



Influence of sowing dates and weed management on weed growth and nutrients depletion by weeds and uptake by chickpea (*Cicer arietinum*) under rainfed condition

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ABSTRACT

A field experiment was conducted at BHU, Varanasi during *rabi* season of 2009-10 and 2010-11 to find out effect of sowing dates and weed management on weed growth, yield attributes, yield and nutrient uptake by weeds and chickpea (*Cicer arietinum* L.) under rainfed conditions. The results revealed that early sowing (10 November) significantly reduced the weed density and its dry matter. Among different weed management treatments, sequential application of pendimethalin (1 kg/ha pre-em) followed by quizalofop (50g/ha post-em) recorded the lowest density and dry weight of weeds. Crop sown at 10 November recorded significantly lowest nutrient depletion by weeds and highest yield and nutrients uptake by chickpea. Significantly lowest nutrient depletion by weeds and highest growth parameters, yield attributes, yield and nutrients uptake by chickpea were recorded under sequential application of pendimethalin (1 kg/ha pre-em) followed by quizalofop (50g/ha post-em). Regression equations revealed that unit increase in weed control efficiency increased the grain and straw yields, respectively by 13.67 and 32.74 kg/ha.

Key words: Chickpea, Planting dates, Weed management, Weed, Yield

Chickpea (*Cicer arietinum* L.), being- slow in its early growth and short stature plant is highly susceptible to weed competition. Depending up on density of weeds and duration of weed competition, an yield loss of 17-75% has been reported (Chaudhary *et al.* 2005). Weed management in chickpea at initial stage of crop growth is important since crop-weed competition is maximum at this stage. Among all the non-monetary inputs, timely sowing assumes the great significance as it brings considerable change in plant environment with respect of temperature, photoperiod, and availability of soil moisture and consequently influences the crop-weed competition and crop productivity. Therefore, optimization of sowing time of chickpea might help to some extent in minimizing the crop-weed competition (Shamsi 2010). In eastern part of Uttar Pradesh, manual weeding is the most common method of weed management. However, this conventional method of weed control in chickpea is time consuming, expensive and labourious. Therefore, it is more favourable to use herbicides due to non-availability of human labour resource during peak crop season (Dungarwal *et al.* 2002). Pendimethalin at 1 kg/ha as pre-emergence is the most common herbicide used in chickpea. There is a need of post-emergence herbicide to

control the second flush of weeds in chickpea and to reduce human labour. Recently some of the post-emergence herbicides such as quizalofop and imazethapyr have been found effective in controlling weeds in pulses. Keeping in view these facts, the present investigation was undertaken to test the performance of sowing dates and post-emergence herbicide either alone or in combination with other weed management options for providing effective weed control in chickpea.

MATERIALS AND METHODS

A field experiment was conducted during winter season 2009-10 and 2010-11, at the Agronomy research farm of Institute of Agricultural Sciences, BHU, Varanasi (23.2° N latitude, 83.03°E longitude and at an altitude of 113 msl) in the north-eastern Gangetic Plains. The soil of experimental site was sandy clay loam in texture with neutral in reaction (pH-7.2). It was low in organic C (0.33%) and available nitrogen (168.9 kg/ha), medium in available phosphorus (26.6 kg/ha) and potassium (242.5 kg/ha) in soil surface. The field was kept under rice (*Oryza sativa* L.)- wheat (*Triticum aestivum* L.) rotation for the last eight years. Treatments consisted of three sowing dates, viz S₁- 10 November, S₂- 25 November and S₃- 5 December and eight weed control systems, viz. W₁- weedy, W₂- weed free, W₃- pendimethalin 1 kg/ha pre-emergence, W₄- quizalofop 50 g/ha post-emergence, W₅- imazethapyr 37 g/ha post-

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emergence, W₆- pendimethalin followed by quizalofop, W₇- pendimethalin followed by imazethapyr and W₈- pendimethalin + mechanical in split plot design with three replications. The chickpea variety T 59 was sown manually at 30 × 10 cm row spacing using 80 kg seed/ha in 4.6 × 3.6 m² gross plot size. Crop was raised with recommended package of practices for the region. Herbicides were applied as per treatments with hand sprayer fitted with flat-fan nozzle and the spray volume was 500 liters/ha. Density (no./m²) and dry weight (g/m²) of weeds were recorded at different stages of weed growth. Data on weed density was recorded from an area enclosed in the quadrat of 0.25m² randomly selected at four places in each plot. Crop was harvested on 30 March 2010 and 3 April 2011. Weed and crop samples were analyzed for nutrient concentration as per the standard procedure. Nutrient uptake (kg/ha) were calculated by multiplying their nutrient concentration with weed biomass and crop yield.

