



Productivity of Chickpea (*Cicer arietinum*. L.) and Mustard (*Brassica juncea*) Intercropping System as Influenced by Different Row Ratios and Liquid Manures

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Authors' contributions

This work was carried out in collaboration among all authors. Author DT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author VS managed the analyses of the study. Author MSCK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during two consecutive *rabi* seasons of 2018-2019 and 2019-2020 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The present experiment comprising with five intercropping systems viz. sole chickpea, sole mustard, chickpea + mustard (1:1), chickpea + mustard (2:1), chickpea + mustard (3:1) row ratios in replacement series and four liquid manures viz. control (no spray), panchagavya 3%, cow urine 10% and vermiwash 10%. Results revealed that among the row arrangements maximum plant height and dry weight of both crop (Chickpea and mustard) were recorded under chickpea + mustard 3:1 row ratio. However sole stand of both crop produced maximum yield attributes and yield. Whereas among the liquid manures foliar application of panchagavya 3% found to be superior over rest of the liquid manures.

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1. INTRODUCTION

Chickpea and mustard are major rabi pulse and oilseed crops having seasonal, rhizospheric and micro-climate compatibility and therefore chickpea + mustard is a prominent intercropping system in Indian sub-continent. Growing of mustard as an intercrop in chickpea is a common practice in India. Chickpea is an important pulse crop of India, while Indian mustard is well established and popular among oilseeds. Area of chickpea has increased from 7.57 million hectare in 1950-51 to 9.44 million hectare in 2018-19. While, production of chickpea increased from 3.65 million tonnes to 10.13 million tonnes during 2018-19 and production of chickpea crop in Uttar Pradesh was 0.73 million tonnes from 0.57 million hectare. And also area of mustard has increased from 2.07 million hectare in 1950-51 to 6.23 million hectare in 2018-19. Whereas, mustard production was increased from 0.76 million tonnes to 9.34 million tonnes during 2018-2019 and its production in Uttar Pradesh was 1.12 million tonnes from 0.75 million hectare [1].

Chickpea is traditionally grown as a mixed crop with several crops like mustard, linseed, barley etc. without taking into consideration of spatial row arrangement Ramarao and Chandranath [2]. Consequently, crop suffers to a great extent and hence yields are reduced. Spatial arrangements in intercropping have important effect on the balance of competition between the component crops and their productivity [3]. Mustard is taller plant with broader crop canopy shows the greater competing ability than chickpea accommodating more rows of mustard in between the chickpea cause shading effect which affect the photosynthesis ultimately hamper growth and yield of chickpea [4]. Foliar fertilization is a simple and effective method of providing nutrients to crops. Foliar application will be more efficient than soil application at the late growth stage when there is preferential assimilates translocation into seeds/fruits and root activity for nutrient uptake is limited [5]. However liquid manures meet the nutrient requirement of crops during standing condition with greater nutrient use efficiency [6]. Keeping the above points in view, the present experiment was done at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh).

