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Effect of bio-fertilizers on biological nitrogen fixation of banana cv. GIANT CAVENDISH

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ABSTRACT : The effect of bio-fertilizer was studied in banana accessions intensively collected from ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram during 2009-2010. To assess the efficacy of different bio-fertilizer *viz.*, *Azospirillium, Azotobacter* and phosphorus solubilizing bacteria (PSB) either alone or in combination was applied 20g per plant with recommended dose of FYM. The six treatments were arranged in a Randomized Block Design in three replications and spaced at 2.5 × 2.5 m in order to study its effect on growth, yield and quality attributing traits. All the characters were significantly increased except number of suckers and number of leaves due to application of each of the two-bio fertilizers either separately or in combination. Moreover in combination of *Azotobacter* + PSB 20g per plant showed that more effective than either combination or in separately of another bio-fertilizers. This might be due to because biological nitrogen fixation depends appreciably on the available form of phosphorus. So the combined inoculation of nitrogen fixers and PSB may benefit the plant better (by providing both nitrogen as well as phosphorus) than either alone.

KEY WORDS : Bio- fertilizer, Nitrogen fixation, *Azospirillium*, *Azotobacter*, PSB, Banana,

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Banana a member of genus *Musa*, family Musaceae is one of the most important fruit crop grown in the world in the context of nutritional point of view. Banana comes in a variety of sizes and colors when ripe, including yellow, purple, red and in popular culture and commerce, “banana” usually refers to soft, sweet “dessert” bananas. Owing to its greater socio economic significance, multifaced and virtues of plant it is rightly referred as apple of paradise, Adam’s fig, Kalpatru and Kalpavriksha. Banana is the most nourishing fruit, contains vitamins, minerals and several medicinal properties and it is rich source of energy, low in protein, fat contents provides a balance diet. Centre core of the pseudo stem and male bud are good for making delicious cuisines. Several processed products like chips, banana fig, soft drink, RTS, beer, vine, alcohol, vinegar, powder, jam, confectionaries and halwa are made from the fruits. The plant along with its bunch used extensively in all auspicious occasions such as weeding, festival and for worship (Radha and Mathew, 2007).

Banana requires large quantity of chemical fertilizers for its growth and development moreover, such chemical fertilizers pose a health hazards and microbial population problem in soil besides being quite expensive and making the cost of production high in such a situation the bio fertilizer play a major role (Tiwari *et al.*, 1998) for fruit traits in banana, moreover, bio fertilizers on application remain in soils, multiply and keep benefiting the growing crops. They do not get depleted as in the case of chemical fertilizers and, therefore, if the optimum soil condition prevail, population of added micro-organisms build up and frequent application of bio fertilizers can be avoided (Sharma, 2002). Use of bio fertilizers for crop production is gaining momentum, as they are environmentally safe when compared to chemical fertilizers. The availability and uptake of inorganic nutrients like nitrogen, phosphorus and potassium by plant influenced by micro-organisms that are involved in the uptake of essential

plant nutrients. Bio fertilizers are inputs containing micro-organism which is capable of fix atmospheric nitrogen and mobilizing nutritive elements from non usable form to usable form through biological process (Tien *et al.*, 1979). Therefore, this research work aims to standardize the bio-fertilizers for banana cv. GIANT CAVENDISH.

RESEARCH METHODS

The experiment consisted of different treatment of alone and in combinations of different bio-fertilizers *viz.*, *Azospirillium, Azotobacter* and PSB. The different treatment manipulated as follows: T_1- control, T_2- *Azotobacter* @ 20g per plant, T_3- *Azospirillium* @ 20g per plant, T_4- PSB @ 20g per plant, T_5- *Azotobacter* @ 20g per plant + PSB @ 20g per plant, T_6- *Azospirillium* @ 20g per plant+ PSB @ 20g per plant. All plant under investigation received the FYM 15 kg per plant per year moreover, bio-fertilizers either separately or in combination as per treatment. The treatments were arranged in a RBD with six treatments in three replications. The soil was good in organic matter and climate is well suited for banana cultivation (Table A). Plant were spaced at 2.5 × 2.5 m as they were uniform in growth, vigour and the normal cultural practices follow usually applied for commercial orchards 18 plants were selected for such study. At the beginning of the emergence the florescence, the following vegetative growth parameters estimated. Pseudo stem height (cm) was measured from the soil surface up to the petiole of the last emergence leaf. Pseudo stem girth (cm) was measured at the base (20 cm). Number of emerged suckers, number of functional leaves per plant and days to shooting was recorded whereas fruit physical properties at the maturity stage. The bunch weight (kg), bunch length (cm), number of finger per bunch was recorded whereas acidity and ascorbic acid at ripe stage by indophenol's method and using 0.1N sodium hydroxide, respectively. TSS % also at ripe stage as per centage was recorded by using hand refracto meter.

