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EFFECT OF MICRONUTRIENT CATIONS ON YIELD, QUALITY AND THEIR UPTAKE BY MUSTARD IN ALLUVIAL SOIL

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ABSTRACT

A field experiment was conducted at Bichpuri (Agra) on a sandy loam soil to study the effect of micronutrient cations on yield and their uptake by mustard during rabi season of 2007-09. Mustard crop responded significantly to Fe, Mn and Zn application over control. The highest seed yield (18.90 q ha^{-1}) was obtained with 10 kg Zn ha^{-1} with a record of 30.7 % yield increase over control while the application of Fe, Mn and Cu alone brought 11.1, 16.3 and 9.7 % yield increase, respectively. Oil content and yield was increased by the addition of micronutrient cations over control and maximum value of oil yield (7.45 q ha^{-1}) was recorded with 10 kg Zn ha^{-1}. Uptake of Fe, Mn, Cu and Zn increased with their respective addition. Iron and Cu levels showed antagonistic effect on Mn and Zn uptake by the crop. Manganese and Zn application enchanted the uptake of all micronutrient cations by the crop.
Keywords: Micronutrient cations, yield, uptake, mustard

INTRODUCTION

Rapeseed and mustard are next only to groundnut in importance amongst oil seed crops and provide major source of cooking oil. Mustard is the most important oil seed crop of Agra region. Productivity of mustard is decreased continuously in the intensively cultivated areas due to use of high analysis chemical fertilizers, which have made the soils deficient in micronutrients. Consequently, along with NPK the deficiencies of micronutrient cation are frequently reported in soils (Singh and Singh 1996). Further, application of high analysis NPK fertilizers and very limited use of organic manures cause micronutrient depletion in soil. To enhance the productivity of crop, micronutrients like Fe, Mn, Cu and Zn need to be supplemented alongwith NPK fertilizers (Kumar et al. 2012). Inadequate and scanty information is available on the micro-nutrients nutrition of mustard in Agra region. Therefore, the present investigation was initiated to study the effect of micronutrients on yield, quality and uptake of nutrients by mustard.

MATERIALS AND METHODS

A field experiment was conducted during rabi seasons of 2007-08 and 2008-09 at the research farm of R.B.S. College Bichpuri, Agra on sandy loam soil. The soil was alkaline in reaction (pH 8.2), low in available N (170 kg ha^{-1}), P (9.5 kg ha^{-1}), K (105 kg ha^{-1}) and S (8.5 mg kg^{-1}). The soil contained 4.2, 2.0, 0.28 and 0.55 mg kg^{-1} DTPA, Fe, Mn, Cu and Zn, respectively. Zinc, Fe and Cu were supplement in their sulphate forms at the rate of 5 and 10, 10 and 20, 10 and 20 and 5 and 10 kg ha^{-1}, respectively at the time of sowing. The recommended dose of nitrogen, P and K (80, 40, 40 kg ha^{-1}) was applied at the time of sowing in the form of urea, triple super phosphate and muriate of potash respectively. The treatments were replicated thrice in a randomized block design. Mustard (cv. Rohini) was sown in the first week of October in the both years. Seed and stover yields were recorded at harvest. Seed samples were digested in diacid mixture and analysed for Fe, Mn, Cu and Zn using an atomic absorption spectrophotometer. The seed samples were analysed for oil content using Soxhlet apparatus (AOAC, 1990).

RESULTS AND DISCUSSION

Application of Fe, Mn and Zn significantly raised the seed and stover yields of mustard. Maximum increase was recorded at 10 kg of Zn followed by 20 kg Mn ha^{-1} levels which appeared to be the optimum dose. The increases in seed yield due to 10 kg Zn and 20 kg Mn ha^{-1} over control were 30.7 and 16.3 %, respectively. The corresponding increases in stover yield were 36.0 and 15.3%. The favourable influence of zinc application on yield of mustard may be attributed to its role in various enzymatic reactions, growth processes, hormone production and protein synthesis and also the translocation of photosynthates to seed thereby leading to higher seed yield. Application of 20 kg Fe ha^{-1} produced significantly higher seed and stover yield over control (Table 1). The highest mean seed and stover yields of mustard recorded with the application of 20 kg Fe ha^{-1}, were respectively 11.1 and 10.2 % higher than the control. This increase might be attributed to the low status of iron in soil. Kumar et al. (2006) reported similar results in mustard. The response of mustard to Mn was slightly

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higher than that of iron and significantly lower than that of Zn. The higher magnitude of zinc response may be due to the fact that the initial available Zn status of the soil was quite low (0.55 $mgkg^{-1}$). Similarly, the significant yield responses to Fe and Mn may be attributed to their low available content. Lack of response to copper is possibly due to adequate level of DTPA extractable Cu in the soil. However, a slight increase in seed and stover yield was observed by copper application over control. Antil et al. (1988) also found response to copper up to 5 ppm.

