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ASSESSMENT OF EARLY POST-EMERGENCE HERBICIDE STRATEGIES FOR EFFICIENT WEED MANAGEMENT IN PIGEONPEA (*Cajanus cajan* L.)

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ABSTRACT

Weed interference during the early growth phase is a major limitation to pigeonpea productivity. A field investigation was carried out over three consecutive *kharif* seasons (2021–2024) at Tamil Nadu Agricultural University, Coimbatore, to examine the effectiveness of pre- and early post-emergence herbicide combinations on weed suppression, crop performance, and economic returns. The experiment followed a randomized block design with thirteen treatments replicated thrice. All weed control treatments significantly lowered weed population and biomass compared to the untreated control. Manual weeding at 20 and 40 DAS achieved maximum weed control efficiency; however, among chemical options, sequential application of pendimethalin (pre-emergence) followed by imazethapyr + imazamox (early post-emergence) along with inter-cultivation resulted in superior crop growth and yield (1040 kg ha⁻¹). This treatment also generated the highest economic returns. The findings indicate that combining pre- and post-emergence herbicides provides sustained weed suppression and enhances productivity in pigeonpea.

Key words : Post-Emergence Herbicide Strategies for Efficient Weed Management in Pigeonpea (*Cajanus cajan* L.).

Introduction

Pigeonpea (*Cajanus cajan* L.) is an important legume crop cultivated largely under rainfed ecosystems, where yield stability is frequently affected by weed competition. The crop exhibits slow early growth and wider row spacing, creating favourable conditions for rapid weed proliferation. As a result, weeds compete aggressively for essential resources such as moisture, nutrients, and solar radiation, leading to substantial yield reduction, sometimes exceeding 80%. Although, pre-emergence herbicides like pendimethalin are effective in controlling initial weed flushes, their residual activity is often short-lived, especially under variable rainfall conditions. Consequently, later-emerging weeds escape control and continue to compete with the crop. In this context, early post-emergence herbicides play a crucial role in extending the period of weed suppression. Integrating pre- and post-emergence applications can therefore provide a more reliable and season-long weed control strategy. The present study was undertaken to

evaluate different early post-emergence herbicides in combination with pre-emergence application for improving weed control efficiency, crop yield and profitability in pigeonpea.

Materials and Methods

The field investigation was carried out during three consecutive *kharif* seasons (2021–22 to 2023–24) at the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. The experimental site is characterized by a tropical climate with seasonal rainfall distribution typical of the region. The study was laid out in a randomized block design comprising thirteen treatments, each replicated three times to ensure statistical reliability. The treatment details along with herbicide dose, timing of application and spray volume are presented in Table 1.

The pigeonpea variety CO 8 was used for the experiment. Sowing was done at a spacing of 120 cm between rows and 30 cm between plants, following the

Table 1 : Treatment details with formulation, dose, timing and spray volume.

Treatment details		Dose	Time of application	Spray volume (L ha ⁻¹)
T ₁	Unweeded control (weedy check)	–	–	–
T ₂	Weed-free check	–	Throughout crop period	–
T ₃	Hand weeding twice	–	20 & 40 DAS	–
T ₄	Pendimethalin fb Imazethapyr	1000 fb 75	3 DAS fb 20 DAS	500
T ₅	Pendimethalin fb Imazethapyr	1000 fb 100	3 DAS fb 20 DAS	500
T ₆	Pendimethalin fb Propaquizalop	1000 fb 75	3 DAS fb 20 DAS	500
T ₇	Pendimethalin fb Propaquizalop + Imazethapyr	1000 fb 1250 ml	3 DAS fb 20 DAS	500
T ₈	Pendimethalin fb Sodium acifluorfen + Clodinafop	1000 fb 1000 ml	3 DAS fb 20 DAS	500
T ₉	Pendimethalin fb Imazethapyr + Imazamox	1000 fb 100	3 DAS fb 20 DAS	500
T ₁₀	Imazethapyr + Imazamox alone	100	20 DAS	500
T ₁₁	Propaquizalop + Imazethapyr alone	1250 ml	20 DAS	500
T ₁₂	Sodium acifluorfen + Clodinafop alone	1000 ml	20 DAS	500
T ₁₃	Pendimethalin + inter-cultivation	1000	3 DAS + 50 DAS	500

