

Effect of Bunch Feeding on Yield of Banana Cv. Robusta (Aaa-group) Under Hill Zone of Karnataka

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ABSTRACT: A field experiment was conducted at farmer field to determine the effect of different bunch stalk feeding with different growth regulators on yield of banana cv. Robusta (AAA-group) under hill zone of Karnataka. The experiment was laid in RCBD with 16 treatments and three replications. Urea (2.0, 4.0 and 6.0 %), sulphate of potash (1.5, 2.0 and 2.5 %), 2, 4-D (10, 20 and 30 ppm), panchagavya (2.0, 4.0 and 6.0 %) and banana special (0.2, 0.4 and 0.6 %) and compared with control (without bunch stalk feeding). Results revealed that, at the time of harvest, bunch fed with 2 per cent sulphate of potash recorded significantly highest intermodal length (8.93 cm), bunch length (85.20 cm), finger girth (12.79 cm), finger weight (170.10 g), weight of hands (2.60 kg), weight of bunch (24.21 kg), total yield (60.53 t/ha) and benefit cost ratio (2.68).

Key words: Bunch, Feeding, Banana, Robusta, Fingers, Hands, Hill Zone, Yield & Quality.

Banana is one of the major commercial fruit crops grown in tropics, subtropics and considered as one of the most economical source of food. In India bananas are cultivated in an area of 8.3 lakh hectare sand producing 29.78 Million tones and 1.2 lakh hectares and production of 2.28 Million tonnes in Karnataka, with average national and state productivity of 35.9MT/ha and 20.4 MT/ha respectively (Anon., 2011). with average national and state productivity of 35.9MT/ha and 20.4 MT/ha respectively (Anon., 2011). Banana plant is supplied with nutrients through soil and foliage, *denavelling* (removal of male inflorescence for nutrient diversion) and post-shooting feeding nutrients through the distal stalk-end of rachis (Venkatarayappa *et al.*, 1976, Prasanna Kumari Amma *et al.*, 1986, Ancy *et al.*, 1998 and Ancy and Kurien, 2000) to achieve high yields. De-navelling serves dual purposes of saving mobilization of food into unwanted sink of banana plant as well as earning additional income when excised male bud is used as a vegetable (Singh, 2001). Therefore, an attempt was made to enhance the bunch yield by feeding Urea, sulphate of potash (SOP), 2, 4-D, panchagavya and Banana special (micronutrient

mixture) through the excised distal stalk-end of rachis after de-navelling and to determine influence of treatments on yield of "Robusta" banana.

Table 1
Details of Treatments in the Study as Follows

T ₁	Control (without bunch stalk feeding)
T ₂	2 % - Urea
T ₃	4 % - Urea
T ₄	6 % - Urea
T ₅	1.5 % - SOP
T ₆	2.0 % - SOP
T ₇	2.5 % - SOP
T ₈	10 ppm - 2, 4-D
T ₉	20 ppm - 2, 4-D
T ₁₀	30 ppm - 2, 4-D
T ₁₁	2 % - Panchagavya
T ₁₂	4 % - Panchagavya
T ₁₃	6 % - Panchagavya
T ₁₄	0.2 % - Banana special
T ₁₅	0.4 % - Banana special
T ₁₆	0.6 % - Banana special

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MATERIALS AND METHODS

The experiment was conducted in the farmer field during the year 2011-2012 at Palguni village (Tq. Mudigere, Dist. Chikmagalur) which situated at 13° North latitude and 77° 38' East longitude at an altitude of 980 m above mean sea level in the hill zone (Zone-9) of Karnataka state with an average rainfall of 3833.40 mm annual average temperature of the area varies from 27.0 to 36.6 °C. The soil was sandy clay loam and slightly acidic in nature (pH 5.70) with safe level of 0.35 dSm⁻¹ electrical conductivity (EC) and high in organic carbon content (1.70%). The experiment was laid in the existing plantation, spaced at 2.2 X 1.2 m, the land was ploughed twice and harrowed to bring it to good tilth. Uniform sized suckers had been procured from previously grown crop in the same farm. Before a week of planting 20 kg of well decomposed farm yard manure (FYM) was added to each pit. Inorganic fertilizers were applied at 2nd, 4th and 6th months after planting with recommended dose per plant (180: 108: 225 g NPK). And no further organic and inorganic fertilizers were applied. At 7th month after planting. Protective irrigation was given at weekly intervals. The experiment was laid out in RCBD with 16 treatments (table 1) replicated twice. Total no of plots were 16 per each replication. Out of 9 plants in a plot, 3 plants were selected for recording observation. For bunch stalk feeding, uniform bunches from 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 prepared 250ml solution was placed in a thick polythene bag and tied securely by dipping the excised rachis and maintained till harvest.

