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Effect of orchard floor management treatments on soil hydrothermal regimes under rainfed conditions of Himachal Pradesh in nectarine (*Prunus persica* var. *nucipersica*) cv. Snow Queen

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ABSTRACT

The present investigation was carried out to study the effect of orchard floor management treatments on soil hydrothermal regimes under rainfed conditions of Himachal Pradesh in nectarine cv. Snow Queen during the years 2016 and 2017. The experiment was laid out in a Randomized Block Design replicated four times. The experiment consisted of seven treatments including control. Among these treatments, soil hydrothermal regimes were maintained effectively under black polythene mulch. Bicolour polythene mulch recorded maximum fruit size (length- 52.85, 57.27 mm; breadth- 51.21, 55.04 mm), fruit weight (77.86, 89.41 mm), proportion of "A" grade fruits (62.15, 66.48 %), whereas maximum fruit yield (42.44, 54.63 kg/tree and 16.98, 21.85 tonne/ha) was recorded under black polythene mulch in 2016 and 2017, respectively. However, the minimum values of hydrothermal regimes, fruit size, fruit weight, proportion of "A" grade fruits and fruit yield were recorded under control during both the years of the study.

Key words: Moisture, Nectarine, Orchard, Temperature, Yield

The peach [*Prunus persica* (L.) Batsch] is an important stone fruit crop of the sub-temperate mid hill regions of Himachal Pradesh. Nectarine [*P. persica* var. *nucipersica* (or var. *nectarina*)] has a non-pubescent skin due to lack of fuzz or short hairs. Several genetic studies have concluded that nectarines are produced due to a recessive allele, whereas a fuzzy peach skin is dominant (Bal 1997).The lack of skin fuzz make nectarine skin appears more reddish than those of peaches, providing fruit's plum-like appearance. In recent years, the cultivation of nectarines is catching up in Himachal Pradesh due to its attractive appearance and better remuneration in comparison to peaches being early in maturity. It can be cultivated all over the state except, dry and cold region of Lahul and Spiti and Kinnaur districts. However, mid hill zone, especially Rajgarh and Kullu valley areas are dominant peach and nectarine growing belts because of highly congenial agro-climatic conditions for its successful cultivation. In Himachal Pradesh, among stone fruits, peach ranks next only to plum with an area and production of 5076 ha and 8045 MT respectively (Anonymous 2016). However, no separate state and country level area and production data is available of nectarine.

Orchard floor management is one of the most important and effective tool in successful orcharding. It effects the growth, yield and fruit quality indirectly through its effect on moisture conservation, availability of nutrients and water. Effective orchard soil management is key to profitable and sustainable fruit production as it controls weeds, conserves soil moisture, prevents soil erosion, maintains soil organic matter and structure, improves water infiltration and nutrient retention, and thereby enhances the fruit quality (Derr 2001).

High moisture stress and erratic rainfall in Himachal Pradesh are some of the major constraints in nectarine cultivation. Therefore, it becomes essential to develop strategies to conserve the soil moisture during the growing period in nectarine orchard. Proper orchard floor management is vital to the health and productivity of fruit trees, with management practices impacting tree growth, fruit yield and fruit quality. This makes the long-term conservation of soil fertility and favourable soil physical conditions especially important from horticultural, economic and environmental perspectives (Merwin 2004). Keeping in view all these factors the present study was conducted to study the effect of different orchard floor management practices on soil hydrothermal regimes in nectarine cv. Snow Queen under rainfed conditions.

MATERIALS AND METHODS

The present study was carried out on 10 years old plants of 'Snow Queen' nectarine which were planted at a spacing of 5 × 5 m at the experimental orchard of Department of Fruit Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, during

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the years 2016 and 2017.The experiment was laid out in a randomized lock design with seven treatments and four replications. Different orchard floor management treatments viz., black polythene mulch (100 µ) (T_1), bicolour polythene mulch (100 µ) (T_2), nylon mulch mat (90 GSM) (T_3), grass mulch (10-12 cm) (T_4), chemical weed control (Glyphosate @ 5ml/l) (T_5), hand weeding (T_6) and control (no orchard floor management treatment) (T_7) were uniformly imposed in the first week of March. Nutritional management practices were carried out as per standard package of practices of the university (Anonymous 2014).

