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Effect of nitrogen, phosphorus and sulphur applied to cotton (*Gossypium hirsutum*) and their residual effect on succeeding Indian mustard (*Brassica juncea*) crop

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ABSTRACT

An experiment conducted during May 1995–April 1998 with 3 successive croppings in cotton (*Gossypium hirsutum* L.)–Indian mustard [*Brassica juncea* (L.) Czernj & Cosson] rotation revealed that nitrogen application up to 100 kg/ha on cotton (cv. 'Pusa 8–6') significantly improved the growth, yield attributes and seed-cotton yield. Application of phosphorus and sulphur also influenced the seed-cotton yield in 1996–97 and 1997–98. The nitrogen and phosphorus applied to cotton showed significant residual effect on the succeeding 'Pusa Bold' Indian mustard crop. Transplanted mustard gave more seed yield (4.7 q/ha) than direct-seeded one. After the harvest of cotton, 'Pusa Bold' Indian mustard was successfully transplanted even in November and December for getting higher yield.

Key words : N, P, K, S, Cotton, Residual effect, Indian mustard

India's population is expected to increase by 150 million by 2025 AD, which will require more fibre and oil. On the other hand, the availability of land is decreasing day by day. There is almost no scope for horizontal expansion to meet the future demand. This ever-growing population of India triggers the transition from traditional practices to new technology of cotton-based cropping system. After cotton, timely sowing of Indian mustard is major problem for the farmers. Untimely sown Indian mustard generally gives very poor yield. To overcome this problem, it was felt to transplant the seedlings of Indian mustard even in November and December for getting as good yield as normal sown (October) mustard.

MATERIALS AND METHODS

The field experiment was conducted during May 1995– April 1998 at New Delhi. The soil was sandy loam having low organic carbon (0.41%) and available sulphur (7.4 ppm), medium available P (14.2 kg/ha) and available K (221.2 kg/ha), with pH 7.2. The treatment combinations of 3 levels of N (0,50 and 100 kg/ha), 2

Table 1. Effect of N, P and S on growth, yield and yield attributes of cotton

Treatment	Plant height (cm)			Bolls/ plant			Boll weight (g)			Seed-cotton yield (q/ha)		
	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997
Nitrogen (kg/ha)												
0	82.1	124.1	83.2	21.5	14.3	10.2	4.3	4.0	3.9	22.1	16.5	14.5
50	95.4	148.8	97.4	25.2	18.9	12.0	4.7	4.3	4.2	26.0	25.2	19.9
100	101.8	164.5	99.6	26.6	20.4	16.1	4.8	4.4	4.3	29.7	26.1	21.3
CD (P = 0.05)	2.00	2.68	2.10	1.30	0.53	0.40	0.18	0.10	0.10	1.5	0.35	0.31
Phosphorus (kg/ha)												
50	92.1	142.4	93.5	24.3	17.5	11.4	4.5	4.2	4.0	26.0	22.3	18.1
100	95.1	149.2	97.4	24.5	18.2	12.0	4.7	4.3	4.2	27.1	32.1	19.0
CD (P = 0.05)	NS	NS	NS	NS	Ns	NS	NS	NS	NS	NS	0.29	0.10
Sulphur (kg/ha)												
0	93.7	144.5	94.0	24.4	17.7	11.5	4.5	4.2	4.0	26.3	22.4	18.3
25	94.4	147.1	76.2	24.4	18.0	12.0	4.6	4.2	4.1	26.9	22.8	18.4
CD (P=0.05)	NS	2.19	NS	NS	NS	NS	NS	NS	NS	NS	0.29	0.1

Table 2. Residual effect of N,P and S applied to cotton on growth parameters of Indian mustard

Treatment	Plant height (cm)					Branches/plant				
	Transplanted			Direct seeded		Transplanted			Direct seeded	
	1995–96	1996–97	1997–98	1996–97	1997–98	1995–96	1996–97	1997–98	1996–97	1997–98
Nitrogen (kg/ha)										
0	88.4	78.3	75.0	94.7	85.7	3.5	3.4	3.2	2.6	2.5
50	99.1	88.9	87.4	102.1	92.0	3.7	3.6	3.3	2.7	2.6
100	100.5	90.5	90.9	112.0	99.3	3.8	3.7	3.4	2.9	2.8
CD (P = 0.05)	1.05	1.02	1.30	1.04	1.03	0.07	0.07	0.06	0.067	0.05
Phosphrus (kg/ha)										
50	95.3	85.4	83.6	106.2	86.4	3.6	3.5	3.3	2.7	2.5
100	96.7	86.6	85.1	108.0	90.0	3.7	3.6	3.4	2.8	2.7
CD (P=0.05)	0.86	0.8	0.81	0.8	0.81	0.05	0.07	0.07	0.054	0.05
Sulphur (kg/ha)										
0	85.6	85.6	84.0	102.1	86.6	3.7	3.6	3.4	2.7	2.6
25	84.4	86.0	84.2	103.7	87.1	3.7	3.6	3.4	2.7	2.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Residual effect of N, P and S applied to cotton on yield and yield attributes of mustard