The finger characters namely, length, girth and finger weight, were measured in 'D' finger, i.e. middle finger in top row of the second hand (Gottreich *et al.*, 1964). The bunches were harvested when the fingers had fully developed and devoid of any ridges on its surface of the fruit and weighed and the bunch weight was expressed in kilogram. Weight of hand was recorded by weighing middle hand from the labelled plants and taken average and was expressed in kilogram. The plant yield was calculated by multiplying the yield per plant with the total number of plants per hectare and expressed in tonnes per hectare.

The data in respect of all the above parameters were tabulated and subjected to the statistical analysis

using methods of analysis of variance (ANOVA) for randomized block design by Fisher and Yates (1963). Whenever 'F' test was found significant for comparing the means of two treatments critical difference (C.D. at 5%) were worked out.

RESULTS AND DISCUSSION

The internodal length between hands and length of bunch differed significantly among the treatments. The maximum internodal length (8.93 cm) between hands of the bunch and length of bunch (85.20 cm) was obtained in the treatment (T₆) supplied with 2 per cent sulphate of potash, The increased length of bunch and internodal length might be due to the cell division and cell expansion by their effect on RNA and DNA synthesis, this was in conformity with the findings of Nalina and Kumar (2007) in cv. Robusta. The length of finger was increased (21.96cm) in the treatment (T₃) where the bunch fed with 4 per cent urea. The increase in the length of fruit was in turn reflected in finger weight in all most all treatments. The results were in close conformity with Ancy and Kurien (2000) in cv. Nendran and Nandan *et al.* (2011) in cv. Nanjangudurasabale (AAB). 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. The urease activity also coincided with lengthening of fruits as reported by Ancy *et al.* (1998).

The results pertaining to girth of fingers shown that, the bunch fed with 2 per cent sulphate of potash (T₆) gave a better result (12.79cm). The increase in girth intern reflected on final weight of the finger, which clearly indicated that potassium is involved in cell enlargement rather than cell division as there was not much increase in length of fruit when compared to other treatments. The increase in finger girth by 2 per cent sulphate of potash might be due to the exogenous potassium supply which acted as an activator of several enzymes. Potassium also had a role in synthesizing the precursor of chlorophyll pigments. 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 size of fruit. Similar observations made by Mustaffa *et al.* (2004) in cv. Nendran, Ramesh and Kumar (2007) in cv. Neypoovan and Nandan *et al.* (2011) in cv. Nanjanagudu Rasabale. The Robusta bunch fed with 2 per cent sulphate of potash (T₆) recorded the maximum finger weight (170.10 g) which was on par

with 0.6 per cent banana special (T_{16}) and 4 per cent urea (T_3) which resulted in mean fruit weight of 168.80 g and 166.50 g respectively (Table-1). Similar results on fruit weight were found by Venkatarayappa, (1975), who reported that application of urea as a spray in Dwarf Cavendish and Giant cavendish over control by 14.80 per cent and 17.24 per cent respectively and Ramesh and Kumar (2007 and 2010) in cv. Neypoovan, Nandan *et al.* (2011) in NanjanaguduRasabale and Ramesh *et al.* (2008) in cv. Robusta.

The increase in finger weight by urea 4 per cent can be supported with the findings by Calvin *et al.* (1952), Mothes (1961) and Harper (1984), 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 glycoxylic 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). The results were in close conformity with Ancy and Kurien (2000) in cv. Nendran.

The increased yield and yield parameters influenced by increase in girth, length and weight of individual fingers (Table 1). Bunch feeding with 2 per cent sulphate of potash (T_6) which showed higher girth and weight of finger finally resulted in highest weight of hands (2.60 kg), weight of bunch (24.21 kg) and total yield (60.53 t/ha), which was on par with (T_{16}) 0.6 per cent banana special (2.55 kg, 23.75 kg and 59.39 t/ha respectively), (T_3) 4 per cent urea (2.54 kg, 23.64 kg and 59.11 t/ha respectively), (T_5) 1.5 per cent sulphate of potash (2.53 kg, 23.53 kg and 58.82 t/ha respectively) and (T_{15}) 0.4 per cent banana special (2.52 kg, 23.35 kg and 58.68 t/ha respectively) weight of hands, bunch and total yield respectively, Increase in the weight of hand, weight of bunch and yield is due to Sulphur present in the sulphate of potash (SOP) might be responsible for the formation of ferridoxin (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. Sulphur can increase the absorption of potassium or it can react with nitrogen and potassium (Farrag *et al.*, 1990). 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 bananas was stressed by Lahav and Turner (1983). 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). 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). RuBP carboxylase, the prime enzyme of carbon fixation is dominant the soluble protein fraction of leaves and therefore is known as the most abundant protein in the world (Noggle and Fritz, 1986). The present findings are in close conformity with Alagarsamy and Neelakandan (2008) in cv. Robusta, Ramesh and Kumar (2007 and 2010) in cv. Neypoovan and Ramesh *et al.* (2008) in cv. Robusta.

