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Bioefficacy of post-emergence herbicides in pearlmillet (*Pennisetum typhoides)*

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ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2016 to study the efficacy of post emergence herbicides against weeds in pearlmillet. Results of the experiment revealed that the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) was effective and economical in controlling weeds in pearlmillet and is thus an effective alternative for manual weeding.

Key words: *Economics, Pearlmillet, Post-Emergence herbicides.*

Pearlmillet, also known as candle millet, bulrush millet or bajra, is an important crop of rainfed areas of India. It is the fifth important cereal after paddy, wheat, maize and sorghum. In pearlmillet the critical period of weed competition is upto 35 days after sowing, suggesting the importance of maintaining weed free environment during this period. Weeds cause reduction in grain and straw yields of *kharif* pearlmillet. On an average, 55% yield reduction due to heavy weed infestation in pearl millet crop was observed by Banga *et al*. (2000).

Keeping a crop weed free throughout the crop season is a labourious and cost intensive affair. With the discovery of synthetic herbicides in the early 1940s, there was a shift in control methods towards high input and target-oriented ones. Though the pre-emergence application of herbicides was found to be effective in controlling weeds, their usage is not only difficult but also can cause crop injury and effect environment because of higher doses used. Ecological problems emanating from the use of higher dose of herbicides lead to the birth of environmentally safer new generation of post-emergence herbicides, which are effective at very low doses in different crops (Dhiman and Singh, 2002). Hence, the present study was taken up to know the efficacy of different post emergence herbicides in pearlmillet.

MATERIAL AND METHODS

An experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2016. in sandy soil with a pH of 7.4, low in organic carbon (0.4%) and available nitrogen (159.5 kg ha^{-1}), medium in available phosphorus (20 kg ha^{-1}) and available potassium (330.5 kg ha^{-1}). A total rainfall of 541.30 mm was received in 22 rainy days during the crop growth period. The experiment was laid out in a randomized block design with nine treatments (Table 1) and replicated four times. Recommended doses of 60:30:20 kg ha^{-1} nitrogen, phosphorus and potassium were applied in the form of urea, SSP and MOP, respectively. Entire quantity of phosphorus, potassium and half of nitrogen was applied as basal. The remaining nitrogen was applied as top dressing at 35 days after sowing. Bold and healthy seeds were hand dibbled by adopting a spacing of 45 cm x 15 cm. Seed rate (3 kg ha^{-1}) was calculated based on test weight and germination percentage. In weedy check, weeds were allowed to grow throughout the crop growth period, where as in treatment T_2 weed free conditions were maintained. First hand weeding was done at 20 DAS followed by a second hand weeding at 40 DAS to remove weeds. Treatments involving the application of post-emergence herbicides (T_3, T_4, T_5, T_6, T_7, T_8, and T_9) were sprayed uniformly with a knapsack sprayer fitted with flood jet nozzle at 20 DAS. The spray volume used for the herbicide application was 500 L ha^{-1}. The data on weed density

Table 1. Effect of weed management practices on weed density (No.m^{-2}), weed drymatter (kg ha^{-1}) and weed control efficiency (%) in pearlmillet

Treatments	Weed density (No.m^{-2})		Weed drymatter (kg ha^{-1})		Weed control efficiency(%)	
	60 DAS	Harvest	60 DAS	Harvest	60 DAS	Harvest
T_1 - Weedy check	3.87 (213.00)	14.53 (230.00)	133.95	137.95	-	
T_2 - Hand weeding at 20 and 40 DAS	9.76 (100.00)	0.06 (104.50)	4.45	5.83	96.66	95.78
T_3 -Cyhalofop butyl @ 100 g a.i. ha^{-1} as PoE at 20 DAS	14.45 (218.50)	14.71 (227.25)	95.58	97.40	28.59	29.37
T_4 -Fenoxaprop ethyl+ safenor @ 63 g a.i. ha^{-1} as PoE at 20 DAS	11.84 (147.00)	12.24 (156.00)	59.95	64.53	55.26	53.21
T_5- Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} as PoE at 20 DAS	14.45 (211.50)	15.08 (230.00)	56.38	58.13	57.57	57.64
T_6- Bisphyribac sodium @ 25 g a.i. ha^{-1} as PoE at 20 DAS	14.91 (226.50)	15.32 (237.50)	87.78	90.15	34.18	34.74
T_7- Penoxsulam @ 22.5 g a.i. ha^{-1} as PoE at 20 DAS	12.27 (160.00)	12.73 (172.00)	47.43	48.80	64.09	64.63
T_8- 2, 4-D @ 800 g a.i. ha^{-1} as PoE at 20 DAS	16.45 (282.00)	16.83 (293.00)	93.75	95.65	29.99	30.63
T_9- Ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 20 DAS	15.44 (242.50)	16.06 (263.00)	66.05	68.23	50.46	50.53
SEm±	1.75	1.68	5.08	4.02	3.72	3.03
CD (P=0.05)	NS	NS	15.23	12.06	11.14	9.08
CV (%)	25.40	23.60	14.1	10.80	14.2	11.60

