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Weed Dynamics and Grain Yield of Transplanted Finger Millet (*Eleusine coracana* L.) as Affected by Weed Management Practices

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A B S T R A C T

A field investigation was conducted at Zonal Agricultural Research Station, V. C. Farm, Mandya, to study the effect of herbicides for controlling weeds in transplanted finger millet with protective irrigation. The experiment was carried out consecutively for three years from 2015 to 2017 during *Kharif* in randomized block design with twelve treatments, replicated thrice. The treatments included pre-emergence application of herbicides alone at two doses each of pendimethalin 50 EC (0.5 kg a.i./ha and 0.75 kg a.i./ha), bensulfuron methyl (0.6G%) + pretilachlor (6. 0G%) (0.132 kg a.i/ha and 0.198 kg a.i./ha) and one dose of oxyflurofen 23.5 EC (0.1 kg a.i./ha) and combination of these herbicides with one inter cultivation at 40 days after sowing. Among herbicides, significant reduction in weed density was observed with application of oxyflurofen @ 0.1 kg a.i./ha (1.9 /0.25m^2) and bensulfuron methyl + pretilachlor @ 0.198 kg a.i./ha (5.0/0.25 m^2) when compared to unweeded check (34.9 /0.25m^2) at 30 DAP. Application of bensulfuron methyl + pretilachlor @ 0.198 kg a.i./ha resulted in significantly higher grain yield (4357 kg/ha), net returns per rupee invested (2.56) and higher weed control efficiency (84.9%) among the different herbicides tested.

Key words: *Eleusine coracana* L., Weed density, Weed control efficiency, Grain yield

In Karnataka, finger millet (*Eleusine coracana* Gaertn.) is a major food crop largely grown under rain fed condition. The production and productivity of finger millet is low because of unbalanced and insufficient nutrient application, heavy weed infestation, incidence of diseases etc. Among the several agronomic practices like unbalanced nutrition, weeds pose one of the major constraints in production of finger millet worldwide. Initial slow growth of the finger millet favours weed growth and results in very acute period of crop weed competition for first 35 to 40 days of sowing and delay in weed control beyond the critical period significantly reduces the yield by 34 to 61 per cent (Prasad *et al.* 1991). Traditional practice of weeding involves inter cultivation with tyne hoes and manual weeding using sickles and hand pulling which are time consuming and labour intensive (Saha 2005). So, controlling weeds by the use of herbicides is gaining attention due to shortage of labour and increased labour wages (Sundaresh *et al.* 1972). There is also a demand from farmers for the selective pre emergence herbicides which became cheaper when compared to manual weeding for timely control of weeds in finger millet crop. Chemical weeding is becoming more important as it is easier, time saving and economical as compared to manual weeding, thereby, it is the need of the hour. Hence this present investigation was under taken to study the effect of herbicides for controlling weeds in transplanted finger millet in irrigated tracts.

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MATERIALS AND METHODS

The experiment was conducted for three consecutive years from 2015 to 2017 during *Kharif* season at Zonal Agricultural Research Station, V. C. Farm, Mandya, University of Agricultural Sciences, Bangalore, Karnataka. The soil of the experimental site was red sandy loam, low in available nitrogen (248.30 kg/ha), medium in available phosphorus (48.14 kg/ha) and medium in potassium (215.04 kg/ha) with soil pH of 7.1. The experiment was laid out in

