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EVALUATION OF DIFFERENT PRE AND POST EMERGENCE HERBICIDES IN PEARL MILLET AND ITS RESIDUAL EFFECT ON SUCCEEDING BLACKGRAM

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ABSTRACT

A field investigation was conducted at the Dryland farm of S. V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, during *Rainy season,* 2023 in a randomized block design. Eleven treatments were undertaken and each replicated thrice. The lowest weed density and biomass, higher weed control efficiency and pearl millet growth parameters, yield attributes, grain and stover yield were recorded with hand weeding (HW) twice at 20 and 40 DAS, but it was equally effective with pre emergence (PE) application of pendimethalin 0.5 kgha^{-1} *fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS. Among the pre followed by post emergence (PoE) herbicides the density and dry weight of total weeds were lower with PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 gha^{-1} at 25 DAS, which was at par with PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS. Growth parameters of blackgram were not significantly influenced by weed management practices imposed in pearl millet. Application of atrazine, pendimethalin, pyrithiobac sodium, metsulfuron methyl + chlorimuron methyl, carfentrazone ethyl and tembotrione in pearl millet did not exert any residual/inhibitory effect on succeeding blackgram.

Key words: Blackgram,Herbicides,Pearl millet, Residues, Weed management

INTRODUCTION

Pearl millet [*Pennisetum americanum* (L.)] commonly known as Bajra or Bulrush millet is the most widely grown millet crop in India and it is a drought tolerant, warm weather coarse cereal grown in semi-arid and arid climatic conditions of tropical and sub-tropical regions of our country. India is the largest producer and consumer of pearl millet in the world. India is producing around 9.62 million tonns from an area of 6.70 million hectares and with a productivity of 1.43 tonns ha^{-1} (Directorate of Millets Development, 2021-22). Weed management is one of the main constraints in achieving the desired yield in pearl millet, as weeds have better competing ability than the crop and they can thrive under adverse conditions too. The predominant

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method of weed management in pearl millet is hand weeding, which is generally labour intensive. Sequential application of pre followed by post emergence herbicides helps to suppress wide variety of weeds that are actively growing besides maintaining crop performance at its best throughout the growing season. Ready-mix herbicides are formulated by combining different group of herbicides with different mode of action to target specific weed species for broad spectrum weed control. Herbicides applied at recommended rates may have a positive impact. However, even at recommended doses, some herbicides may not breakdown fast and can persist in soil for weeks, months and sometimes years after treatment and may inhibit the growth of subsequent crops (Rani *et al*., 2021). Field studies on persistence and effect of new generation herbicide molecules in pearl millet and their residual effect on succeeding crop are lacking. Hence, the present study was undertaken to find out the suitable pre and post emergence herbicides for effective weed control and for high net returns in pearl millet and also to study the effect of herbicide residues on succeeding blackgram.

MATERIAL AND METHODS

An experiment was conducted during Rainy season of, 2023 at S.V. Agricultural college, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh which is geographically situated at 13.5°N latitude and 79.5°E longitude with an altitude of 182.9 m above the mean sea level in the Southern Agro-Climatic Zone of Andhra Pradesh. The soil was sandy loam in texture, neutral in soil reaction, low in organic carbon (0.26%) and available nitrogen (212 kg ha^{-1}), medium in available phosphorus (26.6 $kgha^{-1}$) and potassium (234 kg ha^{-1}).The total rainfall received during the crop growth period was 753.0 mm in 29 rainy days. The experiment was laid out using randomized block design with eleven treatments and three replications. Treatments include pre emergence (PE) application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 days after sowing (DAS), PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS, PE application of atrazine 0.5 kg ha^{-1}*fb* post emergence (PoE) application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS, PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS, PE application of atrazine 0.5 kg ha^{-1}*fb*PoEapplication of metsulfuron methyl + chlorimuron ethyl 4 g/ha at 25 DAS, PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of metsulfuron methyl + chlorimuron ethyl 4 g/ha at 25 DAS, PE application of atrazine 0.5 kg ha^{-1}*fb* PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS, PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of carfentrazone ethyl 20 g/ha at 25 DAS, PoE application of tembotrione 60 g/ha at 25 DAS, HW twice at 20 and 40 DAS and weedy check.