Soil temperature was recorded at 15 days intervals with soil thermometers embedded at 15 cm depth at 8:30 AM and 2:30 PM and mean of both the timings were recorded. Soil moisture content was determined at fortnightly interval by Diviner 2000 (a portable soil moisture monitoring system) at 15, 30, 45 and 60 cm depths and expressed as per cent. For fruit size, ten randomly selected fruits from each experimental tree were 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 millimetre (mm). For fruit weight, selected fruits taken for recording the fruit size data were weighed on electronic top pan balance and the average fruit weight was expressed in gram (g). Marketable yield was calculated by grading the fruits into three different grades as "A" grade (size > 50 mm), "B" grade (size between 45 to 49 mm) and "C" grade (size < 45 mm). Marketable yield under different grades was expressed as percentage of total yield.

The two years data was statistically analyzed with the standard procedure as suggested by Gomez and Gomez (1984). The level of significance for different variables was tested at 5% value of significance.

RESULTS AND DISCUSSION

Soil temperature

The data presented in Tables 1 and 2 indicated that different orchard floor management treatments significantly influenced the soil temperature at15 cm depth during the years 2016 and 2017. Soil temperature was found maximum under treatment black polythene mulch (T_1) on all dates of observation, which ranged from 18.40°C to 25.14°C. Significantly lowest soil temperature was found in mulching with grass mulch (T_4) on all the dates of observation which ranged from 15.54 to 21.65°C. Similar trends was observed in the second year of study with maximum soil temperature ranging from 18.64 to 25.19°C under black polythene mulch (T_1) and minimum under grass mulch (T_4) which ranged from 15.89 to 20.29°C.

The soil temperature under black polythene mulch was higher than all other orchard floor management treatments. This may be attributed to the fact that black polythene mulch absorb more radiation from sun and thus transmit the absorbed radiation to the upper layer of soil (Sharma and Kathiravan 2009). Also, the warming under black polythene mulch may be due to the entrapment of long wave radiation from soil, reduction in conduction loss and cut off of convection loss under the black polythene mulch (Pandey *et al.* 2016). These results were in accordance with the findings of Pandey *et al.* (2016) in strawberry cv. Winter Dawn, Mehraj *et al*. (2015) in plum, Kumar and Dey (2011) in strawberry cv. Chandler, Sharma and Kathiravan (2009) in 'Santa Rosa' plum and Shylla (1993) also in 'Santa Rosa' plum who also reported higher soil temperature in black polythene mulch. The treatment with bicolour polythene mulch recorded lower soil temperature

Table 1 Effect of orchard floor management practices on soil temperature (°C) at 15 cm depth in 2016

Treatment	01-Apr	15-Apr	01-May	15-May	01-Jun	15-Jun
T_1 : Black polythene mulch	18.40	18.94	20.47	22.67	25.14	23.54
T_2 : Bicolour polythene mulch	18.21	18.66	20.29	22.45	24.92	23.36
T_3 : Nylon mulch mat	16.65	16.99	18.66	20.62	22.84	20.69
T_4 : Grass mulch	15.54	15.84	17.52	19.46	21.65	19.59
T_5 : Chemical weed control	17.91	18.32	19.97	22.05	24.54	22.16
T_6 : Hand weeding	18.00	18.44	20.07	22.14	24.67	22.28
T_7 : Control	18.09	18.56	20.16	22.29	24.79	22.36
$CD_{0.05}$	0.50	0.65	0.49	0.62	0.79	0.70

Table 2 Effect of orchard floor management practices on soil temperature (°C) at 15 cm depth in 2017

