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Yield, Nutrient Content and Uptake by Indian Mustard (*Brassica juncea* (L.) Czernj and Cossonj as Influenced by FYM, Nitrogen and Source of Fertilizer

R. H. Patel, T. G. Meisheri, B. K. Patel* and J. R. Patel

Department of Agronomy, B. A. College of Agriculture, Gujarat Agricultural University, Anand Campus, Anand-388 110

ABSTRACT

An experiment was conducted at Anand during winter season of 1992-93 and 1993-94 to study the effect of FYM, nitrogen and source of fertilizer on yield and nutrient uptake in mustard crop. P-content in stover, S-content in seed and stover and N-uptake during 1993-94, P and S-uptake as well as seed and stover yields in both the years were significantly higher in FYM applied either @ 10 or 20 tonnes ha^{-1}. Increasing the rate of N progressively raised the N and S-contents in both seed and stover and N, P and S uptake as well as seed and stover yields in both the years of study. S carrying source (S_2) gave significantly higher N, P and S contents in seed and stover and their uptake, by crop, seed and stover yields as compared to sulphur free fertilizer source (S_1) during both the years. The N and S content in seed and stover and uptake of N, P and S by crop were strongly associated with seed yield in mustard.

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INTRODUCTION

The concentration of plant nutrients in a crop and the amount of nutrients being removed by a particular crop from the soil may be helpful guide for formation of a sound fertilizer management programme (Tandon, 1989). Also, nutrient translocation from vegetative parts (source) to the grain (sink) during grain filling has been considered to be an important factor that influences the yield. Studies on direct effect of FYM, nitrogen and source of fertilizer on the content and uptake of nutrients by crops have been found to be helpful in economizing the fertilizer use without any adverse effect on soil fertility.

MATERIALS AND METHODS

A field experiment was conducted during the winter of 1992-93 and 1993-94 at College Farm, B. A. College of Agriculture, Anand Campus, Anand on loamy sand soil containing 0.36 per cent organic matter, 0.036 per cent total nitrogen, 42.5 kg available P_2O_5, 274.8 kg available K_2O and 10 ppm S ha^{-1} with a pH of 7.9. Mustard cv. GM-1 was sown at 45 cm x 15 cm spacing. Treatments consisted of three levels of FYM (0, 10 and 20 tonnes ha^{-1}) as main plots and combinations of three N-levels (25, 50 and 75 kg ha^{-1}) and two sources of fertilizers (S-free source : Urea + DAP and S-carrying

*Present address : Senior Biochemist, Bidi Tobacco Research Station, GAU, Anand-388 110.

source : AS + SSP) as sub-plots. The treatments were replicated six times in a split-plot design. Entire quantity of FYM and 50 per cent of N were applied as basal and remaining N was top dressed 45 DAS in respective treatments. The whole quantity of N (basal + top dressed) and recommended dose of phosphorus (50 kg ha^{-1}) were applied through two sources viz., Urea + DAP (S-free fertilizers) and AS + SSP (S-carrying fertilizers).

Mustard seed and stover samples collected were analysed for N, P and S contents. N was estimated by microkjeldahl method (Jackson, 1973), P by Vanadate method colorimetrically (Jackson, 1973) and S turbidimetrically (Chopra and Kanwar, 1976). Uptake of nutrients was calculated by multiplying the yield with per cent content of the respective nutrient and converted in kg ha^{-1} for each nutrient. All data thus obtained were processed statistically.

RESULTS AND DISCUSSION

Seed and stover yield

The data on seed yield (Table 1) indicated that FYM application (10 and 20 tonnes ha^{-1}) significantly increased the seed yield of mustard over no application in individual years as well as in pooled results too. The magnitude of mean increase in seed

TABLE 1

Seed and stover yields of mustard as influenced by varying levels of FYM, nitrogen and source of fertilizer.