Pearl millet variety *'ABV-04'* was sown at a spacing of 45 cm x 15 cm, on 2nd July 2023. After harvest of pearl millet, blackgram variety *'TBG-104'* was sown in undisturbed layout of pearl millet experimental field as a succeeding crop after ploughing the pearl millet field, at a spacing of 30 cm x 10 cm to study the residual effect of pre and post emergence herbicides applied to pearl millet on the weeds and on blackgram. Pearl millet was fertilized with 80 kg N, 40 kg P and 30 kg Kha^{-1}. Nitrogen was applied in the form of urea in two equal splits, *viz*. half as basal and the remaining half at 25 DAS and entire dose of phosphorus as single super phosphate and potassium as muriate of potash was applied basally at the time of sowing. All the herbicides alone or in combination were applied uniformly in the experimental plots with the help of knapsack

sprayer fitted with flat fan nozzle using a spray volume of 500 L ha^{-1}. Pre emergence herbicide was applied within 24 hours after sowing and post emergence herbicides application was done at 25 DAS of pearl millet. The data on weed density and dry weight were recorded at different growth stages of pearl millet. The number of weeds associated with pearl millet was recorded by placing a quadrat of 0.5 m x 0.5 m inside the net plot area and expressed as weed density (number m^{-2}). While recording weed density, weeds were harvested from each quadrat for estimating weed dry weight. The weeds collected from the sampling area were dried under shade for 24 hours followed by oven drying at 60°C, till a constant weight was obtained and expressed as weed biomass (gm^{-2}). At every stage of sampling, weeds were categorized into grasses, sedges and broadleaved weeds for both density and dry weight of weeds. These were subjected to square root transformation to normalize their distribution and the corresponding transformed values were used for statistical analysis as suggested by Gomez and Gomez (1984). Five randomly selected plants were tagged in each treatment, from each replication in the net plot area and used for making observations on yield parameters of pearl millet.

RESULTS AND DISCUSSION

Weed flora

Weed flora of experimental plots were comprised of *Dactyloctenium aegyptium* and *Digitaria sanguinalis* among grasses; *Cyperus rotundus,* a sedge; *Boerhavia erecta, Cleome gynandra, Commelina benghalensis* and *Euphorbia hirta* among the broadleaved weeds. Similar type of weed flora were reported by Mishra *et al*.(2014). However, narrow leaved weeds were dominated over broadleaved weeds.

Weed density and dry weight

At harvest of pearl millet, significantly lower density and biomass of grasses was recorded with HW twice at 20 and 40 DAS(Table 1), but it was significantly lower than PE application of atrazine 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS (T_1), which was at par with the post emergence application of tembotrione 60 g ha^{-1}at 25 DAS (T_9). Grasses count was not recorded in treatments with pendimethalin due to the greater efficacy of pre emergence application of pendimethalin 0.5 kg ha^{-1} in controlling the grasses by inhibiting cell division, causes mitotic aberrations which inturn inhibits the root growth of the germinating grasses. Significantly higher density and biomass of grasses were recorded with weedy check (T_{11}).

Lower density and dry weight of sedges was recorded with hand weeding twice at 20 and 40 DAS, which was significantly lower than pre emergence application of pendimethalin 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS, pre emergence application of atrazine 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS and post emergence application of tembotrione 60 gha^{-1}at 25 DAS, while the later three were at par with one another. As mentioned in the above treatments hand weeding performed twice might effectively reduced the weed density or PoE application of tembotrione may have a considerable effect in reducing grasses and sedge count as also reported by Yadav *et al*.(2018). Broadleaved weeds were not observed in treatments with PE application of atrazine as it controlled the weeds by blocking the hill reaction and produces reactive singlet oxygen species in photosystem II leading to inhibition of ATP formation during photosynthesis thereby reduces the density of broadleaved weeds. This was in accordance with Gupta, 2012.Significantly higher total weed density and biomass was reported in weedy check.

