Effect of 4-HPPD inhibitors on weed dynamics, growth, and yield of pearl millet (*Pennisetum glaucum*) in a custard apple (*Annona squamosa*) based agri-horticulture system in Mirzapur, Uttar Pradesh

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ABSTRACT: *This study aimed to explore the effects of different weed management strategies on pearl millet production and its economic viability during the Kharif season of 2023 at Banaras Hindu University, Mirzapur. The experiment was conducted with ten treatments, which included various herbicides and mechanical methods. At 60 days after sowing (DAS), Atrazine 1.0 kg/ha followed by hand weeding (T_1) showed the best results, significantly reducing weed density and dry weight compared to other treatments, with the weedy check performing the worst. T_1 also resulted in the highest weed control efficiency, panicle length, and grain yield. Other treatments such as Pendimethalin 1.0 kg/ha fb 1 HW (T_2) and combinations with Tembotrione 100 g/ha and 2,4-D 0.75 kg/ha also showed good results, though T_1 remained the most effective. Economic analysis suggested that T_1 offered the best returns, making it a viable option for enhancing pearl millet productivity in this region. The results support informed decision-making for sustainable and efficient crop management in the agro-climatic conditions of eastern Uttar Pradesh.*

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1. INTRODUCTION

Agroforestry can be typically characterized as 'agriculture with trees' or, more broadly, as a land use strategy with conscious integration of woody perennials into primary agriculture crop and livestock farming systems; to create multiple benefits, including soil conservation, enhanced soil fertility, reduced erosion, and provision of additional income from tree products, conservation of biodiversity, increased crop and livestock productivity, and better livelihoods. Agroforestry practice in recent times presents itself as an extremely desirable means of sustainable agriculture essential for proper nutrition and food security for an ever-growing population and especially for a densely populated country such as India with a head count of 1428 million. As a result, agroforestry has grown in popularity and now covers 43.3 million hectares, a rise of over 4.21 million hectares (9.69%) between 1990 and 2020 (FAO, 2020). The current area under agroforestry in India is estimated as 25.31 million hectares or 8.2 percent of the total reporting geographical area of the country. As such, on average, 14.2% of total cultivated land has agroforestry in one form or the other, with states such as Uttar Pradesh having an area of 1.86 million hectares under agroforestry (Dhyani *et al.,* 2013). The common belief that planting trees or greening the earth is the ultimate solution to environmental issues emphasizes an important part of ecological conservation. However, the challenge of expanding forested areas is made more difficult by the limited availability of land. To tackle this issue, tree-based farming practices such as agri-horticulture and agroforestry offer practical alternatives for increasing tree cover. The agri-horti system significantly boosts returns per unit of land, particularly during the early stages of horticultural fruit trees. Fruit tree-based agroforestry involves the intentional and simultaneous association of annual or perennial crops with perennial fruit-producing trees on the same land unit. Both the tree and crop components support each other by creating favorable conditions for growth, leading to efficient land use and better economic returns compared to sole crops during the early phase of orchard establishment. This interaction is complementary and beneficial under rainfed conditions. Due to the relatively short juvenile phase of fruit trees, their high market value, and their contribution to household dietary needs, fruit-tree-based agroforestry is highly popular among producers worldwide. Custard apple (*Annona squamosa* L.) is a significant fruit tree in the agri-horti system. It is widely distributed throughout the tropics and is primarily a desert fruit, usually eaten fresh. The vitamin C content is notable (35-42 mg per 100 grams), slightly higher than in grapefruit. The tree also

