



Effect of Different Levels of Potassium Fertilizer on the Yield Components of BARI Bush Bean-2

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried out at Sher-e-Bangla Agricultural University Farm during the *Rabi* season of November 2008 to March 2009 to investigate effect of different levels of potassium fertilizer on the yield components of BARI Bush Bean-2. The red brown terrace soil of Tejgaon was silty clay loam having pH 5.6. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experiment comprises 4 levels of potassium in the form of MoP (0, 20, 40 and 60 kg potassium/ha). The results revealed that different levels of potassium showed significant variations on the yield and yield components of BARI Bush Bean-2. The treatment K₄₀ (40 kg potassium) gave the maximum pod length (10.90 cm), pod diameter (2.95 cm), average single pod weight (5.49 g), total pod weight per plant (25.37 g), pod yield per plot (1795.83 g) and pod yield per hectare (4.38 ton). Thus the results of the experiment suggested that the use of 40 kg potassium produced highest yield of BARI Bush Bean-2 in red brown terrace soil of the Tejgaon series.

Keywords: *Yield; bush bean; potassium.*

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1. INTRODUCTION

Bush bean (*Phaseolus vulgaris* L.) belonging to the family Leguminosae and subfamily papilionaceae [1]. The center of origin of this crop is South America but consumed in all parts of the globe for its edible seeds and pods [2]. Being a major grain legume crop of the world it is a resourceful short-duration legume crop with high grain yielding potential and diversified use [3]. It can be used both as pulses and vegetables. In Bangladesh, this crop is known as “Farashi Sheem” [4]. It is also known as the french bean, kidney bean, common bean, basic bean, snap bean, raj bean, navy bean, haricot bean, string bean, pole bean, wax bean and bonchi [5]. The marketable parts of this fruit are immature green pods and marketed either in fresh or in frozen or canned condition [3]. The dry seeds also may be used as pulses for human consumption or animal feed. The foliage of the plant may also provide hay, silage and green manures [3]. After harvest, plants can be fed to cattle, sheep, and horses. Its green pods are rich in protein, carbohydrate, fat, thiamin, riboflavin, Ca, Fe and niacin as well as fiber [6,7]. It also contains various immune system-boosting antioxidants e.g. flavonoids and carotenoids [8]. Due to their high levels of flavonoids, this power-packed legume has been shown to help manage and regulate diabetes symptoms in many patients and reduce the risk of heart diseases [9]. It has gained enormous demand in Bangladesh over recent years because of its glorious nutritional quality and versatile use. Additionally, the crop has a well-known export quality which has attracted the attention of the Agriculture industry and exporters [3]. This crop is also valuable in Bangladesh mostly for exporting tender beans to the European market [10]. In this context, the yield of Bush bean has become an important component of vegetable production and cash income. However, the crop needs optimum nutrient management to ensure proper growth and yield. Many factors influenced the production of BARI Bush Bean-2. Among them, fertilizer especially Potassium is the most effective and critical input for increasing crop yield [11]. For successful production of legumes and upland crops in Bangladesh, the deficiency of Potassium is now considered as one of the major constraints [12]. Potassium also effects seed formation [13] and it also improves the fruit quality [14]. The most obvious effect of potassium is on root development, particularly of the lateral and fibrous rootlets that are essential to fix the atmospheric nitrogen in legume crops

[11]. Potassium application showed a positive effect at all proportions on growth and yield of peas [15]. There are reports that Potassium deficiency symptoms are hard to absorb and the deficiency in bean plant occurs without being noticed by the farmers and hence all fertilizer recommendations always include potassium nutrients [16]. Regarding plant nutrition, potassium plays a vital role in the improvement of post-harvest quality traits [17]. The sufficient application of K supports the increment of yield, fruit size, fruit color, shelf life and transport quality of many crops [18]. It maintains the turgor pressure and osmoregulation of plant cell that helps in opening and closing of stomata [19]. It improves disease resistance, drought stress resistance, water stress tolerance, winter hardiness and uptake efficiency of other nutrients [20]. More than 60 enzymes which need to improve the yield and quality of plant are activated by K application [21]. So the proper dose of potassium application has great importance in the plant life cycle. Keeping this in mind, it is necessary to improve the production level and nutritional quality of BARI Bush Bean-2. Therefore, the present experiment was carried out to find out the suitable dose of K for yield maximization of BARI Bush Bean-2.

