



Response of BARI Bush Bean-2 at Different Levels of Nitrogen Fertilization

Basudeb Roy^{1*}, Alok Kumar Paul² and A. T. M. Shamsuddoha²

¹Department of Agricultural Extension, Ministry of Agriculture, Govt. of the People's Republic of Bangladesh, Bangladesh.

²Department of Soil Science, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

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 Research Farm during the *Rabi* season of 2008 to investigate the response of BARI Bush Bean-2 at different levels of nitrogen fertilization in respect of various yield components. The soil of the experimental area belongs to the Modhupur Tract (AEZ No. 28) which had shallow red brown terrace soil. The selected plot was medium highland and the soil series was Tejgaon. The experiment was laid out in a RCBD design with three replications. The experiment comprises 4 levels of nitrogen in the form urea (0, 40, 80 and 120 kg ha⁻¹ N). The results obtained revealed that different levels of nitrogen showed significant variations on the different parameters studied. Among the different treatments of the study the treatment N₈₀ (80 kg N) gave the highest pod length (11.15 cm), pod diameter (2.93 cm), average single pod weight (5.42 g), total pod weight plant⁻¹ (25.63 g), pod yield plot⁻¹ (1789.58 g) and pod yield hectare⁻¹ (4.37 ton). Thus the findings of the experiment revealed that the use of 80 kg N maximally influence the yield and yield contributing characters of BARI Bush Bean-2 in the selected red brown terrace soil of the Tejgaon series.

Keywords: Yield; bush bean; nitrogen.

*Corresponding author: Email: bhbasu@gmail.com;

1. INTRODUCTION

Being a major grain legume crop of the world Bush bean (*Phaseolus vulgaris* L.) is consumed in all parts of the globe for its edible seeds and pods [1]. It belongs to the family Leguminosae, and sub-family Papilionaceae [2]. In Bangladesh, this crop is known as “Farashi Sheem” [3]. It is also known as french bean, kidney bean, common bean, basic bean, snap bean, raj bean, navy bean, haricot bean, string bean, pole bean, wax bean and bonchi [4]. Bush bean originated in Central and South America [5]. Now it is cultivated in many parts of the tropics, subtropics and throughout the temperate region [6]. It is an annual herbaceous vegetable crop-producing strait or slightly curved pod. Bush beans are green, tender, rounded shaped pods, 4 to 6 inches (10 to 15 cm) long. The pods are eaten whole, including the immature seeds, when they are still young, juicy and tender. Its green pods are rich in protein, carbohydrate, fat, thiamin, riboflavin, Ca, Fe and niacin as well as fiber [7,8]. It also contains various immune system-boosting antioxidants e.g. flavonoids and carotenoids [9]. Due to its 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 [10]. Bush bean has a delicate texture and sweet flavor. Fresh green beans are sweeter than canned. This crop is also valuable in Bangladesh mostly for exporting tender beans to the European market [11]. In recent years, the Hortex Foundation, Vegetable Export Center of BRAC and some other organizations facilitated the export of this vegetable of Bangladesh. Although, to play an important role in the economy of Bangladesh and increasing popularity in vegetable consumption, the yield of Bush bean in Bangladesh is lower than the world average. In this context, the yield of Bush bean has become an important component of vegetable production and cash income. Many factors influenced the production of BARI Bush Bean-2. Among them, fertilizer especially nitrogen is the most effective and critical input for increasing crop yield [12]. In agro-ecological zones the requirement of fertilizer for any crop varies with the cultivars and soil types [13]. Nitrogen is one of the most limiting nutrients to plant growth several authors [14,15] found a maximum pod yield of Bush bean from 120 kg N ha⁻¹. By using 120 kg N ha⁻¹, [16] found the maximum plant height, the number of branches plant⁻¹ and green pod yield⁻¹ of Bush bean. Ali et al. [2] stated that the maximum plant height

