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Evaluation of different herbicides on growth and yield of chickpea (*Cicer arietinum* L.) under Uttarakhand conditions

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ABSTRACT

A field experiment was conducted during rabi season of 2017-2018 at Dehradun (Uttarakhand) with four herbicides, integrated with HW to evaluate the effectiveness of the herbicides on controlling weeds, their impacts on return and production economics on chickpea (Cicer arietinum L.) variety 'Pant Gram-186'. The dominant weed species among monocot weeds were Phalaris minor, Cynodon dactylon, Brachiaria mutica and Cyperus rotundus and among the dicot weed species Chenopodium album, Medicago denticulate, Convolvulas arvensis, Melilotus indica, Parthenium hysterophorus were detected during growing season. Weed dry weight of moncot and dicot weed was the lowest by hand weeding carried out 25 and 45 DAS. Extreme weed control efficiency was noticed with interculturing HW on 25 and 45 DAS. This treatment also recorded advanced yield attributes and seed and stover yield (1761 kg ha^{-1} and 2245 kg ha^{-1}) and maximum net monetary returns and benefit: cost ratio (₹ 34076 and 1.88, respectively).

Keywords: Chickpea, herbicides, weed control efficiency, weed index, and yield

Chickpea is most essential pulse crop of India, which accounts for 44% of total pulse production from 33% of total pulse area. In India chickpea is grown over an area of 8.84 million ha with production of 8.32 million tones and average productivity of 942 kg ha^{-1} (Anonymous, 2016a). Madhya Pradesh, Utter Pradesh, Rajasthan, Maharashtra, Gujarat, Andhra Pradesh and Karnataka are the chief chickpea producting states sharing over 95%. In Uttarakhand chickpea grown up in an area of 668 ha with ayearly production on 531 metric tons and average output of 795 kg ha^{-1}(Anonymous, 2016b). Chickpea is unfortunate challenger of weeds because of slow growing rate and inadequate leaf area growth at initial phases of crop growth and establishing, if weed is deserted under such condition, caused yield damage 68% (Kumar *et al*., 2014). 30 to 60 days existence period is well thought-out to be the serious for crop-weed rivalry in chickpea (Kumar and Singh, 2010). Appropriate weed controlling practices plays an important role in the successful cultivation of the crop.

A field experiment was conducted during *rabi* spell 2017-2018 at Doon (P.G) College of Agriculture Science and Technology, Selaqui, Dehradun (Uttarakhand). The soil of the experiment site was sandy loam in texture having neutral pH 7.4, 0.88 % organic carbon, Nitrogen (115 kg ha^{-1}), Phosphorus (17.92 kg ha^{-1}) and Potash (119 kg ha^{-1}). The experiment was carried out in randomized block design with three replications. The experiments consisted of eleven treatments *viz*. pendimethalin 30 EC 900 g ha^{-1}at 2 DAS PE, pendimethalin 30 EC 1200 g ha^{-1}at 2 DAS PE, pendimethalin 30 EC 1400 g ha^{-1} at 2 DAS PE, pendimethalin (extra) 38.5 % CS 900 g ha^{-1} at 2 DAS PE, oxyfluorfen 23.5 EC 120 g ha^{-1}at 2 DAS PE, metribuzin 70 WP 200 g ha^{-1}at 2 DAS PE, oxyfluorfen 23.5 EC + metribuzin 70 WP 120 @ 300 g ha^{-1}at 2 DAS PE, oxyfluorfen 23.5 EC 120 g ha^{-1}at 12 DAS early PoE, metribuzin 70 WP 200 g ha^{-1}at 20 DAS PoE, HW twice @ 25 and 45 DAS, weedy check. Recommended dose of fertilizers Nitrogen (20 kg ha^{-1}), Phosphorus (45 kg ha^{-1}) and Potash (20 kg ha^{-1}) were applied through DAP and MOP, individually. The herbicides were functional with their particular amounts as per treatments. Spraying was completed with flat fen nozzle by Knapsack sprayer using 500 liter ha^{-1}. Weed population and dry weight of weeds were counted using quadrate of 0.25 m^2 size by 30 and 60 days after sowing and by harvest. Weed figures were exposed to square root conversion before statistical study. Growth and yield attributes, seed and stover produce recorded and economics remained also were calculated.

