

## Plant density and row arrangement of lentil (*Lens culinaris*) and mustard (*Brassica juncea*) intercropping for higher productivity under Bihar plateau

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### ABSTRACT

A 3-year field experiment was conducted during winter season of 1995–98 to find out the suitable plant density and row arrangement of lentil (*Lens culinaris* Medikus) + mustard [*Brassica juncea* (L.) Czernj. & Cosson] intercropping for higher productivity. Treatments consisted of 9 combinations of lentil + mustard intercropping along with their respective sole cropping. Six intercrop systems were in additive series with 100% lentil + 25 and 50% mustard each in 3 row ratios (2:1, 3:1 and 5:1) and the remaining 3 in replacement series where 33, 25 and 17% lentil was replaced by mustard in the corresponding row ratios of 2:1, 3:1 and 5:1. Grain yield of intercropped lentil and mustard decreased irrespective of their plant density and row arrangement, except the grain yield of lentil under 100% lentil + 25% mustard and 83% lentil + 17% mustard both in 5:1 row ratio. Reduction of lentil yield was more than that of mustard yield with respect to the corresponding plant density, and the extent of reduction in intercrop lentil yield was more in additive (32.5%) than in replacement (29.3%) series, whereas the reverse was true for mustard. Intercropping of 100% lentil + 25% mustard in 5:1 row ratio produced as high intercrop lentil yield (1,120 kg/ha) as sole lentil (1,250 kg/ha) with a bonus yield of mustard (700 kg/ha) and had maximum lentil-equivalent yield (1,850 kg/ha), net return (Rs 19,824/ha), land-equivalent ratio (1.54), monetary advantage (Rs 8,738/ha) and net benefit : cost ratio (3.89).

**Key words :** Intercropping, Lentil mustard, Plant density, Row arrangement, Productivity

Production of pulses and oilseeds needs to be enhanced to meet the national shortfall, as availability of pulses and edible oil in India is about 42 and 20 g/day/head against the balanced nutritional requirement of 80 and 30 g/day/head respectively (Rajagopalan, 1996). Lentil (*Lens culinaris* Medikus) and mustard [*Brassica juncea* (L.) Czernj. & Cosson] are grown in Bihar plateau as sole or mixed crops in a haphazard manner, producing low yield. Intercropping is more advantageous than sole crop-

ping of both pulses and oilseeds (Thakur *et al.*, 1995). Plant density and spatial arrangement are the two important facets of agronomic management, which need to be worked out for minimizing the competition and maximizing the yield advantages of intercropping system. Hence the present investigation was undertaken to find out the suitable plant density and row arrangement of lentil + mustard intercropping system for higher productivity.

### MATERIALS AND METHODS

A field experiment was conducted at the university farm, Ranchi during winter season of 1995–98 in randomized block design, replicated 3 times. The treatments consisted of 9 combinations of lentil + mustard intercropping along with their respective sole cropping. Six intercrop systems were in additive series with 100% lentil +25 and 50% mustard each grown in 3

row ratios (2 : 1, 3 : 1 and 5 : 1), whereas the remaining 3 systems were in replacement series, where 33, 25 and 17% lentil was replaced by mustard in the corresponding row ratios of 2 : 1, 3 : 1 and 5 : 1. The soil was sandy loam (16.4% silt and 15.2% clay), acidic in reaction (pH 5.1), low in available N (213 kg/ha), and medium in available P (16 kg/ha) and K (149 kg/ha) with available water-holding capacity 150 mm/m soil depth.

'PL 406' lentil and 'Varuna' mustard were sown 30 cm apart during the first week of November in all the 3 years of experimentation, using 30 and 7 kg seed/ha respectively for sole cropping, whereas in intercropping the population of the component crops was maintained by adjusting the seed rate as per treatment. Sole lentil received 20 kg N + 40 kg P<sub>2</sub>O<sub>5</sub>/ha, and sole mustard received 60 kg N + 30 kg P<sub>2</sub>O<sub>5</sub> + 20 kg K<sub>2</sub>O/ha. In intercropping

**Table 1.** Grain yield, lentil-equivalent yield, land-equivalent ratio, net return, monetary advantage and benefit : cost ratio of lentil + mustard intercropping under different plant densities and row arrangements (3-year mean data)

Treatment		Row ratio	Grain yield (kg/ha)		Lentil-equivalent yield (kg/ha)	Land-equivalent ratio	Net return (Rs/ha)	Monetary Benefit : advantage (Rs/ha)	cost ratio
Lentil (%)	Mustard (%)		Lentil	Mustard					
100	25	2 : 1	860	600	1,480	1.24	14,914	3,873	2.93
100	50	2 : 1	650	720	1,400	1.17	13,391	2,740	2.45
100	25	3 : 1	750	460	1,230	1.02	11,469	325	2.25
100	50	3 : 1	680	780	1,490	1.25	14,638	4,020	2.68
100	25	5 : 1	1,120	700	1,850	1.54	19,824	8,738	3.89
100	50	5 : 1	1,000	680	1,700	1.42	17,558	6,809	3.21
67	33	2 : 1	700	620	1,340	1.12	13,338	1,943	2.78
75	25	3 : 1	850	450	1,320	1.09	13,003	1,468	2.72
83	17	5 : 1	1,100	350	1,460	1.20	14,989	3,292	3.15
Soil lentil			1,250		1,250		12,234		2.63
Soil mustard			1,100		1,140		10,477		2.13
CD (P = 0.05)			168	120	210		2,502	489	0.53

the component crops received fertilizer proportionate to plant density. The crop received 186.9, 35.8 and 297.6 mm rainfall in 16, 5 and 25 rainy days during the first, second and third years of experimentation respectively. To find out the suitable plant density and row arrangement of lentil + mustard intercropping, lentil-equivalent yield, land equivalent ratio, net return, monetary advantage and benefit : cost ratio were calculated.

