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Short Communication

Performance of pearl millet (*Pennisetum glaucum* L.) as affected by weed control measures

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Pearl millet (*Pennisetum glaucum* L.) is an important nutritious millet crop of India. Its nutritious grain forms the important component of human diet and stover forms the principal maintenance ration for ruminant livestock during the dry season. It is a drought tolerant cereal having the maximum potentiality of grain production in adverse climatic conditions (Acharya *et al.*, 2017). As pearl millet is grown predominantly in warm rainy season, heavy infestation of weeds deprives the crop of vital nutrients, moisture, light and space leading to heavy reduction in grain yield. Yield reduction to the tune of 55 per cent has been recorded in pearl millet due to heavy weed infestation (Banga *et al.,* 2000). Whereas, Das and Yaduraju (1995) have reported 72 per cent yield loss in pearl millet due to heavy weed infestation. The field should be kept free from weeds at least for the first 25-30 days after sowing (DAS). The predominant methods of weed management are inter-culturing and hand weeding in pearl millet. The use of herbicides has revolutionized weed management and reduces the cost of cultivation. Among herbicides, atrazine as pre-emergence is a broad-spectrum widely used herbicide in pearl millet. Chhokar *et al.,* 2021 have reported the better efficacy of atrazine applied as post emergence compared to pre-emergence. There is a need to evaluate the efficacy of atrazine under both pre- and post- emergence applications in pearl millet also. Keeping these in views under consideration both pre- and post-emergence applications of atrazine were evaluated to find out the best option for weed management. Experiment was laid out in Randomised Block Design with three replications having twelve treatments *viz*., weedy check, weed free, two hand hoeing at 20 and 40 DAS, two hand wheel hoeing at 20 and 40 DAS, atrazine 0.125 kg/ha pre-emergence (PE), atrazine 0.250 kg/ha (PE), atrazine 0.500 kg/ha (PE), atrazine 0.100 kg/ha post-emergence (PoE) at 20 DAS, atrazine 0.200 kg/ha (PoE) at 20 DAS, atrazine 0.300 kg/ha (PoE) at 20 DAS, 2,4-D 0.300 kg/ha (PoE) at 30 DAS and 2,4-D 0.500 kg/ha (PoE) at 30 DAS. Soil of the experimental field was loamy sand with alkaline in nature and low in organic carbon (0.08 %) and available N (78 kg/ha) and medium in available P_2O_5 (22 kg/ha) and available K_2O (210 kg/ha). Pearl millet variety "HHB- 67" was sown at 45 cm x 15 cm row to row and plant to plant spacing using seed rate of 4 kg/ha. All other agronomic practices were adopted as per recommendation. Observations were recorded on plant height, plant dry weight and number of tillers, chlorophyll content (Arnon, 1949). After threshing, winnowing and cleaning, the produce of each net plot was weighed and expressed in grain yield as kg ha^{-1}. Nitrogen (Snell and Snell, 1959) and Phosphorus (Jackson, 1973) content in grain and straw of pearl millet was also estimated. The total N and P uptake was computed from N and P concentration in grain as well as stover multiplying by their corresponding yield (q/ha.).

The effect of various weed control treatments on crop growth and weeds are given in Table 1 and 2. The maximum plant height of pearl millet was recorded under weed free treatment which was statistically at par with all other weed control treatments except weedy check. All the weed control treatments significantly increased dry matter accumulation at harvest compared to weedy check (888.6 g/m^2).

Table 1. Effect of weed control on growth, chlorophyll, yield attributes and grain yield of pearl millet

