and 90 days of treatment. Highest weed control efficiency and lowest weed index of 3.09 percent was observed with black polythene mulch treatment. Among tree characters, highest annual shoot extension growth (45.20 cm), leaf area (37.20 cm^2) and increase in tree volume (37.96 m^3) was recorded with black polythene mulch. Black polythene mulch was found to be superior as compared to other mulching material in term of yield attributes as it registered highest fruit set of 65.20 per cent, minimum fruit drop (30.11%) and highest fruit yield of 56.40 kg per tree. Fruits produced on tress having black polythene mulch had highest fruit weight (90.41 g), fruit length (5.90 cm), fruit diameter (4.84 cm), fruit volume (90.40 cm^{-3}), pulp weight (83.29 g) and pulp : stone ratio (11.70), followed by the fruits produced on the trees treated with 2.0 kg a.i ha^{-1} Atrazine. Black polythene mulch also proved superior in term of chemical fruit characteristics such as total soluble solids (12.25° B), vitamin C (6.97mg $100g^{-1}$ pulp), total sugars (9.52%), reducing sugars (5.14%) and non-reducing sugars (4.16%)in comparison to rest of the treatments.

Keywords: Peach, low chilling, OFM, weed management, fruit quality.

Peach (*Prunus persica* (L.) Batsch) belonging to family Rosaceae is one of the widely grown stone fruit in temperate region of the world. Cultivated peach was probably introduced into India during later half of 19th century. In India it is being grown in the mid hill zone of Himalaya at about 1000-2000 m above mean sea level extending from Jammu and Kashmir to Khasi hills. A wild type peach grows naturally in Himachal Pradesh locally called *kateru.* Though, on a limited scale but peach is also grown in the hills of South and in the North eastern region of India. Low chilling cultivars of peach are also grown in sub-tropical regions of Jammu, Himachal Pradesh, Uttrakhand, Punjab, Haryana, Delhi and Western U.P. In India, the total area under peach is estimated to be 19,000 ha with an estimated annual production of 1,25,000 metric tonnes (Anonymous, 2021). However, the productivity of peach in India is considerably lower as compared to rest of the world. Among other factors, orchard floor management is one of the most important operations for successful cultivation of fruit plants which influences the growth and overall development of fruit trees. Different orchard floor management systems helps in suppression of the weed growth, improvement in soil structure and enhancement of the soil nutrient status as a consequence of their amelioration into soil. The peach plants face 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 Union Territory of Jammu and Kashmir offers favourable conditions for rapid growth of different weeds, therefore, peach trees in orchards face severe weed competition. Mulching is well known to be a beneficial practice for obtaining higher yield resulting in more income from orchards. Mulching of fruit orchards imparts number of beneficial effects, like, regulation of soil temperature, decrease in water loss through evapo-transpiration yielding conservation of soil moisture, maintenance of soil fertility, weed growth suppression, improvement in plant growth and yield, reduction in water and wind erosion and checks run-off (Pande *et al*., 2005). In the recent years, with the development of different types of herbicides, greater emphasis is also being laid on use of weedicides for control of weeds in fruit orchards because it is considered to be economical, convenient and feasible. Keeping in view the beneficial effects of different orchard management practices, the studies were under taken to standardize the best orchard floor management practice in low chilling peach orchard.

