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Effects of Different Biofertilizer on Soybean (*Glycine max*) Production

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ABSTRACT

The experiment was conducted in the agriculture field of the International University of Business Agricultural and Technology (IUBAT), Dhaka, from January to June 2017 to find out the effect of different *Rhizobium* inoculations on soybean production. The experiment was set up in a Completely Randomized Design (CRD) with four replications. Eight *Rhizobium* inoculations and one control treatment were used in the study to assess the effect of different biofertilizers on soybean production. The findings of the study showed that Strain Bacteria (SB) 316 inoculant performed better in all aspects of growing parameters and yield components like nodulation, vegetative growth, and yield. However, the control treatment performed lowest in every parameter. As a result of the experiment, it could be concluded that *Rhizobium* inoculation has a significant effect on vegetative growth, nodulation, and yield component of soybean. The SB 316 inoculant has been found as the most effective *Rhizobium* inoculation in soybean production.

Keywords: Soybean, Biofertilizer, *Rhizobium* inoculation, Strain, Bacteria, Growth, Production, and Yield.

INTRODUCTION:

Soybean (*Glycine max* L.) is a globally important grain legume crop. Soybean is known as the golden beans of the 21st century. As a grain legume, it is gaining important position in the agriculture of tropical countries, including Bangladesh. It has huge potentiality and has emerged as an important commercial oilseed crop in Bangladesh. In Bangladesh, the soybean is cultivated mainly as pulses crops. The total annual production of global soybean in 2018 was 348 million metric tons (FAO, 2018). The major producers of soybean are Brazil, the United States, Argentina, China and India. The world average yield of soybean is 2.80 MT/ha (Lange Meier and Purdy, 2019) where our

average yield is 1.59 MT/ha, which is much lower than the world average soybean production. Our soybean production yield is much lower than the world average soybean production. Imbalanced nutrition is one of the major obstacles to low soybean productivity in Bangladesh. The application of biofertilizer into the soil leads to increase soil fertility and crop productivity (Yadav and Sarkar, 2019). *Rhizobium* is one of the dominant symbiotic nitrogen-fixation bacteria. As most of our soils are poor in organic matter, response to fertilizer has not been higher due to the rapid fixation of nutrients (Rabiul *et al.*, 2020). Under such conditions, *Rhizobium* inoculation could be advantageous. To overcome these adverse effects the

Rhizobium inoculation needs to be established with a high level of effectiveness. The application of *Rhizobium* inoculation increases plant growth, nutrient uptake and crop yields. Kazmi et al. (2005) reported that soybean seed inoculation by rhizobia bacteria significantly increases the yield. Effective bacteria add enough nitrogen by nodulation which is very important for the growth and development of the plant. It is also very crucial for improving soil fertility and productivity. The objective of the study is to find out the effects of different biofertilizer on soybean growth and yield.

MATERIALS AND METHODS:

The experiment was conducted in the agriculture field of International University of Business Agricultural and Technology (IUBAT), Dhaka, from January to June 2017. This experiment was performed to evaluate the effects of various biofertilizers on soybean production. The soil of the experiment was sandy loam. The experiment was set up in a Completely Randomized Design (CRD) with four replications. The crop used in the experiment was soybean (*Glycine max*) and the variety of the crop was BINA Soybean 3.

The study comprised of eight *Rhizobium* inoculants treatments such as T2: SB-66, T3: SB-321, T4: SB-306, T5: SB-316, T6: SB-343, T7: SB-394, T8: SB-433, T9: SB-212, and one control treatment T1 (without any treatment). TSP and MOP fertilizers were used as source of P and K nutrition. No nitrogenous fertilizer was used during the experimental period. The Strain Bacteria (SB) was prepared in the agricultural laboratory of IUBAT, Dhaka. Some molasses was also used with the Strain Bacteria. Molasses and Strain Bacteria were well mixed in a petri dish at the rate of 15 ml per kg and mixed well with the seeds thoro-

ughly. For each treatment, a separate Petri dish and a separate hand globe were used to avoid contamination of the treatment. Seed inoculation was done on 02 February 2017 and inoculated seeds were shown in the field on the same afternoon. The spacing between the lines was 30 cm and between the plants was 5 cm. Intercultural operations were done for ensuring and maintaining the normal growth of the crop.

The crop was harvested on 13th May, 2017 by observing the physiological maturity. The harvested plant materials were allowed to dry in the sun for 3 days. After drying, threshing and processing was done carefully on a plot basis. The data collection was done at different dates from different parameters and collected data were analyzed statistically by using computer software, Statistics 10.