randomized block design with twelve treatments replicated thrice. The land preparation was carried out and sowing was done. Short duration variety KMR 204 which matures in 100 days was used in the study. The treatments consisted of three pre-emergence herbicides used alone and in combination with one inter cultivation at 40 days after transplanting. The treatments were T_1- Pendimethalin (30 EC) @0.5 kg a.i./ha, T_2-pendimethalin (30 EC) @ 0.75 kg a.i./ha, T_3- bensulfuron methyl (0.6 % G) + pretilachlor (6% G) @ 0.132 kg a.i./ha, T_4- bensulfuron methyl (0.6% G) + pretilachlor (6% G) @ 0.198 kg a.i./ha, T_5- oxyflurofen (23.5 EC) @ 0.1 kg a.i./ha, T_6- pendimethalin (30 EC) @ 0.5 kg a.i./ha fb one inter cultivation at 40 DAP, T_7- pendimethalin (30 EC) @ 0.75 kg a.i./ha fb one inter cultivation at 40 DAP, T_8- bensulfuron methyl (0.6% G) + pretilachlor (6% G) @ 0.132 kg a.i./ha fb one inter cultivation at 40 DAP, T_9- bensulfuron methyl (0.6% G) + pretilachlor (6% G) @ 0.198 kg a.i./ha fb one inter cultivation at 40 DAP, T_{10}- oxyflurofen (23.5 EC) @ 0.1 kg a.i./ha fb one inter cultivation at 40 DAP, T_{11}- two inter cultivations at 20 and 40 DAP with one hand weeding at 30 days after plating (DAP) and T_{12}- Un weeded check (control). The data on weed density and weed biomass were recorded at 30 and 60 days after planting. The data on weed density were transformed using square root transformation ($\sqrt{x}$ + 0.5) to normalize the distribution. The data on different growth and yield parameters were recorded at harvest and analysed statistically for interpretation of data.

Table 1 Effect of pre-emergence application of herbicides on (No./0.25 m^2) and weed dry weight (g/m^2) at different growth stages in transplanted finger millet