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provides thiamine, potassium, and dietary fiber in significant amounts. It is a good source of firewood, with light yellow sapwood and brownish heartwood that are soft, lightweight, and weak. Green fruits, seeds, and leaves possess effective vermicidal and insecticidal properties, while the leaves, shoots, bark, and roots have reported medicinal properties. Many crops are grown in the alleys left between tree rows and pearl millet is one such crop. The Poaceae family encompasses pearl millet (*Pennisetum glaucum* L. R. Br. emend. Stuntz), a crucial food grain crop in India, ranking fifth after rice, wheat, sorghum, and maize. India and Africa are responsible for 90% of the world's pearl millet production, and it constitutes about 10% of global food grain output. In India, pearl millet, commonly known as bajra or bajri, is valued for its affordability and nutritional benefits. Its grains are rich in carbohydrates (69.4%), protein (12.1%), fats (4.3% to 5.0%), minerals (2.0% to 7.0%), and sugars (2.4%). It is also easily digestible and a good source of vitamins such as thiamine and riboflavin, providing significant energy (Pal *et al.,* 2019). Weed infestation is a major challenge for pearl millet cultivation, as weeds compete with the crop for moisture, nutrients, space, and light, leading to reduced yields and increased production costs. Banga *et al.* (2020) reported an average yield loss of 55% due to severe weed competition, especially noticeable during the crop's early development stages. Effective weed management during this critical period is essential to minimize competition and optimize yield. Therefore, this study aims to evaluate how different weed management strategies impact pearl millet's production, weed dynamics, and economic viability during the summer growing season.

2. MATERIALS AND METHODS

Site description

A field experiment was conducted during the *Kharif* season of 2023 at the Rajiv Gandhi South Campus, Banaras Hindu University, Mirzapur, on the agroforestry farm. The experimental field had sandy clay loam soil, neutral in reaction (pH 5.64), low in organic carbon (0.39%), low available nitrogen (173.51 kg/ha), medium phosphorus (18.65 kg/ha), and medium potassium (183.22 kg/ha) with normal electrical conductivity (0.28 dS/m).

Experimental design

The study involved ten weed management treatments, including pre-emergence application of Atrazine (1.0 kg/ha), Pendimethalin (1.0 kg/ha), Tembotrione (100 g/ha), and 2,4-D (0.75 kg/ha) alone, and combinations with hand weeding (HW) at 25 DAS. Treatments also included combinations such as Atrazine 1.0 kg/ha *fb* Tembotrione 100 g/ha at 25 DAS**,** Pendimethalin 1.0 kg/ha fb Tembotrione 100 g/ha at 25 DAS, Atrazine 1.0 kg/ha *fb* 2,4-D 0.75 kg/ha at 25 DAS**,** Pendimethalin 1.0 kg/ha *fb* 2,4-D 0.75 kg/ha at 25 DAS**,** Atrazine 0.5 kg/ha + Pendimethalin 0.5 kg/ha *fb* 1 HW at 25 DAS**,** and Atrazine 0.5 kg/ha + Pendimethalin 0.5 kg/ha *fb* Tembotrione 100 g/ha at 25 DAS. Hand weeding twice (25 and 45 DAS) and a weedy check were also included. Treatments were laid out in a randomized block design with three replications. The pearl millet variety MPMH-17 was sown on 25th July 2023 at a seed rate of 5 kg/ha with a row spacing of 30 cm. A uniform dose of 60 kg N + 40 kg P_2O_5 + 30 kg K_2O/ha was applied to all plots. Half the nitrogen dose, along with the full phosphorus and potassium, was applied as basal at sowing, and the remaining nitrogen was top-dressed at 30 DAS.

Observations on pearl millet

Grain samples were randomly collected from each plot. A thousand seeds were manually counted to measure test weight. Dried ear heads were weighed and threshed to calculate grain yield per hectare (kg/ha). Stover yield was recorded after sun drying, and biological yield was calculated as the sum of stover and grain yields. Weed density and dry matter accumulation were recorded species-wise and analyzed statistically.

Statistical analysis

Growth and yield attributes of the crop were measured at 60 DAS and statistically analyzed using the Analysis of Variance (ANOVA) method. Differences among treatment means were tested using Critical Difference (CD) and Duncan Multiple Range Test (DMRT) (Gomez and Gomez, 1984). All statistical analyses were performed using SPSS (Statistical Package for Social Sciences), presently owned by IBM Corporation.