Treatment	Plant height (cm) at harvest	Dry matter accumulation (g m^{-2}) at harvest	Chlorophyll content (mg g^{-1}) at 50 DAS	Effective no. of tillers plant^{-1}	Length of ear head (cm)	Grain weight ear head^{-1} (g)	Grain yield (kg ha^{-1})
Weedy check	152.3	888.6	2.83	1.41	23.7	8.29	1313
Weed free	185.3	1505.7	3.06	2.97	28.5	10.61	2480
Two hand hoeing 20 and 40 DAS	175.7	1342.8	3.08	2.49	27.0	9.53	2333
Two hand wheel hoeing 20 and 40 DAS	172.3	1303.3	2.94	2.32	26.7	9.89	2283
Atrazine 0.125 kg ha^{-1} (PE)	171.9	1160.1	2.88	2.08	25.5	9.89	1973
Atrazine 0.250 kg ha^{-1} (PE)	178.1	1248.9	2.92	2.09	25.8	9.81	2027
Atrazine 0.500 kg ha^{-1} (PE)	181.7	1451.4	2.99	2.80	27.2	8.63	2420
Atrazine 0.100 kg ha^{-1} (PoE) At 20 DAS	171.3	1145.3	2.93	2.06	25.4	9.88	1960
Atrazine 0.200 kg ha^{-1} (PoE) At 20 DAS	174.7	1219.3	3.03	2.19	25.8	10.10	2180
Atrazine 0.300 kg ha^{-1} (PoE) At 20 DAS	170.4	1273.7	3.06	2.40	25.9	9.16	2150
2,4-D 0.300 kg ha^{-1}(PoE) at 30 DAS	173.3	1293.4	3.68	2.60	26.7	8.74	2210
2,4-D 0.500 kg ha^{-1}(PoE) at 30 DAS	179.0	1362.5	3.74	2.90	27.2	8.32	2387
CD (P=0.05)	16.59	197.2	0.34	0.46	2.30	1.67	414

The highest plant dry matter (1505.7 g/m^2) was recorded under weed free treatment which was found statistically similar with two hand hoeing, atrazine 0.500 kg ha^{-1} PE, 2,4-D 0.500 kg ha^{-1}. These treatments were responsible for the considerable reduction in weed population and fresh weight of weeds. It further enhanced the availability of resources to the crop rather than to the weeds (Sharma and Jain, 2003). Two hand hoeing and two hand wheel hoeing treatments also increased yield due more growth of roots and increase aeration in soil causing higher uptake of nutrients by crop as suggested by Singh *et al.* (2006).

Chlorophyll content in leaves was significantly influenced due to different weed control treatments. The treatment 2,4-D 0.500 kg ha^{-1} recorded the maximum chlorophyll content (3.74 mg g^{-1}) which was significantly higher over weedy check (2.83 mg g^{-1}). The data further indicated the increase in chlorophyll content due to weed free treatment, 2,4-D 0.300 and 0.500 kg ha^{-1} was 8.1, 30.0 and 32.2 per cent, respectively, over weedy check. Maximum grain, straw and biological yield was recorded under weed free being at par with atrazine 0.5 kg ha^{-1} PE followed by 2,4-D 0.500 kg ha^{-1}, 2,4-D 0.300 kg ha^{-1} and atrazine 0.200

Table 2. Effect of weed control on nutrient uptake by crop and nutrient removal by weeds and weed index

Treatment	Total nutrient uptake by crop (kg ha^{-1})		Total nutrient removal by weeds (kg ha^{-1})		WI (%)
	N (kg ha^{-1})	P (kg ha^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	
Weedy check	46.20	10.28	88.83	1.71	88.8
Weed free	96.62	22.56	0.00	0.00	0.0
Two hand hoeing 20 and 40 DAS	88.65	19.79	6.29	0.11	6.3
Two hand wheel hoeing 20 and 40 DAS	80.17	17.60	8.61	0.14	8.6
Atrazine 0.125 kg ha^{-1} (PE)	74.50	16.48	25.68	0.33	25.7
Atrazine 0.250 kg ha^{-1} (PE)	75.17	17.59	22.37	0.37	22.4
Atrazine 0.500 kg ha^{-1} (PE)	93.49	21.03	2.48	0.10	2.5
Atrazine 0.100 kg ha^{-1} (PoE) At 20 DAS	74.17	15.84	26.53	0.21	26.5
Atrazine 0.200 kg ha^{-1} (PoE) At 20 DAS	79.15	18.16	13.76	0.17	13.86
Atrazine 0.300 kg ha^{-1} (PoE) At 20 DAS	81.14	19.45	15.35	0.16	15.4
2,4-D 0.300 kg ha^{-1}(PoE) at 30 DAS	89.88	18.06	12.22	0.63	12.2
2,4-D 0.500 kg ha^{-1}(PoE) at 30 DAS	96.36	18.15	3.91	0.46	3.9
CD (P=0.05)	17.26	4.85	1.01	0.22	-