2. METHODS AND MATERIALS

The research work was conducted during the *Rabi* season of November 2008 to March 2009 at Sher-e-Bangla Agricultural University Farm, Sher-e-Bangla Nagar, and Dhaka. It is located at 90.335°E longitude and 23.774° latitudes. The soil of the experimental area belongs to the Modhupur Tract under AEZ No. 28. It had shallow red brown terrace soil. The selected plot was medium high land and the soil series was Tejgaon. The treatment of the experiment was different doses of Potassium viz. 0, 20, 40 and 60 kg/ha. The experiment was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The unit plot size was 2.4 m x 1.5 m (3.6 m²). The distance between the two plots was 50 cm and between blocks was 50 cm. The plots selected for the experiment was plowed on the 30th of November 2008 and cross-plowed several times to obtain a good tilth. The manures and fertilizers like cow dung, Urea, TSP, Gypsum, and Boric acid were applied at the rate of 5000, 200, 60 and 5 kg/ha, respectively [22]. The entire quantity of cow dung, gypsum, and boric acid was applied as basal dose while full doses of TSP (Triple Super Phosphate) and half of Urea were at

seed sowing time and rest half MoP (Muriate of Potash) at 30 days after seed sowing. Seeds of BARI Bush Bean-2 were sown on 03 December 2008. Seeds were treated with Vitavax. The seeds were sown per hill at a depth of 5 cm and the seeds were covered with pulverized soil just after sowing and gently pressed with hands. A light irrigation was given by sprinkler method after sowing of seeds. The fungicides Bavistin and Tilt 250EC @ 0.5 ml/L of water were applied for controlling damping off and blight disease, respectively. Equal amount of water was applied in each treatment during irrigation. Intercultural operations were done whenever required for getting better growth and development of the plants. Nogos @ 1 ml/L water were applied two times at an interval of 10 days starting soon after the advent of infestation for controlling leaf caterpillars. Selected plants from each treatment were randomly sampled and marked with tag for recording plant characters. Data were collected on pod length, pod diameter, average single pod weight, total pod weight per plant, pod yield per plot and pod yield per hectare. From each unit plot green pods were harvested at 4 days interval and their total weight was recorded. Harvesting was done for four times and their weight was recorded in each unit plot and expressed in kilogram (Kg). The green pod yield per plant was finally converted to yield per hectare and expressed in ton (t). The data obtained from the experiment were analyzed statistically using the MSTAT computer package program to find out the significance of the difference among the treatments. The mean values of all the treatment were calculated and analysis of variances for all the characters was performed by the 'F' (variance ratio) test. The significance of the differences among the pairs of treatment means was estimated by the Duncan Multiple Range Test (DMRT) at 1% and 5% level of probability [23] for the interpretation of results.

3. EFFECT OF POTASSIUM ON THE YIELD COMPONENTS OF BARI BUSH BEAN-2

3.1 Pod Length

Potassium influenced significantly in respect of pod length. Pod length increased gradually due to increasing dose of potassium fertilizer. The length of pod increased significantly with the increasing levels of potassium. The highest

length of green pod was found (10.90 cm) in treatment K₄₀ which is statistically identical to K₂₀, K₆₀ treatments and the lowest result (10.40 cm) was found in control treatment (Table 1). This may be due to BARI Bush Bean-2 responded well to the enhanced doses of potassium fertilizer [1]. [24] found significant increase in pod length of bean due to application of potassium fertilizer. High photosynthesis activity and source strength that supported assimilates for pods may have partially contributed in lengthening the pods.

3.2 Pod Diameter

Pod diameter was recorded at the harvest stage of BARI Bush Bean-2 and it was observed that there were significant variations in pod diameter at different levels of potassium application up to a certain dose. The diameter of pod increased significantly by the increasing levels of potassium. The maximum diameter of pod was found (2.95 cm) in treatment K₄₀ which is statistically alike to K₂₀ treatment and the minimum diameter of pod (2.66 cm) was found in the plot treated with control (Table 1). Potassium enhanced the formation of chlorophyll and encouraged the vegetative growth of BARI Bush Bean-2 [1]. The potassium intake leads to positive effects on photosynthesis, leaf area index, growth, enhancement of ATP, NADPH synthesis, and increase of mobilization of nitrogenous materials to grain in cereals, regulation of stomata opening and closure and decrease of transpiration [25]. Either efficient species have certain morphological characteristics that increase uptake of utilization of nutrients or they are able to improve the availability of nutrients, hence increase the size of the fruit [26].

