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Effect of mulching, herbicides and hand hoeing on seedling growth and weed population in jujube nursery

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ABSTRACT

Experiment was conducted to evaluate the efficacy of pre- and post-emergence herbicides and organic and plastic mulches to control weeds in jujube (*Zizyphus mauritiana*) nursery. Nutsedge (*Cyperus rotundus*) was the major monocot weed (67.9%), followed by wiregrass *Eleusine indica* (18.2%), love grass, *Eragrostis tenella (*8.2%) and bermuda grass, C*ynadon dactylon* (5.8%). Among the dicot weeds, puncture vine (*Tribulus terrestris*) was the major weed (88.1%), followed by 10.3% in case of pigweed (*Amaranthus viridis)*. All the herbicidal treatments hampered jujube seed germination. Pendimethalin resulted in highest inhibition of jujube seed germination. Paraquat resulted in poor seed germination as compared to glyphosate treatments. Pyrazosulfuron-ethyl delayed germination, led to plants with lesser plant girth and reduced proportion of buddable plants. The highest proportion of buddable plants (85.9%) was obtained with straw mulch which did not differ significantly from proportion of buddable plants recorded with weed mulch, black polythene mulch and weed free check. Paraquat treatments resulted in lesser number of buddable plants as compared to glyphosate. At all the intervals, highest weed control efficiency was obtained with straw mulch which did not differ significantly from the weed control efficiency obtained with weed mulch. Among the herbicidal treatments, double application (10 and 60 DAS) of glyphosate resulted in the best control of monocot as well as dicot weeds.

Key words: *Ber*, Herbicides, Jujube, Mulching, Nursery, Weed control, Weed population

Indian jujube (*Zizyphus mauritiana* L.) commonly known as 'Ber' in India is a hardy fruit tree and cultivated all over the hot arid and semi-arid regions of North-West India. The jujube nursery is raised during summer season. The seeds of jujube rootstock (*Zizyphus rotundifolia* Lam.) are sown in the month of April and the rootstock is budded in July–August. High soil moisture due to frequent surface irrigations, abundant application of farmyard manure, and warm and humid environment favour the profuse growth of grassy and broad-leaved weeds in jujube nursery. *Cyperus rotundus* is the major weed in jujube nursery. The infestation of weeds in the jujube nursery results in the poor growth of the rootstock. Therefore, all the jujube seedlings do not attain buddable stem thickness even after four months of sowing and budding success is reduced due to delayed budding. The delay in the attainment of desirable stem thickness also results in staggering of budding process in two to three stages and even after this many rootstocks do not even become buddable during that budding season. In the next season, the leftover rootstocks become unbuddable as they attain very vigorous size, hence, the rootstocks are wasted. Some nursery men utilize these leftover rootstocks in next budding season. They cut the rootstock to ground level at the end of winter and a single sprout is maintained and budded in the budding season. The jujube plants such raised on the two year old rootstocks show poor transplanting success. Moreover, it is very tedious and laborious to maintain the rootstocks till next year.

In the jujube nursery, the weeds are generally being controlled by hand hoeing. Hand weeding is very labour intensive and in the arid regions of North-West India, there is an acute shortage of labour especially during the nursery production of jujube. Hand hoeing has been even realized not effective in controlling weeds as they grow again very rapidly after hand hoeing. The use of herbicides as suggested by Yadav *et al*. (2004) and locally available waste material such as crop straw, weeds, bark and composted municipal green waste can provide effective weed control (Radwan and Hussein 2001). Hence, the present study was conducted to evaluate the efficacy of different mulches and herbicides for the management of weeds in jujube nursery.

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MATERIALS AND METHODS

The present study was conducted at fruit nursery of Punjab Agricultural University, Regional Research Station at Bathinda (latitude 30^0 17" N, longitude 74^0 58" E and altitude 211 m). The soil was sandy loam and characterized with pH 8.5, organic carbon (0.55%), EC 0.21 dS/m^2, calcium carbonate, N (290 kg/ha), P (18.6 kg/ha) and K (219 kg/ha). The jujube seeds were collected from a single plant of jujube rootstock (*Zizyphus rotundifolia* Lam.) and sown in beds in April, 2007 and 2008 in paired rows. The paired rows were 45 cm apart and the inter row distance within a paired row was kept 15 cm. The weed control treatments were assigned to plots of 1.5 x 1.5 m having 6 rows.

