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RESEARCH NOTE

Effect of weeds control measures on weeds and yield of pearl millet [*Pennisetum glaucum* L.]

S.R. Samota, S.P. Singh*, Hansraj Shivran, Ranjeet Singh and A.S. Godara

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ABSTRACT

A field experiment was conducted at the Instructional Farm, Agricultural Research Station, S.K. Rajasthan Agricultural University, Bikaner, Rajasthan during rainy *(Kharif)* season 2018 to identify effective weed control measures to manage weeds and increase yield of pearl millet [*Pennisetum glaucum* L.]. The experiment was laid out in randomised block design having 12 treatments with three replications. The pre-emergence application (PE) of atrazine 0.5 kg/ha was significantly superior in reducing weed density and biomass of both broad-leaved and grassy weeds.Weed free, atrazine 0.5 kg/ha PE and post-emergence application (PoE) of 2,4-D 0.5 kg/ha at 30 days after seeding (DAS), hand hoeing twice at 20 and 40 DAS and hand wheel hoeing twice at 20 and 40 DAS registered 2.48, 2.42, 2.39, 2.33 and 2.28 t/ha seed yield, respectively as against 1.31 t/ha seed yield in weedy check. The maximum gross returns of ₹ 86360/ha was recorded under weed free treatment while highest B:C ratio was recorded with 2,4-D 0.5 kg/ha PoE at 30 DAS (3.17), which was closely followed by atrazine 0.5 kg/ha PE (3.16).

Keywords: Atrazine, 2,4-D, Herbicides, Hoeing, Pearle millet, *Pennisetum glaucum* L., Weed management

Pearl millet [*Pennisetum glaucum* L.], also known as candle millet or bajra, is an important 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 resistant cereal having the maximum potentiality of grain production in adverse 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. Like other rainy season crops, pearl millet faces severe weed competition during initial slow growth stage leading to heavy (20-72%) reduction in grain yield due to heavy weed infestation (Das and Yaduraju 1995, Banga *et al.* 2000). Pearl millet picks up growth, start tillers and increase in height after 25-30 days after seeding (DAS) and becomes more competitive against the weeds. Thus, the field should be kept free from weeds at least for the initial 25-30 DAS for attaining higher pearl millet yield. The predominant methods of weed management used in pearl millet by farmers are inter-culturing and hand weeding. The use of herbicides for weed management reduces the cost of cultivation due to non-availability of labour and increased wages. Atrazine is a broad-spectrum herbicide and is recommended for pre-emergence application (PE). Post-emergence herbicides application (PoE) appears to be as more practical and economical as these can be applied after weeds emergence. Hence, in this study both pre- and post-emergence applications of herbicides were evaluated to identify the best effective and economical option for weed management in pearl millet.

A field study was conducted during rainy *(Kharif)* season of 2018 at Instructional Farm (28.01^{0}N latitude and 73.22^{0}E longitude at an altitude of 234.7 M above mean sea level) of SKRAU, Bikaner, Rajasthan. The soil was loamy sand, low in organic carbon (0.08 %) and available N (78 kg/ha) and medium in available P (22 kg/ha) and available K (210 kg/ha) with pH 8.3. The 12 treatments, *viz.* weedy check, weed free, hand hoeing twice at 20 and 40 DAS, hand wheel hoeing twice at 20 and 40 DAS, atrazine 0.125 kg/ha PE, atrazine 0.25 kg/ha PE, atrazine 0.5 kg/ha PE, atrazine 0.1 kg/ha PoE 20 DAS, atrazine 0.2 kg/ha PoE 20 DAS, atrazine 0.3 kg/ha PoE 20 DAS, 2,4-D 0.3 kg/ha PoE 30 DAS and 2,4-D 0.5 kg/ha PoE 30 DAS. The experiment was laid out using randomised block design with three replications. Pearl millet variety "*HHB-67*" was sown

College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan 334006, India

* Corresponding author email: spbhakar@gmail.com

at 45 x15 cm row spacing using seed rate of 4 kg/ha. Except management of weeds, all other agronomic practices were adopted as per the University recommendation. Weed density was taken from two random spots in each plot by counting the number of weeds per quadrat of 1.0 m^2 and the average was computed. In order to draw valid conclusion, the weed density data were subjected to square root transformation before subjecting to statistical analysis. Weed control efficiency of each treatment was calculated by using the following formula:

$$WCE\ (\%) = \frac{\text{Weed biomass in weedy check plot} - \text{Weed biomass in treated plot}}{\text{Weed biomass in treated plot}} X100$$

Grain and stover yields were recorded from net plot and economics was worked out in terms of net return and B:C ratio to find out most economic treatment using prevailing market prices of inputs and out puts.

