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Effect of Bunch Feeding of Macro and Micronutrients on Yield of Tissue Culture Banana Cv. Grand Naine (AAA)

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Abstract
The present experiment on Effect of bunch feeding of macro and micronutrients on yield of tissue culture banana Cv. Grand Naine (AAA) was conducted at the farmer field located in Agrahara playa, Bengaluru, Karnataka during 2017-18. The results of the experiment revealed that the bunches supplied with additional nutrient combination of 10g Urea + 10g SOP + 5g banana special + 300g vermicompost through bunch feeding has recorded highest finger length (21.23 cm), finger girth (13.60 cm), finger volume (162.17 cm^3), finger weight (186.53 g), bunch length (84.48 cm), hand weight (3.62 kg), bunch weight (33.28 kg) and total yield (74.88 t/ha). Similarly the nutrient combination of 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost was found to be on par with the best treatment.

Keywords: Banana, Bunch feeding, Grand Naine, Vermicompost, Macro and micro-nutrients

Introduction
Banana is one of the major commercial fruit crop of world distributed throughout the warmer countries situated in the region between 30° N and 30° S of the equator. India is the largest producer of banana in the world and cultivated in an area of 8.58 lakh ha. with the production of 29.16 million tonnes wherein, Karnataka has 1.01 lakh ha. with the production of 2.48 million tonnes. National productivity and state productivity of banana is 33.98 MT/ha and 24.55 MT/ha, respectively (Anon. 2017) [5].

Banana is a nutrient loving crop. The optimum amount of nitrogen and potash fertiliser application is very much essential for better growth and production of quality bunch with total dry matter accumulation in plants. The total amount of nitrogen taken up by the plant is closely related to total dry matter production (Lahav, 1995) [15]. Insufficient potassium supply reduces the total dry matter production of banana plants and the distribution of dry matter within the plant. The yield and quality of bunch is most drastically affected. Turner and Barkus (1980) [27] found that, while low potassium supply halved the total dry matter produced, the bunch dry matter was reduced by 80 per cent and the roots were unaffected. Adequate amount of micronutrients is also required to obtain good yield in banana (Kumar and Jeyakumar, 2002) [12].

Banana owing to its large size and rapid growth rate require relatively large amount of nutrients for high yield. To supplement nutrients applied to banana plant through soil and foliage, de-navelling (removal of male inflorescence) and post shooting feeding through the distal stalk-end of the rachis have gained importance. De-navelling saves mobilization of food into the unwanted sink of banana plant (Singh, 2001) [26].

Material and methods
The investigation on "Effect of bunch feeding on yield of tissue culture banana cv. Grand Naine (AAA)" conducted during the year 2017 to 2018 in a farmer's field at Agrahara playa, Dasanapura hobli of Bengaluru North Taluk and District, Karnataka. Experimental location is situated at 13° 7' North latitude and 77° 27' East longitude at an altitude of 902 m above mean sea level (MSL), which comes under the Eastern Dry zone (Zone-5) of Karnataka state. Tissue cultured plants were planted at the spacing of 2.0 X 2.0 m. The required intercultural operations were taken regularly and the Fertilizers were applied at monthly intervals after planting to till two months before shooting with recommended dose per plant NPK (200:100:300 g).

For bunch stalk feeding, uniform bunches for each treatment were selected. Rachis at the distal end of the bunch was excised along with male bud giving a slant cut. (De-navelling by excision of rachis 10 cm after the last hand) immediately after all the pistillate (female) flowers had set fruits. *i.e*., after four bracts were shed (about 15 days after flower emergence). The 500 ml solution is poured into polythene bag and tied securely by dipping the excised rear end of the bunch and maintained till harvest according to the treatments (Figure 1).

Table 1: Details of the treatments imposed during the experimentation

Treatment No.	Treatment
T_1	Control
T_2	7.5g urea + 7.5g SOP + 500g cow dung + 100 ml of water (IIHR Bunch feeding recommendation)
T_3	7.5g urea + 7.5g SOP + 5g banana special + 100g vermicompost
T_4	7.5g urea + 7.5g SOP + 5g banana special + 200g vermicompost
T_5	7.5g urea + 7.5g SOP + 5g banana special + 300g vermicompost
T_6	10g urea + 10g SOP + 5g banana special + 100g vermicompost
T_7	10g urea + 10g SOP + 5g banana special + 200g vermicompost
T_8	10g urea + 10g SOP + 5g banana special + 300g vermicompost
T_9	12.5g urea + 12.5g SOP + 5g banana special + 100g vermicompost
T_{10}	12.5g urea + 12.5g SOP + 5g banana special + 200g vermicompost
T_{11}	12.5g urea + 12.5g SOP + 5g banana special + 300g vermicompost

Note: The vermicompost was dissolved in 500 ml of water along with the prepared solution.

