

Growth Parameters, Dry Matter Accumulation and Yield of Indian Mustard (*Brassica juncea*) as Affected by Phosphorus and Sulfur Levels

BIRBAL SAHU¹, RAMA MOHAN SAVU AND DINESH SAH

Department of Agronomy, JNKVV, Jabalpur, MP, India
¹*Krishi Vigyan Kendra, Kanker, Chhattisgarh, India*

Abstract

Field experiments were carried out on Indian mustard (*Brassica juncea* (L.) Czern & Coss) cv Pusa Bold in sandy loam soil during rabi season of 2004-05 and 2005-06 to evaluate the suitable phosphorus and sulfur requirements. Results revealed that the plant height, primary branches per plant, leaf area index (LAI), dry matter accumulation per plant, crop growth rate (CGR) and relative growth rate (RGR) increased significantly upto 50 kg P₂O₅/ha and 40 kg S/ha. Seed yield also increased upto these P and S levels because of increased plant height, primary branches per plant and more photosynthates accumulated per plant.

Key words : Phosphorus levels, Sulfur levels, Dry matter accumulation, Indian mustard.

The average productivity of mustard in India is quite low (944 kg/ha) compared to its average productivity of the world (1,477 kg/ha). Among the major constraints to harvest its potential yield, the insufficient and imbalance use of fertilizers especially P and S are one of them. Indian mustard responds to P and S nutrients positively both in terms of growth and seed yield (1, 2). The suitable combination of P and S for mustard is lacking for the Vindhyan plateau zone of Madhya Pradesh, Hence, the present experiment was taken up.

Methods

Field experiments were conducted on mustard cv Pusa Bold during winter season of 2004-05 and 2005-06 in sandy loam soil of Sehore. The soil of experimental field has low available N (237 kg/ha), high available P₂O₅ (55 kg/ha), medium available K₂O (272 kg/ha) and low available S (12 kg/ha) contents with pH 7.5. The rainfall was 25 and 373 mm during the crop season in the two consecutive years. Treatments consisted with four levels of each P (0, 25, 50 and 75 kg P₂O₅/ha) and S (0, 20, 40 and 60 kg S/ha) were tested in four randomized blocks. A uniform dose of 60 kg N + 20 kg K₂O/ha was applied through urea and muriate of potash respectively to all treatments besides P and S based on treatments. P and S were given through diammonium phosphate and elemental sulfur, respectively. Half dose of N along with P, K and S was applied as basal while, remaining half dose of N

was top dressed immediately after irrigation at 35 days growth stage of crop. Irrigation were given uniformly at 35, 55 and 70 days growth stages during both the years. Weed control and plant protection measures were also followed uniformly to all treatments. Observation on plant height and primary branches/plant were taken from five randomly tagged plants from each plot at harvest.

Results and Discussion

Effect of Phosphorus Levels

Growth parameters viz. plant height, primary branches/plant increased correspondingly with increasing P levels but the mean plant height was not significant beyond 50 kg P₂O₅/ha, whereas primary branches increased upto highest P level in both years (Table 1). Similar results were also reported by Tomar et al. (3) and Rana et al. (4).

Increasing level of P significantly increased dry matter accumulation/plant and LAI (Tables 1 and 2) but the deviation between closer levels particularly between 50 to 75 kg P₂O₅/ha, were not significant for dry matter accumulation at all stages of growth in 2004-05. LAI increased because of increased plant height and primary branches per plant and LAI is the source (Photosynthetic ability) which attributes to production of DM/plant. Similar trend was observed in CGR and RGR values because these values are

Table 1. Effect of P and S on plant population, plant height, primary branches per plant and leaf area index.

Treatments	Plant population (per/m ²)			Plant height (cm)			Primary branches/plant			LAI at 30 DAS			LAI at 60 DAS		
	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean	04-05	05-06	Mean
P levels															
(P ₂ O ₅ kg/ha)															
0	34.09	43.88	38.98	124	122	123	3.63	3.25	3.44	0.16	0.18	0.17	1.73	1.90	1.81
25	35.19	44.12	39.65	126	128	126	3.84	4.05	3.94	0.19	0.28	0.23	1.91	2.04	1.97
50	35.83	44.42	40.13	129	140	134	4.18	4.33	4.25	0.23	0.35	0.29	2.12	2.34	2.23
75	38.09	43.48	40.78	129	144	136	4.28	4.40	4.34	0.25	0.48	0.36	2.20	2.35	2.27
S levels															
(S kg/ha)															
0	34.86	43.68	39.23	118	130	124	3.21	4.01	3.61	0.11	0.26	0.18	1.57	2.16	1.86
20	35.86	44.22	39.99	125	130	127	3.90	4.05	3.97	0.17	0.29	0.23	1.84	2.10	1.97
40	35.99	43.92	39.95	130	138	134	4.38	4.16	4.27	0.22	0.32	0.27	2.17	2.36	2.26
60	36.59	44.12	40.35	137	137	136	4.55	4.23	4.39	0.33	0.41	0.37	2.25	2.39	2.32
S ±	1.26	0.37	-	0.75	0.98	-	0.07	0.04	-	0.004	0.02	-	0.04	0.01	-
(CD at 5%)	NS	NS	-	2.14	2.79	-	0.20	0.12	-	0.014	0.06	-	0.12	0.04	-

