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Effect of Sowing Methods and Sequential Application of Herbicides on Crop Growth, Nodulation, Weed Growth and Economics of Chickpea

MANDHATA SINGH*[1], DEOKARAN[1], JS MISHRA AND BP BHATT
ICAR Research Complex for Eastern Region, Patna (India)

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ABSTRACT

Chickpea is highly sensitive crop to weed competition as early stage of growth. A field experiment was conducted during winter season of 2013-14 to 2015-16to know the response of application of sequential application of herbicides under different sowing methods. Results revealed that chickpea sowing in reduced tillage performed better and produced higher number of pods per plant, seed yield and protein yield over conventional tillage. In weed management treatment, sequential application of pendimethalin@0.75 kg a.i./ha pre-em followed by imezethapyr @40 g a.i./ha post-em improve the crop growth and produced higher seed yield (1515 kg/ha) and protein yield. Total weed density and weed dry weight were recorded minimum under reduced tillage at both 30 and 60 days after sowing. Application of pendimethalin @0.75 kg a.i./ha pre-emfollowed by imezethapyr @40 g a.i./ha post-em reduced the total weed density and weed dry weight over other treatments and recorded minimum. Weed control efficiency recorded higher with conventional tillage (70.04%) and closely followed by reduced tillage (70.81%). Pendimethalin@0.75kg a.i./ha pre-emfbimazethapyr @ 40 g a.i./ha recorded highest weed control efficiency (92.93%) followed by pendimethalin 0.75 kg a.i./ha fbquizalofop ethyl 50 g a.i./ha (85.41%) and pendimethalin 1.0 kg a.i./ha (73.78). Net return of Rs 42265and benefit cost ratio of 1.55 were also recorded higher under reduced tillage. Among weed management pendimethalin1.0 kg a.i./ha pre-em followed by imezethapyr @50 g a/i/ha post-em recorded higher net return (Rs 48782) and benefit cost ratio (1.81).

Keywords: Chickpea, Economics, Growth, Weed management, Yield.

INTRODUCTION

Chickpea or gram (*Cicer arietinum*)is an important pulse crop of the semi-arid tropics, particularly in the rainfed ecology of the Indian sub-continent (Singh *et al.*, 2014a). The daily per caput availability of 14g chickpea is a source of approximately 2.3% (56Kcal) energy and 4.7% (2.7g) protein to Indian population besides, being an important source of calcium and Iron (10-12%).Chickpea also plays an important role in sustaining soil productivity by improving its physical, chemical and biological properties and trapping atmospheric nitrogen in their root nodules (Ali and Kumar, 2005).Chickpea being slow in its early growth and short stature plant ispoor competitor to weeds, especially during initial growth period suffers 17-85% yield loss depending upon the nature and intensity of weed flora and management practices (Singh *et al.*, 2014b).Weed management in chickpea at initial stage of crop growth is important since crop-weed competition is higher at this stage. Among all the agronomic practices sowing method assumes the great significance as it brings considerable change in plant environment with respect of spacing, light and availability of soil moisture and consequently influences the crop-weed competition and crop productivity (Singh *et al.* 2015). Therefore, using appropriate sowing method might help to some extant in minimizing the crop-weed competition. In southern part of Bihar, manual weeding is the most common method of weed management. However, this conventional method of weed control in chickpea is time consuming, expensive and laborious. Therefore, it is more favourable to use herbicides due to non-availability of human labour resource during peak crop season.

Pendimethalin at 1.0 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 imazethapyr and quizalofop ethyl 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 method and post-emergence herbicide in combination with pre-emergence herbicides for providing effective weed control in chickpea.

