



RESEARCH NOTE

Comparative efficacy of herbicides and hand weeding in managing weeds in irrigated summer finger millet (*Eleusine coracana* L. Gaertn.)

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ABSTRACT

A field experiment was conducted at M.S. Swaminathan School of Agriculture, Bagusala farm, Gajapati district, Odisha during the summer season of 2020 to assess the comparative efficacy of herbicides and hand weeding in managing weeds and improve productivity of irrigated summer finger millet (*Eleusine coracana* L. Gaertn.). The pre-emergence herbicide application (PE) of pendimethalin 500 g/ha or oxadiargyl 80 g/ha PE at 3 days after transplanting (DAT) followed by post-emergence application (PoE) of ethoxysulfuron 12 g/ha or bispyribac-sodium 20 g/ha at 20 DAT were found to be equally effective as hand weeding twice at 20 and 40 DAT in effectively managing weeds and improving the productivity of finger millet.

Keywords: Bispyribac-sodium, Ethoxysulfuron, Finger millet, Herbicides, Oxadiargyl, Pendimethalin, Weed management

Finger millet (*Eleusine coracana* L. Gaertn.) is cultivated over an area of 0.97 Mha with a production of 1.68 Mt giving an average productivity of 1.73 t/ha in India (Tonapi 2020). The crop is mainly cultivated in Karnataka, Maharashtra, Uttarakhand, Tamil Nadu, Andhra Pradesh, Jharkhand, Odisha, Chhattisgarh and Gujarat. Weeds are the constraints limiting the productivity of finger millet. A wide diversity in weed flora was reported to be associated with finger millet and the extent of finger millet yield loss due to weed competition was reported to be influenced by the types of weeds species and their density (Shubhashree and Sowmyalatha 2019). The grain yield losses ranging from 34 to 61% was reported due to uncontrolled weeds in finger millet (Patil *et al.* 2013). Thus, weed management was found to contribute to 43% increase in finger millet yield (Kumara *et al.* 2007). Weeds in the crop can be managed either by cultural, mechanical or chemical techniques or by means of integration of all these methods (Rao and Nagamani 2010). Hand weeding is the conventional method used by farmers for managing weeds in finger millet. The hand weeding has turned out to be a costly operation due to unavailability of labour and high labour wages. Hence, as an alternative to hand weeding, herbicides are being evaluated for managing weeds in finger

millet (Kumar *et al.* 2015). The current experiment was conducted with an objective to identify suitable herbicides and compare them with hand weeding in effectively managing weeds in irrigated summer finger millet.

The field experiment was conducted in summer season of 2020 at Bagusala farm, M.S Swaminatham School of agriculture, Gajapati district, Odisha. The experimental field's soil was sandy clay loam in texture, slightly acidic in reaction with pH of 6.4. The available nitrogen is 208 kg/ha, phosphorus is 139 kg/ha and potassium is 390 kg/ha. The experiment consisted of ten weed management treatments replicated thrice in randomized block design. The treatments include: oxadiargyl 80 g/ha pre-emergence application (PE) at 3 days after transplanting (DAT), pendimethalin 500 g/ha PE at 3DAT; bispyribac-sodium 20 g/ha post-emergence application (PoE) at 20 DAT; ethoxysulfuron 12 g/ha PoE at 20 DAT; oxadiargyl 80 g/ha PE at 3 DAT followed by (*fb*) bispyribac-sodium 20 g/ha PoE at 20 DAT, oxadiargyl 80 g/ha PE at 3 DAT *fb* ethoxysulfuron 2 g/ha at 20 DAT, pendimethalin 500 g/ha at 3 DAT *fb* bispyribac-sodium 20 g/ha PoE at 20 DAT, pendimethalin 500 g/ha PE at 3 DAT *fb* ethoxysulfuron 12 g/ha PoE at 20 DAT.

Finger millet variety 'GPU-28' was transplanted at a spacing of 20 x 25 cm on 6th February 2020, using 30-day old seedlings which were grown separately in nearby field. The recommended dose of

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fertilizer (RDF) (90:45:45 kg/ha) was applied to all the treatments. The entire level of P and K along with the 45 kg Nitrogen/ha was applied at the time of transplanting. The remaining nitrogen was applied at 20 DAT. The fertilizer nitrogen was made through urea, P through SSP and K through MOP. The crop was irrigated at 20, 40 and 50 DAT.

