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Response of Common Bean (*Phaseolus vulgaris)* to Basal Applied and Foliar Feeding of Different Nutrients Application

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Abstract: In Asian countries especially Pakistan micronutrient deficiency is widespread due to high pH, low organic matter, drought and salt stress, calcareous soil nature, in irrigation H2O high bicarbonate content and imbalanced NPK fertilizers application. A field trial was conducted to examine the growth and yield response of *Phaseolus vulgaris* to different basal and foliar nutrients application during 2012-13. The experiment was comprised of seven treatments including: Control (Water spray), DAP (solid from) 123.5 kg ha^{-1}, Potassium (K_2SO_4) 100 kg ha^{-1}, Boron 60 mg L^{-1}, Molybdenum 30 mg L^{-1}, Zinc 300 mg L^{-1} and Boron + Molybdenum + Zinc (60+30+300 mg L^{-1}, respectively) were compared. Experimental results showed that foliar feeding of micronutrients (B+ Mo + Zn) combined application significantly increased the plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, biological and seed yields, while control (H_2O spray alone) gave the minimum value in all the traits. Thus the present study suggested that foliar application of micronutrients (B+ Mo + Zn) is beneficial to get the maximum seed yield of common bean.

Key words: Pakistan · Common bean · Micronutrient · H_2O spray · Seed yield

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is the member of family leguminaceae which is self-pollinated annual plant [1]. It is a short-season crop having a range 65-110 days from emergence to physiological maturity [2]. Common bean seed is good source of energy, it contains high protein content, dietary fiber, complex carbohydrates and also provides folic acid [3]. Soil type until well-drained, fertile and conditions interfere with germination, the common bean is a non-sensitive crop [4].

Micronutrients (trace elements) are required in minute quantity. Micronutrients nutrients are Fe, Zn, Mo, Mn, B, Cu, Co and Cl [5]. Foliar form of application is most effective when roots are incapable of absorbing required amount of nutrients from soil due to some reasons like high degree of fixation, lack of soil moisture, losses from leaching and low soil temperature [6]. Nutrients foliar application at proper growth phases is essential for their consumption and improved crop performance [7]. Foliar application of Fe, Mn and Zn considerably boost the growth and yield parameters of Mung bean plants [8].

The objective of this study was to investigate the effect of foliar micronutrients B, Mo, Zn alone, in combination and its comparison with DAP, K_2SO_4 (solid form) on growth, yield and yield components of common bean.

MATERIALS AND METHODS

A field trial was carried out at the Experimental Field Department of Botany, Hazara University in randomized complete block design with seven treatments replicated three times during winter season of 2012 to study the Response of common bean (*Phaseolus vulgaris)* to basal applied and foliar feeding of different nutrients application.

Soil samples for physiochemical analysis were taken randomly before sowing from the experimental field from 0 to 10 cm and 10 to 20 cm in depth. Soil pH was measured

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by pH meter [9]. The nitrogen was analyzed through Macro-Kjeldahl method [10]. Ammonium bicarbonate-Diethylen triamin penta acetic acid (AB-DTPA) method was used to analyze both phosphorus and potassium [11].

Common bean seeds were soaked for 18 hours and then were sown with 6 inches plant to plant and 12 inches row to row distance and the area of each plot was 3 x 3 m^2. With interval of 14 days the foliar applications were revised till maturity while basal placement of DAP and K_2SO_4 was done single time. The applications were as follows:

- T_0 Control (Water spray)
- T_1 DAP (solid form) 123.5 kg ha^{-1}
- T_2 Potassium (K_2SO_4) 100 kg ha^{-1}
- T_3Boron 60 mg L^{-1} (Borax form)
- T_4Molybdenum 30 mg L^{-1} (Sodium molybdate form)
- T_5Zinc 300 mg L^{-1} (Zinc sulphate form)
- T_6 Boron + Molybdenum + Zinc (60+30+300 mg L^{-1}, respectively)

Fifteen bean plant samples from each plot were collected after maturity to notice the following growth yield and yield components. Morphological and yield parameters of common bean are; Plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, yield $m^{-2}$and biological yield m^{-2}. All recorded data was statistically analyzed by software SPSS 16.0. The differences among the means were calculated using LSD test ($p< 0.05$).

