

Original Research Article

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Bio- efficacy of Different Herbicides in Broad Spectrum Weed Management for Chickpea

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ABSTRACT

A field experiment was conducted during *rabi* seasons of 2014-15 and 2015-16 at research farm of TCA, Dholi, Muzzafarpur a campus of Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar (India) to evaluate the bio- efficacy of different herbicides in broad spectrum weed management for chickpea. Ten treatments were tested in randomized block design with three replications. Among the herbicides pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS recorded significantly higher seed yield (1348.50 kg/ha), straw yield(1600.33 kg/ha)lower weed dry weight (1.34g/m²), lower weed index (5.91 %), higher weed control efficiency (73.28%) and more added returns (Rs. 64280/ha) than all other herbicidal treatments. Present investigation revealed that pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS could be used effectively as an alternative for controlling most of the weeds and obtaining optimum seed yield of chickpea during *rabi* season in Bihar.

Keywords

Broad-spectrum, Pendimethalin, Bio-efficacy, CS Formulation and Partial budgeting

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Introduction

Chickpea (*Cicer arietinum* L.) belongs to genus *Cicer*, family Fabaceae, and sub-family Papilionaceae. India is the largest producer of

chickpea in the world covering 9.51mha area and producing 8.83 MT of grain with an average productivity of 929 kg ha⁻¹.In Bihar chickpea is cultivated in an area of 0.59 million hectare with annual production 0.64

million tonnes and average productivity is 1087 kg ha⁻¹ (Anonymous, 2018). The yield of this crop is adversely affected due to many factors but among those, weed infestation is very important (Singh *et al.*, 2008). Chickpea is a poor competitor to weeds because of its slow growth rate and limited leaf area development at early stages of crop growth. The critical period of crop-weed competition in chickpea usually falls between 30-45 days after sowing (Goud *et al.*, 2013). In addition to slow initial crop growth, wider crop spacing also facilitates crop-weed competition which poses a serious limitation to chickpea production, and thus, adversely affecting yield potential (Bhalla *et al.*, 1998). Weeds also pose negative effect on main crop by competing with the crop plants for soil moisture, nutrients, space and sunlight (Patel *et al.*, 2006). Chickpea is being grown in both rainfed and irrigated systems, where weed control is a major obstacle to profitable production. Due to high weed infestation, chickpea producers experienced decreased profits in recent years. Further, the input costs have also increased more rapidly than crop prices. In the absence of any suitable herbicides, majority of Indian farmers usually do manual weeding that is time consuming, labour-intensive and higher wages increases cost of cultivation. If this operation is delayed, it will not be effectively preventing adverse effect of the weeds on crop yield. The use of appropriate herbicides can eliminate this early weed competition prevent yield losses and cost of production. Herbicides are selective, cost effective, and easy to apply, and offer flexibility in application time (Hoseiny and Jagannath, 2011). The current trend and future development of intensive agriculture are likely to seek the help of chemicals as an effective weed control measures and replace the conventional method of weed control. Whereas use of herbicides had revolutionized weed control, reduce the cost of production.

Materials and Methods

A field experiment was conducted at research farm of TCA, Dholi, Muzzafarpur a campus of Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar (India) for two consecutive *rabi* seasons of 2014-15 and 2015-16 to evaluate bio- efficacy of different herbicides in broad spectrum weed management for chickpea. Dholi Farm is situated in North Bihar on the southern and Western bank of the river *Burhi Gandak* at 25°59' North latitude and 85°75' East longitudes with an altitude of 52.9 m above mean sea level (MSL). It enjoys a humid subtropical climate, influenced greatly by southwest monsoon. The main characteristic of the climate is hot-dry summer and cold winter. The rainfall received during crop seasons were 33 mm and 8.6 mm during 2014-15 and 2015-16, respectively. Whereas the average maximum and minimum temperatures of 2014-15 and 2015-16 were 24.78°C, 16.65°C, 27.60°C and 13.30°C respectively. The soil of the experimental site was sandy loam texture having high pH 8.2, EC 1.01dSm⁻¹, medium Organic carbon 0.45 %, low available N (207.00kg ha⁻¹), medium available P (16.80kg ha⁻¹) and normal K (108.50kg ha⁻¹). The experiment was laid out in a Randomized Block Design with three replications and the treatments were consist of ten different weed management practices *viz.*, Pendimethalin EC formulation (1 kg/ha), PE + One hoeing 30 DAS (T₁), Pendimethalin CS formulation (1 kg/ha), PE (T₂), Pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS (T₃), Fenoxapropethyle @ 60 g/ha POE at 30 DAS (T₄), Pendimethalin 30 EC formulation + Imazethapyr 2% (ready mix combination) @ 1kg/ha PE (T₅), Pendimethalin 30 EC formulation + Imazethapyr 2% (ready mix combination) @ 1kg/ha PE + one hoeing at 30 DAS (T₆), Pendimethalin CS formulation @ 1kg/ha, PE + Imazethapyr 2% (tank mix combination @

1kg/ha) (T₇), One hoeing/hand weeding at 30 DAS (T₈), Weed free (T₉) and Weedy check (T₁₀). The variety of HK-2seeds was sown in line manually with 30 X 10 cm spacing in the well prepared field. Pre-sowing irrigation was given before sowing. In nutrient management, entire dose of nitrogen (20kg/ha) phosphorus (45 kg ha⁻¹), potassium (20 kg ha⁻¹) and sulphur (20kg/ha) were applied as a basal. Three hand weedings were done in weed free plots, the pre- and post-emergence herbicidal treatments were imposed as per schedule. Data for individual years were pooled and statistically analyzed as per the procedure given by Gomez and Gomez (1984) for randomized block design then, weed index and weed control efficiency (WCE) was calculated by the respective formula.

