Bunch Feeding Can Improve the Quality of Banana CV. Robusta (AAA-Group) Under Hill Zone of Karnataka (Zone-09)

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Received: 20.08.2017 | Revised: 29.09.2017 | Accepted: 3.10.2017

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 2.5 per cent sulphate of potash recorded significantly lowest physiological loss in weight (10.44 %), more days to ripe (14.33 days) under ambient condition, longer shelf life (8.67 days), highest total sugars (18.49 %), less titratable acidity (0.25 %), highest Sugar : acid ratio (73.14), reducing sugar (15.86 %) and non-reducing sugar (2.63 %) compared to control (13.20 %, 10.67 days, 6.67 days, 15.21 %, 0.33 %, 45.62, 13.01 % and 2.20 % respectively). Bunches fed with 2.0 per cent sulphate of potash recorded significantly highest pulp weight (109.16 g), peel weight (42.31 g), pulp to peel ratio (2.58) and TSS (23.51°Brix) compared to control (90.81 g, 38.00 g, 2.39 and 19.88°Brix respectively).

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

INTRODUCTION
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 hectares and 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 35.9 MT/ha and 2 0.4 MT /ha respectively with average national and state productivity of 35.9MT/ha and 20.4 MT/ha respectively. 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 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. Therefore, an attempt was made to enhance the bunch yield by feeding Urea, sulphate of potash (SOP), 2,4D, panchagavya and Banana special (micronutrient mixture) through the excised distal stalk-end of rachis after de-navelling and to determine influence of treatments on quality of “Robusta” banana.

**Details of Treatments in the Study as Fallows**

1. **T1**: Control (without bunch stalk feeding)
2. **T2**: Urea - 2 %
3. **T3**: Urea - 4 %
4. **T4**: Urea - 6 %
5. **T5**: Sulphate of Potash - 1.5 %
6. **T6**: Sulphate of Potash – 2.0 %
7. **T7**: Sulphate of Potash - 2.5 %
8. **T8**: 2, 4-D - 10ppm
9. **T9**: 2, 4-D - 20ppm
10. **T10**: 2, 4-D - 30ppm
11. **T11**: Panchagavya - 2 %
12. **T12**: Panchagavya - 4 %
13. **T13**: Panchagavya - 6 %
14. **T14**: Banana special - 0.2 %
15. **T15**: Banana special - 0.4 %
16. **T16**: Banana special - 0.6 %

**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 replicated twice. Total no of plots was 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 Physiological loss in weight of fruits was expressed in percent loss of weight from day of harvest to 7th day after harvest. The fully matured hands were taken and kept for ripening under ambient condition and the days taken for ripening was recorded. Days to ripe (Greenlife) has been defined as the time a harvested fruit takes to reach maturity under defined conditions. Shelf life of fruits was decided based on the appearance and marketability of the fruits. When the fruits attained beyond edible ripe stage, then those fruits were considered to have reached the end of their shelf life.

The Shelf life can be defined as the time over which the ripe fruit remains acceptable for consumption. The reducing sugar and total sugar content of the fruit was estimated by following the method of Ranganna. The percentage of non-reducing sugars was obtained by subtracting the percentage of reducing sugars from the total sugars. The standard method of A.O.A.C. was followed to estimate the acidity. The acidity of the fruit and was expressed as percentage of citric acid.
on fresh weight of sample. The Sugar/acid ratio of the pulp was arrived at by dividing the value of total sugars by that of acidity and this was reckoned as a measure of fruit quality. The total soluble solids were recorded with the extracted juice using a ‘Zeiss’ hand refractometer at room temperature and expressed in percentage.

The pulp weight and peel weight were recorded separately from the ripened fruits and expressed in grams. The pulp to peel ratio was worked out by dividing the mean weight of pulp by mean weight of peel. 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. 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
Results revealed that, at the time of harvest, bunch fed with 2.5 per cent sulphate of potash recorded significantly lowest physiological loss in weight (10.44 %), more days to ripe (14.33 days) under ambient condition, longer shelf life (8.67days), highest total sugars (18.49 %), less titratable acidity (0.25 %), highest Sugar: acid ratio (73.14), reducing sugar (15.86 %) and non-reducing sugar (2.63 %).

Ramesh and Kumar, reported that extended shelf life by bunch fed with sulphate of potash might be due to the lesser Physiological loss in weight experienced in fruits. Similarly, the extended shelf life was found in Ney Poovan banana by Ramesh and Kumar by spraying 1.5 % sulphate of potash, Kumar et al., in Robusta, Nandan et al., in cv. Nanjanagudu Rasabale and Sateesh and Bangarusamy in cv. Rasthali by spraying 1 % potassium chloride.

