



Effect of Integrated Weed Management Practices on Weed Dynamics, Growth Performance and Yield of Direct Sown Finger Millet (*Eleusine coracana* L.)

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ABSTRACT

Background: Finger millet is an important dryland crops since they can tolerate unfavorable weather and are frequently planted in soils with low nutrient and poor water holding capacity in soils. The main cause for yield loss is weed infestation which occurs in finger millet. Several integrated weed management techniques were carried out to control them particularly and to increase yield which benefits farmers.

Methods: In this context a field experiment was conducted in Karunya Institute of Technology and Sciences, Coimbatore, during *Rabi* season of 2022-23 in direct sown finger millet under irrigated condition. The experiment was laid out in RCBD with ten treatments and three replications viz., PE pendimethalin @ 0.75 kg ha⁻¹ 8 DAS + Hand weeding @ 35 DAS, PoE 2,4-D @ 2 kg ha⁻¹ 40 DAS + Hand weeding @ 35 DAS, PE pretilachlor @ 0.75 kg ha⁻¹ 8 DAS + Hand weeding @ 35 DAS, PoE 2,4-D @ 2 kg ha⁻¹ 40 DAS + Twin wheel hoe @ 30 DAS, PE pendimethalin @ 0.75 kg ha⁻¹ 8 DAS + Twin wheel hoe @ 30 DAS, PE pretilachlor @ 0.75 kg ha⁻¹ 8 DAS + Twin wheel hoe @ 30 DAS, Hand weeding @ 25 and 40 DAS, Twin wheel hoe @ 25 and 40 DAS, Hand weeding @ 25 DAS + Twin wheel hoe @ 40 DAS and Unweeded control. The CO 14 finger millet was used a test variety with 110 days medium duration.

Result: The result showed that pre-emergence pretilachlor @ 0.75 kg ha⁻¹ 8 DAS + Twin wheel hoe weeding @ 30 DAS significantly decreased weed density, importance value index and summed dominance ratio of weeds with higher weed control. The same treatment combination recorded higher plant height (115.8 cm) and grain yield (2368 kg ha⁻¹) at harvest.

Key words: Finger millet, Growth parameters, Integrated weed management, Weed density, Weed dynamics.

INTRODUCTION

Finger millet is scientifically called as *Eleusine coracana* belongs to poaceae family. It covers 5% of all cereal-growing land (Shinggu *et al.*, 2009). In India, finger millet is cultivated in an area of 1.15 million ha with a yield of 1724 kg ha⁻¹ and a production of 1.99 million tonnes during 2020-21 (Indiastat, 2022). Due to crop weed competition and critical crop weed days observed between 25 and 45 days in direct seeded finger millet further sowing causes a greater reduction in yield. Weeds that grow alongside crops deplete a significant amount of plant nutrients, resulting in lower crop yields. The integration of chemical and cultural control further increased the weed control and enabled that herbicide rates to be reduced (Anonymous, 2004). Several new generation pre-emergence herbicides have been reported to provide appropriate weed control when used alone or in combination with hand weeding or chemical. The twin wheel hoe has two wheels for easy movement while removing unwanted plants and weeds that have overgrown the crop grown in the field. In this context, an experiment has been carried out to investigate the effect of integrated weed management practices in direct sown finger millet.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2022-23 in field no. R₂₄ at Karunya Institute of Technology

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and Sciences, Coimbatore. The experimental site is geographically located in Western agro-climatic zone of Tamil Nadu at 10°56'N latitude and 76°44'E longitude with 474 m above MSL. The soil was clay loam in texture with neutral soil pH (6.9). The available nitrogen is 336 kg ha⁻¹, phosphorus is 91 kg ha⁻¹ and potassium are 261 kg ha⁻¹. The organic content was 0.37%.

