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# Bio Fertilizer on Rachis: A New Method Facilitates Higher Banana (*Musa sapientum*) Production

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**Abstract:** Due to huge demand and availability of Banana, innovative cost effective method is necessary to promote and smoothen the banana production among farmers commercially mitigating the demand. Method and Materials in this study, we feed cow dung mixture along with Urea, Triple Super Phosphate (TSP), Murate of Potash (MoP), water to the distal part of rachis after cutting down male bud as soon as the female flowers matured into fruits (T1). The effect of this method was then compared with two control groups; one with the same strategy except fertilizer applied on root following ring method (C1, Positive control) and another was male flower untouched without applying fertilizer on rachis or root (C2, Negative control). Results and Conclusion T1 showed more than double increase in length than controls. In the same way, in case of shape (Diameter), T1 (0.46 cm) showed twice as better growth in the C1 (0.22 cm) and C2 (0.18 cm).Trend analysis showed the test group T1 curve is much steeper than the control groups suggesting faster growth rate than the other two. Finally, the cost of fertilizers for T1 per plant was estimated 0.091 USD while for positive control C1 it was 2.9 USD. This study shows an approach to be effective and economic comparing to traditional method of fertilizer application, which can be adapted as a new method of banana production.

**Key words:** Rachis · Traditional · Post Shooting Approach · Economic Production · Demand

## INTRODUCTION

Bananas are berry belong to the genus *Musa*, is a well-known tropical fruit with high nutrition value used both as a staple food and dietary supplements. Not only nutritive but Bananas also have several medicinal uses [1]. According to FAO [2] Banana constitute the 4$^{th}$ most important staple food commodity of the world, while Bangladesh ranks 14th among the top 20 banana producing countries in the world. The country produces nearly 1.00 million tons of bananas annually [3]. The total per capita consumption in Bangladesh is about 4.7 kg where its consumption is much higher in Europe [4, 5]. A number of dessert banana varieties are available in Bangladesh, but their performance varies among regions due to difference in varietal adaptability and microclimatic variation [6]. However, in spite of its unique position among the fruit crops of Bangladesh, limited studies have been done regarding area, production, yield and constraints of banana. The present experiment has showed a new improvised method to develop the size and shape of banana fingers with minimal cost and labor. This new method will help the farmers to produce more bananas with minimum cost and labor. Farmers can be benefitted economically and will be able to mitigate public demands. This method maintains the main principle of agricultural production is less input with more outputs.

## MATERIALS AND METHODS

**Study Area:** The study was conducted at a commercial farm named Suborno Agro-Based Initiative (SABI),

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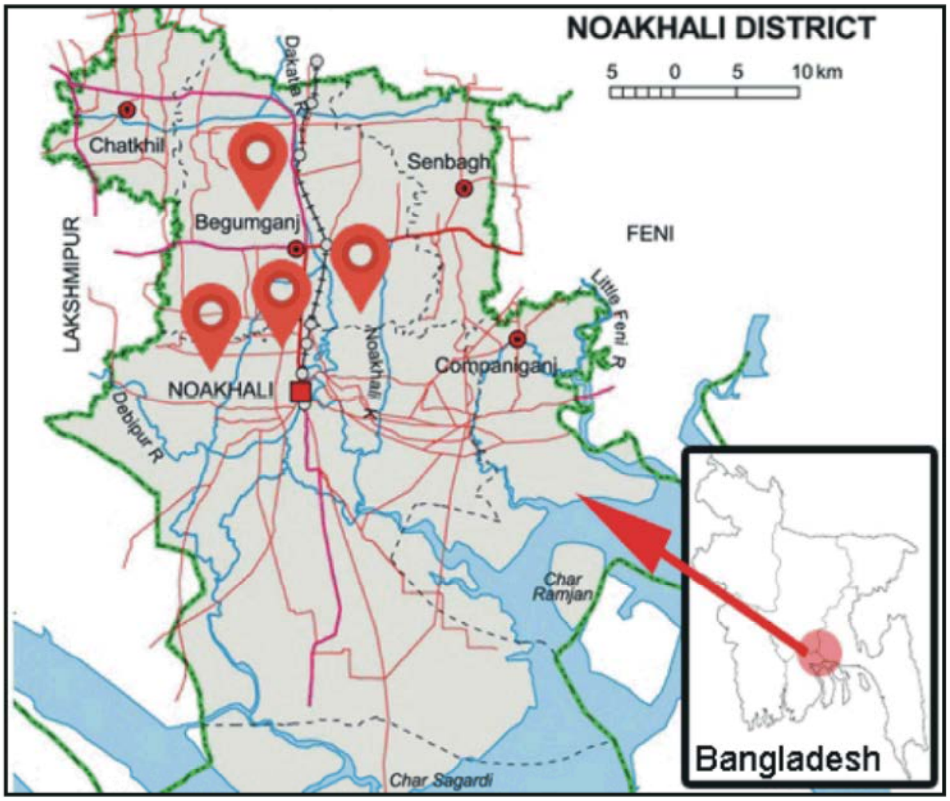