Table 1: Effect of micronutrients on yield, quality and uptake of micronutrient cations in mustard (mean of 2 years)

Treatments	Yield (kg ha^{-1})		Oil		Uptake of micronutrients (g ha^{-1})			
	Seed (q ha^{-1})	Stover (q ha^{-1})	Content (%)	Yield (q ha^{-1})	Iron	Mn	Cu	Zn
Control	14.45	41.90	37.85	5.45	356.3	62.5	11.2	51.9
5 kg Zn ha^{-1}	15.60	43.10	38.73	6.05	377.7	64.5	11.4	77.3
10.0 kg Zn ha^{-1}	18.90	56.95	39.43	7.45	435.5	75.3	13.4	106.9
10.0 kg Fe ha^{-1}	15.50	43.25	38.58	6.00	426.6	62.8	11.8	52.7
20.0 kg Fe ha^{-1}	16.05	46.20	39.03	6.25	420.6	60.9	11.8	50.8
10.0 kg Mn ha^{-1}	15.95	44.35	38.48	6.15	385.7	85.6	11.9	56.0
20.0 kg Mn ha^{-1}	16.80	48.30	38.80	6.50	392.9	109.9	12.1	55.4
5 kg Cu ha^{-1}	15.15	40.20	38.50	5.05	378.4	61.4	14.8	51.5
10.0 kg Cu ha^{-1}	15.85	45.25	38.78	6.15	374.9	61.0	17.2	50.6
CD= (P=0.05)	1.69	4.46	2.77	0.53	51.3	10.9	1.53	11.5

Application of zinc, in general, increased oil content and yield over control. Zinc functions in plants largely as a metal activator of enzymes like cysteine disulphydrase, dihydropeptilase glycyle glycine dipeptidase. Thus, addition of zinc might have activated the enzymes responsible for the producing oil and caused higher oil content. Beneficial effects of zinc application were also reported by Shri Krishna and Singh (1992) and Akbari et al. (2011). Iron application increased the content and yield of oil in mustard but the increase was significant in oil yield only. Kumar et al. (2006) reported similar results in mustard. Similarly oil percentage and oil yield was improved due to Mn application over control. Copper addition also enhanced the oil content and oil yield but the effect of copper in enhancing the oil percentage and oil yield was lower than those of zinc, Fe and Mn. Among the micronutrients, zinc proved superior in enhancing the oil yield than those of Mn and Fe. Similar results were reported by Kumar et al. (2012). The control treatment produced the minimum oil yield. Zinc uptake in seeds progressively increased from 51.9 to 106.9 g ha^{-1} with the level of its application (Table 1). The percentage increase in Zn uptake over no zinc at 5 and 10 kg ha^{-1} was 98.9 and 106.0, respectively. Zinc application increased the Fe uptake in seeds indicating some what beneficial effect on Fe nutrition. Increasing levels of Zn markedly enhanced the uptake of Mn and Cu by seeds over control. Application of Fe at both the levels (10 and 20 kg ha^{-1}) increased significantly the uptake of Fe and reduced the uptake of, Mn by the seeds of mustard. Gangadhar et al. (1992) has reported similar experience with sunflower crop. Addition of Mn increased significantly the uptake of all the micronutrient cations by the seed. The magnitude of increase was higher in Mn uptake than those of Fe, Zn and Cu. Gangadhar et al. (1992) also reported similar results. Application of copper enhanced the uptake of copper and iron and decreased those of Zn and Mn over control. However, the effect of copper on the uptake of Zn, Mn and Fe by the crop was statistically non-significant. The results indicate that zinc and manganese application are very much needed to enhance the productively, quality and utilization of micronutrient cations by the mustard crop in alluvial soil of Agra region.

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