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Efficiency of Integrated Weed Management Strategies on Weed Dynamics in Transplanted Finger Millet (*Eleusine coracana*)

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ABSTRACT

To evaluate the effects of different weed management techniques on the dynamics of weeds in transplanted finger millet, a field experiment was conducted from January to April 2023 at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India. Nine treatments and three replications were used in the randomized block design experiment. The experimental treatments are T_1- Unweeded control, T_2- Two hand weeding on 10 DAT and on 25 DAT, T_3- Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT, T_4-Pendimethalin 30 % EC @ 750g a.i ha^{-1} on 3 DAT + Intercrop (Blackgram), T_5- Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT, T_6- Bensulfuron methy l 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT, T_7- Bensulfuron methy l 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT+ Intercrop (Blackgram), T_8- Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT and T_9- One hand weeding on 10 DAT+ Bispyribac Sodium 10% SC @ 25 g a.i ha^{-1} on 25 DAT. According to the study's findings, pre-emergence application of Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT and intercropping of blackgram in transplanted finger millet showed the lowest total weed population, lowest total weed biomass, and highest weed control efficiency.

Keywords Finger millet, Blackgram, Weed population, Weed biomass, Weed control efficiency.

INTRODUCTION

Finger millet (*Eleusine coracana* L. Gaertn), popularly known as ragi, belongs to the family poaceae, one of the major millet crops. It is an underutilized minor millet with numerous industrial and edible purposes. Growing in over 25 Asian countries, it accounts for around 12% of global millet acreage (Chandra *et al.* 2016). Additionally, it is grown in Africa's east and south. The states in India that produce the most finger millet include Karnataka, Uttarakhand, Maharashtra, Tamil Nadu, Odisha, Andhra Pradesh, Gujarat, Jharkhand, West Bengal, Bihar, and Chhattisgarh

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(GOI 2018). Finger millet is a crop that can withstand a range of abiotic stresses, including drought. In India ragi is grown on 1.21 million hectares with an average productivity of 1396 kg ha^{-1} and a production of 1.70 million tons (India agristat, 2023). In Tamilnadu, it is cultivated about 7.04 lakh hectares yielding 2.78 lakh tons and productivity of 1966 kg ha^{-1} (Agricultural Statistics at a Glance 2023). Due to several problems such as poor weed control, have caused the finger millet yield to drop to almost half of what it was in 1955–1956 (Sakamma *et al.* 2018). Due to the fact that weeds compete with crop for various resources like sunlight, water, nutrients and space they can drastically reduce yield by up to 70% (Rao *et al.* 2021). For finger millet, the critical period for crop weed competition ranges 25 to 60 DAS (Rao *et al.* 2015). Weeds associated with finger millet are able to adapt to shifting weather and edaphic conditions. Employing suitable weed management techniques is essential under these conditions to boost finger millet cultivation's profitability, productivity, and production costs.

MATERIALS AND METHODS

The experimental study was carried out from January to April 2023 at the experimental farm of the Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu, India. The experiment is situated at an elevation of ± 5.79 MSL, with latitudes of 11°24'N and longitudes of 79°44' E. The experimental region has a humid tropical climate with an average rainfall of 1500 mm. During the growth season, the minimum and maximum temperatures were 22.6 °C and 32.3 °C respectively. The experiment was employed in nine treatments and three replications in randomized block design. The treatment consists of T_1- Unweeded control, T_2- Two hand weeding on 10 DAT and on 25 DAT, T_3- Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT, T_4- Pendimethalin 30 % EC @ 750g a.i ha^{-1} on 3 DAT + Intercrop (Black gram), T_5- Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT, T_6- Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT, T_7- Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT+ Intercrop (Black gram), T_8- Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT and T_9- One hand weeding on 10 DAT+ Bispyribac Sodium 10% SC @ 25 g a.i ha^{-1} on 25 DAT. The test crop ragi variety CO15, was cultivated as a transplanted crop by planting 18 days old seedlings with spacing of 30 × 10 cm. ADT 5 blackgram was grown as an intercrop between ragi crop with a 10 cm intrarow spacing. Application of Bensulfuron Methyl 0.6% + Pretilalchor 6% G @ 660 g a.i ha^{-1} as a preemergence herbicide combined with 50 kg ha^{-1} of sand for evenly distribution. On the other hand, knapsack sprayer equipped with a flood fan nozzle was used to apply Pendimethalin 30% EC @750 g a.i ha^{-1} as a pre-emergence and Bispyribac Sodium 10% SC @ 25 g a.i ha^{-1} as a post-emergence herbicide at a spray volume of 500 L ha^{-1}. In hand weeding, weeds were uprooted with a hand hoe on the days stipulated in the treatment schedule, both within and between rows. To calculate the total weed population in each net plot 0.25 m^2 quadrant was used, which was then expressed as the total number of weeds per m^{-2}. Prior to the statistical analysis, the weed population data collected were transformed to $(\sqrt{X+0.5})$ in order to arrive an accurate conclusion. In order to determine the weed biomass, the weeds were air dried in a hot air oven until their weight remained constant. The weed control efficiency was calculated using the formula proposed by (Mani *et al*. 1973).