3. RESULTS AND DISCUSSION

Production, weed dynamics and economic viability of pearl millet under custard apple (*Annona squamosa*) based agri-horticulture system

The application of herbicides significantly influenced the density and dry weight of major weeds at 60 DAS under different weed control treatments (Table 1). Weed management treatments effectively reduced the density and dry weight of broad-leaved weeds at 25 DAS, except in the weedy check. Late-growing perennials such as *Cynodon dactylon* and *Cyperus rotundus*, which reproduce through subterranean tubers and stem fragments, were less affected due to their inherent resistance to herbicides. Pre-emergence herbicides like Atrazine and Pendimethalin successfully suppressed weed germination up to 25 DAS, significantly delaying crop-weed competition.

Table 1. Effect of different treatments on weed density and dry weight at 60 DAS in pearl millet

Treatments	Weed density (No./ m^2)									
	Amaranthus virdis (L.)	*Commelina benghalensis* (L).	*Brachiaria reptans* (L).	*Cynodon dactylon* (L.)	*Euphorbia species* (L.)	*Cyperus rotundus* (L.)	Miscellaneous weeds	Total Weed density (No./m^2)	Weed control efficiency (%)	Weed Index
Atrazine 1.0 Kg/ha *fb* 1 HW at 25 DAS.	1.36^{e} (0.85)	1.37^{c} (0.87)	1.31d (0.71)	1.32^{c} (0.80)	1.34^{c} (0.80)	1.34^{c} (0.80)	1.39^{c} (0.70)	2.54^{c} (5.50)	98.07	56.25
Pendimethalin 1.0 Kg/ha *fb* 1 HW at 25 DAS.	1.40^{e} (0.97)	1.41^{c} (0.99)	1.35^{d} (0.80)	1.37^{c} (0.90)	1.39^{c} (0.93)	1.38^{c} (0.91)	1.35^{c} (0.80)	2.70^{c} (6.33)	89.85	50.89
Atrazine 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	1.82^{bc} (2.33)	1.83^{b} (2.35)	1.67^{c} (1.80)	1.68^{b} (1.81)	1.81^{b} (2.29)	1.70^{b} (1.90)	1.67^{b} (1.80)	3.90^{b} (14.26)	79.82	38.13
Pendimethalin 1.0 Kg/ha *fb* tembotrione 00 g/ha 1at 25 DAS.	1.85^{b} (2.43)	1.86^{b} (2.45)	1.73^{bc} (2.00)	1.74^{b} (2.01)	1.84^{b} (2.39)	1.75^{b} (2.10)	1.73^{b} (2.01)	4.04^{b} (15.36)	77.13	23.04
Atrazine 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	1.71^{d} (1.93)	1.72^{b} (1.95)	1.79^{bc} (2.19)	1.80^{b} (2.20)	1.70^{b} (1.89)	1.81^{b} (2.30)	1.79^{b} (2.20)	3.96^{b} (14.66)	74.58	21.25
Pendimethalin 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	1.77^{cd} (2.13)	1.77^{b} (2.15)	1.81^{b} (2.31)	1.82^{b} (2.30)	1.76^{b} (2.09)	1.84^{b} (2.40)	1.81^{b} (2.30)	4.08^{b} (15.66)	71.28	11.61
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* 1 HW at 25 DAS.	1.42^{e} (1.02)	1.43^{c} (1.04)	1.37^{d} (0.90)	1.39^{c} (0.89)	1.42^{c} (0.98)	1.40^{c} (1.01)	1.37^{c} (0.90)	2.77^{c} (6.70)	88.25	45.54
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	1.72^{d} (1.97)	1.73^{b} (1.98)	1.68^{c} (1.80)	1.69^{b} (1.91)	1.71^{b} (1.93)	1.71^{b} (1.90)	1.68^{b} (1.80)	3.78^{b} (13.33)	76.32	27.86
2 Hand Weedings at 25 and 45 DAS.	1.00^{f} (0.00)	1.00^{d} (0.00)	1.00^{e} (0.00)	1^{d} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	99.24	57.36
Weedy check	3.78^{a} (13.32)	3.92^{a} (14.34)	4.02^{a} (15.2)	3.90^{a} (14.2)	3.64^{a} (12.283)	3.91^{a} (14.3)	3.89^{a} (14.2)	9.94^{a} (97.79)	0.00	0.00
LSD (P=0.05)	0.020	0.046	0.027	0.040	0.039	0.042	0.043	0.096	-	-

Superscript letters indicate the mean statistical grouping by DMRT at P<0.05 for each column separately.