Days to ripe of harvested fruit is an important attribute decides the market value of the produce. It is desired to have longer days to ripe to withstand longer transit time from field to consumer. However, more number of days to ripe was noticed in the bunches fed with 2.5 % sulphate of potash (T7) which remained green till 14.33 days, and lesser days to ripe was noticed in urea 6 % (T4) which remained green only for 9.33 days.

Reduced number of days to ripe in 6 % urea might be due to high N content of fruits accelerated ripening by promoting autocatalytic ethylene synthesis, which might be the reason for early ripening of fruits in urea sprayed treatments in banana, this were opined by Dominguez and Vendrell. These results were supported by Sateesh and Bangarusamy by 4 per cent urea spraying in cv. Rasthali. High levels of N have been shown to reduce green life (days to ripe)19.

Application of sulphate of potash was also found to be good in increasing sugar per cent as potassium plays a major role in carbohydrates synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids. This finding agreed with that of Tisdale and Nelson. Going further, potassium when supplied in the form of sulphate of potash favours conversion of starch into simple sugars during ripening by activating the sucrose synthatase enzyme thus resulting in higher sugar percentage. Potassium is involved in phloem loading and unloading of sucrose and amino acids, and storage in the form of starch in developing fruits by activating the enzyme starch synthase. In plants supplied with potassium, the osmotic potential of the phloem sap and the volume flow are higher than in bunches with low K supply, and as a result, sucrose concentration in content of fruits is increased. Similar results were found by Ramesh and Kumar in banana cv. Neypoovan, Nandan et al., in cv. Nanjanagudu Rasabale and Ramesh et al., in cv. Robusta. Enhanced quality of fruits particularly the sugar content may be due to the role of sulphate (SO4) ions released from sulphate of potash as sulphate favours, while chloride reduces, the activity of anabolic enzymes, resulting in accumulation of highly polymerized carbohydrates (starch), which
would have subsequently disintegrated into sugars on ripening. Increased level of potassium application results in reduced acid content of fruits. This could be due to the fact that under low potassium regime, phosphoenol pyruvate (PEP) was apparently shunted into alternate pathways resulting in a shortage of acetyl CO-A. Hence, oxalo acetate appeared to be preferentially formed from PEP in plants with low levels of potassium and this organic acid derivative accumulated. Neutralization of organic acids due to a high potassium level in tissues could have also resulted in the reduction in acidity. This results were agreed with Nanjanagudu Rasabale and Ramesh and Kumar. The total soluble solids (TSS) a prime factor which determine the quality of fruits. Nandan et al., reported that increase in TSS shows that sulphate of potash when supplied exogenously increased the flow of plant assimilates into the developing fruits especially when assimilate flow from other parts of plant becomes limited in banana cv. Nanjanagudu rasabale. The findings were closely conformity with Ramesh and Kumar, in cv. Neypoovan and Ramesh et al., in cv. Robusta.

As such Robusta pulp is very thick and they become still thicker at the edible stage. This indicates the beneficial role of potassium and panchagavya 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., in cv. Neypoovan.