Treatment	01-Apr	15-Apr	01-May	15-May	01-Jun	15-Jun
T_1 : Black polythene mulch	18.64	19.25	19.66	21.27	23.49	25.19
T_2 : Bicolour polythene mulch	18.46	19.04	19.44	21.02	23.23	24.89
T_3 : Nylon mulch mat	16.93	17.47	17.63	18.66	20.40	21.60
T_4 : Grass mulch	15.89	16.38	16.54	17.51	19.15	20.29
T_5 : Chemical weed control	18.02	18.56	18.82	19.99	21.86	23.23
T_6 : Hand weeding	18.13	18.69	18.95	20.18	22.09	23.44
T_7 : Control	18.27	18.83	19.12	20.38	22.37	23.75
$CD_{0.05}$	0.62	0.99	0.83	0.82	0.57	0.46

than black polythene mulch (Tables 1 and 2) which may be because of its reflective nature (Sharma and Kathiravan 2009). Minimum soil temperature under grass mulch may be due thick grass cover (10-12 cm thick), thereby preventing atmospheric heat to reach the soil surface. Greenham (1953) reported that organic mulches generally insulate the orchard soil and as a consequence reduce orchard soil temperature variability, reducing daily and annual temperature extremes. Thus, mean soil temperatures beneath mulch in summer are frequently lower under organic mulches (Gormley *et al*. 1973). The results for lower soil temperature under grass mulch than other treatments confirmed the findings of Negi (2015) in nectarine, Kumar and Dey (2011) in strawberry cv. Chandler and Sharma and Kathiravan (2009) in 'Santa Rosa' plum.

Soil moisture

Different orchard floor management treatments had significant effect on per cent soil moisture content at soil depths of 15, 30, 45 and 60 cm during the present course of study.

The perusal of data presented in Table 3, indicate that black polythene mulch (T_1) recorded highest soil moisture content of 23.42% and 21.24% at 15 cm depth on 1st and 15th April, respectively. The minimum soil moisture content of 18.70% and 16.14% at 15 cm depth on 1st and 15th April, respectively was recorded in control (T_7). Black polythene mulch (T_1) at 30 cm depth recorded highest soil moisture content of 24.70% and 22.32% on 1st and 15th April, respectively. The minimum soil moisture content of 20.48% and 17.39% was recorded in control (T_7) at 30 cm depth on 1st and 15th April, respectively. Maximum soil moisture content of 23.52% and 21.27% on 1st and 15th April, respectively was recorded at 45 cm depth under black polythene mulch (T_1). The minimum soil moisture content of 19.06% and 15.94% was recorded in control (T_7) on 1st and 15th April, respectively at 45 cm depth. At 60 cm depth the maximum soil moisture content of 22.65% and 20.62% was recorded under black polythene mulch (T_1) on 1st and 15th April, respectively. The minimum soil moisture content of 18.87% and 15.80% was recorded in control (T_7) on 1st April and 15th April, respectively at 60 cm depth.

The perusal of data presented in Table 4 unveil that black polythene mulch (T_1) recorded highest soil moisture content of 18.46% and15.96% at 15 cm depth on 1st and 15th May, respectively. The minimum soil moisture content of 11.79% and 7.96% at 15 cm depth on 1st and 15th May, respectively was recorded in control (T_7). Black polythene mulch (T_1) at 30 cm depth recorded highest soil moisture content of 19.78% and 17.06% on 1st and 15th May, respectively. The minimum soil moisture content of 13.68% and 9.84% was recorded in control (T_7) at 30 cm depth on 1st and 15th May, respectively. Maximum soil moisture content of 18.82% and 16.12% on 1st and 15th May, respectively at 45 cm depth was recorded under black polythene mulch (T_1). The minimum soil moisture content of 12.64% and 9.11% was recorded in control (T_7) on 1st and 15th May, respectively at 45 cm depth. At 60 cm depth the maximum soil moisture content of 18.49% and 16.25 % was recorded under black polythene mulch (T_1) on 1st and 15th May, respectively. The minimum soil moisture content of 12.61% and 9.11% was recorded in control (T_7) on both the dates.