Treatments	1,000-seed weight (g)					Seed yield (q/ha)				
	Transplanted			Direct seeded		Transplanted			Direct seeded	
	1995–96	1996–97	1997–98	1996–97	1997–98	1995–96	1996–97	1997–98	1996–97	1997–98
Nitrogen (kg/ha)										
0	4.3	3.7	3.6	3.0	3.3	21.2	12.3	12.4	7.7	8.6
50	4.4	4.0	3.8	3.5	3.4	24.2	14.3	15.2	9.4	10.2
100	4.5	4.5	3.4	3.5	3.5	25.3	15.6	16.5	10.0	12.5
CD (P = 0.05)	0.12	0.13	0.14	0.12	0.11	0.47	0.18	0.16	0.16	0.16
Phosphrus (kg/ha)										
50	4.4	3.9	3.2	3.5	3.4	18.9	13.7	13.2	8.1	9.0
100	4.6	4.2	3.9	3.7	3.6	19.3	14.2	16.4	8.5	11.4
CD (P=0.05)	0.12	0.12	0.13	0.12	0.12	0.16	0.15	0.14	0.15	0.14
Sulphur (kg/ha)										
0	3.8	3.9	3.6	3.6	3.4	18.9	13.5	13.8	8.2	8.2
25	4.1	4.3	3.7	3.8	3.6	19.2	14.1	14.2	8.2	9.0
CD (P = 0.05)	0.12	0.12	0.11	0.12	0.12	NS	NS	NS	NS	NS

each of phosphorus (50 and 100 kg/ha) and sulphur (0 and 25 kg/ha) were tested in randomized block design and strip-plot design for cotton and mustard respectively with 3 replications. The cotton was sown by dibbling 2–3 Seeds/hill at a spacing of 75 cm × 30 cm in the last week of May. Full dose of P and S along with half dose of N was applied at the time of seeding and the remaining N was top-dressed at square-formation stage.

Nursery of Indian mustard was sown in third week of October in 1996 and first week of November in 1997 and 1998. After harvest of cotton, transplanting and direct seeding were done on the same day in the last week of November in 1995 and first week of December in 1997 and 1998. The plant-protection measures were taken as per recommendations.

RESULTS AND DISCUSSION

Nitrogen @ 100 kg/ha gave maximum seed-cotton yield and proved significantly superior to lower level of N (Table 1). The increase in seed-cotton yield was possible owing to more bolls/plant and boll weight at higher N levels. The result confirm the findings of Bhasker *et al.* (1993). Application of phosphorus and sulphur did not show any significant effect on growth and yield attributes, however, seed-cotton yield was influenced significantly in 1997 and 1998. Application of 100 kg phosphorus gave more yield than 50 kg. Application of 25 kg S/ha gave significantly more seed-cotton yield than no sulphur application.

'Pusa Bold' Indian mustard grown after cotton had significant residual effect on plant height (Tables 2, 3). Application of 100 kg N/ha to cotton produced significantly taller plant than the control. The height of Indian mustard plant was less in the first year than that of the second and third year crops. It was because of cumulative N after the cotton crop (organic carbon 0.42%). Direct-seeded mustard produced taller plants and less number of branches (Table 3) than transplanted one. The mean seed yield of transplanted mustard and direct-seeded was 16.0 q/ha and 4.0 q/ha respectively. The residual effect of 100 kg P_2O_5/ha produced significantly taller plant than those obtained with 50 kg P_2O_5/ha. Residual effect of P on the seed yield of Indian mustard was also found significant during all the years. The residual dose of 100 kg P_2O_5 recorded significant increase in the seed yield of 'Pusa Bold' over the control. Application of sulphur to cotton did not show any significant residual effect on plant height, number of branches and seed yield of Indian mustard, however, 1,000-seed weight was affected significantly. Transplanted Indian mustard produced more branches than direct-seeded crop (Table 3).

Thus the adoption of cotton-Indian mustard may help the farmers in terms of more yield where the irrigation facilities exist. In late-sown conditions, cv. 'Pusa Bold' may be transplanted for getting higher seed yield.

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