The tested weed control treatments markedly reduced crop-weed competition. Atrazine 0.5 kg/ha PE significantly lowered the density of grassy weeds compared to hand wheel hoeing twice at 20 and 40 DAS, atrazine 0.3 kg/ha PoE at 20 DAS, 2,4-D 0.3 kg/ha PoE and 2,4-D at 0.5 kg/ha PoE and was statistically at par with, atrazine 0.25 kg/ha PE. Atrazine was superior than 2,4-D because of its efficacy on both broad-leaved and grassy weeds. In case of broad-leaved weeds also, lowest weed density was recorded with atrazine 0.5 kg/ha PE which was significantly superior to two hand wheel hoeing at 20 and 40 DAS, atrazine 0.25 kg/ha PE, atrazine 0.125 kg/ha PE and atrazine 0.1 kg/ha PoE at 20 DAS and was statistically at par with two hand hoeing at 20 and 40 DAS, atrazine 0.2 kg/ha PoE at 20 DAS, atrazine 0.3 kg/ha PoE at 20 DAS, 2,4-D at 0.3 kg/ha PoE, and 2,4-D at 0.5 kg/ha PoE. Atrazine 0.5 kg/ha PE significantly reduced the biomass of grassy weeds compared to atrazine 0.1 kg/ha PoE at 20 DAS, 2,4-D at 0.3 kg/ha PoE at 30 DAS and 2,4-D at 0.5 kg/ha PoE at 30 DAS and was statistically at par with hand hoeing twice at 20 and 40 DAS, hand wheel hoeing twice at 20 and 40 DAS, atrazine 0.25 kg/ha PE and atrazine 0.125 kg/ha PE. With respect to broad-leaved weed biomass also, atrazine 0.5 kg/ha PE was found superior than rest of the treatments. Lowest broad-leaved weed biomass was recorded with atrazine 0.5 kg/ha (PE) and which was statistically at par with 0.1 kg/ha PoE at 20 DAS, atrazine 0.2 kg/ha PoE at 20 DAS, 0.3 kg/ha PoE at 20 DAS, 2,4-D at 0.5 kg/ha PoE at 30 DAS, hand hoeing twice at 20 and 40 DAS and hand wheel hoeing twice at 20 and 40 DAS. The 2,4-D treated plot had lower broad-leaved weed biomass than atrazine PE as it effectively controlled only broad-leaved weeds. Weed control efficiency is directly associated with the weed biomass under these treatments. The atrazine PE had high weed control efficiency as it effectively controlled broad-leaved weeds as well as grassy weeds.

The increase in seed, straw and biological yield were by 88.88, 77.00 and 79.34%, respectively with weed free treatment when compared to weedy check. The maximum seed yield was recorded with atrazine 0.5 kg/ha which was significantly superior over the atrazine 0.1 kg/ha PoE at 20 DAS and atrazine 0.125 kg/ha PE, and it remained at par with hand hoeing

Table 1. Effect of weed control treatments on grasses, broad-leaved weeds and total weed density and biomass at pearl millet harvest