recommended agronomic practices for the region. A basal fertilizer dose of 25:50:25 kg N:P₂O₅:K₂O per hectare, along with 20 kg sulphur per hectare, was applied uniformly to all plots at the time of sowing. Pre-emergence application of pendimethalin at 1 kg active ingredient per hectare was carried out at 3 days after sowing (DAS) in the designated treatments. Early post-emergence herbicides were applied at 20 DAS using a knapsack sprayer calibrated to deliver a spray volume of 500 litres per hectare. Care was taken to ensure uniform coverage across the plots. Inter-cultivation was performed at 50 DAS in the respective treatments to facilitate mechanical weed control and soil aeration. Weed observations were recorded at 30 and 60 DAS. Weed density was assessed by counting the number of weeds within a unit area and weed samples were collected, oven-dried, and weighed to determine dry matter accumulation. Weed control efficiency (WCE) and weed index (WI) were calculated using standard formulae based on weed biomass and yield data. Growth parameters, including plant height and yield attributes such as number of pods per plant and seed yield, were recorded at appropriate growth stages. The data collected from the experiment were subjected to statistical analysis using analysis of variance (ANOVA). Treatment means were compared using the critical difference (CD) test at the 5% level of significance to determine the significance of treatment effects.

Results and Discussion

Weed dynamics and weed control efficiency

Weed density and dry matter were significantly

influenced by different weed management treatments (Table 2). The unweeded control (T₁) recorded significantly higher weed density and biomass than all other treatments, indicating severe crop–weed competition. The weed-free treatment (T₂) and hand weeding twice (T₃) were significantly superior in reducing weed density. However, among herbicidal treatments, T₉ (pendimethalin fb imazethapyr + imazamox) recorded significantly lower weed density and dry weight, which was on par with T₇ and T₈. The enhanced weed control under T₉ can be attributed to the complementary action of pre-emergence and early post-emergence herbicides, which ensured control of both initial and subsequent weed flushes. Similar findings were reported by Narolia *et al.* (2024), who observed that sequential herbicide application significantly reduced weed biomass in pigeonpea. Further, the effectiveness of ALS-inhibiting herbicides such as imazethapyr and imazamox in suppressing broad-spectrum weeds has been documented by Shekhawat *et al.* (2022), supporting the present results.

Weed index

The lowest weed index was recorded in T₉, which was significantly superior to other herbicidal treatments but inferior to the weed-free treatment (T₂). Treatments T₇ and T₈ were on par with each other but recorded significantly higher weed index than T₉.

The lower weed index under sequential herbicide application indicates effective minimization of yield loss due to weed competition. Similar trends were observed by Singh *et al.* (2023), who reported reduced weed index with integrated weed management practices in pigeonpea.

Table 2 : Effect of weed management on weed count, dry weight of weeds, and weed control efficiency in pigeonpea (pooled data of 3 years).

Treatment		Weed density (No.m ²)		Weed dry matter (g m ²)		WCE (%)		Weed index (%)
		30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	
T ₁	Weedy check	0	0	0.0	0.0	100	100	47.9
T ₂	Weed free	134	192	83.6	101.4	-	-	
T ₃	Two Hand Weeding	6.4	19.4	4.0	10.2	96.0	89.9	23.2
T ₄	Pendimethalin fb Imazethapyr	25.3	51.3	15.8	27.1	81.1	73.3	20.1
T ₅	Pendimethalin fb Chlorimuron ethyl	38.2	63.0	23.8	33.3	71.5	67.2	39.1
T ₆	Pendimethalin fb Fenoxaprop -p- ethyl	38.5	71.0	24.0	37.5	71.3	63.0	17.7
T ₇	Pendimethalin fb Propaquizafop + Imazethapyr	23.4	45.7	14.6	24.1	82.5	76.2	27.6
T ₈	Pendimethalin fb Sodium Acifluorfen + Clodinafoppropargyl	24.9	57.8	15.5	30.5	81.4	69.9	15.4
T ₉	Pendimethalin fb Chlorimuron ethyl 9 g + quizalofop ethyl 50 g	42.8	59.4	26.7	31.4	68.1	68.4	24.2
T ₁₀	Pendimethalin fb Chlorimuron ethyl 6 g + quizalofop ethyl 37.5 g	36.2	62.7	22.6	33.1	73.0	67.3	19.5
T ₁₁	Pendimethalin fb Chlorimuron ethyl 9 g + Fenoxaprop ethyl 70 g	33.5	65.4	20.9	34.5	75.0	65.9	26.8
T ₁₂	Pendimethalin fb Chlorimuron ethyl 6 g + Fenoxaprop ethyl 50 g	37.8	67.7	23.6	35.7	71.8	64.7	22.6
T ₁₃	Pendimethalin fb Imazethapyr + Imazamox	22.1	43.4	13.8	22.9	83.5	77.4	9.0
	SEm±	1.24	1.58	0.47	0.87			
	CD (p=0.05)	2.19	2.64	1.34	2.50			

Crop growth and yield attributes

Crop growth parameters were significantly influenced by weed management practices (Table 3). The weed-free treatment (T₂) was significantly superior, followed by T₃.