The experiment was laid out in randomized complete block design with ten treatments and three replications viz., T₁: PE pendimethalin @ 0.75 kg ha⁻¹ 8 DAS + Hand weeding (HW) @ 35 DAS, T₂: PoE 2, 4-D @ 2 kg ha⁻¹ 40 DAS +

Hand weeding (HW) @ 35 DAS, T₃: PE pretilachlor @ 0.75 kg ha⁻¹ 8 DAS + Hand weeding (HW) @ 35 DAS, T₄: PoE 2,4-D @ 2 kg ha⁻¹ 40 DAS + Twin wheel hoe weeding (TWHW) @ 30 DAS, T₅: PE pendimethalin @ 0.75 kg ha⁻¹ 8 DAS + Twin wheel hoe weeding @ 30 DAS, T₆: PE pretilachlor @ 0.75 kg ha⁻¹ 8 DAS + Twin wheel hoe weeding (TWHW) @ 30 DAS, T₇: Hand weeding (HW) @ 25 and 40 DAS, T₈: Twin wheel hoe weeding (TWHW) @ 25 and 40 DAS, T₉: Hand weeding (HW) @ 25 DAS + Twin wheel hoe weeding (TWHW) @ 40 DAS, T₁₀: Unweeded control.

Finger millet CO 14 with a medium duration of 110 days was used which was sown at 30 cm × 15 cm spacing. The data on total weed density, importance value index and summed dominance ratio was observed and calculated using the following formulas suggested by Raju (1997). Observation on growth parameters and yield at harvest were recorded. The data obtained in the study were statistically analyzed using AGRES at 5% level of significance suggested by Gomez and Gomez (1984).

Absolute density

Absolute density (AD) =

$$\frac{\text{Total number of individuals of species in all quadrates}}{\text{Total number of quadrates employed}}$$

Relative density

Relative density (RD %) =

$$\frac{\text{Absolute density for a given species}}{\text{Total absolute density for all species}} \times 100$$

Importance value index

Importance value index (IVI %) =

$$\text{Relative density} + \text{Relative frequency}$$

Summed dominance ratio

$$\text{Summed dominance ratio (SDR)} = \frac{\text{Importance value index}}{2}$$

RESULTS AND DISCUSSION

Plant height

Fig 1 shows among different IWM T₆ recorded significantly higher plant height of 115.8 cm which was on par with T₅ (114.2 cm) followed by T₃ (105.4 cm) at harvest. This may be the result for effective weed management techniques that reduce weed growth, allowing the crop to better utilize nutrients, moisture, space and light which resulting in improvement of plant height (Fig 1). Similar observation was observed by Prithvi *et al.* (2015). T₁₀ shows the lowest plant height of 75.1 cm. This might be due to severe crop weed competition for the resources during earlier stages of crop growth. These outcomes were confirmed with the findings of Madhukumar *et al.* (2013).

Grain yield

Different IWM significantly influenced grain yield in finger millet (Fig 1). T₆ recorded highest grain yield 2368 kg ha⁻¹ which was statistically comparable with T₅ recorded grain yield of 2209 kg ha⁻¹. Higher grain yield in this treatment was due to better control of weed growth in all stages of finger millet (Sunil *et al.*, 2010). T₁₀ records lower grain yield (698 kg ha⁻¹). The yield was adversely affected in unweeded control due to severe weed competition by weed for space, light, moisture and nutrients throughout the crop growth period. These findings are similar with (Pradhan *et al.*, 2012).

Absolute density (AD)

Table 1 shows that among different IWM carried out to control the grassy weeds the lowest AD was recorded in T₆ (3.4 no m⁻²) which was on par with T₅ recorded 3.8 no m⁻² followed by T₃ (4.4 no m⁻²). Kujur *et al.* (2019) observed that higher herbicide use efficiency was owing to superior weed control. The highest AD was noticed in T₁₀ (17.9 no m⁻²).