Among the sequential application of pre and post emergence herbicides, density and biomass of total weeds were lower with PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS.Carfentrazone ethyl was found to be effective to control broadleaved weeds by inhibiting activity of protoporphyrinogen oxidase (PPO) in chlorophyll biosynthetic pathway thereby reduced the density of weeds and it was at par with PE application of pendimethalin 0.5 kg ha^{-1}*fb* post emergence application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS.Pyrithiobac sodium was effective in reducing the density of broadleaved weeds as it is readily absorbed by plant foliage and inhibits aceto-lactate synthase (ALS), a key enzyme responsible for biosynthesis of branched chain amino acids leading to reduced amino acids production in susceptible plants. The results are in conformity with the findings of Paswan *et al.*(2017) and Nandagavi and Halikatti (2021).

Weed control efficiency and weed index

Higher weed control efficiency and lower weed index were recorded with HW twice at 20 and 40 DAS (Table1). The next best treatments were PE application of pendimethalin 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS. Among pre followed by post emergence herbicides, higher weed control efficiency and lower weed index were recorded with PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS, which was on par with PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS. Reduced density and dry weight of weeds from the initial stages of crop growth due to the absence of weeds might have resulted in higher weed control efficiency as also observed by Girase *et al*.(2017).

Effect on crop gowth

Among the weed control treatments, higher values of growth parameters *viz*., plant height, leaf area index, dry matter production and number of tillers m^{-2} were recorded with HW twice at 20 and 40 DAS, which was at par with PE application of pendimethalin 0.5 kg ha-1 *fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS due to the tremendous growth and development of the crop in a weed free environment during the vital stage of crop growth leading to efficient utilization of light, space, moisture and nutrients leading to increased plant height and leaf area index, which in turn increased the biomass and number of tillers m^{-2}. The next best treatment was PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS, which was on par with PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS (Table 2). Weedy check registered lowest values of all the growth parameters due to high degree of crop weed competition.

Effect on yield attributes and yield

Yield attributes and yield of pearl millet differs significantly under different weed control treatments. Significantly higher yield attributes *viz*., number of paniclesm^{-2}, length and diameter of panicle, number of grains/ panicle, test weight, grain and stover yield were recorded with HW twice at 20 and 40 DAS, which was on par with PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS (Table 2).This might be due to timely and effective weed control that increased the nutrient availability which inturn accelerated the photosynthates production as well as their translocation to sink leading to the production of higher yield attributes coupled with higher grain and stover yield as reported by

Chaudhary *et al*.(2022) and Kumar *et al*. (2012). Among the sequential application of herbicides, higher yield attributes and yield were recorded with PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS, which was on par with PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS. Significantly lower values of yield attributes and yield were reported with weedy check due to greater competition for the growth resources among the crop and weeds as evident by the lowest crop stature, yield attributes and yield of pearl millet.

Effect on nutrient uptake by crop and weeds

Among the different weed management practices investigated, highest nutrient uptake *viz*., nitrogen, phosphorus and potassium by pearl millet and lowest nutrient uptake by weeds were reported with hand weeding twice at 20 and 40 DAS, which was at par with PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and the above treatments were significantly higher than PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS and PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS due to decreased weed competition which concurrently increased the nutrient availability and produced higher biomass production coupled with more nutrient content (Table 3).These results are in conformity with Kiroriwal *et al*. (2012).The lowest nutrient uptake by pearl millet and highest nutrient uptake by weeds was obtained with weedy check.