Treatment	Weed density (no./m^2)			Weed biomass (g/m^2)			WCE (%)		
	Grasses	Broad-leaved	Total	Grasses	Broad-leaved	Total	Grasses	Broad-leaved	Total
Atrazine 0.125 kg/ha PE	1.96 (3.3)	2.32 (5.00)	2.96 (8.33)	3.87	11.00	14.87	85.50	75.56	79.26
Atrazine 0.25 kg/ha PE	1.35 (1.33)	2.73 (7.00)	2.94 (8.33)	3.00	13.33	16.33	88.75	70.37	77.21
Atrazine 0.5 kg/ha PE	1.34 (1.33)	0.91 (0.33)	1.46 (1.66)	2.00	2.33	4.33	92.50	94.81	93.95
Atrazine 0.1 kg/ha PoE 20 DAS	2.54 (6.00)	1.46 (1.67)	2.85 (7.67)	6.07	3.00	9.07	77.25	93.33	87.35
Atrazine 0.2 kg/ha PoE 20 DAS	2.41 (5.33)	1.22 (1.00)	2.61 (6.33)	4.67	2.89	7.56	82.50	93.58	89.46
Atrazine 0.3 kg/ha PoE 20 DAS	2.27 (4.66)	1.08 (0.66)	2.41 (5.33)	4.33	2.83	7.17	83.75	93.70	90.00
2,4-D 0.3 kg/ha PoE 30 DAS	4.04 (16.33)	1.08 (0.66)	4.13 (17.00)	21.00	7.00	28	21.26	84.44	60.93
2,4-D 500 g/ha PoE 30 DAS	3.94 (15.33)	0.91 (0.33)	3.99 (15.66)	17.50	2.67	20.17	34.38	94.07	71.86
Hand hoeing twice 20 and 40 DAS	2.11 (4.00)	1.07 (0.66)	2.26 (4.66)	2.00	3.00	5.00	92.50	93.33	93.02
Hand wheel hoeing twice 20 and 40 DAS	2.19 (4.33)	1.46 (1.67)	2.54 (6.00)	3.25	3.37	6.62	87.80	92.52	90.76
Weedy check	4.55 (20.33)	6.14 (40.67)	7.67 (61.00)	26.67	45.00	71.67	0.00	0.00	0.00
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.00	0.00	0.00	100.00	100.00	100.00
LSD (p=0.05)	0.49	0.41	0.56	3.21	3.75	12.78	-	-	-

Data in the parentheses were subjected to square root transformation $\sqrt{x+0.5}$

Table 2. Effect of weed control treatments on pearl millet yield and economics

Treatment	Grain yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	Net returns (₹) ($x10^3$/ha)	B:C ratio
Atrazine 0.125 kg/ha PE	1.97	7.73	9.71	20	43084	2.64
Atrazine 0.25 kg/ha PE	2.03	7.81	9.84	21	44368	2.68
Atrazine 0.5 kg/ha PE	2.42	9.15	11.57	21	57273	3.16
Atrazine 0.1 kg/ha PoE 20 DAS	1.96	7.23	9.19	22	40823	2.55
Atrazine 0.2 kg/ha PoE 20 DAS	2.18	7.93	10.11	22	47876	2.82
Atrazine 0.3 kg/ha PoE 20 DAS	2.15	8.22	10.37	21	48401	2.83
2,4-D 0.3 kg/ha PoE 30 DAS	2.21	8.75	10.96	21	51662	2.95
2,4-D 500 g/ha PoE 30 DAS	2.39	9.41	11.80	20	57642	3.17
Hand hoeing twice 20 and 40 DAS	2.33	8.83	11.17	21	50306	2.65
Hand wheel hoeing twice 20 and 40 DAS	2.28	8.40	10.68	21	49728	2.75
Weedy check	1.31	5.37	6.68	20	20810	1.79
Weed free	2.48	9.50	11.98	21	54768	2.73
LSD (p=0.05)	0.41	2.28	2.34	NS		

twice at 20 and 40 DAS and hand wheel hoeing twice at 20 and 40 DAS, 2,4-D 0.5 kg/ha PoE, 2,4-D 0.3 kg/ha PoE and atrazine 0.2 kg/ha PoE. Highest stover and biological yield were recorded with 2,4-D 0.5 kg/ha PoE at 30 DAS. However, it was statistically at par with all other treatments.

The maximum net return of ₹ 57642 /ha was recorded with 2,4-D 0.5 kg/ha PoE at 30 DAS and it was closely followed by atrazine 0.5 kg/ha PE; weed free; 2,4-D 0.3 kg/ha PoE, hand hoeing twice; hand wheel hoeing twice, atrazine 0.3 kg/ha PoE and atrazine 0.2 kg/ha PoE. The maximum B:C ratio was obtained with 2,4-D 0.5 kg/ha PoE and it was closely followed by atrazine 0.5 kg/ha PE, 2,4-D 0.3 kg/ha, atrazine 0.3 kg/ha PoE and atrazine 0.2 kg/ha, two hand hoeing, two hand wheel hoeing. Similar observations were made by Mishra *et al.* (2016, 2017), Bhuva and Detroja (2018).

It may be concluded that application of 0.5 kg/ha atrazine PE and 2,4-D 0.5 kg/ha PoE 30 DAS are equally effective in better weed management, higher pearl millet yields and economic returns.

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