Fig. 1: Study area marked with GPS icon

Noakhali, Bangladesh. The study was conducted from January, 2017 to March, 2018. The experiment was laid out in a Completely Randomized Block Design (CRBD) consisted of three treatments and three replications.

**Treatment:**

**T1:** Cow dung (250 g) + Urea (85 g) + Triple Super Phosphate (TSP) (70 g) + Murate of Potash (MOP) (65 g) + 20 ml water; Removal of male bud as soon as female flower transform into fruits and application of the mixture on slanted rachis (Fig 2). For T1 the rachis of the distal end of the bunch was excised along with the male bud giving a slanted cut immediately after all the pistillate flowers had formed into fruits. 250 g Cow dung was mixed with 20 ml water to form slurry with 85g of urea, 70g of TSP and 65 g of MOP. The blend was then placed in a polythene bag and tied carefully to dip the excised rachis into the slurry.

**Controls:**

**C1:** Control group: Urea (3kg) +TSP (3kg) +MOP (2.5kg) + Cow dung (5kg), Removal of male bud as soon as female flower transform into fruits and application of the mixture on tree root. In control group C1, when the female flowers transformed into fruits male flower were cut down. Cow dung with an amount of 5kg were placed at the bottom of plant in ring method. Urea (3kg) +TSP (3kg) + MOP (2.5kg) were mixed and applied to the bottom of plant along with cow dung following the same method

**C2:**

**Control Group:** Retention of male bud till harvest without fertilizer application on rachis or root (Fig. 3).

In the plants of control group C2, the male bud retain in rachis till harvest without any modification or application of any fertilizer either on rachis or plant root. For all three groups, initial data for the banana finger length (cm), finger diameter (cm) and weight of fingers (g) was collected as soon as the female flower matured into fruits and data collection continued for two weeks with seven day interval until banana ripen.

**Data Collection:** The data were collected every week after treating. The data were collected in the morning and very carefully to avoid any destruction to fruits and plants.

**Size:** The size of the banana was measured in centimeter by measuring tape.

**Shape:** At first the average area was collected by using slide calipers and then the shape (Diameter) was calculated by the formula $A = \pi r^2$

Or, $r = \sqrt{a + \pi}$

Or, $d = 2, r$

where,

A = Area of Banana which is determined by Slide Calipers

r = Radius

d = Diameter

$\pi$ = 3.1416

**Cost:** The total cost (Input) was calculated after harvesting for all three groups.

**Statistical Analysis:** The data were put into the computer for statistical analyses. The SPSS computer program was used for analyzing the data. Various descriptive statistical measures such as range, frequency, number, mean, standard deviation (SD), coefficient of variation (CV), $R^2$ and rank order were used for categorization and describing the variables.

## RESULTS

**Size (Length):** In the study, T1 showed the highest growth in the size of fingers in every bunch of banana than other treatment control groups. The trend curve for T1 was much steeper than other control group with highest slope value of 1.125 (Table 3). In T1, the average banana size (Length) increasing was 2.25 cm where C1 increase 1.32 cm and C2 was 1.16 cm (Table 1).

Table 1: Size (length) of the samples of banana in treatment and control groups. S (1-6) indicates the sample number of the replicates. All data were collected in 'cm' scale

