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# Productivity of chickpea (*Cicer arietinum* L.)- mustard (*Brassica juncea* L.) intercropping under various fertility levels and row combinations

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and Vinay Kumar Pandey

#### Abstract

A field experiment was carried out on silt loam soil of the Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during winter (*rabi*) season of 2015-16 & 2016-17 to study the productivity of chickpea (*Cicer arietinum* L.)- mustard (*Brassica juncea* L.) intercropping under various fertility levels and row combinations. Growth and yield attributes, grain and straw yields of chickpea and mustard were affected significantly with fertility levels and row combinations. Fertilizer level at 125% RDF recorded higher chickpea yield equivalent and land equivalent ratio over fertilizer level 75% RDF and 100% RDF. Sole crop of chickpea, being statistically at par with chickpea- mustard intercropping row ratio 6:1 and 4:1, resulted highest chickpea yield equivalent over sole crop of mustard, rest of the row combinations. Higher value of land equivalent ratio (LER) was recorded in fertility level 125% RDF and row combination 2:2.

**Keywords:** Chickpea, mustard, fertility management, intercropping and row combinations

#### Introduction

Intercropping is an age-old practice of growing two or more crops simultaneously on the same piece of land. Intercropping has been recognized as a potentially beneficial system of crop production as it utilizes the inter space of widely spaced crop like mustard and chickpea. An intercropping of mustard in chickpea augments the production and provides additional income to the farmers and also efficient use of land and labour, better control of weeds, insect and pathogens as compared to sole crops. In chickpea+ mustard intercropping system, chickpea being legume augments the soil fertility by fixing atmospheric nitrogen, which improves the nitrogen nutrition of the associated crop by direct nitrogen transfer to oilseed or cereal (Giller and Wilson, 1991) [4]. Legume intercropping are also potential sources of plant nutrient that compliment/ supplement to inorganic fertilizers. In addition, legumes are included in cropping system because they reduce soil erosion (Giller and Cadisch, 1995) [5] and suppress weeds (Exner and Cruse, 1993) [3]. Chickpea + mustard intercropping with row ratio of (6:1) and fertilized with 100% RFN + full P & K recorded highest yield and net profit (Tanwar *et al.*, 2011) [9]. Hence, an experiment was planned to study the production potential of chickpea + mustard intercropping at various row combination at varying fertility levels.

#### Materials and Methods

The field experiment was conducted at the Agronomy Research Farm, Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during winter (*rabi*) season of 2015-16 and 2016-17. The experimental site falls under sub-tropical zone in Indo-Gangatic plains and lies between 26°47' North, latitude 82°12' East, longitudes at an altitude of about 113.0 metre from mean sea level. The soil of experimental field was low in available nitrogen (203 & 208 kg/ha) having organic carbon content (0.38% & 0.42%), medium in available phosphorus (12.25 & 13.20 kg/ha) and high in potassium (265.00 & 267 kg/ha) in first and second year, respectively. The reaction of the soil was slightly alkaline (7.8). Twenty four treatment combinations comprised of 3 fertility management (75% RDF, 100% RDF and 125% RDF for both crops) and 8 row combinations of chickpea + mustard (2:1, 4:1, 6:1, 2:2, 4:2 and 6:2) with sole mustard and chickpea were tested in randomized block design with 4 replications. The crop was commonly fertilized with

full dose of phosphorus and potassium, along with half of the nitrogen as basal, while remaining half dose of nitrogen was top-dressed at first irrigation. The crop was irrigated twice at branching and podding stage. In order to check the weed growth, one manual weeding was done at 35 days after sowing. All improved package of practices was adopted to raise for both crops. The crop was harvested at full maturity stage as determined by visual observation on 17<sup>th</sup> February in 2015 and 19<sup>th</sup> February in 2016.