Email: fruitbreeding.12@gmail.com

MATERIALS AND METHODS

The experimental field was situated at an elevation of 333 m above mean sea level and lies between 32° 44′ North latitude and 74° 52′ East longitude. The climatic conditions of the experimental site are sub-tropical experiencing hot and dry summer, hot and humid rainy season and cold winter months. Experiment was laid out in randomized block design with fourteen treatments *viz*., 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^{-1} at pre-emergence, T_6 : Atrazine @ 1.5 kg a.i ha^{-1} at pre-emergence, T_7 : Atrazine @ 2.0 kg a.i ha^{-1} at pre-emergence, T_8 : Oxyflurofen @ 0.5 l a.i ha^{-1} at pre-emergence, T_9 : Oxyflurofen @ 0.75 l a.i ha^{-1} at pre-emergence, T_{10} : Oxyflurofen @ 1.0 l a.i ha^{-1} at pre-emergence, T_{11} : Pendimethalin @ 1.0 l a.i ha^{-1} at pre-emergence, T_{12} : Pendimethalin @ 1.5 l a.i ha^{-1} at pre-emergence, T_{13} : Pendimethalin @ 2.0 l a.i ha^{-1} at pre-emergence and T_{14} : Control. All the treatments were replicated three times. Application of treatments was done for two consecutive years on 6th February during the spring season. During the study period, all the experimental peach trees were maintained uniformly as per the cultural practices suggested in the package of practices for fruit crops of SKUAST-Jammu. The weed flora of experimental field was examined, identified and classified into monocotyledon and dicotyledon groups, prior to the application of orchard floor management practices. A permanent 30 x 30 cm quadrant was randomly marked in each experimental plot before the emergence of weeds. Monocotyledon and dicotyledon weeds were counted on 30, 60 and 90 days after application of treatments. The data recorded on weed density was analysed using n+1 transformation. For weed dry matter accumulation estimation, the samples of weed in the experimental plot were recorded at harvest. The weeds were uprooted from the area selection at random. The weeds were oven dried at 65°C temperature for 48 hours. The results were expressed as weed dry matter accumulation in quintal per hectare.

The weed control efficiency and weed index were calculated by using the following formula.

$$\text{Weed control efficiency} = \frac{\text{Weed population in control - Weed population in treated plot}}{\text{Weed population in control}} \times 100$$

Weed index was worked out by using the following formula

$$\text{Weed index} = \frac{\text{Yield from weed free plant- Yield from treated plant}}{\text{Yield from weed free plant}} \times 100$$

For measuring annual shoot extension growth, 10 shoots from current season's growth of each plant were selected from all the 4 geographical directions and top of tree (3 from each) at random. The volume of the tree was calculated from spread and height of the tree by using the following formula:

Volume (v) = $4/3\ \pi r^2 h$

Where, r = Average tree spread, h = Tree height (m) and $\pi = 3.14$.

Average leaf area was worked out with the help of leaf area meter (Li-COR 3100) and expressed as cm^2. Observations on flowering period, duration of flowering and time of maturity were recorded by selecting four branches in all geographical directions. Per cent fruit set and fruit drop were computed by using following formula:

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

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

Fruit length and diameter were recorded with the help of Vernier Calliper and expressed as centimeters. The fruit weight, pulp weight and stone weight were taken separately on electronic balance and expressed in grams. The volume of peach fruits were determined by water displacement method. Specific gravity of fruits was determined by dividing the weight of the fruit with its volume. Total soluble solids (TSS) of peach fruits was determined with the help of hand refractometer after calibrating it with distilled water. The titratable acidity and sugar content and Ascorbic acid content was determined by the procedure suggested by AOAC (1994). The data obtained during the course of study were subjected to statistical analysis as per the method suggested by Gomez and Gomez, (1996).

RESULTS AND DISCUSSION

Major weed species

The experimental area was found to be infested with 4 monocotyledonous and 11 dicotyledonous weed species consisting of *Cynodon dactylon*, *Cyprus rotundus*, *Parthenium histerophorous*, *Sorghum helepense*, *Medicago denticulate*, *Rumex dentatus*, *Chenopodium album*, *Ageratum conyzoides*, *Solanum nigrum*, *Lepidium sativum*, *Cannabis sativa*, *Argemone*

Table 1: Effect of orchard floor management practices on weed count, dry matter accumulation, weed control efficiency and weed index of peach cv. Shan-e-Punjab. (Pooled over 2 years)