Treatments	Weed density at 30 DAP (No./0.25m^2)				Weed dry weight at 30 DAP (g/0.25m^2)				Weed density at 60 DAP (No./0.25m^2)				Weed dry weight at 60 DAP (g/0.25m^2)				WCE (%) at 60 DAP
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled	
T_1	4.17 (17.00)	5.37 (28.33)	4.11 (16.67)	4.65 (20.7)	2.68 (6.40)	2.67 (6.64)	2.82 (7.43)	2.79 (6.8)	5.36 (28.67)	5.57 (30.67)	4.94 (24.33)	5.37 (27.9)	2.75 (6.59)	3.27 (10.18)	3.44 (11.37)	3.22 (9.4)	62.6
T_2	3.85 (14.33)	4.95 (24.00)	3.71 (13.33)	4.27 (17.2)	2.6 (5.85)	2.64 (6.49)	2.69 (6.74)	2.71 (6.4)	5.02 (24.67)	5.49 (29.67)	4.52 (22.00)	5.12 (25.4)	2.73 (6.46)	2.66 (6.60)	3.3 (10.43)	2.97 (7.8)	68.7
T_3	3.62 (12.67)	3.22 (10.00)	3.49 (12.00)	3.54 (11.6)	2.49 (5.25)	2.43 (5.42)	2.43 (5.42)	2.52 (5.4)	4.03 (16.00)	3.94 (15.00)	4.49 (20.67)	4.24 (17.2)	2.67 (6.11)	2.81 (7.42)	2.87 (7.77)	2.85 (7.1)	71.6
T_4	1.91 (4.00)	2.35 (5.33)	2.46 (5.67)	2.44 (5.0)	1.79 (2.49)	2.39 (5.22)	1.93 (3.22)	2.15 (3.7)	3.08 (9.00)	3.18 (9.67)	3.57 (12.33)	3.37 (10.3)	2.08 (3.33)	2.64 (6.47)	2.14 (4.10)	2.37 (4.6)	81.5
T_5	1.18 (1.33)	1.57 (2.33)	1.48 (2.00)	1.67 (1.9)	1.82 (2.31)	2.32 (4.91)	1.5 (1.80)	2.0 (3.0)	2.73 (7.00)	3.11 (9.33)	2.84 (7.67)	3.00 (8.0)	1.91 (2.67)	2.6 (6.25)	2.02 (3.57)	2.27 (4.2)	83.4
T_6	3.72 (13.67)	5.08 (25.33)	4.1 (16.33)	4.41 (18.4)	2.65 (6.15)	2.68 (6.68)	2.68 (6.68)	2.74 (6.5)	5.34 (28.00)	5.33 (28.67)	5.27 (27.33)	5.38 (28.0)	2.94 (7.67)	2.78 (7.27)	3.18 (9.63)	3.03 (8.2)	67.3
T_7	3.13 (9.33)	4.88 (23.33)	3.85 (15.00)	4.1 (15.9)	2.64 (5.97)	2.62 (6.41)	2.62 (6.41)	2.69 (6.3)	4.86 (23.67)	5.18 (26.33)	5.1 (25.67)	5.11 (25.2)	2.91 (7.49)	2.71 (6.99)	2.95 (8.20)	2.92 (7.6)	69.8
T_8	2.76 (7.33)	3.24 (11.00)	3.43 (11.67)	3.29 (10.0)	2.51 (5.33)	2.34 (4.97)	2.34 (4.97)	2.47 (5.1)	4.08 (16.67)	4.88 (23.33	4.74 (22.00)	4.65 (20.7)	2.71 (6.33)	2.55 (6.06)	2.85 (7.63)	2.77 (6.7)	73.4
T_9	2.34 (5.00)	2.23 (5.67)	2.41 (5.33)	2.51 (5.3)	1.83 (2.36)	2.28 (4.72)	2.28 (4.72)	2.22 (3.9)	2.28 (5.00)	3.23 (10.00)	4.13 (16.67)	3.39 (10.6)	1.75 (2.10)	2.51 (5.81)	1.99 (3.47)	2.19 (3.8)	84.9
T_{10}	2.18 (4.33)	1.44 (2.67)	1.6 (2.33)	2.00 (3.1)	1.88 (2.63)	2.27 (4.65)	2.27 (4.65)	2.23 (4.0)	2.06 (4.67)	2.97 (8.33)	3.11 (9.33)	2.90 (7.4)	1.97 (2.89)	2.60 (6.27)	2.02 (3.60)	2.29 (4.3)	83.0
T_{11}	2.54 (6.00)	3.06 (9.00)	3.18 (9.67)	3.03 (8.2)	1.93 (2.76)	2.59 (6.28)	2.59 (6.28)	2.47 (5.1)	2.1 (5.00)	3.96 (15.33)	4.14 (16.67)	3.64 (12.3)	2.32 (4.41)	2.81 (7.43)	2.06 (3.77)	2.49 (5.2)	79.2
T_{12}	5.15 (26.67)	6.68 (44.33)	5.85 (33.67)	5.98 (34.9)	4.19 (16.57)	4.43 (19.09)	4.74 (22.03)	4.5 (19.2)	5.76 (33.00)	7.56 (56.67)	7.08 (49.67)	6.89 (46.4)	4.57 (19.88)	4.8 (22.60)	5.75 (32.67)	5.10 (25.1)	0
S.Em ±	0.39	0.50	0.40	0.2	0.26	0.09	0.11	0.1	0.53	0.27	0.46	0.3	0.10	0.16	0.12	0.1	
C.D.@ p=0.05	1.15	1.46	1.16	0.6	0.75	0.27	0.32	0.3	1.55	0.79	1.34	0.7	0.28	0.46	0.35	0.2	

Values in the parenthesis are original values

Square root transformed values are given outside the parenthesis

RESULTS AND DISCUSSION

Weed density and dry weight

The prominent weed flora observed in the experimental site was *Digitaria sangularis, Elesuine indica, Setaria glauca, Cyperus rotundus, Celosia argentia, Commelina benghalensis and Euphorbia geniculata*. Pooled data of three years showed that at both the growth stages, (30 DAP and 60 DAP) significant reduction in weed density and weed dry weight was observed with herbicide application as compared to unweeded check. Among different herbicides used, application of oxyflurofen 23.5 EC @ 0.1 kg a.i./ha followed by inter cultivation at 45 days after sowing resulted in lower weed density (7.4 /0.25 m^2) and weed dry weight (4.3 g/0.25 m^2). At 60 DAP, pre-emergence application of oxyflurofen 23.5 EC @ 0.1 kg a.i./ha, bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg/ha, application of bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg/ha followed by inter cultivation at 45 days after sowing, two inter cultivation (20 and 40 DAP) and one hand weeding (30 DAP) recorded on par weed density and weed dry weight with that of application of oxyflurofen 23.5 EC @ 0.1 kg a.i./ha followed by inter cultivation at 40 days after sowing as compared to unweeded check. Effective weed control throughout the crop growth period has led to reduction in weed density and weed dry weight their by recording higher weed control efficiency (84.9 per cent) with application of bensulfuron

methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha followed by inter cultivation at 45 days after sowing (Table 1). Similar results have been reported from Prithvi *et al.* (2015), Banu *et al.* (2016), Pandey *et al.* (2018).

