Annals of Plant and Soil Research 17(3): 266-268 (2015)

YIELD, NUTRIENT UPTAKE AND ECONOMICS OF INDIAN MUSTARD AS INFLUENCED BY VARIETIES, SOURCES AND LEVELS OF SULPHUR

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Received: June, 2014; Revised accepted: April, 2015

ABSTRACT

A field experiment was conducted during rabi season of 2010-11 and 2011-12 at Kota (Rajasthan) on clay loam soil to study the effect of varieties, sources and levels of sulphur on yield, nutrient uptake and economics of Indian mustard [Brassica juncea (L.) Czern and Cosson]. Results revealed that mustard variety DMH-1 gave significantly higher seed (1734 kg ha^{-1}) and straw yield (5558 kg ha^{-1}) and total uptake of N (100.6 kg ha^{-1}), P (27.9 kg ha^{-1}), K (66.5 kg ha^{-1}) and S (13.7 kg ha^{-1}), net return (₹. 25145 ha^{-1}) over rest of varieties. Sulphur application through gypsum gave higher seed and straw yields, total uptake of nutrients and net return as compared to elemental S and pyrites. Sulphur fertilization upto 90 kg ha^{-1} gave significantly higher seed (1711 kg ha^{-1}) and straw yield (5517 kg ha^{-1}), total nutrient uptake of N (99.6 kg ha^{-1}), P (27.7 kg ha^{-1}), K (63.6 kg ha^{-1}) and S (13.8 kg ha^{-1}), net return (₹. 24192 ha^{-1}).

Keywords: Indian mustard, economics, nutrient uptake, sulphur, variety, yield

INTRODUCTION

Indian mustard occupies more than 70 % of the area under Rapeseed-mustard group of crops grown in India. Inherited yield potentials of mustard varieties can be achieved by providing plant nutrients specially sulphur to the crop. Sulphur could be supplied through different sources like elemental sulphur, gypsum, pyrites, ammonium sulphate, super phosphate and potassium sulphate. Plants can take sulphur in sulphate form which is more pertinent to neutral to slightly alkaline soils. Out of these sources gypsum is the best option for the plant nutrition. Sulphur is involved in oil synthesis and in many physiological functions like amino acid synthesis, chlorophyll and oil (Aulakh and Pasricha, 1988 and Rathore *et al*. 2015). Genetic constitution of the varieties and their characters vary accordingly under different agro-edaphic conditions. That`s why it is essential to evaluate the performance of recommended varieties for commercial cultivation. Hence, this study was undertake to study the effect of varieties, sources and levels of sulphur on yield, nutrient uptake and economics of Indian mustard.

MATERIALS AND METHODS

A field experiment was conducted during rabi seasons 2010-11 and 2011-12 at Chambal Agricultural Research Station, Nanta farm, Kota (Rajasthan). The soil was clay loam in texture with pH 7.4, organic carbon 4.9 g kg^{-1} and available nitrogen, phosphorus, potash and sulphur was 160, 31, 460 and 23 kg ha^{-1}, respectively. The experiment comprising of four mustard varieties (DMH-1, NRC-HB-506, Bio-902 and Pusa bold), three sources of sulphur (gypsum, elemental sulphur, pyrites) and three levels of sulphur (30, 60, 90 kg ha^{-1}) making 36 treatment combinations. The experiment was laid out in split plot design allocating varieties in main plots, sources of sulphur in sub plots and levels of sulphur in sub- sub plots with randomized three times. A basal dose of 30 kg N and 30 kg P_2O_5 ha^{-1} through DAP and urea was drilled uniformly in the furrows at 8-10 cm depth. At the time of first irrigation remaining dose of 30 kg N ha^{-1} was applied through urea as top dressing uniformly to all the plots. The sources of sulphur i.e. gypsum, elemental sulphur and pyrites were applied as per treatment in earmarked plots 30 days before sowing and incorporated in the soil. Crop was sown by ‘Kera’ method with row spacing of 30 cm by deshi plough and seed was sown at the rate of 5 kg ha^{-1}. At maturity, the seed and stover yields were recorded. The seed and stover were analysed for their contents of N, P, K and S by adopting standard procedures (Jackson 1973). The ecxonomics of the treatments was calculated as per prevailing market prices of inputs.

RESULTS AND DISCUSSION

Yield

Mustard yield significantly influenced by its genetic makeup, soil and climatic conditions. DMH-1 significantly gave higher seed (1734 kg ha^{-1}) and straw yield (5558 kg ha^{-1}) over rest of the varieties which was to the tune of 19.2, 8.8 and 5.6% in seed and 15.9, 8.0 and 2.1% in straw, respectively over NRC-HB-506, Pusa bold and Bio-902. This might be due to differential behavior of varieties with respect to growth produced more photo synthesizing leaf surface and consequently more photosynthates which are essentially required to enhance the activity of

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yield attributes ultimately increased the seed yield. The increased uptake of nutrients was another parameter which contributed towards higher seed yield. Similar findings were also reported by Muraliya *et al* (2002) and Patel *et al* (2009). Amongst the sources of sulphur, gypsum gave significantly higher seed and straw yield. Similarly application of 90 kg S ha^{-1} also showed significant effect on seed and straw yield. The per cent increase in seed yield with gypsum was 8.2 and 2.1 over elemental sulphur and pyrites, respectively whereas, increase in seed yield at 90 kg S ha^{-1} over 30 and 60 kg S ha^{-1} were 14.5 and 5.9 % respectively. This might be due to increased yield attributes under gypsum leads to higher solubility and easy availability of sulphate sulphur and also increased uptake of mainly N, P, K and S resulted into larger photosynthesizing surface and accelerated the formation and translocation of photosynthates and hence overall development of the plant. These results are in conformity with those of Kumar *et al* (2002) and Patel *et al* (2009).