Treatment	Seed (kg ha^{-1})			Stover (kg ha^{-1})		
	1992-93	1993-94	Pooled Mean	1992-93	1993-94	Pooled Mean
FYM (tonnes ha^{-1})						
F_0	2510	2508	2509	5319	5858	5589
F_{10}	2681	2761	2721	5674	6099	5887
F_{20}	2767	2831	2799	5713	6604	6159
C. D. (P = 0.05)	110	144	85	187	290	NS
Nitrogen (kg ha^{-1})						
N_{25}	2360	2489	2424	5109	5669	5539
N_{50}	2709	2764	2737	5733	6294	6013
N_{75}	2889	2847	2868	5864	6299	6082
C. D. (P = 0.05)	108	146	89	279	270	191
Source of fertilizer						
Urea + DAP (S_1)	2549	2564	2556	5357	6056	5707
AS + SSP (S_2)	2756	2836	2796	5781	6319	6050
C. D. (P=0.05)	88	119	73	227	220	155

TABLE 2

Nitrogen content in seed and stover of mustard and nitrogen uptake by plant as influenced by varying levels of FYM, nitrogen and source of fertilizer.

Treatment	N content (%)						N uptake (kg ha^{-1})		
	Seed			Stover					
	1992-93	1993-94	Pooled Mean	1992-93	1993-94	Pooled Mean	1992-93	1993-94	Pooled Mean
FYM (tonne ha^{-1})									
F_0	3.75	3.64	3.69	0.40	1.00	0.70	115.80	150.76	133.28
F_{10}	3.66	3.69	3.68	0.42	1.12	0.77	124.08	175.08	149.58
F_{20}	3.73	3.50	3.62	0.40	1.07	0.73	126.47	172.57	149.52
C. D. (P = 0.05)	NS	NS	NS	NS	NS	0.48	NS	12.05	7.49
Nitrogen (kg ha^{-1})									
N_{25}	3.54	3.50	3.52	0.39	0.99	0.69	104.14	145.74	124.94
N_{50}	3.64	3.65	3.65	0.40	1.04	0.72	121.81	171.71	146.76
N_{75}	3.96	3.69	3.82	0.42	1.17	0.80	140.40	180.96	160.68
C. D. (P = 0.05)	0.185	0.137	NS	0.026	0.037	NS	7.90	9.11	5.94
Source of fertilizer									
Urea + DAP (S_1)	3.60	3.47	3.54	0.39	1.00	0.70	114.02	152.06	133.04
AS + SSP (S_2)	3.82	3.75	3.79	0.42	1.13	0.78	130.22	180.21	155.21
C. D. (P = 0.05)	0.151	0.112	0.093	0.021	0.030	NS	6.47	7.44	NS

yield with 10 and 20 tonnes ha^{-1} was 11.6 and 8.5 per cent, respectively over no application. The results confirm the findings of Khurana *et al.*, (1991). The stover yield when pooled however, was not affected by FYM application.

The results further indicated that graded increase in levels of N significantly increased the seed yield in 1992-93 and in pooled analysis, whereas during 1993-94, N_{50} and N_{75} being at par, significantly increased the seed yield over N_{25}. The stover yield of mustard was significantly increased upto 50 kg N ha^{-1} during both the years and in pooled analysis.

Sulphur carrying source of fertilizer (AS + SSP) significantly produced higher seed and stover yields than S-free source of fertilizer (Urea + DAP) individual years as well as in pooled analysis.

N-concentration and uptake

The N-content of seed and stover was not improved significantly due to FYM application in both the years (Table 2). However, pooled data showed the significant improvement in N-content of stover, wherein FYM @ 10 tonnes ha^{-1} registered the maximum N-content. The data of 1993-94 and of pooled analysis also indicated significant increase in N-uptake at 10 tonnes FYM ha^{-1} over no FYM application. Similar results were obtained by Sharma *et al.* (1993) and Sardana and Sidhu (1994).

The N-content of seed as well as stover was significantly increased by N-levels. Application of N @ 75 kg ha^{-1} recorded significantly the highest N-content in seed and stover during 1992-93 and 1993-94. Similar results were obtained by Joshi *et al.*, 1991. N-uptake was also significantly increased with increased level of applied N (Table 2). The higher uptake due to N fertilization was also recorded by Nepalia (1991).

