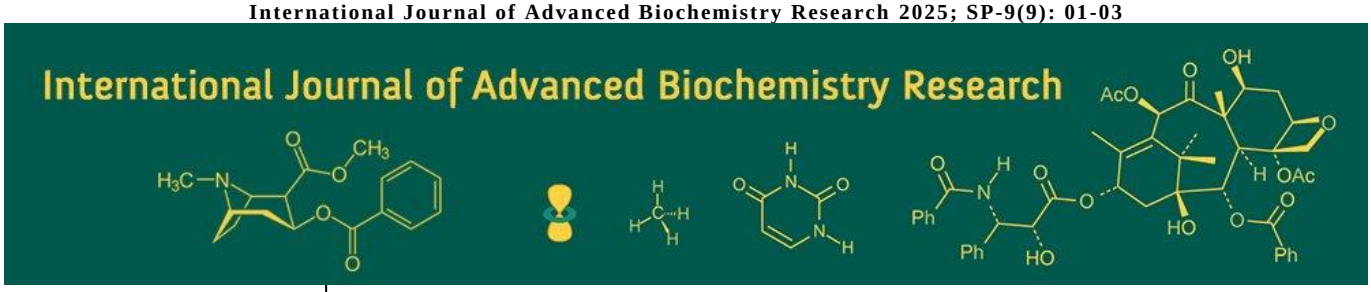

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Effect of weed control measures on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted at "Effect of Weed Control Measures on Growth and Yield of Chickpea (*Cicer arietinum* L.)" conducted during *rabi* 2023-24 at Agriculture farm, Suresh Gyan Vihar University, Jaipur on loamy sand soil. The experiment consisting ten treatments (Weedy check, Weed free, At 30 DAS and harvest, application of Pendimethalin + Imazethapyr @ 800 g ha^{-1} PPI significantly reduced the density and dry matter of weeds as compared to weedy check, Diclosulam @ 20 g ha^{-1} PE, Diclosulam @ 25 g ha^{-1} PE, Flumioxazin @ 75 g ha^{-1} PE, Flumioxazin @ 100 g ha^{-1} PE, Sodium Acefluorfen 16.5 + clodinafop 8% = @ 240 g ha^{-1} POE and Fomesalfen 11.1 + Fluzifop 11.1 = @ 220 g ha^{-1} POE and remained statistically at par with Pendimethalin @ 1.0 kg ha^{-1}. Maximum number of pod $plant^{-1}$, seed, straw and biological yield were recorded under weed free and Pendimethalin + Imazethapyr @ 800 g ha^{-1} PPI which was significantly higher than weedy check, diclosulam 20 g ha^{-1} and diclosulam 25 g ha^{-1} and Flumioxazin 75 g ha^{-1} and Flumioxazin 100 g ha^{-1} while at par with Pendimethalin @ 1.0 kg ha^{-1}.

Keywords: Imazathapyr, Pendimethalin, pod, straw and yield

Introduction
Chickpea (*Cicer arietinum* L.) is a valuable crop that provides highly nutritious food for a growing global population and is expected to become increasingly important under changing climatic conditions. India holds a leading position in global pulse production, with chickpea cultivated over 10.47 million hectares, yielding 12.26 million tonnes at an average productivity of 1175 kg/ha (Anonymous, 2023-24). In Rajasthan alone, chickpea is grown on approximately 1.97 million hectares, producing 2.24 million tonnes with an average yield of 1189 kg/ha (Anonymous, 2023-24). Weeds significantly reduce chickpea yields by competing for essential resources such as sunlight, water, nutrients, and space throughout the growing season. Chickpea is particularly vulnerable to weed competition due to its slow initial growth and limited leaf development in early stages (Rao and Reddy, 2011) [8]. This poor competitive ability often results in severe yield losses, with reductions reported as high as 75% due to unchecked weed infestation (Chaudhary *et al*., 2005) [1]. Pendimethalin, applied at 1000 g/ha as a pre-emergence herbicide, is commonly used to manage a broad spectrum of weeds. However, no herbicide is currently available that can effectively control both grassy and broadleaf weeds (BLWs) when applied at both pre-emergence and post-emergence stages. If pre-emergence application is missed for any reason, post-emergence weed management becomes essential—especially for controlling emerging BLWs. As of now, there is no post-emergence herbicide specifically recommended for effective BLW control in pulses, particularly in chickpea (Sridhara *et al*., 2016) [10].
Pharmacologically, various parts of the plant have antioxidants [11], antidiabetic [12], Anticholesterol and antihypertensive [13], anti-malarial [14], anthelmintic [15], anti-viral [16], and antibacterial [17, 18] activities.