MATERIALS AND METHODS

A field experiment was conducted during winter season2013-14 and 2015-16, at the Research farm (25°34'6.33"N, 83°59'0.18" E and 63 m above sea level) of Krishi Vigyan Kendra (ICAR Research Complex for Eastern Region), Buxar, Bihar, India. 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 - wheat cropping system for the last five years. The experiment was laid out in split plot design with two sowing methods, viz

[1]KVK, Buxar, ICAR Research Complex for Eastern Region, Patna (India)
*Corresponding Author Email : mandhataagro@gmail.com

S1- reduced tillage(sowing was done by zero-till seed cum ferti drill after two tillage operation by cultivator), S2- conventional tillage and fiveweed management practices, viz. W1- weedy, W2- weed free, W3- pendimethalin 1.0 kg/ha pre-emergence, W4- pendimethalin 750g ai/ha pre emergence fbimazethapyr (40g ai/ha) at 25 DAS post-emergence and W5- pendimethalin 750g ai/ha pre-emergence fbquizalofop-ethyl 50g ai/ha at 25 DAS post-emergence. The chickpea variety KWR 108used for test crop. Crop was sown on first week of December in each year. 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/m^2) and dry weight (g/m^2) of weeds were recorded at different stages of weed growth. Data on weed density was recorded from an area enclosed in the quadrate of 0.25m^2 randomly selected at three places in each plot. 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

Effect on crop

Plant height, no of branches, number of nodules/plant, nodule dry weight/plant and 100 seed weight was not significantly influenced by sowing method. Number of pods per plant was recorded highest (72.64) with reduced tillage and significantly superior over conventional tillage sowing of chickpea (67.42). Seed yield (1382 kg/ha), stover yield (3021 kg/ha) and protein yield (290 kg/ha) was associated highest with reduced tillage and super imposed over conventional tillage. Seed yield under reduced tillage was 22% higher over conventional tillage (Table 1).

Reduced tillage increase the protein yield and recorded 18.36% higher over conventional tillage. It could be ascribed due to reduced tillage enhanced the seed germination and more absorption of light; proper spacing between row to row and plant to plant suppress the weed population and better crop growth resulting more number of pods/plant led higher seed, stover and protein yield. Results are agreement with the findings of Mishra *et al.*, 2012. Amongst weed management practices plant height varies from 23.46 to 33.41 cm and recorded tallest plant with pendimethilene 0.75 kg a.i./hafbquizalofop ethyl 50 g a.i./ha. No of branches/plant and number of nodules/plant, nodule dry weight were recorded highest with pendimethalin0.75 kg a.i./ha fbquizalfop ethyl 50 g a.i./ha. Number of pods/plant (80.30) and 100 seed weight (23.6 g)recorded highest under pendimethalin 0.75kg a.i./hafbimazethapyr 40 g a.i./ha over other weed management practice, except pendimethalin 0.75 kg a.i./hafbquizalofop-ethyl 50 g a.i./ha. Minimum pod/plant was recorded with weedy check. Weed management treatment showed marked improved in seed yield and maximum seed yield (1515 kg/ha) was recorded under pendimethalin 0.75 kg a.i./ha fbimazethapyr 40 g a.i./ha which was on par with weed free (1572 kg/ha) and pendimethalin 0.75 kg a.i./hafbquizalofop ethyl 50 g a.i./ha. This result can be attributed due to marked improvement in yield attributes and better weed control efficiency. The minimum grain yield was recorded in weedy check which was attributed due to more weed growth and poor yield

Table 1: Effect of sowing method and weed management on growth, nodulation, yield attributes and yield of chickpea (Pooled data over 3 years)

Treatments	Plant height (cm)	No of branches/ plant	No of nodules/ plant	Nodule dry weight/ plant	No of pods/ plant	100 seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Protein yield (kg/ha)
Sowing method									
Reduced tillage	31.73	20.95	25.14	22.45	72.64	23.8	1382	3021	290
Conventional tillage	30.41	20.59	26.42	21.91	67.42	22.7	1174	2703	245
CD (P=0.05)	NS	NS	NS	NS	3.86	NS	68	157	14
Weed management									
Weedy	23.46	11.98	12.97	10.57	37.94	22.3	619	1353	129
Weed free	33.66	25.13	33.17	29.96	83.90	24.0	1572	3451	336
Pendimethalin (1000g ai/ha PE)	32.32	19.17	25.27	21.87	70.66	23.0	1213	2784	246
Pendimethalin (750g ai/ha PE) fbImazethapyr (40g ai/ha) at 25 DAS (POE)	32.51	23.15	27.58	24.79	80.30	23.6	1515	3382	316
Pendimethalin (750g ai/ha PE) fbQuizalofop-ethyl (50g ai/ha) at 25 DAS(POE)	33.41	24.42	29.91	23.71	77.35	23.2	1469	3339	309
CD (P=0.05)	1.46	1.02	1.24	1.07	3.41	1.1	65	144	14

