INNSPUB

International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 4, No. 3, p. 20-26, 2014

RESEARCH PAPER OPEN ACCESS

Growth and Yield of *Phaseolus vulgaris* as influenced by Different Nutrients Treatment in Mansehra

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Article published on March 18, 2014

Key words: *Phaseolus vulgaris*, foliar spray, Mansehra, poultry manure, yield.

Abstract

In Pakistan one of the main causes of the low production of common bean (*Phaseolus vulgaris* L.) is lack of proper fertilizer management especially of mineral nutrients which plays crucial role in growth and yield of bean. Foliar feeding of mineral nutrients may be used as a supplement for obtaining higher yield. Experiment was conducted to investigate the effect of different nutrients application on common bean at experimental field, Department of Botany, Hazara University, Mansehra during 2012-13 in Randomized Complete Block Design with three replicates and four treatments i.e. control (H_2O spray alone), poultry manure, DAP (Di-ammonium Phosphate) and foliar spray of (NPK 20:20:20). The results showed that foliar spray of NPK significantly increased number of pods plant^{-1}, number of seeds pod^{-1}, number of seeds plant^{-1}, biomass and grain yield. It may be concluded that foliar spray of NPK is the suitable application for the maximum yield of common bean.

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Introduction

Common bean (*Phaseolus vulgaris* L.) is an annual leguminous, self-pollinated plant having non-endospermic seeds which mostly differ in size and colour from wild type small black to mottled large red, black, brown or white seeds 7-16mm long (Cobley and Steele, 1976). With most of varieties it is considered as short-season crop from emergence to physiological maturity it ranges 65-110 days (Buruchara, 2007). It is a non-sensitive crop to soil type uptill well-drained, fertile and conditions interfere with germination and emergence (Wortmann *et al*., 1998). Edje *et al*., (1980) stated that common bean is a good source of energy, it provides folic acid, complex carbohydrates, dietary fiber and also contains high protein content.

Tahir, 1980 stated that seventeen elements are required by plants for normal growth. C, H and O are taken from water and air. Other nutrients are obtained from soil. Primary nutrients are used by plants in comparatively large quantity and often complemented as fertilizers (Nitrogen, Phosphorus and Potassium). To increase crop yield the use of fertilizer is one of the most essential factor (Kakar *et al.,* 2002). Whe poultry manure applied in combination with chemical fertilizers then it gave better yield (Deore *et al.,* 2002).

In agriculture practices fertilizer is an important source to increase crop yields. Among fertilizer application methods, one of the most important methods of application is foliar nutrition because foliar nutrients facilitate easy and quick consumption of nutrients by penetrating the stomata or leaf cuticle and enters the cells (Latah and Nadanassababady, 2003). Due to several compensations of foliar application methods like quick and proficient response to needs of plants, less needed products and soil conditions independency, the concentration towards foliar fertilizers is arising day by day. It is also determined that during crop growth supplementary foliar fertilization increase plants mineral status and improve crop yields (Kolota and Osinska, 2001).The proper amount of fertilizer application is thought a key role to increase crop production the judicious application of inorganic fertilizers can improve yield from 30-40%. N, P and K are the basic and important plant food nutrients and the most of our soil face deficiency in these nutrients (Tahir, 1980).

Verma and Sahani, (1963) reported that plant nutrients through gave quick benefits and also economize the nutrient element as compared to soil dressing. As fertilizers application is complicated to apply through top dressing or placement. Therefore the scope of foliar fertilization is best suited for Rabi pulses (Bhowmick *et al.,* 2005).

Keeping these facts in view, demonstration experiment were conducted on the experimental field to demonstrate appropriate rate of different nutrients treatment such as, foliar spray, DAP and poultry manure on growth and yield of common bean (*Phaseolus vulgaris* L.) where results achieved from application of different nutrient sources foliar by comparing with between them and with unsprayed i.e. control plots.

Material and methods

Field experiment was carried out at the experimental field Department of Botany, Hazara University in randomized complete block design (RCBD) with four treatments replicated three times during winter season of 2012-13 to study the effect of various nutrient treatments on growth and yield of common bean.

Soil samples were taken randomly before sowing from the experimental field from 0 to 15cm and 15 to 30cm in depth for physiochemical analysis. Air dried soil (50 g) and 50 ml distilled water were added into a glass beaker. Mixture was made and allowed to stand for 1 hr. Then soil pH was measured by pH meter (McLean, 1982). A representative random sample was analyzed for physical and chemical analysis at Land Resources Research Institute, NARC. The nitrogen was analyzed through Macro-Kjeldahl method (Paul & Berry, 1921). Ammonium bicarbonate- Diethylen triamin penta acetic acid (AB-DTPA) method was used to analyze both phosphorus and potassium (Soltanpour & Woekman, 1979).