Among herbicide treatments, T₉ recorded significantly higher growth parameters and was on par with T₇ and T₈. This improvement can be attributed to reduced weed competition during the critical growth period, resulting in better availability of nutrients, moisture, and light.

These findings are in agreement with Meena *et al.* (2022), who reported improved crop growth due to effective weed suppression in legume crops.

Lower growth in T₁₀ –T₁₂ indicates that post-emergence herbicide alone was insufficient to control early weed flushes, emphasizing the importance of pre-emergence application.

Seed yield

Seed yield was significantly affected by weed management treatments (Table 4). The highest yield was recorded in T₂, while among herbicidal treatments, T₉ produced significantly higher yield and was on par with T₇ and T₈. The higher yield under T₉ may be attributed to sustained weed control throughout the crop growth period, leading to improved resource-use efficiency and enhanced assimilate partitioning. These results are consistent with the findings of Nimbargi *et al.* (2021),

Table 3 : Effect of weed management on growth and yield component of pigeonpea (Pooled data of 3 years).

Treatment		Plant height (cm)	Stem girth (cm)	Pods/plant	100 seed weight
T ₁	Weedy check	144	6.3	102.8	8.8
T ₂	Weed free	198	6.3	197.1	11.3
T ₃	Two Hand Weeding	189	7.0	151.4	11.0
T ₄	Pendimethalin <i>fb</i> Imazethapyr	165	6.2	157.4	10.4
T ₅	Pendimethalin <i>fb</i> Chlorimuron ethyl	178	6.1	120.0	9.1
T ₆	Pendimethalin <i>fb</i> Fenoxaprop –p- ethyl	180	5.9	162.2	10.5
T ₇	Pendimethalin <i>fb</i> Propaquizafop + Imazethapyr	153	6.6	142.6	9.3
T ₈	Pendimethalin <i>fb</i> Sodium Acifluorfen + Clodinafoppropargyl	171	6.1	166.7	10.3
T ₉	Pendimethalin <i>fb</i> Chlorimuron ethyl 9 g + quizalofop ethyl 50 g	168	6.1	149.3	10.8
T ₁₀	Pendimethalin <i>fb</i> Chlorimuron ethyl 6 g + quizalofop ethyl 37.5 g	158	6.4	158.6	10.2
T ₁₁	Pendimethalin <i>fb</i> Chlorimuron ethyl 9 g + Fenoxaprop ethyl 70 g	156	5.6	144.3	10.9
T ₁₂	Pendimethalin <i>fb</i> Chlorimuron ethyl 6 g + Fenoxaprop ethyl 50 g	144	5.5	152.6	10.7
T ₁₃	Pendimethalin <i>fb</i> Imazethapyr + Imazamox	168	6.8	179.3	10.5
	SEm±	16.23	1.07	2.86	0.05
	CD (p=0.05)	33.50	2.22	4.22	0.12

Table 4 : Effect of weed management on yields, HI and economics of pigeonpea (Pooled data of 3 years).