There were 17 weed control treatments, *viz*. pendimithalin (0.25, 0.50, 0.75 and 1.0 kg/ha), pyrazosulfuron- ethyl (0.005, 0.01 and 0.02 kg/ha), glyphosate (1.64 kg/ha) at 10 DAS *i.e*. after emergence of weeds but, before germination of jujube seeds, paraquat (0.72 kg/ha) at 10 DAS, double application of glyphosate (1.64 kg/ha) at 10 and 60 DAS, double application of paraquat (0.72 kg/ha) at 10 and 60 DAS, wheat straw mulch 6 cm (14.0 t/ha), weed mulch 6 cm (9.0 t/ha) [*Kans* grass mulch (*Saccharum spontaneum* L.)], black plastic mulch 200 µm, weedy check, weed free check (hand hoeing done at weekly intervals to maintain weed free plots.), hand hoeing (3 weeks interval). The pre-emergence herbicides (pendimethalin 0.25, 0.5, 0.75 and 1.0 kg/ha and pyrazosulfuron- ethyl 0.005, 0.01 and 0.02 kg/ha) were sprayed on the beds after seed sowing. The herbicides were sprayed with a knapsack sprayer using 500 l/ha. The post-emergence application of herbicides (glyphosate 1.64 kg/ha and paraquat 0.72 kg/ha) was done 10 days after sowing (DAS). In another treatment, glyphosate and paraquat were applied twice *i.e*. 10 DAS and 60 DAS at the same doses mentioned above. The second spray of the herbicide at 60 DAS was directed in between the rows with the help of a hood fitted on the nozzle of sprayer. The organic mulches (wheat straw and *Saccharum* grass mulch) were spread all over the bed *i.e*. beneath the jujube seedlings and in between the rows of seedlings and the thickness of the mulch was maintained at 6 cm by giving topping mulch after 6 weeks, whereas black polyethylene mulch was spread only in between rows of jujube seedlings after 5 weeks of sowing. All the plots subjected to mulch treatments were manually weeded till 5 weeks. The weed control efficiency was calculated.

The experiment was carried out in randomized block design and replicated thrice. The data was pooled as an average of 2007 and 2008. The least significant difference (LSD) was calculated by multiplying standard error with't' value (P=0.05) at error degree of freedom to compare the means of the treatments.

RESULTS AND DISCUSSION

The monocot weeds which appeared in the jujube nursery were nutsedge (*Cyperus rotundus* L.), wire grass [*Eleusine indica* (L.) Gaertn.], bermuda grass [*Cynodon dactylon* (L.) Pers.] and love grass *Eragrostis tenella* (Linn.) P Beauv. Pigweed (*Amaranthus viridis* L.), puncture vine (*Tribulus terrestris* L.), spurge (*Euphorbia hirta* L.) and horsepurslane (*Trianthema portulacastrum* L.) were the prominent dicot weeds. Out of these, nutsedge was the major monocot weed (67.9%), followed by wiregrass (18.2 %), love grass (8.1%) and bermuda grass (5.8%). Among the dicot weeds, puncture vine (88.1%) was the major dicot weed followed by pigweed (10.3%).

All the weed control treatments significantly affected the germination of jujube seeds (Fig. 1). The highest germination (81.8 %) was found in weed free check and it was at par with the mulching treatments (polyethylene and organic mulches), hand hoeing, and manual weeding. In the mulching treatments, hand weeding was done till 5 weeks after sowing till the plants become big enough to put the mulches hence, the mulching treatments were at par with weed free check for seed germination. All the weedicide treatments hampered jujube seed germination. Pendimethalin at 1.0 kg/ha resulted in minimum seed germination (21.7%). Pendimethalin at 0.25, 0.50 and 0.75 kg/ha did not differ significantly for seed germination. Paraquat resulted in poor seed germination as compared to glyphosate treatments. The paraquat treatments were at par to pyrazosulfuron-ethyl at 0.02 kg/ha. Among the herbicidal treatments, the highest seed germination (76.6 %) was recorded with pyrazosulfuron-ethyl at 0.005 kg/ha and it was at par with pyrazosulfuron-ethyl at 0.01 kg/ha. Highest proportion of buddable plants (85.9%) was obtained with straw mulch and it was at par with weed mulch, black polyethylene mulch and weed free check (Fig. 1).