The perusal of data presented in Table 5 indicated that black polythene mulch (T_1) recorded highest soil moisture content of 13.24% and15.14% at 15 cm depth on 1st and 15th June, respectively. The minimum soil moisture content of 6.26% and 12.55% at 15 cm depth on 1st and 15th June, respectively was recorded in control (T_7). Black polythene mulch (T_1) at 30 cm depth recorded highest soil moisture content of 14.19% and 16.61% on 1st and 15th June, respectively. The minimum soil moisture content of 6.39% and 13.53% was recorded in control (T_7) at 30 cm depth on respective dates. Maximum soil moisture content of 13.65% and 15.36% on 1st and 15th June, respectively at 45 cm depth was recorded under black polythene mulch (T_1) on these dates. The minimum soil moisture content of 5.26% and 8.41% was recorded in control (T_7) on 1st and 15th June, respectively. At 60 cm depth the maximum soil moisture content of 13.89% and 14.72% was recorded under black polythene mulch (T_1) on 1st and 15th June, respectively.

Table 3 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15th April at 15, 30, 45 and 60 cm depth in 2016

Treatment	1st April				15th April			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
T_1	23.42	24.70	23.52	22.65	21.24	22.32	21.27	20.62
T_2	22.89	24.00	23.38	22.45	20.63	21.60	21.13	20.42
T_3	22.58	23.39	20.99	20.68	20.14	20.75	18.54	18.51
T_4	21.54	22.59	20.73	20.25	19.32	20.04	18.40	18.09
T_5	19.10	20.99	19.30	19.16	16.59	17.96	16.41	16.35
T_6	18.88	20.83	19.16	18.90	16.35	17.73	16.11	16.00
T_7	18.70	20.48	19.06	18.87	16.14	17.39	15.94	15.80
$CD_{0.05}$	0.48	0.73	0.54	0.47	0.43	0.73	0.67	0.50

Details of treatment are given in Materials and Methods.

Table 4 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15th May at 15, 30, 45 and 60 cm depth in 2016

Treatment	1st May				15th May			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
T_1	18.46	19.78	18.82	18.49	15.96	17.06	16.12	16.25
T_2	17.98	19.12	18.65	18.22	15.49	16.33	15.30	15.91
T_3	17.21	18.02	15.93	16.03	14.47	15.07	13.21	13.55
T_4	16.52	17.43	15.90	15.84	13.89	14.59	13.29	13.47
T_5	12.41	14.38	13.23	13.22	8.76	10.63	9.75	9.98
T_6	12.10	14.10	12.87	12.86	8.39	10.31	9.36	9.42
T_7	11.79	13.68	12.64	12.61	7.96	9.84	9.11	9.11
$CD_{0.05}$	0.48	0.77	0.67	0.57	0.51	0.75	0.65	0.60

Details of treatment are given in materials and Methods.

Table 5 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15th June at 15, 30, 45 and 60 cm depth in 2016

Treatment	1st June				15th June			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60cm
T_1	13.24	14.19	13.65	13.89	15.14	16.61	15.36	14.72
T_2	12.76	13.64	13.43	13.51	14.90	16.17	15.13	14.44
T_3	11.92	12.67	10.34	10.96	14.90	16.30	12.68	11.80
T_4	11.24	11.89	10.55	11.01	14.63	16.19	13.22	11.92
T_5	7.12	7.16	6.10	6.46	12.73	13.99	9.20	8.48
T_6	6.73	6.82	5.67	5.82	12.66	13.71	8.88	8.14
T_7	6.26	6.39	5.26	5.51	12.55	13.53	8.41	7.88
$CD_{0.05}$	0.51	0.78	0.70	0.62	0.24	0.48	0.75	0.48

Details of treatment are given in Materials and Methods.

The minimum soil moisture content of 5.51% and 7.88 % was recorded in control (T_7) which was statistically at par with hand weeding (T_6) on both the dates.