RESULTS AND DISCUSSION:

The ultimate objective of crop production is its economic yield. Seed yield is the major concern for soybean. The effects of biofertilizers on soybean production presented by their contributions to vegetative growth, nodulation, and yield.

Vegetative growth - The effect of different biofertilizer on the vegetative growth of soybean is measured in terms of plant height, weight and length. The effect of biofertilizer on vegetative growth of different treatments has shown that *Rhizobium* inoculation is more significant than the control treatment. Among the various *Rhizobium* inoculants, SB 316 treatment growth performance was a maximum in every aspect of growing parameters like plant height, shoot fresh weight, shoot dry weight, root length, root fresh weight, and root dry weight.

Table 1: Vegetative growth of soybean in different parameters

Treatment	Plant height	Root length	Shoot fresh weight	Shoot dry weight	Root fresh weight	Root dry weight
	(cm/plant)		(gm/ plant)			
Control	90.5 c	38.25 c	165 b	52 c	22.75 d	6.75 d
SB 66	119.5 b	40.5 bc	203.25 b	68.75 bc	25.5 cd	7.75 cd
SB 321	134 ab	45 abc	293 a	82.75 ab	30.5 bcd	8.75 bcd
SB 306	138 ab	49.25 ab	295 a	86.5 ab	37.25 ab	10.75 ab

SB 316	142 a	50.75 a	305.5 a	88 a	40.25 a	12.25 a
SB 343	136 ab	49.5 ab	285.75 a	82.25 ab	36.75 ab	9.25 bcd
SB 394	135.5 ab	47.25 abc	277.25 a	81.25 ab	36.5 ab	9.5 bc
SB 433	129 ab	46.5 abc	261.5 a	76 ab	32.25 abc	9.25 bcd
SB 212	132 ab	48 ab	266 a	81 ab	36 ab	9.75 abc
CV	11.48	14.03	14.78	16.41	19.60	20.10
LSD	21.40	9.41	56.05	18.47	9.40	2.72

The Analysis of variance indicates that the *Rhizobium* inoculation has a significant effect on all plant growth parameters such as plant height, shoot fresh weight, shoot dry weight, root length, root fresh weight, and root dry weight. Among the various *Rhizobium* inoculations, the SB 316 treatment significantly increased the plant height and root length by 142 cm and 50.75 cm, respectively. Similarly, a significant increase of 88 gm, 40.25 gm, and 12.25 gm was observed in the shoot dry weight, root fresh weight, and root dry weight, respectively. In contrast, to shoot fresh weight, SB 316 inoculant was less significant than other inoculations (**Table 1**). However, the lowest vegetative growth performance was observed from the control treatment. The increased vegetative growth might be due to the increased metabolic activities and stimulation of root growth resulting in enhanced

uptake of nutrients. Jaga and Sharma, (2005) agreed with these findings who reported that bio-fertilizer adds nutrient additionally and increase plant growth activity.

Nodule - *Rhizobium* inoculation has a significant effect on plant nodulation. Different *Rhizobium* inoculation significantly influenced the number of nodule plant-1, nodule fresh weight plant-1, and nodule dry weight plant-1 (**Fig 1**). The highest number of nodules (57.5) recorded from SB 316 treatment. The maximum nodule fresh weight (27.75 gm) and nodule dry weight (3.4 gm) were also observed from SB 316 treatment. On the other hand, the lowest number of the nodule (26.25), nodule fresh weight (13.75 gm), and nodule dry weight (1.27 gm) were found from the control treatment (**Fig 1**).