RESULTS AND DISCUSSION

Species of weeds in the experimental field

Cyanodon dactylon, Dactylactium aegyptium, Digiteria sangulensis, Eclipta alba, Panicum repens, Cyperus rotundus, Trianthema portulacastrum, Phyllanthus niruri, and *Cleome viscosa* were the most common weeds flora in the experimental field during the cropping period. (Vidhyabharathi 2020) also described the broad range of weeds found in the transplanted finger.

Effect of integrated weed management on total weed population

The data on the total weed population recorded on 15, 30 and 45 DAT of ragi crop are presented in

Table 1. Effect of various integrated weed management practices on total weed count (m^{-2}) in transplanted finger millet at 15, 30 and 45 DAT.

Treatments	15 DAT	30 DAT	45 DAT
T_1 - Unweeded control	8.38 (69.73)	11.04 (121.32)	14.52 (210.45)
T_2 - Two hand weeding on 10 DAT and on 25 DAT	3.25 (10.05)	3.99 (15.42)	4.89 (23.43)
T_3 - Pendimethalin 30% EC @ 750g a.i on 3 DAT + one hand weeding on 25 DAT	3.54 (12.01)	4.37 (18.62)	5.64 (31.34)
T_4 - Pendimethalin 30 % EC @ 750g a.i/ha on 3 DAT + Intercrop (Black gram)	3.02 (8.62)	3.61 (12.54)	4.22 (17.14)
T_5 - Pendimethalin 30% EC @ 750g a.i on 3 DAT + mulching (Sugarcane trash) on 21 DAT	3.51 (11.83)	5.89 (34.24)	8.53 (72.24)
T_6 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i/ha on 3 DAT + one hand weeding on 25 DAT	3.76 (13.61)	4.83 (22.82)	6.08 (36.45)
T_7 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i/ha on 3 DAT+ Intercrop (Black gram)	3.69 (13.09)	4.02 (15.64)	4.91 (23.64)
T_8 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i/ha on 3 DAT + mulching (Sugarcane trash) on 21 DAT	3.93 (14.96)	6.15 (37.31)	9.13 (82.93)
T_9 - One hand weeding on 15 DAT + Bispyribac sodium 10% SC @ 25 g a.i. ha^{-1} on 25 DAT	3.90 (14.71)	4.98 (24.31)	6.39 (40.27)
SEd	0.05	0.07	0.13
CD (p=0.05)	NS	0.15	0.28

(Figures in the parenthesis indicates the original values).

(Table 1). Integrated weed management techniques had significant effect on the total weed population (m^{-2}) at 15, 30 and 45 DAT. The higher total weed population of 69.73, 121.32 and 210.45 m^{-2} at 15, 30 and 45 DAT were recorded with unweeded check (T_1). Pendimethalin 30% EC @750 g a.i ha^{-1} as pre-emergence application on 3 DAT and blackgram intercropping. On the other hand, significantly decreased the total weed population and outperformed over the the other treatments by registering lower total weed populations of 8.62, 12.54 and 17.34 m^{-2} at 15, 30 and 45 DAT respectively. Additionally, the long-lasting and efficient herbicide weed control that is improved by intercropping blackgram, which suppresses late-emergence weeds. The pre-emergence application of pendimethalin inhibited the growth of the roots and shoots of annual grasses and broad-leaved weeds. The primary mechanism of action of pendimethalin is to hinder vulnerable monocot and dicot weed cells from producing microtubules, which

Table 2. Effect of various integrated weed management practices on total weed biomass (g m^{-2}) in transplanted finger millet at 15, 30 and 45 DAT.