The herbicides were applied as per the treatments by using hand operated knap sack sprayer fitted with the flat pan nozzle at a spray volume of 500 l/ha. The observations on weeds were recorded from the area of 0.5 x 0.5 m at 20, 40 and 60 DAT and harvest and it was converted to square root transformation and analysed statistically by following the procedure given by Panse and Sukhatme (1985). The weed index was calculated by following the formula given by Gill and Kumar (1969). The weed control efficiency was calculated by using the following formula (Mani *et al.* 1981). The growth and yield and yield attributes were per standard procedure and subjected to standard statistical analysis.

The weeds recorded in the summer irrigated finger millet experimental field include: grasses: *Digitaria sanguinalis*, *Eleusine indica*, *Dactyloctenium aegyptium*, *Cynodon dactylon*, *Echinochloa colona*, *Sorghum helepense*; sedges: *Cyperus rotundus*, and *Cyperus iria* and broad-leaved/dicot weeds: *Chenopodium album*, *Parthenium hysterophorus*.

The weed density and biomass were lower and finger millet plant dry weight was higher in hand weeded plot as compared to other treatments (Table 1). Significantly higher finger millet grain yield was obtained with hand weeding twice (Table 2). The application of pre-emergence herbicides in combination with post-emergence herbicides has

given higher grain yield when compared to application of pre- or post-emergence herbicides alone.

The grain, straw and dry matter yield of finger millet at harvest was significantly greater with pendimethalin 500 g/ha PE *fb* ethoxysulfuron 12 g/ha PoE; oxadiargyl 80 g/ha PE at 3 DAT *fb* bispyribac-sodium 20 g/ha PoE; pendimethalin 500 g/ha PE *fb* bispyribac-sodium 20 g/ha PoE and oxadiargyl 80 g/ha PE *fb* ethoxysulfuron 12 g/ha PoE treatments than that observed with ethoxysulfuron 12 g/ha PoE at 20 DAT, oxadiargyl 80 g/ha PE ; bispyribac-sodium 20 g/ha PoE and pendimethalin 500 g/ha PE (Table 2). The grain yield in the latter treatments was significantly higher over unweeded control.

The gross and net returns and B:C ratio were higher with pre-emergence application of oxadiargyl 80 g/ha at 3 DAT followed by post-emergence application of bispyribac-sodium 20 g/ha or ethoxysulfuron 12 g/ha PoE, and Pendimethalin 500 g/ha PE at 3 DAT *fb* bispyribac-sodium 20 g/ha PoE or ethoxysulfuron 12 g/ha PoE at 20 DAT as compared to all other treatments (Table 2). However, the gross returns were lower and net returns were comparable to that of hand weeding at 20 and 40 DAT. The increase in net returns in the former treatments was 20 to 47% over that of application of pre-emergence herbicides. The net returns were negative with no weed control treatment.

The improvement in yield due to combined application of herbicides was due to lower weed biomass and increase in yield attributing characters. The sequential application of pre- and post-emergence herbicides has resulted in lower weed density and biomass and higher finger millet plant dry weight as compared to pre- or post-emergence

Table 1. Effect of weed management treatments on weed and crop growth and yield attributes of summer finger millet

