



Fertilizer Management for Maximizing Soybean (*Glycine max* L.) Production in Char Lands of Bangladesh

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Abstract

An experiment was conducted at Char Martin under Multi Location Testing site in Laxmipur district during Rabi season of 2011-12 & 2012-13 with different fertilizer doses to find out the economic fertilizer dose for soybean variety BARI Soybean 6 under farmers field condition. Four fertilizer combinations viz; T₁: 17-27-55-2.7-2.0-0 kg ha⁻¹ of N-P-K-S-Zn-B (Soil Test Based fertilizer), T₂: 25-25-50-10-0-0 kg ha⁻¹ of N-P-K-S-Zn-B (Fertilizer Recommendation Guide, 2005 based fertilizer), T₃: 28-13-0-0-0-0 kg ha⁻¹ of N-P-K-S-Zn-B (Farmers practice) and T₄: Native fertility (control) were selected. All the yield and yield contributing characters of BARI Soybean 6 varied significantly with the different fertilizer treatments. The highest seed yield (2.99 t ha⁻¹) was recorded from plants treated with T₁ which was statistically similar to T₂. The lowest seed yield (1.74 t ha⁻¹) was obtained from T₄. The highest gross return (Tk.104650 ha⁻¹), net return (Tk. 56375 ha⁻¹) and benefit cost ratio (2.16) were obtained from T₁ and the lowest gross return (Tk. 60900 ha⁻¹), net return (Tk.19900 ha⁻¹) and BCR (1.48) was obtained from T₄.

Keywords: Fertilizer dose, soybean, cost and return

1. Introduction

Char lands of Bangladesh are not suitable for all crops and all seasons. Nutrient status of char land is poor due to coarse textured soils, low water holding capacity, low nutrient capacity, river bank erosion and flooding. Soybean (*Glycine max* L.) have the ability to fix atmospheric nitrogen (N) through root nodule bacteria (*Bradyrhizobium japonicum*) and thus it enriches the soil fertility (Mahabal, 1986). Reports indicated that *B. japonicum* can fix about 300 kg N ha⁻¹year⁻¹ in symbiosis with soybean (Keser and Li, 1992). Soybean an important oil seed producing crop is called

“Protein hope of future” for its nutritional value. It contains 40-45 % protein, 18-20 % edible oil, 24-26 % carbohydrate and a good amount of vitamins (Kaul and Das, 1986).

The soybean oil is cholesterol free and is an easily acceptable diet. Soybean accounts for approximately 50 % of the total production of oilseed crops in the world (FAO, 2007). As a grain legume, it is gaining important position in the agriculture of tropical countries including Bangladesh. Now, soybean producing areas are Barisal, Bhola, Faridpur, Patuakhali, Meherpur, Jessore, Rangpur, Kurigram, Thakurgaon, Tangail, Mymensingh, Jamalpur, Chandpur,

Feni, Noakhali and Laxmipur (Chowdhury *et al.*, 2013). Soybean production area is increasing day by day and in the year 2013 it reaches above 61000 ha. The average yield of soybean in the world is about 3.0 t ha⁻¹ while in Bangladesh, it is only 1.2 t ha⁻¹ (SAIC, 2007). Farmers of this area generally grow local variety of soybean with no or limited application of fertilizer. For this reason, the yield of soybean in this region is much below than that of potential yield level. Balanced fertilization can play a major role to enhance the present yield level. Experimental evidences reveal that the crop is highly responsive to different fertilizers and its yield can be increased remarkably through the judicious fertilization (BARI, 1988; Mohamed, 1984; Roy and Singh, 1986; Kazi *et al.*, 2002). Although soybean can fix atmospheric N in soil, this element is necessary for better yield.

