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RESPONSE OF MUSTARD CULTIVARS TO BORON APPLICATION

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ABSTRACT

A field experiment was conducted to study the responses of mustard cultivars to boron application at Directorate of Rapeseed Mustard Research Sewar, Bharatpur. Results revealed that mustard cultivar Laxmi recorded higher mean dry matter yield (11.95 q ha^{-1}) and lowest in vardan (11.17 q ha^{-1}). The dry matter yield of mustard cultivars increased significantly with increasing levels of boron application upto 20 kg borax ha^{-1} over control. The higher contents of B, Mn and Zn were noted in Laxmi cultivar, whereas Fe and Cu content was higher in Aravali cultivar of mustard. The contents of B, Fe, Mn, Cu and Zn in plants of mustard cultivars increased significantly with B application. Laxmi cultivar utilized the higher amounts of B, Mu, Cu and Zn in its plants. On the other hand, Vardan utilized the higher amounts of iron. The uptake of these micro nutrients increased significantly with B levels over control.

Key words: Response, mustard cultivars, boron, yield, nutrients uptake

INTRODUCTION

Indian mustard is cultivated on 5.86 million ha area in India and predominantly in Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat and West Bengal, Rajasthan alone contributes 45.5% of total area and 48.6% of the total production (6.4 mt) in the country. The major reason of low productivity of the crop is mainly its cultivation on marginal lands. Apart from major plant nutrients, boron plays an important role in the production phenology of mustard and this crop responds to applied boron (Karthikeyan and Shukla, 2008). Genotypic variations exist in sensitivity to boron deficiency. Differential response of cultivars to nutrients is genetically controlled and is a heritable character. Varietal differences in response and utilization of native as well as applied nutrients have been of great concern for many crops. Boron plays a vital role in cell wall synthesis, root elongation, glucose metabolism, nucleic acid synthesis, lignifications and tissue differentiation. Boron plays a vital role in oil seed production. It is needed for carbohydrate transport as well as cellular-differentiation and development. Often the farmers do not supply boron in any form to the crops. As a result the yield and quality of the crop decline. Since meager information is available on the response of mustard genotypes to boron application in Bharatpur district of Rajasthan. The present investigation was undertaken to study the effect of boron levels on dry matter yield, content and uptake of micro nutrients in mustard genotypes.

MATERIAL AND METHODS

A field experiment was conducted at research farm of DRMR, Bharatpur (Raj.) during rabi season of 2004-05 and 2005-06. The soil was sandy loam in texture and slightly alkaline in reaction (pH 7.9), low in organic carbon (3.1 g kg^{-1}), available N (171 kg ha^{-1}), available P (9.4 kg ha^{-1}), available potassium (217.5 kg ha^{-1}) available S (16.0 kg ha^{-1}) available Zn (0.56 mg kg^{-1}) and B (0.45 mg kg^{-1}). Three cultivars of mustard namely, Aravali, Laxmi and vardan and five levels of boron (0, 5, 10, 15 and 20 kg borax ha^{-1}) were evaluated in randomized block design with three replications. Mustard cultivars were sown in lines 30 cm apart using a uniform seed rate of 5 kg ha^{-1} in the first week of October during both the years. Recommended doses of N, P_2O_5 and K_2O @ 80, 40 and 20 kg ha^{-1} were applied through urea, diammonium phosphate and muriate of potash, respectively at the time of sowing. Irrigation was applied 35 days after sowing. The crop was allowed to grow upto pre flowering stage and dry matter yield was recorded. The plant samples of mustard cultivars were collected and analysed for their B, Fe, Mn, Cu and Zn contents. The micronutrients (Fe, Mn, Cu and Zn) in the acid extract obtained after digestion with HNO_3 and perchloric acid were determined on atomic absorption spectrophotometer. Boron in the diacid digest of the plant material was determined by carmine method (Hatcher and Wilcox, 1950). The uptake of nutrients by various mustard cultivars was computed by multiplying contents of the elements with the dry matter yield data.

RESULTS AND DISCUSSION

Dry matter yield

The data (Table 1) showed that Laxmi cultivar of mustard produced maximum dry matter (11.95 q ha^{-1}) followed by Aravalli (11.51 q ha^{-1}) and Vardan (11.17 q ha^{-1}), though the difference in dry matter yield was non-significant. The dry matter yield of mustard cultivars at pre-flowering stage increased significantly with boron application over control. The increases in yield due to boron application were significant but all the three cultivars showed an increasing trend in yield with boron levels as compared to control. The differential responses of various crops to added boron have also been reported by Noor *et al.* (1997). On an average, application of 5, 10, 15 and 20 kg borax ha^{-1}, significantly increased the dry matter yield of three cultivars of mustard by 8.0, 12.4, 16.1 and 19.5 percent, respectively. Thus, boron application brought about a significant improvement in dry matter yield of various cultivars but the magnitude of increase varied appreciably. The increase in dry matter yield may be attributed to carbohydrate metabolism with B application which favoured the increase in seed yield. Response of mustard at pre-flowering stage of growth to boron application was also reported by Ateeque *et al.* (1993) and Mathew *et al.* (2013).