related with dry matter accumulation/plant at different growth stages. These results confirm the findings of Saran and Giri (2) and Narang et al. (1).

Both seed and stalk yields (Tables 3 to 5) also increased with every incremental dose of P upto the highest level (75 kg P₂O₅/ha) but the response beyond 50 kg P₂O₅/ha was not much conspicuous in both the years. Similar results were also reported by Narang et al. (1) and Jain et al. (5).

Effect of Sulfur Levels

Increasing rates of S application also increased the plant height and primary branches per plant at

maturity stage in both the years. This is because of S application contributes to greater cell division, cell expansion and cell elongation which ultimately result in production of taller plants with more branching and foliage.

LAI increased progressively upto highest of S (60 kg S/ha) which resulted in increased carbohydrates accumulation and ultimately increased DM production per plant at all stages of growth in both the years. However, differences between 40 and 60 kg S/ha were not much at 30 and 60 days after sowing. CGR and RGR (Tables 3 and 4) follows same trend as dry matter accumulation per plant with application of sulfur. These results are in close confirmity with the find-

Table 2. Effect of various Levels of P and S on dry matter production per plant (g).

Treatments	30 days after sowing			60 days after sowing			90 days after sowing		
	4-5	5-6	Mean	4-5	5-6	Mean	4-5	5-6	Mean
P levels									
(P ₂ O ₅ kg/ha)									
0	3.72	2.66	3.19	11.90	12.12	12.01	26.37	15.62	20.99
25	4.06	3.50	3.78	13.60	14.20	13.90	27.56	24.80	26.18
50	4.38	4.18	4.28	16.10	16.38	16.24	29.75	29.30	29.52
75	4.52	4.50	4.51	17.10	17.25	17.17	30.81	31.29	31.05
S levels									
(S kg/ha)									
0	3.51	3.44	3.47	10.00	13.98	11.99	23.06	23.42	23.24
20	3.86	3.68	3.77	12.50	15.01	13.75	26.68	26.58	26.63
40	4.55	4.69	4.62	15.80	16.66	16.23	30.68	29.12	29.90
60	4.66	4.72	4.69	16.50	16.24	16.37	35.06	30.36	32.71
S ±	0.06	0.08	-	0.36	0.12	-	0.48	0.18	-
(CD at 5%)	0.19	0.24	-	108	0.38	-	1.37	0.56	-

Table 3. Effect of various levels of P and S on crop growth rate (g/m²/day) at different growth stages of crop.

Treatments	0-30 days after sowing			30-60 days after sowing		
	04-05	04-05	Mean	04-05	05-06	Mean
P levels (P ₂ O ₅ kg/ha)						
0	0.60	0.11	0.35	3.59	3.97	3.78
25	0.67	0.56	0.61	3.75	4.33	4.04
50	0.72	0.6	0.71	3.94	5.52	4.73
75	0.79	0.94	0.86	4.09	5.69	4.89
S levels (S kg/ha)						
0	0.42	0.48	0.45	3.34	3.49	3.41
20	0.63	0.72	0.67	3.84	4.79	4.31
40	0.79	0.90	0.84	4.03	5.98	5.00
60	0.59	0.51	0.73	4.16	5.86	5.01
S±	0.01	0.09	-	0.07	0.16	-
CD at 5%	0.05	0.28	-	0.21	0.47	-

Table 3. Continued.

Treatments	60-90 days after sowing			90 days to harvest		
	04-05	05-06	Mean	04-05	05-06	Mean
P levels (P ₂ O ₅ kg/ha)						
0	7.43	5.79	6.61	3.43	3.52	3.47
25	7.50	7.38	7.44	3.79	3.00	3.39
50	7.80	9.08	8.44	4.21	3.30	3.75
75	8.03	9.72	8.87	4.40	4.56	4.48
S levels (S kg/ha)						
0	7.25	7.09	7.17	3.55	3.36	3.45
20	7.48	8.04	7.76	3.87	3.06	3.46
40	7.95	8.41	8.18	4.18	3.84	4.01
60	8.08	8.43	8.25	4.24	4.10	4.17
S±	0.09	0.16	-	0.07	0.17	-
CD at 5%	0.27	0.47	-	0.22	0.49	-

Table 4. Effect of various levels of P and S on relative growth rate (mg/g/day).