The lowest number of buddable plants was obtained with pyrazosulfuron-ethyl at 0.02 kg/ha and it did not differ significantly from pyrazosulfuron-ethyl at 0.01 kg/ha and pendimethalin treatments at 0.75 and 1.0 kg/ha. Paraquat treatments also resulted in lesser number of buddable plants as compared to glyphosate. Paraquat reduced germination and had some detrimental effects on plant growth which lead to lesser proportion of buddable plants as compared to glyphosate. The effect of different

treatments on the proportion of buddable plants might be due to their effect on plant girth (Table 1). Mulching treatment which suppressed the weeds and checked moisture loss from the soil resulted in highest proportion of buddable plants. Pyrazosulfuron-ethyl delayed germination and lead to plants with lesser girth, produced lowest number of buddable plants.

Data on plant height (Table 1) revealed that after 40 and 80 days, the highest plant height was obtained with weed free check and after 120 days the highest plant height (64.5 cm) was observed with black polyethylene mulch which was at par with straw and weed mulch. The mulch treatments were able to check weed growth (Table 2) and mulches have been reported to conserve moisture which may be responsible for the good seedling growth as reported by Faber *et al*. (2001).

At all the intervals, the highest weed control efficiency (Fig. 2) was obtained with straw mulch which was at par with weed mulch. At 40 DAS, black polyethylene mulch was also on par with organic mulches. However, at 80 and 120 DAS, the weed control efficiency was reduced to 60.5 and 45.4%, respectively. The black polyethylene mulch was spread in-between the plant rows and it could not be applied beneath the plants within the rows, hence it controlled the weeds only in between the rows. Single application of glyphosate at 10 DAS also resulted in high weed control efficiency (88.3%) till 40 DAS which was at par with single glyphosate application at 10 DAS, single paraquat application at 10 DAS and double application of glyphosate at 10 and 60 DAS. At 80 DAS, glyphosate showed better WCE (70.3%) and it was at par with double application of paraquat. However, these treatments resulted in poor weed control efficiency (42.6 and 30.9%, respectively) after 120 DAS. This is because the second application of post-emergence herbicides, *viz*. glyphosate and paraquat was done only in-between the rows. The pre-emergence herbicdes pendimethalin and pyrazosulfuron-ethyl resulted in very poor weed control efficiency (Fig. 2).

Different weed control treatments affected number of monocot and dicot weeds at 40, 80 and 120 DAS (Table 2). There were no monocot and dicot weeds after 40 and 80 days of treatment in straw and weed mulch. In the mulching treatments, hand weeding was done till 5 weeks after sowing till the plants became big enough to put the mulches. The higher efficacy of the mulches may be because of reduction in light interception (Mohanty *et al*. 2002). The study corroborated with earlier findings that organic mulches are capable of providing effective weed control (Timothy 2007, Abouziena *et al*. 2008). However, after 120 days, some monocot and dicot weeds developed in wheat straw and weed mulches, respectively. In

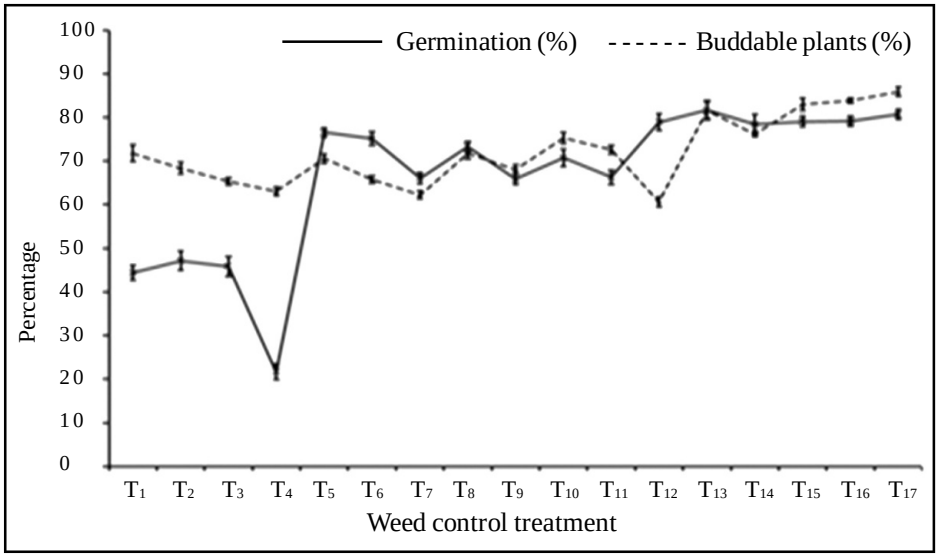
Table 1. Effect of organic and polyethylene mulches, herbicides and hand hoeing on plant girth and height