Economics

Higher gross returns were realized with HW twice at 20 and 40 DAS, which was on par with, PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS (T_1), whereas, higher net returns were realized with PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS (T_2), which was on par with pre emergence application of atrazine 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS and HW twice at 20 and 40 DAS (Table 3). Higher gross returns were mainly due to minimal crop weed competition promoted higher grain yield which in turn increased the gross returns. The higher net returns might be due to increased yields and reduced cost of cultivation as reported by Aruna *et al*.(2018). Benefit-cost ratio was higher with PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS, PE application of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 g ha^{-1} at 25 DAS. Significantly lower gross and net returns and benefit cost ratio were realized with weedy check.

Effect of weed management practices imposed in pearl millet on succeeding blackgram

Germination percentage of succeeding blackgram was found to be unaffected and exhibited its normal growth and development. This might be due to the degradation of phytotoxic form of herbicides by several ways and resulted in less persistence rate of herbicides. The residual effect of weed management practices imposed in pearl millet on total weed density and biomass of succeeding blackgram was found to be significant at 20 DAS **(**Table 4). The results showed that total weed density and dry weight were significantly lower with HW twice at 20 and 40 DAS. The next best treatments with lower density and biomass of total weeds were PE application of pendimethalin 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS, which was at par with PE application

Table 1. Weed dynamics at harvest of pearl millet as influenced by different weed management practices

Treatments	Weed density (Nom^{-2})				Weed biomass (gm^{-2})				WCE(%)	WI(%)
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total		
PE application of atrazine 0.5 kg ha^{-1} *fb* hand weeding at 30 DAS	4.94 (24.33)	7.36 (54.33)	0.71 (0.00)	8.89 (78.67)	2.74 (7.13)	4.43 (19.23)	0.71 (0.00)	5.19 (26.69)	76.0	7.99
PE application of pendimethalin 0.5 kg ha^{-1} *fb* hand weeding at 30 DAS	0.71 (0.00)	7.29 (52.67)	5.05 (25.33)	8.86 (78.00)	0.71 (0.00)	4.28 (18.05)	3.06 (8.96)	5.11 (25.68)	76.9	6.51
PE application of atrazine 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS	7.25 (52.67)	8.89 (79.00)	0.71 (0.00)	11.49 (131.67)	4.16 (16.89)	5.49 (29.67)	0.71 (0.00)	6.85 (46.56)	58.2	47.95
PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS	0.71 (0.00)	9.15 (83.33)	5.04 (25.00)	10.46 (108.33)	0.71 (0.00)	5.31 (27.80)	3.30 (10.59)	6.14 (37.33)	66.5	25.39
PE application of atrazine 0.5 kg ha^{-1} *fb* PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} at 25 DAS	7.57 (57.00)	9.24 (85.00)	0.71 (0.00)	11.93 (142.00)	4.19 (17.10)	5.54 (30.27)	0.71 (0.00)	6.92 (47.37)	57.5	52.08
PE application of pendime thalin 0.5 kg ha^{-1} *fb* PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} at 25 DAS	0.71 (0.00)	9.77 (95.00)	5.56 (30.67)	11.23 (125.67)	0.71 (0.00)	5.83 (33.48)	3.56 (12.37)	6.81 (45.85)	59.0	44.37
PE application of atrazine 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 g ha^{-1} at 25 DAS	7.54 (56.67)	9.21 (84.33)	0.71 (0.00)	11.89 (141.00)	4.16 (16.80)	5.53 (30.10)	0.71 (0.00)	6.89 (47.03)	57.9	51.34
PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of carfentrazone ethyl 20 g ha^{-1} at 25 DAS	0.71 (0.00)	9.19 (84.00)	5.07 (25.33)	10.43 (109.33)	0.71 (0.00)	5.32 (27.92)	3.08 (9.00)	6.11 (36.92)	66.9	20.50
PoE application of tembotrione 60 g ha^{-1} at 25 DAS	5.22 27.79	7.42 (54.67)	5.27 (27.33)	10.47 (109.00)	3.06 (8.87)	4.36 (18.65)	3.22 (9.93)	6.15 (37.45)	66.3	27.79
Hand weeding twice at 20 and 40 DAS	2.67 (6.67)	4.14 (16.67)	3.38 (11.00)	5.90 (34.33)	1.23 (1.03)	1.36 (1.40)	1.63 (2.20)	2.26 (4.63)	95.9	0.0
Weedy check (Control)	9.91 (97.67)	10.81 (116.67)	8.26 (67.66)	16.80 (282.00)	6.22 (38.22)	6.98 (48.19)	5.06 (25.23)	10.59 (111.64)	0.0	65.04
LSD (P=0.05)	0.73	0.92	0.62	0.73	0.39	0.66	0.56	0.65	-	-