Treatments	Weed count			Weed dry matter accumulation (q ha^{-1})	Weed control efficiency (%)	Weed Index (%)
	30 Days	60 Days	90 Days			
T_1	0 (1.00)	0 (1.00)	0 (1.00)	0.00	100.00	3.09
T_2	85.17 (9.27)	222.22 (14.92)	377.77 (19.45)	10.62	36.40	16.15
T_3	0 (1.00)	159.25 (12.64)	270.36 (16.45)	3.49	79.10	13.96
T_4	0 (1.00)	129.62 (11.42)	237.03 (15.42)	3.32	80.12	13.83
T_5	0 (1.00)	70.36 (8.40)	129.64 (11.40)	2.47	85.20	8.59
T_6	0 (1.00)	55.55 (7.49)	92.53 (9.67)	2.37	85.80	5.67
T_7	0 (1.00)	37.03 (6.15)	70.36 (8.42)	2.27	86.40	5.32
T_8	0 (1.00)	103.18 (8.86)	140.73 (11.88)	2.98	82.15	14.19
T_9	0 (1.00)	55.55 (7.49)	99.99 (10.04)	2.85	82.90	14.15
T_{10}	0 (1.00)	40.73 (6.44)	74.06 (8.65)	2.70	83.83	12.20
T_{11}	0 (1.00)	88.88 (9.46)	155.55 (12.46)	3.12	81.30	15.20
T_{12}	0 (1.00)	66.66 (8.20)	114.81 (10.74)	2.98	82.10	15.15
T_{13}	0 (1.00)	55.55 (7.52)	88.88 (9.46)	2.90	82.63	15.03
T_{14}	151.84 (12.35)	322.21 (17.95)	595.55(24.41)	16.70	0.00	19.07
LSD(0.05)	**(0.34)**	**(0.97)**	**(0.85)**	**3.45**	**4.51**	

*Figure in the parenthesis is "n+1 transformed value.

Table 2: Effect of orchard floor management practices on tree characteristics of peach cv. Shan-e-Punjab. (Pooled over 2 years)

Treatments	Annual shoot extension growth (cm)	Leaf area (cm^2)	Increase in tree height (m)	Increase in tree spread (m)		Increase in tree volume (m^3)	Fruit yield (Kg/tree)
				North-South	East-West		
T_1	45.20	37.20	0.45	0.45	0.44	56.40	37.96
T_2	39.10	32.45	0.39	0.38	0.38	48.80	31.49
T_3	41.30	34.25	0.41	0.4	0.41	50.07	32.20
T_4	42.10	34.30	0.42	0.42	0.41	50.15	34.38
T_5	42.20	34.45	0.42	0.41	0.4	53.20	33.51
T_6	42.35	35.20	0.42	0.42	0.41	54.90	34.49
T_7	43.40	36.35	0.43	0.42	0.42	55.10	34.84
T8	41.10	33.25	0.41	0.41	0.4	49.94	34.74
T9	41.20	34.20	0.41	0.4	0.39	49.96	33.23
T_{10}	42.15	34.45	0.42	0.42	0.41	51.10	34.25
T_{11}	39.25	33.20	0.39	0.39	0.4	49.35	33.75
T_{12}	40.15	33.20	0.40	0.4	0.41	49.38	32.97
T_{13}	40.50	34.10	0.40	0.4	0.4	49.45	32.02
T_{14}	35.10	32.10	0.35	0.34	0.33	47.10	27.85
LSD(0.05)	**2.53**	**3.43**	**0.02**	**0.03**	**0.03**	**1.09**	**3.91**

mexicana, *Anagelis arvensis*, *Cirsium arvences* and *Launea asplanifolia*. Among the total weed flora most predominant were *Cynodon dactylon*, *Cyprus rotundus*, *Parthenium histerophorous*, *Sorghum helepense*, *Chenopodium album*, *Medicago denticulate, Rumex dentatus, Solanum nigrum, Argemone Mexicana, Anagelis arvensis, Cannabis sativa* and *Ageratum conyzoides*. Similarly Negi (2015) also observed identical weed flora in nectarine orchard in North India.