Reduced tillage (sowing was done by zero-till seed cum ferti drill after two tillage operation by cultivator)

attributes formations. Results are agreements with the findings of Singh et al., 2014 and Singh, 2016.

Effect on weeds

In the experimental plot eight weed species identified and grouped in grasses, sedges and broad leaved weeds. Composition of weed flora varies from sowing methods and weed management practices. In conventional tillage and weedy check plot recorded 10.21% *Phalaris minor*, 4.0% *Avena ludoviciana*, 4.0% *Cynodon dactylon*, 25.56% *Chenoppdium album*, 15.0% *Rumex retroflexus*, 3.95% *Anagalisa rvensis*, 24.73% *Vicia sativa* and 12.39% others. Density of different weed species was influenced by different sowing methods. Maximum density of all types of weed flora recorded under conventional tillage (Table 2).

Among the weed management treatments, sequential application of pendimethalin 0.75 a.i./hafbimazethapyr 40 g a.i./ha found very effective to controlling the density of weed flora and super imposed over other weed management treatment. Dry weight of weed flora recorded highest under crop sown by conventional method. Among weed management practices, pendimethalin 0.75 kg a.i./hafbimazethapyr 40 g a.i./ha found effective to controlling the dry weight of weed flora. Total density of weed flora was recorded minimum under reduced tillage and weed pressure was 22.6% and 10.06% lower than conventional tillage at 30 and 60 DAS, respectively. Total weed density at both stages 30 and 60 DAS were recorded higher under conventional tillage compared to reduced tillage. Among weed management practices sequential application of pendimethalin 0.75 kg a.i./hafbimazethapyr 40 g a.i./ha was found very effective to controlling the density of weed flora and their dry weight at both the growth stages. It could be ascribed due to fact that pendimethalin controlled the germination of initial flushes of weeds and imazethaypr controlled the grassy weeds emerged at later stages. Higher weed control and long lasting effects of 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 (Gupta *et al.*, 2012).

Maximum weed control efficiency was recorded under conventional tillage (70.81%) closely followed by reduced tillage. Among weed management treatment pendimethalin fbimazethapyr (92.93%) recorded highest weed control efficiency followed by pendimethalin fbquizalofop ethyl (85.41) and pendimethalin (73.78%). This is due to lesser number of weed germinate under this treatment (Singh *et al.*, 2014).

Table 2: Effect of sowing method and weed management on total weed density, weed dry weight and nutrient uptake (Pooled data over 3 years)

Treatments	Total weed density (no/m²)		Total weed dry weight (g/m²)		Nutrient uptake by grain (kg/ha)			Nutrient uptake by Stover (kg/ha)			Nutrient uptake by weeds (kg/ha)			Weed control efficiency (%)
	A	B	A	B	N	P	K	N	P	K	N	P	K	
Sowing method														
Reduced tillage	38.9	48.7	9.2	21.4	46.3	7.6	6.8	34.7	9.6	20.3	2.57	0.56	1.93	70.04
Conventional tillage	47.7	52.6	11.3	23.8	39.2	6.6	5.4	31.0	7.8	17.5	2.73	0.59	2.05	70.81
CD (P=0.05)	2.1	2.3	0.5	1.1	2.3	0.4	0.3	1.8	0.5	1.0	0.12	0.03	0.09	
Weed management														
Weedy	144.2	169.4	34.6	76.6	20.2	3.2	2.8	14.8	3.7	8.6	8.97	1.94	6.73	0.00
Weed free	0.0	0.0	0.0	0.0	53.9	8.9	7.9	40.2	11.0	23.8	0.00	0.00	0.00	100.00
Pendimethalin (1000g ai/ha PE)	40.2	46.2	9.5	20.0	39.5	6.6	5.3	31.9	8.0	17.2	2.35	0.51	1.76	73.78
Pendimethalin (750g ai/ha PE) fbImazethapyr (40g ai/ha) at 25 DAS (POE)	11.1	12.2	2.4	5.4	50.7	8.4	7.2	38.6	10.1	22.0	0.64	0.14	0.48	92.93
Pendimethalin (750g ai/ PE) fbQuizalofop-ethyl (50g ai/ha) at 25 DAS (POE)	20.8	25.3	4.6	11.1	49.5	8.2	7.2	38.7	10.5	23.0	1.30	0.28	0.98	85.41
CD (P=0.05)	3.5	4.1	0.8	1.8	2.2	0.4	0.3	1.7	0.4	1.0	0.22	0.05	0.16	

