Effect of organic and inorganic mulches on growth, yield and fruit quality of peach cv Redhaven

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ABSTRACT

The present study was carried out on the effect of mulch materials on growth, yield and fruit quality of peach [*Prunus persica* (L) Batsch] cv Redhaven at experimental block of Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2019-2020. Various types of mulches like grass mulch, black polyethylene mulch, silver red polyethylene mulch, polyethylene mulch, nylon mulch mat and coir mulch were evaluated in this experiment. The results of the study showed that plant growth, yield and fruit quality of peach were significantly affected by all the mulching treatments as compared to control. The maximum increase in tree height, spread, volume, annual shoot extension growth, fruit set, lowest fruit drop, fruit yield, leaf area, leaf chlorophyll content, fruit size, weight and volume were recorded in the plants under black polyethylene mulch which was statistically at par with nylon mulch mat. The maximum fruit quality parameters like total soluble solids, titratable acidity, reducing and non-reducing sugars were recorded under nylon mulch mat.

Keywords: Peach; organic mulches; inorganic mulches; quality; yield

INTRODUCTION

Peach [*Prunus persica* (L) Batsch] is one of the important stone fruit crops of family Rosaceae. This delicious fruit is a native of China which was domesticated 4,000-5,000 years ago. In India it has spread to various parts viz low hills, mid hills and high hills to wider adaptability to climate change due to its varying chilling requirement. In India peach was introduced in early 20th century where it is cultivated mostly in Himachal Pradesh, Uttar Pradesh, Punjab, northeastern hills and Nilgiri hills of south India. In Himachal Pradesh among stone fruits peach ranks next only to plum and covers an area of 5,090 ha with an annual production of 7,262 MT (Anon 2018).

It has been observed that ground water levels declined by 0.5 to 1 m below the ground surface in many parts of the country during the last five years. These areas have been experiencing drought due to large variation in spatial-temporal rainfall (Ranjan et al 2017). It is known that market value of fruits depends on size and quality. There are different cultural practices to maintain an orchard and mulching is one of them. Mulching can be done almost any time in a year. If mulch is applied in March it has greatest effect on fruit growth and development by increasing soil temperature and maintaining soil moisture. Mulches used in fruit production are categorized into two groups viz organic and inorganic (Liang et al 2002, Pakdel et al 2013).

Inorganic mulches include various types of gravel, stone and polyethylene. Plastic mulches prevent sunlight from reaching the soil and thus inhibit growth of most of annual as well as perennial weeds (Tarara 2000). The most popular plastic mulch used worldwide is black polyethylene mulch though white-on-black and clear mulches are also used. White-on-black and silver mulches reflect 39 and 48 per cent of short wave radiations respectively (Ham et al 1993). Organic materials such as straw, hay, wood chips, sawdust, leaves, grass clippings and pine needles are common organic mulching materials. These should be applied

to a depth of 4 to 6 inches and cover the ground around a plant out to the drip line. These organic mulches have considerable impact on physical and chemical properties of the soil and make the availability of nutrient pool for enhancing crop yield and quality of fruits especially in dry conditions (Das et al 2016). Moderation of soil hydrothermal regime through the use of different kinds of mulches may enhance the yield and fruit quality in peach. The most important factor is to control soil temperature and increase moisture availability so that these remain within optimum range during the whole growing season.

MATERIAL and METHODS

The study was conducted at an elevation of 1,250 m amsl at 30° 51'N latitude and 76° 11'E longitude in the experimental farm of Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh on four-year old plants of peach cultivar Redhaven. The experiment was laid out in randomized complete block design (RCBD) with four replications and seven treatments. Twenty-eight trees having uniform vigour and size, planted at a spacing of 3 x 3 m were selected for the study. The treatments were T_1: Grass mulch (10 cm) T_2: Black polyethylene mulch (100 micron) (Fig 1), T_3: Silver polyethylene mulch (100 micron) T_4: Red polyethylene mulch (100 micron), T_5: Coir mulch (10 mm) , T_6: Nylon mulch mat (90 gsm) (Fig 2) and T_7: Control.