Treatment	Plant girth (cm)	Plant height (cm)		
		40 DAS	80 DAS	120 DAS
T_1- Pendimithalin 0.25 kg/ha	0.73	11.5	34.5	53.2
T_2- Pendimithalin 0.50 kg/ha	0.67	10.3	29.5	49.0
T_3- Pendimithalin 0.75 kg/ha	0.65	8.3	27.1	49.1
T_4- Pendimithalin 1.0 kg/ha	0.55	2.4	25.8	47.8
T_5- Pyrazosulfuron- ethyl 0.005 kg/ha	0.74	8.0	34.7	50.3
T_6- Pyrazosulfuron-ethyl 0.01 kg/ha	0.56	6.8	26.3	48.6
T_7- Pyrazosulfuron-ethyl 0.02 kg/ha	0.44	5.8	24.0	43.6
T_8- Glyphosate 1.64 kg/ha at10 DAS	0.77	8.4	34.4	50.5
T_9- Paraquat 0.72 kg/ha at 10 DAS	0.66	6.2	30.7	44.9
T_{10}- Glyphosate 1.64 kg/ha at 10 and 60 DAS	0.79	8.8	31.3	49.8
T_{11}- Paraquat 0.72 kg/ha at 10 and 60 DAS	0.70	6.3	29.5	45.5
T_{12}- Wheat straw mulch	0.89	10.9	33.1	64.0
T_{13}- Weed mulch	0.91	10.8	32.2	63.5
T_{14}- Black polyethylene mulch	0.91	11.3	30.4	64.5
T_{15}- Weedy check	0.67	10.2	26.0	45.4
T_{16}- Weed free check	0.84	13.6	38.7	58.4
T_{17}- Hand hoeing	0.81	11.8	33.8	54.0
LSD (P=0.05)	0.08	1.4	3.7	5.3

Table 2. Effect of organic and polyethylene mulches, herbicides and hand hoeing on weed density (no./m²) at different days after sowing

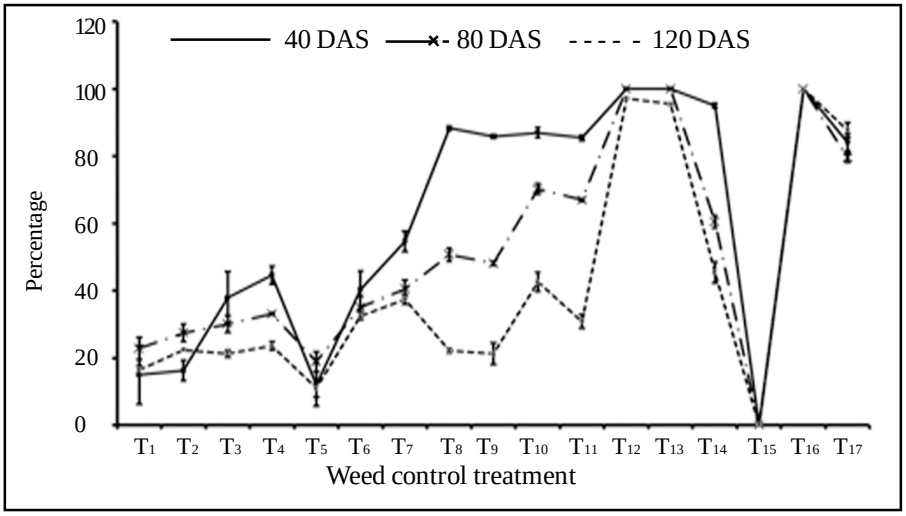
Treatment	Monocot weeds			Dicot weeds		
	40 DAS	80 DAS	120 DAS	40 DAS	80 DAS	120 DAS
T_1	26.5 (701.3)	28.9 (834.2)	30.5 (928.0)	1.0 (0.0)	11.7 (136.3)	12.4 (154.3)
T_2	25.4 (647.0)	27.9 (777.5)	28.5 (814.3)	1.0 (0.0)	10.0 (98.0)	12.7 (160.7)
T_3	22.5 (506.3)	26.0 (675.2)	26.8 (715.7)	1.0 (0.0)	8.8 (76.3)	11.1 (122.3)
T_4	18.8 (354.0)	24.3 (587.5)	24.9 (617.3)	1.0 (0.0)	7.9 (61.3)	9.3 (86.3)
T_5	24.5 (601.3)	26.1 (681.2)	27.9 (778.3)	17.3 (299.0)	19.4 (376.3)	20.3 (411.3)
T_6	22.1 (488.7)	23.2 (536.7)	23.7 (563.7)	18.2 (329.0)	19.7 (386.3)	21.1 (442.3)
T_7	19.6 (385.0)	21.2 (448.3)	22.2 (493.7)	17.7 (313.0)	20.4 (414.7)	21.3 (453.0)
T_8	11.8 (139.0)	17.9 (320.7)	20.2 (409.0)	6.0 (35.4)	8.2 (66.3)	11.1 (122.3)
T_9	12.1 (146.0)	20.1 (402.0)	18.9 (367.3)	4.6 (20.7)	8.7 (76.7)	99.1 (82.67)
T_{10}	12.6 (157.7)	9.4 (88.9)	10.6 (112.3)	5.6 (30.7)	4.1 (23.0)	1.0 (0.0)
T_{11}	11.7 (137.0)	9.9 (96.7)	11.8 (140.0)	5.2 (26.3)	4.2 (27.3)	1.0 (0.0)
T_{12}	1.0 (0.0)	1.0 (0.0)	8.5 (69.3)	1.0 (0.0)	1.0 (0.0)	14.7 (219.7)
T_{13}	1.0 (0.0)	1.0 (0.0)	9.5 (88.0)	1.0 (0.0)	1.0 (0.0)	3.7 (12.7)
T_{14}	8.0 (61.7)	13.6 (185.0)	18.7 (347.0)	4.8 (22.0)	7.7 (57.3)	4.2 (17.0)
T_{15}	32.6 (1035.3)	36.6 (1336.7)	39.3 (1539.7)	18.5 (343.9)	14.2 (225.0)	21.2 (469.3)
T_{16}	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)
T_{17}	12.1 (145.0)	13.6 (184.0)	32.2 (1041.3)	3.9 (15.7)	5.6 (29.0)	13.8 (193.0)
LSD (P=0.05)	1.7	1.2	2.8	1.2	1.4	1.8