Table 1: Effect of varieties, sources and levels of sulphur on yield, nutrient uptake and net returns of Indian mustard (Average of 2 years)

Treatments	Yield (kg ha^{-1})		Nutrient uptake (kg ha^{-1})				Net return (₹. ha^{-1})
	Seed	Straw	N	P	K	S	
Varieties							
DMH-1	1734	5558	100.6	27.9	66.5	13.7	25145
NRC-HB-506	1574	5113	88.6	24.1	52.6	11.3	23387
Pusa bold	1402	4672	79.3	24.5	50.3	10.2	21063
Bio-902	1631	5442	96.2	26.8	60.6	13.2	23918
CD (P= 0.05)	35.43	92.73	1.45	0.46	3.79	0.28	448.6
Sources of Sulphur							
Gypsum	1645	5370	97.2	27.4	62.1	13.4	24334
Elemental sulphur	1510	4946	84.6	22.8	55.4	10.9	22118
Pyrites	1602	5118	91.7	25.0	59.3	12.2	23645
CD (P= 0.05)	31.68	43.49	1.18	0.29	2.82	0.17	207.6
Sulphur level (kg ha^{-1})							
30	1492	4901	81.5	22.0	50.4	10.6	22293
60	1607	5465	92.7	25.5	58.2	12.4	23618
90	1709	5521	99.4	27.8	63.3	13.9	24180
CD (P= 0.05)	32.31	39.90	0.81	0.26	2.72	0.17	189.8

Nutrient uptake

Amongst the mustard varieties, DMH-1 absorbed significantly higher amount of nitrogen (100.6 kg ha^{-1}), phosphorus (27.9 kg ha^{-1}), potassium (66.5 kg ha^{-1}) and sulphur (13.7 kg ha^{-1}) than other tested varieties. Bio-902 was the second best in respect of utilization of nutrients (Table 1). Significant increase in uptake of nutrients might also be the results of cumulative effect of higher content of these nutrients in seed and straw. Besides it, variety DMH-1 responded positively to sulphur thereby increased uptake of nutrients. Similar findings were also reported by Yadav and Sharma (2002) and Patel *et al. (*2009). Among the different sources of sulphur, maximum amounts of nitrogen, phosphorus, potassium and sulphur were utilized by the crop gypsum application followed by pyrites application. Uptake of nutrients is directly proportional to its content in plants; hence significant increase in uptake of these nutrients might be the result of cumulative effect of these nutrients in seed and straw together with higher seed and straw yield with gypsum. These results corroborate the findings of Kumar *et al.* (2002) and Yadav *et al.* (2010). Increasing levels of sulphur significantly increased nutrient uptake in plants up to 90 kg S ha^{-1} to the tune of 21.9, 26.4, 25.6 and 31.1%, respectively over 30 kg S ha^{-1}. This increase might be the result of increased availability of nutrients (N, P, K and S) to the plants by reducing the pH of soil and this might have helped in greater uptake of nutrients by the plants for profuse vegetative and root growth by activating greater absorption of nutrients from soil. The results confirm the findings of Kumar *et al.* (2002) and Yadav *et al.* (2010).

Table 2: Interactive effect of varieties and sources of sulphur on net return (Rs ha^{-1})

Varieties	Sources of Sulphur		
	Gypsum	Elemental sulphur	Pyrites
DMH-1	26494	23494	25404
NRC-HB-506	24407	21908	23723
Pusa bold	21585	20435	21172
Bio-902	24844	22631	24276
CD (P= 0.05)		79.1	

Economics

The net return varied with the mustard varieties and their yield potential. Maximum net return of `. 25145 $ha^{-1}$ was fetched with DMH-1 followed by Bio-902 (`. 23917 ha^{-1}) as compared to NRC-HB-506 and Pusa bold. The increase was to the magnitude of ₹. 4081, 1759 and 1228 ha^{-1} over NRC-HB-506, Pusa bold and Bio-902, respectively. Significantly maximum net return (₹ 24333 ha^{-1}) was fetched in gypsum application over elemental sulphur and pyrites. This might be due to higher availability and cheaper than other sources of sulphur. Maximum net return (₹ 24181 ha^{-1}) was fetched with application of 90 kg S ha^{-1} to the tune of ₹ 1899 and 574 ha^{-1} over preceding levels of sulphur (30 and 60 kg ha^{-1}).

Table 3: Interactive effect of varieties and levels of sulphur on net return (₹ ha^{-1})

Sulphur (kg ha^{-1})	Varieties			
	DMH-1	**NRC-HB-506**	**Pusa bold**	**Bio-902**
30	24156	22073	19993	22952
60	25427	23664	21253	24132
90	25808	24302	21946	24679
CD (P= 0.05)	73.7			

Interactive effect of varieties and sources of sulphur revealed that application of gypsum significantly higher net return was fetched in DMH-1 (₹. 26494 ha^{-1}) as compared to other varieties and sources of sulphur. Next best treatment was pyrites in DMH-1 (₹. 25404 ha^{-1}). Similarly, application of 60 kg S ha^{-1} was remained statistically at par with 90 kg S ha^{-1} in DMH-1 for net return. However, variety Bio-902 gave significantly maximum net return (₹. 24697 ha^{-1}) up to 90 kg S ha^{-1} as compared to rest of the varieties.

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