2. MATERIALS AND METHODS

A field trial was laid out during winter season of 2018-2019 and 2019-2020 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). Experimental treatments consisted of five intercropping systems viz. sole chickpea (I_1), sole mustard (I_2), chickpea + mustard (1:1) (I_3), chickpea + mustard (2:1) (I_4) and chickpea + mustard (3:1) (I_5) row ratios in replacement series and four liquid manures viz. control (no spray) (L_1), panchagavya 3% (L_2), cow urine 10% (L_3) and vermiwash 10% (L_4). Sole cropping of chickpea and mustard were included for comparison. Thus, 20 treatment combinations were tested in split plot design which were replicated thrice in which intercropping system were kept in main plot and liquid manures in sub-plots. The soil of experimental plot was sandy loam in texture having soil pH (7.7 and 7.2), low organic carbon (0.46 and 0.47%) and nitrogen (118 and 120 kg/ha), medium phosphorus (26.5 and 28 kg/ha) and high in potassium (312 and 316 kg/ha) during two consecutive years, respectively. The gross plot size was 4 m × 4 m. The seed rate of chickpea is 80 kg/ha and for mustard is 6 kg/ha were considered. The crop was shown on 05/11/2018 and 05/11/2019 with using Pusa-362 and Varuna variety for chickpea and mustard, respectively. A common spacing of 45 cm × 10 cm was adopted for all intercrops and sole crops with respective recommended spacing. The recommended dose of fertilizer for chickpea is 20 kg N, 40 kg P_2O_5 and 20 kg K_2O and for mustard 80 kg N, 40 kg P_2O_5 and 40 kg K_2O per hectare were applied through urea, single super phosphate and muriate of potash in sole crop only. In intercropping combinations, seed rate and fertilizers were adjusted according to number of row arrangement. Foliar application of liquid manures was applied at branching and flowering stage on both crop. The crop wise harvesting was done at maturity. The analysis was done as individual crop basis by using excel analysis software.

3. RESULTS AND DISCUSSION

3.1 Chickpea Growth Attributes

The data pertaining to plant height and dry weight of chickpea among intercropping systems

and liquid manures at 125 DAS were depicted in Table 1.

3.2 Intercropping Systems and Liquid Manures

Intercropping system with different row ratios showed no significant difference among treatments. However, plant height and dry weight of chickpea was recorded maximum under chickpea + mustard (3:1) row ratio during (72.45, 73.53 and 72.99 cm), and (23.48, 23.70 and 23.59 g/plant) during first, second and in pooled analysis, respectively. However, in case of liquid manures significant difference were noticed among the treatments. Foliar application of panchagavya 3% performed significantly higher plant height (80.30, 81.22 and 80.76 cm) and dry weight (26.27, 26.24 and 26.26 g/plant), followed by foliar application of vermiwash 10% during both the years of experimentation and in pooled analysis. The data regarding interaction of plant height and dry weight of chickpea are given in (Table 2). No significant interaction effects were observed between the intercropping systems and liquid manures. However, treatment combination of I₅L₂ was found to be highest in plant height (81.67, 81.93 and 81.80 cm) and also in dry weight (26.94, 27.32 and 27.13 g/plant) in all respective years and in pooled analysis, respectively.

Increase in growth attributes due to the presence of macro and micro nutrients in panchagavya also, different microflora aid in increased plant height. Presence of naturally occurring beneficial microorganisms predominantly yeast, actinomycetes, bacteria, photosynthetic bacteria and some fungi were detected in organic liquid manures. Similar results of findings were also reported by Rakesh et al. [7] and Chaudhary et al. [8].

3.3 Mustard Growth Attributes

The data pertaining to plant height and dry weight of mustard among intercropping systems and liquid manures at 100 DAS were presented in Table 3.

3.4 Intercropping Systems and Liquid Manures

Among the intercropping system non significant difference were noticed in relation to plant height and dry weight mustard. However maximum plant height (172.05, 173.23 and 172.64 cm) and dry weight (30.96, 31.73 and 31.34 g/plant) of

mustard was noticed under chickpea + mustard (3:1) row ratio during two consecutive years and pooled data, respectively. Whereas among the liquid manures significant difference were recorded in different treatments. However foliar application of panchagavya 3% noticed significantly higher plant height (178.84, 180.21 and 179.52 cm) and dry weight (33.43, 34.83 and 34.13 g/plant) which were statistically at par with foliar application of vermiwash 10% during both the years of investigation and in pooled analysis. However, the data regarding interaction of plant height and dry weight are given in Table 4. Among interaction, no significant difference was observed between intercropping and liquid manures. However, treatments combinations of I₅L₂ was found to be maximum in plant height (181.97, 183.30 and 182.63 cm) and dry weight (35.23, 35.32 and 35.28 g/plant) during first year, second year and in pooled analysis, respectively. This might be due to increased supply of plant nutrients, specific weight of leaf chlorophyll synthesis, nitrogen metabolism and phytohormones with the application of panchagavya. Apart from nutrient supply, panchagavya is a proven to the presence of biofertilizer and microorganisms like *azospirillum*, *azotobacter*, *phosphobacter*, *pseudomonas* play an important role in stimulation of plant growth by secreting IAA and GA₃. Similar findings are under the conformation of Patel et al. [9].