The perusal of data presented in Table 6 indicated that black polythene mulch (T_1) recorded highest soil moisture content of 14.77% and 12.68% at 15 cm depth on 1st and 15th April, respectively. The minimum soil moisture content of 11.67% and 8.55% at 15 cm depth on 1st and 15th April, respectively was recorded in control (T_7). Black polythene mulch (T_1) at 30 cm depth recorded highest soil moisture content of 18.31% and 15.95% was recorded on 1st and 15th April, respectively. The minimum soil moisture content of

Table 6 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15th April at 15, 30, 45 and 60 cm depth in 2017

Treatment	1st April				15th April			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
T_1	14.77	18.31	18.44	17.93	12.68	15.95	16.22	16.03
T_2	14.40	18.00	18.36	17.76	12.29	15.69	16.10	15.77
T_3	14.22	15.22	16.15	15.02	11.77	12.37	13.66	12.88
T_4	13.74	16.08	16.87	15.60	11.44	13.63	14.47	13.61
T_5	12.79	14.36	15.32	13.85	9.75	10.85	11.87	11.28
T_6	12.67	14.20	15.13	13.39	9.52	10.72	11.70	10.75
T_7	11.67	14.01	14.83	12.99	8.55	10.42	11.27	10.28
$CD_{0.05}$	1.07	0.89	0.79	0.83	0.60	0.77	0.49	0.82

Details of treatment are given in Materials and Methods.

14.01% and 10.42% was recorded in control (T_7) at 30 cm depth on respective dates. Maximum soil moisture content of 18.44% and 16.22% on 1st and 15th April, respectively was recorded at 45 cm depth was under black polythene mulch (T_1). The minimum soil moisture content of 14.83% and 11.27% was recorded in control (T_7) on 1st and 15th April, respectively at 45 cm depth. At 60 cm depth, the maximum soil moisture content of 17.93% and 16.03% was recorded under black polythene mulch (T_1) on 1st and 15th April, respectively. The minimum soil moisture content of 12.99% and 10.28% was recorded in control (T_7) on respective dates.

The perusal of data presented in Table 7 indicated that chemical weed control (T_5) recorded highest soil moisture content of 23.02% and 30.72% at 15 cm depth on 1st and 15th May, respectively. The minimum soil moisture content of 15.70% and 20.40% was recorded under bicolour polythene mulch (T_2) at 15 cm depth on 1st and 15th May, respectively. Chemical weed control (T_5) at 30 cm depth recorded highest soil moisture content of 20.06% and 30.35% on 1st and 15th May, respectively. The minimum soil moisture content of 17.14% and 19.48% was recorded in bicolour polythene mulch (T_2) at 30 cm depth on respective dates. Maximum soil moisture content of 17.28% and 26.77% on 1st and 15th May, at 45 cm depth was recorded under grass mulch (T_4) and chemical weed control (T_5) respectively. The minimum soil moisture content of 15.99% and 18.52% was recorded in bicolour mulch (T_2) on 1st and 15th May, respectively at 45 cm depth. At 60 cm depth, the maximum soil moisture content of 15.45% and 24.20% was recorded under black polythene mulch (T_1) and chemical weed control (T_5) on 1st and 15th May, respectively. The minimum soil moisture content of 14.09% and 17.27% was recorded in control (T_7) and bicolour polythene mulch (T_2) on respective dates.

The perusal of data presented in Table 8 indicated that grass mulch (T_4) recorded highest soil moisture content of 24.66% and 25.66% at 15 cm depth on 1st and 15th June, respectively. The minimum soil moisture content of 18.20% and 21.12% at 15 cm on 1st and 15th June was recorded in bicolour polythene mulch (T_2) and black polythene mulch (T_1), respectively. Grass mulch (T_4) at 30 cm depth recorded highest soil moisture content of 24.16% and 26.76% on 1st and 15th June, respectively. The minimum soil moisture content of 17.41% and 20.09% was recorded in bicolour polythene mulch (T_2) on respective dates. Maximum soil moisture content of 21.61% and 23.47% on 1st and 15th

Table 7 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15 May at 15, 30, 45 and 60 cm depth in 2017

Treatment	1st May				15th May			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
T_1	15.78	17.29	16.11	15.45	20.53	19.55	18.62	17.30
T_2	15.70	17.14	15.99	15.33	20.40	19.48	18.52	17.27
T_3	22.45	19.34	16.64	14.78	29.70	29.20	25.45	22.45
T_4	21.73	19.64	17.28	15.03	29.66	29.41	25.80	22.95
T_5	23.02	20.06	16.63	14.47	30.72	30.35	26.77	24.20
T_6	22.94	19.99	16.51	14.28	30.55	30.25	26.64	24.11
T_7	22.86	19.86	16.40	14.09	30.52	30.1	26.40	23.93
$CD_{0.05}$	0.95	0.54	0.76	0.48	0.50	0.35	0.45	0.33

Details of treatment are given in Materials and Methods.