The AD among sedges was lowest in T₆ recorded 2.2 no m⁻² which was on par with T₅ (2.7 no m⁻²) followed by T₃ (3.2 no m⁻²). The lowest AD was mainly due to better control of weeds from sowing to 45 DAS, which is the critical period for crop weed competition. These results are in conformity with Prashanth (Kumar *et al.*, 2015). T₁₀ recorded the highest AD of 17.2 no m⁻².

The AD of BLW was significantly reduced by different IWM the lowest AD was observed in T₆ (5.6 no m⁻²) followed by T₅ (6.1 no m⁻²). Highest AD was noticed in T₁₀ (15.6 no m⁻²). Integrated application of pre-emergence herbicides along with inter-cultural operations viz., hoeing and hand weeding at 30 to 35 days after sowing of seeds will give an effective and economical results of controlling weeds (Mishra *et al.*, 2018). Similar findings were observed by (Satish *et al.*, 2018).

Relative density (RD)

Adoption of IWM on grasses significantly influenced the RD of the weeds (Table 2). The lowest RD of grassy weeds was observed in T₆ recorded 98 % which was followed by T₅ (102%) which was on par with T₃ (104%). T₁₀ shows the highest density of 159% (Table 2). Similar results were also found by Mynavathi *et al.* (2008) in irrigated maize discovered that, when compared to other mechanical weeders, passing wheel hoe greatly decreased the weed dry weight and enhanced the maize yield. This study findings were consistent with those made before by Ramamoorthy *et al.* (2009) in finger millet.

The lower RD was observed in T₆ (115%) which was followed by T₅ (129%) IWM measures drastically reduced weed population and weed dry matter at initial as well as up to final stages of the finger millet. T₁₀ recorded higher RD of 203%.

The BLW show significant difference in the RD. Lowest density was found in T₆ (83%) followed by T₅ (93%) were on par with T₃ (98%). IWM with combination of herbicides,

Table 1: Effect of IWM on absolute density of grasses, sedges and BLW in direct sown finger millet.

Treatment	Grasses					Sedges			BLW					
	Cy da	Di ma	El in	Da ae	Ch ba	Total	Cy ro	Cy ir	Ag co	Al se	Co be	Ph ni	Eu hi	Total
T ₁	1.5	1.8	0.8	0.8	0.5	5.4	2.5	1.5	2.2	1.2	1.2	1.0	1.7	7.3
T ₂	2.3	1.0	1.3	2.0	1.0	7.6	3.7	3.0	2.5	1.7	1.5	1.2	1.5	8.4
T ₃	1.5	0.5	0.8	1.3	0.3	4.4	1.0	2.2	1.0	1.5	2	0.7	1.7	6.9
T ₄	2.0	0.8	1.3	1.0	1.0	6.1	1.7	3.7	2.0	1.1	1.6	1.8	1.4	7.9
T ₅	1.0	0.5	0.8	1.0	0.5	3.8	1.5	1.2	1.0	0.7	1.7	1.5	1.2	6.1
T ₆	1.0	0.8	0.3	0.8	0.5	3.4	1.2	1.0	0.7	1.0	2.0	1.2	0.7	5.6
T ₇	1.3	1.8	2.5	0.8	3.5	9.9	5.5	5.0	2.5	2.2	2.5	1.5	1.5	10.2
T ₈	1.5	1.3	2.0	2.5	1.8	9.1	5.0	4.0	1.2	1.0	2.1	1.9	2.7	8.9
T ₉	2.5	1.8	2.0	1.5	2.5	10.3	6.2	5.7	1.5	4.2	2.2	2.0	2.0	11.9
T ₁₀	5.3	3.0	1.8	3.5	4.3	17.9	8.2	9.0	2.5	2.7	3.2	2.5	4.7	15.6
SEd	0.2	0.2	0.2	0.2	0.2	1.0	0.5	0.5	0.2	0.2	0.2	0.2	0.3	1.1
CD (P =0.05)	0.5	0.3	0.4	0.4	0.5	2.0	1.1	1.1	0.5	0.5	0.5	0.4	0.5	2.3

(Cy da- *Cynodon dactylon*, Di ma- *Digitaria marginata*, El in- *Eleusine indica*, Da ae- *Dactyloctenium aegyptium*, Ch ba- *Chloris barbata*, Cy ro- *Cyperus rotundus*, Cy ir- *Cyperus iria*, Ag co- *Ageratum conyzoides*, Al se- *Alternanthera sessilis*, Co be- *Commelina benghalensis*, Ph ni- *Phyllanthus niruri*, Eu hi- *Euphorbia hirta*).