Table A : Soil fertility status and atmosphere at ICAR Complex, Kolasib, Mizoram

Factors	Range	Status
Soil factors		
N	280-560 kg/ ha	Medium
P	10-20 kg/ ha	Medium
K	>280 kg/ ha	High
S	>30 ppm	High
B	<0.33 ppm	Low
Mo	<0.1 ppm	Low
Acidity	5.6-6.0	Medium
OM	1-2 %	High
Climatic factors		
Temperature	11.8 ºC - 29.6 ºC	Medium
Relative humidity	58.12 - 89.16 %	High
pH	4.5 - 5.5	Acidic
Rainfall	2776.3 - 3730.3 mm	High
E longitude	92^0 15" - 93^0 29"	-
N latitude	21^0 58" - 24^0 35"	-

RESEARCH FINDINGS AND DISCUSSION

All the traits studied exhibited the pseudo stem height and girth was significantly affected by different treatment of bio fertilizer on banana cv. GIANT CAVENDISH. Received combination of *Azospirillium* + PSB 20 g per plant, produced the highest pseudo stem height and girth 245.33 cm and 63.00 cm, respectively closely followed by *Azotobacter* with PSB, which was significantly superior over control and alone application. The results (Table 1) indicate that due to the release of growth promoting substances like IAA and GA, which help in better growth of Giant Cavendish plants.

The response of bio fertilizer was found to be non-significant in influencing the number of suckers and number of functional leaves whereas maximum number of suckers and number of functional leaves were counted with the application of *Azospirillium* + PSB 20g per plant followed by *Azotobacter* with PSB; while the lowest value was counted under control. These findings are also in conformity with previous researchers (Zodape, 2001; Baset *et al.*, 2010; Abdullah *et al.*, 1999; Bashan, 1998).

The result showed that the effect of PSB with either *Azotobacter* or *Azospirillium* on days to shooting was significantly affected by treatments over control and alone application of bio fertilizers. Earliest shooting was found with *Azospirillium* + PSB 20g per plant followed by *Azotobacter* + PSB 20g per plant, where as the delay shooting was recorded with control plot. This might be due to symbiotic relationship between plant and microbes in the root zone.

In the present study, the numbers of fingers were significantly affected by different treatments of bio-fertilizer over control. The maximum number of fingers was observed with *Azospirillium* + PSB 20g per plant followed by *Azotobacter* + PSB 20g per plant (Fig. 1). This is due to their ability to fix atmospheric nitrogen and transform native soil nutrients like phosphorus, potassium, zinc, copper, iron, sulphur from the non usable fixed to usable form and decomposed organic wastes through biological process which in turn release nutrients in a form which can be easily assimilated by plants resulting to produce more numbers of fingers. Similar results were obtained into banana by Mehta *et al.* (1995); Snehal *et al.* (1998); Mahmoud and Amara (2000) and Das *et al.* (2001).

Generally, the use of bio-N fertilizer was highly affective for increasing vegetative growth, finger yield and enhancing nutritive values. It could be analyzed that biological nitrogen fertilization could be used to reduce the total cost of the chemical nitrogen requirements to 50 per cent or less,

Table 1 : Effect of bio-fertilizers on growth, yield and quality traits of banana cv. GIANT CAVENDISH

Treatments	Pseudo-stem height (cm)	Pseudo stem girth (cm)	Number of suckers	Number of functional leaves	Days to shooting	No. of fingers/ bunch	Average weight of bunch / plant (kg)	TSS %	Total sugar %	Acidity %	Ascorbic acid mg/ 100 g
Control	186.67	53.27	4.67	11.33	282.67	75.64	8.00	22.30	14.00	0.31	9.60
Azotobacter	231.00	57.00	4.67	11.67	269.00	90.00	12.45	24.70	17.30	0.22	9.00
Azospirillum	233.00	56.20	4.33	12.00	272.67	92.88	12.47	24.80	17.60	0.21	8.90
PSB	227.33	56.33	5.33	12.33	267.00	89.00	12.00	23.90	16.50	0.28	9.25
Azotobacter + PSB	243.00	62.00	5.00	13.67	258.00	93.00	13.60	25.50	18.60	0.18	8.20
Azospirillum + PSB	245.33	63.00	5.33	13.33	256.33	95.00	13.90	26.00	18.90	0.17	8.01
S.E.±	3.79	1.53	N.S	N.S	2.38	2.32	0.49	0.33	0.22	0.02	0.44
C.D. (P=0.05)	10.90	4.40	N.S	N.S	6.86	6.67	1.42	0.96	0.63	0.06	0.08

