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Weed management in transplanted finger millet with pre-and post-emergence herbicides

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ABSTRACT

A field experiment was conducted during *Rabi* (winter season), 2020-21 at wetland farm of S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India to identify suitable pre-and post-emergence herbicide for managing weeds and enhancing productivity and profitability of transplanted finger millet. The hand weeding (HW) twice at 20 and 40 days after transplanting (DAT) resulted in lower density and biomass with higher weed control efficiency, grain yield, and benefit-cost ratio. It was closely followed by pre-emergence application (PE) of pretilachlor 500 g/ha or pyrazosulfuron-ethyl 15 g/ha. Post-emergence application (PoE) of penoxsulam 20 g/ha resulted in higher grain yield and benefit-cost ratio with broad-spectrum weed control among the post-emergence herbicides. The weeds in unweeded check reduced the grain yield by 64.39% compared to HW twice.

Finger millet [*Eleusine coracana* (L.) Gaertn] is a staple food crop for millions of people, who thrive under subsistence farming in dry areas like Eastern Africa, India and Sri Lanka. The grain of finger millet has an outstanding nutritional properties, *viz*. calcium (8.3%), iron (0.017%), dietary fibers and polyphenols (0.3 to 3%). Among different constraints that limit the productivity of finger millet, weed menace is one of the serious problems. Finger millet is a high stature crop with slower initial growth which remains under smothering due to the infestation of weeds at early stages of growth (Dhanapal *et al.* 2015). Generally, small millets are relatively poor competitors for growth resources than weeds, especially during the early stages of the crop. This severe competition due to uncontrolled weeds may result in drastic reduction in the yield up to 34 to 61% in finger millet depending on crop cultivars, nature and intensity of weeds, spacing, duration of weeds infestation, management practices and environmental conditions (Nanjappa and Hosamani 1985 and Mishra *et al*. 2018). Critical period for crop-weed competition of finger millet was 25-45 days after sowing (Yathisha *et al*. 2020). The research on chemical weed management in small millets is very meagre. Only limited pre-and post-emergence herbicides are selective in nature to control weeds in small millets with small seed size and sown at shallow depths (Mishra *et al*. 2018). Thus, there is need to have an alternate herbicides with different modes of action for obtaining broad-spectrum weed control coupled with low dose and high-efficacy herbicide for control of mixed weed flora in transplanted finger millet. Hence, the present study was undertaken to assess the performance of pre-and post-emergence herbicides for broad-spectrum weed control in transplanted finger millet.

A field experiment was conducted during *Rabi* (winter season), 2020-21 at wetland farm of S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil of experimental site was sandy loam in texture, neutral in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and potassium. The total rainfall received during crop period was 574.4 mm with 28 rainy days. The experiment was laid out in a randomized block design with tentreatments and replicated thrice. The treatments consisted of pre-emergence application (PE) of alachlor 1000 g/ha, isoproturon 750 g/ha, pyrazosulfuron-ethyl 15 g/ha, pretilachlor 500 g/ha, post-emergence application (PoE) of bispyribac-sodium 20 g/ha, topramezone 20 g/ha, penoxsulam

20 g/ha, ethoxysulfuron 20 g/ha, and hand weeding twice at 20 and 40 days after transplanting (DAT) and unweeded check. (**Table 1**). Phytotoxicity scoring was done at 6th and 7th days after herbicide application of pre-and post-emergence herbicides, respectively as per the method suggested by Singh and Rao (1976). Finger millet was transplanted at 30 x 10 cm spacing on 12th October, 2020. Pre-and post-emergence herbicides were applied to transplanted finger millet at two and 20 DAT by using power operated knapsack sprayer fitted with flat fan nozzle and spray volume of 500 L/ha. The crop was fertilized with 60 kg N, 30 kg P and 30 kg K/ha. Nitrogen was applied in two splits, *viz*. ½ as basal and the remaining ½ as top dressing at 30 DAT and entire dose of phosphorous and potassium was applied as basal at the time of sowing itself. The rest of the packages of practices were adopted as per the recommendations of the Acharya N.G. Ranga Agricultural University. Weed density and biomass were recorded randomly at harvest with the help of 0.25 m^2 quadrat and subjected to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution as suggested by Gomez and Gomez (1984). Weed control efficiency was computed as per the method suggested by (Mani *et al*. 1973). Growth parameters, *viz*. plant height and dry matter production yield attributes, *viz*. productive tillers/m^2, weight of ear head and weight of grains/ head were recorded at harvest from the randomly selected plants from net plot area. The crop was harvested on 9th January, 2021. Grain and straw yield of transplanted finger millet were recorded based on the yield obtained from net plot. Net returns were calculated by subtracting the cost of cultivation from the gross returns. Benefit-cost ratio was calculated after dividing gross returns with cost of cultivation.