Table 2: Effect of IWM on relative density of grasses, sedges and BLW in direct sown finger millet.

Treatment	Grasses					Sedges			BLW						
	Cy da	Di ma	El in	Da ae	Ch ba	Total	Cy ro	Cy ir	Total	Ag co	Al se	Co be	Ph ni	Eu hi	Total
T ₁	27.8	33.3	14.8	14.8	9.3	122	126	28.5	154	30.1	16.4	16.4	13.7	23.3	100
T ₂	30.3	13.2	17.1	26.3	13.2	130	120	45.8	165	29.8	24.2	17.9	18.3	17.9	108
T ₃	34.1	11.4	18.2	29.5	6.8	104	64.5	78.8	143	19.0	37.0	8.9	11.5	21.5	98
T ₄	32.8	13.1	21.3	16.4	16.4	128	80.9	76.5	157	19.1	18.1	25.2	19.4	23.4	105
T ₅	26.3	13.2	21.1	26.3	13.2	102	95	34.4	129	11.5	27.9	24.6	12.7	16.7	93
T ₆	29.4	23.5	8.8	23.5	14.7	98	90	25.5	115	20.9	12.7	21.4	12.5	15.5	83
T ₇	13.1	18.2	25.3	8.1	35.4	138	130	45.6	175	27.6	24.5	22.7	20.7	24.7	120
T ₈	16.5	14.3	22.0	27.5	19.8	134	125	44.4	169	19.4	20.8	17.7	30.1	25.1	113
T ₉	24.3	17.5	19.4	14.6	24.3	150	138	43.9	181	29.4	20.2	23.3	28.3	24.3	126
T ₁₀	29.6	16.8	10.1	19.6	24.0	159	140	63.3	203	27.3	20.5	26.8	30.1	32.1	137
SSEd	3.0	2.0	2.0	2.3	2.2	14.6	12.9	5.9	18.4	2.8	2.5	2.3	2.5	2.6	12.4
CD (P=0.05%)	6.2	4.2	4.3	4.9	4.6	30.7	27.3	12.3	38.7	0.5	0.5	0.5	0.4	0.5	2.3

Table 3: Effect of IWM on importance value index of grasses, sedges and BLW in direct sown finger millet.

Treatment	Grasses						Sedges						BLW					
	Cy da	Di ma	El in	Da ae	Ch ba	Total	Cy ro	Cy ir	Total	Ag co	Al se	Co be	Ph ni	Eu hi	Total			
T ₁	40.8	49.3	28.8	24.8	28.3	172	136	38.5	174	40.1	26.4	26.4	23.7	33.3	149			
T ₂	42.3	28.2	31.1	38.3	40.2	180	130	55.8	185	39.8	34.2	27.9	28.3	27.9	158			
T ₃	38.1	29.4	28.2	35.5	22.8	154	74.5	88.8	163	29.0	47.0	18.9	21.5	31.5	147			
T ₄	42.8	35.1	31.3	38.4	30.4	178	90.9	86.5	177	29.1	28.1	35.2	29.4	33.4	155			
T ₅	36.3	23.2	31.1	36.3	25.2	152	105	44.4	149	21.5	37.9	34.6	22.7	26.7	143			
T ₆	39.4	33.5	18.8	33.5	22.7	148	100	35.5	135	30.9	22.7	31.4	22.5	25.5	133			
T ₇	31.1	38.2	35.3	38.1	45.4	188	140	55.6	195	37.6	34.5	32.7	30.7	34.7	170			
T ₈	28.5	40.3	32.9	37.5	44.8	184	135	54.4	189	29.4	30.8	27.7	40.1	35.1	163			
T ₉	34.3	42.5	44.4	44.6	34.3	200	148	53.9	201	39.4	30.2	33.3	38.3	34.3	175			
T ₁₀	39.6	44.8	48.1	34.6	42	209	150	73.3	223	37.3	30.5	36.8	40.1	42.1	186			
SED	4.1	4.2	3.8	4.0	4.0	20.1	14.0	6.9	20.6	3.8	3.5	3.4	3.5	3.7	17.8			
CD (P=0.05)	8.7	8.8	8.1	8.5	8.5	42.2	27.3	12.3	38.7	8.1	7.4	7.9	7.4	7.8	37.5			