RESULTS AND DISCUSSION

Density and dry weight of weed

Composition of weed flora varied with the date of sowing. The major weeds in experimental crop were *Melilotus alba* 44.2%, *Cynodon dactylon* 31.3%, *Phalaris minor* 7.6%, *Chenopodium album* 6.1%, *Medicago hispida* 4.2% and other weeds 6.9% at 60 DAS. The results are corroborated with the findings of Gupta *et al.* (2012). Early sown crop (10 November) recorded lower density and dry matter accumulation of all the weed species than that of crop sown at later dates (25 November and 5 December) (Table 1 and 2). Among the weed control treatments, sequential application of pendimethalin (1 kg/ha) as pre-emergence followed by quizalofop (50 g/ha) as post-emergence recorded lowest density and dry weight of weeds followed by the alone application of quizalofop (50 g/ha post-em), pendimethalin (1 kg/ha pre-em) followed by mechanical weeding at 60 DAS and imazethapyr (37.5 g/ha post-em), respectively. Lower weed density and dry matter under pendimethalin followed by quizalofop applied treatment was due to fact that pendimethalin controlled the germination of initial flushes of weeds and quizalofop controlled the grassy weeds emerged at later stages. Higher weed control and long lasting effects of quizalofop and imazethapyr in reducing density and weed dry matter might be primarily due to broad-spectrum activity of these herbicides particularly on both narrow and broad leaf weeds (Mishra *et al.* 2005). Likewise, Gupta *et al.* (2012) also recommended use of imazethapyr in legumes which inhibit acetohydroxy acid synthase and the synthesis of branched chain amino acids. Pre-emergence

Table 1 Effect of sowing dates and weed management on density (m²) of different weed species (Pooled data of two year)

Treatment	<i>Melilotus alba</i>				<i>Cynodon dactylon</i>				<i>Phalaris minor</i>				<i>Chenopodium album</i>				<i>Medicago hispida</i>				Other weeds				
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	
<i>Dates of sowing</i>																									
S ₁	21.3	22.6	19.5	14.6	17.2	20.8	17.5	15.8	2.7	4.3	2.3	2.0	3.5	4.9	3.1	2.0	2.5	3.7	1.4	0.9	4.5	5.9	4.1	3.0	
S ₂	21.9	23.5	19.7	16.9	17.5	23.0	17.7	16.1	2.8	4.6	2.7	2.2	3.6	5.0	3.1	2.2	3.0	4.0	2.2	1.1	4.6	6.1	4.1	3.2	
S ₃	22.2	25.4	20.3	17.5	18.7	23.3	18.9	17.0	3.2	4.7	3.0	2.3	3.9	5.1	3.5	2.8	3.0	4.3	2.4	1.3	4.9	6.1	4.5	3.8	
CD(P=0.0 5)	NS	NS	1.50	1.50	NS	NS	NS	NS	NS	NS	0.4	NS	NS	NS	NS	NS	NS	NS	0.4	NS	NS	NS	NS	0.2	0.3
<i>Weed management</i>																									
W ₁	55.0	72.0	48.3	31.7	40.3	51.6	31.4	27.1	9.6	12.3	10.4	9.8	8.0	10.2	8.1	6.6	4.7	6.7	4.9	3.2	9.0	11.2	9.1	7.6	
W ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
W ₃	23.0	23.0	20.3	18.0	18.4	23.2	19.3	18.0	3.0	5.1	2.2	1.4	7.1	9.4	7.8	6.4	4.0	5.8	3.6	2.6	8.1	10.4	8.8	7.4	
W ₄	17.3	18.2	17.2	14.7	15.7	19.7	18.4	16.7	1.7	3.0	1.7	1.1	1.9	2.8	1.8	0.9	2.9	3.0	0.8	0.1	2.9	3.8	2.8	1.9	
W ₅	21.3	21.6	19.9	17.8	17.9	22.6	19.0	17.7	3.0	5.0	2.0	1.3	3.8	5.6	2.3	1.4	3.4	5.3	2.3	1.2	4.8	6.6	3.3	2.4	
W ₆	16.6	17.0	16.8	14.3	15.2	18.7	18.3	16.6	1.0	2.6	1.2	1.0	1.7	2.4	1.2	0.8	1.3	2.4	0.2	0.3	2.7	3.4	2.2	1.8	
W ₇	20.9	20.3	18.2	16.4	17.4	21.9	19.0	17.6	2.8	4.3	2.0	1.2	3.6	5.1	2.3	1.3	3.2	4.8	2.2	0.9	4.6	6.1	3.3	2.3	
W ₈	20.1	18.2	17.8	14.7	17.3	21.4	18.6	16.6	2.2	3.7	1.8	1.1	3.3	4.6	2.3	1.2	3.1	4.1	2.0	0.9	4.3	5.6	3.3	2.2	
CD (P=0.05)	3.5	3.5	2.5	3.0	2.2	3.8	3.5	3.3	0.7	0.8	0.8	0.7	0.6	0.7	0.9	1.5	0.7	1.1	1.2	0.9	1.2	1.4	2.1	2.0	