3.5 Yield Attributes of Chickpea

3.5.1 Number of pods/plant

3.5.1.1 Intercropping system and liquid manures

Table 5. showed that number of pods/plant of chickpea not influenced significantly due to different row ratio of intercropping system. However maximum (40.75, 42.25 and 41.50/plant) were produced by sole stand of chickpea during all experimental years. However, statistically analysed data of number of pods/plant of chickpea showed significant variation among different liquid manures. Significantly maximum pods (45.25, 48.17 and 46.71/plant) was recorded under foliar application of panchagavya 3% which were statistically at par with foliar application of vermiwash 10% during all experimental years except in pooled data. Whereas interaction data shows that non-significant difference (Table 6) among different treatment combinations. However Highest number (50.33, 52.67 and 51.50) of pods/plant was recorded under I₁L₂.

More of number of pods/plant could be due to the amount of IAA and GA₃ present in panchagavya which must have created a stimuli in the plant system and increased the production of plant growth regulators in cell system encouraging the necessary growth of crop as reported by Patel et al. [9].

3.6 Yield Attributes of Mustard

3.6.1 Number of siliquae/plant

Among the different row ratio, number of siliquae per plant of mustard were significantly influenced. Significantly maximum (Table 5). (284.17, 296.83 and 290.50/plant) were recorded under sole stand of mustard which were statistically at par with chickpea + mustard (3:1) row ratio during all experimental years except first year. In case of liquid manures, number of siliquae per plant were influenced significantly with different liquid manures. However maximum number (307.00, 319.58 and 313.29) of siliquae per plant were recorded through foliar application of panchagavya 3% which was found statistically at par with foliar application of vermiwash 10% during first year, whereas during second year and in pooled data. None of the treatments were found at par value. In case Interaction effects of intercropping systems and liquid manures on number of siliquae per plant were found non-significant difference. Maximum (315.33 and 321.00/plant) number of siliquae per plant (Table 6) was observed in I₂L₂ treatment combination in first year and in pooled data but I₅L₂ treatment combination noticed maximum number of siliquae per plant (329.67/plant) in second year. Higher yield attributing characters could be a consequence of increased rate of photosynthesis coupled with efficient translocation of photosynthetic end products from source to sink which could be result in increased number of branches/plant which might result in the development of more number of reproductive parts and thereby increasing the sink size to obtained higher seed yield. Similar findings were reported by Sajjan and Sharif (2017).

3.6.2 Biological yield of chickpea

Among the intercropping system, biological yield of chickpea were significantly influenced due to different row ratios of intercropping system. Significantly highest (5284.92, 5428.58 and 5356.75 kg/ha) biological yield were recorded

under sole stand of chickpea and no one other treatments found at par value during all experimental years. Whereas, biological yield of chickpea were influenced significantly due to foliar application of different liquid manures. Significantly maximum (5031.61, 5093.48 and 5062.55 kg/ha) biological yield were recorded under foliar application of panchagavya 3% which were at par with foliar application of vermiwash 10% during all respective years. Interaction data of biological yield have shown non-significant variation among different treatment combinations. However maximum (6367.67, 6411.00, 6389.3 kg/ha) biological yield was observed under treatment combination of I₁L₂. This might be due to higher plant population under sole cropping and absence of competition from component crop and limited disturbance of habitat under the findings of Kaparwan et al. [10] and Ramrao et al. [11]

