Ann. Pl. Soil Res. 14(1):68-70 (2012)

EFFECT OF MICRONUTRIENTS ON YIELD, QUALITY AND NUTRIENTS UPTAKE BY MUSTARD IN ALLUVIAL SOIL

AJAY KUMAR[1], SANDEEP SINGH AND KAUSHLENDRA SINGH[2]
Department of Agricultural Chemistry and Soil Science, Raja Balwant Singh College Bichpuri, Agra (U.P.) - 283 105
Received: December, 2010

ABSTRACT

A field experiment was conducted to study the effect of combined use of micronutrients on yield and uptake of nutrients in mustard at Bichpuri Agra (U.P.). Response of mustard was significant due to application of micronutrients. The highest mean yield of seed (19.20 q ha-^{1}) and stover (56.30 q ha^{-1}) was obtained in treatment receiving 40 kg $ZnSO_4$ + 50 kg $FeSO_4$ + 30 kg $MnSO_4$ ha^{-1} followed by 20 kg $ZnSO_4$ + 30 kg $MnSO_4$ + 50 kg $FeSO_4$ ha-^{1} application (7.93 and 53.03 q ha-^{1}). The yield reductions in mustard due to Fe + Mn, Zn and Fe + Mn + Zn omissions were 21.8, 18.1 and 28.9%, respectively. Foliar application of Fe (T_8) also improved the yield of mustard over no micronutrients (T_7) and no Fe (T_6) in both crop seasons. The higher oil content (39.25 and 39.0%) and yield (741.82 and 760.50 kg ha-^{1}) were recorded with 40 kg $ZnSO_4$ + 50 kg $FeSO_4$ + 30 kg $MnSO_4$ ha-^{1} treatment in both crop seasons. The uptake of nutrients by mustard seeds and stover was affected mainly by combined use of higher doses of micronutrients (40 kg $ZnSO_4$ + 30 kg $MnSO_4$ + 50 kg $FeSO_4$ ha-^{1}). Foliar application of Fe alongwith 40 kg $ZnSO_4$ + 30 kg $MnSO_4$ (T_8) also improved the uptake of nutrients over no micronutrients. Iron uptake by its foliar application improved significantly over T_7, T_6 and T_5 treatments.

INTRODUCTION

Mustard is the most important crop of Agra region of Uttar Pradesh. Productivity of mustard is decreased continuously in the intensively cultivated region due to use of imbalanced and high analysis chemical fertilizers, which have made the soils deficient in micro nutrients. To increase or to sustain the productivity of mustard, there is a need for application of micronutrients as the application of these nutrients is not common with the introduction of high analyses fertilizers. The alluvial soils of western Uttar Pradesh are poor in organic matter and deficient in micronutrients (Singh and Singh, 1996). Use of micronutrients like Fe, Mn and Zn can increase the productivity of the crops. However, little work has been done on this aspect. Therefore an experiment was conducted to study the effect of micronutrients on yield and uptake of nutrient in mustard.

MATERIALS AND METHODS

A field experiment with mustard, variety Rohini was conducted at the experimental farm of R.B.S. College Bichpuri, Agra during the rabi season of 2001-04. The soil was sandy loam in texture and alkaline in reaction (pH 8.0). The status of organic carbon was 4.4 g kg-$^{1.}$The initial level of available N, P and K was 160, 8.5 and 100 kg ha-^{1}, respectively. Available (DTPA-extractable) Fe, Mn, Cu and Zn in the soil were 4.0, 1.8, 0.26 and 0.55 mg kg-^{1}, respectively. There were 8 treatments viz. , T_1, 40 kg Zn SO_4+30 kg $MnSO_4$+50 kg $FeSO_4$, T_2-20 kg $ZnSO_4$+30 kg $MnSO_4$+50 kg $FeSO_4$, T_3-no $ZnSO_4$+30 kg $MnSO_4$+50 kg $MnSO_4$, T_4-40 kg $ZnSO_4$+15 kg $MnSO_4$+50 kg $FeSO_4$, T_5-40 kg $ZnSO_4$ +30 kg $MnSO_4$+no $FeSO_4$, T_6-20 kg $ZnSO_4$+no $MnSO_4$+no $FeSO_4$, T_7-no $ZnSO_4$+no $MnSO_4$+no $FeSO_4$ and T_8-40 kg $ZnSO_4$+30 kg $MnSO_4$+1% spray of $FeSO_4$. The design was randomized block design involving three replications. The recommended dose of different nutrients for the crop was 120 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1}. Half amount of nitrogen, full P and K were applied as basal and rest of N at first irrigation. The seed and stover yields were recorded at maturity. Nitrogen in seed samples was determined by micro-Kjeldahl method. The samples were digested with diacid mixture (HNO_3:$HClO_4$ in the ratio of 4.1) for determining other nutrients. Phosphorus in acid extract was determined by vanadomolybdate yellow color

