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RESEARCH NOTE

Effect of different pre- and post-emergence herbicides for weed management in chickpea

Anamika Nepali, Arvind Verma, J.K. Singh*, Deepa Verma and Pooja

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ABSTRACT

A field experiment was conducted during the winter (*Rabi*) season 2017-18 at Instructional Agronomy Farm of Rajasthan College of Agriculture, MPUAT, Udaipur. The experiment consisted of twelve weed management treatments which were replicated thrice in Randomize Block Design. Chickpea (cv. *Pratap Chana-1*) was used as a test crop. The hand weeding twice 30 and 60 days after seeding (DAS) followed by pre-emergence application (PE) of pendimethalin 1000 g/ha or pendimethalin 750 g/ha have significantly reduced total weed density and biomass and attained the highest chickpea seed yield. The net return and B:C ratio was significantly higher with pendimethalin 1000 g/ha PE and pendimethalin 750 g/ha PE due to lesser cost of herbicides usage compared to hand weeding.

Keywords: Chickpea, Economics, Herbicides, Pendimethalin, Weed management

India is the largest producer as well as a consumer of pulses. In India, the area under chickpea was 10.17 million hectares with a production of 11.35 million tons and average productivity 1116 kg per hectare, during 2019-20. Rajasthan ranks first in area, followed by Maharashtra, Madhya Pradesh and Uttar Pradesh. In Rajasthan, chickpea is one of the major crop grown with 2.46 million ha of area, 2.66 million tons of production and 1080 kg/ha productivity (GOI 2020). Unchecked weeds were reported to cause considerable reduction in chickpea seed yield up to 63% (Kaur and Kumar 2016). Manual weeding which is commonly used by farmers is constrained by limited availability and high prices of farm workers resulting in difficulty to the manually control weeds during critical periods of crop growth. Thus, the use of herbicides may be desirable for the control of weeds particularly at early stages as herbicides will control the emerging weeds for a substantial period of time (Rathod *et al*. 2017). However, herbicides use in chickpea by farmers is limited and a few farmers integrate pre-emergence herbicides use with manual weeding once or twice. This study was carried out to assess the effect of different pre- and post-emergence herbicides on weeds, crop yield and economics of chickpea.

Maharana Pratap University of Agriculture and Technology, Udaipur, Rajsthan-313 001, India

***** Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

* Corresponding author email: jksinghbhu3@gmail.com

The field experiment was carried out during winter (*Rabi*) season of 2017-18 at Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur, Rajasthan. The experiment consisting of 12 weed management treatments *viz*., pre-emergence application (PE) of pendimethalin 750 g/ha, pendimethalin 1000 g/ha PE, metribuzin 150 and 200 g/ha PE, post-emergence application (PoE) of imazethapyr 50 and 75 g/ha at 20 days after seeding (DAS), quizalofop - ethyl 40 and 50 g/ha PoE at 20 DAS, imazethapyr + imazamox ready mix (RM) 15+15 g/ha PoE at 20 DAS, imazethapyr + imazamox (RM) 20+20 g/ ha PoE at 20 DAS, hand weeding twice at 30 and 60 DAS and weedy check. A randomized block design with three replications was used. The required amounts of herbicides were applied using 500 liters/ha of water with a knap-sack sprayer fitted with a flat-fan nozzle. The soil of the experimental site was clay loam in texture, slightly alkaline in reaction. The pH of soil was 8.1. Available N, P and K content in the soil was 249.2, 21.6 and 378.7 kg/ha, respectively. Chickpea '*Pratap Channa-1*' was grown with a seed rate of 80 kg/ha at 30 cm x 25 cm plant geometry. The crop was provided with 20 kg N and 40 kg P/ha as basal dose. The crop received total rainfall of 4.20 mm during the cropping season and the maximum and minimum temperatures were ranged between 23.47 to 31.71°C and 5.21 to 13.03°C, respectively. At sampling time of 30, 60 DAS and at harvest, a quadrat of 0.25 m^2 was placed at four places in each plot marked with wooden pegs

and observations like weed density, weed biomass were recorded and weed control efficiency percentage was calculated using standard procedures. Yield attributes were estimated at harvest and yield was calculated and expressed in kg/ha. Weed density and biomass were square root transformed by using formula ($\sqrt{x+0.5}$) before analysis. While ANOVA indicated significance in treatment effects it was adjudged by calculating critical difference at 5 per cent level of significance, wherever, the results were found significantly by 'F' test.

