Ann. Agric. Res. New Series Vol. 34 (3) : 236-240 (2013)

Effect of FYM and mineral nutrients on yield, content and uptake of nutrients in mustard

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Received : June 2012; Revised accepted : March 2013

Abstract

A field experiment was conducted at Agronomy Farm of S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan) during the *rabi* season of 2005-06 using randomized block design with three replication to study the effect of FYM and mineral nutrients on seed and stover yield, content and uptake of nutrients in mustard. The experiment consisted of three levels of FYM *viz*., control, 5 t/ha & 10 t/ha and five levels of mineral nutrients *viz*., no mineral nutrients, 40 kg S/ha, 40 kg S/ha+ 25 kg $ZnSO_4$/ha, 40 kg S/ha + 50 kg $FeSO_4$/ha and 40 kg S/ha + 25 kg $ZnSO_4$/ha+ 50 kg $FeSO_4$/ha. The results revealed that each successive increasing levels of FYM and mineral nutrients individually and in combination significantly increased the seed and stover yield, content and uptake of nitrogen (N), sulphur (S), zinc (Zn) and iron (Fe) in seed and stover as compared to control. The combined application of FYM and mineral nutrients was found to increase Zn uptake in seed and Fe uptake in stover as compared to their individual application. The highest Zn uptake in seed (87.4 g/ha) and Fe uptake in stover (868.5 g/ha) was obtained under 10 t FYM/ha and 40 kg S/ha+ 25 kg $ZnSO_4$/ha+ 50 kg $FeSO_4$/ha (F_2M_4) treatment.

Key words : Content, FYM, mineral nutrients, mustard, uptake, yield.

Presently, rapeseed-mustard [*Brassica juncea* (L.) Czern and Coss] is the third most important oilseed crops after soybean and groundnut in India occupying 6.9 million hectare acreage, 8.18 million tonnes production and 1185 kg/ha productivity (FAI, 2011-12). The productivity is quite lower than other developed countries mainly due to sub-optimal application of fertilizers and their cultivation on marginal lands under rainfed conditions. The organic manures (FYM) being cheaper and eco-friendly, could be the alternatives to fertilizers for improving both crop productivity and sustainability of the systems. The continuous mining of nutrients from soils coupled with inadequate and imbalanced fertilizer use has resulted in emergence of multinutrient deficiencies. The deficiencies of at least six nutrients (N, P, K, S, Zn and B) are quite widespread in Indian soils (Tewatia, 2007). Sulphur is involved directly or indirectly in different metabolic pathways of plants and also as a constituent of many metabolites. The involvement of S as an important component of several enzymes and metabolic processes in plants is well documented (Lakkineni and Abrol, 1994). Activator of several enzymes such as urease, nitrogenase, nitrate reductase and ribonuclease are known to be retarded by deficiency of sulphur (Qi, 1989). Zinc is one of the first micronutrients recognized as essential for plants. It is a micronutrient most commonly limiting crop yields in Indian soils. Some crops are more responsive to Zn than others. Zinc is transported to plant root surface through diffusion. It aids in the synthesis of plant growth substances and enzyme systems and is essential for promoting certain metabolic reactions. It is necessary for production of chlorophyll and carbohydrates. Iron plays an important role in the synthesis of chlorophyll and also helps in the absorption of other nutrients. As a constituent of chlorophyll, it regulates respiration, photosynthesis, reduction of nitrates and sulphates. Therefore, the present study was carried out with objective to study the effect of FYM and mineral nutrients on yield, content and uptake of nutrients in mustard.

