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Effect of orchard floor management practices on weed population and fruit quality and yield of peach [*Prunus persica* (L.) Batsch]

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Abstract

An experiment with nine orchard floor management practices viz., legume intercropping (soybean-peas), turmeric intercropping, fodder intercropping (pearl millet-oats), sod culture (setaria grass), glyphosate, paraquat, weed mulch, manual weeding and weedy check was carried out at Palampur during *kharif* 2018 to *rabi* 2019-20 to study their effect on fruit quality and yield of peach. Highest weed population was recorded in weedy check in all the months and lowest weed count was observed in legume intercropping during both the years. Legume intercropping resulted in highest peach yield and quality over rest of the treatments and lowest fruit yield per tree was recorded under weedy check during both the years of study. Uninterrupted growth of weeds reduced the fruit yield by 41.13 per cent during 2019 and by 50.84 per cent during 2020. No phytotoxicity of any herbicide tested (pendimethalin, quizalofop and chlorimuron ethyl to intercrops and directed application of glyphosate and paraquat) was recorded on peach indicating that all the herbicides used were safe for managing weeds in peach orchard.

Key words: Weed management, peach orchard, fruit quality, fruit yield

Peach is one of the most important stone fruit crops belonging to the family *Rosaceae* (Chaurasiya and Mishra, 2017). In India, it is grown in the mid-hill zone of the Himalayas extending from Jammu and Kashmir to Khasi hills up to an elevation of 2000 m above mean sea level (Meitei *et al*. 2013). In Himachal Pradesh, it is cultivated all over the state except the dry and cold regions of Lahaul and Spiti, Kinnaur, Pangi and Bharmour area of Chamba district. Rajgarh valley in Sirmour district is famous for its high production due to favourable agro-climatic conditions needed for the crop cultivation (Anonymous 2015).

Peach orchards are generally, infested with plurispecific weed flora, which competes with the fruit plants for nutrients, space, moisture and light (Majek *et al*., 1993; MacRae *et al*., 2007; Steenwerth and Guerra, 2012). Weed present in orchard, if not controlled, can harbour insects and pathogens leading to number of fungal, bacterial and viral diseases (Killian and Meyer, 1984; Leskey and Hogmire, 2005) which will further lead to adverse impacts on tree growth, fruit set, flower initiation, yield and fruit quality (Majek *et al*., 1993). Thus, weed management is very important to avoid all the adverse impacts and losses in tree growth and yield (Varshney 2009). Sustainable weed management in peach orchards is not only crucial for healthy tree growth and quality fruit yield but also for sustaining soil quality and promoting orchard biodiversity (Mia *et al*., 2020). Weed control in orchard can be usually accomplished by various methods like manual, mechanical and chemical means, yet the conventional hand weeding is the most common method of weed control (Melander *et al*., 2005; Mia *et al*., 2020).

Single weed management method is not sufficient, so the concept of integrated weed management has emerged which involves different orchard management practices like clean cultivation either through ploughing or by use of herbicides, intercropping, cover cropping, use of mulches, sod culture, etc. Recently, a large number of management methods have been applied to reduce weed emergence

in orchards, for instance combination of mulches, herbicide use, hand mowing, traditional and mechanical tillage (Rifai *et al*., 2002; Lisek, 2014). However, these management methods require strategies such as knowledge of weed biology, herbicide application procedures, herbicide efficacy against target weeds and correct timing of application (Altland *et al*., 2003). Intercropping can provide substantial yield advantages when compared to sole cropping. However, the success of intercropping system mainly depends on the selection of a suitable intercrop (Din *et al*., 2012). The leguminous intercrops are most effective because of their desirable impact on improvement of nutrient status of soil and fruit tree of orchard. Experiments have also proved that yield stability is greater with intercropping than sole cropping. Keeping in view all these factors the present study was conducted to study the effect of orchard floor management practices on fruit quality and yield of peach under mid hill conditions of Himachal Pradesh.

Materials and Methods

The present study was carried out in 5-year-old high density peach orchard at Department of Horticulture, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, (32°06' N latitude, 76°3'E longitude and at an altitude of 1290 m above mean sea level) during kharif 2018 to rabi 2019-20. Agro-climatically, Palampur falls under sub-temperate humid zone of Himachal Pradesh, and receives an average rainfall of 2332 mm per annum, major portion of which (about 80%) is received during June to September. Winter rains are received during December to February. The relative humidity in the region varies from 46 to 84 per cent. During winter soil temperature drops to as low as 2°C and frost incidence is common.

