RESEARCH PAPER International Journal of Agricultural Sciences, June to December, 2009, Vol. 5 Issue 2 : 396-398

Effect of nitrogen, phosphorus and sulphur fertilization on growth and yield of mustard (*Brassica juceae* Coss)

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ABSTRACT

A field experiment was conducted during the winter season of 2004-2005 at Agricultural Research Farm, Allahabad. The experiment consisted of three factors namely nitrogen (80 and 100 kg ha^{-1}) and sulphur (10, 20 and 30 kg ha^{-1}), phosphorus (40 and 60 kg ha^{-1}) with blanket application of potash at 40 kg ha^{-1}. Highest plant height and maximum plant dry weight was recorded with higher doses of these factor. Also, more number of siliqua/plant, seed/siliqua and the test weight was also recorded with higher levels of these factors which ultimately resulted in higher seed yield.

Key words : Tropical sugarbeet, Hybrids, Nitrogen, Yield, Integrated nitrogen management.

INTRODUCTION

Indian mustard responds to nitrogen (Joshi *et al*., 1998) phosphorus and sulphur fertilization and also shows a role in promoting seed-yield and other ancillary characters. Since, very limited information is available on these aspects under agro-climatic conditions. The present investigation was carried out to study nitrogen, phosphorus and sulphur on seed yield of Indian mustard.

MATERIALS AND METHODS

The field experiment was conducted during the *rabi* season of 2004-2005 at Agricultural Research Farm, Allahabad. The soil was sandy loam in texture, having 180.50, 58.60 and 348.65 kg ha^{-1} available N, P and K, respectively. The sulphur level of the experimental site was 0.00014%, which was quite below the critical limit for mustard crop. The experiment was laid out in factorial R.B.D. with N, P and S with three replications. The treatments consisted of 2 levels of Nitrogen (80 and 100 kg ha^{-1}), phosphorus (40 and 60 kg ha^{-1}) and sulphur (10, 20 and 30 kg ha^{-1}) with blanket application of potash at 40 kg ha^{-1}. Urea, S.S.P. and elemental sulphur were used as source of N, P and S, respectively. 'Varuna' ('T 59') Indian mustard was sown using 4 kg ha^{-1} seed at spacing of 40 cm x 10 cm and first irrigation was given at 30 days after sowing.

RESULTS AND DISCUSSION

Response of nitrogen:

Application of nitrogen significantly increased the plant height, dry weight, number of branches/plant at harvest. The plant height increased progressively up to 100 kg N ha^{-1}, but significantly over its preceding level up to 80 kg N ha^{-1}.

The increase in the growth character described above may be ascribed to the fictional role of N in the plant body. The chief function of N is multiplication and cell elongation and tissue differentiation. With adequate supply of N the plants grow tall, produce more branches and ultimately greater production of dry weight ha^{-1}. The findings confirm the observations of Rathor and Manohar (1989).

The number of siliquae/plant, number of seeds/siliqua, test weight, seed yield and straw yield increased significantly by N 100 kg ha^{-1} over the N 80 kg/ ha^{-1}. It might be due to improved availability of nitrogen through urea. Siliquae/plant increased significantly with increasing level of N, the N_{100} resulted in maximum sliliquae/plant. The length of siliqua was also maximum with N_{100} and significantly superior to just preceding level. The results confirm the findings of Chauhan and Paroda (1995).

Response of phosphorus:

Application of 60 kg P_2O_5 ha^{-1} significantly improved plant height, number of branches/plant, number of leaves/ plant, dry weight of plant over the 40 kg P_2O_5 ha^{-1} (Table 1). This may be because of the fact that phosphorus encourages the cell division and cell elongation in the meristematic region of the plant, besides helping in nitrogen fixation, thereby resulted in improved growth and development of the plant. The results are in close conformity with the findings of Dubey and Khan (1993).

The increase in the vegetative growth owing to P_2O_5 application resulted in the production of more siliquae/ plant and improved the test weight. Maximum seed yield (30.93 q/ ha^{-1}) was recorded with application of 60 kg P_2O_5 ha^{-1} maximum straw yield (59.44 q ha^{-1}) was also

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Table 1 : Effect of N,P and S on plant height, branches/plant, leaves/plant, dry weight (g/plant) and test weight (1000 seeds) of mustard