Among the treatments, T1 (Atrazine 1.0 kg/ha *fb* 1 HW at 25 DAS) consistently recorded the lowest weed density, statistically at par with T2 (Pendimethalin 1.0 kg/ha *fb* 1 HW at 25 DAS). Similarly, T3 (Atrazine 1.0 kg/ha fb Tembotrione 100 g/ha at 25 DAS) significantly reduced weed density compared to T4 (Pendimethalin 1.0 kg/ha fb Tembotrione 100 g/ha at 25 DAS), T5 (Atrazine 1.0 kg/ha *fb* 2,4-D 0.75 kg/ha at 25 DAS), and T6 (Pendimethalin 1.0 kg/ha fb 2,4-D 0.75 kg/ha at 25 DAS), which were statistically at par. Furthermore, T7 (Atrazine 0.5 kg/ha + Pendimethalin 0.5 kg/ha *fb* 1 HW at 25 DAS) exhibited significantly lower weed density than T8 (Atrazine 0.5 kg/ha + Pendimethalin 0.5 kg/ha *fb* Tembotrione 100 g/ha at 25 DAS). Manual weeding at 25 and 45 DAS further minimized weed density and dry matter accumulation, demonstrating the precision of mechanical control. Similar trends were observed for weed dry weight across treatments (Table 2). These results are consistent with the findings of Choudhary *et al,* (2017) and Sindhu *et al.* (2021), highlighting the combined efficacy of herbicidal and manual weed management in reducing weed infestation and enhancing pearl millet productivity.

The weed index, representing the percentage reduction in grain yield due to weed presence (Table 1 and Figure 1), showed an inverse relationship with weed control efficiency. At 60 DAS, T1 (Atrazine 1.0 kg/ha fb 1 HW at 25 DAS) recorded the highest weed control efficiency (87.87%) and a significantly

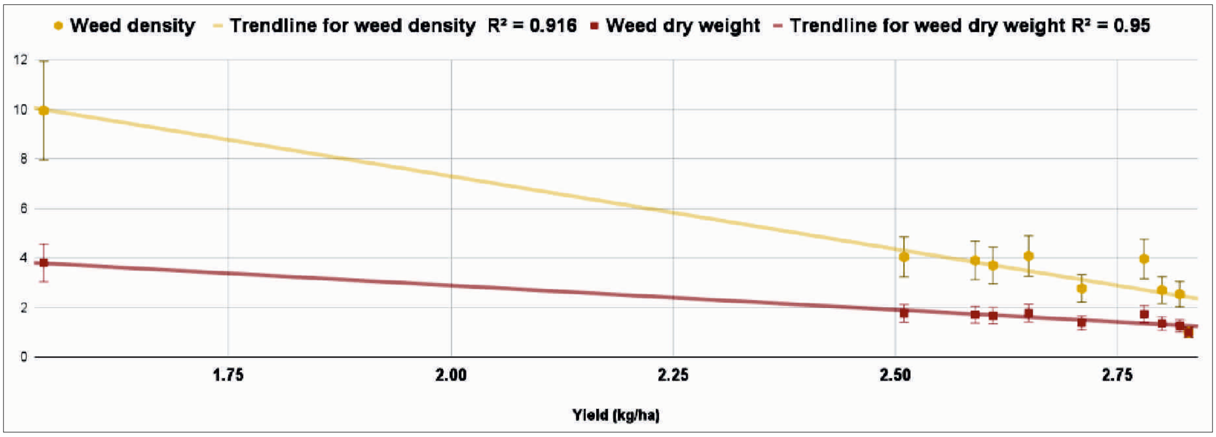

Figure 1. Co-relation between the grain yield (Kg/ha), weed density (no./ m^2) and weed dry weight (Kg/m^{-2}) at 60 DAS

