

Organic Nutrition with Biofertilizer Enriched Poultry Manure Caused High Yield of Quality Giant Cavendish Banana

Abigail Zothansiami¹ and Debashis Mandal*²

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ABSTRACT

An experiment was conducted during 2017-18 at Aizawl District, Mizoram to evaluate the response of different organic manure with biofertilizer combination on growth, yield and fruit quality of banana cv. Giant Cavendish planted at 3mX3m spacing in clay loam soil. 13 treatments viz. T₁: Farm Yard Manure (FYM), T₂: Vermi compost (VC), T₃: Neem Cake (NC), T₄: Poultry Manure (PM), T₅: Azotobacter (AZ), T₆: Phosphate Solubilizing Bacteria (PSB), T₇: Potash Solubilizing Bacteria (KSB), T₈: FYM +AZ+PSB+ KSB, T₉: VC +AZ+PSB+ KSB, T₁₀: NC +AZ+PSB+ KSB, T₁₁: PM +AZ+PSB+ KSB, T₁₂: AZ+PSB+ KSB and T₁₃: Control (no fertilizer) were used with three replications laid out in Randomized Block Design. Result showed that plants applied with PM+AZ+PSB+KSB (T₁₁) had good growth in terms of pseudo stem height (255.67cm), girth (69.33cm) and number of leaves (24.27) along with high finger weight (179.90gm) and yield (22.90 kg tree⁻¹). Besides, fruits from this treatment had high pulp:peel ratio (2.30), Total Soluble Solids (TSS: 25.17°Brix) and TSS:acid ratio (125.85). However, fruits from the plants manured with VC+AZ+PSB+KSB had highest TSS (25.50°Brix) and ascorbic acid content (12.23mg 100g⁻¹).

Key words: Banana, Pseudostem, Poultry manure, Biofertilizers, Fruit quality, Yield

Bananas are grown in all tropical regions and play a key role in the economies of many developing countries. They are a staple food and an export commodity. As a staple, bananas (including plantains and other types of cooking bananas) contribute to the food security of millions of people in much of the developing world, and when traded in local markets they provide income and employment to rural populations. India being the largest producer of banana contributes 24.4% of world production with 30808 thousand tons of banana produced from 884 thousand hectares of land and fetched export earnings of Rs. 34,877.39 lakhs in 2017-18 [1]. Banana is one of the most commercially important fruit crops of Mizoram [2], where Giant Cavendish cultivar is preferred due to its unique quality in terms of sweetness, aroma and exquisite texture. During the last four decades, indiscriminate use of inorganic fertilizers, pesticides and fungicides without any organic manure caused environmental pollution, especially in soil thereby affecting its fertility on long term basis. Excessive use of chemical fertilizers can cause irreparable damage to land and environment. Increasing realization of the ill effects of long term, exclusive use of chemical fertilizers, and consistent growing demand from the consumers for fruit quality, coupled with unsustainable productivity of banana, have fostered experimentation with some alternative cultural practices. Previous study shows that FYM and vermi-compost along with bio-fertilizers

significantly influence the plant growth in strawberry [3]. The effect of biofertilizers along with organic manure on litchi and found that application of farm yard manure along with biofertilizers resulted in greater fruit weight, number of fruits, fruit yield and fruits with higher total soluble solids and total sugar content [4]. Organic nutrition with neem cake and biofertilizer reported to increase yield, fruit size and improve quality of guava cv. Sardar fruit [5]. Further, organic nutrient management paved the sustainable nutrient use with high potency in fetching good market return in citrus [6].

Use of organic nutrients such as farmyard manure, cakes of plant origin, vermicompost, and microbial bio-fertilizers are important components of the bio-organic concept of banana cultivation. However, there is very scanty information on organic nutrient management of banana. Hence, this study was taken up to evaluate the effect of different organic nutrients and biofertilizer on quality and yield of banana cv. Giant Cavendish.