If the government support is available, 7-8 lakh hectares of lands in char areas could be brought under soybean cultivation from where 1.7-1.8 million tons of soybean could be produced (Mollah, 2011). Fertilizer recommendation solely based on crop response data often fails to show economic viability. In this context, Perrin *et al.*, (1979) reported that response of yield should be supported by economic evaluation for judicious fertilizer recommendation. Since the application of optimum dose of fertilizer is important for increasing the yield of soybean, but

very limited information in this regard is available in Bangladesh, the present study was undertaken to determine the optimum fertilizer dose of soybean in char land.

2. Materials and Methods

A field experiment was conducted at MLT site of Char Martin under Laxmipur during *Rabi* season of 2011-12 and 2012-13 in Young Meghna Estuarine Floodplain (AEZ-18) to examine the effects different fertilizer doses on soybean yield (variety : BARI Soybean 6). Before conducting the experiment, initial composite soil samples (0-15 cm) were collected from the experimental plots and were analyzed. The initial soil analysis values were presented in Table 1. The unit plot size was 4 m × 3 m. In both the years, seeds were sown in the last week of January with the spacing of 30 x 10 cm. Four fertilizer treatments viz.; T₁ : 17-27-55-2.7-2.0-0 kg ha⁻¹ N-P-K-S-Zn-B (Soil Test Based fertilizer), T₂: 25-25-50-10-0-0 kg ha⁻¹ of N-P-K-S-Zn-B (Fertilizer Recommendation Guide, 2005 based fertilizer), T₃ : 28-13-0-0-0-0 kg ha⁻¹ of N-P-K-S-Zn-B (Farmers practice) and T₄ : Native fertility (control) were applied in a Randomized Complete Block Design with three replications. Half of urea and entire amount of other fertilizers were applied as basal during final land preparation and the remaining half of urea was top dressed after 22 days of sowing.

Table 1. Chemical properties of soil (0 -15 cm depth) collected before cultivation of the crop in experimental field at Char Martin, Laxmipur

Sample	pH	EC	OC	OM	Total N	K	P	S	Zn	B
		dS/m	(%)	(%)		(%)		Meq/ 100 g soil	µg/g soil	
Average	6.8	0.9	0.9	1.54	0.08	0.11	9	30	0.5	0.4
Critical level	-	-	-	-	0.12	0.12	10	10	0.6	0.2
Interpretation	Neutral	Non saline	Low	Low	Low	Low	Low	High	Low	Optimum

EC = Electrical Conductivity, OC = Organic Carbon, OM = Organic Matter

Irrigation was applied twice. First irrigation was applied after 35 days of sowing before flowering and second irrigation was applied at pod formation stage. Different intercultural operations and plant protection measures were taken as and when necessary to raise healthy crops. The crop was harvested in the 2nd week of May. Data were collected on an individual plant basis from 10 randomly selected plants of each plot in such a way that the border effect was avoided for high precision. Plant height and number of branches plant⁻¹ were recorded during harvest. Number of pods plant⁻¹ and 100 seed weight were recorded after harvesting of the crop. However seed yield plant⁻¹ (g) was estimated after cleaning and proper drying. Plot yield was recorded (3m² from each plot) and then converted to t ha⁻¹. Analysis of variance and comparison of means were calculated separately with statistical package MSTAT-C programme (Gomez and Gomez, 1984). The means were compared using the least significance difference (LSD) test.

3. Results and Discussion

3.1. Plant height

The effect of different fertilizer treatments on the plant height is presented in Table 2. There was significant variations among treatments. The highest plant height (72.6 cm) was observed in T₂ which was similar to T₁ (71.4 cm) and T₃ (64.7 cm) treatments. The shortest plants (58.2 cm) were observed in T₄ (control) treatment.

3.2. Branches per plant⁻¹

The highest number of branches plant⁻¹ (3.9) was observed in T₁ treatment which was almost identical with T₂ treatment. The lowest number of branches plant⁻¹ (2.2) was observed in T₄ treatment (Table 2).

