



## Research Article

**EFFECT OF INTERCROPPING AND PHOSPHORUS ON GROWTH AND YIELD OF CHICKPEA AND LENTIL UNDER RAINFED CONDITION****Harendra Kumar Yadav and Phool Chandra Singh**

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**Abstract** The experiment was conducted to investigate the effect of intercropping and phosphorus on growth and yield of chickpea and lentil under rainfed condition. The experiment was laidout in Split Plot Design with four replication at Agricultural Farm Shri Durga Ji Post Graduate College, Chandeshwar, Azamgarh-276128 (UP). The experiment comprising of twenty treatments as four cropping systems in main plot viz., Chickpea + Mustard (8:2), Chickpea + Mustard (4:1), Lentil + Mustard (16:2) and Lentil + Mustard + (8:1) and five phosphorus level viz., Control, 20, 40, 60 and 80 kg/ha. The sown of chickpea Cultivar Awarodhi and lentil Cultivar Mallika-75 varieties were used in the experiment. The results were observed that the significantly higher all growth and yield attributes of chickpea and lentil intercropped with mustard alongwith row ratios of 8:2 and 16:2, respectively. The yield of chickpea and lentil were observed significantly higher in 12.98 q/ha in chickpea + mustard with row ratios of 8:2 and 11.28 q/ha in lentil + mustard with row ratios of 16:2, respectively. The economics as gross income, net income and B:C ratio were obtained significantly higher in cropping of chickpea + mustard (8:2 ratios) and intercropping of lentil + mustard with row ratio of 16:2. Among the levels of phosphorus it was also observed significantly that the all growth and yield attributes and yield as well as economics were recorded under the application of phosphorus @ 80 kg/ha in respect of chickpea and lentil crop.

**Key words:** Experiment, cultivar, mustard, income**Introduction**

In India, inter and mixed cropping system has been practiced since long for sustained production as well as risk produce and the continuation of these practice for centuries alone is enough to justify their importance (Willey, 1979). In traditional agriculture, particularly in rainfed areas, these systems have been practiced at a low of technology largely for reduction of risk of late, intercropping has been recognized as a potentially beneficial system of crop production and evidences suggest that intercropping can provide substantial yield advantages as compared to sole cropping. Pulses play an equally important role in rainfed and irrigated agriculture by improving physical, chemical and biological properties of soil and are considered excellent crops for natural resource management, environmental security, crop diversification and consequently for viable agriculture. The scope for increasing area under pulses is limited and therefore, inter and mixed cropping area one of the systems of increasing the production pulses. Pulses like chickpea and lentil has been found a very good crops for intercropping with mustard as it has a great plasticity of plant. Intercropping/mixed cropping of mustard with chickpea

and lentil have been recommended by several research workers (Prasad *et al.* 2000, Ali *et al.* 2002 and Singh and Rathi 2003). It yield can further be increased in association of pulses by application of optimum dose of phosphorus and selecting a suitable pulse crop during *Rabi* season.

**Material and method**

A field experiments were conducted at the Agricultural Farm of the Shri Durga Ji Post Graduate College, Chandesar, Azamgarh (UP), India during two consecutive *Rabi* seasons of 2004-05 and 2005-06. The experiment comprising of twenty treatments was laidout in a Split Plot Design with four replications. The pooled analysis for all observations was done according to the methods suggested by Yates and Cochran (1938). Treatment comprised four cropping systems in main plot viz., Chickpea + Mustard (8:2), Chickpea + Mustard (4:1), Lentil + Mustard (16:2) and Lentil + Mustard + Lentil (8:1) and five phosphorus level viz., Control, 20, 40, 60 and 80 kg/ha. The sown of main crop as chickpea of Awarodhi and lentil of Mallika-75 and sub crop as mustard of Varuna were used in the experiment. The soil of the experimental field was loamy in texture with pH of 8.5 – 9.0 and EC of 0.42 – 0.45 mmhos/cm at 25°C during both

the year, respectively. The seed rate of pulses were like chickpea 80 kg/ha and lentil 50 kg/ha. The sowing of lentil and chickpea were done in row 22.50 cm and 45.0 cm apart by country plough at intercropping, respectively and phosphorus level as per treatments. Recommended dose of fertilizers was used in the study years.

