Original Research Article

WEED MANAGEMENT FOR ENHANCING THE GROWTH ATTRIBUTES AND YIELD OF PEARL MILLET

ABSTRACT

The field experiment was conducted in the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during June - September, 2023 to study the weed management for enhancing growth attributes and yield of pearl millet. There are eleven weed management treatments *viz.,* T_1 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre), T_2 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre), T_3 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre), T_4 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_5 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_6 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_7 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_8 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_9 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_{10} - Two hand weeding at 15 and 30 DAS and T_{11} - Unweeded Control were laid out in randomized block design with three replications. Among the herbicide treatments, Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE) (T_8) recorded the higher growth attributes and yield of pearl millet *viz*., plant height (155.84 cm), leaf area index (4.97) and dry matter production (7822 kg ha^{-1}), grain yield (3347 kg ha^{-1}) and stover yield (5155 kg ha^{-1}). The unweeded control (T_{11}) recorded the lowest values of growth attributes, grain and stover yield of pearl millet.

Keywords: *growth attributes, herbicides, pearl millet, weed management, and yield.*

1. INTRODUCTION

"Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important millet, rich in nutrition with the ability to grow in harsh climatic conditions. It is the world's hardest warm-season cereal crop. In India, Pearl millet is an indispensable arid and semi-arid crop cultivated for multiple purposes namely food, feed, green and dried forages. It is the sixth most important cereal after rice, wheat, maize, barley and sorghum in the world and stands fourth after rice, wheat, and maize, in order of importance as a food

grain in India" [1]. The crop is considered a "nutra-cereal" because of its high energy and protein supplying ability and more balanced amino acid profile than maize or sorghum [2].

Amongst all the millets, pearl millet occupies 95% of the production in India which is about more than 170 lakh tonnes (80% of Asia's and 20% of global production) of millets. In India, it occupies an area of 9.16 million hectares and production of 13.51 million tonnes with a productivity of 1.5 t ha^{-1} [3]. "In Tamil Nadu, it occupies an area of 0.46 lakh ha with a production of 1.19 lakh tonnes and productivity of 2578 kg ha^{-1}" [4]. "The area under pearl millet is gradually declining due to improper management of insects, weeds, diseases and others. The weeds are one of the major barriers responsible for the low productivity of pearl millet" [5].

"Weeds emerge fast and grow rapidly competing with the crop severally for growth resources *viz*., nutrients, moisture, sunlight and space during the entire vegetative and early reproductive stages of pearl millet" [5]. "Infestation of weeds throughout the cropping period caused a reduction in grain yield up to 37 per cent and more" [6]. "It is essential to manage the weeds by various means during the crop weed competition period to obtain the potential yield of pearl millet. Weed management is an imperative task, and executing this operation enhances the productivity of the crops" [7] and [8]. "The use of herbicides has revolutionized weed management and reduced the cost of cultivation to a greater extent. The application of herbicide at an appropriate rate may prove as an effective control measure and replace the conventional method of weed control" [7].

Atrazine is a selective systemic pre-emergence herbicide used to control annual grasses and broad-leaved weeds. Pendimethalin is a selective systemic pre-emergence herbicide used to control most of the annual grasses and broad-leaved weeds. Pretilachlor is a selective systemic pre-emergence herbicide that can be used to control a variety of weeds, including annual grasses, sedges, and broad-leaved weeds. 2,4-D dimethyl amine salt is a selective systemic post-emergence herbicide that can be used to control annual and perennial broad-leaved weeds. Tembotrione is a selective systemic post-emergence herbicide that can be used to control a wide range of broad-leaved and grassy weeds.

2. MATERIALS AND METHODS

2.1 Experiment details

The field experiment was conducted in the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during June-September, 2023 (*Kharif*) titled "Weed management for enhancing growth attributes and yield of pearl millet.". The Experimental Farm is situated at 11°24' N latitude and 79°44' E longitude and an altitude of + 5.79 m above mean sea level (MSL). The texture of the experimental field soil was clay loam with a neutral pH. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium. The hybrid pearl millet ANKUR 045 was chosen for this study. The seeds are dibbled at the rate of 3.5 kg ha^{-1} with a spacing of 45 × 15 cm. The pearl

millet crop was fertilized with 80:40:40 kg ha^{-1} of NPK. The well matured earheads were harvested in 90 DAS.

2.2 Treatment schedule

The experiment was laid out in a randomized block design (RBD) with three replications and eleven treatments. The treatment schedule was as follows: T_1 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre), T_2 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre), T_3 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre), T_4 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_5 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_6 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + 2, 4-D @ 0.5 kg a.i. ha^{-1} (PoE), T_7 - Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_8 - Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_9 - Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE), T_{10} - Two hand weeding at 15 and 30 DAS and T_{11} - Unweeded Control.

Pre-emergence herbicides of atrazine, pendimethalin and pretilachlor were sprayed at 3 DAS on soil with optimum moisture followed by post-emergence herbicides of 2,4 - D and tembotrione were sprayed at 20 DAS using the hand operated knapsack sprayer fitted with flood jet nozzle using 500 liters of water ha^{-1}. Manual hand weeding was done on 15 DAS and 30 DAS in specified plots as per the treatment schedule. Observations on growth attributes were taken at periodical intervals during the cropping period. The experimental data on crops were statistically analysed.