Effect on weeds

The predominant weed flora associated with transplanted finger millet was *Digitaria sanguinalis* (L.) Scop. (35%), *Dactyloctenium aegyptium* (L.) (21%), *Cyperus rotundus* L. (17%), *Trichoderma indicum* (L.) Lehm. (12%), *Celosia argentea* L., (6%), *Commelina benghalensis* L., (5%) and others (4%). All the weed management practices significantly influenced weed density and biomass (**Table 1**). Among the weed management treatments, the lowest density and biomass of grasses, broad-leaved weeds and total weeds as well as higher weed control efficiency were obtained with pretilachlor 500 g/ha PE, which was comparable with pyrazosulfuron-ethyl 15 g/ha PE and penoxsulam 20 g/ha PoE. The HW twice at 20 and 40 DAT was superior than all other treatments tested. Pretilachlor 500 g/ha as PE found effective in suppressing the density and biomass of grasses, sedges and broad-leaved weeds followed by pyrazosulfuron-ethyl 15 g/ha. These results are in agreement with findings of Tuti *et al.* (2016) and Banu *et al*. (2016). Among the post-emergence herbicides, penoxsulam 20 g/ha was effective in suppressing density and biomass of total weeds including grasses, sedges and broad-leaved weeds. Topramezone 20 g/ha PoE resulted in higher density and biomass of total weeds as this herbicide was unable to control heavy infestation of weeds and it caused phytotoxicity on crop, which in turn created vacant spaces due to stand loss and reduced crop competitiveness against weeds that led to rampant growth of weeds.

Effect on finger millet growth and yield

Different weed management treatments tested in transplanted finger millet exerted significant and

Table 1. Weed density, weed biomass and weed control efficiency (%) as influenced by different treatments in transplanted finger millet

Treatment	Weed density (no./m^2)				Weed biomass (g/m^2)				WCE (%)
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total	
Alachlor (1000 g/ha) 2 DAT	5.55(30.3)	5.49(29.7)	6.43(41.0)	10.05(101.0)	5.02(24.8)	5.00(24.5)	5.37(28.4)	8.84(77.7)	55.13
Isoproturon (750 g/ha) 2 DAT	6.92(47.3)	6.70(44.3)	7.20(51.3)	11.97(143)	5.70(32.0)	5.65(31.4)	5.91(34.6)	9.92(98.0)	43.42
Pyrazosulfuron-ethyl (15 g/ha) 2 DAT	4.81(22.7)	4.56(20.3)	5.02(24.7)	8.24(67.7)	4.34(18.4)	4.21(17.2)	4.52(19.9)	7.48(55.5)	67.93
Pretilachlor (500 g/ha) 2 DAT	4.67(21.3)	4.26(17.7)	4.81(22.7)	7.86(61.7)	4.24(17.5)	4.18(17.0)	4.49(19.8)	7.40(54.3)	68.66
Bispyribac-sodium (20 g/ha) 20 DAT	5.51(29.8)	5.46(29.3)	6.22(38.3)	9.89(97.5)	4.99(24.4)	4.75(22.1)	5.32(27.8)	8.65(74.3)	57.07
Topramezone (20 g/ha) 20 DAT	6.87(46.7)	6.27(39.0)	7.18(51.2)	11.71(136.8)	5.60(30.9)	5.45(29.3)	5.82(33.4)	9.70(93.6)	45.93
Penoxsulam (20 g/ha) 20 DAT	4.83(22.9)	4.71(21.7)	5.21(26.7)	8.46(71.2)	4.44(19.3)	4.24(17.5)	4.62(20.9)	7.61(57.7)	66.68
Ethoxysulfuron (20 g/ha) 20 DAT	4.85(23.0)	4.64(21.0)	5.46(29.3)	8.58(73.3)	4.45(19.3)	4.23(17.4)	4.81(22.6)	7.71(59.3)	65.73
Hand weeding 20 and 40 DAT	4.02(15.7)	3.46(11.5)	3.58(12.3)	6.32(39.5)	2.65(6.5)	2.70(6.8)	3.17(9.6)	4.85(23.0)	86.71
Unweeded check (control)	7.70(59.5)	7.37(54.3)	7.92(62.7)	13.30(176.5)	7.05(49.3)	7.96(63.0)	7.83(60.8)	13.2(173.2)	-
LSD (p=0.05)	0.60	0.59	0.68	1.08	0.38	0.40	0.44	0.81	-