Weed Population

Perusal of data presented in Table 1 reveals that all orchard floor management practices reduced the weed density significantly in comparison to control. The weed count was zero in all the treatments except in white polythene mulch and control, where weed count of 85.17 numbers m^{-2} and 151.84 numbers m^{-2} respectively was recorded, 30 days after treatment. It is clear from the

Table 3: Effect of orchard floor management practices on flowering behavior, fruit set and fruit drop of peach cv. Shan-e-Punjab. (Pooled over 2 years)

Treatment	No. of flowers/ meter shoot length	Flowering initiation	Full bloom	End of flowering	Duration from full bloom to fruit set	Duration from fruit set to maturity	Fruit set		Fruit drop (%)
							Initial (%)	Final (%)	
T_1	39	17th Feb	28th Feb (12)	11th March (23)*	14th March (15)	15th May (63)	93.30	65.20	30.11
T_2	30	19th Feb	4th March (14)	11th March (21)	19th March (16)	25th May (68)	89.33	57.83	35.26
T_3	32	17th Feb	28th Feb (12)	9th March (21)	14th March (15)	17th May (65)	92.25	61.70	33.11
T_4	32	17th Feb	28th Feb (12)	9th March (21)	14th March (15)	17th May (65)	92.30	61.90	32.93
T_5	33	18th Feb	2nd March (13)	10th March (21)	16th March (15)	21th May (67)	92.50	62.40	32.54
T_6	33	18th Feb	2nd March (13)	10th March (21)	16th March (15)	20th May (66)	92.90	63.62	31.51
T_7	34	17th Feb	1st March (13)	10th March (22)	15th March (15)	17th May (64)	93.10	63.90	31.36
T_8	31	18th Feb	2nd March (13)	10th March (21)	16th March (15)	21th May (67)	92.00	61.20	33.47
T_9	31	19th Feb	4th March (14)	11th March (21)	18th March (15)	22th May (66)	92.10	61.40	33.24
T_{10}	33	18th Feb	2nd March (13)	10th March (21)	16th March (15)	19th May (65)	92.35	62.20	32.64
T_{11}	30	18th Feb	3rd March (14)	10th March (21)	17th March (15)	22th May (67)	91.70	60.70	33.80
T_{12}	30	18th Feb	2nd March (13)	10th March (21)	16th March (15)	19th May (65)	91.80	60.83	33.73
T_{13}	30	18th Feb	2nd March (13)	10th March (21)	16th March (15)	19th May (65)	91.90	61.00	33.62
T_{14}	20	20th Feb	6th March (15)	11th March (20)	22th March (17)	29th May (69)	87.21	54.81	37.15
LSD(0.05)	**3.86**	**-**	**-**	-	-	-	**1.84**	**1.62**	**0.04**

*Figure in the parenthesis is the number of days

Table 4: Effect of orchard floor management practices on fruit characteristics of peach cv. Shan-e-Punjab. (Pooled over 2 years)

Treatment	Fruit weight (g)	Fruit size		Pulp weight (g)	Stone weight (g)	Pulp : stone ratio	Fruit volume (cm^3)	Specific gravity	TSS (^oB)	Titratable acidity (%)	Vitamin C (mg/100 g)	Sugars		
		Length (cm)	Dia. (cm)									Total (%)	Reducing (%)	Non-reducing (%)
T_1	90.41	5.90	4.84	83.29	7.12	11.70	90.40	1.00	12.25	0.66	6.97	9.52	5.14	4.16
T_2	80.29	4.90	3.70	73.12	7.17	10.20	82.77	0.97	10.50	0.83	5.90	8.67	4.86	3.61
T_3	84.01	5.15	4.70	76.89	7.12	10.80	83.95	1.00	11.25	0.71	6.11	9.27	5.03	4.02
T_4	85.32	5.17	4.75	78.15	7.17	10.90	84.85	1.00	11.50	0.71	6.15	9.36	5.05	4.09
T_5	87.05	5.30	4.81	79.80	7.25	11.00	87.10	1.00	11.50	0.69	6.20	9.41	5.06	4.13
T_6	86.84	5.37	4.81	79.78	7.06	11.30	87.70	0.99	12.00	0.68	6.33	9.44	5.08	4.14
T_7	88.46	5.56	4.82	81.39	7.07	11.50	88.10	1.00	12.25	0.66	6.34	9.47	5.12	4.13
T_8	83.52	5.15	4.70	76.38	7.14	10.70	85.20	0.98	11.25	0.75	6.10	9.11	5.00	3.90
T_9	83.88	5.15	4.70	76.71	7.17	10.70	83.60	1.00	11.50	0.73	6.10	9.16	5.01	3.94
T_{10}	85.42	5.21	4.80	78.24	7.18	10.90	86.20	0.99	11.50	0.69	6.15	9.37	5.11	4.04
T_{11}	82.84	4.90	4.10	75.51	7.33	10.30	83.70	0.99	11.00	0.75	5.95	8.78	4.87	3.71
T_{12}	83.39	5.08	4.17	76.14	7.25	10.50	83.10	1.00	11.25	0.76	5.97	9.04	4.93	3.90
T_{13}	83.37	5.12	4.65	76.18	7.19	10.60	83.10	1.00	11.50	0.78	6.10	9.07	4.98	3.88
T_{14}	74.97	4.60	3.95	67.83	7.14	9.50	79.77	0.94	10.25	0.85	5.69	8.64	4.83	3.61
LSD(0.05)	**2.06**	**0.02**	**0.05**	**2.68**	**0.11**	**0.24**	**1.39**	**0.02**	**0.04**	**0.11**	**0.16**	**0.54**	**0.14**	**0.13**

