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Efficacy of Herbicides, Mulching and Sod Cover on Control of Weeds in Plum Orchards

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The Japanese plum (*Prunus salicina* Lindl.) native to China is an important fruit tree which is grown as a commercial fruit as well as filler tree in orchards in north India. Satluj Purple plum is a cross-pollinated exotic variety, which has a great potential because of its low chilling requirements, precociousness, prolific bearing and medium vigour with large sized firm fruits. Amongst the various problems faced by the plum growers, the problem of weeds in the orchard is very serious. The weeds cause heavy losses by competing for water and nutrients and also provide potential breeding niche for various insect/pests and diseases. They also secrete root exudates in soil which adversely affect the plant growth and ultimately the yield. The conventional method of controlling the weeds is manual which has always vexed the growers as this is expensive, strenuous and time consuming, while the mechanical inter culture is not much convenient in the orchards. Hence, the chemical weed control and mulching are gaining momentum during the last decade. Infestation of annual grasses/ broad-leaved and some perennial weeds has been controlled in plum orchards under temperate conditions with herbicides (Bhan *et al.*, 1983; De Oliveria *et al.*, 2000). However, until now no such studies have been conducted in plum orchards planted in sub-tropical plains. Hence, present weed management studies were conducted in high density plum cv. Satluj Purple to evaluate the effect of various herbicides, mulching and sod cover on weed control.

Investigations were carried out in New Orchard of Department of Horticulture, Punjab Agricultural University, Ludhiana during the cropping season of 2002-03, in four-year old trees of cv. Satluj Purple planted at 6 x 1.5 m on sandy loam soils with pH 8.2. The experiment was laid out in a randomized block design with 10 treatments replicated thrice. Three trees were kept as experimental unit. Pre-emergence herbicides viz., diuron @ 1.2, 1.6 and 2.4 kg/ha were sprayed during the first fortnight of March. Post-emergence herbicide viz., glyphosate @ 0.8, 1.2 and 1.6 l/ha was sprayed on second fortnight of March. Mulching with black polythene of 400 gauge thickness was applied as pre-emergence treatment. Manual weeding and sod culture were done at monthly intervals. A control (unweeded) plot was kept for comparison. The commonly growing weeds in plum orchard were identified with common and botanical names. The observations on periodic weed density were taken with one square quadrate and average per m^2 was worked out. The weeds were dried at 65ºC for 48 h for recording weed dry weight. Fruit yield was calculated by picking all the fruits from experimental trees during second week of May and were weighted to express yield per tree. The mean fruit weight was determined by selecting 10 fruits randomly from each treatment at the time of picking and it was expressed in grams. The total solute solids (TSS) of the fruit juice were recorded with hand refractometer. Acidity in juice as malic acid was determined by titrating a known volume of juice with 0.1 N NaOH using phenolphthalein as an indicator. The total sugar content in fruits was estimated by following the standard method as outlined by A. O. A. C. (2000).

The plum orchard was found to be infested with eight monocot and 12 dicot weed species. The weed flora consisting mainly of *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Sorghum halepense* (L.) Pers., *Dactyloctenium aegyptiacum* (L.) Wild, *Euphorbia hirta* L. etc. have been presented alongwith their common names in Table 1. It was found difficult to control *C. rotudus*, *C. dactylon* and *S. halepense* due to the presence of rhizomes and sets of these weeds which remain buried in the soil upto greater depth. Similar type of weed flora was reported by Rathi and Sharma (1987) in plum orchards and Singh (1992) in peach orchards.

The weed density was significantly lower in all the treatments compared to unweeded control (Table 2). The pre-emergence application of black polythene mulch and post emergence glyphosate @ 1.6 l/ha maintained superiority over all other treatments. This might be due to the preventive effect of mulch on light penetration that acted as a physical barrier affecting the

Table 1. Weed flora observed in the plum orchard

Botanical name	Common name
Cynodon dactylon (L.) Pers.	Khabbal grass/Bermuda grass
Cyperus rotundus L.	Motha/Purple nut sedge
Sorghum halepense (L.) Pers.	Baru/Johnson grass
Conyza stricta	Daryai booti
Digitaria sanguinalis (L.) Scop.	Takkri Gha/Crab Grass
Dactyloctenium aegyptiacum (L.) Wild	Madhana/Crow foot grass
Poa annua L.	Neel fuli/Annua blue grass
Saccharum spontaneum L.	Kaahi/Tiger grass
Chenopodium album	Bathu/Lambsqarters
Amaranthus viridis L.	Chulai/Slender amaranthus
Digera muricata (L.) Mart	Lahasua
Solanum nigrum L.	Makhoi
Rumex dentatus L.	Jangli Palak
Euphorbia hirta L.	Badi Dhodhak
Euphorbia microphylla Heyne ex Roth	Chotti Dhodhak
Parthenium hysterophorus L.	Congress grass
Commelina benghalensis L.	Kaon Makki (Day flower)
Tribulus terestris L.	Bhakhra/Puncture vine
Cannabis sativa L.	Bhang Hemp
Ipomea maxima (L. f.) Sweet	Morning glory

growth of most of the annual and perennial weeds. Glyphosate also effectively reduced weed density, as it acted both as contact as well as systemic herbicide. Diuron @ 2.4 kg/ha also significantly suppressed the weed count as compared to sod culture and manual weeding. However, sod culture proved better than manual weeding. Present findings are in agreement with those of Kaundal *et al.* (1995) in peach.