Common bean seeds were soaked for 12 hours and then were sown with 4 inches plant to plant and 12 inches row to row distance and the area of each plot was 2.4 x 1.5 m^2. The treatments were arranged in factorial split plot (RCBD) with three replications. Foliar treatments were repeated after 14 days of interval till maturity while basal placement of DAP and poultry manure was done single time. The applications were as follows:

1. T_0 Control (Water spray)
2. T_1 (Poultry manure) 1953.125 kg/ha
3. T_2 DAP (Solid form) 123.5 kg /ha
4. T_3 (NPK 20:20:20) in powder form 6177.4g + 1235.4 L H_2O /ha

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

Results and discussion

The results of soil analysis before sowing of bean plants showed that the experimental soil was found deficient in nutrient values (Table 1). The standard soil nutrient values are given in (Table 2) (Soltanpour, 1985).

Table 1. Physiochemical analysis of soil sample before sowing of common bean in experimental field, department of botany 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)	6.4	1.82	0.76	121	0.17
2.	(15-30 cm)	7.14	1.49	0.61	115	0.34

Table 2: Standard values of different nutrients 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

In the present research study it is noticed that foliar treatment of foliar treatment of NPK increased the plant height, number of branches $plant^{-1}$, number of leaves $plant^{-1}$, plant weight and was followed by the poultry manure while the water spray alone for all the vegetative traits resulted in minimum values (Table 3 and Fig 1). The results are in accordance with (Anurag *et al.*, 2002 and Reager *et al.*, 2003) for both the plant height and number of branches $plant^{-1}$. Ali *et al.* (2010) also found similar results who noticed that P treatment produced maximum number of branches in mungbean. Root length of bean plant was increased significantly through the poultry manure treatment. Our results are also in accordance with (Khan *et al.,* 2010 and Khosa *et al.,* 2011).

Table 3. Mean comparison effect of different nutrient treatments on growth parameters of bean plant

Treatment	Height of Plant (cm)	Length of Root (cm)	No. of branches $plant^{-1}$	No. of leaves $plant^{-1}$	Wt. of plant (g)
To	24.9±0.8d	3.4±0.2c	2.8±0.1c	9±0.4c	2.9±0.08d
T1	27.9±0.7b	6±0.10a	3.2±0.1a	11.4±1a	4.3±0.7b
T2	26.8±0.1c	5.1±0.6b	3±0.08b	11.2±0.3b	3.2±0.08c
T3	29±0.5a	5.6±0.7b	3.3±0.1a	11.6±0.6a	4.6±0.1a

Note: The letter indicate the least significant ($P<0.05$) difference in the same column according to LSD test.

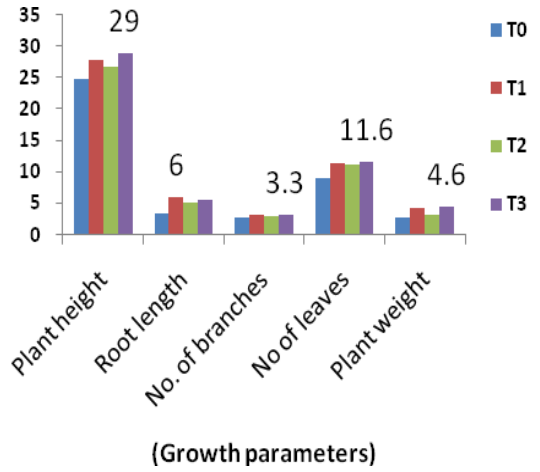

Fig. 1. Effect of different nutrient treatments with indication of maximum value on growth parameters of bean plant.

The attributes which play an essential and key role in yield production are pod length, number of pods plant^{-1} (2.5), number of seeds pod^{-1} (3.7) and number

of seeds plant^{-1} (8.6) were significantly increased by the application of foliar application of NPK and minimum values were noticed in control (water spray alone) as presented in (Fig. 2).

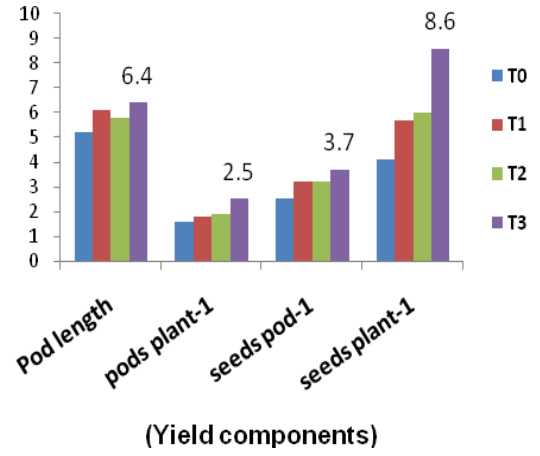

Fig. 2 Effect of different nutrient treatments with indication of maximum value on yield parameters of bean plant.