Table 8 Effect of orchard floor management practices on soil moisture content (%) on 1st and 15th June at 15, 30, 45 and 60 cm depth in 2017

Treatment	1st June				15th June			
	15 cm	30 cm	45 cm	60 cm	15 cm	30 cm	45 cm	60 cm
T_1	18.38	17.53	16.50	15.53	21.12	20.09	18.80	17.15
T_2	18.20	17.41	16.40	15.38	21.14	20.28	18.59	17.04
T_3	24.33	23.95	21.33	19.20	25.39	26.57	23.22	21.18
T_4	24.66	24.16	21.61	19.47	25.66	26.76	23.47	21.52
T_5	24.47	21.44	19.47	17.47	22.45	24.32	22.53	20.78
T_6	24.32	21.20	19.22	17.35	22.51	24.20	22.27	20.56
T_7	24.27	21.12	19.12	17.24	22.39	24.09	22.20	20.40
$CD_{0.05}$	0.49	0.50	0.44	0.36	0.33	0.41	0.40	0.36

Details of treatment are given in Materials and Methods.

June respectively at 45 cm depth was recorded under grass mulch (T_4). The minimum soil moisture content of 16.40% and 18.59% was recorded in bicolour polythene mulch (T_2) on 1st and 15th June, respectively at 45 cm depth. At 60 cm depth, the maximum soil moisture content of 19.47% and 21.52% was recorded under grass mulch (T_4) on 1st and 15th June, respectively. The minimum soil moisture content of 15.38% and 17.04% was recorded in bicolour polythene mulch (T_2) on both the dates.

The higher moisture contents under all mulching treatments as compared to all other treatments (Tables 3 to 8) may be due to the fact that mulching act as a barrier for direct impact of sunlight on soil surface which ultimately prevents evaporation of moisture from soil surface and reduce vapour diffusion to the atmosphere. Among different mulches, comparatively higher moisture contents under black and bicolour polythene mulch may be due to the fact that water after evaporation condenses on the bottom side of the polythene sheet mulch and trickles down again on soil surface (Kathiravan 2007). The present findings were in consonance with the findings of Pandey *et al.* (2016) in strawberry cv. Winter Dawn, Sharma and Kathiravan (2009) in plum, Mehraj *et al*. (2015) in plum, Kumar *et al.* (2014) in 'Kinnow' mandarin and Kumar and Dey (2011) in strawberry, who also reported higher moisture content under black polythene mulch. Grass mulch was relatively less efficient than polythene mulches in retaining soil moisture which may be attributed to their early decomposable nature which would have favoured the adsorption of evaporated water from the surface of the soil and in turn allowed it to get evaporated from surface layer into the surrounding atmosphere (Kumar *et al.* 2014). The present finding of lower soil moisture content under grass mulch as compared to polythene mulches is in consonance with the findings of Kumar *et al*. (2015) in Eureka lemon, Kumar *et al.* (2014) in 'Kinnow' mandarin and Sharma and Kathiravan (2009) in plum. The higher soil moisture content at soil surface under the nylon mulch mat (T_3), grass mulch (T_4), chemical weed control (T_5), hand weeding (T_6) and even in control (T_7) in the year 2017 (from 1st May to 15th June) was attributed to high rainfall in that period (Fig 1).