Effect on weeds

In the experimental field of chickpea, the predominant broad-leaved weeds were, *Chenopodium album* (22.7%), *Chenopodium murale* (19.2%), *Convolvulus arvensis* (13.0%), *Melilotus indica* (13.3%) and *Malva parviflora* (17.7%) and the narrow-leaved and sedges were *Phalaris minor* Retz. (7.8%) and *Cyperus rotundus* (6.3%) **(Table 1)**. All the weed control treatments resulted significantly lesser density of grasses, broad-leaved weeds as well as total weeds compared to weedy check at 60 DAS **(Table 1)**. Significantly lesser grassy weed density was noticed with quizalofop-ethyl 50 g/ha PoE at 20 DAS and it was at par with quizalofop-ethyl 40 g/ha PoE at 20 DAS and pendimethalin 1000 g/ha PE. These were followed by pendimethalin 750 g/ha PE. The lowest number of broad-leaved weeds was observed with pendimethalin 1000 g/ha PE **(Table 1)** and in which at par with pendimethalin 750 g/ha PE at 60 DAS. The minimum density of total weeds was also recorded with pendimethalin 1000 g/ha PE. Singh *et al.* (2017) found that the pre-emergence application of pendimethalin 0.75 kg/ha was most effective in reducing weed density and biomass in chickpea.

At 60 DAS greater reduction of grassy weeds was with quizalofop-ethyl 50 g/ha PoE at 20 DAS which was statistically at par with quizalofop-ethyl 40 g/ha PoE at 20 DAS, pendimethalin 1000 g/ha PE and pendimethalin 750 g/ha PE as compared to the weedy check. Significant reduction in broad-leaved weeds biomass was observed with pendimethalin 1000 g/ha PE which was statistically at par with pendimethalin 750 g/ha PE. Pendimethalin 1000 g/ha PE also recorded highest (90.04%) reduction in total weed biomass and was statistically at par with pendimethalin 750 g/ha **(Table 1)**. The highest weed control efficiency was recorded with hand weeding twice at 30 and 60 DAS. The highest weed control efficiency of grassy weeds was achieved by quizalofop-ethyl 50 g/ha applied at 20 DAS PoE followed by quizalofop-ethyl 40 g/ha PoE at 20 DAS, pendimethalin 1000 g/ha PE and pendimethalin 750 g/ha PE. Patel *et al.* (2017) reported that quizalofop-ethyl 40 g/ha PoE at 20 DAS + HW at 40 DAS was most effective in controlling weeds in chickpea.

The highest weed control efficiency was observed with pendimethalin 1000 g/ha PE, followed by pendimethalin 750 g/ha and imazethapyr 75 g/ha PoE at 20 DAS. **(Table 1)**. The increased weed control efficiency with integration of pendimethalin 1 kg/ha PE with two inter-cultivations twice at 30 and 45 DAS was reported by Chavada *et al.* (2017).

The minimum uptake of N, P and K by weeds was observed with hand weeding twice at 30 and 60 DAS which was statistically at par with pendimethalin 1000 g/ha PE and pendimethalin 750 kg/ha PE **(Table 3)**. Chavada *et al.* (2017) observed that hand weeding at 30 and 45 DAS recorded significantly higher nutrient uptake of N (72.79 kg/ha), P (13.99 kg/ha) and K (20.23 kg/ha) by chickpea

Table 1. Effect of weed control treatments on weed density, weed biomass and weed control efficiency at 60 DAS in chickpea

Treatment	Weed density* (no./m^2)			Weed biomass (g/m^2)			Weed control efficiency (%)		
	Grassy weeds	Broad-leaved weeds	Total weeds	Grassy weeds	Broad-leaved weeds	Total weeds	Grassy weeds	Broad-leaved weeds	Total weeds
Pendimethalin 750 g/ha PE	2.81	3.92	4.78	3.14	3.97	5.01	87.71	87.94	87.90
Pendimethalin 1000 g/ha PE	2.41	3.68	4.40	3.04	3.60	4.65	88.67	90.13	90.04
Metribuzin 150 g/ha PE	4.66	5.62	7.27	7.39	8.73	11.41	30.16	39.92	36.16
Metribuzin 200 g/ha PE	4.47	6.31	7.70	6.04	7.30	13.50	53.34	58.20	56.39
Imazethapyr 50 g/ha PoE at 20 DAS	3.93	4.64	6.04	3.96	5.65	6.86	80.05	75.22	77.17
Imazethapyr 75 g/ha PoE at 20 DAS	3.73	4.88	6.10	3.81	5.07	6.30	81.83	80.02	80.67
Quizalofop-ethyl 40 g/ha PoE at 20 DAS	2.41	7.40	7.76	2.88	11.00	11.40	89.72	4.61	36.51
Quizalofop-ethyl 50 g/ha PoE at 20 DAS	2.17	7.36	7.64	2.72	10.93	11.24	91.00	5.84	38.51
Imazethapyr + imazamox 15 + 15 g/ha PoE at 20DAS	5.13	5.81	7.71	6.76	8.35	10.72	41.42	45.23	43.84
Imazethapyr + imazamox 20 + 20 g/ ha PoE at 20 DAS	5.02	6.03	7.82	6.64	7.85	10.26	43.07	51.46	48.27
Hand weeding twice at 30 and 60 DAS	0.71	0.71	0.71	0.71	0.71	0.71	100.00	100.00	100.00
Weedy check	5.86	7.41	9.42	8.83	11.26	14.30	0.00	0.00	0.00
LSD (p=0.05)	0.41	0.34	0.32	2.54	3.28	3.47			