3.3. Pods per plant⁻¹

Table 2 shows that the highest number of pod plant⁻¹ (47.1) was produced in T₁ treatment followed by T₂ (43.2) and T₃ (35.1) treatment. The lowest number of pod plant⁻¹ (30.6) was observed in T₄ treatment. This result is in conformity with the findings of Karte *et al.* (1983).

3.4. 100 seed weight

The maximum 100 seed weight (13.3 g) was obtained from T₁ treatment which was statistically at par with T₂ treatment and the lowest 100 seed weight (11.6 g) was obtained from T₄ treatment. The present results were in agreement with those of Singh *et al.* (1995) who reported that 100 seed weight increased by STB based fertilizer dose over control due to optimum uptake of nutrients.

3.5. Seed yield plant⁻¹

The highest seed yield plant⁻¹ (14.5 g) was found in T₁ treatment followed by T₂ (13.2 g) and T₃ (10.0 g) treatment (Table 2).

Table 2. Effect of different fertilizer management on the performance of BARI Soybean 6 at Char martin under MLT site, Laxmipur (Pooled of 2011-12 & 2012-13)

Treatment	Plant height (cm)	No. of branches plant ⁻¹	No. of Pod Plant ⁻¹	100 seed weight (g)	Seed yield plant ⁻¹ (g)	Yield (t ha ⁻¹)
T ₁	71.4	3.9	47.1	13.3	14.5	2.99
T ₂	72.6	3.7	43.2	13.3	13.2	2.85
T ₃	64.7	2.9	35.1	12.4	10.0	2.20
T ₄	58.2	2.2	30.6	11.6	8.1	1.74
LSD (0.05)	12.89	0.83	5.73	0.86	3.05	0.37
CV (%)	12.32	14.51	8.65	4.61	14.22	9.54

LSD = Least Significant Difference, CV = Coefficient of Variance

T₁ : STB based fertilizer, T₂ : FRG, 2005 based fertilizer, T₃ : Farmers practice and T₄ : Native fertility

Table 3. Cost and return analysis of BARI soybean 6 as influenced by different fertilizer management at Char martin under MLT site, Laxmipur (Pooled of 2011-12 & 2012-13)

Treatment	Seed Yield (t ha ⁻¹)	Gross return (Tk ha ⁻¹)	Total Cost (Tk ha ⁻¹)	Net return (Tk ha ⁻¹)	BCR
T ₁	2.99	104650/-	48275/-	56375/-	2.16
T ₂	2.85	99750/-	47021/-	52729/-	2.12
T ₃	2.20	77000/-	43650/-	33350/-	1.76
T ₄	1.74	60900/-	41000/-	19900/-	1.48

*Selling price of Soybean @ Tk 35 kg⁻¹

3.6. Seed yield

Table 2 shows that the highest seed yield (2.99 t ha⁻¹) was recorded from plants in : 17-27-55-2.7-2.0-0 kg ha⁻¹ of N-P-K-S-Zn-B (STB based fertilizer) which was statistically similar to T₂ : 25-25-50-10-0-0 kg ha⁻¹ of N-P-K-S-Zn-B (FRG, 2005 based fertilizer). The lowest seed yield (1.74 t ha⁻¹) was obtained from T₄ (control) treatment. The result was supported by the findings of Paikera and Mishra (1989).

3.7. Cost and return

From Table 3, it is evident that the gross return, net return and BCR were the highest (Tk.104650, Tk. 56375 ha⁻¹ and 2.16 respectively) in plots treated with T₁ : 17-27-55-2.7-2.0-0 kg ha⁻¹ of N-P-K-S-Zn-B (STB based fertilizer), while the lowest gross return, gross margin and BCR (Tk. 60900 , Tk. 19900 ha⁻¹ and 1.48, respectively) were found from the control plot (native fertility).

4. Conclusions

It may be concluded from the present study that STB based fertilizer doses is superior to the other fertilizer management packages in respect of yield, net return and BCR for soybean cultivation in the char areas soil under study and its extrapolation areas as well.

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