After harvesting of fruits, both physical and biochemical traits of fruit quality were evaluated. Ten randomly selected fruits from each experimental tree were collected and fruit size was recorded in terms of length and breadth with the help of digital Vernier calliper (Mitutoyo, Japan). The average values of fruit length and breadth were expressed in millimeter (mm). Fruit weight was measured with electronic top pan balance and the average fruit weight was expressed in gram per fruit (g/fruit). Volume of fruits was measured by water displacement method and expressed in cubic centimeter per fruit. Biochemical analysis of fruits for evaluation of quality was done as per standard procedure described by AOAC (Horowitzed 1980).

Data on the above parameters were collected and analyzed statistically (Gomez and Gomez 1984).

RESULTS and DISCUSSION

Effect of mulching on growth characters

Growth parameters were significantly affected by different mulch treatments (Table 1). Annual shoot extension growth (168.00 cm), plant height (34.96%), plant spread (33.85%), plant volume (163.50%), leaf area (46.62 cm^2) and leaf chlorophyll (2.37 mg/g fresh weight) were significantly higher under black polyethylene mulch as compared to nylon mulch mat. Results are in accordance with the findings of Joshi et al (2012) in litchi cv Rose Scented. This might be due to increased temperature under black polyethylene mulch that enhanced the microbial activity of nitrifying bacteria that access the nitrification and nitrate to plant roots under soil as reported by Khan et al (2013) in guava and Mal et al (2006) in pomegranate cv Ganesh. However plant growth is influenced by the use of mulch such as enhanced moisture content, reduced competition for light and availability of nutrients, absence of weeds, pest reduction and increased soil temperature in banana (Agrawal and Agrawal 2005). Different types of mulches

Fig 1. Black polyethylene mulch

Fig 2. Nylon mulch mat

Table 1. Effect of organic and inorganic mulches on growth parameters of peach cv Redhaven

Treatment	Annual shoot extension growth (cm)	Increase in plant height (%)	Increase in plant spread (%)	Increase in plant volume (%)	Leaf area (cm^2)	Leaf chlorophyll content (mg/g fresh weight)
T_1	150.70	32.61 (34.18)	30.00 (33.19)	148.25	44.42	2.12
T_2	168.00	34.96 (36.23)	33.85 (35.56)	163.50	46.62	2.37
T_3	155.75	32.26 (34.58)	31.22 (33.92)	145.25	45.23	2.24
T_4	146.00	30.69 (33.62)	27.6 (31.67)	138.25	44.68	2.14
T_5	151.50	32.23 (34.57)	28.23 (32.07)	143.75	44.73	2.18
T_6	164.00	33.58 (35.39)	32.23 (34.56)	161.75	45.68	2.29
T_7	145.50	28.42 (32.19)	25.34 (30.19)	135.73	41.40	2.05
$CD_{0.05}$	4.34	1.90	0.69	9.84	2.6	0.13

T_1: Grass mulch (10 cm) T_2: Black polyethylene mulch (100 micron), T_3: Silver polyethylene mulch (100 micron) T_4: Red polyethylene mulch (100 micron), T_5: Coir mulch (10 mm) , T_6: Nylon mulch mat (90 gsm), T_7: Control

significantly affected the leaf area and leaf chlorophyll content. This might be due to increase in photosynthetic rate. Higher leaf chlorophyll content was also reported by Wang et al (2006) in cherry and Solomakhin et al (2012) in apple trees.