Fruiting characters

The perusal of data in Tables 9 and 10 revealed that orchard floor management treatments had a significant effect on fruit size (length and breadth), fruit weight as well as on fruit yield (both total fruit yield and marketable yield) during the present course of study. Maximum fruit size (length- 52.85, 57.27 mm; breadth- 51.21, 55.04 mm), fruit weight (77.86, 89.41 g) and proportion of "A" grade fruits (62.15, 66.48 %) were recorded under bicolour polythene mulch (T_2), while black polythene mulch (T_1) recorded the maximum fruit yield (42.44, 54.63 kg/tree and 16.98, 21.85 tonne/ha) during 2016 and 2017, respectively. The minimum fruit size (length- 47.07, 51.16 mm; breadth- 45.91, 49.28 mm), fruit weight (66.93, 77.38 g), proportion of "A" grade fruits (41.21, 48.94 %) and fruit yield (22.50, 32.31 kg/ tree and 9.00, 15.32 tonne/ha) were recorded under control (T_7).

The maximum fruit size, weight and proportion of "A" grade fruits of nectarine under bicolour polythene mulch were attributed to reflective property of bicolour polythene mulch to reflect back the light in tree canopy which resulted in increase in photosynthesis and ultimately improved fruit quality. Beside this, good hydrothermal regimes (Tables 1 to 8) in plant basin under bicolour polythene mulch lead plants roots to remain active throughout the fruit growing season which results in optimum availability of nutrients and proper translocation of food materials (Kumar *et al.* 2014) which accelerate the fruit growth and development in nectarine and ultimately increased the fruit size, weight and proportion of "A" grade fruits. The present study confirmed the findings of Shiukhy *et al.* (2015), Sharma *et al.* (2013) and Posada *et al.* (2011) who also observed increased fruit size, and weight in strawberry by using bicolour mulches. Negi (2015) also observed that bicolour

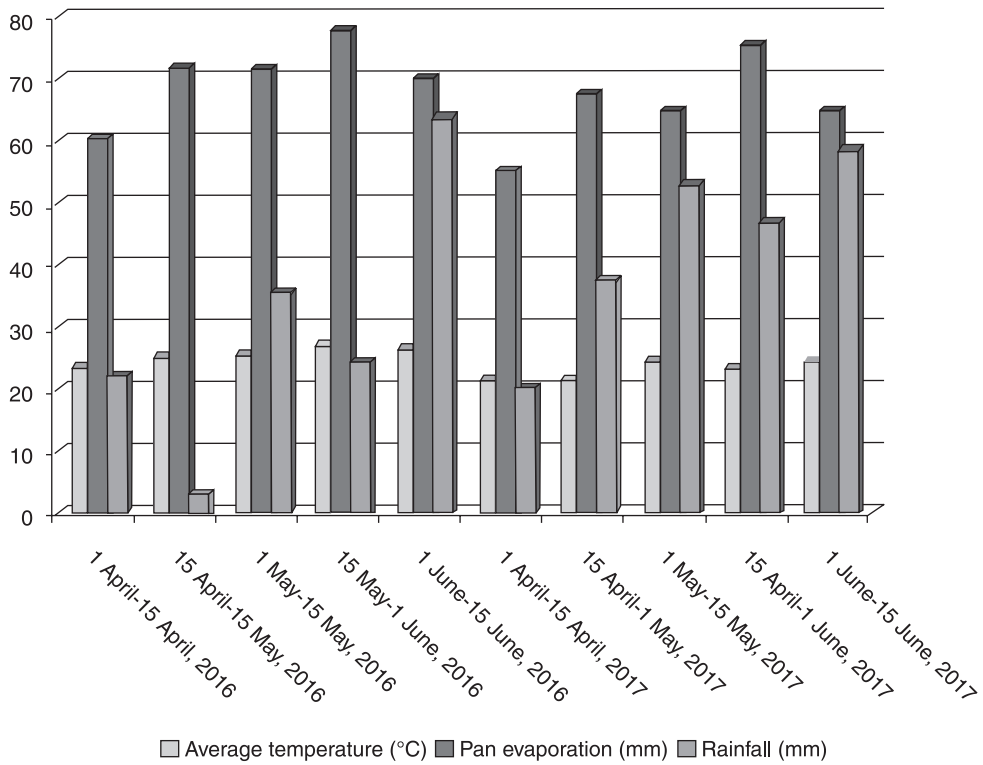

Fig 1 Average temperature (°C), pan evaporation (mm), rainfall (mm) during the years 2016 and 2017