The maximum weed dry weight was recorded under unweeded control (Table 2). Mulching with black polythene recorded significantly lowest weeds dry weight followed by glyphosate and diuron. Higher dose of diuron had significantly lower weeds dry weight than lower doses. Black polythene mulch maintained its superiority because it acted as a physical barrier on the surface of soil, which might create partially anaerobic conditions for the survival of weed species and thus finally resulting in very low weed density and least weed dry weight. Sod culture and manual weeding both showed significantly lesser weed dry weight than control.

Maximum fruit weight of 37.05 g and fruit yield of 9.4 kg were noted with black polythene mulch followed by glyphosate @ 1.6 l/ha and diuron @ 2.4 kg/ha (Table 2). Manual weeding produced the fruits of smaller size but significantly better than fruit weight on control trees. The increase in fruit weight was directly related to the reduced weed density and high weed control efficiency under different weed control treatments that resulted in increased availability of soil water and nutrients to fruit plants that subsequently enhanced fruit weight and fruit yield. The present observations are in line with the findings of Singh (1992) wherein he reported the highest fruit weight in peach under polythene mulching, while the fruit weight under glyphosate and diuron was significantly higher than the weight of fruit obtained in control plots.

The data in Table 3 indicate that total soluble solids did not vary significantly under various herbicidal treatments. Black polythene mulch showed an overall superiority over other treatments. However, lowest TSS content was noted with unweeded control. These findings are in agreement with those of Bajwa *et al.* (1991) in pear who reported a non-significant variation in total soluble solids of fruits under different weed control treatments.

Black polythene mulch was found to be the most effective treatment in reducing the acid content (Table 3) of plum fruits followed by different doses of glyphosate and diuron which were equally effective in lowering the acid content of plum fruits. The results are in agreement with those of Kaundal *et al.* (1995) in peach.

Table 2. Effect of various weed management treatments on weed density, weed dry weight and fruit yield in plum cv. Satluj Purple

Treatments	Dose (kg/l a. i./ha)	Weed density (No./m^2) after 90 days	Weed dry weight (g/m^2)	Fruit weight (g)	Fruit yield (kg/plant)
Diuron	1.2	106.0	10.25	29.41	7.70
Diuron	1.6	102.0	9.86	29.85	8.00
Diuron	2.4	99.7	9.64	32.83	8.50
Mulch	Black polythene (400 gauge)	6.0	0.58	37.05	9.40
Glyphosate	0.8	75.7	7.32	28.30	7.90
Glyphosate	1.2	69.3	6.70	31.97	8.40
Glyphosate	1.6	54.3	5.25	32.83	8.70
Sod culture	-	138	13.34	30.03	7.60
Manual weeding	-	152	14.70	25.78	7.00
Control	-	194	18.76	18.50	6.00
LSD (P=0.05)	-	10.1	0.98	2.58	0.88

Table 3. Effect of various weed management treatments on chemical constituents of plum fruits cv. Satluj Purple

Treatments	Dose (kg/l a.i./ha)	TSS (%)	Acidity (%)	TSS : acid ratio	Total sugar (%)
Diuron	1.2	13.69	0.98	13.90	8.83
Diuron	1.6	13.73	0.97	14.20	9.02
Diuron	2.4	14.06	0.96	14.60	9.32
Mulch	Black polythene (400 gauge)	14.21	0.87	16.30	9.57
Glyphosate	0.8	13.33	0.98	13.60	9.42
Glyphosate	1.2	13.81	0.97	14.20	9.45
Glyphosate	1.6	14.09	0.94	15.00	9.52
Sod culture	-	14.17	1.00	14.20	8.59
Manual weeding	-	13.79	1.08	12.80	8.52
Control	-	12.89	1.17	11.00	8.42
LSD (P=0.05)	-	NS	NS	NS	NS

NS–Not Significant.

The different weed management treatments did not significantly improve the total sugar content of plum fruits. TSS : Acid ratio varied non-significantly with all weed control treatments.

From the results, it was concluded that black polythene mulch was the most effective treatment in suppressing the weeds throughout the year. It further improved the fruit quality and yield. The second best treatment was glyphosate @ 1.6 l/ha which also produced good quality fruits with improved yield.

Black polythene mulch was found to be the most effective in controlling many of the weed species followed by glyphosate @ 1.6 l/ha and diuron @ 2.4 kg/ha. The highest fruit yield was obtained with black polythene mulch followed by glyphosate @ 1.6 l/ha and diuron 2.4 kg/ha. The biochemical characteristics of plum fruits did not vary significantly with different weed management treatments.

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