*Data in parentheses are original values, which were transformed to $\sqrt{X + 0.5}$ and analysed statistically.

WCE: Weed control efficiency; WI: Weed Index; DAS: Days after sowing

Table 2. Growth parameters, yield attributes and yield of pearl millet as influenced by weed management practices

Treatments	Plant height (cm)	Leaf area index	Dry matter production (kgha^{-1})	No. of tillers m^{-2}	No. of panicles m^{-2}	Panicle length (cm)	Test weight (g)	Grain yield (kgha^{-1})	Stover yield (kgha^{-1})
PE application of atrazine 0.5 kg ha^{-1}*fb* hand weeding at 30 DAS	189	3.16	9107	35.0	33.0	28.1	9.70	3180	6973
PE application of pendimethalin 0.5 kg ha^{-1}*fb* hand weeding at 30 DAS	195	3.18	9184	35.7	33.7	28.5	9.87	3332	6982
PE application of atrazine 0.5 kg ha^{-1}*fb* PoE application of pyrithiobac sodium 0.05 kg/haat 25 DAS	161	1.92	7341	26.0	24.3	22.8	7.24	1796	5788
PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS	176	2.56	8270	30.3	28.7	25.7	8.57	2579	6399
PE application of atrazine 0.5 kg ha^{-1}*fb*PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1}at 25 DAS	154	1.82	7147	25.0	23.7	22.2	7.16	1658	5718
PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1}at 25 DAS	162	2.00	7418	26.3	24.7	23.0	7.33	1923	5817
PE application of atrazine 0.5 kg ha^{-1}*fb*PoE									
application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS	156	1.88	7261	25.3	24.0	22.7	7.19	1682	5758
PE application of pendimethalin 0.5 kg ha^{-1}*fb*									
PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS	177	2.60	8327	30.7	29.0	25.8	8.60	2745	6433
PoE application of tembotrione 60 g ha^{-1}at 25 DAS	174	2.52	8148	29.7	28.3	25.1	8.44	2495	6371
Hand weeding twice at 20 and 40 DAS	198	3.21	9296	37.0	35.3	28.6	10.37	3457	7004
Weedy check (Control)	138	1.29	6532	19.0	17.0	19.0	6.03	1210	5149
LSD (P=0.05)	10	0.50	601	3.0	3.3	1.9	1.09	280	508

Table 3. Nutrient uptake by crop and weeds and economics of pearl millet as influenced by weed management practices