## Results and discussion

### (a) Intercropping and phosphorus on growth characters of chickpea and lentil:

The data revealed that the initial plant population of chickpea and lentil influenced by row ratios of chickpea and lentil. The initial plant population of chickpea was observed higher (148.8 q/m<sup>2</sup>) in chickpea + mustard intercropped with row ratios of 8:2 followed by chickpea + mustard 4:1 row ratios (139.44/m<sup>2</sup>). In case of lentil the initial plant population of lentil was recorded higher when lentil intercropped with mustard in 16:2 row ratios (429.52/m<sup>2</sup>). The significantly minimum plant populations were recorded when the lentil intercropped with mustard in row ratios of 8:1 (425.74/m<sup>2</sup>). Among the level of phosphorus it was also observed significantly that the maximum initial plant population were recorded under the application of phosphorus @ 80 kg/ha (294.58/m<sup>2</sup>) but it was significantly at par to with the application of phosphorus @ of 40 and 60 kg P<sub>2</sub>O<sub>5</sub>/ha. The significantly minimum population were recorded without application of phosphorus (268.47/m<sup>2</sup>). In case of final plant population it was observed that the significantly higher plant population chickpea were recorded when chickpea intercropped with mustard with row ratios of 8:2 (140.98/m<sup>2</sup>). The minimum final plant population were recorded that the when chickpea + mustard with the row ratio of 4:1 (131.73/m<sup>2</sup>). Similar trend was also observed in case of lentil + mustard among the phosphorus level, it was observed that the significantly higher final plant population (277.92/m<sup>2</sup>) were with the application of @ 80 kg P<sub>2</sub>O<sub>5</sub>/ha. But it was significantly at par to 40 and 60 kg P<sub>2</sub>O<sub>5</sub>/ha. Branches/plant were influenced by intercropping systems and different doses of phosphorus. It was observed that the significantly higher branches/plant were recorded of chickpea under the intercropping system of chickpea + mustard with row ratio of 8:2 (12.65/plants and minimum in chickpea + mustard, 4:1 (11.78/plant). Lentil when intercropped with mustard in row ratios of 16:2 recorded the significantly higher number of branches/ plant (13.57/plant) and minimum in row ratios of 8:1 (12.35/plant). The different doses of phosphorus also influenced the branches/plant. The significantly higher branches/plant recorded under the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha (16.42/plant). The significantly minimum were recorded without the application of phosphorus (6.11/plant). The height of chickpea was also influenced by

row ratio of chickpea + mustard. The significantly higher plant height was recorded (51.35 cm) when chickpea intercropped with mustard in row ratio of 8:2 and minimum (50.39 cm) in row ratio of (4:1). The height also influenced by different level of phosphorus. The height significantly higher with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha (50.61 cm) and significantly minimum recorded without application of phosphorus (42.75/cm). Fresh weight of chickpea was recorded (70.15 g/plant) higher in when chickpea intercropped mustard with row ratio of 8:2. The minimum fresh weight recorded when chickpea intercropped with mustard in row ratios of 4:2 (67.77 g/plant). The fresh weight also influenced by different doses of phosphorus. The significantly higher fresh weight (58.85 gm/plant) under the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha and minimum fresh weight (52.55 gm/plant) without application of phosphorus. Similar trend was also observed in dry weight/plant.

### (b) Intercropping and phosphorus on yield attributing characters of chickpea and lentil:

Pods/plant, weight of pod/plant, grain/plant, grain weight/plant, grain yield and stover yield were also influenced by intercropping systems and different doses of phosphorus. Pods/plant were also influenced by when chickpea intercropped with mustard in different row-ratios. The number of pods/plant were observed higher in chickpea + mustard 8:2 (26.67 pods/plant) and minimum in chickpea + mustard (4:1) row ratios (23.70 pods/plant). These results support the finding of Gangasaran and Giri (1985), Patel *et al.* (1991) and Singh and Yadav (1992).