lower weed index (56.25%), highlighting its superior performance. This was followed by T2 (Pendimethalin 1.0 kg/ha *fb* 2, 4-D 0.75 kg/ha at 25 DAS) with a weed control efficiency of 82.45% and a weed index of 11.61%. Treatments T3 (Atrazine 1.0 kg/ha fb Tembotrione 100 g/ha at 25 DAS) and T4 (Pendimethalin 1.0 kg/ha *fb* Tembotrione 100 g/ha at 25 DAS) were statistically at par but less effective than T1. These results demonstrate the significant impact of integrated weed management on reducing yield losses and align with the findings of Choudhary *et al.* (2017).

Weed management practices significantly influenced the growth and yield attributes of pearl millet (Table 3). Among the treatments, T1 (Atrazine 1.0 kg/ha *fb* 1 HW at 25 DAS) recorded significantly higher grain yield, stover yield, biological yield, and harvest index, demonstrating its superior efficacy over other treatments. This was attributed to improved growth parameters, including panicle length, panicle girth, grain weight per panicle, and seed index. T2 (Pendimethalin 1.0 kg/ha *fb* 1 HW at 25 DAS) performed at par with T1 in several aspects but was comparatively less effective. The enhanced performance of these treatments is linked to effective weed suppression, minimizing competition for resources such as nutrients, water, and light. The results are consistent with those reported by Mehetre *et al.* (2021). The weedy check exhibited the lowest values across all parameters, further highlighting the importance of integrated weed management for optimizing pearl millet productivity.

Effective weed management is crucial for ensuring economic viability in modern farming, where maximizing profit takes precedence over achieving maximum yield, as noted by Swathy *et al.* (2020). Economic analysis of treatments in the pearl millet + custard apple system (Table 4) revealed significant differences in costs and returns. Among the treatments, T3 (Atrazine 1.0 kg/ha *fb* Tembotrione 100 g/ha at 25 DAS) and T5 (Atrazine 1.0 kg/ha *fb* 2, 4-D 0.75 kg/ha at 25 DAS) recorded significantly higher gross returns, net returns, and B:C ratios compared to other treatments. These treatments proved economically superior to T1 (Atrazine 1.0 kg/ha *fb* 1 HW at 25 DAS) due to reduced labor costs associated with hand weeding, showcasing their practical and financial advantages. For custard apple, the highest B:C ratio (10.21) was observed, attributed to minimal input and labor requirements alongside higher gross returns, leading to increased net returns. These findings highlight the economic feasibility and profitability of adopting T3 and T5, making them ideal for sustainable weed management in agro-horticultural systems.

4. CONCLUSION

The findings of this study underscore the effectiveness of integrated weed management, particularly the combination of Atrazine 1.0 kg/ha followed by hand weeding, in maximizing both yield and economic returns in pearl millet cultivation. This strategy not only ensured superior weed suppression and improved crop growth parameters but also emerged as the most profitable option among all treatments. Therefore, T1 can be recommended as a sustainable and economically sound weed management practice for pearl millet production during the Kharif season in the agro-climatic conditions of Mirzapur. By demonstrating that Atrazine 1.0 kg/ha followed by hand weeding significantly improves yield and economic returns, the findings offer practical guidance for farmers aiming to maximize productivity and profitability. The results support informed decision-making for sustainable and efficient crop management in the agro-climatic conditions of eastern Uttar Pradesh.