Reduced tillage (sowing was done by zero-till seed cum ferti drill after two tillage operation by cultivator)A-30DAS, B-60 DAS

Nutrient uptake

Nutrient (N, P and K) uptake by grain and stover was significantly influenced by sowing methods and weed management treatments. Nitrogen, phosphorus and potassium uptake were recorded highest under reduced tillage over conventional tillage. Higher nutrients uptake under reduced tillage was due to higher seed and stover yield. Among weed management practices sequentional application of pendimethalin 0.75 kg a.i./hafbimazethapyr 40 g a.i./ha significantly increase the uptake of nutrients (N, P and K) by grain and stover over other treatments. This was mainly due to effective management of weed flora in these treatments. Nitrogen, phosphorus and potassium uptake by grain in weed free treatment recorded highest followed by pendimethalin fbimazethapyr. However weedy check recorded minimum nutrients uptake by grain and stover (Table 2).

Nutrients uptake by weed was significantly influenced by sowing methods and weed management. Nitrogen, phosphorus and potassium uptake by weeds were minimum under reduced tillage and significantly superior to conventional tillage. Application of pendimethalin fbimazethapyr recorded minimum nutrient uptake over rest of the treatment. Weedy check recorded higher nutrient uptake by weeds.

Economics

Economic analysis of data represents the chickpeas sowing under reduced tillage recorded the minimum cost of cultivation compared to conventional tillage (Table 3). This was mainly due to higher cost incurred under more number of tillage and sowing by broadcast. Net return (Rs 42265) and BCR (1.55) of chickpea were also higher under reduced tillage. Net return of 34.78% recorded higher under reduced tillage over conventional tillage. Benefit cost ratio recorded significantly higher under reduced tillage over conventional tillage (1.12).Net return and benefit cost ratio were maximum with pendimethalin 0.75 kg a.i./ha fbimazethapyr 40 g a.i./ha. The higher net return and benefit cost ratio under these treatments owing to more grain yield.

Table 3: Effect of sowing method and weed management on economics of chickpea (Pooled data over 3 years)

Treatments	Cost of cultivation (Rs/ha)	Net return (Rs/h a)	B:C ratio
Sowing methods			
Reduced tillage	26821	42265	1.55
Conventional tillage	27321	31357	1.12
CD (P=0.05)	-	3411	0.12
Weed management			
Weedy	22800	8150	0.36
Weed free	33800	44790	1.33
Pendimethalin (1000g ai/ha PE)	24785	35849	1.45
Pendimethalin (750g ai/ha PE) fbImazethapyr (40g ai/ha) at 25 DAS (POE)	26985	48782	1.81
Pendimethalin (750g ai/ha PE) fbQuizalofop -ethyl (50g ai/ha) at 25 DAS (POE)	26985	46487	1.73
CD (P=0.05)	-	3228	0.12

CONCLUSION

On the basis of above finding sowing of chickpea through reduced tillage enhanced the crop growth and suppresses the weed flora population and weight resulting crop produced higher seed, stove and protein yield and greater monetary return. Weed management treatment pendimethalin0.75kg a.i./ha (pre-emergence) followed byimazethapyr 40 g a.i./ha (post emergence)was found very effective for minimizing weed growth, maximizing seed yield and monetary return.

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