3.7 Biological Yield of Mustard

3.7.1 Intercropping system and liquid manures of mustard

Analysed data of intercropping system shows that significant difference were noticed among different treatment. However, significantly maximum (6302.41, 6349.33 and 6325.87 kg/ha) biological weight of mustard were recorded under sole stand of mustard and none of the treatments recorded at par value during all consecutive years (Table 7). Among the liquid manures also significant difference were observed under different treatments. However, foliar application of panchagavya 3% recorded maximum biological yield of mustard (3875.64, 3866.92 and 3871.28 kg/ha) which were followed by foliar application of vermiwash 10% during all consecutive years. Among the interaction effect of intercropping systems and liquid manures also, significant difference were noticed. Significantly maximum biological yield (6482.13, 6488.67 and 6485.40 kg/ha) was observed in I₂L₂ (Table 8) which was statistically at par with treatment combination of I₂L₄ in first, second year, however in pooled data no one treatments recorded at par value. In the present experiment, biological yield of mustard were highest in their respective sole crop as compare to their intercropping, it was obvious due to more number of plant population in sole than intercropping system. The result of this investigation also get supported from Singh et al. [12]

Table 1. Effect of intercropping systems and liquid manures on plant height and dry weight of chickpea

Treatments	Chickpea at 125 DAS					
	Plant height (cm)			Dry weight (g/plant)		
	2018	2019	Pooled	2018	2019	Pooled
Intercropping systems (Row ratio)						
Sole chickpea	69.73	71.85	70.79	22.39	22.39	22.39
Sole mustard	-	-	-	-	-	-
Chickpea + mustard (1:1)	70.40	72.18	71.29	22.76	22.82	22.69
Chickpea + mustard (2:1)	70.87	72.63	71.75	23.03	23.20	23.11
Chickpea + mustard (3:1)	72.45	73.53	72.99	23.48	23.70	23.59
F-test	NS	NS	NS	NS	NS	NS
SEm±	1.54	1.34	1.04	0.79	1.10	0.82
CD (P=0.05)	-	-	-	-	-	-
Liquid manures						
Control	62.20	63.78	62.99	20.19	20.38	20.28
Panchagavya 3%	80.30	81.22	80.76	26.27	26.24	26.26
Cow urine 10%	64.30	66.00	65.15	21.37	21.64	21.50
Vermiwash 10%	76.65	79.20	77.93	23.83	23.86	23.85
F-test	S	S	S	S	S	S
SEm±	1.54	1.52	1.01	0.96	0.98	0.84
CD (P=0.05)	4.49	4.45	2.94	2.81	2.86	2.44

Table 2. Effect of interaction on plant height and dry weight of chickpea

Intercrops × Liquid manures	Chickpea at 125 DAS					
	Plant height (cm)			Dry weight (g/plant)		
	2018	2019	Mean	2018	2019	Mean
I ₁ L ₁	61.00	63.40	62.20	19.49	19.74	19.62
I ₁ L ₂	79.53	80.60	80.07	25.65	25.57	25.61
I ₁ L ₃	63.47	65.33	64.40	21.01	20.83	20.92
I ₁ L ₄	74.93	78.07	76.50	23.39	23.42	23.41
I ₂ L ₁	-	-	-	-	-	-
I ₂ L ₂	-	-	-	-	-	-
I ₂ L ₃	-	-	-	-	-	-
I ₂ L ₄	-	-	-	-	-	-
I ₃ L ₁	62.13	63.67	62.90	20.37	20.44	20.40
I ₃ L ₂	79.73	81.07	80.40	26.04	25.78	25.91
I ₃ L ₃	64.27	65.87	65.07	21.12	21.45	21.28
I ₃ L ₄	75.47	78.13	76.80	23.53	23.63	23.58
I ₄ L ₁	62.60	63.87	63.23	20.50	20.57	20.54
I ₄ L ₂	80.27	81.27	80.77	26.44	26.30	26.37
I ₄ L ₃	64.33	66.13	65.23	21.16	21.75	21.46
I ₄ L ₄	76.27	79.27	77.77	24.01	24.18	24.09
I ₅ L ₁	63.07	64.20	63.63	20.39	20.76	20.58
I ₅ L ₂	81.67	81.93	81.80	26.94	27.32	27.13
I ₅ L ₃	65.13	66.67	65.90	22.18	22.51	22.34
I ₅ L ₄	79.93	81.33	80.63	24.40	24.22	24.31
F-test	NS	NS	NS	NS	NS	NS
SEm±	3.08	3.05	2.01	1.92	1.96	1.68
CD (P=0.05)	-	-	-	-	-	-