[1].C.C.S.S.D.S. College Iglas, Aligarh (U.P.)
[2].R.S.A.C. (U.P.) Lucknow

method (Jackson 1973), K by flame photometer and iron, Mn and Zn by atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Application of micronutrients significantly increased the seed and stover yield of mustard compared to no micronutrients in both crop seasons. The highest seed and stover yields of 18.90 and 19.50 and 55.50 and 57.10 q ha-^{1}, respectively were obtained at 40 kg $ZnSO_4$ + 30 kg $MnSO_4$+50kg $FeSO_4$ ha^{-1} (T_1) followed by 20 kg $ZnSO_4$+ 30 kg $MnSO_4$ + 50 kg $FeSO_4$ ha^{-1} application (17.65 and 18.20 and 52.25 and 53.80 q ha^{-1}) in first and second year, respectively. The effect of these treatments was significant during both the years. The significant effect of T_1 over T_7 on mustard yield was mainly due to build up of Zn, Mn and Fe in soil due to their application. The increase in seed yield due to application of micronutrients may be ascribed to improvement in growth and enhancement in the photosynthetic and other metabolic activities which led to increase in various plant metabolites responsible for cell division and cell elongation. Similar results were reported by Dwivedi et al. (1990) in soybean and wheat. Micronutrients behaved differently for accentuating the yield of mustard and response was highest to zinc followed by Fe and Mn by soil application. Omission of micronutrients from T_1 (40 kg $ZnSO_4$ + 50 kg $FeSO_4$ + 30 kg $MnSO_4$ ha^{-1}) caused yield losses that varied from 16.1 to 28.9 percent. Thus, omission of Zn, Fe and Mn from the T_1 treatment resulted in a marked yield loss indicating the significance of replenishment of these nutrients for achieving high yield target. The yield reductions due to Fe and Mn, Zn and Fe + Mn + Zn omissions were 21.8, 16.1 and 28.9%, respectively. The increase in yield due to Zn application may be due to the fact that Zn plays an important role in plant metabolism and reproduction. Similar observations were also reported by Akabari et al. (2011) in groundnut. Foliar application of Fe being statistically at par with T_1, T_2, T_4, and T_5 improved the yields of wheat significantly over other treatments. Thus, application of iron to soil did not prove significantly superior to its foliar application.

Table1: Effect of various treatments on yield, content and yield of protein in mustard seed

Treatments	Seed yield (q ha^{-1})		Stover yield (q ha^{-1})		Oil content in grain (%)		Oil Yield (q ha^{-1})	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
T_1 $Zn_{40}Mn_{30}Fe_{50}$	18.90	19.50	55.50	57.10	39.25	39.00	741.82	760.50
T_2 $Zn_{20}Mn_{30}Fe_{50}$	17.65	18.20	52.25	53.80	39.10	38.92	690.11	708.34
T_3 $Zn_0Mn_{30}Fe_{50}$	15.82	16.40	46.75	48.25	38.85	38.60	614.60	633.04
T_4 $Zn_{40}Mn_{15}Fe_{50}$	17.20	17.85	51.00	52.60	38.75	38.50	666.50	687.22
T_5 $Zn_{40}Mn_{30}Fe_{50}$	16.45	17.10	48.30	50.00	38.80	38.72	638.26	662.11
T_6 $Zn_{20}Mn_0Fe_0$	14.70	15.32	43.80	43.35	38.35	38.30	563.74	586.75
T_7 $Zn_0Mn_0Fe_0$	13.30	14.00	38.40	40.00	37.80	37.75	502.74	528.50
T_8 $Zn_{40}Mn_{30}Fe1_{\%}$	17.40	18.05	51.90	53.50	38.80	38.80	675.12	700.31
CD (P=0.05)	1.05	1.28	3.56	4.24	0.45	0.76	49.6	55.9

The results of Table 1 revealed that the oil content (37.75 and 39.25%) and oil yield (502.74 and 760.25 kg ha^{-1}) of mustard seed varied with different micronutrient treatments. The content and yield of oil was different under different treatments and maximum percentage of oil in seed and yield of oil were recorded under T_1 (40kg $ZnSO_4$+30kg $MnSO_4$ and 50 kg $FeSO_4$ ha^{-1}), treatment in both crop seasons. Foliar application of iron also improved the oil percentage and yield over no micronutrients (T_7) in both crop seasons. Among the micronutrients, Zn proved superior in enhancing the oil yield than those of Mn and Fe. Nitrogen uptake by mustard was affected significantly by micronutrients (Table 2). Under various treatments of micronutrients, the mean range of uptake of nitrogen was 48.0 to 68.6 kg ha^{-1} with minimum under T_7 and maximum under T_1. Micro-nutrient supply mentation under different combinations helped in balancing the nutrients in soil solution and thus enhanced activity and uptake. Foliar application of 1% $FeSO_4$ solution alongwith 40 kg $ZnSO_4$ and 30 kg $MnSO_4$ also enhanced the uptake of N by mustard crop significantly over other treatments except T_1, T_2 and T_5 treatments. The uptake of P was affected significantly with various treatments with lowest uptake under no micronutrients (T_7) and maximum at combination of micronutrients(40 kg $ZnSO_4$ + 30 kg $MnSO_4$ + 50 kg $FeSO_4$). Uptake of 15.4 kg ha^{-1} under T_1 treatment was significantly superior to rest. It was at par to T_2 (13.0 kg ha^{-1}) and T_8 (12.8 kg ha^{-1}) treatments.