Results and discussion

Finger length

Finger length was significantly influenced by application of different bunch feeding treatments (Table 2). The increase in finger length (21.23 cm) was observed in the bunches provided with 10g Urea + 10g SOP + 5g banana special + 300g vermicompost. The minimum finger length (17.37 cm) was noticed in control. However bunch supplied with 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost (20.87 cm) was found to be the next best treatment which was found to be on par with best treatment. The results were in close conformity with Ramesh Kumar and Kumar (2007) [20] in cv. Ney Poovan and Nandankumar *et al.* (2011) [18] in cv. Nanjangud rasabale (AAB), who have reported that nutrients supplied would have been utilized for cell elongation of fruits and formation of larger intercellular spaces during later part of fruit growth.

Finger girth

The results (Table 2) revealed that the highest finger girth (13.60 cm) was recorded in bunches catered with nutrient solution of 10g Urea + 10g SOP + 5g banana special + 300g vermicompost and the lowest finger girth (11.55 cm) was recorded in control (plants without bunch feeding). Bunch fed with 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost was on par with the highest treatment. The increase in finger girth might be due to the exogenous potassium supply which acted as an activator of several enzymes. Presence of sulphur in sulphate of potash has a synergistic effect with zinc which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin, which increased the girth of fruit. Similar observations were made by Ancy and Kurein (2000) [3] in cv. Nendran, Rameshkumar and Kumar (2007) [20] in cv. Ney Poovan, Nandankumar *et al*. (2011) [18] in cv. Nanjanagudu Rasabale, Sharma *et al.*,(2014) [24] in cv. Borjahaji and Garasangi *et al.* (2018) [10] in cv. Rajapuri.

It can be inferred that, the nutrient supplied in the form of Urea was utilized more for cell elongation of the fruits rather than cell multiplication and the cell enlargement which resulted in more length than girth of the finger. The Urease activity also coincided with lengthening of fruits as reported by Ancy *et al.* (1998) [4].

Finger volume

It was inferred from the results that there were significant differences in finger volume between the treatments (Table 2). The highest finger volume (162.17 cm^3) was observed in the bunches provided with added nutrient combination of 10g Urea + 10g SOP + 5g banana special + 300g vermicompost and the lowest finger volume (164.80 cm^3) was noticed in control. Bunch feeding with 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost was on par with best treatment. The increase in length, girth and weight of finger reflected on finger volume. The increase in finger weight might be due to the rapid multiplication and enlargement of cells and greater accumulation of photosynthates and water in the expanded cells.

Finger weight

The highest finger weight (186.53 g) was recorded in bunches supplied with 10g Urea+ 10g SOP+ 5g banana special+ 300g vermicompost and the lowest finger weight (164.8 cm) was recorded in control (Table 2). Bunches supplied with 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost (159.87 g) was on par with best treatment. The increase in finger weight might be due to the rapid multiplication and enlargement of cells and greater accumulation of sugars or carbohydrates and water in the expanded cells (Ramesh Kumar and Kumar, 2007) [20]. The results are in conformity with those reported by Sandhya *et al.* (2016) [23] in banana cv. Grand Naine, Nandankumar *et al.* (2011) [18] in cv. Nanjangud rasabale.

The increase in finger weight supported with the findings by Calvin *et al.* (1952) [7], Mothes (1961) [16] and Harper (1984) [11], who reported that in plants alointoin and allantonic acid seems to be more immediately concerned with the synthesis and use of nitrogen they contain and these compounds may be derived from glyoxylic acid with Urea as a possible donor (non-urease pathway). In a study on the morpho-physiological aspects of finger development it was observed that, in the final stage of development, cell enlargement took place thus, reducing the available air space followed by starch filling in the cells. The late application of Urea, coinciding with or after the stages of cell division, when the early nitrogen pool becomes exhausted, may be involved in fruit development as a nitrogen source (Kurien *et al.,* 1999) [13]. The results were in

close conformity with Ancy and Kurien (2000) [3] in cv. Nendran.

Bunch length

It could be noticed from the results that there were significant differences in bunch length among the treatments (Table 3). The increased bunch length (84.48 cm) was noticed in treatment with additional nutrient supply of 10g Urea + 10g SOP + 5g banana special + 300g vermicompost as bunch feeding. While, the lowest bunch length (68.43 cm) was noticed in control. The increased bunch length might be due to the additional supply of potassium which helps in cell division and cell expansion by treatment effect on RNA and DNA synthesis. This was in conformity with the findings of Nalina and Kumar (2007) [17] in cv. Robusta.