In case of lentil the higher number of pods/plant were recorded when lentil intercropped with mustard in row ratios of 16:2 (78.37 pods/plant) and minimum was recorded with the row ratios of 8:1 (73.92 pods/plant). The pods/plant were increasing with doses of phosphorus. The maximum number pods/plant (58.55 pods/m<sup>2</sup>) were recorded with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha. and minimum (37.77 pods/plant) without application of phosphorus. This results reported by Bahadur *et al.* (2002). Weight of pods/plant were influenced different row ratios of chickpea and lentil with mustard. The higher weight of pods/plant of chickpea were recorded (14.91 g/plant) in row ratios of 8:2 and minimum (13.59 g/plant) in 4:1 row ratios. Among the different doses of phosphorus it was observed that the maximum weight of pods/plant (11.32 g/plant) under the phosphorus dose of 80 kg/ha. The minimum were recorded (6.12 gm/plant). without application of phosphorus. Grains/plant of chickpea and lentil also influenced by row ratios of chickpea + mustard, lentil + mustard and different doses of phosphorus. The higher number of grains/plant of chickpea was recorded (49.38/plant) in chickpea + mustard row ratios of 8:2 and minimum (45.11/plant). In case of lentil it was observed

Table-1: Pooled as effect of cropping system and phosphorus on growth attributes of chickpea and lentil on pooled data.

Treatments	initial plant population	final plant population	Branches/ plant	Plant height (cm)	Fresh weight (g)	Dry weight (g)
Chickpea + Mustard (8:2)	148.89	140.98	12.65	51.35	70.15	16.24
Chickpea + Mustard (4:1)	139.44	131.73	11.78	50.39	67.77	14.97
Lentil + Mustard (16:2)	429.52	405.80	13.57	43.28	42.51	6.90
Lentil + Mustard (8:1)	425.74	399.97	12.35	43.88	44.01	7.20
SE (d)	3.00	2.26	0.16	0.26	0.39	0.17
C.D. at 5%	6.31	4.74	0.32	0.54	0.82	0.35
Phosphorus (Kg/ha)						
0	268.47	252.68	6.11	42.72	52.55	9.90
20	283.92	266.81	10.61	45.46	54.61	11.02
40	289.27	274.04	13.98	48.00	56.58	11.53
60	293.23	276.63	15.80	49.32	57.95	11.88
80	294.58	277.92	16.42	50.61	58.85	12.30
SE (d)	3.85	3.14	0.28	0.46	0.69	0.35
C.D. at 5%	7.62	6.22	2.55	0.90	1.35	0.68

Table-2: Pooled as effect of cropping system & phosphorus on yield attributes of chickpea and lentil.

Treatments	Pods/plant	Weight of pods/ plant	Grains/ plant	Test weight (g)
Chickpea + Mustard (8:2)	26.67	14.91	49.38	17.26
Chickpea + Mustard (4:1)	23.70	13.59	45.11	14.93
Lentil + Mustard (16:2)	78.37	4.83	143.75	2.49
Lentil + Mustard (8:1)	73.92	4.59	136.61	2.18
SE (d)	0.39	0.16	0.91	0.14
C.D at 5%	0.81	0.33	1.91	0.30
Phosphorus (Kg/ha)				
0	37.77	6.12	75.55	6.03
20	47.88	8.89	89.43	8.31
40	52.87	10.19	98.56	9.62
60	56.23	10.86	101.80	10.80
80	58.55	11.32	103.21	11.30
SE (d)	0.54	0.31	1.10	0.28
C.D. at 5%	1.07	0.61	2.17	0.54

that higher number of grains/plant were recorded in (143.75/plant) and minimum was recorded (136.61/plant). Among the different doses of phosphorus it was observed that the maximum number of grains/plant (103.21) with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha and minimum recorded (75.55 grains/plant) without application of phosphorus. It was observed that the chickpea grain weight/plant were recorded (11.64 gm). In chickpea + mustard row ratios of 8:2. The minimum grain weight/plant was recorded (11.03 gm) in chickpea/ mustard row ratios of 4:1.