Table 4: Effect of IWM on summed dominance ratio of grasses, sedges and BLW in direct sown finger millet.

Treatment	Grasses						Sedges						BLW					
	Cy da	Di ma	El in	Da ae	Ch ba	Total	Cy ro	Cy ir	Total	Ag co	Al se	Co be	Ph ni	Eu hi	Total			
T ₁	20.4	24.7	14.4	12.4	14.2	86.0	68.0	19.3	87.3	20.1	13.2	13.2	11.9	16.7	75.0			
T ₂	21.2	14.1	15.6	19.2	20.1	90.1	65.0	27.9	92.9	19.9	17.1	14.0	14.2	14.0	79.1			
T ₃	19.1	14.7	14.1	17.8	11.4	77.0	37.3	44.4	81.7	14.5	23.5	9.5	10.8	15.8	74.0			
T ₄	21.4	17.6	15.7	19.2	15.2	89.0	45.5	43.3	88.7	14.6	14.1	17.6	14.7	16.7	77.6			
T ₅	18.2	11.6	15.6	18.2	12.6	76.1	52.5	22.2	74.7	10.8	19.0	17.3	11.4	13.4	71.7			
T ₆	19.7	16.8	9.4	16.8	11.4	74.0	50.0	17.8	67.8	15.5	11.4	15.7	11.3	12.8	66.5			
T ₇	15.6	19.1	17.7	19.1	22.7	94.1	70.0	27.8	97.8	18.8	17.3	16.4	15.4	17.4	85.1			
T ₈	14.3	20.2	16.5	18.8	22.4	92.0	67.5	27.2	94.7	14.7	15.4	13.9	20.1	17.6	81.6			
T ₉	17.2	21.3	22.2	22.3	17.2	100	74.0	27.0	101	19.7	15.1	16.7	19.2	17.2	87.8			
T ₁₀	19.8	22.4	24.1	17.3	21.0	104	75.1	36.7	111	18.7	15.3	18.4	20.1	21.1	93.4			
SED	2.1	2.1	1.9	2.0	2.0	10.0	7.0	3.7	10.3	1.9	1.8	1.7	1.8	1.8	8.9			
CD (P=0.05)	4.3	4.4	4.0	4.2	4.2	21.1	14.8	7.3	21.7	4.0	3.7	3.6	3.7	3.9	18.8			