Table 3. Effect of intercropping systems and liquid manures on plant height and dry weight of mustard

Treatments	Mustard at 100 DAS					
	Plant height (cm)			Dry weight (g/plant)		
	2018	2019	Pooled	2018	2019	Pooled
Intercropping systems (Row ratio)						
Sole chickpea	-	-	-	-	-	-
Sole mustard	166.47	168.53	167.50	28.92	29.69	29.30
Chickpea + mustard (1:1)	168.46	170.38	169.42	29.37	30.09	29.73
Chickpea + mustard (2:1)	169.24	171.16	170.20	30.31	31.07	30.69
Chickpea + mustard (3:1)	172.05	173.23	172.64	30.96	31.73	31.34
F-test	NS	NS	NS	NS	NS	NS
SEm±	1.98	1.40	1.14	1.28	2.13	1.36
CD (P=0.05)	-	-	-	-	-	-
Liquid manures						
Control	157.06	160.6	158.83	26.13	26.31	26.22
Panchagavya 3%	178.84	180.21	179.52	33.43	34.83	34.13
Cow urine 10%	165.89	166.78	166.33	29.26	29.28	29.27
Vermiwash 10%	174.44	175.73	175.08	30.74	32.15	31.44
F-test	S	S	S	S	S	S
SEm±	2.09	1.93	1.56	1.32	1.26	0.99
CD (P=0.05)	6.11	5.63	4.56	3.85	3.68	2.88

Table 4. Effect of interaction on plant height and dry weight of mustard

Intercrops × Liquid manures	Mustard at 100 DAS					
	Plant height (cm)			Dry weight (g/plant)		
	2018	2019	Mean	2018	2019	Mean
l ₁ L ₁	-	-	-	-	-	-
l ₁ L ₂	-	-	-	-	-	-
l ₁ L ₃	-	-	-	-	-	-
l ₁ L ₄	-	-	-	-	-	-
l ₂ L ₁	155.30	160.00	157.65	25.01	25.47	25.24
l ₂ L ₂	176.67	178.07	177.37	31.70	34.28	32.99
l ₂ L ₃	163.27	164.00	163.63	28.88	28.43	28.66
l ₂ L ₄	170.66	172.07	171.36	30.09	30.55	30.32
l ₃ L ₁	155.40	160.27	157.83	25.64	25.69	25.67
l ₃ L ₂	178.06	179.37	178.71	32.53	34.61	33.57
l ₃ L ₃	164.74	165.60	165.17	28.84	28.63	28.73
l ₃ L ₄	175.63	176.30	175.97	30.47	31.42	30.95
l ₄ L ₁	156.83	160.40	158.62	25.81	26.30	26.05
l ₄ L ₂	178.67	180.10	179.38	34.27	35.12	34.69
l ₄ L ₃	166.61	167.40	167.00	29.70	29.96	29.83
l ₄ L ₄	174.87	176.73	175.80	31.48	32.92	32.20
l ₅ L ₁	160.70	161.73	161.22	28.07	27.78	27.92
l ₅ L ₂	181.97	183.30	182.63	35.23	35.32	35.28
l ₅ L ₃	168.94	170.10	169.52	29.63	30.08	29.86
l ₅ L ₄	176.60	177.80	177.20	30.91	33.72	32.32
F-test	NS	NS	NS	NS	NS	NS
SEm±	4.18	3.85	3.12	2.64	2.52	1.97
CD (P=0.05)	-	-	-	-	-	-