Table 2 Effect of pre emergence application of herbicides on growth and yield parameters of transplanted finger millet (Pooled mean of three years)

Treatments	Plant height (cm)	No. of tillers per plant	No. of fingers per head	Finger length (cm)	Test weight (gm)
T_1	86.80	3.04	6.80	5.81	2.42
T_2	87.64	3.18	6.84	5.91	2.54
T_3	89.82	3.60	6.93	6.09	2.61
T_4	90.29	3.82	7.18	6.31	2.94
T_5	92.11	3.71	7.29	6.23	3.32
T_6	88.80	3.11	7.04	5.96	2.40
T_7	89.11	3.22	7.16	6.11	2.46
T_8	91.36	3.56	7.27	6.16	2.65
T_9	91.98	3.73	7.62	6.44	2.91
T_{10}	92.29	3.84	7.50	6.38	3.21
T_{11}	92.44	3.87	7.11	6.40	3.27
T_{12}	78.93	2.49	6.00	5.19	2.17
S.Em±	1.31	0.13	0.18	0.13	0.11
C.D.@ p=0.05	3.70	0.38	0.52	0.38	0.30

Growth and yield of crop

Growth and yield attributes of finger millet improved significantly due to different weed management practices as compared to unweeded check. Weed management practice of two inter cultivation and one hand weeding recorded significantly higher plant height (92.44 cm), number of tillers per plant (3.87), finger length (6.40 cm) and test weight (3.27 g) when compared to unweeded check which recorded a plant height of 78.93cm, 2.49 tillers per plant, 5.19 cm finger length and 2.17 gm of test weight (Table 2). Application of bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha along with one inter cultivation at 45 days after sowing as pre emergence herbicide also led to improvement of growth and yield attributes of finger millet which was comparable with that of the effect of two inter cultivations and one hand weeding and also with pre emergence application of oxyflurofen 23.5 EC @ 0.1 kg a.i/ha.

Table.3 Effect of pre emergence application of herbicides on yield and economics of transplanted finger millet (Pooled mean of three years)

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Treatment cost (₹/ha)	COC (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C Ratio
T_1	3253	5261	1139	45503	87650	42147	1.91
T_2	3307	5401	1538	45902	89153	43252	1.93
T_3	3893	5984	710	45074	104518	59444	2.31
T_4	4357	6713	890	45254	116976	71722	2.56
T_5	4266	6790	1370	45734	114786	69052	2.51
T_6	3430	5619	2513	46877	92481	45604	1.96
T_7	3533	5747	2913	47277	95233	47957	2.00
T_8	4039	6255	2085	46449	108486	62037	2.32
T_9	4337	6856	2265	46629	116643	70014	2.49
T_{10}	4384	6784	2745	47109	117751	70642	2.50
T_{11}	4448	6990	4500	48864	119588	70724	2.49
T_{12}	2414	3538	0	44364	64599	20235	1.46
S.Em±	100.42	149.13					
C.D.@ p=0.05	283.25	420.62					

Significantly higher finger millet grain yield of 4448 kg/ha and straw yield of 6990 kg/ha was obtained with weed management practice of two inter cultivations and one hand weeding. On par yield was recorded with oxyflurofen 23.5 EC @0.1 kg a.i./ha followed by one intercalation at 40 days after sowing (4384, 6784 kg/ha), bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha (4357, 6713 kg/ha), bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha followed by inter cultivation at 45 days after sowing (4337, 6856 kg/ha) and oxyflurofen 23.5 EC @ 0.1 kg a.i./ha (4266 kg/ha, 6790 kg/ha) grain yield and straw yield respectively (Table 3).