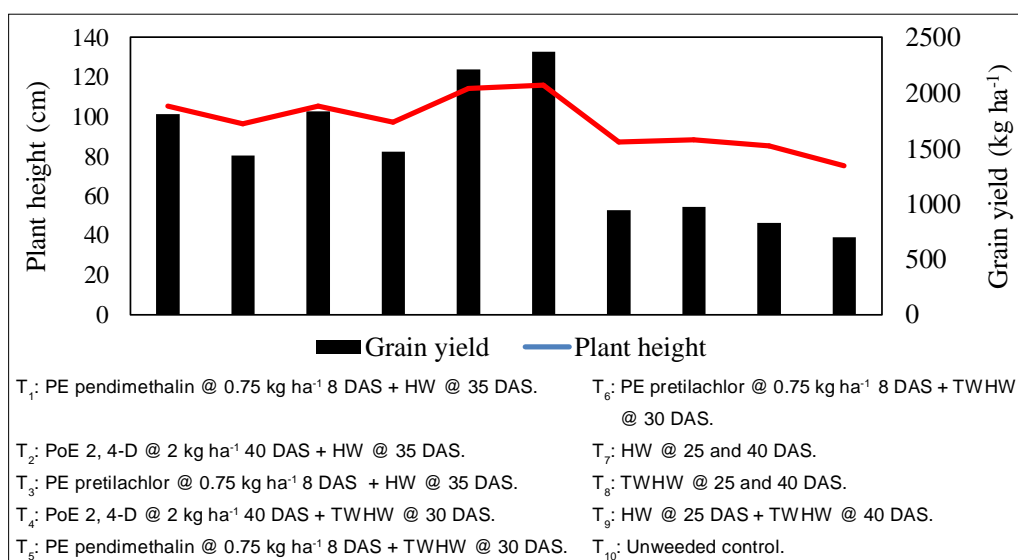


Fig 1: Effect of IWM on plant height and grain yield of direct sown finger millet.

mechanical and hand weeding provide efficient weed control. Similar findings were done by (Rao, 2021). Highest values were recorded in T_{10} (137%).

Importance value index

The lowest IVI of grassy weeds presented in Table 3 were recorded in T_6 (148%) followed by T_5 (152%). The lowest IVI recorded plots could be due to less weed growth by controlling the early emergence of weeds by pre-emergence application of herbicides and late emerged weeds through inter-culture activity. Similar results were reported by Prashanth Kumar *et al.* (2015). Highest was recorded in T_{10} (209%).

Among the sedges the lowest IVI value was recorded in T_6 (135%) The lowest range of IVI value through effective weed management practices in finger millet. Similar finding by Patil and Reddy (2014). Higher values were found in T_{10} (223%).

Among the different IWM the lowest IVI value was found in T_6 recorded 133 % followed by T_5 was on par with T_3 recorded 143 % and 147 %. The pre-emergence application of herbicides combined with a timely inter cultivation at 25-30 days after sowing provides effective weed control and higher yield leading to higher returns (Mishra *et al.*, 2016). Highest was recorded in T_{10} (186%).

Summed dominance ratio (SDR)

The SDR of grassy weeds presented in Table 4 are lower in T_6 (74) which was on par with T_5 followed by T_3 (76.1 and 77). Highest was recorded in T_{10} (104).

Among different IWM on sedges the SDR found lowest in T_6 (67.8) followed by T_5 recorded 74.7. The timely control of weed during the early emergence is very much essential for good yield this can be achieved by using mechanical weeders which can reduce the time spent on weeding (Goel *et al.*, 2008). The highest was observed in T_{10} (111).

The lowest SDR value was noticed in in T_6 (66.5) followed by T_5 recorded (71.7). Because of highest cost and

non-availability of labours the integrated use of herbicides and mechanical weeding for weed control at all stages proved to be an appropriate strategy for finger millet stated by Yadav *et al.* (2005). Similar findings were done by (Gowda *et al.*, 2012). T_{10} recorded highest value 93.4.

CONCLUSION

The study revealed that PE pretilachlor @ 0.75 kg ha⁻¹ on 8 DAS + TWHW on 30 DAS shows reduced absolute weed density, relative weed density, importance value index and summed dominance ratio in finger millet. The same treatment recorded higher plant height and grain yield of finger millet. Hence it was concluded that PE application of pretilachlor @ 0.75 kg ha⁻¹ on 8 DAS + TWHW on 30 DAS had a remarkable effect in increasing productivity and profitability in direct sown finger millet production under irrigated condition.

Conflict of interest

All authors declare that they have no conflicts of interest.

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