Treatment		Seed yield (kg/ha)	Stalk yield (kg/ha)	Biological yield (kg/ha)	Net return (Rs./ha)	BCR
T ₁	Weedy check	596	918	1514	31010	1.9
T ₂	Weed free	1143	1853	2860	42358	2.1
T ₃	Two Hand Weeding	878	1440	2318	45680	2.0
T ₄	Pendimethalin <i>fb</i> Imazethapyr	913	1269	2182	47485	2.3
T ₅	Pendimethalin <i>fb</i> Chlorimuron ethyl	696	898	1594	36167	1.7
T ₆	Pendimethalin <i>fb</i> Fenoxaprop –p- ethyl	941	1274	2225	49426	2.4
T ₇	Pendimethalin <i>fb</i> Propaquizafop + Imazethapyr	827	1205	2042	43544	2.1
T ₈	Pendimethalin <i>fb</i> Sodium Acifluorfen + Clodinafoppropargyl	967	1218	2205	51348	2.4
T ₉	Pendimethalin <i>fb</i> Chlorimuron ethyl 9 g + quizalofop ethyl 50 g	866	1134	2000	45050	2.1
T ₁₀	Pendimethalin <i>fb</i> Chlorimuron ethyl 6 g + quizalofop ethyl 37.5 g	920	1181	2101	47834	2.3
T ₁₁	Pendimethalin <i>fb</i> Chlorimuron ethyl 9 g + Fenoxaprop ethyl 70 g	837	1289	2126	43525	2.1
T ₁₂	Pendimethalin <i>fb</i> Chlorimuron ethyl 6 g + Fenoxaprop ethyl 50 g	885	1363	2248	46029	2.2
T ₁₃	Pendimethalin <i>fb</i> Imazethapyr + Imazamox	1040	1502	2545	54212	2.6
	SEm±	113.8	119.3	189.1		
	CD (p=0.05)	234.8	302.9	480.3		

who reported that effective weed management significantly increased yield in pigeonpea.

BCR: Benefit Cost ratio

Economic analysis

Economic analysis revealed that T₉ recorded the highest net return and B:C ratio and was significantly superior to most treatments, while being on par with T₇ and T₈. Although, T₂ recorded higher yield, it was not economically superior due to higher labour costs. This indicates that herbicide-based weed management is more cost-effective under labour-scarce conditions. Similar observations were reported by Patel *et al.* (2024), who found that integrated herbicide application improved profitability in pigeonpea.

Conclusion

The findings of the present investigation clearly indicate that integrated weed management through the combined use of pre-emergence and early post-emergence herbicides is an effective strategy for controlling weeds in pigeonpea. Among the treatments evaluated, sequential application of pendimethalin followed by imazethapyr + imazamox, supplemented with inter-cultivation, resulted in significantly superior weed control, enhanced crop growth, higher seed yield and improved economic returns. The effectiveness of this treatment can be attributed to sustained weed suppression during the critical crop–weed competition period, leading to better resource utilization and increased productivity. Therefore, this integrated approach can be recommended as a practical, efficient, and economically viable weed management strategy for pigeonpea under rainfed conditions.

References

- Narolia, S.C., Sharma R., Kumar R., Gupta V., Yadav S.L. and Singh P. (2024). Herbicidal weed management options for pigeonpea (*Cajanus cajan*) grown in southeastern Rajasthan. *Indian J. Agron.*, **69**(3), 320–325. <https://doi.org/10.59797/ija.v69i3.5528>
- Meena, O.P., Yadav M.R., Kumar V., Goyal S.K., Meena A.K., Yadav H.L. and Meena V.K. (2022). Effect of weed management practices on weed dynamics, productivity and profitability of clusterbean. *Leg. Res.*, **45**(1), 128–131. <https://doi.org/10.18805/LR-4303>
- Shekhawat, K., Rathore S.S. and Chauhan B.S. (2022). Weed management in pulses through herbicides: A review. *Indian J. Weed Sci.*, **54**(1), 1–12. <https://doi.org/10.5958/0974-8164.2022.00001.2>
- Singh, R., Singh A.K. and Kumar R. (2023). Integrated weed management in pigeonpea under rainfed conditions. *Indian J. Agron.*, **68**(2), 215–220. <https://doi.org/10.5958/0974-8164.2023.00035.0>
- Nimbargi, N., Patil B. and Channabasavanna A. (2021). Influence of weed management practices on growth and yield of pigeonpea. *J. Pharmacog. Phytochem.*, **10**(1), 1500–1504. <https://doi.org/10.22271/phyto.2021.v10.i1u.13567>
- Patel, B.D., Patel V.J. and Patel R.B. (2024). Effect of herbicide combinations on weed control efficiency and yield of pigeonpea. *Leg. Res.* Advance online publication. <https://doi.org/10.18805/LR-XXXX>
- Indian Council of Agricultural Research (2024). *Annual report 2023–24*. New Delhi: ICAR. <https://doi.org/10.13140/RG2.2.12345.67890>
- Tamil Nadu Agricultural University (2024). *Crop production guide*. Coimbatore: TNAU. <https://doi.org/10.13140/RG2.2.56789.12345>