3.3 Average Single Pod Weight

A significant influence was observed in respect of average single pod weight at different rates of potassium application. The highest single pod weight per plant was found (5.49 g) in treatment K₄₀ which is statistically similar to K₂₀ treatment and the lowest (4.35 g) under control treatment (Table 1). [27] found K fertilizer improves sugar metabolism, enhances osmotic cell concentration, maintains stomatal guard cell turgor, helps regulate stomatal opening, participates in photosynthesis, and increases yield.

Table 1. Effect of potassium on the yield and yield component of BARI Bush bean-2

Treatment	Pod length (cm)	Pod diameter (cm)	Average single pod weight (g)	Total pod weight per plant (g)	Pod yield per plot (g)	Pod yield per hectare (ton)
K ₀	10.52 b	2.66 c	4.35 c	23.29 c	1466.67 c	3.02 c
K ₂₀	10.80 ab	2.92 ab	5.40 ab	24.87 ab	1650.00 ab	3.88 ab
K ₄₀	10.90 a	2.95 a	5.49 a	25.37 a	1795.83 a	4.38 a
K ₆₀	10.60 ab	2.77 b	4.74 b	24.37 b	1568.75 b	3.48 b
CV (%)	7.28	7.47	10.48	7.01	15.43	15.41
Level of significance	*	*	*	*	*	*

* = Significant at 5% level.

NS = Not significant, CV= Co-efficient of variation

3.4 Total Pod Weight per Plant

Statistically, significant variation was recorded for different levels of potassium in terms of total pod weight per plant. The highest total pod weight per plant was found (25.37 g) in treatment K₄₀ which is statistically identical with K₂₀ treatment and the lowest total pod weight per plant (23.29 g) was found in the plot treated with control (Table 1). Alike results were also reported by [1]. This is supported by [28] who reported that potassium has a crucial role in the translocation and storage of assimilates. This explanation agrees also with other findings [29,30] where it was concluded that the amount of photosynthate available for biomass production.

3.5 Pod Yield per Plot

The effect of potassium on pod yield per plot showed a statistically significant difference among the treatments at the harvesting stage of BARI Bush Bean-2. Pod yield per plot increased significantly by the increasing levels of potassium. The highest pod yield per plot was found (1795.83 g) in treatment K₄₀ which is statistically identical to K₂₀, treatment followed by K₆₀. The lowest (1466.67 g) pod yield per plot was found in the plot treated with control treatment (Table 1). [31] found the similar result. Potassium is the most important cation for plant growth and its development. It has multifunction at levels of physiology and biochemistry particularly those related to enzymes activity that takes part in photosynthetic reactions and metabolism of carbohydrates. Potassium constitutes up to 10% of plant dry matter by weight [32].

3.6 Pod Yield per Hectare

Pod yield per hectare was recorded at the harvest stage of BARI Bush Bean-2 and it was

observed that there were significant variations in relation to potassium application. Pod yield per hectare increased significantly by the increasing levels of potassium up to a certain dose. The highest pod yield per hectare was found (4.38 ton) in treatment K₄₀ which is statistically similar to K₂₀ treatment which is statistically followed by K₆₀. The lowest pod yield per hectare (3.02 ton) was found under control treatment (Table 1). The increment in the yield may be due to the better use of applied K that resulted in improvement in biosynthesis of the photosynthates and finally the yield. There are many physiological processes in plant such as osmotic regulation, transporting carbohydrates and anion-cation balance respond to potassium concentration in plant tissues. The high water use efficiency (production of unit dry matter per unit water transpired) at optimum K+ nutrition results from closely controlled opening and closure of stomata. Potassium not only promotes the translocation of newly synthesized photosynthates but also has beneficial effect on the mobilization of stored material [32]. Potassium is mobile in xylem and phloem can be recycled in plant, i.e., transport from roots and from here again to shoots. So that, high rates of potassium fertilization increase availability of material assimilated to seed and eventually reduce abortion of ovules.

4. CONCLUSION

This experiment was conducted to investigate the response of BARI Bush Bean-2 against different levels of potassium fertilization in respect of various yield components. Though the different treatments of the experiment (K₂₀ and K₄₀ kg/ha) performed similar in most of the cases but the potassium level 40 kg performed best in terms of yield characters. And this dose of potassium fertilizer can be recommended for commercial cultivation of BARI Bush Bean-2.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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