## Results and Discussion

### Effect on Chickpea

#### Effect of fertility Management

The fertility levels and row combinations affected the growth and yield attributing characters of chickpea significantly except, plant population, number of seeds/ plant, and harvest index (Table-1). Increasing fertility levels from 75% RDF to 125% RDF increased the growth and yield attributes significantly, however, the difference between 100% RDF and 125% RDF was at par for plant height, number of branches, dry weight/ plant and number of pods/ plant. Grain and straw yield was increased significantly with increasing the recommended dose of fertilizer from 75% to 125% RDF. The improvement in grain yield due to 75% RDF to 100% RDF was recorded (2.56 q/ha) and 100% RDF to 125% RDF (1.70 q/ha.) Improvement in grain and straw yield with increasing RDF was mainly attributed to significant improvement in yield attributes owing to sufficient supply of available nutrients to crop. Similar, improvement in grain yield with increasing level of fertilizer from 75% to 125% RDF was reported by Abraham *et al.* (2011) [1].

#### Effect of row combinations

The sole planting of chickpea recorded the highest yield (19.02 q/ha), however, the lowest grain yield (10.49 q/ha) was recorded when chickpea + mustard was sown in row combination of 2: 2 (table-1). Increasing number of rows of chickpea from 2 to 6 irrespective of intercrop rows of mustard recorded less reduction in grain yield of chickpea crop. This might be due to lesser competition for light, moisture, space and nutrients with intercrop of mustard. However, 2 rows of mustard with 2, 4 and 6 row of chickpea reduced the grain yield of chickpea more as compared to 1 row of mustard may be due to heavy competition for light, space, moisture and nutrients with 2 row of mustard. The percent reduction in grain yield of chickpea due to intercropping as compared to sole chickpea+ mustard was recorded to the tune of 31.4, 13.2, 12.6, 44.8, 24.5 and 22.3 in chickpea + mustard (2: 1), chickpea + mustard (4: 1), chickpea + mustard (6: 1), chickpea + mustard (2: 2), chickpea + mustard (4: 2) and chickpea + mustard (6: 2), respectively. The maximum reduction in chickpea yield as compared to sole chickpea was recorded with chickpea + mustard (2: 2). This was mainly attributed to heavy competition for light, moisture, space and nutrient by mustard crop. Reduction in grain yield of chickpea with various intercropping system of mustard was mainly attributed to higher competition of light, moisture, nutrients and space resulted in reduction in yield attributes of chickpea and lower grain yield. However, chickpea mustard sown in row ratio of 4: 1 and 6: 1 resulted lower reduction in grain yield i.e. 13.2 and 12.6 % respectively. This is due to lesser competition by mustard for light, space, moisture and nutrient due to minimum shading effect on chickpea and higher

photosynthesis efficiency of chickpea+ mustard in 4: 1 and 6: 1 row combination.

### Chickpea equivalent yield, land equivalent ratio and harvest index

#### Effect of fertility management

The chickpea equivalent yield was increased significantly with increasing fertility levels from 75% to 125% RDF (table-3). Application of 125% RDF recorded significantly the maximum chickpea equivalent yield (19.22 q/ha) followed by 100% RDF (17.23q/ ha) and 75% RDF (13.98 q/ha). The higher chickpea equivalent yield with increasing level of fertility was mainly attributed to higher availability of plant nutrients resulted in positive effect on all yield attributes and yield. Land equivalent ratio (LER) also exhibited the same trend as in case of chickpea equivalent yield with varying fertility levels. However, the maximum LER (1.12) was recorded with 125% RDF followed by 100% and 75% RDF. Similar improvement in chickpea equivalent yield and LER with increasing fertility level was reported by Srivastava *et.al.* (2007). Harvest index of mustard crop did not have any definite trend with fertility levels; however, application of 100% RDF showed the highest values of harvest index (44.7%).

#### Effect of row combinations

Chickpea intercropped with 1 row of mustard recorded significantly higher chickpea equivalent yield as compared to chickpea with 2 row of mustard, irrespective of number of rows of chickpea. Chickpea+ mustard row combination (4: 1) being at par with chickpea+ mustard row combination (6: 1) but recorded significantly highest chickpea yield equivalent (19.0 q/ha) over rest of chickpea+ mustard row combination. The higher chickpea yield equivalent with chickpea + mustard row combination (4: 1) may be attributed to higher chickpea yield with above row combination. Similar results were obtained by Kumar and Nandan (2007). Land Equivalent Ratio (LER) was little bit higher with chickpea+ mustard with 2 row of mustard as compared to chickpea+ mustard with 1 rows of mustard. However, maximum LER was recorded with chickpea + mustard (2: 2) followed by chickpea+ mustard (4: 1). All the cropping system showed similar harvest index, however, sole crop of mustard recorded slightly higher harvest index (44.7%) as compared to different chickpea+ mustard intercropping.