Table 9 Effect of orchard floor management practices on fruit size, fruit weight and yield in nectarine

Treatment	Fruit length (mm)		Fruit breadth (mm)		Fruit weight (g)		Yield (Kg/tree)		Total yield (tonne/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
T_1	52.03	56.71	50.59	54.32	77.22	88.78	42.44	54.63	16.98	21.85
T_2	52.85	57.27	51.21	55.04	77.86	89.41	40.13	53.43	16.05	21.37
T_3	51.15	55.99	50.20	53.79	74.10	87.62	37.44	50.24	14.98	20.09
T_4	50.69	55.03	49.55	52.94	72.81	86.69	33.66	46.94	13.46	18.78
T_5	49.75	54.61	48.32	52.68	70.69	81.99	28.43	41.69	11.37	16.67
T_6	48.56	53.98	47.35	51.53	69.58	81.11	25.81	40.96	10.33	16.38
T_7	47.07	51.16	45.91	49.28	66.93	77.38	22.50	38.31	9.00	15.32
$CD_{0.05}$	1.20	1.32	0.95	0.97	1.91	1.48	2.55	2.79	1.02	1.15

Details of treatment are given under Materials and Methods.

Table 10 Effect of orchard floor management practices on marketable yield in nectarine

Treatment	A grade fruits (%)		B grade fruits (%)		C grade fruits (%)	
	2016	2017	2016	2017	2016	2017
T_1	62.15 (52.03) **	66.48 (54.61) **	24.42 (29.60) **	22.05 (27.98) **	13.43 (3.79) *	11.47 (3.53) *
T_2	64.72 (53.57)	68.97 (56.16)	23.33 (28.86)	21.66 (27.72)	11.95 (3.56)	9.38 (3.17)
T_3	58.92 (50.12)	63.05 (52.54)	26.22 (30.77)	24.22 (29.46)	14.87 (3.95)	12.74 (3.70)
T_4	54.36 (47.78)	60.01 (50.76)	28.91 (32.51)	25.66 (30.39)	16.74 (4.19)	14.34 (3.91)
T_5	49.08 (44.45)	56.48 (48.70)	30.82 (33.71)	27.97 (31.90)	20.11 (4.59)	15.56 (4.05)
T_6	46.04 (42.71)	53.21 (46.82)	31.34 (34.02)	29.23 (32.71)	22.62 (4.85)	17.56 (4.30)
T_7	41.21 (39.92)	48.94 (44.37)	34.23 (35.78)	31.98 (34.42)	24.56 (5.05)	19.09 (4.48)
$CD_{0.05}$	2.67	1.90	1.49	1.65	0.61	0.51

* and ** Figures in the parentheses are square root and arc sine transformed values

mulch increased the fruit size, fruit weight and proportion of "A" grade fruits in nectarine cv. Snow Queen. Whereas, highest fruit yield under black polythene mulch might be due to good hydrothermal regimes and efficient weed control during the fruit development period as compared to all other treatments which contributed for increased fruit set and lesser fruit drop and ultimately results to highest yield. The present findings for fruit yield were similar to the findings of several other workers who had also reported that black polythene mulches greatly influenced the yield (Iqbal *et al.* 2016, Pandey *et al.* 2016, Kumar *et al.* 2015, Bal and Singh 2011, Kaur and Kaundal 2009, Sharma and Kathiravan 2009, Ali and Gaur 2007, Szewczuk and Gudarowska 2006 and Szewczuk and Gudarowska 2005) in different fruit crops.

From the study it can be inferred that the performance of polythene mulches was better than all other treatments including control. But, overall black polythene mulch recorded maximum values of soil temperature and soil moisture content during the present course of study. In case of fruiting characters, maximum fruit size, fruit weight and "A" grade fruits was recorded under bicolour polythene mulch, whereas maximum fruit yield was recorded under black polythene mulch in both years of study. Keeping in view the moisture stress and erratic rainfall during fruit growing period under rainfed conditions of Himachal Pradesh, it is suggested that use black polythene and bicolour polythene mulches are the most efficient orchard floor management treatment for nectarine.

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