Pre-emergence application of herbicides (bensulfuron methyl (0.6% G) + pretilachlor (6.0% G), oxyflurofen 23.5 EC @ 0.1 kg a.i./ha) followed by inter cultivation at 45 days after sowing recorded higher grain yield which might be

due to better weed control in initial stages by herbicide application and advantage of inter cultivation at later stages in reducing the weed density in addition to creation of better aeration for roots. Similar results with pre-emergence application of bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha fb one inter-culture at 45 DAS for effective weed management, higher net returns and B:C ratio was reported by Pandey *et al.* (2018). Similar results were also obtained from Naik *et al.* (2000).

The lowest grain yield, straw yield and B:C ratio was recorded in unweeded check (2414 kg/ha, 3538 kg/ha, 1.46 respectively). The yield loss due to weeds accounts to be around 45% in unweeded check as compared to the practice of two inter cultivations and one hand weeding. Among different weed management practices, the higher net returns per rupee of investment was obtained with the bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha (2.56) which was due to lower cost of herbicides when compared to the cost involved with two inter cultivations and one hand weeding (Table 3).

From the study it can be concluded that pre-emergence application of bensulfuron methyl (0.6% G) + pretilachlor (6.0% G) @ 0.198 kg a.i./ha at three days after planting was found to be cost effective sustainable weed management practice to achieve higher grain yield in transplanted finger millet under protective irrigation condition.

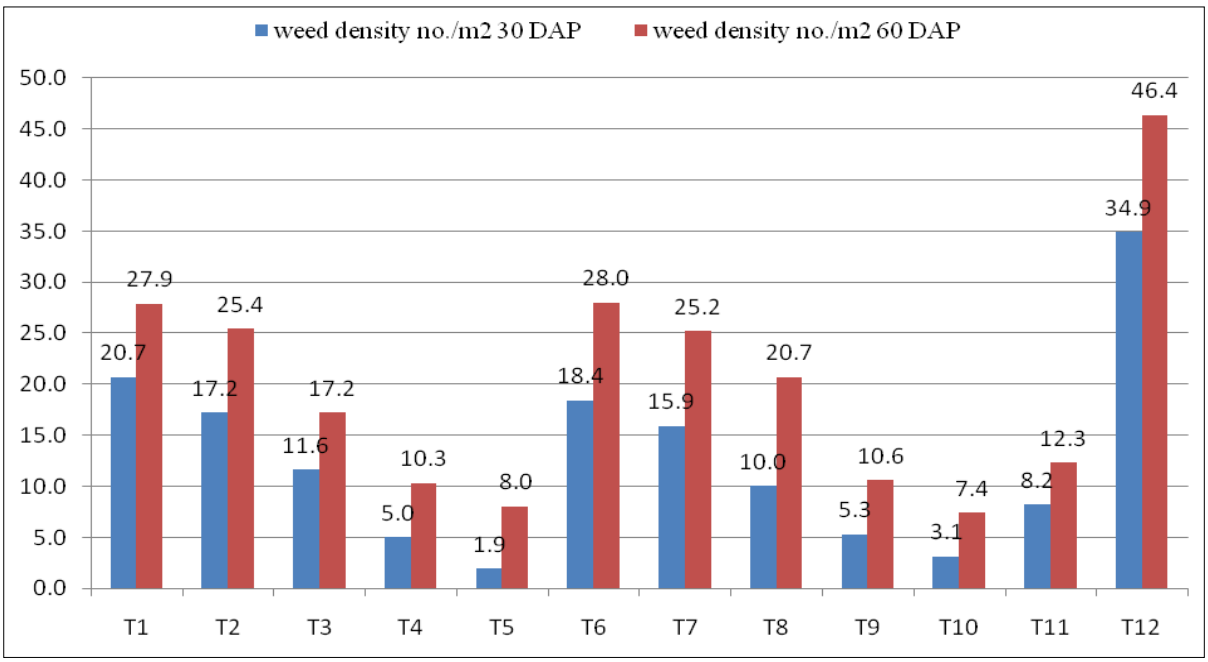

Fig 1 weed density in transplanted finger millet as affected by different weed management practices

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