Treatments	15 DAT	30 DAT	45 DAT
T_1 - Unweeded control	21.74	27.03	33.17
T_2 -Two hand weeding on 10 DAT and on 25 DAT	2.90	3.12	3.47
T_3 - Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT	3.10	3.72	4.02
T_4 - Pendimethalin 30 % EC @ 750g a.i ha^{-1} on 3 DAT + Intercrop (Black gram)	2.50	2.73	2.81
T_5 - Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT	4.85	5.63	6.54
T_6 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT	3.88	4.13	4.86
T_7 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT+ Intercrop (Black gram)	2.95	3.17	3.5
T_8 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT	5.47	6.45	7.28
T_9 - One hand weeding on 15 DAT + Bispyribac sodium 10% SC @ 25 g a.i ha^{-1} on 25 DAT	4.12	4.81	5.56

Table 3. Effect of various integrated weed management practices on weed control efficiency (%) in transplanted finger millet at 15, 30 and 45 DAT.

Treatments	15 DAT	30 DAT	45 DAT
T_1 - Unweeded control	-	-	-
T_2 - Two hand weeding on 10 DAT and on 25 DAT	85.59	87.29	88.87
T_3 - Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT	82.78	84.65	85.11
T_4 - Pendimethalin 30 % EC @ 750g a.i ha^{-1} on 3 DAT + Intercrop (Black gram)	87.64	89.66	91.76
T_5 - Pendimethalin 30% EC @ 750g a.i ha^{-1} on 3 DAT + mulching (Sugarcane trash) on 21 DAT	83.03	71.78	65.67
T_6 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1} on 3 DAT + one hand weeding on 25 DAT	80.48	81.19	82.68
T_7 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1}on 3 DAT+ Intercrop (Black gram)	81.23	87.11	88.77
T_8 - Bensulfuron methyl 0.6% + pretilachlor 6% G @ 660 g a.i ha^{-1}on 3 DAT + mulching (Sugarcane trash) on 21 DAT	78.55	69.25	60.59
T_9 - One hand weeding on 15 DAT + Bispyribac sodium 10% SC @ 25 g a.i. ha^{-1} on 25 DAT	78.90	79.32	80.86

Not analyzed statistically.

are essential for cell division. Because of the lack of nourishment, the newly emerging weed seedling dies as a result of restricted cell division, which stops it from expanding. A comparable decrease in weeds was previously reported by (Mogaka *et al.* 2021).

Effect of Integrated weed management on weed biomass

The data about weed biomass is shown in (Table 2). The weed biomass was significantly impacted by integrated weed management approaches at 15, 30 and 45 DAT. Higher weed biomass was measured with an unweeded check (T_1) at 15, 30 and 45 DAT and it was 21.74, 27.03 and 33.17 gm^{-2}. On the other hand, pre-emergence pendimethalin application and blackgram intercropping significantly reduced weed biomass and outperformed the other treatments, registering lower weed biomass of 2.50, 2.73 and 2.81 g m^{-2} at 15, 30, and 45 DAT respectively. It might be due to Pendimethalin effectively suppresses weeds in the early phases of crop growth by killing susceptible weed species by preventing their roots and shoots from cell division, particularly during crucial period of crop growth. In order to decrease the amount of light that enters the canopy, finger millet and blackgram work together to minimize the biomass of weeds. The results of (Gupta *et al.* 2017) are consistent with this observation.

Effect of integrated weed management weed control efficiency

The calculated values for the weed control efficiency are given in the (Table 3). Integrated weed management techniques had a notable impact on weed control efficiency in finger millet. Pre-emergence application of pendimethalin and Blackgram (T_4) intercropping outperformed the other treatments among the integrated weed management techniques, achieving greater weed control efficiencies of 87.64, 89.66 and 91.76% at 15, 30 and 45 DAT respective. The higher weed control efficiency was achieved by successfully suppressing weeds with herbicide and intercropping to suffocate weeds during the critical period of crop weed competition. These results concur with those of the study conducted by (Mathukia *et al*. 2015).

CONCLUSION

According to the experiment, results the pre-emergence application of Pendimethalin 30% EC @750 g a.i ha^{-1} on 3 DAT along with blackgram intercropping (T4) is the most efficient weed control technique for achieving lower total weed count, weed biomass and higher weed control efficiency in transplanted finger millet.

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