Treatments	Plant higher (cm)	Branches/ plant	Leaves/plant	Dry weight (g/ plant)	Test weight (g/1000 seeds)
T_1 N_1 P_1 S_1 Nitrogen 80 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 10 kg ha^{-1}	91.49	12.86	26.73	38.80	14.44
T_2 N_1 P_1S_2 Nitrogen 80 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 20 kg ha^{-1}	93.37	14.20	31.67	39.07	15.05
T_3 N_1 P_1S_3 Nitrogen 80 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 30 kg ha^{-1}	103.37	15.73	34.73	39.97	15.57
T_4 N_1 P_2S_1 Nitrogen 80 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 10 kg ha^{-1}	104.65	15.87	34.00	41.67	16.59
T_5 N_1 P_2S_2 Nitrogen 80 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 20 kg ha^{-1}	122.35	15.93	37.40	41.83	17.05
T_6 N_1 P_2S_3 Nitrogen 80 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 30 kg ha^{-1}	131.25	17.03	39.07	42.63	17.60
T_7 N_2 P_1S_1 Nitrogen 100 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 10 kg ha^{-1}	136.53	17.13	39.47	43.73	18.15
T_8 N_2 P_1S_2 Nitrogen 100 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 20 kg ha^{-1}	140.98	18.07	40.20	44.17	18.68
T_9 N_2 P_1S_3 Nitrogen 100 kg ha^{-1} + Phosphorus 40 kg ha^{-1} + Sulphur 30 kg ha^{-1}	169.77	18.33	41.53	44.27	19.29
T_{10} N_2 P_2S_1 Nitrogen 100 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 10 kg ha^{-1}	175.32	19.10	45.93	44.27	19.65
T_{11} N_2 P_2S_2 Nitrogen 100 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 20 kg ha^{-1}	184.79	20.17	40.40	46.90	20.30
T_{12} N_2 P_2S_3 Nitrogen 100 kg ha^{-1} + Phosphorus 60 kg ha^{-1} + Sulphur 30 kg ha^{-1}	190.39	20.20	48.70	48.80	20.98
S.E. (±)		2.85	0.30	0.60	0.14
C.D. (P=0.05)		5.91	0.63	1.24	0.28

recorded with application of 60 kg P_2O_5. Harvest index was also significantly improved owing to 60 kg P_2O_5 ha^{-1} (Table 2). The results confirm the findings of Joshi *et al.* (1998) and Jain *et al.* (1998).

Response of sulphur :

Increasing level of sulphur significantly increased plant height at harvest up to 30 kg S ha^{-1} over its preceding level. Primary and secondary branches increased significantly up to 30 kg S ha^{-1}, the significant response was observed with application of S@ 30 kg ha^{-1} over just preceding levels. In general, the dry weight increased up to 30 kg S ha^{-1} (Table 1). Similar findings were obtained by Trivedi and Sharma (1997).

Siliquae/plant, length of siliqua, seeds/siliqua and test weight of seed (Table 2) were maximum with S_{30} in pooled analysis. Seed yield increased significantly with an increase in level of suophate (30 kg ha^{-1}). Sulphur enhanced cell multiplication, elongation and expansion, imparted a deep colour to leave due to better chlorophyll synthesis, resulting in greater amounts of dry weight in comparison to sulphur deficient plant. Dhankar *et al.* (1996) reported similar findings with sulphur at 30 kg ha^{-1}.

Economics:

Net return and B:C ratio was significantly increased

Table 2: Effect of N, P and S on siliquae/plant, seeds/siliqua, length of siliqua, seed (q/ha), net return (Rs/ha), B:C:R and gross return (Rs/ha) of mustard

Treatments	Siliqae /plant	Seeds/ siliquae	Length of siliquae	Seed yield (q/ha)	Net return	B:C:R	Gross return
T_1 $N_1P_1S_1$	141.40	15.00	6.27	9.39	3335.08	1.25	16164.00
T_2 $N_1P_1S_2$	151.20	15.73	6.33	9.74	3444.58	1.25	16836.00
T_3 N_1 P_1S_3	169.53	15.60	6.50	13.50	9786.08	1.73	23115.00
T_4 N_1 P_2S_1	188.00	15.60	6.50	13.50	9786.08	1.73	23115.00
T_5 N_1 P_2S_2	217.33	16.87	6.57	15.68	12882.58	1.92	26774.00
T_6 N_1 P_2S_3	245.60	17.20	6.60	17.80	15965.08	2.10	30419.00
T_7 N_2 P_1S_1	261.00	17.40	6.87	20.51	21190.69	2.67	34975.00
T_8 N_2 P_1S_2	282.93	18.33	7.20	22.94	25232.44	2.85	38863.00
T_9 N_2 P_1S_3	292.60	19.47	7.33	24.50	27492.94	2.93	41686.00
T_{10} N_2 P_2S_1	348.07	19.93	7.47	26.60	31550.94	3.32	45119.00
T_{11} N_2 P_2S_2	367.47	20.00	7.67	28.41	34052.44	3.40	48183.00
T_{12} N_2 P_2S_3	383.67	20.00	7.90	30.93	37766.94	3.57	52460.00
S.E. (±)	4.36	0.17	0.03	0.36	-------	-----	----
C.D. (P=0.05)	9.64	0.06	0.75	0.75	-------	------	----

with increasing levels applied nitrogen, phosphorus and sulphur. The maximum net return (Rs. 37766.94) were recorded in the plots applied with higher rates of fertilizers. While the minimum net return (Rs 3335.00) were recorded in the plots applied with lower doses of fertilizers. The maximum benefit cost ratio (3.57) were recorded in the plots applied with higher rates of fertilizers (Nitrogen 100 kg ha^{-1} + phosphorus 60 kg ha^{-1} + sulphur 30 kg ha^{-1}). The maximum gross return (Rs. 52460.00) were obtained in the plots applied with higher levels of nitrogen, phosphorus and sulphur. While the minimum gross return (Rs.16164.00) were recorded in the plots applied with lower doses of nitrogen, phosphorus and sulphur (Table 2).

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Received : January, 2009; Accepted : March, 2009