MATERIALS AND METHODS

Location of experiment

The experiment was carried out at farmer's field situated at Kelsih, Aizawl District, Mizoram during 2017-2018 with banana cv. Giant Cavendish planted at 3m × 3m spacing. The place is situated at 23.55°N latitude and 92.71°E longitude having an attitude of 791 m above mean sea level (MSL). The soil of the experimental field was clay loamy with a pH of 5.7 and EC of 0.414 dSm⁻¹. Physicochemical analyses of fruits were performed at Research Laboratory, Department of Horticulture, Aromatic and Medicinal Plants, Mizoram University, Aizawl.

*Debashis Mandal
debashismandal1982@gmail.com

^{1,2}Department of Horticulture, Aromatic and Medicinal Plants, Mizoram University (A Central University), Aizawl -796 004, Mizoram, India

The experiment was carried out in a randomized block design with 13 treatments and 3 replications and data was analyzed by following the statistical methods described by [7]. The treatments were: T₁: Farm yard manure (FYM), T₂: Vermi compost (VC), T₃: Neem Cake (NC), T₄: Poultry Manure (PM), T₅: Azotobacter (AZ), T₆: Phosphate Solubilizing Bacteria (PSB), T₇: Potash Solubilizing Bacteria (KSB), T₈: FYM+AZ+PSB+ KSB, T₉: VC+AZ+PSB+KSB, T₁₀: NC+AZ+PSB+KSB, T₁₁: PM+AZ+PSB+KSB, T₁₂: AZ+PSB+KSB and T₁₃: Control (no fertilizer).

Installation of treatments

Different dose of organic manures viz. FYM, VC, NC and PM was calculated based on the 50% of Potash (K) requirement of recommended dose of fertilizer (RDF) i.e. Nitrogen: Phosphorus: Potassium (N:P:K), 300:100:300 g plant⁻¹ year⁻¹ [8] and 100 grams each of Azotobacter, Phosphate Solubilizing and Potash Solubilizing Bacteria were applied to each plant. Both the manures and biofertilizers were applied in soil by making shallow trench during month of April.

Observations

Observations on pseudo stem height (cm) and pseudo stem girth (cm) were recorded at small (3 months after planting), at large (5 months after planting) and at shooting (initiation of inflorescence) stage, number of leaves and time

taken for shooting (in days) were recorded by counting arithmetically, fruit weight was recorded with digital balance, peel thickness was measured with digital slide caliper, and fruit qualitative characteristics like Total Soluble Solids (TSS), acidity, TSS: acid ratio and ascorbic acid were analyzed following standard procedure as described by [9].

RESULTS AND DISCUSSION

Pseudostem height and girth

Enumeration of the data presented in (Table 1) showed that pseudostem height and girth of banana significantly varied among the treatments and in all the stages viz. small, large and shooting, had consistent increment both in height and girth. Banana plants had consistent increase in pseudostem height and girth due to growth factors [10]. Among the treatments, plants provided with poultry manure along with bio-fertilizer combination of azotobacter, PSB and KSB (T₁₁) had maximum pseudostem height (255.67 cm) and girth (69.33 cm) at shooting stage compared with plant at control (201.67cm, 58.83cm, respectively). Maximum increment in pseudostem height and girth at shooting stage with application of 100% RDF along with PSB and Azospirillum due to enhance availability of nutrients for biofertilizer action [11]. Poultry manure was reported to cause maximum height promotion in pomegranate [12].

Table 1 Effect of organic manures on growth characters of banana cv. Giant Cavendish