Materials and Methods

A field experiment was conducted on mustard (var. Bio-902) during the *rabi* season of 2005-06 at Agronomy Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) (26.050 N, 75.280 E and 427 m above mean sea level). The experimental soil was loamy sand in texture, alkaline in reaction (pH 8.3) with EC 0.90 dS/m, organic carbon l.8 g/kg, available N 156.6 kg/ha, P 7.5 kg/ha, K 149.5 kg/ha, S 7.2 mg/kg, Zn 0.43 mg/kg and Fe 4.3 mg/kg. The experiment was laid out in randomized block design and replicated thrice with three levels of FYM [Control (F_0), 5 (F_1) and 10 (F_2) t/ha] and five levels of mineral nutrients [Mo (control), M_1 (sulphur @ 40 kg/ha), M_2 (sulphur @ 40 kg/ha + zinc sulphate @ 25 kg/ha), M_3 (sulphur @ 40 kg/ha + ferrous sulphate @ 50 kg/ha), M_4 (sulphur @ 40 kg/ha + zinc sulphate @ 25 kg/ha + ferrous sulphate @ 50 kg/ha)]. The recommended dose of N, P, and K was applied in the whole of the field prior to sowing. Whereas, sulphur and FYM were applied about three weeks (21 days) before sowing of the crop. The quantity of sulphur added through $ZnSO_4.7H_2O$ and $FeSO_4.7H_2O$ was equated @ 40 kg S/ha in respective treatments. The mustard var. Bio-902 was taken as test crop and sown in lines 30 cm apart manually by 'Kera methods'. Usual crop husbandry operations were followed to raise a good crop. Yield from each plot was recorded as q/ha. The N, S, Zn and Fe contents in seed and stover were estimated as per the procedures described by Prasad *et al*. (2006). The uptake of these nutrients were calculated by multiplication of concentrations with the respective yield (seed & stover).

Results and Discussion

The increasing levels of FYM significantly increased the seed and stover yield, concentration and uptake of N, S, Zn and Fe in seed and stover of mustard (Tables 1 and 2). The highest values of seed and stover yield, concentration, uptake and total uptake of N (16.9 q/ha, 40.6 q/ha, 3.40 & 0.67%, 57.6 & 27.4 kg/ha and 84.9 kg/ha), S (0.91 & 0.48%, 15.4 & 19.6 kg/ha and 35.0 kg/ha), Zn (38.9 & 15.7 mg/kg, 66.2 & 64.3 g/ha and 130.4 g/ha); and Fe (161.9 & 167.3 mg/kg, 274.4 & 683.0 g/ha and 956.7 g/ha) in seed and stover was found in F_2 (10 t FYM/ha). Application of 10 t FYM/ha significantly increase the seed and stover yield by 47.3 and 42.8% as compared to control. The increase in nutrient content due to application of 10 and 5 t FYM/ha were in order of N 10.8 & 6.2% and 10.5 & 6.6%, S 9.2 & 4.9% and 10.4 & 7.4%, Zn 9.1 & 4.8% and 9.3 & 5.2%; and Fe 6.9 & 3.7% and 4.9 & 2.6% and uptake of N 63.6 & 37.8% and 58.3 & 35.7%, S 60.5 & 35.8% and 58.1 & 36.5%, Zn 61.6 & 35.9% and 57.3 & 34.1%; and Fe 58.1 & 34.5% and 50.8 & 30.8% in seed and stover of mustard, respectively as compared to control (F_0). Total uptake of N, S, Zn and Fe was recorded as 61.2, 58.2, 59.2 and 50.5%, respectively over control (F_0). The increase of nutrient concentration and uptake with application of FYM might be due to increased availability of nutrients to plants and improving the physical condition of the soil. The gradual mineralization and availability of nutrients along with increased moisture holding capacity of soil by FYM might be the reason for higher yield. These findings were supported by Sukmal *et al.* (2004). This may be due to favourable effect of physical and chemical environment of soil with FYM application which causes continuous supply of nutrients (Mandal and Sinha, 2002).

The seed and stover yield, concentration and uptake of N, S, Zn and Fe in seed and stover also increased significantly with the application of mineral nutrients (Tables 1 and 2). The highest values of seed and stover yield, concentration and uptake of N, S, Zn and Fe in seed and stover was obtained in M_4 (40 kg S/ha + 25 kg $ZnSO_4$/ha + 50 kg $FeSO_4$/ha) treatment. Application of mineral nutrients under M_4 (40 kg S/ha + 25 kg $ZnSO_4$/ha + 50 kg $FeSO_4$/ha) significantly increased seed and stover yield by 57.3 and 49.6 % as compared to control. The increase in nutrient concentration due to application of 40 kg S/ha + 25 kg $ZnSO_4$/ha + 50 kg $FeSO_4$/ha (M_4) were in order of N 9.1 and 8.5%, S 12.5 and 16.1%, Zn 14.1 and 12.9%; and Fe 8.3 and 6.0% and uptake of N 72.0 and 62.2%, S 76.6 and 73.1%, Zn 81.0 and 70.0%; and Fe 71.3 and 59.2% in seed and stover of mustard, respectively as compared to control (M_0). The total uptake of N, S, Zn and Fe in plants was recorded as 67.9, 75.3, 75.4 and 62.5%, respectively over control (M_0). This is clear from the fact that experimental soil was coarse textured and low in organic carbon and N status. The application of mineral nutrients supplied the N as well as other nutrients and increased their availability to the plants. This result confirms the findings of Misra (2001). It is owing to the fact that experimental soil was deficient in S status; the increase in S uptake seemed to be associated with increased S availability with a concomitant increase in crop yield with S application (Kumawat and Aswal, 2005). The higher response of micronutrients was because of inadequate availability of these micronutrients in the experimental soil. The increase in uptake may be attributed to increased seed and stover yields with the application of different mineral nutrient combinations (Samui *et al.*, 1981).