## RESULTS AND DISCUSSION

### Productivity

Grain yield of intercrops lentil and mustard decreased significantly compared with their respective sole crop irrespective of their plant density and row arrangement except intercrop lentil yield under 100% lentil + 25% mustard and 83% lentil + 17% mustard both in 5 : 1 row ratio (1,120 and 1,100 kg/ha respectively). However, reduction in lentil yield was more than of

mustard yield with respect to their corresponding plant densities (Table 1). Further, the extent of reduction in intercrop lentil yield was more in additive (32.5%) than in replacement (29.3%) series due to competition for growth resources. Contrarily, the reduction in intercrop mustard yield was more in replacement (57%) than in additive (40.3%) series owing to differential population density of mustard crop in the system. Grain yield of intercrop lentil decreased more in narrow row than in wider row ratio owing to more shading effect of mustard, leading to lower grains/pod and 1,000-grain weight (Table 2) of lentil under narrow row spacing. This confirms the findings of Tiwari *et al.* (1992). The increased plant density of mustard component from 25 to 50% induced more competition for growth resources, which consequently reduced the yield attributes and yield of both lentil and mustard crops (Table 3).

**Table 2.** Yield components of lentil in lentil + mustard intercropping under different plant densities and row arrangements (3-year mean data)

Treatment Plant density (%)		Row ratio	Primary branches/ plant	Secondary branches/ plant	Pods/ plant	Grains/ pod	1,000- grain weight (g)
Lentil	Mustard						
100	25	2 : 1	3.26	6.80	41.33	1.78	17.68
100	50	2 : 1	3.13	6.73	37.26	1.78	17.45
100	25	3 : 1	3.33	7.20	42.60	1.73	18.40
100	50	3 : 1	2.93	6.46	36.46	1.76	18.15
100	25	5 : 1	3.26	6.93	39.46	1.83	18.96
100	50	5 : 1	2.80	6.06	36.26	1.81	18.37
67	33	2 : 1	3.46	8.00	46.46	1.85	19.14
75	25	3 : 1	3.66	8.20	48.40	1.88	19.18
83	17	5 : 1	3.80	8.60	51.26	1.88	18.55
Sole lentil			3.53	8.40	45.40	1.90	19.18
CD (P = 0.05)			0.56	1.33	6.07	0.08	1.05

**Table 3.** Yield components of mustared in lentil + mustard intercropping under different plant densities and row arrangements (3-year mean data)

Treatment Plant density (%)		Row ratio	Primary branches/ plant	Secondary branches/ plant	Siliquae/ plant	Seeds/ pod	1,000- grain weight (g)
Lentil	Mustard						
100	25	2 : 1	3.93	8.93	87.26	8.10	4.12
100	50	2 : 1	3.53	8.00	77.13	7.80	4.01
100	25	3 : 1	3.80	8.73	83.33	7.98	4.10
100	50	3 : 1	3.40	7.46	74.46	7.45	3.90
100	25	5 : 1	3.66	8.20	79.33	7.85	4.09
100	50	5 : 1	2.93	6.80	65.26	7.11	3.87
67	33	2 : 1	4.20	9.73	99.21	8.90	4.10
75	25	3 : 1	4.33	10.06	98.53	8.78	4.20
83	17	5 : 1	4.60	10.26	101.46	8.75	4.21
Sole mustard			3.86	9.26	80.60	8.03	3.95
CD (P = 0.05)			NS	1.61	12.30	0.64	NS

Intercropping of 100% lentil + 25% mustard (5 : 1 row ratio) produced a bonus yield of mustard (700 kg/ha) without any significant reduction in lentil yield compared with lentil alone (1,250 kg/ha). It consequently gave maximum lentil-equivalent yield (1,850 kg/ha) and land-equivalent ratio (1.54), closely followed by 100% lentil + 50% mustard (5 : 1 row ratio) with 1,700 kg/ha lentil-equivalent yield and 1.42 land-equivalent ratio, owing to better utilization of growth resources. This confirms the findings of Singh and Rajput (1996).

### Economics

Intercropping of 100% lentil with 25 or 50% mustard in 5 : 1 row ratio had almost similar net returns, which were 62 and 44% higher than with sole cropping of lentil (Rs 12,234/ha) owing to better yields of both the component crops. However, 100% lentil + 25% mustard (5.1 row ratio), having highest monetary advantage (Rs 3.89 per rupee investment), had an edge over 100% lentil + 50% mustard (5 : 1 row ratio). This

confirms the findings of Upasani (1994) and Pali *et al.* (1997).

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