* $\sqrt{x+0.5}$ transformed values and data in parentheses are original values, PE: pre-emergence, PoE: post-emergence

and significantly lower uptake of N (3.87 kg/ha), P (0.39 kg/ha) and K (1.68 kg/ha) by weeds.

Effect on chickpea

The highest chickpea plant height was observed with pendimethalin 1000 g/ha PE followed by pendimethalin 750 g/ha PE, imazethapyr 75 g/ha and imazethapyr 50 g/ha PoE at 20 DAS, metribuzin 150 g/ha PE and imazethapyr + imazamox (RM) 20+20 g/ha PoE at 20 DAS **(Table 2)**. The plant dry matter was higher with hand weeding twice and was on par with pendimethalin 1000 g/ha PE, pendimethalin 750 g/ha PE and imazethapyr 75 g/ha PoE. Pendimethalin 1000 g/ha PE has recorded significantly higher pods/plant and the weight of seeds/plant followed by its lower dose of 750 g/ha PE than the rest of the herbicidal treatments **(Table 2)**. The seeds/pod and 100-seed weight were not influenced by the weed management treatments. The minimum seed yield was recorded in weedy check **(Table 3)**. Amongst the treatments, significantly higher chickpea seed yield was obtained with hand weeding twice at 30 and 60 DAS which was statistically at par with pendimethalin 1000 g/ha PE followed by pendimethalin 750 g/ha PE and imazethapyr 75 g/ha PoE at 20 DAS. The greater biological yield was with hand weeding twice at 30 and 60 DAS followed by pendimethalin 1000 g/ha PE, pendimethalin 750 g/ha PE, imazethapyr 75 g/ha at 20 DAS, imazethapyr 50 g/ha at 20 DAS and metribuzin 150 g/ha. The maximum seed yield of chickpeas with manual hand weeding twice at 30 and 50 DAS was reported earlier (Kaur and Kumar, 2016). Dubey *et al*. (2018) reported highest chickpeas seed yield and test weight with tank mix application of pendimethalin 1000 g (PE) *fb* imazethapyr 75 g + quizalofop 60 g/ha as PoE. The highest net return was realized with pendimethalin 1000 g/ha PE (**Table 3)** which was higher than the rest of the treatments, except with pendimethalin 750 g/ha PE, hand weeding twice at 30

Table 2. Effect of weed control treatments on growth and yields attributes of chickpea during rabi 2017-18

Treatment	Plant population (lakh/ha)	Plant height (cm)	No. of branches/ plants	Plant dry matter accumulation (g/plant)	No. of Pods/ plant	No. of Seeds/ pod	Weight of seeds (g/plant)	100-seed weight (g)
Pendimethalin 750 g/ha PE	2.87	46.2	4.0	29.53	40.1	1.4	14.9	23.54
Pendimethalin 1000 g/ha PE	2.89	46.6	4.1	30.03	40.8	1.4	15.4	23.56
Metribuzin 150 g/ha PE	2.80	44.5	3.9	26.22	38.4	1.3	13.3	23.21
Metribuzin 200 g/ha PE	2.76	42.9	3.7	25.81	36.4	1.2	11.6	22.64
Imazethapyr 50 g/ha PoE at 20 DAS	2.85	45.2	3.9	26.32	39.1	1.4	14.5	23.45
Imazethapyr 75 g/ha PoE at 20 DAS	2.84	45.9	4.0	28.65	39.8	1.3	14.0	23.53
Quizalofop-ethyl 40 g/ha PoE at 20 DAS	2.78	41.7	3.6	17.06	34.8	1.2	10.5	22.36
Quizalofop-ethyl 50 g/ha PoE at 20 DAS	2.78	42.2	3.7	25.63	35.8	1.2	11.1	22.43
Imazethapyr + imazamox 15+15 g/ha PoE at 20 DAS	2.78	44.1	3.8	26.07	37.5	1.3	12.6	22.87
Imazethapyr + imazamox 20+20 g/ha PoE at 20 DAS	2.76	43.9	3.8	25.92	36.8	1.2	12.0	22.81
Hand weeding twice at 30 and 60 DAS	2.91	47.4	4.2	31.49	41.8	1.5	16.2	23.67
Weedy check	2.77	41.4	3.6	15.28	31.3	1.1	8.13	20.37
LSD (p=0.05)	NS	3.73	NS	2.88	3.9	NS	3.37	NS