Results and Discussion

Effect on grain and straw yield

From the study, the data clearly revealed that weed management practices significantly influenced the grain and straw yield of chickpea during both the years. Among the treatments, application of pendimethalin CS

formulation (1 kg/ha), PE + One hoeing 35 DAS and pendimethalin 30 EC formulation + imazethapyr 2% (ready mix combination) @ 1kg/ha PE + one hoeing at 30 DAS had significantly higher grain and straw yield than other treatments, also these two treatments were on par with weed free check, where the maximum grain yield was recorded (Table 1). It is mainly due to the complete elimination of weeds throughout the crop growth which enabled minimum competition and causing better plant growth along with higher number of branches and number of pods per plant during first and second year. Higher seed and straw yield in these treatments could be occasioned to more number of branches and number of pods per plants due to lesser competition deliverable by weeds for light, water and nutrients etc., which resulted in more uptake of nutrients, water and produced more photosynthates. Similar results had also been reported by Ratnam and Reddy (2011), Pedde *et al.*, (2013) and Rathod *et al.*, (2016). The minimum grain and straw yield was recorded under weedy check which was significantly lower than other weed management practices (Table 1).

Table.1 Effect of different weed management practices on grain & straw yield (kg/ha)

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
T ₁	939	1245	1100.00	1103	1470.66	1288.67
T ₂	978	889	921.50	1179	1027.66	1079.17
T ₃	1075	1633	1348.50	1254	1973.33	1600.33
T ₄	790	889	839.83	969	1042.33	996.00
T ₅	922	1522	1219.83	1080	1783.66	1443.00
T ₆	1084	1589	1329.67	1193	1795	1492.50
T ₇	958	1033	980.00	1005	1193.33	1079.83
T ₈	863	1067	966.00	897	1237.66	1068.33
T ₉	1106	1733	1437.67	1144	1995	1587.33
T ₁₀	632	578	608.83	690	700.66	698.83
SEd	43.51	198.07	109.83	49.90	217.42	118.28
CD (p= 0.05)	89.28	416.15	230.74	102.39	456.80	248.50

Table.2 Effect of different weed management practices on weed dry matter (g/m²), weed index (%) and (WCE %)

Treatments	Weed dry weight (g/m ² at 60 DAS)			Weed Index (%)			Weed Control Efficiency (%)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
T ₁	1.81	1.81	1.81	14.86	28.20	22.20	61.22	67.66	64.08
T ₂	2.367	3.86	3.18	10.80	47.32	31.74	48.63	33.65	39.02
T ₃	1.35	1.35	1.34	2.12	5.18	5.91	70.82	76.23	73.28
T ₄	3.01	3.49	3.25	28.22	49.17	39.94	34.85	37.96	35.61
T ₅	3.49	2.15	2.85	16.08	11.35	15.39	24.05	60.34	40.53
T ₆	2.15	2.55	2.43	1.30	7.97	7.02	54.38	55.08	52.57
T ₇	2.74	3.33	3.13	12.74	40.29	29.52	40.45	40.04	37.58
T ₈	1.77	2.95	2.38	21.65	39.05	31.61	61.59	49.00	54.34
T ₉	0.55	0.45	0.49	0.00	0.00	0.00	88.07	91.98	90.21
T ₁₀	4.7	5.8	5.19	42.51	66.89	55.32	0.00	0.00	0.00
SEd	0.26	0.50	0.31	4.00	11.5	6.73	5.79	8.44	5.68
CD (p= 0.05)	0.54	1.07	0.66	8.21	24.2	14.14	11.89	17.73	11.93

Table.3 Partial budgeting analysis

Weedy free (T ₉) Vs Weedy check(T ₁₀)				
	Losses(Rs ha ⁻¹)		Gains (Rs ha ⁻¹)	
Added cost	9750		Added returns 74535	
Reduced returns	Nil		Reduced cost Nil	
Total	9750		Total 74535	
Pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS (T ₃) Vs Weedy check (T ₁₀)				
	Losses(Rs ha ⁻¹)		Gains (Rs ha ⁻¹)	
Added cost	990		Added returns 66570	
Reduced returns	1300		Reduced cost Nil	
Total	2290		Total 66570	
Estimated change: Rs. +64280				
Estimated change: Rs. +64785				

Effect on weed parameters

All the weed management treatments significantly suppressed the weeds than weedy check. Among the weed management practices weed free (check) and treatment pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS were recorded similarly lowest weed dry weight, weed index and highest weed control efficiency which were significantly effective over weedy check treatment in respect of weed suppressing ability (Table 2). The same results were reported by Ratnam and Reddy (2011) and Rathod *et al.*, (2016).

Partial budgeting analysis

In the present investigation partial budgeting was undertaken as an economical tool to analyze the relative economics of various weed management treatments. The study resulted that more added returns obtained from pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS treatment plot compared to rest of all other treatment plots (Table 3). The weed free plot was record higher grain yield, but it was economically similar to the treatment pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS. This was mainly due to higher gross return along with lesser cost of cultivation especially, weed management cost. Similar result was reported by Rathod *et al.*, (2016).

From the present investigation concluded that application of pendimethalin CS formulation (1 kg/ha), PE + One hoeing 35 DAS is economically viable and best alternative for controlling weeds and acquiring optimum seed yield of chickpea during *rabi* season in

Bihar.

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