#### Effect on intercrop (mustard)

##### Effect of fertility management

Application of fertility level from 75% RDF to 125% RDF increased the grain and stover yield of mustard significantly (table-2). The maximum seed yield of mustard (7.46 q/ha) was recorded with application of 125% RDF followed by 100% RDF with grain yield of mustard (5.0 q/ha). The improvement in yield of intercrop of mustard with increasing fertility levels was mainly attributed to sufficient supply of plant nutrients as per with crop requirement resulted in higher growth and yield attributes and finally the grain yield of mustard. Similar higher yield of mustard with increasing of fertility level was reported by Tripathi *et al.* (2005 b). Harvest index of intercrop of mustard was affected significantly due to different fertility levels, however, application of 100% RDF recorded significantly higher harvest index (24.11%) over 75% RDF, further increasing fertility levels from 100% RDF to 125% RDF did not improve the harvest index.

**Table 1:** Effect of fertility management and row combinations on growth and yield contributing characters of chickpea (pooled data of 2 years)

Treatments	Plant population (m <sup>-2</sup> ) at harvest	Plant height (cm)	No. of branches plant <sup>-1</sup>	Dry weight/ plant <sup>-1</sup> (g)	No. of pods/ plant	No. of seeds/ plant	100- seed weight (g)	Seed yield (q ha <sup>-1</sup> )	Straw yield (q ha <sup>-1</sup> )	Harvest index (%)
<b>Fertility Management-</b>										
75% RDF	14.3	31.62	10.27	12.82	58.7	1.04	176.66	12.59	15.49	44.6
100% RDF	14.0	32.63	11.28	13.56	63.2	1.07	181.53	15.15	18.78	44.7
125% RDF	13.8	32.94	11.48	13.75	65.7	1.14	183.70	16.86	20.91	44.6
S.Em.+	0.13	0.22	0.20	0.25	0.65	0.045	1.535	0.24	0.58	0.37
C.D.(5%)	NS	0.63	0.57	0.71	1.855	NS	4.39	0.68	1.65	NS
<b>Row Combinations-</b>										
2:1	13.9	32.12	10.79	13.08	61.5	1.07	178.63	13.15	16.32	44.6
4:1	14.1	32.34	11.02	13.37	62.7	1.09	180.48	16.50	20.49	44.6
6:1	14.2	32.66	11.24	13.66	63.6	1.10	183.06	16.70	20.70	44.6
2:2	13.9	31.96	10.56	12.81	61.0	1.06	177.49	10.49	13.04	44.6
4:2	14.1	32.22	10.90	13.22	62.1	1.07	178.63	13.41	16.66	44.6
6:2	14.0	32.53	11.11	13.52	62.8	1.09	181.58	14.77	17.99	44.6
Sole Chickpea	14.3	32.96	11.48	13.96	64.1	1.11	184.54	19.02	23.55	44.7
S.Em.+	0.20	0.34	0.31	0.38	0.99	0.07	2.35	0.37	0.88	0.57
C.D.(5%)	NS	0.97	0.88	1.09	2.84	NS	6.71	1.04	2.52	NS

**Table 2:** Effect of fertility management and row combinations on growth and yield contributing characters of mustard (pooled data of 2 years)