RESULTS AND DISCUSSION

Soil Chemistry Analysis: The data in Table 1 showed the soil analysis results that the soil of experimental area was deficient in nutrients quantity except potassium. In Table 2 the standard values are presented [12]. The deficiency of nutrients may affect the growth and yield of bean plant negatively but the application of different nutrients leads to positive results. When soil nutrient deficiencies can't be recovered through any way then foliar nutrition application is the only option [13].

Growth Characters: Data in Table 3 and Fig. 1 showed that combined foliar application of B, Mo and Zn significantly increased the plant height of common bean, while in rest of applications Mo showed maximum plant height value. The minimum plant height value was recorded in H_2O spray alone. The maximum number of branches was noted through foliar spray of B, Mo and Zn

Table 1: Physiochemical analysis of soil sample before mung bean sowing in experimental field, showing the amount of NPK in mg Kg^{-1} in soil

S.no	Sample Id	pH	NO_3-N	P	K	EC (dSm^{-1})
1)	{0-15 cm}	6.7	1.53	0.84	114	0.23
2)	{15-30 cm}	7.16	1.37	0.65	98	0.41

Table 2: Nutrients standard values in soil (mg/kg)

S. no	Elements	Low	Medium	High
1)	N	≤10.00	11-20	21-30
2)	P	≤03.00	04-07	08-11
3)	K	≤60.00	61-120	121-181

Table 3: Mean comparison response of growth attributes of common bean to different nutrients application

S. No.	Treatments	Plant height (cm)	Branches $plant^{-1}$
1)	T_0	25.8^{e}±0.8	2.4^{e}±0.2
2)	T_1	27.6^{d}±0.6	2.9^{bcd}±0.4
3)	T_2	28^{cd}±0.4	3.2^{b}±0.6
4)	T_3	28.4^{c}±1	3^{bc}±0.1
5)	T_4	29.6^{b}±0.8	3.2^{b}±0.2
6)	T_5	28.8^{c}±0.9	3^{bc}±0.1
7)	T_6	32.2^{a}±1.2	3.4^{a}±0.4

Note: Within each column, treatments carry same superscript letter are not significantly different at 5% level

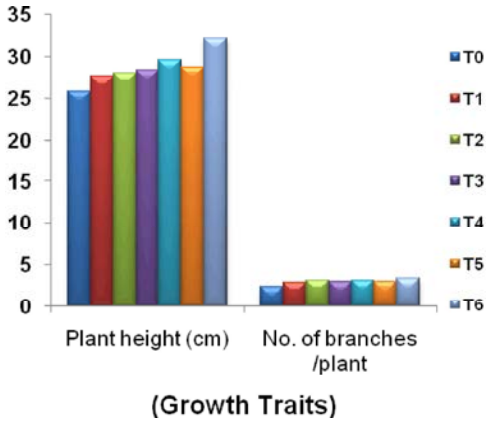

Fig. 1: Response of growth traits of common bean to different nutrients application

mixture while basal potassium sulphate and foliar spray of molybdenum both applications showed similar, nearby results and minimum number of branches $plant^{-1}$ were recorded in H_2O spray. Our findings are in accordance with Bameri *et al*. [14] who reported that foliar treatment of micronutrients (Fe + Mn) significantly increased the plant height. Application of Zn enhanced the plant height due to increasing distance of internodes [15]. Increase in plant height might be due to micronutrients involvement in various physiological processes such as; enzyme activation [16], chlorophyll formation [17], electron transport and stomata regulation [18].

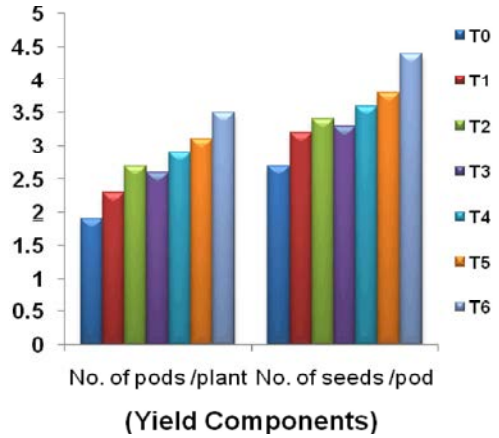

Fig. 2: Response of yield components of common bean to different nutrients application

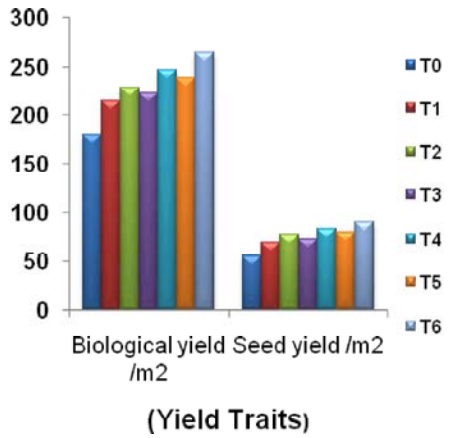

Fig. 3: Response of biological and seed yield of common bean to different nutrients application.