***** PE: pre-emergence application, PoE: post-emergence application, DAS: Days after seeding

Table 3. Effect of weed control treatments on yield and economics of chickpea and nutrients uptake by weeds and crop at harvest

Treatment	Seed yield (t/ha)	Haulm yield (t/ha)	Biological yield (t/ha)	Harvest index (%)	Net return (x10^3₹/ha)	B:C	Nutrient uptake by crop (kg/ha)			Nutrient uptake by weed (kg/ha)		
							N	P	K	N	P	K
Pendimethalin 750 g/ha PE	1.69	3.88	5.57	30.32	64.83	2.84	89.7	15.1	75.8	5.63	0.88	5.67
Pendimethalin 1000 g/ha PE	1.72	3.96	5.68	30.31	65.89	2.80	92.3	16.4	78.4	4.27	0.60	4.37
Metribuzin 150 g/ha PE	1.59	3.70	5.30	30.10	61.08	2.81	81.9	13.7	68.3	34.91	7.33	34.75
Metribuzin 200 g/ha PE	1.50	3.37	4.87	30.95	56.07	2.56	73.2	10.8	58.9	25.20	6.05	24.72
Imazethapyr 50 g/ha PoE at 20 DAS	1.64	3.80	5.44	30.18	62.99	2.83	86.5	14.6	72.9	8.55	1.54	8.57
Imazethapyr 75 g/ha PoE at 20 DAS	1.61	3.75	5.36	30.02	60.90	2.68	84.0	13.0	70.2	7.62	1.42	7.64
Quizalofop-ethyl 40 g/ha PoE at 20 DAS	1.48	3.13	4.61	32.32	53.44	2.32	67.8	10.7	53.6	38.92	9.08	36.39
Quizalofop-ethyl 50 g/ha PoE at 20 DAS	1.50	3.26	4.77	31.59	54.17	2.32	71.1	11.6	56.2	36.40	8.69	34.99
Imazethapyr + imazamox 15 + 15 g/ha PoE at 20 DAS	1.57	3.46	5.03	31.22	59.18	2.70	78.1	12.1	62.8	31.59	7.18	31.16
Imazethapyr + imazamox 20 + 20 g/ha PoE at 20 DAS	1.55	3.43	4.98	31.20	58.09	2.63	76.2	11.8	61.0	30.09	6.91	29.18
Hand weeding twice at 30 and 60 DAS	1.75	4.07	5.81	30.17	63.75	2.35	95.3	17.5	82.0	2.36	0.45	3.54
Weedy check	0.77	1.11	1.87	47.24	17.23	0.83	31.3	4.1	20.5	68.47	16.71	65.10
LSD (P=0.05)	0.12	0.60	0.55	NS	5.41	0.11	9.5	2.1	12.71	3.58	0.80	3.49

Market price of chickpea seed ₹ 45.0 and halum ₹ 2.5/kg ***** PE: pre-emergence, PoE: post-emergence, DAS: Days after seeding

and 60 DAS, imazethapyr 50 g/ha PoE at 20 DAS, imazethapyr 75 g/ha PoE at 20 DAS and metribuzin 150 g/ha PE. The highest B:C ratio was recorded with pendimethalin 750 g/ha PE. The B:C ratio with imazethapyr 50 g/ha PoE at 20 DAS, metribuzin 150 g/ha PE and pendimethalin 1000 g/ha PE was at par with each other. Maximum net returns and B:C ratio with pendimethalin 1.00 kg/ha in chickpea was reported earlier by Kour *et al.* (2015). All the weed control treatments recorded significant increases in N, P and K uptake by the crop compared to weedy check **(Table 3)**. The highest uptake of N, P and K were recorded with hand weeding twice at 30 and 60 DAS and was statistically at par with pendimethalin 1000 g/ha PE.

Conclusion

The pre-emergence application of pendimethalin 1000 g/ha was found effective and most remunerative weed management treatment in chickpea under rainfed condition of Udaipur region of Rajasthan.

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