Nine orchard floor management practices *viz*., Legume intercropping (T_1), Turmeric intercropping (T_2), Fodder intercropping (T_3), Sod culture (T_4), Glyphosate (T_5), Paraquat (T_6), Mulch (T_7), Manual weeding (T_8) and Weedy check (T_9) were imposed in randomized block design with three replications. Each plot of 5 × 5 m was having four 5 years peach plants. In legume intercropping, soybean was grown in *kharif* with recommended weed control i.e. quizalofop 5 EC at 60 g/ha + chlorimuron ethyl 25 WP at 4g/ha and one hand weeding and peas in *rabi* with recommended weed control i.e. pendimethalin 30 EC at 1.5 kg/ha and one hand weeding. In turmeric intercropping, planting was done in May with recommended weed control i.e. pendimethalin 30 EC at 1.5 kg/ha and one hand weeding. In fodder intercropping, pearl millet crop was grown in *kharif* season and in *rabi* season oats crop was grown. In sod culture, intercultural practices were done in basin of peach tree in winters and setaria grass was grown in rest of the plot. Glyphosate and paraquat spray was done 4 times in a year (May, July, September and January). Mulch of *Lantana camara/Chromolaena odorata* of 10-15 cm layer thickness was applied 3 times in a year. In manual weeding treatment, scrapping was done 3 times in a year. In weedy check, no treatment was applied.

Weed counts were made at monthly interval using a quadrat of 50× 50 cm. The data on phytotoxicity was visually recorded at different stages *i.e.* 0, 3, 7, 10 and 15 days after herbicide application. The fruit crop was assessed for visual injury (chlorosis/necrosis) due to application of herbicides and evaluated on a scale of 0 (no chlorosis/necrosis) to 10 (complete plant death). The data on various physico-chemical parameters of fruit were recorded after harvest. The fruit length and diameter were recorded in millimetre with the help of digital Vernier Calliper. Fruit weight was expressed in grams. The TSS of selected fruits was determined with the help of hand refractrometer (0-32°B). The firmness of selected fruits was taken with the help of penetrometer. Thin layer of fruit skin was removed with stainless steel knife at three places on a single fruit and the penetrometer was inserted inside the fruit and pressure was calculated in terms of Newton (N) as follow:

$$\text{Newton (N)} = \text{Force in kg/cm}^2 \times 9.807$$

The data obtained were subjected to statistical analysis as per Gomez and Gomez (1984).

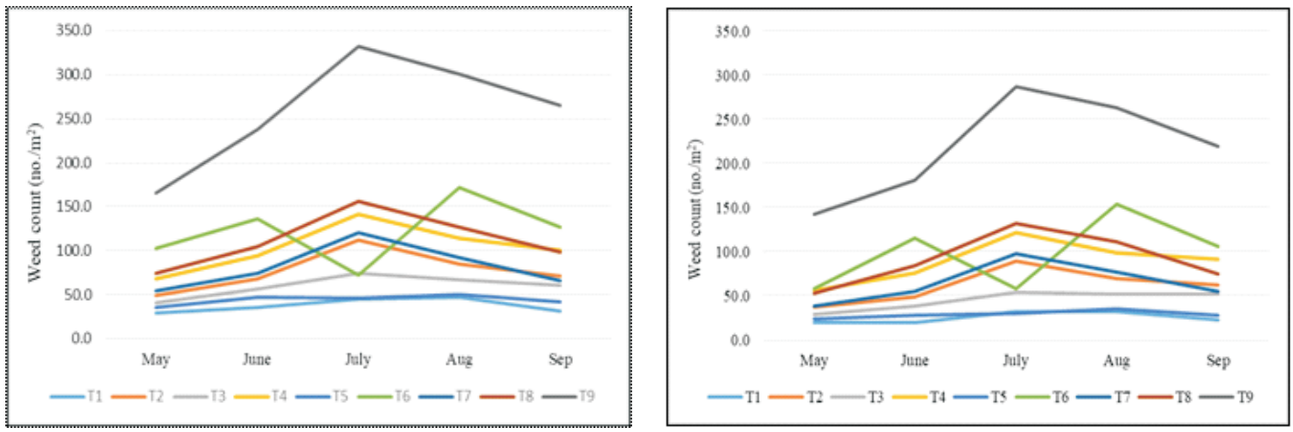
Results and Discussion

Weed studies

Weed count during kharif 2018 and 2019 has been presented graphically in Fig. 1 (a and b). Maximum weed count was observed in July in all the treatments expect for glyphosate and paraquat treated plots where

