

Revised Paper Version 1

Effect of bunch feeding of nitrogen (N) and potassium (K) on yield characters in Banana, cv. Barjahaji (*Musa* AAA group) under Assam condition

ABSTRACT

INTRODUCTORY STATEMENT..... The present investigation was carried out at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during March 2015 to June 2016. Nitrogen and Potassium were applied in the form of different chemicals along with FYM and compared with control. **SAMPLING PROCEDURE AND SIZE????** Results revealed that the highest yield of (58.65 t ha⁻¹), highest finger length (22.28 cm), finger girth (14.10 cm), volume of fingers (254.25 cc), weight of fingers (148.73 g), weight of second hand (4.00 kg), and bunch weight (19.00 kg), were observed when the bunch fed with T₇ (500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄). However, the highest pulp to peel ratio of 3.40 was recorded in T₆ (500g fresh cowdung + 7.5g Urea + 7.5g KCl). Whereas, maximum rind thickness (3.71 mm) was observed in T₄ (500g fresh cowdung + 7.5g K₂SO₄). **ReRECOMMENDATION/CONCLUSION???**

Keywords: Bunch, Feeding, Urea, Fingers, Yield.

1. INTRODUCTION

Banana is one of the most important fruit crops majorly grown in India. In view of its nutritive value and fruit value, banana could be considered as "Apple of paradise" and it is cheaper than any other fruits in the country. It contains about 71.3 g moisture, 26.56 g carbohydrate, 1.08 g protein, 0.11 g fibre, 5 mg calcium, 0.49 mg iron, 18 mg phosphorus, 494 mg potassium, 5.1 mg ascorbic acid, 0.044 mg thiamine, 0.045 mg riboflavin and 88 IU Vitamin A per 100 g edible portion (Wenkam, 1990). Banana and Plantains (*Musa* spp.) belong to the family Musaceae. It is one of the major commercial fruit crop grown in tropics, subtropics and considered as the most economic source of food. It is considered as one of the most important energy producing foods, cheap, highly nutritious and easily digestible fruit. They are excellent source of potassium which benefits the muscle spasms. They are one of the most affordable fruits in the market and can be found all year round nearly everywhere in the world. At present banana production in India is 30.0 million tonnes from an area of 0.88 million hectares and the productivity is 34.1 tonnes (NHB, 2015). Nitrogen and Potassium are the most used nutrient elements in plant growth and development which plays an essential role in high yields and fruit quality. Potassium is the key element in banana nutrition. Bunch is the most drastically affected organ if potassium is insufficiently supplied. It stimulates early shooting and significantly shortens the time required for fruit maturity. It improves the grade of the bunches as well as the size of the individual fingers. Banana plants fed with recommended quantity of major and micro nutrients either through soil or by foliar application, the uptake and utilization of nutrients by banana plants is inadequate resulting in poor growth of the bunch and fingers at the distal end of the bunch. This

Comment [GD1]: Title lacks study area/country

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reduces both the total weight as well as its overall appearance leading to a lower profitability. This has been a major constraint faced by the banana growers irrespective of the variety of banana grown. Bunch feeding of banana at distal end by removing of male bud will not only help in easy translocation of nutrient to the sink but it also removed the unwanted male bud which can be used as vegetable (Singh, 2001). Therefore, the present investigation was taken to study investigates the potential impact of these nutrient placement at the cut stalk end on yield characters in banana cv. Barjahaji which is one of the commercial variety in the state of Assam.

2. MATERIAL AND METHODS

The present investigation was carried out at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during March 2015 to June 2016. The experiment was laid out in Randomized Block Design (RBD) with three replications comprising nine treatments (Table 1). There were twenty seven plots each having eight numbers of plants with the spacing of 1.8 m x 1.8 m. Individual plot size was 25.92 m² and the total area of the experimental site was 699.84 m². Uniform cultural practices were followed for all the treatments. Immediately after the fruit set or bunch formation and shedding of 7 - 8 flower petals (spathes), the male bud was denavelled at the stalk end of the bunch by cutting with a sharp knife at 60° angle in such a way that about 10-15 cm long rachis / stalk end was available after the last hand of the bunch. A fresh cow dung of 500 g is blended with the fertilizers (7.5g each Urea, KCl, K₂SO₄, and KNO₃) dissolved in 100 ml of water to form slurry for imposing to Barjahaji banana bunches after denavelling. This slurry was placed in a 200 gauge 15 cm x 25 cm plastic bag and tying the bag with a strong thread such that about 8 – 10 cm of the distal end of the rachis was immersed in the slurry and the remaining part above the tied portion is visible. Harvesting was done uniformly at three fourth maturity stages when the ridges of the fingers had disappeared and colour turned from dark green to light green. The peduncle was cut at 22.5 cm above the first hand along with the bended poly bag.