(39.03 cm), number of branches plant⁻¹ (18.25), pod length (14.10 cm), pod weight (5.37 g) and pod yield (8.26 t ha⁻¹) were recorded in the treatment receiving 120 kg N. The short growth cycle of this crop is one of the reasons that Nitrogen fixation is not as efficient as other legumes because carbohydrate production by the Bush bean plant occurs at the same time as the plants and the rhizobium needs a maximum carbohydrate supply and there is a heavy competition for carbohydrate between the bacteria and Bush bean [17]. Nitrogen is the most essential elements for crop production. It encourages vegetative growth and increases the leaf area of plants, which helps in photosynthetic activity. It stimulates the root growth and development of the plant. Furthermore, it helps in the uptake of other nutrients from the soil. The vegetative growth and yield of BARI Bush Bean-2 were increased with a successive increase in the dose of nitrogen [18]. BARI Bush Bean-2 can fix atmospheric nitrogen in its root zone. An optimum amount of nitrogen for the whole growth period is necessary to produce the maximum yield of good quality zhar sheem or BARI Bush Bean-2 [19]. For that reason, nitrogen fertilizer should be applied in an optimum dose to maximize its utilization for crop production. Therefore the present experiment carried out to investigate the response of BARI Bush Bean-2 at different levels of nitrogen fertilization in respect of various yield components.

2. MATERIALS AND METHODS

The research work was conducted in *Rabi* season at Sher-e-Bangla Agricultural University Research Farm, Sher-e-Bangla Nagar, and Dhaka during the Rabi season of November 2008 to March 2009. It is located at 90.335°E longitude and 23.774° latitudes. The treatment of the experiment was different doses of Nitrogen viz. 0, 40, 80, 120 kg ha⁻¹. 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, TSP (Triple Super Phosphate), MoP (Muriate of Potash), Gypsum, and Boric acid were applied at the rate of 5000, 2000, 60 and 5 kg ha⁻¹, respectively [20]. The entire quantity of Cow dung, Gypsum, and Boric acid were applied during the final land preparation while full doses

of TSP and half of MoP were at seed sowing time and rest half MoP at 30 days after seed sowing. Seeds of BARI Bush Bean-2 were sown on 03 December 2008. 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. Intercultural operations were done whenever required for getting better growth and development of the plants. Data were collected on pod length, pod diameter, average single pod weight, total pod weight plant⁻¹, pod yield plot⁻¹ and pod yield hectare⁻¹. 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 [21] for the interpretation of results.

3. RESULTS AND DISCUSSION

3.1 Pod Length

Nitrogen influenced significantly in respect of pod length. Pod length increased gradually due to increasing dose of nitrogen fertilizer. The length of pod increased significantly with the increasing levels of nitrogen up to 80 kg N ha⁻¹. The highest length of the green pod was found (11.15 cm) in treatment N₈₀ which is statistically identical with N₄₀, N₁₂₀ treatments and the lowest (10.30 cm) was found in the plot treated with N₀ treatment (Table 1). This result is in full agreement with several authors [22,23]. They reported that pod length was significantly influenced by optimum dose of N. Nitrogen is a part of the chlorophyll molecule which activates the normal metabolic process of leaves. The leaves become metabolically most active those contain the highest level of N. So the addition of nitrogen enhances the vegetative growth viz. pod length of BARI Bush Bean-2.

3.2 Pod Diameter

At different levels of nitrogen application there were found significant variations in pod diameter. By the increasing levels of nitrogen the diameter of pod increased significantly up to 80 kg N ha⁻¹. The topmost diameter of the pod was found (2.93 cm) in treatment N₈₀ which is statistically alike

with N₁₂₀ treatment and the lower most (2.73 cm) was found in the plot treated with N₀ treatment (Table 1). These results are in alike with the findings of several authors [15,24]. An adequate supply of nitrogen favors the formation of carbohydrates as it is a part of the chlorophyll molecule. The ideal level of N promotes the metabolic process and produces more food that reserved in fruits. That's why pod diameter increases with the application of an optimum dose of N.