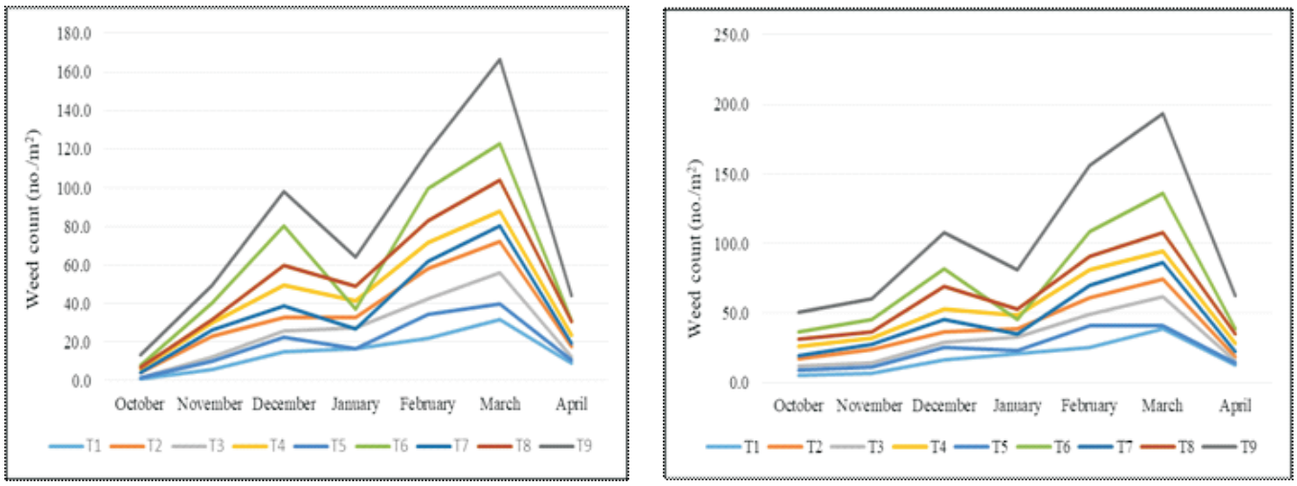
it was maximum in August. In these treatments, the spray was done in July month. Highest weed population was recorded in weedy check in all the months and lowest weed count was observed in legume intercropping due to smothering effect of intercrop on weeds.

Weed count taken during rabi 2018-19 and 2019-20 has been presented graphically in Fig. 2 a&b. The highest weed population was observed in weedy check in all the months. Maximum weed count was observed in all the treatments in the March. However, lowest weed count was observed in legume intercropping.



(a) **(b)**

Fig.1. Effect of weed control treatments on weed count during kharif 2018 (a) and 2019 (b)



(a) **(b)**

Fig.2. Effect of weed control treatments on weed count during rabi 2018-19 (a) and 2019-20 (b)

Chemical traits

The total soluble solids ranged between 10.50 to 12.00 °Brix during 2019 and 11.00 to 12.67 °Brix during 2020 (Table 1). Fruit firmness values under different treatments varied from 71.00 to 73.00 N and 71.00 to 73.43 N in the years 2019 and 2020, respectively. Maximum fruit firmness and total soluble solids were recorded in legume intercropping during both the years. Similar results were reported by Gill *et al*. (2018) on fruit quality. They reported that intercropping in fruit plants helps to improve fruit quality and yield. However, different weed management treatments did not show any significant influence on fruit firmness and total soluble solids of fruits in both the years.

Physical traits

The perusal of the data given in Table 2 revealed that the fruit length and fruit diameter were significantly influenced by different weed management treatments. Legume intercropping was

Table 1. Effect of orchard floor management treatments on fruit firmness (N) and total soluble solids (%) in peach

	Treatment detail	Fruit firmness (N)		Total soluble solids (%)	
		2019	2020	2019	2020
T_1	Legume intercropping (soybean-peas)	73.00	73.43	12.00	12.67
T_2	Turmeric intercropping	72.17	73.00	11.33	12.00
T_3	Fodder intercropping (pearl millet-bajra)	72.00	72.00	11.00	11.67
T_4	Interculture basin area + sod culture (setaria grass)	71.53	72.00	10.93	11.40
T_5	Glyphosate (4 times in a year)	72.00	73.33	11.33	12.00
T_6	Paraquat (4 times in a year)	71.00	71.50	10.67	11.00
T_7	Weed mulch (3 times in a year)	72.67	73.27	11.67	12.00
T_8	Manual weeding (3 times in a year)	71.33	71.67	10.83	11.33
T_9	Weedy check	71.00	71.00	10.50	11.00
	SEm±	0.50	0.57	0.37	0.47
	CD (P=0.05)	NS	NS	NS	NS