3. RESULTS AND DISCUSSION

3.1 LENGTH OF FINGER

The significantly highest finger length of 22.28 cm (Table 2) was recorded in T₇ (500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄). Finger length is the important factor which decides compactness, symmetry and rigidity of bunches as well as the market price of the fruit. The results are in accordance with Ancy and Kurien (2000) in cv. Nendran and Nandan *et al.* (2011) in cv. Nanjangudu rasabale (AAB). According to them nutrient supplied externally in the form of urea helped more in cell elongation of the fruits which resulted in more fruit length. There was a direct relation between urease activity and lengthening of the fruit as reported by Ancy *et al.*, (1998).

3.2 GIRTH AND VOLUME OF FINGER

The significantly highest finger girth of 14.10 cm and finger volume of 254.25 cc was recorded in T₇ (Table 2). The increase in girth and volume of the finger clearly indicated that potassium was involved in cell enlargement. The increase in finger circumference by 500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄ might be due to exogenous potassium supply which acted as an activator of several enzymes.

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Potassium has also a role in synthesizing the precursor of chlorophyll pigments. Presence of sulphur in K_2SO_4 has a synergistic effect with zinc which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin which increases the size of fruit. Similar observations were reported by Mustaffa *et al.* (2004) in cv. Nanjanagudu rasabale and Kumar and Kumar (2007) in cv. Neypoovan and Nandan *et al.* (2011) in cv. Nanjanagudu rasabale.

3.3 RIND THICKNESS

The data regarding the rind thickness (Table 2) revealed that T_4 (500g fresh cowdung + 7.5g K_2SO_4) recorded the significantly highest value of 3.71 mm. However, the lowest rind thickness of 3.24 mm was observed in T_9 (Control). Such result might be due to comparatively lower availability of nutrient in control treatment than other treatments.

3.4 PULP TO PEEL RATIO

The significantly highest pulp to peel ratio of 3.40 (Table 2) was recorded in T_6 (500g fresh cowdung + 7.5g Urea + 7.5g KCl) which was at par with T_8 (3.33). The reason behind such result might be due to more pulp and less rind weight. This indicates the beneficial role of potassium to get good pulp recovery. This might be due to less experienced physiological loss in weight by fruits may contribute towards the more pulp weight. The results were in conformity with those obtained by Kumar *et al.* (2008) in Robusta, Nandan *et al.* (2011) in cv. Nanjanagudu rasabale.

3.5 WEIGHT OF FINGER

Exogenous application of nitrogen, potassium as bunch feeding along with cowdung improved the finger weight over control. The data regarding the weight of fingers (Table 2) revealed that T_7 (500g fresh cowdung + 7.5g Urea + 7.5g K_2SO_4) recorded the significantly heaviest finger of 148.73 g. The increase in fruit weight might be due to removal of flower bud after formation of bunch which helped in conservation and utilization of photosynthates in more efficient way. Potassium improves fruit weight and number of fingers per bunch, and increases the content of starch and sugar content (Bhargava *et al.*, 1993).

3.6 WEIGHT OF SECOND HAND

The significantly heaviest second hand (Table 2) was recorded in the treatment T_7 (4.00 Kg) which was at par with T_4 (3.40 Kg). Increase in weight of the hand might be attributed to the application of potassium which indirectly improves utilization of nitrogen and protein formation in terms of size, weight etc. In the present study application of sulphate of potash improved yield of hand and the findings are in accordance with the results of Pandey and Sinha (1999) who reported that the increase in weight of the hand, weight of the bunch and yield per hectare are due to sulphur present in the sulphate of potash which might be responsible for the formation of iron-sulphur protein in plants which might have a direct impact in activating the catalase and peroxidase enzymes.