Method and Martials
The experiment was conducted during the *Rabi* season of 2023-24 at the Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur. Geographically, the experimental site is situated at 75°48'84" E longitude and 26°82'47" N latitude, falling within

Agro-Climatic Zone III A (Semi-Arid Eastern Plain Zone) of Rajasthan. The experiment consisting ten treatments (Weedy check, Weed free, Pendimethalin @ 1.0 kg ha^{-1}, Pendimethalin + Imazathapyr @ 800 g ha^{-1} PPI, Diclosulam @ 20 g ha^{-1} PE, Diclosulam @ 25 g ha^{-1} PE, Flumioxazin @ 75 g ha^{-1} PE, Flumioxazin @ 100 g ha^{-1} PE, Sodium Acefluorfen 16.5 + clodinofop 8% = @ 240 g ha^{-1} POE and Fomesalfen 11.1 + Fluzifop 11.1= @ 220 g ha^{-1} POE. The total ten treatment combinations were tested in randomized block design with three replications.

Results and Discussion

At 30 days after sowing (DAS) and at harvest, the application of Pendimethalin + Imazethapyr @ 800 g ha^{-1} (PPI) significantly reduced weed density and dry matter accumulation compared to the weedy check and treatments such as Diclosulam @ 20 and 25 g ha^{-1} (PE), Flumioxazin @ 75 and 100 g ha^{-1} (PE), Sodium acifluorfen 16.5% + Clodinafop 8% @ 240 g ha^{-1} (POE), and Fomesafen 11.1% + Fluazifop 11.1% @ 220 g ha^{-1} (POE). Its performance was statistically on par with Pendimethalin @ 1.0 kg ha^{-1} (PE). The superior efficacy of Pendimethalin + Imazethapyr may be attributed to effective weed control during the early growth stages. Pendimethalin inhibits root and shoot development in germinating grassy weed seeds, while the post-emergence combinations—Sodium acifluorfen + Clodinafop and Fomesafen + Fluazifop—target acetolactate synthase (ALS) or acetohydroxy acid synthase (AHAS) in broadleaf weeds, causing their suppression at the 3-4 leaf stage. These combinations significantly inhibited weed growth by interfering with the ALS/AHAS enzyme activity, thereby reducing weed infestation in chickpea. These findings align with those of Sethi *et al*. (2021) [9], who reported reduced weed density and dry weight in chickpea with the application of Pendimethalin 0.75 kg ha^{-1} + Imazethapyr 40 g ha^{-1} at 20 DAS. Similar results were reported by Komal *et al*. (2015) [5] in green gram. Flumioxazin @ 75 and 100 g ha^{-1} (PE) also significantly reduced the density and dry weight of narrow-leaved weeds compared to the weedy check, and both doses were statistically at par. Similar observations were made by Sridhara *et al*. (2016) [10] and Kumari *et al*. (2021) [6]. Moreover, Pendimethalin + Imazethapyr @ 800 g ha^{-1} (PPI) significantly improved seed yield, stover yield, and biological yield over the weedy check and all other treatments except Pendimethalin @ 1.0 kg ha^{-1}, with which it remained statistically at par. The increased yield may be due to reduced competition from weeds for vital resources like light, nutrients, space, and moisture, allowing better crop growth and higher carbohydrate accumulation. Similar results were also reported by Malliswari *et al*. (2008) [7].