Physical parameters

Fruit physical parameters of peach fruit viz fruit length, fruit diameter, fruit weight and fruit volume (Table 2) were significantly varied under different mulching materials during the present investigations. Maximum fruit length (55.56 mm), fruit breadth (53.17 mm), fruit weight (84.34) and fruit volume (87.56 mm) were observed under black polyethylene mulch (T_2). The maximum fruit yield (6.36 kg/tree) was observed in T_2 (black polyethylene mulch). However minimum yield (4.46 kg/tree) was observed in treatment T_7 (control). Improvement in yield due to black polyethylene mulch was also reported in citrus cv Nagpur Mandarin by Shirugure et al (2003) and Neilsen et al (2003) in apple. They reported that black polyethylene mulch increased fruit yield by 56-60 per cent as compared to unmulched trees which may be due to better conservation of soil moisture, regulation of temperature and suppressing weed growth.

Fruit physico-chemical characteristics like total soluble solids (TSS), titratable acidity, total sugars and reducing sugars were also found to be significant with the application of organic and inorganic mulch treatments while non-significant for non-reducing sugars (Table 3). The fruits harvested from the treatment T_6 (nylon mulch mat) had maximum TSS (13.78°B), titratable acidity (0.54%), total sugars (7.98%), reducing sugars (2.56%) and non-reducing sugars (5.14%). Minimum values of these parameters were recorded under T_7 (control).

Total sugars and reducing sugars were also significantly affected by different mulching treatments.

Table 2. Effect of organic and inorganic mulches on physical parameters of peach cv Redhaven

Treatment	Fruit length (mm)	Fruit diameter (mm)	Fruit volume (cc)	Fruit weigh (g)	Fruit set (%)	Fruit drop (%)	Fruit yield (kg/tree)
T_1	53.12	51.45	84.68	81.78	65.23	30.12 (33.26)	5.78
T_2	55.56	53.17	87.56	84.34	68.30	28.56 (32.28)	6.36
T_3	53.82	52.13	85.78	82.56	66.56	29.78 (32.63)	5.98
T_4	52.59	50.34	83.99	80.34	64.56	30.67 (33.60)	5.49
T_5	52.45	50.99	83.79	81.46	64.89	30.06 (33.23)	5.56
T_6	54.3 5	53.15	86.78	83.67	67.57	29.12 (33.05)	6.12
T_7	50.78	49.89	80.67	78.78	62.34	32.45 (34.70)	4.46
$CD_{0.05}$	2.6	1.8	2.4	1.9	2.2	2.2	0.8

T_1: Grass mulch (10 cm) T_2: Black polyethylene mulch (100 micron), T_3: Silver polyethylene mulch (100 micron) T_4: Red polyethylene mulch (100 micron), T_5: Coir mulch (10 mm) , T_6: Nylon mulch mat (90 gsm), T_7: Control

Table 3. Effect of organic and inorganic mulches on bio-chemical parameters of fruit in peach cv Redhaven

Treatment	TSS (°Brix)	Titratable acidity (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)
T_1	12.68	0.46	7.57	2.31	4.99
T_2	13.46	0.43	7.78	2.46	5.05
T_3	12.89	0.44	7.71	2.41	5.03
T_4	12.35	0.48	7.34	2.23	4.85
T_5	12.62	0.47	7.56	2.35	4.95
T_6	13.78	0.54	7.98	2.56	5.14
T_7	11.98	0.41	6.89	2.12	4.53
$CD_{0.05}$	0.60	0.04	0.63	0.26	NA

T_1: Grass mulch (10 cm) T_2: Black polyethylene mulch (100 micron), T_3: Silver polyethylene mulch (100 micron) T_4: Red polyethylene mulch (100 micron), T_5: Coir mulch (10 mm) , T_6: Nylon mulch mat (90 gsm), T_7: Control

The change in micro-climatic conditions by reflective mulches and increase in temperature have resulted in advanced ripening and more accumulation of total sugars. These results are also in conformity with those of Mathieu and Aure (2000) who reported better fruit quality in apple under plastic reflective mulches. These findings are also in accordance with the work of several other research workers (Akasaka and Imai 2002, XiangMing et al 2012) in peach who also reported that reflective mulches improve the chemical parameters in different fruit crops. The overview of this study concluded that the black polythene mulch was found to be best mulching material in respect of enhanced growth, quality and yield with minimum fruit drop of peach.

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