| | Size (length) (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Groups | S1 | S2 | S3 | S4 | S5 | S6 | Average | S.D. | S.E.M. |
| | | | | Initial stage | | | | | |
| T1 | 14 | 15.6 | 13.6 | 12.5 | 12.3 | 11.9 | 13.32 | 1.256207 | 0.512844 |
| C1 | 13.6 | 14.5 | 13.5 | 12.9 | 13.1 | 13.8 | 13.56 | 0.515321 | 0.210379 |
| C2 | 13.8 | 14.1 | 11.8 | 11.3 | 12.1 | 11.9 | 12.5 | 1.056724 | 0.431406 |
| | | | | After one week | | | | | |
| T1 | 15.2 | 16.3 | 14.5 | 13.6 | 13.5 | 13.1 | 14.37 | 1.027712 | 0.419562 |
| C1 | 14.7 | 15.1 | 13.9 | 13.4 | 13.9 | 14.1 | 14.18 | 0.519387 | 0.212039 |
| C2 | 14.2 | 14.5 | 12.1 | 11.9 | 12.8 | 12.5 | 13 | 0.92582 | 0.377964 |
| | | | | After two week | | | | | |
| T1 | 16.8 | 17.5 | 16.1 | 14.5 | 14.4 | 14.1 | 15.57 | 1.206728 | 0.492645 |
| C1 | 15.2 | 15.8 | 15.1 | 13.9 | 14.5 | 14.8 | 14.88 | 0.548809 | 0.224051 |
| C2 | 14.9 | 14.9 | 13.1 | 12.4 | 13.1 | 13.6 | 13.66 | 0.869595 | 0.355011 |

S.D: Standard deviation; S.E.M.: Standard error mean

Table 2: Shape (diameter) of the samples of banana in treatment and control groups. S (1-6) indicates the sample number of the replicates. All data were collected in 'cm' scale

| | Shape (Diameter) (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Group | S1 | S2 | S3 | S4 | S5 | S6 | Average | S. D. | S.E.M. |
| | | | | Initial Stage | | | | | |
| T1 | 3.41 | 3.4 | 3.2 | 3.25 | 3.17 | 2.94 | 3.23 | 0.15826314 | 0.064611 |
| C1 | 3.8 | 3.89 | 3.77 | 3.75 | 3.72 | 3.69 | 3.77 | 0.06403124 | 0.026141 |
| C2 | 3.47 | 3.23 | 3.6 | 3.42 | 3.43 | 3.53 | 3.45 | 0.11469767 | 0.046825 |
| | | | | After one Week | | | | | |
| T1 | 3.6 | 3.5 | 3.4 | 3.4 | 3.4 | 3.1 | 3.4 | 0.15275252 | 0.062361 |
| C1 | 3.9 | 4.02 | 3.89 | 3.84 | 3.85 | 3.77 | 3.88 | 0.07602996 | 0.031039 |
| C2 | 3.58 | 3.36 | 3.8 | 3.49 | 3.58 | 3.62 | 3.57 | 0.13296825 | 0.054284 |
| | | | | After Two Week | | | | | |
| T1 | 3.85 | 3.82 | 3.89 | 3.6 | 3.6 | 3.4 | 3.69 | 0.1745152 | 0.071246 |
| C1 | 4.05 | 4.11 | 4.08 | 3.92 | 3.95 | 3.84 | 3.99 | 0.09581522 | 0.039116 |
| C2 | 3.69 | 3.47 | 3.67 | 3.58 | 3.69 | 3.65 | 3.62 | 0.07868714 | 0.032124 |

S.D: Standard deviation; S.E.M.: Standard error mean

Table 3: Trend curve analysis for test and control groups

| | Average growth (size) cm | | | Trend properties | |
|---|---|---|---|---|---|
| Sample group | Initial Stage | After one week | After two week | Equation | $R^2$ value |
| T1 | 13.32 | 14.37 | 15.57 | y = 1.125x + 12.17 | 0.9985 |
| C2 | 13.56 | 14.18 | 14.88 | y = 0.58x + 11.893 | 0.9937 |
| C2 | 12.5 | 13 | 13.66 | y = 0.66x + 12.887 | 0.9988 |
| | Average growth (shape) cm | | | Trend properties | |
| Sample group | Initial Stage | After one week | After two week | Equation | $R^2$ value |
| T1 | 3.23 | 3.4 | 3.69 | y = 0.23x + 2.98 | 0.9778 |
| C1 | 3.77 | 3.88 | 3.99 | y = 0.11x + 3.66 | 1 |
| C2 | 3.45 | 3.57 | 3.62 | y = 0.085x + 3.3767 | 0.9465 |