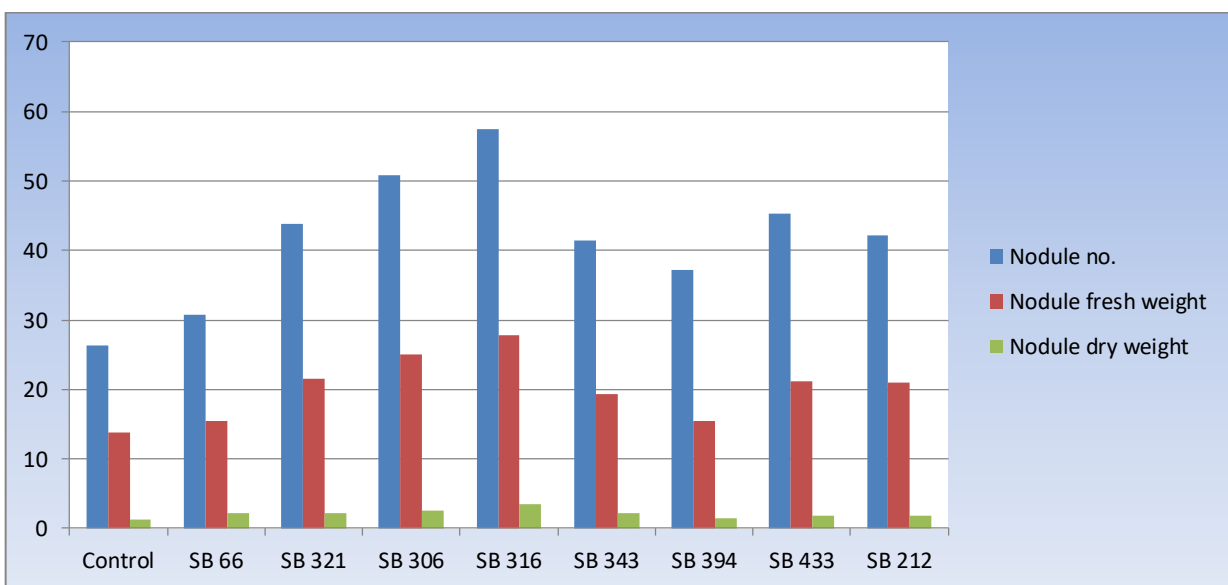


Fig 1: Nodule number, nodule fresh weight (gm) and nodule dry weight (gm) of soybean.

Rhizobia strain significantly increases plant nodulation. Nodulation enhances the crop yield remarkably. The increased nodulation may due to effective sym-

biosis between legume and rhizobia strains. Similar findings showed by Sultana *et al.* (2014) and Egamberdiyeva *et al.* (2004), who reported that soybean

inoculation significantly increased the nodulation that affected the yield. The result of the experiment indicates that *Rhizobium* inoculation influenced the soybean inoculation significantly. SB 316 showed the maximum nodulations.

Yield - Soybean crop yield is considered by its fruit number, the number of seeds, and seeds weight. The result presented in **Table 2** shows that the yield and yield attributes were significantly affected by the

different *Rhizobium* inoculations. The highest number of fruits, number of seeds, and 100 seed weights were 216.8, 420, and 12 gm, respectively, which is obtained from SB 316 inoculation. Similarly, the maximum yield/plant and yield/ha were also found from the SB 316 inoculation. The highest yield/plant and yield/ha were 50.4 gm/plant and 2.71 t/ha, respectively, while the minimum was 19.6 gm/plant and 1.05 t/ha, which are found from the control treatment.

Table 2:Yield attributes of soybean in different treatments

Treatment	Fruits number/plant	Seeds/plant	100-Seed weight (gm)	Yield (gm/plant)	Yield (t/ha)
Control	103.5 d	194 d	10.1 e	19.6 d	1.05 d
SB 66	108 cd	202 cd	10.8bcd	21.8 cd	1.17 cd
SB 321	157 b	301 b	11 b	33.2 b	1.79 b
SB 306	183.3 ab	350 ab	11.8 a	41.1 ab	2.21 ab
SB 316	216.8 a	420 a	12 a	50.4 a	2.71 a
SB 343	171.8 ab	330 ab	10.9bc	36 b	1.93 b
SB 394	151.5bc	288bc	10.7bcd	30.8bc	1.65bc
SB 433	107.8 cd	203 cd	10.5cde	21.3 cd	1.15 cd
SB 212	104.5 d	198 cd	10.4 de	20.5 cd	1.1 cd
CV	22.29	22.94	2.73	23.27	23.34
LSD	46.85	91.94	0.43	10.29	0.55

Rhizobium inoculations have a significant effect on soybean growth and yield. *Rhizobium* inoculation enhances the metabolism of the soybean plant, which promotes growth and nodulation. The resulting of better growth offers a healthy yield. In this study, SB 316 treatment was found to be the most significant inoculation for soybean production compared to other inoculations.

CONCLUSION:

The study was conducted to detect the effect of different biofertilizers on soybean growth and yield. *Rhizobium* inoculation enhances the metabolism of plants which increases the growth and yield of soybean. In this study, the effects of *Rhizobium* inoculation were found to be significantly higher than in control treatment. SB 316 was the most effective inoculation compared to other treatments used in the

study that significantly increased plant growth, nodulation, and yield component.

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CONFLICTS OF INTEREST:

The authors declared there are no conflicts of interest in publishing the research work.

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