The S-containing fertilizer significantly increased N-content of seed and stover during both the years. However, it was higher in seed than stover (Table 2). Such an increase of N-content in seed and stover might be due to synergistic effect of both N and S which were supplied through S-containing fertilizers (Aulakh and Pasricha, 1983). The N-uptake by mustard crop increased significantly with the use of source S_2 (AS + SSP) during both the years, which might be due to the cumulative effect of increased seed and stover yields as well as increased N-content in both seed and stover. Similar positive effects on increase in N-content of seed and stover as well as N-uptake were recorded at Junagadh (Anon., 1992).

P-concentration and uptake

Application of FYM @ 20 tonnes ha^{-1} significantly increased the P-content of seed over no application but it was at par with 10 tonnes FYM ha^{-1} on pooled basis (Table 3). The differences in P-content in stover due to FYM treatment were found significant only in 1993-94 wherein 20 tonnes FYM ha^{-1} recorded significantly the highest P-content. It was further observed that the P-uptake by plant was increased significantly with each successive increase in FYM levels during 1993-94 and in pooled analysis. The highest P-uptake noted with 20 tonnes ha^{-1} which increased the P- uptake to the tune of 11.8, 25.9 and 18.4 per cent over no FYM in 1992-93, 1993-94 and in pooled data, respectively, FYM helps in increasing P utilization on account of organic compounds

TABLE 3

Phosphorus content in seed and stover of mustard and phosphorus uptake by plant as influenced by varying levels of FYM, nitrogen and source of fertilizer.

Treatment	P content (%)						P uptake (kg ha^{-1})		
	Seed			Stover					
	1992-93	1993-94	Pooled Mean	1992-93	1993-94	Pooled Mean	1992-93	1993-94	Pooled Mean
FYM (tonnes ha^{-1})									
F_0	0.83	0.64	0.73	0.07	0.09	0.083	24.63	21.51	23.07
F_{10}	0.85	0.66	0.75	0.07	0.09	0.082	27.06	24.36	25.71
F_{20}	0.85	0.68	0.76	0.07	0.11	0.092	27.54	27.09	27.31
C. D. (P = 0.05)	NS	NS	0.020	NS	0.009	NS	1.86	2.19	1.28
Nitrogen (kg ha^{-1})									
N_{25}	0.84	0.67	0.75	0.07	0.09	0.080	23.22	22.14	22.68
N_{50}	0.84	0.65	0.75	0.07	0.10	0.085	23.62	25.06	25.84
N_{75}	0.85	0.66	0.75	0.08	0.10	0.092	29.38	25.78	27.58
C. D. (P = 0.05)	NS	NS	NS	0.009	NS	0.007	1.38	1.47	NS
Source of fertilizer									
Urea + DAP (S_1)	0.85	0.68	0.77	0.08	0.11	0.091	25.93	24.28	25.11
AS + SSP (S_2)	0.83	0.64	0.74	0.07	0.09	0.080	26.88	24.37	25.63
C. D. (P = 0.05)	0.015	0.010	0.010	NS	0.010	0.006	NS	NS	NS

TABLE 4

Sulphur content in seed and stover of mustard and sulphur uptake by plant as influenced by varying levels of FYM, nitrogen and source of fertilizer.

Treatment	*S content (%)*						*S uptake (kg ha^{-1})*		
	Seed			*Stover*					
	1992-93	*1993-94*	*Pooled Mean*	*1992-93*	*1993-94*	*Pooled Mean*	*1992-93*	*1993-94*	*Pooled Mean*
FYM (tonnes ha^{-1})									
F_0	1.63	1.28	1.46	0.34	0.65	0.50	59.58	70.42	65.00
F_{10}	1.78	1.57	1.68	0.34	0.76	0.55	68.11	92.64	80.37
F_{20}	1.79	1.59	1.69	0.35	0.80	0.57	69.81	99.69	84.75
C. D. (P = 0.05)	NS	0.224	0.13	NS	0.049	NS	7.82	4.16	NS
Nitrogen (kg ha^{-1})									
N_{25}	1.63	1.37	1.50	0.31	0.67	0.49	54.72	74.05	64.39
N_{50}	1.80	1.45	1.62	0.35	0.77	0.56	69.27	90.78	80.03
N_{75}	1.77	1.63	1.70	0.36	0.78	0.57	73.49	97.93	85.71
C. D. (P = 0.05)	0.101	0.165	0.10	0.032	0.049	0.029	4.05	5.86	3.51
Source of fertilizer									
Urea + DAP (S_1)	1.64	1.39	1.51	0.29	0.58	0.44	58.13	72.30	65.21
AS + SSP (S_2)	1.83	1.58	1.70	0.39	0.89	0.64	73.53	102.87	88.20
C. D. (P = 0.05)	0.0083	0.135	0.08	0.026	0.039	NS	3.31	4.78	NS