data presented in table 1 that after 60 days of treatment, black polythene mulch maintained zero weed count whereas, application of 2.0 kg a.i ha^{-1} Atrazine and 1.0 litre a.i ha^{-1} Oxyflurofen also controlled weed growth satisfactorily with a weed count of 37.03 and 40.73 numbers m^{-2}, respectively. Maximum weed density of 322.21 numbers m^{-2} was observed in control. Black polythene maintained zero weed population even upto 90 days after treatment. Other treatments *viz*., 2.0 kg a.i. ha^{-1} Atrazine, 1.0 litre a.i. ha^{-1} Oxyflurofen and 2.0 litre ha^{-1} Pendimethalin also controlled weeds with a weed count of 70.36, 74.06 and 88.88 numbers m^{-2} respectively. Dry matter accumulation by weeds at the end of the experiment was significantly higher under control treatment (16.70 q ha^{-1}). There was zero dry matter accumulation in black polythene mulch closely followed by 2.0,1.5 and 1.0 kg a.i ha^{-1} Atrazine, 1.0, 0.75 and 0.50 litre a.i ha^{-1} Oxyflurofen, 2.0,1.5 and 1.0 litre ha^{-1} Pendimethalin and saw dust with dry matter accumulation of 2.27, 2.37, 2.47, 2.70, 2.85, 2.98, 2.90, 2.98, 3.12 and 3.32 q ha^{-1} respectively. The smaller number of weed population under black polyethylene mulching is due to the fact that black polythene mulch blocks light penetration through it and creates partially anaerobic conditions under it which are detrimental for the growth and survival of weed species and thus resulting in nil or very low weed density. The maximum dry matter accumulation of weeds (16.70 q ha^{-1}) was observed under control. Similar results pertaining to dry matter accumulation by weeds has been reported by Rao and Pathak (1998) in aonla plants planted under sodic soil. Among the herbicidal treatments, 2.0 kg a.i. ha^{-1} Atrazine recorded a lowest weed dry matter accumulation (2.27q ha^{-1}), next to black polythene mulch treatment. Lower weed dry matter accumulation resulted due to effective control of weeds and poor weed growth under different treatments. The present investigations showed black polythene to be the most effective treatment by having cent percent weed control efficiency, followed by 86.40 per cent weed control efficiency with 2.0 kg a.i. ha^{-1} Atrazine. Zero per cent weed control efficiency was recorded under control treatment. This may be due to decrease in weed population in black polythene mulch and under herbicide treatment.

Vegetative growth characteristics

Perusal of data given in Table 2 reveal that highest annual shoot extension growth (45.20 cm) was obtained under black polythene mulch while lowest annual shoot extension growth (35.10 cm) was recorded under control. The increase in annual shoot extension growth may be attributed to checking of weed growth and increased availability of soil moisture and nutrients under these treatments, as it is well known fact that mulches help in conservation of soil moisture, checking weed growth and improving soil fertility. Maximum leaf area of 37.20 cm^2 was recorded under black polyethylene mulch followed by 2.0 kg a.i ha^{-1} Atrazine (36.35cm^2). The lowest leaf area of 32.10 cm^2 was recorded under control. The maximum leaf area observed under black polyethylene mulching is probably due to better moisture conservation, maintenance of soil temperature and suppression of weed under plants mulched with black polyethylene than other mulches. The results are in agreement with the findings of Sharma and Khokhar (2006), where, they reported highest leaf area in strawberry mulched with black polyethylene. Maximum increase in tree volume was recorded under black polythene mulch as 37.96 m^3 which was found to be at par with increase in tree volume recorded under saw dust mulch, Atrazine 1.5 and 2.0 kg a.i. ha^{-1} and Oxyflurofen 0.5 litre a.i. ha^{-1}.