Interactive effect of FYM and mineral nutrients

The data (Table 3) showed that irrespective the levels of mineral nutrients, the increasing levels of FYM enhanced the Zn uptake in seed and Fe uptake in stover significantly, expect that of control (F_0M_0) level mineral nutrients here the increase in Zn uptake in seed and Fe uptake in stover under 10 t FYM/ha over 5 t FYM/ha was not significant. Similarly, irrespective of the levels of FYM the increasing levels of mineral nutrients significantly enhanced the Zn uptake in seed and Fe uptake in stover except that of control (F_0M_0). The combined application of 10 t FYM/ha and 40 kg S/ha + 25 kg $ZnSO_4$/ha + 50 kg $FeSO_4$/ha gave significantly highest Zn uptake in seed (87.4 g/ha) and Fe uptake in stover (868.5 g/ha) as compared to all other combination of FYM and mineral nutrients. Besides, the combined application of FYM and mineral nutrients further improved the nutrient uptake mainly due to better growth and dry matter accumulation. The balanced nutrition also enhanced the synergistic effect on uptake of other plant nutrients (Ahmad *et al.*, 2007).

Based on above results, it can be concluded that coarse textured soils are low in organic carbon and deficiency of multi-nutrients (N, S,

Table 1. Effect of FYM and mineral nutrients on N, S, Zn and Fe content in seed and stover of mustard

Treatment	Yield (q/ha)		N (%)		S (%)		Zn (mg kg^{-1})		Fe (mg kg^{-1})	
	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover
FYM (t/ha)										
F_0	11.4	28.4	3.07	0.61	0.83	0.43	35.7	14.4	151.4	159.5
F_1	14.8	36.1	3.26	0.65	0.88	0.47	37.4	15.1	157.1	163.7
F_2	16.9	40.6	3.40	0.67	0.91	0.48	38.9	15.7	161.9	167.3
SEm ±	0.25	0.69	0.02	0.004	0.005	0.003	0.49	0.19	1.66	1.14
CD (P=0.05)	0.73	2.00	0.06	0.012	0.016	0.009	1.43	0.54	4.79	3.31
Mineral nutrients (kg/ha)										
M_0	10.9	27.5	3.09	0.61	0.81	0.42	34.6	14.0	151.1	159.1
M_1	13.4	32.8	3.19	0.64	0.87	0.46	35.6	14.7	152.5	160.5
M_2	15.5	37.1	3.30	0.65	0.89	0.47	39.0	15.5	153.8	161.3
M_3	14.9	36.7	3.26	0.65	0.88	0.47	37.8	15.2	162.9	167.9
M_4	17.2	41.2	3.37	0.66	0.91	0.48	39.5	15.8	163.6	168.7
SEm ±	0.33	0.89	0.03	0.005	0.007	0.004	0.64	0.24	2.14	1.47
CD (P=0.05)	0.95	2.58	0.08	0.015	0.021	0.011	1.84	0.70	6.19	4.27

F_0 : 0 t FYM/ha; F_1 : 5 t FYM/ha; F_2 : 10 t FYM/ha; M_0 : control (no sulphur); M_1 : 40 kg sulphur/ha; M_2: 40 kg sulphar/ha + 25 kg zinc sulphate/ha; M_3: 40 kg sulphur/ha + 50 kg ferrous sulphate/ha; M_4: 40 kg sulphur/ha + 25 kg zinc sulphate/ha + 50 kg ferrous sulphate/ha.