present in it which are capable of chelating cations like Al and Fe, thus preventing them to become insoluble as Al and Fe phosphates (Lal and Dravid, 1993). This was clearly evident from the results of present study on P-uptake. P-content of seed remained unchanged due to N-fertilization. However, P-content of stover was significantly increased in 1992-93 and in pooled results, wherein the highest level of N (75 kg ha^{-1}) showed maximum P-content. The differences in P-uptake by crop were found significant due to different N-treatments and maximum P-uptake was recorded in N applied @ 75 kg ha^{-1} during both the years of study. Similar, significant response to N-fertilization was for P content of stover observed in earlier work (Prasad and Shukla, 1991).

S-free source (Table 3) helped in increasing the P-content of seed (during both the years) and stover during 1993-94 and in pooled analysis. The relatively lower P-concentration in seed and stover under S_2 could be due to simple dilution effect. Aulakh *et al.* (1977) also reported similar findings. However, the P-uaptake under both the sources of N and P fertilizers remained unaltered.

S-concentration and uptake

Application of FYM @ 20 tonnes ha^{-1} significantly increased the S-content of seed and stover over no application during 1993-94 (Table 4). The addition of FYM besides improving physical and biological properties of soil, supplies macro, secondary and micro-nutrients and improves root proliferation which might have helped in increasing sulphur absorption (Lal and Dravid, 1993). The data further revealed that S-uptake was significantly increased by FYM application upto 10 tonnes ha^{-1} during 1992-93 and 20 tonnes ha^{-1} in 1993-94. Dhillon and Dhillon (1991) also obtained similar effect of FYM on S-uptake.

The highest level of N (75 kg ha^{-1}) showed significantly the highest S-content in seed and stover during both the years and in pooled analysis. It was further observed that the S-uptake by crop was increased significantly with every increased level of applied N. On an average N_{25}, N_{50} and N_{75} removed 64.39, 80.03 and 85.71 kg S ha^{-1}, respectively. N application is known to increase the root cation - exchange capacity which may improve the absorption of P and S ions through synergistic effect of N on these ions (Aulakh and Pasricha, 1983). This was well elucidated by significantly improved uptake of P and S due to N- fertilization as observed in the present study.

TABLE 5

Correlation coefficient (r) between seed yield and nutrients content and uptake.

Sr. No.	*Characters*	*Correlation coefficient (on pooled basis)*
1.	N–content in seed (%)	0.63*
2.	N–content in stover (%)	0.83*
3.	P -content in seed (%)	-0.04
4.	P -content in stover (%)	0.22
5.	S - content in seed (%)	0.84*
6.	S - content in stover(%)	0.78*
7.	N - uptake (kg ha^{-1})	0.96*
8.	P - uptake (kg ha^{-1})	0.91*
9.	S - uptake (kg ha^{-1})	0.93*

Critical value at 5%, 0.47

* Significant at 5% level.

The source having S significantly increased S-content of both seed and stover over S-free source. This may be due to the fact that S-source (AS) not only increases the availability of S from applied fertilizer but also the availability of native S of soil as reported by Dhillon and Dev (1980). The highest uptake of S was also observed in favour of S_2 source during both the years. The increased uptake of S by mustard crop with S-containing source seems to be partly due to increased content of this element in seed and stover (Table 4) and partly due to higher yield with source carrying sulphur.

Correlation study

The nutrients content (N and S) and uptake (N, P and S) have indicated significant positive correlation with seed yield, while P-content in seed and stover did not show any significant association with seed yield of mustard.

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