Table 4: Mean comparison response of yield components of common bean to different nutrients application

S. No.	Treatments	Pods plant^{-1}	Seeds pods^{-1}
1)	T_0	1.9±0.08	2.7^{e}±0.1
2)	T_1	2.3d±0.05	3.2^{cd}±0.2
3)	T_2	2.7c±0.04	3.4^{c}±0.1
4)	T_3	2.6c±0.08	3.3^{cd}±0.2
5)	T_4	2.9b±0.05	3.6^{b}±0.3
6)	T_5	3.1b±0.06	3.8^{b}±0.5
7)	T_6	3.5a±0.07	4.4^{a}±0.6

Note: Within each column, treatments carry same superscript letter are not significantly different at 5% level.

Table 5: Mean comparison response of biomass and seed yield of common bean to different nutrients application

S. No.	Treatments	Biological yield m^{-2} (g)	Seed yield m^{-2} (g)
1)	T_0	180.1^{e}±7.2	54.7^{e}±3.1
2)	T_1	215.3^{d}±11.7	69.3^{d}±4.6
3)	T_2	228.5^{c}±13.6	76.9^{c}±5
4)	T_3	222.9^{cd}±8.6	72.8^{cd}±3.7
5)	T_4	248^{b}±9.4	83.1^{b}±5.2
6)	T_5	239^{b}±7.2	79.6^{bc}±4.2
7)	T_6	265.2^{a}±8.6	90.6^{a}±4

Note: Within each column, treatments carry same superscript letter are not significantly different at 5% level

Yield Components: Data in Table 4 showed that combined foliar treatment of B, Mo and Zn significantly increased the number of pods plant^{-1} while in other treatments Zn showed maximum number of pods plant^{-1}. Minimum number of pods plant^{-1} was noted by H_2O spray alone. Significantly highest number of seeds pod^{-1} was recorded in foliar spray of B, Mo and Zn mixture while foliar spray of zinc showed 2nd best results and H_2O spray alone produced minimum number of seeds pod^{-1} (Fig. 2). These results are matching with our results are in contradiction with those obtained by Raman and Venkataramana [19], who reported that nutrient uptake, yield and yield traits of green gram like number of pods plant^{-1} and number of seeds pod^{-1} were significantly raised through foliar nutrition. Foliar spray of micronutrients significantly increased the yield components of lentil crop, due to boosting of enzymatic activity the micronutrients effectively raised photosynthesis and translocation of assimilates to seed [20].

Biological and Seed Yield: The results in Table 5 showed that combined foliar treatment of B, Mo and Zn significantly augmented the seed yield (90.6g) of common bean. The same application also positively affected the important yield components which plays major role in yield production. In comparison of other applications foliar spray of molybdenum produced the better seed yield (83.1g) and minimum yield (54.7g) was examined due to H_2O spray (Fig. 3).

Biological yield was significantly increased through the application of combined foliar spray of B, Mo and Zn which produced (265.2g), while foliar spray of Mo and Zn resulted (248g and 239g, respectively). H_2O spray alone produced minimum (180.1g) biological yield (Table 5 and Fig. 3). Our results are in agreement with those reported by Yassen *et al.* [16] who found that application of (Fe + Zn) combine and zinc alone significantly increased the seed yield. Seilsepour [21] reported that application of iron and zinc increased the grain yield. Our findings are in accordance with Bameri *et al*. [14], who reported that combination of three micronutrients Mn, Zn and Fe significantly increased the grain yield. Cakmak [13] and Kaya *et al.*[15] also investigated similar results that the biological yield was enhanced due to micronutrient (Zn).

CONCLUSION

It may be concluded that foliar feeding of micronutrients application especially (B+ Mo + Zn) combined enhanced the plant height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, biological yield and seed yield. Thus, foliar application of micronutrients (B+ Mo + Zn) is suggested to get the seed yield of common bean.

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