Treatment	Weed density at 40 DAT (no./0.25 m ²)	Weed biomass at 40 DAT (g/0.25 m ²)	Weed control efficiency at 40 DAT (%)	Weed control efficiency (%) at harvest	Weed index (%)	Plant dry weight (g/ plant) at 60 DAT	No. of fingers per ear head	No. of effective tillers/hill	Grain yield/ ear head (g)	1000 grain weight (g)
Oxadiargyl 80 g/ha PE at 3 DAT	76.6 (8.7)	10.6	54.15	78.5	36	113	5.4	8.4	1.5	4.7
Pendimethalin 500 g/ ha PE at 3 DAT	69.6(8.3)	15.8	34.86	46.6	39	109.3	5.5	8.1	1.4	4.9
Bispyribac-sodium 20 g/ha PoE at 20 DAT	90(9.4)	15.8	11.68	46.2	37	111.7	5.2	8.1	1.2	4.6
Ethoxysulfuron 12 g/ha PoE at 20 DAT	81.6(9.04)	16.9	12.35	39.5	33	109.3	5.2	8.2	1.2	4.3
Oxadiargyl 80 g/ha PE at 3 DAT <i>fb</i> bispyribac-sodium 20 g/ha PoE at 20 DAT	81(9)	12.5	26.90	66.5	11	107.7	5	8	1.2	4.4
Oxadiargyl 80 g/ha PE at 3 DAT <i>fb</i> ethoxysulfuron 12 g/ha PoE at 20 DAT	72(8.4)	16.0	32.15	45.4	14	111.7	5.1	8.2	1.3	4.7
Pendimethalin 500 g/ ha PE at 3 DAT <i>fb</i> bispyribac-sodium 20 g/ha PoE at 20 DAT	87(9.3)	17.6	32.32	35.1	12	111.3	4.9	8.1	1.5	4.8
Pendimethalin 500 g/ha at 3 DAT <i>fb</i> ethoxysulfuron 12 g/ha PoE at 20 DAT	85.3(9.2)	16.5	32.65	42.1	10	108	5	8.3	1.3	4.6
Hand weeding twice at 20 and 40 DAT	52(7.2)	16.3	51.27	43.3	0	116	5.3	8.3	1.5	4.7
Weedy check	98.6(9.9)	23.4	0	0	61	88.7	3.5	5.3	1.1	3.9
LSD (p=0.05)	7.5(4.5)	1.89	-	-	-	5.07	0.6	0.5	NS	0.5

Table 2. Effect of weed management treatments on yield and economics of summer finger millet

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Dry matter at harvest (grain + straw) (t/ha)	Harvest index (%)	Gross return ($\times 10^3$ /ha)	Cost cultivation/treatment ($\times 10^3$ /ha)	Net returns ($\times 10^3$ /ha)
Oxadiargyl 80 g/ha PE at 3 DAT	1.13	3.17	4.30	26.26	54.18	46.87	7.31
Pendimethalin 500 g/ ha PE at 3 DAT	1.09	3.29	4.38	24.81	52.16	46.65	5.51
Bispyribac-sodium 20 g/ha PoE at 20 DAT	1.12	3.06	4.18	26.77	53.76	46.67	7.09
Ethoxysulfuron 12 g/ha PoE at 20 DAT	1.19	3.23	4.42	26.87	57.02	46.43	10.59
Oxadiargyl 80 g/ha PE at 3 DAT <i>fb</i> bispyribac-sodium 20 g/ha PoE at 20 DAT	1.58	4.07	5.65	27.95	75.84	47.71	28.13
Oxadiargyl 80 g/ha PE at 3 DAT <i>fb</i> ethoxysulfuron 12 g/ha PoE at 20 DAT	1.52	4.08	5.60	27.14	72.96	47.47	25.49
Pendimethalin 500 g/ ha PE at 3 DAT <i>fb</i> bispyribac-sodium 20 g/ha PoE at 20 DAT	1.57	4.10	5.67	27.65	75.26	47.49	27.78
Pendimethalin 500 g/ha PE at 3 DAT <i>fb</i> ethoxysulfuron 12 g/ha PoE at 20 DAT	1.60	4.17	5.77	27.68	76.61	47.24	29.36
Hand weeding twice at 20 and 40 DAT	1.77	4.78	6.56	27.05	85.15	53.83	31.32
Weedy check	0.69	2.62	3.32	20.92	33.31	45.83	-12.52
LSD (p=0.05)	0.10	0.34	0.36	-			

PE: pre-emergence; PoE: post-emergence; DAT: Days after transplanting; *fb*: Followed by

application of herbicides alone due to better control of weeds in the herbicide treatments that received sequential application of pre- and post-emergence herbicides. The greater herbicide efficiency was owing to superior weed control both in terms reduction in density and biomass (Kujur *et al.* 2019), as reported earlier (Bhargavi *et al.* 2016).

It can be concluded that hand weeding twice controlled the weed efficiently, but it is the laborious and costly method of weed control. Thus when labour shortage conditions prevail, pre- and post-emergence herbicide combination of pendimethalin 500 g/ha PE or oxadiargyl 80 g/ha PE at 3 DAT followed by ethoxysulfuron 12 g/ha or bispyribac-sodium 20 g/ha PoE at 20 DAT can be used for effective weed management and higher finger millet yield under summer irrigated conditions.

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