A, 30 DAS; B, 60 DAS; C, 90 DAS; D, at harvest, S₁, 10 November, S₂, sowing at 25 November, S₃, sowing at 05 December; W₁, weedy, W₂, weed free (Hand weeding at 30 and 60 DAS); W₃, pendimethalin (Pre-em)@1 kg/ha, W₄, quizalofop (Post-em) @0.05 kg/ha, W₅, imazethapyr (Post-em) @ 0.0375, W₆, pendimethalin fb quizalofop; W₇, pendimethalin fb imazethapyr and W₈, pendimethalin fb mechanical weeding (60 DAS)

Table 2 Effect of sowing dates and weed management on dry weight (g/m²) of different weed species (Pooled data of two year)

Treatment	Melilotus alba				Cynodon dactylon				Phalaris minor				Chenopodium album				Medicago hispida				Other weeds				
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	
Dates of sowing																									
S ₁	7.6	8.1	6.6	5.1	1.0	1.3	1.0	0.9	0.07	0.12	0.04	0.01	1.53	2.30	1.35	0.92	0.69	1.21	0.49	0.30	5.2	7.0	4.6	3.3	
S ₂	7.9	8.6	6.7	5.3	1.1	1.4	1.2	1.0	0.11	0.12	0.07	0.03	1.65	2.32	1.43	1.03	0.96	1.37	0.72	0.37	5.3	7.1	4.6	3.5	
S ₃	8.0	8.8	6.7	5.4	1.2	1.5	1.3	1.0	0.13	0.13	0.08	0.05	1.78	2.33	1.57	1.33	1.01	1.48	0.91	0.46	5.7	7.3	5.1	4.2	
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.16	0.23	NS	NS	NS	0.02	NS
Weed management																									
W ₁	20.4	27.4	24.0	16.9	2.1	3.6	2.2	1.4	0.40	0.34	0.28	0.20	3.29	4.27	3.50	3.05	1.39	2.28	1.62	1.07	10.4	13.3	10.2	8.3	
W ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.2	1.2	1.1	1.1	
W ₃	8.0	7.9	5.6	4.8	1.2	1.4	1.4	1.1	0.13	0.14	0.06	0.03	3.64	4.65	3.52	2.86	1.22	2.00	1.21	0.88	9.4	12.4	9.9	8.1	
W ₄	6.2	6.2	4.5	4.9	1.1	1.1	1.1	1.0	0.05	0.09	0.04	0.02	0.80	1.43	0.85	0.42	0.87	0.90	0.61	0.27	3.4	4.5	3.1	2.1	
W ₅	7.6	7.3	5.3	4.4	1.1	1.4	1.3	1.1	0.09	0.14	0.05	0.03	1.80	2.48	1.10	0.78	1.15	1.88	0.79	0.43	5.6	7.9	3.7	2.6	
W ₆	5.9	5.8	4.5	4.8	1.0	0.9	1.0	1.0	0.04	0.08	0.02	0.01	0.68	1.26	0.57	0.34	0.47	0.80	0.25	0.15	3.1	4.0	2.5	2.0	
W ₇	7.5	6.7	4.8	4.2	1.1	1.3	1.1	1.1	0.08	0.11	0.04	0.03	1.55	2.29	1.09	0.68	1.03	1.61	0.79	0.31	5.3	7.3	3.7	2.5	
W ₈	7.0	6.3	5.7	5.0	1.2	1.2	1.1	1.1	0.07	0.09	0.04	0.02	1.45	2.16	0.98	0.61	0.97	1.35	0.65	0.31	5.0	6.7	3.7	2.4	
CD(P=0.05)	1.3	1.3	1.0	NS	0.3	0.4	0.4	0.2	0.15	0.03	0.03	0.04	0.36	0.37	0.41	0.78	0.34	0.39	0.54	0.31	1.2	1.3	1.6	1.7	