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Table 2. Effect of different treatments on dry weight at 60 DAS in pearl millet

Treatments	Weed dry weight (g/m^2)							
	***Amaranthus viridis* (L.)**	***Commelina banghalensis* (L.)**	***Euphorbia* species**	***Bracharia reptans* (L.)**	***Cynodonn dactylon* (L.)**	***Cyprus rotundus* (L.)**	**Miscellaneous weeds**	**Total weed dry weight**
Atrazine 1.0 Kg/ha *fb* 1 HW at 25 DAS.	1.37^{d} (0.883)	1.33^{c} (0.78)	1.32^{c} (0.75)	1.30^{c} (0.70)	1.29^{e} (0.70)	1.31^{c} (0.70)	1.28^{c} (0.60)	1.26^{b} (0.73)
Pendimethalin 1.0 Kg/ha *fb* 1 HW at 25 DAS.	1.41^{d} (1.00)	1.38^{c} (0.9)	1.37^{c} (0.87)	1.34^{c} (0.81)	1.33^{e} (0.80)	1.35^{c} (0.80)	1.32^{c} (0.80)	1.36^{b} (0.85)
Atrazine 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	1.83^{bc} (2.36)	1.80^{b} (2.25)	1.80^{b} (2.24)	1.66^{b} (1.80)	1.65^{d} (1.70)	1.67^{b} (1.80)	1.65^{b} (1.70)	1.71^{b} (1.98)
Pendimethalin 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	1.86^{b} (2.45)	1.83^{b} (2.35)	1.83^{b} (2.34)	1.72^{b} (2.00)	1.71^{cd} (1.90)	1.73^{b} (2.00)	1.71^{b} (1.90)	1.76^{b} (2.14)
Atrazine 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	1.72^{c} (1.96)	1.69^{b} (1.86)	1.68^{b} (1.84)	1.78^{b} (2.20)	1.77^{bc} (2.10)	1.78^{b} (2.20)	1.77^{b} (2.10)	1.73^{b} (2.04)
Pendimethalin 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	1.78^{bc} (2.16)	1.75^{b} (2.06)	1.74^{b} (2.04)	1.81^{b} (2.30)	1.80^{b} (2.20)	1.81^{b} (2.30)	1.79^{b} (2.20)	1.77^{b} (2.18)
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* 1 HW at 25 DAS.	1.43^{d} (1.05)	1.40^{c} (0.95)	1.39^{c} (0.93)	1.36^{c} (0.90)	1.35^{e} (0.80)	1.37^{c} (0.90)	1.34^{c} (0.80)	1.38^{b} (0.90)
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	1.73^{bc} (2.01)	1.70^{b} (1.89)	1.70^{b} (1.88)	1.68^{b} (1.80)	1.67^{cd} (1.80)	1.68^{b} (1.80)	1.66^{b} (1.80)	1.67^{b} (1.85)
2 Hand Weedings at 25 and 45 DAS.	1.00^{e} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	1.00^{f} (0.00)	1.00^{d} (0.00)	1.00^{d} (0.00)	1.00^{b} (0.00)
Weedy check	3.92^{a} (14.34)	3.90^{a} (14.25)	3.77^{a} (13.23)	3.76^{a} (13.20)	3.76^{a} (13.10)	3.76^{a} (13.20)	3.76^{a} (13.1)	3.80^{ab} (14.35)
CD (0.05)	0.030	0.033	0.036	0.032	0.025	0.044	0.035	0.225
SEm+	0.010	0.011	0.012	0.011	0.008	0.015	0.012	0.075
CV (%)	0.960	1.080	1.180	1.047	0.819	1.464	1.171	7.481

Superscript letters indicate the mean statistical grouping by DMRT at $P<0.05$ for each column separately.

Table 3. Effect of different treatments on yields of pearl millet.