3. RESULT AND DISCUSSION

3.1 Growth attributes

All the weed management treatments that significantly influenced the growth parameters in pearl millet crops are furnished in Table 1. The most common grassy weed species identified in the experimental field were *Brachiaria reptans*, *Echinochloa colonum*, and *Leptochloa chinensis*. Only one species, *Cyperus rotundus* was classified as sedges, whereas *Corchorus trilocularis*, *Cyanotis axillaris*, *Phyllanthus maderaspatensis*, and *Trianthema portulacastrum* were found to be dominant broad-leaved weed species. A close examination of data, among the herbicidal treatments indicated that maximum values of plant height (155.84 cm), leaf area index (4.97) and dry matter production (7822 kg ha^{-1}) in pearl millet recorded with the application of pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + tembotrione @ 0.08 kg a.i. ha^{-1} (PoE) (T_8). It was followed by the treatment with the application of pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + 2,4 - D @ 0.5 kg a.i. ha^{-1} (PoE) (T_5). The reason for this could be that there was minimal weed competition during the critical crop weed competition period (30 DAS to 45 DAS) due to the low density and dry weight of weeds. This enhanced the pearl millet crop growth attributes due to better utilization of resources through effective control of weeds. In comparison to the unweeded control, the pearl millet growth metrics were significantly enhanced by this weed management treatment because they preserved growth inputs such as light, space,

moisture and nutrients, thereby improving the edaphic and nutritional environment in the root zone. These results are in accordance with the findings of [5]; [9]; [10] and [11].

3.2 Grain and stover yield

The results of the field study on pearl millet crops revealed that the grain and stover yield was significantly influenced by the weed management treatments presented in Table 1. Among the herbicidal treatments, the application of pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + tembotrione @ 0.08 kg a.i. ha^{-1} (PoE) (T_8) recorded the maximum grain yield (3347 kg ha^{-1}) and stover yield (5155 kg ha^{-1}). It was followed by the treatment with the application of pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + 2,4 - D @ 0.5 kg a.i. ha^{-1} (PoE) (T_5). This might be due to the simultaneous application of pendimethalin as a pre-emergence herbicide and post-emergence herbicide of tembotrione, it was significantly found to be better than the application of pre-emergence herbicides alone. This difference may be attributed to the subsequent use of post-emergence herbicides, which effectively controlled the annual grasses and a wide range of broad-leaf weeds. The unweeded control resulted in a noticeably lower production of grain and stover yield. By enhancing the source-sink connections, higher grain yield may most likely be the result of higher yield attribute values combined with increased dry matter observed under this treatment. These results are in conformity with the findings of [12]; [13]; [14] and [11].

4. CONCLUSION

According to the field study, applying pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + tembotrione @ 0.08 kg a.i. ha^{-1} (PoE) might increase pearl millet production. It was the most efficient herbicide treatment in terms of improving pearl millet's growth characteristics, grain yield and stover yield. This study aims to modify the pearl millet crop's cultural processes, which will help researchers and farmers enhance pearl millet production by more effective weed management.

Conflict of interest

The general abstract of this study was previously presented at the Two-Day International Conference on BioRevolution- Pioneering Innovations in Life Sciences (BIO-PILS - 2024) in Coimbatore, India on the 21st and 22nd March 2024, without revealing the specific data of this study. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during the writing or editing of manuscripts.

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Table 1. Effect of weed management practices on growth attributes and yield of pearl millet crop at harvest

Treatments		Plant height (cm)	Leaf area index (45 DAS)	Dry matter production (kg ha^{-1})	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	Atrazine @ 0.5 kg a.i. ha^{-1} (Pre)	127.21	4.25	4990	1897	3527
T_2	Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre)	129.87	4.28	5125	2004	3567
T_3	Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre)	129.07	4.26	5041	1928	3551
T_4	Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + 2, 4 - D @ 0.5 kg a.i. ha^{-1} (PoE)	137.52	4.50	6052	2401	4178
T_5	Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + 2, 4 - D @ 0.5 kg a.i. ha^{-1} (PoE)	142.65	4.66	7423	3075	4993
T_6	Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + 2, 4 - D @ 0.5 kg a.i. ha^{-1} (PoE)	139.78	4.55	6987	2813	4782
T_7	Atrazine @ 0.5 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE)	138.54	4.51	6558	2611	4517
T_8	Pendimethalin @ 0.75 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE)	155.84	4.97	7822	3347	5155
T_9	Pretilachlor @ 0.45 kg a.i. ha^{-1} (Pre) + Tembotrione @ 0.08 kg a.i. ha^{-1} (PoE)	140.71	4.60	7347	2991	4995
T_{10}	Two hand weeding at 15 and 30 DAS	158.33	5.05	7825	3389	5116
T_{11}	Unweeded Control	105.85	3.24	3559	1325	2544
SE(d)		**3.90**	**0.11**	**206.36**	**108.97**	**185.20**
CD (P=0.05)		**7.52**	**0.21**	**398.28**	**210.31**	**357.43**

*DAS: Days After Sowing; Pre: Pre-emergence; PoE: Post-emergence