3.3 Average Single Pod Weight

A significant influence was observed in respect of average single pod weight at different rates of nitrogen. The highest average single pod weight was found (5.42 g) in treatment N₈₀ which is statistically similar with N₄₀, N₁₂₀ treatments while the lowest (4.78 g) was found in the control plot (Table 1). It was clearly observed that there was a positive effect between optimum level of nitrogen and the pod weight plant. Sharma et al. [25] also reported similar results. The increment in the yield component may be due to the proper use of nitrogenous fertilizer which resulted in boosting in biosynthesis of the photosynthates and finally the yield.

3.4 Total Pod Weight Plant⁻¹

Statistically, a significant variation was found for different levels of nitrogen with total pod weight plant⁻¹. The highest total pod weight per plant was observed (25.63 g) in treatment N₈₀ which is statistically identical with N₄₀, N₁₂₀ treatments and the lowest (22.85 g) was found in the zero treated plot (Table 1). This result is similar to that of Sharma et al. [26]. About 50% at higher doses of applied N remains unavailable to a crop due to N loss through leaching. So, optimum dose of N gave the best result.

3.5 Pod Yield Plot⁻¹

The effect of nitrogen on pod yield plot⁻¹ showed a statistically significant difference among the treatments at the harvesting stage of BARI Bush Bean-2. Pod yield plot⁻¹ increased significantly by the increasing rates of nitrogen up to 80 kg N ha⁻¹. The maximum pod yield plot⁻¹ was found (1789.58 g) in treatment N₈₀ which is statistically alike with N₄₀ treatment followed by N₁₂₀. The lowest on pod yield plot⁻¹ (1454.17 g) was found in control treatment (Table 1). Similar result was found by several authors [22,27]. On the other hand Gomez and Gomez [21] found significantly influenced by optimum dose of nitrogen on green

Table 1. Effect of nitrogen on the growth and yield 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)
N ₀	10.30 b	2.73 c	4.78 b	22.85 c	1454.17 c	3.55 c
N ₄₀	10.55 ab	2.74 b	5.17 ab	24.42 ab	1600.00 ab	3.90 ab
N ₈₀	11.15 a	2.93 a	5.42 a	25.63 a	1789.58 a	4.37 a
N ₁₂₀	10.90 ab	2.90 ab	5.00 ab	24.99 ab	1537.50 b	3.750 b
CV (%)	7.28	7.47	10.48	7.01	15.43	15.41
Level of significance	*	*	*	*	*	*

pod yield. Nitrogen is an integral part of proteins, phytochromes, compounds, coenzymes, chlorophyll and nucleic acids. All the biochemical processes occurring in plants are mainly governed by nitrogen and its associated compounds which make it essential for the growth and development of BARI Bush Bean-2.

3.6 Pod Yield Hectare⁻¹

Pod yield hectare⁻¹ was recorded at the harvest stage of BARI Bush Bean-2 and it was observed that there were significant variations in relation to nitrogen application. Pod yield hectare⁻¹ increased significantly by the increasing levels of nitrogen up to a certain dose. The highest pod yield hectare⁻¹ was found (4.37 ton) in treatment N₈₀ which is statistically identical with N₄₀ treatment followed by N₁₂₀. The lowest (3.55 tons) was found in the control treated plot (Table 1). Nasrin et al. [22] Found the similar result and stated that pod yield of bush bean increase with the increment of nitrogenous fertilizer. Among all the essential nutrients applied to the plants nitrogen is the major one which has a key role in the process of photosynthesis. Increased rate of photosynthesis by the best dose of nitrogen gave more yield because large amount of dry matter, more assimilates were produced and transported to fill the seeds as a result of more applied nitrogen.

4. CONCLUSION

This experiment was conducted to investigate the response of BARI Bush Bean-2 at different levels of nitrogen fertilization in respect of various yield components. Though the different treatments of the experiment (N₈₀ and N₁₂₀ kg ha⁻¹) performed similarly but 80 kg ha⁻¹N performed best in all the studied characters. As for maximum output, an over-fertilized condition of nitrogen did not bring out any significant advantage, so excessive use of N fertilizer

should avoid. Therefore, this dose of nitrogen 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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