Treatments	Nutrient uptake by pearl millet(kgha^{-1})			Nutrient uptake by weeds(kgha^{-1})			Economics (₹ ha^{-1})		
	Nitrogen	Phosp-horus	Potas-sium	Nitrogen	Phosp-horus	Potas-sium	Gross returns	Net returns	B:C ratio
PE application of atrazine 0.5 kg ha^{-1}*fb* hand weeding at 30 DAS	86.6	17.2	83.6	16.6	6.0	12.1	104951	72343	3.2
PE application of pendimethalin 0.5 kg ha^{-1}*fb* hand weeding at 30 DAS	88.3	17.8	85.4	15.4	5.5	11.3	109966	76733	3.3
PE application of atrazine 0.5 kg ha^{-1}*fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS	57.3	11.9	63.5	27.4	11.4	23.6	59272	28814	1.9
PE application of pendimethalin 0.5 kg ha^{-1}*fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS	73.0	14.4	74.1	21.0	8.2	18.1	85118	54035	2.7
PE application of atrazine 0.5 kg ha^{-1}*fb* PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1}at 25 DAS	53.6	10.7	62.3	28.3	12.1	25.0	54714	25438	1.9
PE application of pendimethalin 0.5 kg ha^{-1} *fb*PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1}at 25 DAS	60.3	12.0	65.2	26.2	10.9	23.1	63443	33542	2.1
PE application of atrazine 0.5 kg ha^{-1}*fb* PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS	55.6	11.1	62.1	27.8	11.8	24.5	55494	25994	1.9
PE application of pendimethalin 0.5 kg a^{-1}*fb* PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS	74.2	14.6	76.5	19.9	7.8	16.7	90597	60472	3.0
PoE application of tembotrione 60 g ha^{-1}at 25 DAS	72.7	14.2	73.3	22.2	8.9	18.7	82328	52641	2.8
Hand weeding twice at 20 and 40 DAS	89.2	18.8	87.4	14.6	4.6	10.3	110787	72249	2.9
Weedy check (Control)	41.1	8.0	44.3	33.0	16.7	21.6	39923	13085	1.5
LSD (P=0.05)	11.3	1.9	4.0	2.9	1.5	2.2	9501	9501	0.3

Table 4. Weed density (Nom^{-2}), biomass (gm^{-2}) and growth parameters of blackgram at 20 DAS as influenced by weed management practices imposed in preceding pearl millet