Treatments	Pseudostem Height (cm)			Pseudostem Girth (cm)			Total no. of leaves	Days taken for shooting
	Small	Large	Shooting	Small	Large	Shooting		
T ₁	86.00	191.67	230.00	32.67	62.82	66.33	23.90	214.50
T ₂	81.33	199.00	236.67	27.83	59.00	63.17	23.77	222.67
T ₃	77.67	180.33	224.67	29.67	60.33	65.17	22.87	238.67
T ₄	85.67	185.33	228.00	28.83	59.43	63.83	24.13	208.67
T ₅	73.33	176.00	220.67	28.83	60.83	65.50	19.73	224.93
T ₆	75.00	165.33	212.33	29.67	57.17	62.33	18.97	234.10
T ₇	71.00	171.33	211.67	28.50	59.50	63.83	19.53	220.33
T ₈	95.33	208.33	250.00	35.33	63.50	67.50	23.70	215.17
T ₉	94.33	193.33	236.00	36.67	62.50	67.00	23.07	214.18
T ₁₀	92.33	184.00	226.00	34.33	61.50	66.17	23.90	215.00
T ₁₁	95.67	210.00	255.67	36.83	64.17	69.33	24.27	206.67
T ₁₂	81.00	182.00	223.33	27.83	61.17	65.33	20.20	221.00
T ₁₃	67.67	160.67	201.67	25.67	55.50	58.83	17.07	223.33
SE m(±)	9.76	9.76	9.57	1.03	1.43	1.64	0.68	7.35
CD (5%)	28.49	28.49	27.94	3.00	4.16	4.77	1.98	21.45

Data are mean of two years (2017-2018)

Total number of leaves, days taken for shooting

Total number of leaves per plant was minimum in control (17.07), whereas it was found maximum in plants applied with PM+AZ+PSB+KSB (24.27) followed by sole application of poultry manure (T₄: 24.13). High number of leaf emergence and yield in cabbage with application of poultry manure [13]. Maximum days (238.67) for shooting was occurred in plants given with neem cake, however it was least in T₁₁ (206.67 days) followed by T₄ (208.67 days), which clearly showed that promotional growth with poultry manure caused earliness in flower emergence. Flowering earliness in Cavendish banana with manure and compost application [14].

Peel thickness and pulp peel ratio

Banana plants where only combined biofertilizer (AZ+PSB+KSB; T₁₂) was applied had maximum thickness of fruit peel (3.15 mm) followed by plants provided with FYM+AZ+PSB+ KSB (T₈: 3.06 mm). Thinnest peel (2.46) was found if fruits from the plant given with Azotobacter (Table 2). Banana cv. Grand Naine had high peel thickness of fruits in plants treated with FYM+NC+VC+Ash [15]. However, in the current study, pulp: peel ratio was found highest in fruits from the plant treated with FYM+AZ+PSB+KSB (2.33) followed by plants provided with PM+AZ+PSB+ KSB (2.30), whereas, it was minimum in fruits from the plant treated with vermicompost (1.97). Banana plants manured with FYM+NC+VC+Ash had maximum pulp to peel ratio in fruits [16] High pulp:peel ratio (2.78) in banana

fruits from the plants treated with FYM+PM+Green Manure + Azospirillum [17].

Finger weight and yield

Weight of the banana finger was significantly varied among the different treatments and was found maximum in the fruits from the plant manured with NC+AZ+PSB+KSB (180.06 g) followed by PM+AZ+PSB+KSB (179.90 g)

compared with control (118.03 g). High bunch weight (22.13 kg) of Grand Naine banana from the plants manured with 5 kg neem cake along with 10 kg FYM, 50% RDF, Azotobacter and PSB [18]. Present study showed that banana plants treated with PM+AZ+PSB+KSB had maximum yield (22.90 kg tree⁻¹) followed by NC+AZ+PSB+KSB (21.40 kg tree⁻¹) compared with control (12.43 kg tree⁻¹). Banana plants treated with chicken manure had significantly higher finger length, diameter and weight of fruits [19].

Table 2 Effect of organic nutrients on fruit physical characters and yield of banana cv. Giant Cavendish