A, 30 DAS; B, 60 DAS; C, 90 DAS; D, at harvest, S₁, 10 November; S₂, sowing at 05 December; S₃, sowing at 25 November; W₁, weedy; W₂, weed free (Hand weeding at 30 and 60 DAS); W₃, pendimethalin (Pre-em)@1 kg/ha; W₄, quizalofop (Post-em) @0.0375; W₅, imazethapyr (Post-em) @ 0.0375; W₆, pendimethalin fb quizalofop, W₇, pendimethalin fb imazethapyr and W₈, pendimethalin fb mechanical weeding (60 DAS)

application of pendimethalin (1 kg/ha) was least effective against weeds.

Nutrients depletion by weeds

The lowest nutrients depletion by weeds was recorded in early sown crop (10 November) as compared to crop sown at 25 November and 5 December (Table 4) due to lower dry matter accumulation by weeds. Among herbicidal treatments, sequential application of pendimethalin (1 kg/ha) followed by quizalofop (50 g/ha) recorded significantly the lowest nutrients depletion by weeds over pendimethalin followed by imazethapyr.

Crop growth

Crop sown on 10 November recorded tallest plant, maximum dry matter accumulation, number of root nodules, canopy cover and branches/plant as compared to that of 25 November and 5 December, respectively (Table 2). This might be due to fact that the timely sowing of crop sown (10 November) facilitated better growth and development of plant as compared to delay sown crop. Results are in close conformity with the findings of Singh *et al.* (2010). Among the herbicidal treatments, sequential application of pendimethalin (1 kg/ha) followed by quizalofop (50 g/ha) recorded significantly the tallest plant, higher dry matter accumulation, root nodules and branches/plant and was on a par with alone application of quizalofop (50 g/ha post-em), pendimethalin (1 kg/ha pre-em) followed by mechanical weeding at 60 DAS and imazethapyr (37.5 g/ha post-em).

Yield and nutrient uptake

Yield and nutrients uptake were significantly influenced by the time of sowing (Table 3 and 4). Crop sown on 10 November recorded significantly the highest yield and nutrient uptake over crop sown on 25 November and 5 December, respectively. Reduction in growth parameters and yield attributes were apparently responsible for lower yield as well as nutrients uptake under delayed sowing conditions. Higher yield and nutrient uptake in early sown crop was due to better growth and development of crop.

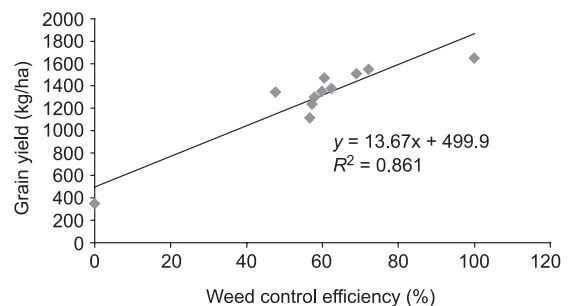


Fig 1 Relationship between WCE and grain yield

Table 3 Effect of sowing dates and weed management practices on weed dry weight, growth and yield of chickpea (Pooled data of two year)