kg ha^{-1} PoE. It might be due to reduction in weed density and dry weight, which allocated the available resources to the crop. These enhanced the yield attributes which further contributed in enhancement of the grain yield. Maximum yield in 2,4-D treated plot might be due to enhancement of chlorophyll content, growth, dry matter and reduced the weed competition to crop. The results so obtained for straw corroborate with the finding of Suryavanshi *et al.* (2012) and Pathak *et al.* (2015). The yield attributing characters *viz.* effective tillers plant^{-1}, length of ear head (cm) and grain weight ear head^{-1} were significantly improved under various weed control treatments as compared to weedy check and the effect was more pronounced with weed free closely followed by atrazine @ 0.500 kg ha^{-1} PE and 2,4-D @ 0.500 kg ha^{-1}. This was attributed to minimum infestation of weeds together with lesser competition for growth promoting resources. Thus, reduced crop-weed competition resulted into overall improvement in crop growth as reflected by plant height and dry weight consequently resulted into better development of reproductive structure and translocation of photosynthates into the sink. The results corroborated with the findings of Kaur and Singh (2006) and Rao *et al.* (2009). The maximum ear head length (28.5 cm) was observed under the weed free treatment which was statistically at par with two hand hoeing, two hand wheel hoeing, atrazine 0.500 kg ha^{-1} PE, 2,4-D 0.300 and 0.500 kg ha^{-1}. The maximum grain weight ear head^{-1} (10.61 gm) was observed under the weed free treatment which was statistically at par with two hand hoeing, two hand wheel hoeing, atrazine 0.500 kg ha^{-1} PE, 2,4-D 0.300 and 0.500 kg ha^{-1}. All the weed control treatments exerted significant influence on grain yield. The maximum grain yield was observed under the atrazine 0.500 kg ha^{-1} PE (2420 kg ha^{-1}) treatment which was statistically at par with two hand hoeing, two hand wheel hoeing, atrazine 0.250 kg ha^{-1} PE, atrazine 0.200 kg ha^{-1} PoE, atrazine 0.300 kg ha^{-1} PoE, 2,4-D 0.300 and 0.500 kg ha^{-1}. Atrazine 0.500 kg ha^{-1} PE, 2,4-D 0.300 and 0.500 kg ha^{-1} increased the grain yield to the extent of 84.3, 81.8 and 68.3 per cent, respectively over weedy check.

The results showed that weed control measures effectively reduced crop-weed competition for nutrient uptake. All weed control treatments significantly increased N and P uptake by grain and stover of pearl millet over weedy check. Weed free treatment resulted in significantly highest total uptake of N (96.62 kg ha^{-1}) and P (22.56) followed by atrazine 0.500 kg ha^{-1} having N (93.49 kg ha^{-1}) and P (21.03). All weed control treatments significantly reduced nitrogen and phosphorus uptake by the weeds compared to weedy check. It might be due to lesser weed competition in these treatments which enhanced the availability of the

nutrients *viz*., N & P to the main crop. Among herbicide treatments, the lowest N and P uptake by weeds was recorded under application of atrazine 0.500 kg ha^{-1} and it was followed by 2,4-D 0.500 kg ha^{-1}.

The lowest and highest weed index was recorded under weed free (0%) and weedy check (88.8 %), respectively as given in Table 2. Among the herbicides, the lowest weed index of (2.5 %) was recorded with application of atrazine 0.500 kg ha^{-1} PE followed by 2,4-D 0.500 kg ha^{-1} (3.9 %), two hand hoeing (6.39 %) and two hand wheel hoeing (8.6 %).

Based on this study it can be concluded that atrazine 0.500 kg ha^{-1} applied as PE was superior in reducing the weed infestation and improving the crop growth, and grain yield of pearl millet. The second best option was application of 2,4-D 0.500 kg ha^{-1}. Therefore, under the scarcity of manual labour, these herbicide options can be used for weed control in pear millet.

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Author's contribution

Conceptualization of research (SRS); Designing of the experiments (SRS, SPS and HS); Contribution of experimental materials (SRS, SPS and HS); Execution of field/lab experiments and data collection (SRS, SPS and HS); Analysis of data and interpretation (SRS, SPS and HS); Preparation of the manuscript (SRS, SPS and HS).

Declaration

The authors declare no conflict of interest.

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