Treatments	Yield attributes and crop yields							
	Panicle length (cm)	Panicle girth (cm)	Grain weight of panicle (gm)	Test weight (gm)	Grain yield (Kg/ha)	Stover yield (Kg/ha)	Biological yield (Kg/ha)	Harvesting Index (HI) %
Atrazine 1.0 Kg/ha *fb* 1 HW at 25 DAS.	30.25^{ab}	6.50^{a}	14.76^{ab}	6.10^{a}	2820^{a}	6280^{a}	9100^{a}	30.99^{a}
Pendimethalin 1.0 Kg/ha *fb* 1 HW at 25 DAS.	29.48^{ab}	6.10^{ab}	13.60^{ab}	5.80^{ab}	2800^{a}	6200^{a}	9000^{a}	31.11^{a}
Atrazine 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	28.00^{ab}	5.89^{abc}	12.70^{bc}	4.90^{abcd}	2590^{a}	5700^{a}	8290^{a}	31.24^{a}
Pendimethalin 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	26.38^{bc}	4.90^{cd}	11.20^{cd}	4.50^{cd}	2510^{a}	5612^{a}	8122^{a}	30.90^{a}
Atrazine 1.0 Kg/ha *fb* 2,4-D, 0.75 Kg/ha at 25 DAS.	25.37^{bc}	4.50^{d}	10.30^{de}	4.30^{d}	2780^{a}	6142^{a}	8922^{a}	30.83^{a}
Pendimethalin 1.0 Kg/ha *fb* 2,4-D, 0.75 Kg/ha at 25 DAS.	24.17^{bc}	4.50^{d}	8.40^{e}	4.10^{de}	2650^{a}	5960^{a}	8610^{a}	30.90^{a}
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* 1 HW at 25 DAS.	28.38^{ab}	6.30^{a}	13.80^{ab}	5.50^{abc}	2710^{a}	6080^{a}	8790^{a}	31.16a
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	27.29^{b}	5.10^{bcd}	11.34^{cd}	4.70^{bcd}	2610^{a}	5830^{a}	8440^{a}	30.78^{a}
2 Hand Weedings at 25 and 45 DAS.	34.66^{a}	6.90^{a}	14.90^{a}	6.00^{a}	2830^{a}	6290^{a}	9120^{a}	31.03^{a}
Weedy check	20.27^{c}	4.10^{d}	9.10^{e}	3.10^{e}	1542^{b}	4000^{b}	5542^{b}	27.82^{b}
CD (0.05)	0.53	0.25	0.44	0.12	114.64	243.83	338.26	0.44
SEm+	0.51	0.08	0.14	0.08	38.58	82.07	113.85	0.15
CV (%)	3.25	2.66	2.15	3.16	2.57	2.45	2.35	2.16

Superscript letters indicate the mean statistical grouping by DMRT at $P<0.05$ for each column separately.

Table 4. Combined effect on economics of pearl millet + custard apple of different establishment methods and herbicidal treatments

Treatments	Combined cost of cultivation (Pearl millet + Custard apple) (₹/ha)	Gross return (Pearl millet + Custard apple) (₹/ha)	Net return (Pearl millet + Custard apple) (₹/ha)	B:C ratio (Pearl millet + Custard apple)
Atrazine 1.0 Kg/ha *fb* 1 HW at 25 DAS.	90582	322670^{b}	232088^{f}	3.56
Pendimethalin 1.0 Kg/ha *fb* 1 HW at 25 DAS.	90702	316105^{h}	225403^{h}	3.49
Atrazine 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	74347	322040^{c}	247693^{a}	4.33
Pendimethalin 1.0 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	74467	314049^{i}	239582^{e}	4.22
Atrazine 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	74712	321454^{d}	246742^{b}	4.30
Pendimethalin 1.0 Kg/ha *fb* 2,4-D 0.75 Kg/ha at 25 DAS.	74494	318035^{f}	243541^{c}	4.27
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* 1 HW at 25 DAS.	90642	319685^{e}	229043^{g}	3.53
Atrazine 0.5 Kg/ha + Pendimethalin 0.5 Kg/ha *fb* tembotrione 100 g/ha at 25 DAS.	74407	316835^{g}	242428^{d}	4.26
2 Hand Weedings at 25 and 45 DAS.	106602	322925^{a}	216323^{i}	3.03
Weedy check	72602	288077^{j}	215475^{j}	3.97
CD (0.05)	-	0.003	0.002	0.03
SEm+	-	0.001	0.002	0.01
CV (%)	-	0.01	0.001	0.37

Superscript letters indicate the mean statistical grouping by DMRT at $P<0.05$ for each column separately.

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