Treatment	Plant height (cm)	Nodules/plant at 45 DAS	Dry matter production (g/plant)	Primary branches/plant	Secondary branches/plant	Grain yield (kg/ha)	Straw yield (kg/ha)	Weed dry weight (kg/ha)
<i>Dates of sowing</i>								
10 November	32.5	19.1	2.9	4.9	6.8	1475	3354	123
25 November	31.4	18.3	2.8	4.4	6.0	1304	2989	131
05 December	30.8	18.0	2.7	4.2	5.7	1118	2529	134
CD(P=0.05)	1.15	1.22	0.10	0.60	0.60	162.2	317	4
<i>Weed management</i>								
Weedy	29.7	17.6	2.5	4.0	5.7	352	990	311
Weed free (HW 30&60 DAS)	32.7	20.9	3.0	5.0	6.6	1652	4165	0.0
Pendimethalin (Pre-em)@1 kg/ha	30.3	17.8	2.7	4.3	5.7	1348	2712	163
Quizalofop (Post-em)@ 0.05 kg/ha	32.3	18.3	2.9	4.6	6.6	1514	3313	97
Imazethapyr (Post-em) @ 0.0375 kg/ha	31.1	17.8	2.7	4.1	5.9	1240	2651	133
Pendimethalin fb quizalofop	32.5	19.3	2.9	4.8	6.6	1551	3562	87
Pendimethalin fb imazethapyr	31.8	17.9	2.8	4.4	6.1	1354	3099	125
Pendimethalin fb mechanical weeding (60 DAS)	32.2	18.1	2.8	4.4	6.2	1381	3166	117
CD (P=0.05)	1.04	1.22	0.27	0.40	0.73	188.8	451.3	29

Table 4 Effect of sowing dates and weed management practices on nutrient depletion by weed and their uptake by chickpea (Pooled data of two year)

Treatment	Nutrients uptake by grain (kg/ha)			Nutrients uptake by straw (kg/ha)			Nutrients uptake by weeds (kg/ha)		
	N	P	K	N	P	K	N	P	K
<i>Dates of sowing</i>									
10 th November	47.5	7.8	6.5	38.2	9.1	20.8	2.41	0.21	2.23
25 th November	43.3	7.0	5.8	34.4	8.4	18.8	2.46	0.22	2.31
05 th December	36.7	6.3	5.3	29.6	7.6	16.7	2.49	0.24	2.35
CD (P=0.05)	5.3	0.9	0.6	4.1	0.6	1.8	0.06	0.03	0.07
<i>Weed management</i>									
Weedy	12.0	2.1	1.9	12.2	3.4	7.5	5.60	0.50	5.40
Weed free (HW 30&60 DAS)	53.0	8.0	5.9	45.4	10.4	23.9	0.00	0.00	0.00
Pendimethalin (Pre-em)@1 kg/ha	44.3	7.7	6.9	32.6	8.2	18.9	2.84	0.26	2.88
Quizalofop (Post-em)@ 0.05 kg/ha	48.4	7.8	7.6	37.1	8.9	22.4	1.96	0.17	1.77
Imazethapyr (Post-em) @ 0.0375 kg/ha	42.3	6.9	5.8	31.2	7.9	16.7	2.45	0.22	2.32
Pendimethalin fb Quizalofop	49.9	8.5	6.5	40.6	9.8	21.4	1.81	0.16	1.60
Pendimethalin fb Imazethapyr	44.9	7.5	6.1	35.9	8.9	19.5	2.53	0.21	2.31
Pendimethalin fb mechanical weeding (60 DAS)	45.3	7.7	6.3	37.4	9.4	19.8	2.35	0.20	2.09
CD (P=0.05)	2.4	0.7	0.4	2.5	0.3	1.2	0.04	0.02	0.04

Among the weed control treatments, significantly highest yield and nutrient uptake was found under weed free treatment and lowest in control plot. Among herbicidal treatments, sequential application of pendimethalin (1 kg/ha) followed by quizalofop (50 g/ha) recorded significantly the highest yield and nutrients uptake over pendimethalin followed by imazethapyr, alone application of pendimethalin and imazethapyr and these were on a par with alone application of quizalofop and pendimethalin followed by mechanical weeding at 60 DAS. This was due to effective control of weeds resulting into better crop growth, yield and nutrients uptake. The regression equation predicted linear increase in the grain yield with a unit increase in the weed control efficiency (Fig 1). The extent of increase could be 13.67 kg/ha in grain yield for weed control efficiency.

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