Table 2. Effect of FYM and mineral nutrients on N, S, Zn and Fe uptake and total uptake in seed and stover of mustard

Treatment	N uptake (kg/ha)		Total N uptake (kg/ha)	S uptake (kg/ha)		Total S uptake (kg/ha)	Zn uptake (g/ha)		Total Zn uptake (g/ha)	Fe uptake (g/ha)		Total Fe uptake (g/ha)
	Seed	Stover		Seed	Stover		Seed	Stover		Seed	Stover	
FYM (t/ha)												
F_0	35.2	17.3	52.7	9.6	12.4	22.1	41.0	40.9	81.9	173.6	453.0	627.4
F_1	48.5	23.4	72.0	13.0	16.9	30.1	55.7	54.8	110.5	233.5	592.7	826.2
F_2	57.6	27.4	84.9	15.4	19.6	35.0	66.2	64.3	130.4	274.4	683.0	956.7
SEm ±	1.00	0.48	1.62	0.24	0.35	0.73	1.29	1.43	2.64	5.02	12.95	17.31
CD (P=0.05)	2.90	1.39	4.68	0.70	1.01	2.13	3.74	4.16	7.64	14.55	37.52	50.15
Mineral nutrients (kg/ha)												
M_0	34.0	16.9	50.9	8.9	11.5	20.4	37.9	38.7	76.6	165.6	438.2	603.7
M_1	43.0	20.9	64.9	11.7	15.1	27.1	48.0	48.5	96.4	204.9	527.2	732.1
M_2	51.4	24.2	75.3	13.8	17.6	31.5	60.6	57.7	118.3	238.4	598.6	837.0
M_3	48.8	23.9	72.8	13.2	17.3	30.5	56.5	56.0	112.5	243.4	619.9	863.3
M_4	58.4	27.5	85.4	15.8	20.0	35.8	68.6	65.7	134.4	283.7	697.4	981.1
SEm ±	1.26	0.62	2.09	0.31	0.45	0.95	1.66	1.85	3.40	6.48	16.72	22.35
CD (P=0.05)	3.74	1.79	6.05	0.91	1.30	2.74	4.82	5.36	9.86	18.78	48.44	64.74

F_0 : 0 t FYM/ha; F_1 : 5 t FYM/ha; F_2 : 10 t FYM/ha; M_0 : control (no sulphur); M_1 : 40 kg sulphur/ha; M_2: 40 kg sulphar/ha + 25 kg zinc sulphate/ha; M_3: 40 kg sulphur/ha + 50 kg ferrous sulphate/ha; M_4: 40 kg sulphur/ha + 25 kg zinc sulphate/ha + 50 kg ferrous sulphate/ha.

Table 3. Interactive effect of FYM and mineral nutrients on zinc and iron uptake of mustard

Treatment	F_0	F_1	F_2
		Zn uptake in seed (g/ha)	
M_0	30.2	40.7	42.9
M_1	35.7	49.4	58.9
M_2	47.3	61.7	72.8
M_3	43.9	56.5	69.2
M_4	48.0	70.4	87.4
SEm ±		2.88	
CD (P=0.05)		8.35	
		Fe uptake in stover (g/ha)	
M_0	358.9	471.8	483.8
M_1	414.9	558.5	608.1
M_2	493.3	599.7	702.9
M_3	494.0	613.9	751.8
M_4	504.1	719.6	868.5
SEm ±		28.96	
CD (P=0.05)		83.90	

F_0 : 0 t FYM/ha; F_1 : 5 t FYM/ha; F_2 : 10 t FYM/ha; M_0 : control (no sulphur); M_1 : 40 kg sulphur/ha; M_2: 40 kg sulphar/ha + 25 kg zinc sulphate/ha; M_3: 40 kg sulphur/ha + 50 kg ferrous sulphate/ha; M_4: 40 kg sulphur/ha + 25 kg zinc sulphate/ha + 50 kg ferrous sulphate/ha.

Zn, Fe and B) are quite widespread in semi-arid regions of Rajasthan. The combined application of l0 t FYM/ha and 40 kg S/ha + 25 kg $ZnSO_4$/ha + 50 kg $FeSO_4$ /ha was found to be optimum for nutrient uptake (Zn in seed and Fe in stover) in mustard crop grown in loamy sand soils.

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