Figures in parenthese correspond to the original values of the data, which were transformed ($\sqrt{x+0.1}$) before analysis.
Treatment details are given in Table 1.



Treatment details are given in Table 1.

Fig. 1. Effect of organic and polyethylene mulches, herbicides and hand hoeing on seed germination and percentage of buddable plants. Vertical bars represent S.E.



Treatment details are given in Table 1.

Fig. 2. Effect of organic and polyethylene mulches, herbicides and hand hoeing on weed control efficiency after 40, 80 and 120 DAS in Indian jujube. Vertical bars represent S.E.

black polyethylene mulch, weeds were even after 40 days and the weed density increased by 120 days. The black polyethylene can only be applied in between the rows of the plants and weeds developed beneath the plants within the plant rows, hence, the monocot and dicot weeds developed in this treatment. Among the herbicidal treatments, double application (at 10 and 60 DAS) of glyphosate resulted in the best control of mono and dicot weeds. Yadav *et al.* (2004) also reported that glyphosate provided good control of prominent weeds of the jujube nursery. The straw mulch was also equally effective to double application (10 and 60 DAS) of glyphosate but, only up to 60 days after treatment. In the present experiment, the thickness of the straw mulch was maintained at 6 cm by giving some toppings after 6 weeks which made organic mulches very effective in controlling the weeds.

REFERENCES

Abouziena HF, Hafez OM, El-Metwally IM, Sharma SD and Singh M. 2008. Comparison of weed suppressin and mandarin fruit yield and quality obtained with organic mulches, synthetic mulches, cultivation and glyphosate. *Horticulture Science* **43**: 795-799.

Faber BA, Downer AJ and Menge JA. 2001. Differential effects of mulch on citrus and avocado. *Acta Horticulturae* **557**: 303-308

Mohanty S, Sonkar RK and Marathe RA. 2002. Effect of mulching on Nagpur mandarin cultivation in drought prone region of central India. *Indian Journal of Soil Conservation* **30**: 286-89.

Radwan SMA and Hussein HF. 2001. Response of Onion (*Alleum cepa* L.) plants associated weeds to biofertilization under some plant mulches. *Annals of Agricultural Sciences* **46**: 543-564.

Timothy KB. 2007. Effect of mulch type and fertilizer placement on weed growth and soil pH and nutrient content. *Horticulture Technology* **17**: 174-177.

Yadav A, Balyan RS, Mallik RK, Bhatia SK and Banga RS 2004. Management of weeds in ber (*Zizyphus rotundifolia*) nursery. *Haryana Journal of Horticultural Sciences* **33:** 202-203.