Lentil grain weight/plant higher (3.89 gm/plant) in row ratios of lentil + mustard (16:2) and minimum were recorded (3.53 gm/plant) under the row ratios of chickpea + mustard (8:1). Among the different doses of phosphorus it was observed that the grain weight/plant higher recorded (9.53 g/plant) with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha and minimum were recorded without application of phosphorus (4.86 gm/plant).

The test weight of chickpea and lentil effected by row ratios of mustard. The higher test of chickpea (17.269) was recorded under the intercropping system of chickpea + mustard in row ratios of 8:2 and minimum recorded (14.93 g) in row ratios of 4:1. The test weight of lentil higher (2.49 gm) in lentil + mustard in row ratios of 16:2 and minimum (2.18 g) in row ratios of 8:1. Test weight of both crop also increasing with increasing phosphorus level upto 80 kg P<sub>2</sub>O<sub>5</sub>/ha. Grain yield of chickpea also effected by intercropping of chickpea + mustard in different row ratios. The yield of chickpea was observed higher in (12.98 q/ha) in row ratios of 8:2 and minimum (12.33 q/ha) in row ratios of 4:1. The yield of lentil was higher (11.28 q/ha) in lentil + mustard in row ratios of 16:2 and minimum yield (9.32 q/ha) was recorded under the intercropping systems of lentil + mustard in row ratios of 8:1. The results also supported by Gangasaran and Giri (1985), and Kushwaha (1992). The yield of intercrops also influenced by different doses of phosphorus. The higher yield (14.55 q/ha) of combined yield chickpea + lentil in increasing level of phosphorus @ 80 kg/ha. The minimum yield (7.63 q/ha) were recorded without application of phosphorus. Similar trend was also recorded in biological yield. The Stover yield of chickpea and lentil also influenced by intercropping of mustard with row ratios. The higher stover yield of chickpea (16.31 q/ha) was influenced by with chickpea inter cropped with mustard in row ratios of 8:2 and minimum (15.01 q/ha) were recorded under row ratio of 4:1. In case of lentil it was observed that the higher stover yield (21.73 q/ha) in lentil + mustard in row ratio of 16:2. The minimum yield was recorded (20.53 q/ha) in row ratio of 8:1. The yield of stover along with phosphorus. It was observed that the stover yield of intercropped increasing upto level of phosphorus 80 kg P<sub>2</sub>O<sub>5</sub>/ha. The positive effect of phosphorus application on the yield attributes upto 80 kg P<sub>2</sub>O<sub>5</sub>/ha has

also reported by Chand *et al.* (2004) and Tripathi *et al.* (2005).

The effect of mustard on the grain yield of chickpea and lentil, the estimated yield of chickpea and lentil was findout on the basis of Central row of chickpea and lentil was found on the basis of central row of chickpea and lentil no effect of mustard on growth and yield of central row since the number of rows of chickpea and lentil in association of mustard was 80 per cent. Therefore 80 per cent yield in expected. But yield of chickpea and lentil in association of mustard was lower than 80 per cent in comparison to 100 per cent. It is clear from the results chickpea + mustard (8:2) row ratios the yield of chickpea was significantly increasing upto with the application of 90 kg P<sub>2</sub>O<sub>5</sub>/ha. But in case of chickpea/ mustard (4:1) row ratios the yield of chickpea was significantly increasing upto with the application of 60 kg P<sub>2</sub>O<sub>5</sub>/ha. In case of lentil + mustard (16:2) row ratios the yield of lentil was significantly increasing upto with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha. But lentil + mustard (8:1) row ratios, the yield of lentil was not significantly increasing upto with the application of 40 kg P<sub>2</sub>O<sub>5</sub>/ha.