Treatments	Weed density (No m^{-2})				Weed biomass (g m^{-2})				Germination percentage (%)	Root length (cm)	Shoot length (cm)	SPAD chlorophyll reading	Dry matter production (kgha^{-1})
	Grasses	Sedges	BLW	Total	Grasses	Sedges	BLW	Total					
PE application of atrazine 0.5 kg ha^{-1} *fb* hand weeding at 30 DAS	5.82 (33.33)	5.87 (34.33)	4.60 (21.33)	9.44 (89.00)	3.71 (13.26)	3.95 (15.18)	3.06 (8.88)	6.15 (37.32)	91	6.60	25.8	33.3	144
PE application of pendimethalin 0.5 kg ha^{-1} *fb* hand weeding at 30 DAS	5.43 (29.00)	5.76 (32.67)	4.74 (22.00)	9.17 (83.67)	3.58 (12.41)	3.91 (14.93)	3.17 (9.56)	6.06 (36.27)	90	6.53	25.3	32.7	134
PE application of atrazine 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS	6.84 (46.33)	7.70 (59.00)	5.72 (32.33)	11.74 (137.67)	4.44 (19.22)	4.77 (22.26)	3.74 (13.52)	7.45 (55.00)	89	5.93	24.5	31.0	133
PE application of pendimethalin 0.5 kg ha^{-1} *fb* PoE application of pyrithiobac sodium 0.05 kg ha^{-1} at 25 DAS	6.72 (44.67)	6.67 (44.00)	5.87 (34.00)	11.10 (122.67)	4.43 (19.12)	4.45 (19.30)	3.78 (13.81)	7.26 (52.23)	90	6.40	24.8	32.0	139
PE application of atrazine 0.5 kg ha^{-1} *fb*PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} at 25 DAS	8.13 (65.67)	8.76 (76.33)	6.04 (36.00)	13.36 (178.00)	4.83 (22.95)	5.29 (27.58)	3.81 (14.04)	8.06 (64.57)	88	6.47	24.9	30.7	141
PE application of pendimethalin 0.5 kg ha^{-1} *fb*PoE application of metsulfuron methyl + chlorimuron ethyl 4 g ha^{-1} at 25 DAS	6.63 (43.67)	7.80 (60.33)	5.79 (33.00)	11.72 (137.00)	4.38 (18.72)	4.78 (22.41)	3.75 (13.60)	7.43 (54.72)	89	5.97	24.6	31.3	142
PE application of atrazine 0.5 kg ha^{-1} *fb*PoE application of carfentrazone ethyl 20 g ha^{-1} at 25 DAS	6.74 (45.00)	7.95 (63.00)	5.61 (31.00)	11.80 (139.00)	4.45 (19.35)	4.75 (22.06)	3.68 (13.08)	7.41 (54.48)	91	6.55	25.6	33.0	135
PE application of pendimethalin 0.5 kg ha^{-1} *fb*PoE application of carfentrazone ethyl 20 g ha^{-1} at 25 DAS	5.87 (34.00)	6.69 (44.33)	4.37 (18.67)	9.87 (97.00)	3.77 (13.75)	4.38 (18.71)	2.85 (7.62)	6.37 (40.08)	91	6.23	24.6	32.3	143
PoE application of tembotrione 60 g ha^{-1} at 25 DAS	6.79 (45.67)	6.92 (47.33)	5.46 (29.33)	11.08 (122.33)	4.39 (18.82)	4.40 (18.92)	3.73 (13.44)	7.18 (51.19)	89	6.50	25.0	30.3	136
Hand weeding twice at 20 and 40 DAS	4.63 (21.00)	5.21 (26.67)	4.30 (18.00)	8.13 (65.67)	3.00 (8.53)	3.30 (10.40)	2.84 (7.62)	5.20 (26.55)	92	6.80	28.0	33.7	146
Weedy check	8.21 (67.00)	8.80 (77.00)	6.87 (46.67)	13.82 (190.67)	4.86 (23.12)	5.31 (27.74)	4.37 (18.74)	8.37 (69.59)	87	5.80	23.6	30.0	126
LSD (P=0.05)	0.49	0.67	0.60	0.75	0.37	0.42	0.35	0.37	NS	NS	NS	NS	NS

of atrazine 0.5 kg ha^{-1}*fb* 1 HW at 30 DAS and PE application of pendimethalin 0.5 kg ha^{-1}*fb*PoE application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS. These results revealed that hand weeding twice or pre emergence application of atrazine or pendimethalin followed by one hand weeding in pearl millet reduced the density and dry weight of weeds till harvest which inturn lowered the density of weeds in blackgram(Table 4).Significantly higher weed count and biomass was recorded with weedy check (T_{11}). These results are in line with Singh *et al.*(2012).

Growth parameters of blackgram *viz*., root length, shoot length, SPAD chlorophyll meter readings and dry matter production were not significantly influenced by weed management practices imposed in pearl millet (Table 4). However, higher values of root length, shoot length, SPAD chlorophyll meter readings and dry matter production were recorded with hand weeding twice at 20 and 40 DAS, which was statistically comparable with rest of the weed management practices. These results are in line with Nazreen *et al.* (2018).

CONCLUSION

The study revealed that pre emergence application of pendimethalin 0.5 kg ha^{-1}or atrazine 0.5 kg ha^{-1} *fb* 1 HW at 30 DAS was considered as best weed management practice to increase the productivity and to maximize the net returns, but at times of labour scarcity pre emergence application of pendimethalin 0.5 kg ha^{-1}*fb* post emergence application of carfentrazone ethyl 20 g ha^{-1}at 25 DAS or pre emergence application of pendimethalin 0.5 kg ha^{-1}*fb* post emergence application of pyrithiobac sodium 0.05 kg ha^{-1}at 25 DAS were found to be the most effective and economical weed management practices to control mixed weed flora and to maximize the net returns in pearl millet cultivation Pre and Post emergence herbicides applied in pearl millet did not exert any residual/inhibitory effect on weed density and dry weight as well as growth parameters of succeeding blackgram.