**Effect of bunch feeding on quality parameters of banana cv. Robusta**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total sugars (%)</th>
<th>Titratable acidity (%)</th>
<th>Sugar : acid ratio</th>
<th>TSS (%Brix)</th>
<th>Reducing sugar(%)</th>
<th>Non-reducing sugars (%)</th>
<th>Pulp weight (g)</th>
<th>Peel weight (g)</th>
<th>Pulp to peel ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-, Control</td>
<td>15.21</td>
<td>0.33</td>
<td>45.62</td>
<td>19.88</td>
<td>13.01</td>
<td>2.20</td>
<td>10.81</td>
<td>58.00</td>
<td>2.39</td>
</tr>
<tr>
<td>T2 - Urea - 2 %</td>
<td>16.98</td>
<td>0.32</td>
<td>53.24</td>
<td>20.41</td>
<td>14.63</td>
<td>2.35</td>
<td>99.06</td>
<td>40.11</td>
<td>2.47</td>
</tr>
<tr>
<td>T3 - Urea - 4 %</td>
<td>17.65</td>
<td>0.30</td>
<td>58.86</td>
<td>22.17</td>
<td>15.18</td>
<td>2.47</td>
<td>102.47</td>
<td>41.15</td>
<td>2.49</td>
</tr>
<tr>
<td>T4 - Urea - 6 %</td>
<td>17.05</td>
<td>0.31</td>
<td>55.02</td>
<td>20.43</td>
<td>14.71</td>
<td>2.34</td>
<td>93.47</td>
<td>38.15</td>
<td>2.45</td>
</tr>
<tr>
<td>T5 - Sulphate of Potash - 1.5 %</td>
<td>18.26</td>
<td>0.27</td>
<td>66.96</td>
<td>23.08</td>
<td>15.69</td>
<td>2.57</td>
<td>105.09</td>
<td>41.71</td>
<td>2.52</td>
</tr>
<tr>
<td>T6 - Sulphate of Potash - 2.0 %</td>
<td>18.41</td>
<td>0.26</td>
<td>70.09</td>
<td>23.51</td>
<td>15.80</td>
<td>2.61</td>
<td>109.16</td>
<td>42.31</td>
<td>2.58</td>
</tr>
<tr>
<td>T7 - Sulphate of Potash - 2.5 %</td>
<td>18.49</td>
<td>0.25</td>
<td>73.14</td>
<td>23.11</td>
<td>15.86</td>
<td>2.63</td>
<td>102.66</td>
<td>40.91</td>
<td>2.51</td>
</tr>
<tr>
<td>T8 - 2, 4-D - 10ppm</td>
<td>16.81</td>
<td>0.31</td>
<td>54.91</td>
<td>20.44</td>
<td>14.54</td>
<td>2.27</td>
<td>95.12</td>
<td>38.98</td>
<td>2.44</td>
</tr>
<tr>
<td>T9 - 2, 4-D - 20ppm</td>
<td>17.15</td>
<td>0.30</td>
<td>57.88</td>
<td>20.73</td>
<td>14.79</td>
<td>2.36</td>
<td>96.07</td>
<td>39.21</td>
<td>2.45</td>
</tr>
<tr>
<td>T10 - 2, 4-D - 30ppm</td>
<td>17.28</td>
<td>0.29</td>
<td>60.38</td>
<td>20.96</td>
<td>14.84</td>
<td>2.44</td>
<td>97.81</td>
<td>39.78</td>
<td>2.46</td>
</tr>
<tr>
<td>T11 - Panchagavya - 2 %</td>
<td>17.54</td>
<td>0.28</td>
<td>62.89</td>
<td>22.98</td>
<td>15.03</td>
<td>2.51</td>
<td>99.64</td>
<td>39.86</td>
<td>2.50</td>
</tr>
<tr>
<td>T12 - Panchagavya - 4 %</td>
<td>17.95</td>
<td>0.27</td>
<td>66.75</td>
<td>23.08</td>
<td>15.41</td>
<td>2.54</td>
<td>102.75</td>
<td>40.79</td>
<td>2.52</td>
</tr>
<tr>
<td>T13 - Panchagavya - 6 %</td>
<td>18.14</td>
<td>0.26</td>
<td>70.04</td>
<td>23.18</td>
<td>15.55</td>
<td>2.59</td>
<td>104.23</td>
<td>41.03</td>
<td>2.54</td>
</tr>
<tr>
<td>T14 - Banana special - 0.2 %</td>
<td>17.42</td>
<td>0.30</td>
<td>58.78</td>
<td>22.77</td>
<td>14.94</td>
<td>2.47</td>
<td>99.15</td>
<td>40.31</td>
<td>2.46</td>
</tr>
<tr>
<td>T15 - Banana special - 0.4 %</td>
<td>17.72</td>
<td>0.29</td>
<td>61.16</td>
<td>22.99</td>
<td>15.23</td>
<td>2.49</td>
<td>102.17</td>
<td>40.48</td>
<td>2.50</td>
</tr>
<tr>
<td>T16 - Banana special - 0.6 %</td>
<td>18.03</td>
<td>0.27</td>
<td>65.98</td>
<td>23.18</td>
<td>15.46</td>
<td>2.57</td>
<td>106.15</td>
<td>42.21</td>
<td>2.52</td>
</tr>
<tr>
<td>E- test</td>
<td>**</td>
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</tr>
<tr>
<td>S.Emr</td>
<td>0.14</td>
<td>0.01</td>
<td>1.99</td>
<td>0.18</td>
<td>0.13</td>
<td>0.06</td>
<td>0.87</td>
<td>0.39</td>
<td>0.02</td>
</tr>
<tr>
<td>CO at 5 %</td>
<td>0.40</td>
<td>0.02</td>
<td>5.94</td>
<td>0.51</td>
<td>0.38</td>
<td>0.16</td>
<td>2.20</td>
<td>1.13</td>
<td>0.05</td>
</tr>
</tbody>
</table>

** Highly significant
REFERENCES