The experiment field was occupied by *Phalaris minor*, *Cynodon dactylon* (L.), *Brachiaria mutica* and *Cyperus rotundus* (L.) of monocot weeds and *Chenopodium album*, *Medicago denticulate*, *Convolvulas arvensis*, *Melilotus indica*, *Parthenium hysterophorus* of dicot weeds during of growing season. Relevant results were informed by Singh *et al.* (2010). The weed density and weed dry weight was significantly varied with the weed control practices HW at 25 and 45 DAS recorded significantly less density of monocot and dicot weed dry weight. At all the treatments, HW 25 and 45 days after sowing offered the extreme management of narrow and broad leaf weeds than other treatments since primarily weed remained organized by hand weeding 25 DAS and so on weeds occurred well

Short Communication

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Table 1: Effect of different weed management practices on weed density, weed dry weight and weed control efficiency in chick pea

Treatment	Density of weeds (no. m^{-2})				Dry weight of weeds (g)				Weed control efficiency (%)	
	Monocot		Dicot		Monocot		Dicot			
	30 DAS	60 DAS	30DAS	60 DAS	30 DAS	60 DAS	30 DAS	60DAS	30 DAS	60 DAS
Pendimethalin 30 EC 900 g/ha at 2 DAS PE	9.05 (83.00)	8.49 (73.00)	9.04 (87.33)	8.20 (68.00)	1.05 (1.11)	0.95 (0.93)	1.98 (4.11)	1.94 (1.98)	84.36	88.00
Pendimethalin 30 EC 1200 g/ha at 2 DAS PE	12.72 (162.00)	11.80 (139.67)	13.26 (178.00)	12.57 (159.00)	1.39 (1.98)	1.14 (1.33)	2.54 (6.53)	2.46 (6.03)	81.03	81.42
Pendimethalin 30 EC 1400 g/ha at 2 DAS PE	14.26 (205.67)	12.86 (165.00)	14.77 (219.10)	14.23 (204.00)	1.69 (3.12)	1.48 (2.20)	2.62 (7.03)	2.38 (5.70)	69.55	71.50
Pendimethalin (extra) 38.5 % CS 900 g/ha at 2 DAS PE	14.21 (204)	13.28 (176.33)	14.33 (208.00)	13.76 (190.00)	1.42 (2.01)	1.37 (1.90)	2.61 (6.93)	2.55 (6.35)	73.56	74.20
Oxyfluorfen 23.5 EC 120 g/ha at 2 DAS PE	11.62 (138.00)	10.85 117.00)	11.23 (128.00)	11.04 (122.00)	1.12 (1.27)	1.09 (1.21)	2.23 (5.03)	2.12 (4.63)	81.39	84.74
Metribuzin 70 WP 200 g/ha at 2 DAS PE	14.22 (203)	13.63 (187.00)	14.93 (223.00)	14.47 (211.00)	3.42 (11.92)	3.05 (9.53)	2.89 (8.55)	2.77 (7.70)	42.42	47.56
Oxyfluorfen 23.5 EC + metribuzin 70 WP 120 + 300 g/ha at 2 DAS PE	10.05 (103.00)	9.20 (93.00)	10.20 (105.00)	9.68 (94.67)	1.11 (1.23)	1.02 (1.07)	2.07 (4.55)	1.58 (2.68)	82.63	87.00
Oxyfluorfen 23.5 EC 120 g/ha at 12 DAS early PoE	13.95 (195.33)	11.81 (140.00)	12.40 (156.00)	11.60 (136.00)	1.28 (1.65)	1.16 (1.38)	2.45 (6.11)	2.23 (5.03)	76.93	83.09
Metribuzin 70 WP 200 g/ha at 20 DAS PoE	12.70 (162.00)	10.72 (123.00)	11.57 (137.00)	10.32 (107.00)	1.17 (1.38)	1.06 (1.13)	2.40 (5.98)	2.01 (4.11)	77.97	85.95
HW twice @ 25 and 45 DAS	8.18 (68.00)	5.90 (38.00)	8.39 (73.00)	7.19 (53.00)	0.98 (0.98)	0.72 (0.53)	1.74 (3.35)	1.14 (1.35)	87.05	95.19
Weedy check	14.40 (216.00)	13.79 (190.38)	21.29 (470.00)	20.27 (420.00)	4.91 (24.17)	4.27 (18.27)	4.56 (21.47)	4.32 (19.22)	0.00	0.00
SEm(±)	**0.60**	**0.68**	**0.68**	**0.66**	**0.91**	**0.11**	**0.14**	**0.13**	-	-
LSD(0.05)	**12.89**	**15.35**	**25.3**	**27.3**	**92.29**	**96.58**	**21.56**	**37.43**		

All Numbers are exposed to converted values to square root ($\sqrt{x+0.5}$).

Table 2: Effect of different weed managing practices on Weed index, Plant height, Crop dry matter accumulation, number of branches, yield attributes, yield and economics of chickpea

