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Comparative performance of Indian mustard (*Brassica juncea*) genotypes in relation to sulphur fertilization

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ABSTRACT

A field experiment was conducted during the winter seasons of 1996–98 at Agra, to study the performance of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] genotypes, viz. 'Varuna' ('Type 59'), 'PBM 16', 'Rohini' and 'Pusa Bahar', in relation to sulphur fertilization (0, 20, 40, and 60 kg/ha). 'Pusa Bahar' gave the highest seed yield (1,456 kg/ha), being 5.0, 20.1 and 13.3% more yield than 'Varuna', 'PBM 16' and 'Rohini' respectively. Significantly higher yield attributes and oil content and its production were also noted in 'Pusa Bahar' over all other varieties. Sulphur application @ 20 and 40 kg/ha improved the seed yield significantly, indicating 46.7% and 63.4% increase over the control. Oil content and its production were also increased significantly with the application of sulphur levels over the control. The highest net returns were obtained with 'Pusa Bahar' genotype fertilized with 40 kg S/ha.

Key words : Indian mustard, *Brassica juncea*, Genotypes, Sulphur

Indian mustard is one of the important oilseed crops of Agra region in western Uttar Pradesh. Yield potential of different Indian mustard genotypes may differ under different agro-climatic conditions because of their inherent capacity (Bora, 1997).

Sulphur plays an inevitable and imperative role so far the formation of amino acids (methionine 21%, and cystine 27%), synthesis of protein, chlorophyll and oil in the oilseed is concerned (Aulakh *et al.*, 1980). The adequate supply of sulphur increases crop yields appreciably (Mohan and Sharma, 1992). The information on this aspect related to new genotypes of Indian mustard is quite meagre. Hence a study was conducted to find out the effect of graded doses of sulphur on yield and yield attributes, oil % and net returns of high-yielding genotypes of Indian mustard.

MATERIALS AND METHODS

The field experiment was conducted during the winter (*rabi*) season of 1996–97

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and 1997–98 at Agra, Uttar Pradesh. The soil was sandy loam, containing 0.31% organic caron, 191.3 kg available N, 29.7 kg available P_2O_5 and 299.8 kg available K_2O/ha in upper 30 cm soil depth. The average minimum temperature varied between 2.7 and 17.6°C, average maximum temperature 16.5 and 29.3°C and relative humidity between 86.5 and 96% during the crop seasons.

Sixteen treatments comprising 4 cultivars of Indian mustard, i.e. 'Varuna' ('Type 59'), 'PBM 16', 'Rohini' and 'Pusa Bahar' and 4 levels of sulphur (0, 20, 40 and 60 kg/ha) were evaluated in factorial randomized block design with 4 replications. All the treatments received N and P_2O_5 @ 80 and 40 kg/ha through urea and diammonium phosphate respectively. Sulphur doses were applied through gypsum. Full dose of phosphorus, sulphur and half dose of N were drilled at sowing and remaining half dose of N was top-dressed after first irrigation. The Indian mustard genotypes were sown in rows at 40 cm distance on 21 and 28 October 1996–97 and 1997–98 respectively. All standard agronomic practices were followed to harvest good crop yields and the crop was adequately protected from insect-pests and diseases.

The oil content in seed was determined by Soxhlet's method using petroleum ether. Oil per cent was calculated by using the following formula :

$$\text{Oil content (\%)} = \frac{\text{Weight of oil flask + ether extract} - \text{weight of oil flask}}{\text{Substance taken (g)}} \times 100$$

RESULTS AND DISCUSSION

In general, yield of Indian mustard was higher during 1996–97 than during 1997–98. The lower yield during the second year may probably because of untimely rain (10 rainy days during crop season) which made conducive conditions for the growth of diseases and insect-pests and unfavourable conditions for crop growth, yield attributes and ultimately resulting in poor crop yield. Genotype 'Pusa Bahar' was comparatively tolerant for rust.