Flowering behavior

The data in Table 2 depicts those plants mulched with black polythene produced highest number of flowers (39) among different treatments followed by 34 in 2.0 kg a.i ha^{-1} Aatrazine and minimum as 20 in control. This effect may be due to higher suppression of weeds and retention of more soil moisture which in turn increased growth of flower primordia, increase in carbohydrate and nutrient which are essential to promote flowering in fruit plants. Weedicide application have earlier been associated with increase in flowering of stone and pome fruits (Raese, 1990). Flowering commenced earliest (17th February) with black polythene mulch, paddy straw mulch, saw dust mulch and 2.0 kg a.i ha^{-1} Atrazine, however, flower initiation was delayed in control, which was found to be on 20th February. Mandal and Chattopadhyay (1994) also reported similar findings in apple. Among the different mulching materials, plants mulched with black polythene, paddy straw and saw dust were first to come into full bloom on 28th February (12 days). Full bloom of peach cultivar Shan-e-Punjab was delayed in control *i.e*. on 6th March (15 days). Similar results were obtained by Chattopadhyay and Patra (1992) who reported earliest full bloom in pomegranate plants mulched with black polythene followed by banana trash. Date of end of flowering was last in black polythene mulching on 11th March (23 days) while, control was first to show end of flowering (20 days). These differences might probably be due to different soil hydrothermal regimes. The observations on days taken from full bloom to fruit maturity showed minimum number of days for fruit maturity in black polythene mulch (63 days) followed by Atrazine 2.0 kg a.i ha^{-1} (64 days). The maximum number of days from full bloom to maturity was recorded in control (69 days). The differences under different treatments may be because of different soil hydrothermal regimes created by

different mulches, soil moisture and nutrient conservation and higher soil temperature with the use of black polythene mulch. These results are in consonance with the results obtained by Singh *et al*. (2007) in strawberry.

Yield attributes

Perusal of data presented in Table 2 shows that black polythene mulch resulted in significantly higher fruit set of 65.20% as compared to all the remaining treatments including control where 54.81% fruit set was obtained. This may be attributed to increased in moisture and nutrient availability, creation of better soil micro-climate and vegetation free conditions. Kumar *et al.* (1999) also reported similar findings in apple. Different herbicidal and mulching materials were observed to have a significant effect on fruit drop of peach. Maximum fruit drop of 37.15% was recorded under control trees. The minimum fruit drop of 30.11% was recorded under black polythene mulch. These findings are in agreement with those reported by Iqbal, (2014) in aonla. All the mulching and herbicidal treatments influenced the fruit yield in peach cv. Shan-e-Punjab. However, black polythene mulch significantly increased yield (56.40 kg/tree) as compared to all other treatments including control. The present observations are also in agreement with the findings of Sharma and Kathiravan, (2009). Among the herbicidal treatments, 2.0 kg a.i ha^{-1} Atrazine recorded highest yield of 55.10 kg/tree. Similarly results have also been reported by Thakur *et al*. (2012) in peach.