Table 2 : Effect of weed management practices on plant height, drymatter at harvest, yield attributes, weed index (%), net returns and B:C ratio in pearlmillet

Treatments	Plant height (cm)	Plant Drymatter (kg ha^{-1}) at Harvest	No. of productive tillers	No. of filled grains per ear head	Test weight (g)	Grain yield (kg ha^{-1})	Weed index (%)	Net Returns	B:C ratio
T_1 - Weedy check	175.90	6279.35	14.75	1232.0	10.39	1926	43.04	11005	1.53
T_2 - Hand weeding at 20 and 40 DAS	185.33	9684.66	14.75	1836.8	10.42	3393	0.00	21539	1.66
T_3 -Cyhalofop butyl @ 100 g a.i. ha^{-1} as PoE at 20 DAS	157.61	6390.30	15.00	1170.0	10.20	1765	48.54	6851	1.30
T_4 - Fenoxaprop ethyl+ safenor @ 63 g a.i. ha^{-1} as PoE at 20 DAS	0.00	0.00	0.00	0.00	0.00	0.00	100.00	- 21909	0.00
T_5-Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} as PoE at 20 DAS	167.92	8103.63	14.50	1360.3	11.26	2994	12.07	25728	2.19
T_6- Bisphyribac sodium @ 25 g a.i. ha^{-1} as PoE at 20 DAS	124.04	7282.69	15.00	1373.0	10.47	2130	36.18	11518	1.48
T_7- Penoxsulam @ 22.5 g a.i. ha^{-1} as PoE at 20 DAS	172.58	8209.99	14.50	1810.8	11.07	2631	22.25	19796	1.87
T_8-2, 4-D @ 800 g a.i. ha^{-1} as PoE at 20 DAS	177.71	7993.68	15.00	1434.8	11.21	2387	29.82	17962	1.84
T_9- Ethoxysulfuron @ 18.75 g a.i. ha^{-1} as PoE at 20 DAS	168.54	7018.34	14.75	1318.0	11.45	2295	31.45	15592	1.72
SEm±	9.04	397.86	0.33	200.89	0.49	269	7.52	-	-
CD (P=0.05)	27.09	1192.61	NS	NS	NS	806	22.54	-	-
CV(%)	10.88	10.44	4.47	27.86	9.11	22	41.86	-	-

and weed drymatter were recorded at 60 DAS and harvest and were subjected to square root transformation($\sqrt{X+0.5}$) before statistical analysis to normalize the distribution. The growth and yield attributes were recorded at the time of maturity. Economics of different treatments were calculated taking into account the prevailing market prices of input and output.

RESULTS AND DISCUSSION

The predominant weed species observed in the experimental field during investigation were *Cleome viscosa, Boerhavia diffusa* and *Commelina benghalensis* among broad leaved weeds; *Dactyloctenium aegyptium* and *Echinochloa colona* among grasses; *Cyperus rotundus* and *Fimbristylis milliacea* among sedges.

The data (Table 1) clearly shows that the density of the weeds is not significantly influenced by the treatments at all stages of the crop growth. At 60 DAS, none of the treatments could reach the level of hand weeding done twice at 20 and 40 DAS, in significantly reducing the weed drymatter (4.45). Among the herbicide treatments the lowest weed drymatter was observed with the application of Penoxsulam @ 22.5 g a.i. ha^{-1} (47.43) which was on par with Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (56.38). Similar reports on lower weed drymatter were reported by Singh *et al.* (2009). Highest weed control efficiency (64.09) was with Penoxsulam @ 22.5 g a.i. ha^{-1} (64.09) which was on par with Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1}. This is due better control of weeds over the weedy check than all other herbicides studied. Similar trend was observed at harvest.

Herbicide application exhibited profound influence on growth parameters of pearlmillet viz., plant height and drymatter accumulation. There is no significant influence on productive tillers, No. of filled grains per ear head and test weight. The highest weed control efficiency at harvest was observed with the application of Penoxsulam @ 22.5 g a.i. ha^{-1} (64.63 %) which is on par with the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (57.64 %).

Among the herbicide studied, Penoxsulam @ 22.5 g a.i. ha^{-1} (8209.99) recorded highest drymatter accumulation at harvest which was on par with the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (8103.63). Highest grain yield was obtained in hand weeding (3393 kg ha^{-1}) and among the herbicide treatments, application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) gave higher yield (2994 ha^{-1}) which was on par with the application of Penoxsulam @ 22.5 g a.i. ha^{-1} (2631 ha^{-1}). Lowest weed index (12.07) was observed with the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) which was on par with Penoxsulam @ 22.5 g a.i. ha^{-1} (T_7).

The highest net returns and benefit cost ratio wereobtained with application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5). Though the hand weeding resulted in highest grain yield, net returns and benefit cost ratio were lower compared to Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) due to expensive hand weeding.

CONCLUSION

On the basis of results obtained in the present experiment, it can be concluded that the application of Metsulfuron + Chlorimuron ethyl @ 4 (2+2) g a.i. ha^{-1} (T_5) was effective and economical in controlling weeds in pearlmillet and is thus an effective alternative for manual weeding.

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