Performance of genotypes

Yield attributes such as siliquae/plant, siliqua length, seeds/siliqua, seed yield/plant and 1,000 seed weight were significantly influenced by different genotypes. Among the genotypes, 'Pusa Bahar' gave significantly higher yield during both the years. However, differences between 'Pusa Bahar' and 'Rohini' for seeds/siliqua, seed yield/plant and test weight during 1997–98 were not significant (Table 1). Improvement in yield attributes in 'Pusa Bahar' was owing due to its genetic potential compared to other genotypes.

In 2 years average, genotype 'Pusa Bahar' significantly higher seed yield (1,456 kg/ha) over other genotypes and outyielded 'Varuna', 'PBM 16' and 'Rohini', with a margin of 5.0, 20.1 and 13.3 % respectively (Table 2). 'Varuna' cultivar ranked second. Seed yield is a function of yield-attributing characters. Hence, significant increase in seed yield of 'Pusa Bahar' may be due to increased yield attributes as compared to remaining genotypes (Table 1). Genotypes differences

in Indian mustard in respect of seed yield were also observed by Yadav *et al.* (1995) and Praveen *et al.* (1996). Similarly, the higher yield of straw or stalk (3,472 kg/ha) was recorded with 'Pusa Bahar' compared to other genotypes. Almost similar trend was observed in respect of biological yield during both the years. The different genotypes did not show significant difference in harvest index during 1996–97 (Table 2). However, during 1997–98, 'Varuna' cultivar showed significantly higher harvest index than other genotypes.

Effect of sulphur

Appreciable improvement in yield-attributing characters of Indian mustard was noted owing to the application of sulphur. Significant increase in the yield-attributing characters such as number and length of siliquae, seeds/siliqua and 1,000-seed weight was deserved with every increase in the level of sulphur up to 40 kg/ha. However, there was no significant difference in seed yield between 40 and 60 kg S/ha. The results confirm the findings of Singh *et al.* (1997).

Significant improvement in yield attributes, reflected in seed yield of Indian mustard, increased significantly with the increasing levels of S up to 40 kg/ha (Table 2). However, at higher levels of sulphur application, i.e. 60 kg/ha, the yield difference was not significant compared to 40 kgS/ha. Chauhan *et al.* (1996) and Kachroo and Kumar (1997) also reported significant increase in the seed yield of Indian mustard with S application up to 50 kg/ha. The yield increase owing to 20, 40 and 60 kg S/ha was 42.7, 63.4 and 65.1%, respectively, over the control. Almost similar trends were observed for straw or stalk

Table 1. Yield attributes as affected by Indian mustard genotypes and sulphur levels

Treatment	Siliquae/ plant		Seed yield/ plant (g)		Length of siliqua (cm)		Seeds/ siliqua		1,000-seed weight (g)	
	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98
Genotype										
'Varuna'	580	299	46.28	8.56	4.40	3.64	14.17	12.23	5.53	4.23
'PBM 16'	410	302	32.75	9.02	3.71	3.54	12.25	12.55	4.63	4.42
'Rohini'	531	316	42.50	9.22	4.19	3.58	13.50	12.85	5.23	4.60
'Pusa Bahar'	657	349	52.48	9.23	4.77	4.03	14.96	12.77	5.73	4.69
CD (P=0.05)	10	7	0.67	0.24	0.04	0.13	0.20	0.15	0.23	0.09
Sulphur (kg/ha)										
0	457	202	36.60	7.04	3.93	3.39	12.85	10.50	4.79	4.02
20	545	325	43.17	8.81	4.26	3.70	13.71	12.58	5.27	4.43
40	586	346	47.07	9.71	4.43	3.84	14.13	13.57	5.52	4.70
60	589	353	47.18	10.48	4.44	3.86	14.19	13.76	5.54	4.78
CD (P = 0.05)	10	7	0.67	0.24	0.04	0.13	0.20	0.15	0.23	0.09