Table 4: Cost in test group and positive control. Cost is estimated according to USD

| Test Groups | Fertilizer | Amount | Cost | Total cost |
|---|---|---|---|---|
| T1 | Urea (20 BDT/kg) | 85g | 0.021 USD | 0.091 USD |
| | TSP (40 BDT/kg) | 70g | 0.035 USD | |
| | MOP (20 BDT/kg) | 65g | 0.016 USD | |
| | Cow dung | 200g | 0.0125 USD | |
| | Plythene Sheet | 1 piece | 0.0062 USD | |
| C1 | Urea (20 BDT/kg) | 3kg | 0.75 USD | 2.9 USD |
| | TSP (40 BDT/kg) | 3kg | 1.5 USD | |
| | MOP (20 BDT/kg) | 2.5kg | 0.625 USD | |
| | Cow dung | 500gm | 0.025 USD | |

Fig. 2: Mixed fertilizers on Rachis (T1) A. One week after B. Initial Stage

Fig. 3: Plant without fertilizers C2 B. One week after C. Initial stage

**Shape (Diameter):** In case of shape (Diameter), the test group T1, the average growth of increasing was 0.46 cm greater than the increase of control C1 (0.22 cm) and C2 (0.18cm). The trend for the T1 was the steepest among test groups with highest slop value of 0.23 (Table 2, Table 3).

**Cost:** In Addition, for the test group T1 cost per plant was 0.091 USD while for control C1 cost was 2.9 USD per plant. Cost per fertilizer and ingredients are given in detail (Table 4).

## DISCUSSION

The current study recorded significant improvement in yield parameters *viz.*, length of fingers (cm), shape of fingers (cm) in all replicates, from which the male bud was removed and fertilizers were applied on the slanting cut of banana plant among three treatments. In more details, the treatment with urea (85g)+ TSP (70g)+ MOP (65g)+ cowdung (250 g) + 20 ml water (T1) recorded significant improvement in yield parameters *viz.*, length of fingers (cm), shape of fingers (cm) as compared to application of urea (3kg) + TSP(3kg)+MOP (2.5kg) + cowdung (5kg)+ proper water (C1) and Control (C2).

It was reported that the bunch was fed with urea, sulphate of potash blended with fresh cowdung all the yield attributing characters viz., length of fingers, weight of fingers of first hand, weight of fingers of last hand, girth of fingers, weight of first hand, weight of last hand and bunch weight were significantly highest compared to others [6]. Kumar and Kumar [7] showed that foliar spray of sulfate of potash increase fruit length and weights of banana but it was labor intensive and costly than the present study. On the other hand, Fratoni *et al.* [8] found that applying nitrogen and potassium increase foliar size of banana tree [9, 10]. However, Mishal and Krittiks [11] showed that shade net, fertilizers and pseudo stem sap of banana increase nutrients of fenugreek [12, 13].

Removal of male bud caused an increase in weight because conservation and utilization of energy for finger development which would be otherwise lost for opening of the remainder of the flower and removal of a strong and active competing sink for photosynthesis, despite its smaller size relative to the bunch [14].

Rajon *et al.* [9] found that post shooting spraying of Brassinosteroid @ 2 ml/L increased bunch size but that research did not mentioned about fruits and cost like this present study [15, 16]. On the other hand, Soares *et al.* [10] showed that application of fertilizer after 22th days of plantation increase flowering [17]. However, Baruah *et al.* [18] and Kamal *et al.* [19] found that urea helps the banana bunch to be ripened rapidly after harvesting.

However, tying urea, TSP and MOP at the rachis promoted the growth of bunch and hand because of the availability of urea, TSP and MOP in available form at later stages for a prolonged period. The banana in bunches get nutrients in available form and uptake easily from fertilizer mixer tied in cutting place on rachis. So the loss of fertilizer is minimum.

In this method growth of banana is more with low cost and labor. We can see that 0.09 USD was spent in T1 plant which was maximum in growth while in C1 the cost was 2.9 USD but growth was less than T1 plant (Table 3) so this method is more economic. When the fertilizers are applied bottom of the plant it gets available form and different tissue use it for different physiological reactions but when it applied in this method fruits get direct nutrients in available form easily and nutrients loss is minimal. Banana is an herbaceous flowering plant, in Bangladesh banana plant are cut down after her first fruiting so plant growth is not mandatory but fruits.

**Significance Statement:** This study discovered a new method that can be beneficial for the farmers to produce more production with less cost. In developing country like Bangladesh, have more limitation in Agriculture because of huge population. So, more production is needed from less land and capital. The present study need less fertilizers and labor and give bigger sized and shaped banana. In the market of Bangladesh the demand of bigger sized and shaped banana is high than others. This study will help the researchers to uncover the critical areas of plant modifications and horticulture that many researchers were not able to explore.

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