Application of micronutrients resulted in an uptake of 11.5 to 15.4 kg ha^{-1} with maximum uptake under T_1 and was significantly different to all the rest of combinations. The no micronutrients treatment was significantly inferior to all the treatments in respect of K uptake by mustard seeds. The spraying of 1% $FeSO_4$ solution alongwith 40 kg $ZnSO_4$ and 30 $MnSO_4$ ha^{-1} resulted in significant increase in K uptake by mustard crop over T_7 treatment.

Table 2: Effect of various treatments on uptake of major and micro-nutrients by mustard seed and stover (mean of two years)

Treatments	N (kg ha^{-1})		K (kg ha^{-1})		Ph (kg ha^{-1})		Mn (g kg^{-1})		Fe (g kg^{-1})		Zn (g kg^{-1})	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
T_1	68.0	69.2	15.4	15.1	13.5	13.6	75.6	74.0	341.1	360.8	66.0	64.3
T_2	63.0	63.6	14.8	14.5	13.0	13.2	79.3	80.1	330.0	351.3	53.9	53.1
T_3	56.1	57.3	13.4	13.6	11.8	12.1	75.9	75.4	309.2	328.6	41.9	42.6
T_4	60.5	62.0	14.6	14.6	12.7	12.8	65.4	64.2	314.7	330.8	58.4	58.8
T_5	69.0	60.0	13.8	13.8	12.0	12.1	74.0	75.0	213.9	299.6	56.7	58.0
T_6	52.0	53.76	12.6	12.7	11.0	11.1	47.0	46.0	199.1	214.5	43.2	42.8
T_7	47.7	48.4	11.5	11.7	10.1	10.3	47.9	49.0	186.2	201.0	33.2	34.2
T_8	62.4	63.8	14.7	14.8	12.8	12.9	73.0	73.9	309.6	324.9	60.0	60.4
CD (P=0.05)	3.33	3.72	1.44	1.38	1.13	1.26	5.07	6.12	31.56	29.55	2.93	3.24

Higher uptake of iron was observed due to its application vs. no application with maximum uptake of 341.1g ha^{-1} under T_1 treatment. Combined application effect was synergistic and it increased the uptake to a maximum value 341.1 g ha^{-1} under T_1 treatment. The improved uptake of iron by crop with each supplementation of micronutrients could be assigned to abolishment of limiting factors, which was evident from the initial iron status. Similar results were reported by Sharma et al. (2002) in cowpea. Foliar application of Fe (T_8) proved significantly superior to most of the treatments in respect of its utilization by the crop. It is seen from the present study that foliar spray is less effective than soil application. This has been reported by Dwivedi et al. (1990). The combined application of $ZnSO_4$, $MnSO_4$ and $FeSO_4$ significantly increased the uptake of Mn with highest uptake values at T_2. The highest uptake of Mn at T_2 was mainly due to increase in nutrient use efficiency and thus increase in total yield. The lowest values of uptake of Mn were recorded under T_7 treatment in both crop seasons. Application of Mn improved its uptake but depressed with of zinc. The treatment T_1 among the micronutrients levels was superior to rest of the treatments influencing the uptake of Zn. The minimum value of Zn uptake by mustard crop was recorded under no micronutrients (T_7) treatment. The Zn uptake by seed and stover ranged from 33.2 to 68.0 and 34.2 to 64.3 g ha^{-1}. Treatment T_8 (40 kg $ZnSO_4$ + 30 $MnSO_4$ ha^{-1} + 1% $FeSO_4$ spraying) also enhanced the utilization of zinc by the crop over no micronutrients. Similar results were reported by Sharma et al. (2002).

REFERENCES

Akbari, K.N., Kanzaria, K.K., Vora, V.D., Sutaria, G.S. and Padmani, D.R. (2011) Nutrient management practices for sustaining groundnut yield and soil productivity on sandy loam soil. *Journal of the Indian Society of Soil Science 59:* 308-311.

Dwivedi, G.K., Dwivedi, M. and Pal, S.S. (1990) Modes of application of micronutrients in acid soil in soybean – wheat crop sequence. *Journal of the Indian Society of Soil Science*.38:458-463.

Jackson, M.L. (1973) *Soil Chemical Analysis*. Prentice Hall of India Private Limited, New Delhi.

Sharma, S.R., Bhandari, S.C. and Purohit, H.S. (2002) Effect of organic manure and mineral nutrients on nutrient uptake and yield of cowpea. *Journal of the Indian Society of Soil Science 50:* 47-480.

Singh, V. and Singh, S. (1996) Relation of available micronutrients in soils and plants. *Journal of the Indian Society of Soil Science*.44:800-802.