Table 5. Effect of intercropping systems and liquid manures on number of pods per plant of chickpea and number of siliquae per plant of mustard

Treatments	Chickpea			Mustard		
	Number of pods/plant			Number of siliquae/plant		
	2018	2019	Pooled	2018	2019	Pooled
Intercropping systems (Row ratio)						
Sole chickpea	40.75	42.25	41.50	-	-	-
Sole mustard	-	-	-	284.17	296.83	290.50
Chickpea + mustard (1:1)	37.17	38.00	37.58	261.67	274.83	268.25
Chickpea + mustard (2:1)	37.83	39.58	38.71	272.50	281.00	276.75
Chickpea + mustard (3:1)	38.67	40.91	39.79	279.92	292.25	286.08
F-test	NS	NS	NS	NS	S	S
SEm±	1.55	2.70	1.81	6.11	4.42	3.11
CD (P=0.05)	-	-	-	-	15.33	10.76
Liquid manures						
Control	31.58	33.33	32.46	235.50	248.33	241.92
Panchagavya 3%	45.25	48.17	46.71	307.00	319.58	313.29
Cow urine 10%	36.83	38.00	37.42	258.33	269.75	264.04
Vermiwash 10%	40.75	41.25	41.00	297.42	307.25	302.33
F-test	S	S	S	S	S	S
SEm±	1.97	2.63	1.77	6.15	4.21	3.40
CD (P=0.05)	5.76	7.69	5.16	17.94	12.29	9.92

Table 6. Effect of interaction on number of pods per plant of chickpea and number of siliquae per plant of mustard

Intercrops × Liquid manures	Chickpea			Mustard		
	Number of pods/plant			Number of siliquae/plant		
	2018	2019	Mean	2018	2019	Mean
l ₁ L ₁	33.33	35.00	34.17	-	-	-
l ₁ L ₂	50.33	52.67	51.50	-	-	-
l ₁ L ₃	38.00	39.33	38.67	-	-	-
l ₁ L ₄	41.33	42.00	41.67	-	-	-
l ₂ L ₁	-	-	-	243.00	257.33	250.17
l ₂ L ₂	-	-	-	315.33	326.67	321.00
l ₂ L ₃	-	-	-	272.33	283.00	277.67
l ₂ L ₄	-	-	-	306.00	320.33	313.17
l ₃ L ₁	29.33	30.67	30.00	221.67	238.00	229.83
l ₃ L ₂	41.67	44.00	42.83	294.00	308.33	301.17
l ₃ L ₃	35.67	37.00	36.33	246.00	259.67	252.83
l ₃ L ₄	42.00	40.33	41.17	285.00	293.33	289.17
l ₄ L ₁	31.67	33.00	32.33	235.67	249.00	242.33
l ₄ L ₂	43.67	46.67	45.17	307.00	313.67	310.33
l ₄ L ₃	36.67	37.67	37.17	249.67	260.00	254.83
l ₄ L ₄	39.33	41.00	40.17	297.67	301.33	299.50
l ₅ L ₁	32.00	34.67	33.33	241.67	249.00	245.33
l ₅ L ₂	45.33	49.33	47.33	311.67	329.67	320.67
l ₅ L ₃	37.00	38.00	37.50	265.33	276.33	270.83
l ₅ L ₄	40.33	41.67	41.00	301.00	314.00	307.50
F-test	NS	NS	NS	NS	NS	NS
SEm±	3.95	5.26	3.53	12.29	8.42	6.80
CD (P=0.05)	-	-	-	-	-	-

Table 7. Effect of intercropping systems and liquid manures on biological yield of chickpea and mustard