In bunch stalk feeding of urea, has a higher urease activity coincided with better bunch and finger grade which revealed the possibility of conversion or hydrolysis of urea into ammonia (NH_3) and carbon dioxide (CO_2) and its better absorption and assimilation (urease pathway). This enzyme activity, in turn, is related with the molecular absorption of urea (Ancy *et al.*, 1998). The released NH_3 would be incorporated into amino acids and then into protein via the glutamate synthase cycle (Kumar and Abrol, 1990). Similarly, this study was supported by Ancy and Kurien (2000) in cv. Nendran and Kotur and Keshava (2008) in cv. Robusta.

Increase in the yield by banana special (micronutrient mixture) might be due to important role of micronutrients in increasing the cell elongation and division as suggested by Abdel *et al.* (1992). These findings were agreed with results reported by Yadlod and Kadam (2008a) in cv. Ardhapuri, Yadlod and Kadam (2008b) in cv. Grand Naine and Pathaket *et al.* (2011) in cv. Martaman (AAB, Silk).

Table 1
Effect of Bunch Feeding on Bunch Characters of Banana cv. Robusta

<i>Treatment</i>	<i>Internodal length (cm)</i>	<i>Bunch length (cm)</i>	<i>Length of finger(cm)</i>	<i>Girth of finger(cm)</i>	<i>Weight of finger(g)</i>
T ₁ : Control	7.90	74.20	16.79	10.13	148.40
T ₂ : Urea - 2 %	8.43	79.98	18.90	11.51	160.80
T ₃ : Urea - 4 %	8.83	83.18	21.96	12.30	166.50
T ₄ : Urea - 6 %	7.97	75.23	17.06	10.69	152.90
T ₅ : Sulphate of Potash - 1.5 %	8.77	82.10	20.77	12.24	165.20
T ₆ : Sulphate of Potash - 2.0 %	8.93	85.20	21.67	12.79	170.10
T ₇ : Sulphate of Potash - 2.5 %	8.33	78.23	18.53	11.25	160.30
T ₈ : 2, 4-D - 10ppm	8.03	75.78	17.33	10.82	154.03
T ₉ : 2, 4-D - 20ppm	8.13	76.20	17.57	10.98	155.80
T ₁₀ : 2, 4-D - 30ppm	8.23	77.98	18.07	11.13	159.10
T ₁₁ : Panchagavya - 2 %	8.17	76.77	17.87	11.07	158.50
T ₁₂ : Panchagavya - 4 %	8.57	80.20	19.13	11.69	161.70
T ₁₃ : Panchagavya - 6 %	8.63	80.87	20.23	11.92	162.30
T ₁₄ : Banana special - 0.2 %	8.27	78.10	18.23	11.16	159.80
T ₁₅ : Banana special - 0.4 %	8.73	81.93	20.47	12.11	163.40
T ₁₆ : Banana special - 0.6 %	8.87	83.80	21.27	12.42	168.80
S.Em.±	0.11	1.18	0.40	0.19	1.35
C.D. at 5 %	0.30	3.40	1.17	0.56	3.89

Table 2
Effect of Bunch Feeding on Yield of Banana cv. Robusta.

<i>Treatment</i>	<i>Weight of hand (kg)</i>	<i>Weight of bunch (kg)</i>	<i>Yield (t/ha)</i>
T ₁ : Control	2.21	20.56	51.39
T ₂ : Urea - 2 %	2.49	22.37	55.92
T ₃ : Urea - 4 %	2.54	23.64	59.11
T ₄ : Urea - 6 %	2.36	21.27	53.18
T ₅ : Sulphate of Potash - 1.5 %	2.53	23.53	58.82
T ₆ : Sulphate of Potash - 2.0 %	2.60	24.21	60.53
T ₇ : Sulphate of Potash - 2.5 %	2.46	22.17	55.43
T ₈ : 2, 4-D - 10ppm	2.37	21.36	53.40
T ₉ : 2, 4-D - 20ppm	2.39	21.48	53.71
T ₁₀ : 2, 4-D - 30ppm	2.42	21.79	54.47
T ₁₁ : Panchagavya - 2 %	2.41	21.66	54.15
T ₁₂ : Panchagavya - 4 %	2.50	22.47	56.16
T ₁₃ : Panchagavya - 6 %	2.51	22.62	56.55
T ₁₄ : Banana special - 0.2 %	2.45	22.03	55.08
T ₁₅ : Banana special - 0.4 %	2.52	23.35	58.68
T ₁₆ : Banana special - 0.6 %	2.55	23.75	59.39
S.Em.±	0.04	0.42	1.05
C.D. at 5 %	0.12	1.22	3.04

From the above study it can be concluded that sulphate of potash improved the yield and quality parameters of banana cv. Robusta under hill zone of Karnataka. 2.0 per cent of sulphate of potash increased the yield by 17.79 per cent (60.53t/ha). While, 2 per cent

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