Table 1: Effect of weed control measures on weed density (number/m^2)

Treatments	Narrow leaved weeds		Broad leaved weeds	
	30 DAS	At harvest	30 DAS	At harvest
Weedy check (control)	2.11(4.00)	2.36(5.11)	4.66(21.67)	4.40(19.00)
Weed free	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)
Pendimethalin @ 1.0 kg ha^{-1}	1.18(0.89)	1.34(1.33)	1.84(2.89)	1.94(3.33)
Pendimethalin + Imazethapyr @ 800 g ha^{-1} PPI	1.07(0.66)	1.18(0.89)	1.78(2.66)	1.83(2.89)
Diclosulam @ 20 g ha^{-1} PE	1.98(3.44)	2.06(3.78)	1.84(2.89)	2.48(5.67)
Diclosulam @ 25 g ha^{-1} PE	1.90(3.11)	1.98(3.44)	1.81(2.77)	2.41(5.33)
Flumioxazin @ 75 g ha^{-1} PE	2.01(3.55)	2.07(3.77)	1.90(3.11)	2.39(5.26)
Flumioxazin @ 100 g ha^{-1} PE	1.95(3.33)	2.01(3.55)	1.87(3.00)	2.37(5.11)
Sodium Acefluorfen 16.5 + clodinafop 8% = @ 240 g ha^{-1} POE	1.34(1.33)	1.42(1.55)	1.54(1.89)	1.98(3.44)
Fomesalfen 11.1 + Fluzifop11.1= @ 220 g ha^{-1} POE	1.43(1.55)	1.58(2.00)	1.46(1.67)	1.95(3.33)
SEm±	0.09	0.09	0.16	0.12
CD (p=0.05%)	0.27	0.25	0.48	0.37
CV (%)	9.57	8.66	11.77	9.32

Table 2: Effect of weed control measures on weed dry matter (g/m^2)

Treatments	Narrow leaved weeds		Broad leaved weeds	
	30 DAS	At harvest	30 DAS	At harvest
Weedy check (control)	0.77	92.20	13.33	613.33
Weed free	0.00	0.00	0.00	0.00
Pendimethalin @ 1.0 kg ha^{-1}	0.20	15.33	1.61	73.27
Pendimethalin + Imazethapyr @ 800 g ha^{-1} PPI	0.15	11.00	1.53	66.40
Diclosulam @ 20 g ha^{-1} PE	0.64	40.67	1.83	140.67
Diclosulam @ 25 g ha^{-1} PE	0.59	38.00	1.79	131.67
Flumioxazin @ 75 g ha^{-1} PE	0.69	44.33	2.03	124.20
Flumioxazin @ 100 g ha^{-1} PE	0.63	41.00	1.97	109.20
Sodium Acefluorfen 16.5 + clodinafop 8% = @ 240 g ha^{-1} POE	0.30	22.67	1.79	91.33
Fomesalfen 11.1 + Fluzifop11.1= @ 220 g ha^{-1} POE	0.28	20.33	1.63	90.00
SEm±	0.03	1.68	0.29	7.91
CD (p=0.05%)	0.08	4.98	0.85	23.50
CV (%)	10.59	8.22	13.47	8.71

Table 3: Effect of weed control measures on yields

Treatments	Yield (kg/ha)		
	Seed	**Stover**	**Biological**
Weedy check (control)	1000	1694	2694
Weed free	1851	3211	5062
Pendimethalin @ 1.0 kg ha^{-1}	1518	2606	4124
Pendimethalin + Imazethapyr @ 800 g ha^{-1} PPI	1641	2777	4418
Diclosulam @ 20 g ha^{-1} PE	1177	1969	3146
Diclosulam @ 25 g ha^{-1} PE	1087	1771	2858
Flumioxazin @ 75 g ha^{-1} PE	1395	2361	3756
Flumioxazin @ 100 g ha^{-1} PE	1408	2255	3663
Sodium Acefluorfen 16.5 + clodinafop 8% = @ 240 g ha^{-1} POE	1346	2268	3614
Fomesalfen 11.1 + Fluzifop11.1= @ 220 g ha^{-1} POE	1364	2308	3672
SEm±	49	89	116
CD (p=0.05%)	146	265	344
CV (%)	6.13	6.64	5.39

Conclusion

The study clearly demonstrates that Pendimethalin + Imazethapyr @ 800 g ha^{-1} (PPI) is a highly effective herbicidal option for chickpea, offering superior weed suppression and yield benefits. Its efficacy was comparable to Pendimethalin @ 1.0 kg ha^{-1}, with significant reductions in weed density and dry matter at both 30 DAS and harvest. The combination's dual mode of action, inhibiting germination and ALS/AHAS pathways, ensured broad-spectrum control during critical growth stages. Enhanced seed, stover, and biological yields confirm its role in minimizing crop–weed competition. Thus, Pendimethalin + Imazethapyr provides a reliable and efficient weed management strategy for chickpea cultivation.

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