Treatments	Chickpea			Mustard		
	Biological yield (kg/ha)					
	2018	2019	Pooled	2018	2019	Pooled
Intercropping systems (Row ratio)						
Sole chickpea	5284.92	5428.58	5356.75	-	-	-
Sole mustard	-	-	-	6302.41	6349.33	6325.87
Chickpea + mustard (1:1)	3254.13	3084.67	3169.40	3628.77	3655.96	3642.36
Chickpea + mustard (2:1)	4178.39	4261.00	4219.69	2804.79	2812.03	2808.41
Chickpea + mustard (3:1)	4729.56	4828.35	4778.96	2358.36	2377.35	2367.86
F-test	S	S	S	S	S	S
SEm±	87.64	55.45	57.07	2.63	4.94	2.84
CD (P=0.05)	303.65	192.13	197.75	9.13	17.12	9.84
Liquid manures						
Control	3512.32	3558.26	3535.29	3630.37	3705.35	3667.86
Panchagavya 3%	5031.61	5093.48	5062.55	3875.64	3866.92	3871.28
Cow urine 10%	4132.28	4144.02	4138.15	3720.68	3759.65	3740.16
Vermiwash 10%	4770.78	4806.85	4788.81	3867.64	3862.75	3865.19
F-test	S	S	S	S	S	S
SEm±	163.94	117.98	124.49	9.50	9.07	7.20
CD (P=0.05)	478.53	344.38	363.39	27.73	26.46	21.02

Table 8. Effect of interaction on biological yield of chickpea and mustard

Intercrops × Liquid manures	Chickpea			Mustard		
	Biological yield (kg/ha)					
	2018	2019	Pooled	2018	2019	Pooled
l ₁ L ₁	4110.00	4255.0	4182.5	-	-	-
l ₁ L ₂	6367.67	6411.0	6389.3	-	-	-
l ₁ L ₃	5066.33	5109.3	5087.8	-	-	-
l ₁ L ₄	5595.67	5939.0	5767.3	-	-	-
l ₂ L ₁	-	-	-	6056.81	6231.67	6144.24
l ₂ L ₂	-	-	-	6482.13	6488.67	6485.40
l ₂ L ₃	-	-	-	6233.95	6236.33	6235.14
l ₂ L ₄	-	-	-	6436.76	6440.67	6438.71
l ₃ L ₁	2683.67	2631.5	2657.6	3437.37	3561.17	3499.27
l ₃ L ₂	3200.50	3315.0	3257.8	3776.80	3758	3767.40
l ₃ L ₃	3091.50	3004.5	3048.0	3563.54	3564.83	3564.19
l ₃ L ₄	4040.83	3387.7	3714.3	3737.37	3739.83	3738.60
l ₄ L ₁	3377.11	3423.8	3400.4	2720.82	2721.67	2721.25
l ₄ L ₂	4963.78	5008.7	4986.2	2846.93	2847.11	2847.02
l ₄ L ₃	3899.56	3946.0	3922.8	2758.58	2786.33	2772.46
l ₄ L ₄	4473.11	4665.6	4569.3	2892.83	2893.00	2892.92
l ₅ L ₁	3878.50	3922.8	3900.6	2306.49	2306.92	2306.71
l ₅ L ₂	5594.50	5639.3	5616.9	2396.70	2373.92	2385.31
l ₅ L ₃	4471.75	4516.3	4494.0	2326.64	2451.08	2388.86
l ₅ L ₄	4973.50	5235.2	5104.3	2403.60	2377.5	2390.55
F-test	NS	NS	NS	S	S	S
SEm±	327.88	235.96	248.99	19.00	18.13	14.40
CD (P=0.05)	-	-	-	55.46	52.92	42.04

4. CONCLUSION

Based on the two years of research study, it is concluded that chickpea sown with 3:1 row ratio along with foliar application of panchagavya 3% was found to be beneficial in respect to growth and yield of both chickpea and mustard crops.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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