Hand weight, Bunch weight and Total yield per hectare

The results (Table 3) depicted that the bunches supplied with 10g Urea + 10g SOP + 5g banana special + 300g vermicompost has recorded highest hand weight (3.62 kg), bunch weight (33.28 kg) and total yield per hectare (74.88 t/ha). Whereas, the lowest hand weight (2.87 kg), bunch weight (29.23) kg and total yield per hectare (73.07 t/ha) were recorded in control. Treatments with the bunch feeding of nutrient solution containing 7.5 g Urea + 7.5 g SOP + 500 g cow dung + 100 ml of water and 7.5g Urea + 7.5g SOP + 5g banana special+ 300g vermicompost were found to be subsequent best treatments. Bunch feeding with nutrients aided the additional supply of N which has shown higher Urease activity in fruits (Ancy *et al*., 1998) [4]. This may facilitate hydrolysis of Urea to ammonia (NH_3) for easy absorption and assimilation of N, hence enhanced bunch yield.

Increase in the weight of hand, bunch weight and yield per hectare is due to Sulphur present in the sulphate of potash (SOP) might be responsible for the formation of ferredoxin (Iron - sulphur protein) in plants which might have a direct impact in activating the catalase and peroxidase enzymes. Presence of sulphur in SOP had a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin. Zinc is also essential for chlorophyll formation, which improves the photosynthetic activity (Pandey and Sinha, 1999) [19]. 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.,* 1995) [1]. The influence of sulphur in enhancing fruit yield in bananas was stressed by Lahav and Turner (1983) [14]. SOP also triggered the maximum nitrate reductase in the majority of growth stages. Since nitrate reductase is the key enzyme of nitrate assimilation, the maintenance of the high rate of enzyme activity is imperative for enhanced protein content of the plants. The role of the K^+ ion in this enzyme activity was stressed by Evans and Sorger (1966) [6]. Soluble protein is considered as an indirect measure of Ribulose-1, 5-bisphosphate (RuBP) carboxylase activity as the enzyme constitutes more than 60 per cent of the soluble protein content and hence, it serves as an indicator of the photosynthetic rate (Evans *et al*., 1975) [9]. The present findings are in close conformity with Alagarsamy and Neelakandan (2008) [2] in cv. Robusta, Rameshkumar and Kumar (2007 and 2010) [20, 21] in cv. Neypoovan, Rameshkumar *et al*. (2008) [22] in cv. Robusta and Bhalerao *et al.* (2009) [9] in cv. Grand Naine.

Table 2: Influence of bunch feeding on finger characters of banana Cv. Grand Naine

Treatments details	Finger length (cm)	Finger girth (cm)	Weight of finger (g)	Finger volume (cm^3)
T_1: Control	17.37	11.55	164.8	136.37
T_2: 7.5g Urea + 7.5g SOP + 500g cow dung + 100 ml of water (IIHR Bunch feeding recommendation)	20.57	13.17	182.76	158.47
T_3: 7.5g Urea + 7.5g SOP + 5g banana special + 100g vermicompost	19.13	12.73	174.12	145.83
T_4: 7.5g Urea + 7.5g SOP + 5g banana special + 200g vermicompost	19.83	13.32	178.66	151.78
T_5: 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost	20.87	13.40	184.61	159.87
T_6: 10g Urea + 10g SOP + 5g banana special + 100g vermicompost	19.67	12.98	179.31	149.78
T_7: 10g Urea + 10g SOP + 5g banana special + 200g vermicompost	20.70	13.32	180.66	158.80
T_8: 10g Urea + 10g SOP + 5g banana special + 300g vermicompost	21.23	13.60	186.53	162.17
T_9: 12.5g Urea + 12.5g SOP + 5g banana special + 100g vermicompost	18.77	12.63	172.63	145.60
T_{10}: 12.5g Urea + 12.5g SOP + 5g banana special + 200g vermicompost	18.60	12.37	170.60	142.17
T_{11}: 12.5g Urea + 12.5g SOP + 5g banana special + 300g vermicompost	17.77	12.00	168.26	139.60
S.Em.±	0.72	0.34	5.19	4.31
C.D. at 5 %	2.05	1.12	15.17	13.15

Table 3: Effect of bunch feeding on bunch length, hand weight, bunch weight and total yield of banana Cv. Grand Naine