Figures in parentheses indicates square root transformed values, WCE: Weed control efficiency; DAT: Days after transplanting

Table 2. Yield components and yield as influenced by different weed management treatments in transplanted finger millet

Treatment	Plant height (cm)	Dry matter production (t/ha)	Productive tillers/m^2	Weight of ear head (g)	Weight of grains ear/head (g)	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (`/ha)	B:C ratio
Alachlor (1000 g/ha) 2 DAT	88	5.68	55	8.00	6.75	2.34	3.25	37285	2.08
Isoproturon (750 g/ha) 2 DAT	75	3.60	40	6.33	5.08	1.24	2.16	4280	1.13
Pyrazosulfuron-ethyl (15 g/ha) 2 DAT	102	6.76	68	10.40	9.05	2.82	3.84	53189	2.60
Pretilachlor (500 g/ha) 2 DAT	105	7.30	70	10.42	9.12	2.86	3.88	54075	2.61
Bispyribac-sodium (20 g/ha) 20 DAT	85	5.72	53	7.90	6.65	2.20	2.99	30864	1.84
Topramezone (20 g/ha) 20 DAT	71	2.95	34	5.66	4.41	0.85	1.72	-10315	0.72
Penoxsulam (20 g/ha) 20 DAT	100	6.71	68	9.82	8.42	2.81	3.80	51563	2.49
Ethoxysulfuron (20 g/ha) 20 DAT	89	5.95	60	8.70	7.44	2.39	3.32	39567	2.17
Hand weeding 20 & 40	116	8.12	80	11.36	9.96	3.29	4.37	53958	2.15
Unweeded check (control)	74	3.46	37	5.67	4.42	1.17	1.90	4180	1.13
LSD (p=0.05)	10	0.73	7	0.83	0.79	0.40	0.47	9609	0.33

positive influence on finger millet growth and yield components as well as yield. The highest values of growth parameters, *viz*. plant height and dry matter production and yield components *viz*., productive tillers/m^2, weight of ear head, weight of grains/ear head and grain yield of transplanted finger millet were obtained with HW twice and it was closely followed by pretilachlor 500 g/ha PE due to reduced competition for growth resources from weeds as they were effectively controlled (**Table 2**). The reduction in grain yield due to topramezone 20 g/ha PoE treatment might be due to inhibition of 4-Hydroxyphenyl-pyruvate dioxygenase (HPPD) enzyme in finger millet. Among all the weed management practices, the highest net returns and benefit-cost ratio were obtained with pretilachlor 500 g/ha PE and it was closely followed by pyrazosulfuron ethyl 15 g/ha PE and penoxsulam 20 g / ha PoE. Hand weeding twice even though effective in managing weeds, it recorded lesser benefit-cost ratio than effective pre-and post-emergence herbicides treatments, due to increased cost of manual weeding.

Thus, broad-spectrum weed control, higher finger millet grain yield and monetary returns can be obtained with pre-emergence application of pretilachlor 500 g/ha or pyrazosulfuron-ethyl 15 g/ha on sandy loam soils.

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