REFERENCES

Aruna, K.J, Rao, P.C, Madhavi, M and Padmaja, G. 2018. Effect of herbicides on the activity of soil enzyme urease in maize crop. Indian Journal of Agricultural Research,52 (3): 300-304.

Chaudhary, C., Hooda, V.S., Isha, K.S., Nagora, M., Kumar, S and Nandal, D.P. 2022. Impact of Integrated weed management practices on growth parameters, yield attributes and yield of pearl millet (*Pennisetum glaucum)*. The Pharma Innovation Journal, 11(4): 687-692.

Directorate of Millets Development, 2021-22. Girase, P.P., Suryawanshi, R.T., Pawar, P.P and Wadile, S.C. 2017. Integrated weed management in pearl millet.Indian Journal of Weed Science, 49 (1): 41-43.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedure for Agricultural Research. International Rice Research Institute, Manila, Philippines. 304-305.

Gupta, V., Singh, B.N.,Kumar, J., Singh, M and Jamwal, B.S. 2012. Effect of Imazathypr on weed control and yield in chickpea under Kandi belt of low altitude sub-tropical zone of Jammu. Madras Agricultural Journal, 99(1): 81-86.

Kiroriwal, A., Yadav, R.S. and Kumawat, A. 2012. Weed management in pearl millet based cropping system. Indian Journal of Weed Science, 44(3): 200-203.

Kumar, V., Tyagi, S. and Singh, D. 2012. Yield, N uptake and economics of fodder sorghum and associated weeds as affected by different weed management

practices. Progressive Agriculture, 2(1): 96-102.

Mishra, J.S., Rao, S.S and Patil, J.V. 2014. Influence of sorghum cultivars and weed management practices on nutrient uptake by crop and weeds in semi-arid tropical India. Indian Journal of Plant Physiology, 19(4): 351-355.

Nandagavi, R.A. and Halikatti, S.I. 2021. Bioefficacy of the sequential application of herbicides in cotton. Journal of Pharmacognosy and Phytochemistry, 10(1): 2078-2083.

Nazreen, S., Subramanyam, D., Sunitha, N and Umamahesh, V. 2018. Seedling vigour index and productivity of greengram as influenced by pre and post emergence herbicicdes applied to maize. Journal of Pharmacognosy and Phytochemistry, 7(3): 584-587.

Paswan, A.K., Mandal, D., Kumawat, N., Kumar, J., Kumar, R., Singh, A.K and Kumar, A. 2017. Efficacy of separate and premix formulation of metsulfuron-methyl and carfentrazone-ethyl on weeds in wheat: a review. International Journal of Current Microbiology Applied Sciences. 6(7): 2439-2453.

Rani, B.S., Chandrika, V., Reddy, G.P., Sudhakar, P and Sagar, G.K. 2021. Weed management with pre and post emergence herbicides in maize under maize - greengram cropping system. Indian Journal of Weed Science. 53(4): 405-410.

Singh, V.P., Guru, S.K, Kumar, A., Banga, A and Tripathi, N. 2012. Bioefficacy of tembotrione against mixed weed complex in maize. Indian Journal of Weed Science, 44(1): 1-5.

Yadhav, D.B., Yadhav, A., Punia, S.S., Duhan, A. 2018. Temobotrione for post emergence control of complex weed flora in maize. Indian Journal of Weed Science, 50(2): 133-136.

Harini, V., Rani B.S.,Reddy, P.M., Prasanthi, A. and Chandrika, V. 2025. Evaluation of different Pre and Post emergence Herbicides in Pearl Millet and its Residual Effect on Succeeding Blackgram.The Journal of Research, ANGRAU,53(3):1-11.