Treatments	30-60 days after sowing			60-90 days after sowing			90 days to harvest		
	4-5	5-6	Mean	4-5	5-6	Mean	4-5	5-6	Mean
P levels (P ₂ O ₅ kg/ha)									
0	61.79	61.00	61.39	32.64	22.82	27.73	7.86	6.40	7.13
25	61.43	65.00	64.22	32.97	28.80	30.88	8.86	7.40	8.13
50	64.80	66.50	65.65	33.39	30.80	32.09	10.09	8.70	9.39
75	67.22	69.60	68.41	34.29	31.40	32.84	10.71	8.80	9.75
S levels (S kg/ha)									
0	56.99	62.00	59.49	31.66	27.00	29.33	9.31	6.80	8.05
20	61.10	65.90	63.50	32.51	28.90	30.70	9.38	7.00	8.19
40	65.98	66.90	66.44	32.87	30.40	31.63	9.37	7.10	8.23
60	73.18	67.30	70.24	36.25	30.80	33.52	9.46	7.40	8.43
S±	1.16	0.99	-	0.47	0.36	-	0.21	0.38	-
CD at 5%	3.32	2.82	-	1.35	1.04	-	NS	1.08	-

Table 5. Effect of various levels of P and S on seed and stalkyields of mustard.

Treatments	Seed yields (q/ha)			Stalk yield (q/ha)		
	4-5	5-6	Mean	4-5	5-6	Mean
P levels (P ₂ O ₅ kg/ha)						
0	9.34	9.02	9.18	63.31	58.85	61.08
25	9.67	9.96	9.81	68.00	62.85	65.42
50	10.35	11.05	10.70	69.68	65.45	67.56
70	10.95	11.74	11.34	70.18	71.00	70.59
S levels (S kg/ha)						
0	8.82	9.90	9.36	58.99	61.80	60.39
20	9.64	9.93	9.78	67.00	63.71	65.35
40	10.65	10.85	10.75	73.12	65.82	69.47
60	11.20	11.09	11.14	74.06	67.01	70.53
S±	0.32	0.28	-	0.35	0.67	-
CD at 5%	0.92	0.80	-	1.01	1.91	-

ings of Narang et al. (1) and Chandel et al. (6).

Seed and stalk yield increased due to increasing rates of S application upto the highest level with non-significant differences between closer levels in both the years. The economic yield of crop depends on source-sink relationship and on different components of sources like plant height, branching and DM accumulation/plant. The S application helps in better source sink relationship. Similar results were also reported by Saran and Giri (2) and Narang et al. (1).

References

1. Narang R. S., S. S. Mahal and M. S. Gill. 1993. Effect of Phosphorus and sulfur on growth and yield of toria (*Brassica campestris sub sp. Oleifera var toria*). *Ind. J. Agron.* 38 : 593—597.
2. Saran G. and G. Giri. 1990. Influence of nitrogen, phosphorus and sulfur on mustard under semi-arid rainfed conditions of North-West India. *Ind. J. Agron.* 85 : 131—132.
3. Tomar S., T. S. Tomar, S. Kumar, M. Singh and S. Singh. 1996. Response of Indian Mustard (*Brassica Juncea*) varieties to nitrogen, phosphorus and potash fertilizers. *Ind. J. Agron.* 41 : 624—625.
4. Rana K. S., D. S. Rana and R. C. Gautam. 2005. Influence of phosphorus, sulfur and boron on growth, yield, nutrient uptake and economics of Indian mustard (*Brassica juncea*) under rainfed conditions. *Ind. J. Agron.* 50 : 435—438.
5. Jain N. K., A. K. Vyas and A. K. Singh. 1996. Yield and quality of Indian mustard (*Brassica juncea*) as influenced by phosphorus and sulfur fertilizers. *Ind. J. Agron.* 66 : 539—540.
6. Chandel R. S., A. K. Singh and P. C. Sudhakar. 2003. Effect of sulfur nutrition in rice (*Oryza sativa* L.) and mustard (*Brassica juncea* L. Czern & Coss.) grown in sequence. *Ind. J. Pl. Physiol.* 8 : 155—159.