Treatments details	Length of bunch (cm)	Weight of hands (kg)	Weight of bunch (kg)	Total yield (tons/ha)
T_1: Control	68.43	2.87	29.23	65.77
T_2: 7.5g Urea + 7.5g SOP + 500g cow dung + 100 ml of water (IIHR Bunch feeding recommendation)	81.40	3.53	32.87	73.96
T_3: 7.5g Urea + 7.5g SOP + 5g banana special + 100g vermicompost	74.20	3.34	30.97	69.68
T_4: 7.5g Urea + 7.5g SOP + 5g banana special + 200g vermicompost	78.63	3.44	32.23	72.52
T_5: 7.5g Urea + 7.5g SOP + 5g banana special + 300g vermicompost	81.33	3.53	32.82	73.85
T_6: 10g Urea + 10g SOP + 5g banana special + 100g vermicompost	77.49	3.39	31.23	70.27
T_7: 10g Urea + 10g SOP + 5g banana special + 200g vermicompost	80.75	3.45	32.47	73.06
T_8: 10g Urea + 10g SOP + 5g banana special + 300g vermicompost	84.48	3.62	33.28	74.88
T_9: 12.5g Urea + 12.5g SOP + 5g banana special + 100g vermicompost	71.40	3.28	30.59	68.83
T_{10}: 12.5g Urea + 12.5g SOP + 5g banana special + 200g vermicompost	73.72	3.13	30.37	68.33
T_{11}: 12.5g Urea + 12.5g SOP + 5g banana special + 300g vermicompost	71.21	3.02	30.10	67.73

S.Em.±	2.83	0.14	1.03	0.85
C.D. at 5 %	8.14	0.41	2.23	2.63

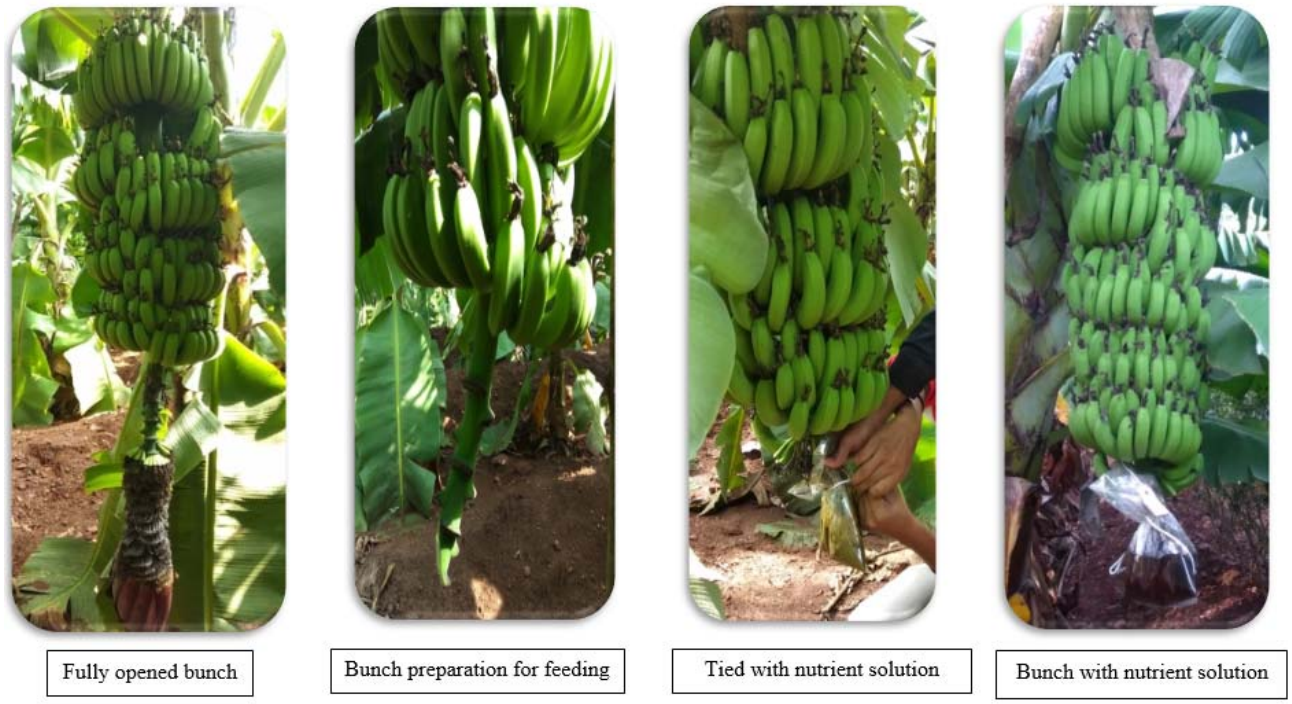

Fig 1: Technique involved in nutrients bunch feeding of banana

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