#### (c) **Intercropping and phosphorus on economics of chickpea and lentil:**

In case of gross income (Rs/ha) it was observed that the maximum gross income (Rs. 38804/ha) was obtained from the chickpea + mustard in row ratio of 8:2 and minimum recorded (Rs. 27807/ha) in lentil + mustard in row ratio of 8:1. Among the different doses of phosphorus the higher gross income (Rs. 40284/ha) was obtained from 80 kg P<sub>2</sub>O<sub>5</sub>/ha. Followed by with the application of 60 kg P<sub>2</sub>O<sub>5</sub>/ha (Rs. 38953/ha). Minimum gross income (Rs. 19188/ha) without application of application of phosphorus. The minimum gross income (Rs. 19188/ha) without application of phosphorus. The net income (Rs./ha) was obtained from higher (Rs. 21899/ha) in chickpea/ mustard in row ratios of 8:2 and minimum (Rs. 11834/ha) was recorded in lentil + mustard in row ratios of (8:1). Among the phosphorus doses it was observed that higher net income (Rs. 23026/ha) was recorded with application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha followed by with application of 60 kg P<sub>2</sub>O<sub>5</sub>/ha (Rs. 20992/ha) and minimum yield (Rs. 4063/ha) was recorded without application of phosphorus. B:C ratio also influenced by intercropping systems with row ratios and phosphorus doses. The higher B:C ratios (1.31) was recorded in chickpea + mustard in row ratios of 8:2. The minimum (0.75) was recorded when lentil intercropped with mustard in row ratios of 8:1. The doses of phosphorus also interned benefit: cost ratios. The higher B:C was recorded with the application of 80 kg P<sub>2</sub>O<sub>5</sub>/ha (1.36) and minimum B:C ratios (0.26) recorded without application of phosphorus.

Table-3: Pooled as effect of cropping system & phosphorus on yield of Chickpea and Lentil on pooled data.

Treatments	Biological yield (q/ha)	Stover yield (q/ha)	Grain yield (q/ha)
Chickpea + Mustard (8:2)	33.94	16.31	12.98
Chickpea + Mustard (4:1)	32.56	15.01	12.33
Lentil + Mustard (16:2)	30.12	21.73	11.28
Lentil + Mustard (8:1)	29.82	20.53	9.32
SE (d)	0.19	0.19	0.11
C.D at 5%	0.40	0.39	0.24
Phosphorus (Kg/ha)			
0	25.32	13.12	7.63
20	30.53	17.16	10.31
40	32.81	19.35	11.77
60	34.99	20.58	13.52
80	34.39	21.75	14.15
SE (d)	0.37	0.32	0.21
C.D at 5%	0.74	0.64	0.42

Table-4: Pooled as effect of cropping system & phosphorus on economics during 2004-06.

Treatments	Mustard		Gross income (Rs/ha)	Net income (Rs./ha)	Benefit: Cost Ratio
	Seed yield (q/ha)	Stover yield (q/ha)			
Chickpea + Mustard (8:2)	5.68	21.62	38804	21899	1.31
Chickpea + Mustard (4:1)	4.94	20.68	34768	17765	1.05
Lentil + Mustard (16:2)	6.35	22.83	29062	13275	0.85
Lentil + Mustard (8:1)	6.98	25.15	27807	11834	0.78
SE (d)	0.09	0.21	1056	1500	0.08
C.D at 5%	0.19	0.45	2185	3097	0.17
Phosphorus (Kg/ha)					
0	2.42	11.86	19188	4064	0.26
20	5.10	19.56	29149	13578	0.86
40	6.62	25.45	35479	19374	1.20
60	7.61	27.63	38953	20992	1.31
80	8.17	28.33	40284	23026	1.36
SE (d)	0.16	0.3	966	1388	0.09
C.D at 5%	0.32	0.74	1893	2721	0.19

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