3.7 BUNCH WEIGHT

The significantly highest bunch weight of 19.00 kg (Table 2) was recorded in T₇ (500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄). It was found from the data that denaveling and bunch feeding improved yield in all the treatments irrespective of the control. This might be due to conservation and utilization of energy of nutrients 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 photosynthates and mineral nutrients despite its smaller size relative to the bunch. The increase in bunch weight can be attributed to the cumulative effect of yield attributing characters like finger weight, length of the finger, circumference of the finger and pulp to peel ratio. The favourable influence of K₂SO₄ as compared to other nutrients on the production of heavier bunches might be attributed to the heavier dry matter and starch accumulation and additionally promoted by the sulphur present in K₂SO₄ (Kumar and Kumar, 2008).

3.8 YIELD

Yield depends upon many factors however, the significantly highest yield of 58.65 t ha⁻¹ was recorded in T₇ (500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄) (Table 2). Sulphur helps in energy transformation and activation of enzymes in carbohydrate metabolism and subsequently greater partitioning of photosynthates. Sulphur application increased the yield since it is a constituent of amino acid and protein production (Ahmed *et al.*, 1998). The influence of sulphur in enhancing fruit yield in banana was stressed by Lahav and Turner (1983).

4. CONCLUSION

Bunch feeding of banana not only helped in increasing the yield and yield characteristics of the plant but it also give additional income by selling the male bud which is used as vegetable. From the above study it can be concluded that treatment T₇ (500g fresh cowdung + 7.5g Urea + 7.5g K₂SO₄) can be used as bunch feeding for increasing the yield of the crop under Assam condition.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between all authors. Authors Thanuram Teron Millik and Kartik Baruah designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Thanuram Teron Millik and Vikash Kumar managed the analyses of the study. Authors Vikash Kumar and Nishant Barik managed the literature searches. All authors read and approved the final manuscript.

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Table 1. Treatment details

Notations	Treatments
T ₁	500g fresh cowdung
T ₂	500g fresh cowdung + 7.5g Urea
T ₃	500g fresh cowdung + 7.5g KCl
T ₄	500g fresh cowdung + 7.5g K ₂ SO ₄
T ₅	500g fresh cowdung + 7.5g KNO ₃
T ₆	500g fresh cowdung + 7.5g Urea + 7.5g KCl
T ₇	500g fresh cowdung + 7.5g Urea + 7.5g K ₂ SO ₄
T ₈	500g fresh cowdung + 7.5g Urea + 7.5g KNO ₃
T ₉	Control

Table 2. Effect of bunch feeding on growth characters of banana

Treatments	Bunch weight (kg)	Weight of second hand (kg)	Weight of fingers (g)	Length of fingers (cm)	Girth of fingers (cm)	Volume of fingers (cc)	Rind thickness (mm)	Pulp peel ratio	Yield (t ha ⁻¹)
T ₁ : 500g fresh cowdung	13.00	2.01	128.36	16.40	12.60	163.51	3.42	2.02	40.13
T ₂ : 500g fresh cowdung + 7.5g Urea	16.33	2.83	128.42	17.70	13.00	186.00	3.50	2.49	50.41
T ₃ : 500g fresh cowdung + 7.5g KCl	13.57	2.26	126.70	16.83	12.65	166.91	3.56	2.92	41.89
T ₄ : 500g fresh cowdung + 7.5g K ₂ SO ₄	17.00	3.40	142.10	19.75	13.49	219.67	3.71	1.81	52.48
T ₅ : 500g fresh cowdung + 7.5g KNO ₃	13.50	2.08	128.42	16.40	12.63	168.75	3.56	2.75	41.67
T ₆ : 500g fresh cowdung + 7.5g Urea + 7.5g KCl	15.67	2.07	126.70	16.36	12.35	154.25	3.41	3.40	48.37
T ₇ : 500g fresh cowdung + 7.5g Urea + 7.5g K ₂ SO ₄	19.00	4.00	148.73	22.28	14.10	254.25	3.50	1.90	58.65
T ₈ : 500g fresh cowdung + 7.5g Urea + 7.5g KNO ₃	15.33	2.07	126.70	16.21	12.07	152.20	3.49	3.33	47.32
T ₉ : Control	11.00	2.50	128.45	16.82	12.62	165.75	3.24	3.01	33.96
S.Ed (±)	0.70	0.30	0.51	0.15	0.10	0.64	0.05	0.10	2.16
C.D _{0.05}	1.48	0.64	1.07	0.32	0.20	1.35	0.11	0.20	4.58