Table 1: Effect of boron levels on dry matter yield and uptake of micronutrients (g ha^{-1}) by mustard cultivars (mean of 2 years)

Treatments	Dry matter yield (qha^{-1})	Boron	Iron	Manganese	Copper	Zinc
Cultivars						
Aravali	11.51	16.9	239.1	30.5	7.8	37.8
Laxmi	11.95	17.8	243.7	31.9	9.2	42.4
Vardan	11.17	15.6	233.7	29.2	7.3	36.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Boron (kg ha^{-1})						
0	10.38	13.1	165.3	25.0	6.2	30.3
5	11.21	15.0	180.7	26.8	7.1	35.8
10	11.68	16.8	214.0	34.6	7.7	40.0
15	12.06	18.3	288.8	34.4	9.2	42.4
20	12.40	20.6	345.3	35.9	10.4	46.3
CD (P=0.05)	0.77	3.61	15.51	6.01	0.99	9.73

The Vardan contained lower amounts of boron than those of other cultivars. The maximum amounts of boron were noted in plants of Laxmi cultivar. Application of boron tended to increase the amount of boron in plants of all the cultivars. As compared to control, the higher levels of boron proved significantly superior in respect of boron content in these cultivars. The maximum values of boron content in these cultivars were recorded at 20 kg borax ha^{-1}. The increase in boron content in mustard cultivars may be ascribed to increased availability of boron in soil solution due to boron application to the soil. The favorable effect of boron application on its content is in conformity with the findings of Sinha and Chatterjee (2003). On the basis of average boron content, the mustard cultivars may be arranged in descending order as: Laxmi > Aravalli> Vardan. The differences in contents of micronutrient cations in plants of various mustard cultivars were statistically non significant. However, the relatively higher values of Fe (207.91 mg kg^{-1}), Mn (26.72 mg kg^{-1}), Cu (7.70 mg kg^{-1}) and Zn (35.46 mg kg^{-1}) were noted in plants of Vardan, Laxmi, Aravali and Laxmi cultivar, respectively. Application of boron levels tended to increase the concentrations of Fe, Mn, Cu and Zn in plants of mustard cultivars significantly over control. The contents of Fe, Mn, Cu and Zn in plants ranged from 159.38 to 277.88, 24.07 to 28.87, 5.94 to 8.38 and 29.18 to 37.19mg kg^{-1} respectively. The maximum values of these micro nutrient cations were noted with 20 kg borax ha^{-1} and lowest in control (Table 2). Laxmi cultivar of mustard removed significantly higher amounts of boron in its plants over other cultivars. The minimum amount of boron was utilized by plants of Vardan cultivar. The uptake of B by cultivars of mustard increased significantly with increasing levels of B and maximum values were recorded at 20 kg borax ha^{-1}. The B uptake by plants of mustard, on an average increased from 13.1 to 20.6 g ha^{-1} with 20 kg borax ha^{-1}. The higher values of B uptake may be attributed to increased dry matter production and B content in plants. Similar results were reported by Patel and Golakiya (1988), Shekhawat and Shivay (2008) and Singh *et al.* (2011).

Table 2: Effect of boron levels on content of micronutrients (mg kg^{-1}) in mustard cultivars (mean of 2 years)

Treatments	Boron	Iron	Manganese	Copper	Zinc
Cultivars					
Aravali	14.56	204.079	26.36	6.75	32.70
Laxmi	14.91	202.32	26.72	7.70	35.46
Vardan	13.94	207.91	26.17	6.53	32.83
CD (P=0.05)	1.17	NS	NS	NS	NS
Boron($kgha^{-1}$)					
0	12.61	159.38	24.07	5.94	29.18
5	13.43	162.03	24.02	6.34	32.14
10	14.47	184.48	26.37	6.62	34.39
15	15.25	241.26	28.76	7.68	35.40
20	16.59	277.88	28.87	8.38	37.19
CD (P=0.05)	2.00	8.46	1.41	1.97	5.64

On the basis of mean B uptake values, the mustard cultivars may be arranged in descending order as: Laxmi > Aravalli > Vardan. Laxmi cultivar removed higher amount of iron from the soil over other cultivars and minimum by Vardan. The difference in Fe uptake by various cultivars of mustard may be due to variation in their production capacity of dry matter. The Fe uptake by plants increased from 165.3 to 345.3 g ha^{-1} with 20 kg borex ha^{-1} addition. This increase may be attributed mainly to increased dry matter production with boron application. The data (Table 1) revealed that cultivar Laxmi utilized the higher amounts of Mn than those of other cultivars which may be attributed to higher dry matter production. The levels of borax addition resulted in increased Mn removal by the cultivars of mustard. It increased from 25.0 to 35.9 g ha^{-1} as the dose of borax was increased from 0 to 20 kg ha^{-1}. The results indicate beneficial effect of B on the utilization of manganese by the crop. Among the cultivars of mustard, maximum mean value of copper uptake was recorded in Aravali. However, the differences in copper uptake by cultivars of mustard were not statistically significant. A progressive increase in borax level upto 20 kg ha^{-1} increased the uptake of copper over control. It increased from 6.2 to 10.4 g ha^{-1} with 20 kg borax ha^{-1}. The results indicate the synergistic effect of borax on the utilization of copper by plants. Mustard cultivar Laxmi utilized relatively higher amounts of zinc from the soil as compared to other genotypes. The lowest uptake of zinc by plants was noted in cultivar Vardan which may be attributed to lower dry matter production. The zinc uptake by the cultivars increased with increasing levels of borax and such increase was significant up to 20 kg borax ha^{-1}. The magnitude of increase in zinc uptake was higher at higher levels of borax as compared to its lower levels. The zinc uptake by plants increased from 30.3 g ha^{-1} at control to 46.3 g ha^{-1} with 20 kg borax ha^{-1}.

It was concluded that the application of 20 kg borax ha^{-1} would be sufficient to sustain the productivity of mustard genotypes and uptake of micronutrients in crop under Bharatpur conditions.

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