Treatment	Plant population (m <sup>-2</sup> )	Plant height (cm)	No. of branches plant <sup>-1</sup>	No. of siliquae plant <sup>-1</sup>	Length of siliquae (cm)	No. of seeds/ siliquae	Test weight (g)	Oil Content (%)	Seed yield (q ha <sup>-1</sup> )	Stover yield (q ha <sup>-1</sup> )	Harvest index (%)
<b>Fertility Management-</b>											
75% RDF	6.8	147.7	18.1	225.25	5.76	10.5	4.06	39.9	5.01	18.52	23.78
100% DF	6.8	149.8	18.7	244.75	6.12	11.0	4.20	40.0	6.71	24.42	24.11
125% DF	6.8	151.1	19.0	253.65	6.31	11.2	4.26	40.0	7.64	27.76	24.06
S.Em.+	0.2	0.6	0.3	3.45	0.09	0.14	0.06	0.12	0.08	0.20	0.09
C.D.(5%)	NS	1.8	0.8	9.85	0.26	0.39	0.16	NS	0.23	0.56	0.26
<b>Row Combinations-</b>											
2:1	6.6	149.7	18.8	244.50	6.12	11.0	4.22	39.9	5.82	21.48	23.86
4:1	7.0	150.8	18.9	246.25	6.18	11.1	4.27	40.0	3.78	13.86	24.06
6:1	6.8	151.6	19.2	250.00	6.28	11.3	4.31	40.1	2.71	10.08	23.68
2:2	6.6	148.6	18.0	236.25	5.95	10.7	4.09	40.1	8.71	31.60	24.18
4:2	6.9	148.8	18.3	239.40	6.02	10.8	4.12	39.9	5.50	20.50	23.76
6:2	6.7	149.2	18.5	242.10	6.09	10.9	4.16	39.9	4.26	15.66	23.97
Sole us+ -tard	7.1	148.2	17.8	230.00	5.81	10.5	4.03	39.8	14.37	51.76	24.36
S.Em.+	0.2	1.0	0.4	5.27	0.14	0.21	0.09	0.19	0.13	0.30	0.14
C.D.(5%)	NS	2.8	1.1	15.06	0.40	0.59	0.24	NS	0.35	0.86	0.39

**Table 3:** Effect of fertility management and row combinations on yield of chickpea, mustard, chickpea yield equivalent and land equivalent ratio (pooled data of 2 years)

Treatments	Seed yield of chickpea (q ha <sup>-1</sup> )	Seed yield of mustard (q ha <sup>-1</sup> )	Chickpea yield equivalent (q ha <sup>-1</sup> )	Land equivalent ratio
<b>Fertility Management-</b>				
75% RDF	12.59	5.01	13.98	1.07
100% RDF	15.15	6.71	17.23	1.10
125% RDF	16.86	7.64	19.22	1.12
S.Em.+	0.24	0.08	0.21	-
C.D.(5%)	0.68	0.23	0.60	-
<b>Row Combinations-</b>				
2:1	13.15	5.82	17.08	1.11
4:1	16.50	3.78	19.07	1.16
6:1	16.70	2.71	18.55	1.10
2:2	10.49	8.71	16.34	1.19
4:2	13.41	5.50	17.13	1.11
6:2	14.77	4.26	17.66	1.10
Sole mustard	0	14.37	9.62	0.96
Sole chickpea	19.02	0	19.02	1.05
S.Em.+	0.37	0.13	0.34	-
C.D.(5%)	1.04	0.35	0.97	-

**Effect of row combinations**

Seed and stover yields of mustard was increased significantly with increasing numbers of rows of intercrop of chickpea from 1 row to 2 rows, irrespective row combination of

chickpea+ mustard affected harvest index significantly. Increasing number of rows of intercrop (mustard) from 1 to 2 rows increased harvest index. Chickpea+ mustard either 4: 1 or 4: 2 row ratio recorded higher harvest index of mustard as

compared to rest of the row combination. Similar higher harvest index with chickpea+ mustard intercropping with 4:1 or 4:2 row combinations was recorded by Kumar and Singh (2006) [5].

The values of growth and yield attributes was higher with intercropping system of chickpea+ mustard with 1 row arrangement as compared to 2 rows of mustard with chickpea. However, higher values of growth and yield attributes of mustard in 1 row arrangement was failed to compensate the yield as compared to higher plant population of mustard in chickpea+ mustard intercropping system with 2 rows combination. Hence, chickpea + mustard cropping system with 2 rows combination produced significantly higher seed and stover yields. Similar higher yield of mustard with chickpea+ mustard in 2 row combination was reported by Ahlawat *et al.* (2005b) [6].

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