Physical fruit characteristics

The perusal of data presented in Table 4 indicates that highest average fruit weight was recorded under black polythene mulch (90.41 g/fruit), followed by Atrazine 2.0 kg a.i ha^{-1} (88.46 g $fruit^{-1}$) and least (74.97 g $fruit^{-1}$) under control. These results are in line with the findings of Sharma and Kathiravan (2009), where highest fruit weight in plums plants was reported which were mulched with polyethylene and lowest in control. The results pertaining to increase in fruit weight by the herbicidal treatments are also according to those observed by Bal and Singh, (2011). A significantly higher fruit length of 5.90 cm was recorded in plants plants mulched with black polythene followed by Atrazine 2.0 kg a.i. ha^{1} (5.56 cm). These results are in line with the findings of Ali and Gaur (2007). Highest fresh weight of pulp (83.29 g $fruit^{1}$) was found in plants mulched with black polythene and was at par with 81.39 g $fruit^{-1}$ obtained in Atrazine 2.0 kg a.i ha^{-1} treatment. Lowest fresh weight of pulp was recorded under control (67.83 g $fruit^{-1}$). These results are in agreement with the findings of Iqbal (2014). Maximum stone weight (7.33 g) was recorded in 1.0 litre a.i ha^{-1} Pendimethalin (Table 4), followed by 1.5 litre a.i ha^{-1} Pendimethalin and 1.0 kg ha^{-1} (7.25 g) Atrazine. The present observations are also in agreement with the findings of Chatha and Chanana (2007), who reported highest stone weight under herbicidal treatments as compared to black polythene mulch. Maximum pulp:stone ratio was observed in plants mulched with black polythene (11.70), followed by 11.50 under 2.0 kg ha^{-1} Atrazine. The lowest pulp:stone ratio was recorded in control (9.50). These results also in agreement with those of Chatha and Chanana (2007) who reported highest pulp:stone ratio of peach fruits under black polythene mulch and minimum in control. Maximum fruit volume (90.40 cm^3) was recorded in fruits in plants mulched with black polythene, followed by Atrazine 2.0 kg a.i ha^{-1} (88.10 cm^3). The least volume (79.77 cm^3) was recorded in fruits of control trees. These results are in agreement with the findings of Pande *et al*. (2005) in apple. Maximum specific gravity of 1.00 was observed in fruits of plants mulched with black polythene, which was found to be statistically at par with all the rest of the treatments except white polythene mulch (0.97) and control (0.94). Similarly, Kumar *et al*. (2012) also obtained highest specific gravity of strawberry under black polyethylene. Maximum leaf:fruit ratio (35:1) was observed in plants mulched with black polythene and minimum in control (32:1). Black polythene mulch treated trees had higher shoot extension growth thereby resulting in increase in number of leaf bearing nodes. Therefore, higher leaf:fruit ratio in plants mulched with black polythene may be due to increase in number of leaves per unit shoot length.

Chemical fruit characteristics

The perusal of the data given in table 4 depicts that total soluble solid were significantly affected by different mulching and herbicidal treatments and total soluble solids were recorded highest (12.25°Brix) in black polythene mulch and in Atrazine 2.0 kg a.i. ha^{-1}, while it was minimum (10.25°Brix) in control. Similarly, in guava Das *et al*. (2010) reported maximum TSS under herbicidal treatment as compared to manual weeding. The highest titratable acidity (0.85%) was found in fruits on untreated plants. The least acidity (0.66%) was recorded in fruits on plants under black polythene mulching. This reduction in acidity may be due to conversion of some of the acids to sugars under black polythene film. Among various mulches and herbicidal treatments, black polythene mulch resulted in higher total sugar (9.52%), reducing sugars (5.14%) and non-reducing sugars (4.16%), followed by (9.47% total sugar, 5.12% reducing sugars and 4.13% non-reducing sugars) in Atrazine 2.0 kg ha^{-1}. The present results are in agreement with Das *et al*. (2010) who reported maximum total, reducing and non-reducing sugars in guava plants mulched with paddy straw in comparison to control. Maximum fruit ascorbic acid content was obtained under black polythene mulch (6.97 mg/100g pulp), followed by Atrazine 2.0 kg /ha (6.34 mg/100g pulp). The improvement in fruit quality obtained by using different

mulching and herbicidal treatments may be associated with availability of better soil moisture and nutrients which ultimately led to the movement of soluble carbohydrates towards the developing fruits. Similarly, Iqbal (2014) also reported similar observations in aonla.

CONCLUSION

Present study led to the inference that among the different mulching and herbicidal treatments, black polythene mulch and Atrazine 2.0 kg a.i ha^{-1} at pre-emergence reduced weed count and enhanced the growth, yield and quality attributes of low chilling peach cultivar Shan-e-Punjab.

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