Treatments	Finger weight (g)	Peel thickness (mm)	Pulp peel ratio	Yield (kg tree ⁻¹)
T ₁ : Farm Yard Manure (FYM)	157.77	2.92	2.07	18.33
T ₂ : Vermi compost (VC)	152.15	2.72	1.97	17.30
T ₃ : Neem Cake (NC)	152.85	2.68	2.10	18.27
T ₄ : Poultry Manure (PM)	157.52	2.69	2.23	19.07
T ₅ : Azotobacter (AZ)	132.59	2.46	2.13	14.33
T ₆ : Phosphate Solubilizing Bacteria (PSB)	138.06	2.66	2.19	14.17
T ₇ : Potash Solubilizing Bacteria (KSB)	141.39	2.75	2.27	14.23
T ₈ : FYM +AZ+PSB+ KSB	178.23	3.06	2.33	20.77
T ₉ : VC +AZ+PSB+ KSB	177.33	2.77	2.27	19.87
T ₁₀ : NC +AZ+PSB+ KSB	180.06	2.90	2.13	21.40
T ₁₁ : PM +AZ+PSB+ KSB	179.90	3.01	2.30	22.90
T ₁₂ : AZ+PSB+ KSB	151.52	3.15	2.17	16.80
T ₁₃ : Control (no fertilizer)	118.03	2.83	2.20	12.43
SEm(±)	1.49	0.09	0.06	0.32
CD (5%)	4.36	0.27	0.18	0.93

Data are mean of two years (2017-2018)

Table 3 Effect of organic nutrients on fruit quality parameters of banana cv. Giant Cavendish

Treatments	TSS (°Brix)	Acidity (%)	TSS : Acidity	Ascorbic acid (mg 100g ⁻¹)
T ₁ : Farm Yard Manure	23.67	0.24	98.63	11.50
T ₂ : Vermi compost	24.67	0.24	102.79	11.33
T ₃ : Neem Cake	22.33	0.21	106.33	10.47
T ₄ : Poultry Manure	23.67	0.25	94.68	9.57
T ₅ : Azotobacter	23.50	0.26	90.38	9.37
T ₆ : Phosphate Solubilizing Bacteria	22.67	0.24	94.46	10.03
T ₇ : Potash Solubilizing Bacteria	23.33	0.25	93.32	9.10
T ₈ : FYM +AZ+PSB+ KSB	24.33	0.21	115.86	11.63
T ₉ : VC +AZ+PSB+ KSB	25.50	0.22	115.91	12.23
T ₁₀ : NC +AZ+PSB+ KSB	23.33	0.22	106.05	11.43
T ₁₁ : PM +AZ+PSB+ KSB	25.17	0.20	125.85	11.83
T ₁₂ : AZ+PSB+ KSB	22.67	0.25	90.68	11.27
T ₁₃ : Control (no fertilizer)	18.67	0.27	69.15	9.03
SEm(±)	0.55	0.01	4.80	0.22
CD (5%)	1.60	0.03	14.01	0.63

Data are mean of two years (2017-2018)

Fruit biochemical qualities

Total soluble solids (TSS) content of banana fruits was found highest (25.50°Brix) in plants treated with VC+AZ+PSB+ KSB (T₉) followed by PM+AZ+PSB+KSB (T₁₁: 25.17°Brix) compared with control (18.67°Brix) (Table 3). However, TSS:acidity ratio was recorded maximum in fruits from the plants treated with PM+AZ+PSB+ KSB (125.85) followed by VC+AZ+PSB+KSB (115.91) as the acidity of the fruits was recorded high in T₉ (0.22%) compared with T₁₁ (0.20%). High TSS (20.47°Brix) in banana from the plants treated with poultry manure and neem cake [20]. High

fruit acidity (0.33%) in banana plants treated with vermi compost (VC) along with farmyard manure (FYM), green manure Azospirillum and Potash Solubilizing Bacteria [21]. Banana plants treated with VC+AZ+PSB+KSB recorded maximum ascorbic acid content of fruits (12.23 mg 100g⁻¹) followed by plants treated with PM+AZ+PSB+KSB (11.83 mg 100g⁻¹) compared with control (9.03 mg 100g⁻¹). Grand Naine banana got highest ascorbic acid content (12.92 mg 100g⁻¹) when the plants were manured with vermi compost along with NC + farmyard manure + woodash + green manure and biofertilizers [22].

CONCLUSIONS

From the present experiment, it may be concluded that organic nutrient management with poultry manure along with

biofertilizers (Azotobacter, Phosphate Solubilizing Bacteria and Potash Solubilizing Bacteria) can be a suitable option for obtaining high yield of quality banana cv. Giant Cavendish at Mizoram condition.

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