NS=Non-significant

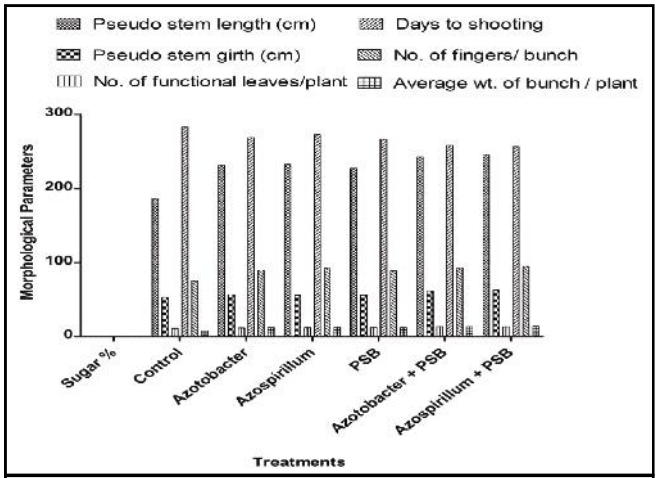

Fig 1 : Effect of bio-fertilizers on growth attributes of banana cv. GIANT CAVENDISH

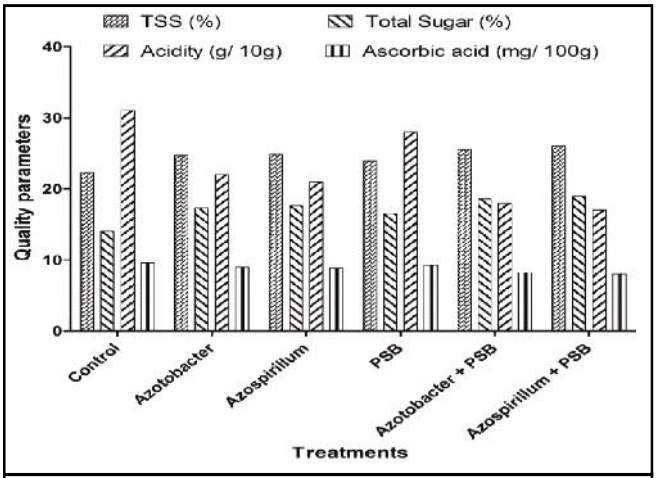

Fig 2 : Effect of bio-fertilizers on quality attributes of banana cv. GIANT CAVENDISH

in point of fact which will facilitate in health along with better return with eco-friendly approach (Robinson, 1996; Bashan and Holguin, 1998 and Blomme, 2000).

The data pertaining to weight of bunch were significantly increased by the combined application of nitrogen fixers and phosphate solublizer over control and alone application The maximum weight of bunch was produced with *Azospirillium* + PSB 20g per plant followed by *Azotobacter* + PSB 20g per plant where as the lesser yield was recorded with control because the biological nitrogen fixation depends upon on the available form of phosphorus. Therefore, the combined inoculation of nitrogen fixers and PSB may benefit the plant better (by providing both nitrogen as well as phosphorus) than either alone.

Soils, which propagate and harbour an adequate number of plant growth promoting microbes, such as N fixers, P solubilisers/ mobilisers, vesicular-arbuscular mycorrhizae, S metabolising microbes and saprophytes, are included to enhance nutrition of plants (Phirke *et al*., 2002 and 2005).

A glance of data enlightens that the combined application of bio-fertilizers showed significantly at par over separately application and control with respect to TSS and sugar content both. The highest TSS and sugar content was obtained with *Azospirillium* + PSB 20g per plant followed by *Azotobacter* + PSB 20g per plant where as the control plot recorded lowest TSS % and sugar content (Table 1).

Significantly, decreased acidity and ascorbic acid content were noticed with *Azospirillium* + PSB 20g per plant followed by *Azotobacter* + PSB 20g per plant where as the highest acidity and ascorbic acid content was recorded with control (Fig. 2). This might be due to production of organic acid, which accompanied by the acidification of the medium (Sharma, 2002).

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