These results are in contradiction with Klacan (1997) and Sharma (1999). The results are also in conformity with those of Subramani *et al.* (2002); Jamal and Chaudhary, 2007. Azarpour *et al.*, (2011) who investigated that foliar spray on cowpea plants with humic acid at the concentration of 50mg L^{-1} in presence of the N fertilizer (45kg ha^{-1}) gave the maximum values of seed yield, number of pods plant^{-1}, number of seeds pod^{-1}, pod length, seed length and seed width.

The data on seed yield of common bean recorded at harvest showed highly significant differences in results by foliar spray of NPK from all other applications. The DAP showed non-significant variation as compare to poultry while both of them showed significances from control. However Maximum grain yield (813kg/ha) was recorded due to foliar application of NPK, followed by DAP and poultry manure. While minimum seed yield was recorded in control as presented in (Table. 4). These result are in contradiction with the findings of Eman and Moqied (1989) as they noticed that foliar application of urea increase the grain yield. Similar results were reported by Manivannan *et al.*, (2002) and Anitha *et al.*, (2005); Zameer *et al.*, (2006); Zafar and Fayyaz (2007); Alam *et al.* (2010); (Saeed *et al.*, 2013) all of them found matching results.

Foliar spray of NPK on Biological yield after harvesting showed highest significant differences from all other applications. Poultry manure showed significant results in comparison with DAP and control. Foliar application of NPK recorded maximum biological yield (2423kg/ha), followed by poultry manure and DAP respectively. Whereas, significantly minimum biological yield was recorded in control as presented in (Table. IV). Rajput *et al.*, (1995) findings are in agreed with present result that biological yield was increased with foliar spray of nitrogen. Dafan *et al.*, (1999) also observed the same results. They reported that foliar application of potassium increased the biological yield. Habashy *et al.*, (2005); (Valenciano *et al.*, 2010) and Moraditochaee, (2012) also found agreed results.

Table 4. Effect of different nutrient treatments on different yield parameters of bean plant

Treatment	Length of Pod (cm)	No. of Pods plant^{-1}	No. of seeds pod^{-1}	No. of seeds plant^{-1}	Biological yield m^{-2}	Seed yield m^{-2}
To	5.2±0.2c	1.6±0.05c	2.5±0.1c	4.1±0.1c	152±4d	40.6±1c
T1	6.1±0.2a	1.8±0.05b	3.2±0.2b	5.7±0.6b	210±12b	52±3b
T2	5.8±0.4b	1.9±0.08b	3.2±0.1b	6±0.3b	176.3±3c	55.6±3b
T3	6.4±0.2a	2.5±0.05a	3.7±0.1a	8.6±0.08a	242.3±9a	81.3±1a

Note: The letter indicate the least significant (P<0.05) difference in the same column according to LSD test.

Common bean cost benefit ratio as presented in (Table.5) showed that foliar spray treatment showed the maximum benefit in less cost on same area where as poultry and di-ammonium phosphate showed 2nd and 3rd ratio respectively while water spray alone showed the lowest cost benefit ratio.

Table 5. The Cost Benefit Ratio was calculated and is given below:

S. No	Treatments	Cost Benefit Ratio					
		Amount of Fertilizer /Area		Cost of Fertilizer/Area		Benefit/Area	
		1ha	2m^2	1ha	2m^2	1ha	2m^2
1.	To (H2O spray)	1500 L H_2O	-	-	-	44660 Rs	8.93 Rs
2.	T1 (Poultry manure)	1953.125kg	390g	8800 Rs	1.76 Rs	57200 Rs	11.44 Rs
3.	T2 DAP (Solid Form)	247.09kg	48g	20748 Rs	4.03 Rs	61160 Rs	12.23 Rs
4.	T3 (Foliar spray NPK)	6177.4g + 1235.4 L H_2O	2.19g + 0.44 L H_2O	667.1 Rs	0.13 Rs	89430 Rs	17.86 Rs

Conclusion

The results of the present research indicated that foliar application of NPK has significant effect on most of the growth attributes, yield and yield components of common bean. Poultry manure showed 2nd best effect on growth parameters and yield attributes than Di-ammonium Phosphate as a nutrient source for yield of bean under the experimental conditions. According to cost benefit ratio the foliar spray of NPK increased yield and biomass of plant in low cost as compare to other treatment sources.

Acknowledgment

The Principal author is very thankful to Dr. Aftab Afzal and Dr. Zafar Iqbal for providing field for experiments at Hazara University Mansehra where many young field scientists are trying to achieve their goals.

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