Table 2. Seed and biological yields, harvest index, oil production and net returns in Indian mustard as influenced by different genotypes and sulphur levels

Treatments	Seed yield (kg/ha)			Biological yield (kg/ha)			Harvest index (%)		Oil (%) in seed		Oil production (kg/ha)		Net return (Rs/ha)
	1996–97	1997–98	Pooled	1996–97	1997–98	Pooled	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	
Genotype													
'Varuna'	1,791	926	1,359	5,336	3,816	4,576	33.5	24.4	32.18	34.12	580.4	317.2	13,675
'PBM 16'	1,473	952	1,213	4,348	3,990	4,169	33.8	23.9	30.93	32.97	459.9	315.8	11,080
'Rohini'	1,604	966	1,285	4,596	4,111	4,354	34.9	23.6	31.46	32.99	507.5	320.2	12,160
'Pusa Bahar'	1,932	979	1,456	5,631	4,223	4,927	34.3	23.2	35.46	36.93	680.5	363.6	14,725
CD=(P=0.05)	42	8	27	117	64	105	NS	0.5	0.16	0.13	13.7	3.41	956
Levels of sulphur (kg/ha)													
0	1,138	721	930	3,319	2,975	3,147	34.3	24.3	30.62	32.22	348.5	232.3	6,835
20	1,689	964	1,327	4,990	3,966	4,478	33.9	24.4	32.36	34.29	546.6	330.0	12,579
40	1,979	1,061	1,520	5,790	4,556	5,173	34.2	23.4	33.29	35.12	658.8	372.7	15,460
60	1,993	1,077	1,535	5,838	4,642	5,240	34.2	23.2	33.34	35.38	664.5	380.8	15,415
CD (P = 0.05)	42	8	27	117	64	105	NS	0.5	0.16	0.13	13.7	3.41	956

and biological yield (Table 2). Harvest index was not affected due to different levels of sulphur application during 1996–97. However, highest harvest index (24.4%) was recorded at 20 kg S/ha and was statistically superior to 40 and 60 kg/ha during 1997–98.

Oil production

Oil content in seed of 'Pusa Bahar' was the maximum, being 35.5 and 36.9% during 1996–97 and 1997–98, respectively, compared with other genotypes and the minimum (32%) in the seeds of 'PBM 16'. Since the oil production is the combined effect of oil content and seed yield, the significantly higher oil production was also obtained from 'Pusa Bahar' genotype. This variety produced 73.3, 134.2 and 108.2 kg/ha more oil than 'Varuna', 'PBM 16' and 'Rohini', respectively. Oil content (%) in seed increased with every increase in level of sulphur and an increase in oil yield was also recorded with increasing sulphur levels. Hence the maximum oil production (522.7 kg/ha) was in the treatments where 60 kg S/ha was applied. However, difference was not significant between 40 and 60 kg S/ha. Singh and Kumar (1996) also reported similar results.

Monetary returns

The regional adoptability of any agronomic practices in the yield of any crop is completely based on maximum economic value of treatments. Based on cost analysis, 'Pusa Bahar' gave the maximum net returns (Rs 14,7235/ha), followed by 'Varuna' (Rs 13,675/ha). This may be because of higher yield of component varieties. Among levels of sulphur, the net returns increased with the increase in sulphur dose up to 40 kg/ha. The highest net returns of Rs 15,460/ha was recorded at 40 kg S/ha, being 126.0 and 22.9% higher than that at 0 and 20 kg S/ha. This may be attributed to higher yield of Indian mustard with 40 kg S/ha. The highest benefit : cost ratio 2.07 was observed with 'Pusa Bahar', indicating the economic viability. In case of sulphur application, highest benefit : cost was registered with the application of 40 kg S/ha which clearly shows the economic viability of the sulphur fertilization @ 40 kg/ha.

It, was concluded that genotype 'Pusa Bahar' may be fertilized with 40 kg S/ha, in addition to other standard agronomic practices, to harvest the optimum yield of Indian mustard and highest net returns.

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