Treatment	Weed Index (%)	Plant height (cm)			Crop dry matter accumulation at 60 DAS (g)	Number of branches plant^{-1}	Number of pods plant^{-1}	Seed index (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Net profits (Rs ha^{-1})	B:C ratio
		30 DAS	60 DAS	At harvest								
Pendimethalin 30 EC 900 g/ha at 2 DAS PE	04.30	21.75	48.52	52.75	14.13	25.13	47.15	26.00	1685	2115	30228	1.86
Pendimethalin 30 EC 1200 g/ha at 2 DAS PE	37.93	18.24	43.50	47.70	09.00	20.44	42.55	18.50	1093	1413	09261	1.25
Pendimethalin 30 EC 1400 g/ha at 2 DAS PE	44.34	16.45	42.03	46.91	07.93	18.00	38.88	18.30	0980	1195	04098	1.11
Pendimethalin (extra) 38.5 % CS 900 g/ha at 2 DAS PE	38.95	17.12	42.13	46.12	08.88	19.00	40.49	18.50	1075	1296	07340	1.19
Oxyfluorfen 23.5 EC 120 g/ha at 2 DAS PE	25.04	18.78	46.50	52.95	13.11	24.23	45.13	21.70	1320	1995	21521	1.50
Metribuzin 70 WP 200 g/ha at 2 DAS PE	49.74	14.52	41.65	44.08	07.67	16.00	37.00	18.10	0885	1020	02373	1.06
Oxyfluorfen 23.5 EC + metribuzin 70 WP 120 + 300 g/ha at 2 DAS PE	14.25	20.76	49.85	51.40	13.85	24.85	46.50	23.00	1510	2095	27577	1.78
Oxyfluorfen 23.5 EC 120 g/ha at 12 DAS early PoE	29.58	18.84	43.11	48.33	10.70	21.85	43.75	19.10	1240	1520	16846	1.49
Metribuzin 70 WP 200 g/ha at 20 DAS PoE	25.44	19.13	45.95	50.13	12.11	23.88	44.00	19.80	1313	1775	20448	1.50
HW twice @ 25 and 45 DAS	00.21	23.45	50.03	53.12	14.84	25.80	49.45	26.50	1761	2245	34076	1.88
Weedy check	73.02	11.85	34.11	37.78	05.00	11.81	29.45	15.10	0475	0659	-13.15	0.59
SEm(±)	**-**	**0.88**	**2.09**	**1.89**	**0.87**	**1.22**	**1.51**	**9.63**	**61.18**	**94.75**		
LSD(0.05)		**11.33**	**2.48**	**3.6**	**24.29**	**10.79**	**10.83**	**10.99**	**34.34**	**26.9**	**-**	**-**

ahead were effectively removed by succeeding HW carried out at 45 DAS. This result is similar with Murade and Patil (2013). The weed density and dry weight of monocot and dicot weeds in control plot were suggestively the highest than rest of the treatments.

Minimum weed index (0.21%) and extreme weed control efficiency (Table1) by 25 and 45 DAS and by harvest were observed at HW completed by 25 and 45 DAS.On 30 and 60 DAS, treatment of hand weeding at 25 and 45 DAS advanced WEC (83 %). The results are relevant with the outcomes of Rathod *et al*. (2016), Singh and Jain (2017), Gore *et al*. (2018). The lower weed index and higher weed control efficiency of treatment of HW at 25 and 45 DAS, advance efficacy of the herbicides at initial growth phase and one HW at advanced stage was active in monitoring weed dry matter in the different combined methods of weed management. This result is supported by Dewangan *et al.* (2016).

The higher plant height of chickpea was recorded at 60 DAS in the treatment of HW 25 and 45 DAS. Crop dry matter accumulation at 60 DAS and at harvest, number of branches, number of pods plant^{-1} and test weight were recorded expressively higher at harvest. More number of branches under this treatment might be due to less weed density, providing adequate space for horizontal spread of crop leading to higher dry matter accumulation plant^{-1}. These results are similar with Singh and Tripathi (2004).

The plant height was highest at 30, 60 DAS and at harvest under the treatment of hand weeding twice at 25 and 45 DAS.These results are in accordance with the findings of Pedde *et al*. (2013), Rathod *et al.* (2016). The reason for variation in plant height in different treatments may be due to the lower competition of weeds with crop for light, nutrients and space along with availability of water which allow the crop to grow to their potential.

The seed and stover income were also suggestively higher under the treatment of HW double at 25 and 45 DAS followed by the treatment pendimethalin 30 EC 900 g ha^{-1}at 2 DAS PE, oxyfluorfen 23.5 EC + metribuzin 70 WP 120 + 300 g ha^{-1}at 2 DAS PE,whereas weedy check, recorded the lowest produce attributes, seed and stover yield of chickpea due to higher weed density (Table 2.). Removal of weed at initial phase in the season reduces crop-weed competition. These results are in agreement with the outcomes of Rathod and Patil(2016), Chourasiya *et al*. (2016). Net monetary returns and Benefit: Cost ratio was advanced under the double hand weeding by 25 and 45 DAS than other weed management practices. The result was similar with Rathod *et al*. (2016), followed by the treatment pendimethalin 30 EC 1200 g ha^{-1}at 2 DAS PE, pendimethalin 30 EC 1400 g ha^{-1} by 2 DAS PE.

CONCLUSION

For definite control of weeds and higher grain produce as well as reasonable returns under the treatments of hand weeding at 25 ad 45 DAS, followed by pendimethalin (extra) 38.5 % CS at 900 g ha^{-1} by 2 DAS PE may be effective.

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