Table 2. Effect of weed control treatments on fruit length, fruit diameter and yield per plant in peach

	Treatment	Fruit Length (cm)		Fruit diameter (cm)		Yield per plant (kg)	
		2019	2020	2019	2020	2019	2020
T_1	Legume intercropping (soybean-peas)	6.32	6.38	5.78	5.97	13.08	16.74
T_2	Turmeric intercropping	6.09	6.21	5.65	5.87	10.17	13.25
T_3	Fodder intercropping (pearl millet-bajra)	6.04	6.20	5.64	5.85	9.82	11.37
T_4	Interculture basin area + sod culture (setaria grass)	5.99	6.18	5.60	5.83	9.60	10.99
T_5	Glyphosate (4 times in a year)	6.20	6.29	5.74	5.92	11.54	14.16
T_6	Paraquat (4 times in a year)	5.82	6.11	5.52	5.72	8.31	9.74
T_7	Weed mulch (3 times in a year)	6.15	6.27	5.71	5.91	11.03	13.83
T_8	Manual weeding (3 times in a year)	5.86	6.16	5.55	5.76	9.02	9.98
T_9	Weedy check	5.79	5.92	5.45	5.52	7.70	8.23
	SEm±	0.021	0.014	0.014	0.014	0.49	0.43
	CD (P=0.05)	0.06	0.04	0.03	0.04	1.48	1.30

found to be the best treatment and gave significantly higher fruit length and fruit diameter over rest of the treatments during both the years. Because of more fruit length and diameter, legume intercropping gave significantly higher fruit yield over rest of the treatments during both the years. Sahoo (2016) also reported higher average fruit yield in the intercropping systems than the sole crop. As intercrops help the main crop through indirect way like creating a micro climate that may have resulted in improvement of fruit number and fruit yield. Similar results were also obtained by Rath and Swain (2006). Leguminous intercrops have the capacity of fixing atmospheric nitrogen in the soil and thereby main crop gets additional nitrogen in fruit crop due to which number of fruits per plant were increased (Ghosh 2001). The increase in fruit yield per plant was directly related to the reduced crop-weed competition in legume intercropping. The lowest fruit yield per tree was recorded under weedy check during both the years of study. Abundance of weeds in weedy check lowered the fruit yield by 41.13 per cent during 2019 and by 50.84 per cent during 2020.

Phytotoxicity of herbicides

No adverse effects in terms of chlorosis, necrosis or

Table 3. Effect of weed control treatments on phytotoxicity in peach orchard during 2018-19 and 2019-20

	Treatment	Pytotoxicity rating (2018-19)	Pytotoxicity rating (2019-20)
T_1	Legume intercropping (soybean-peas)	0	0
T_2	Turmeric intercropping	0	0
T_3	Fodder intercropping (pearl millet-oats)	-	-
T_4	Interculture basin area + sod culture (setaria grass)	-	-
T_5	Glyphosate (4 times in a year)	0	0
T_6	Paraquat (4 times in a year)	0	0
T_7	Weed mulch (3 times in a year)	-	-
T_8	Manual weeding (3 times in a year)	-	-
T_9	Weedy check	-	-

stunted growth were observed on peach trees and the intercrops grown under the peach trees with the application of all the herbicides indicating that all the herbicides tested *i.e.* pendimethalin, quizalofop and chlorimuron ethyl to intercrops and directed application of glyphosate and paraquat indicating that all the herbicides used were safe for managing weeds in peach orchard during both the years (Table 3).

Conclusion

Results from the present study revealed that weed count was considerably influenced due to different orchard floor management treatments. These brought about significant reduction in the count of weeds over weedy check. Lowest weed count was recorded in legume intercropping during both the years. Fruit length and fruit diameter in peach was significantly increased by different floor management treatments as compared to weedy check during both the years as highest fruit length and fruit diameter were recorded in legume intercropping than rest of the treatments. As a result, legume intercropping resulted in highest peach yield and quality during the experimental years. No phytotoxicity of herbicides was observed on peach trees. Based on the results of the study, it is suggested to follow legume intercropping among all the treatments for high fruit quality and yield in peach.

Conflicts of Interest: The authors declare no conflict of interest in this research paper.

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