Foliar and bunch nutrition studies on yield and economics of banana (*Musa paradisiaca* L.) cv. Rajapuri

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Abstract

The present study entitled “Foliar and bunch nutrition studies on yield and economics of banana (*Musa paradisiaca* L.) cv. Rajapuri” was carried at ICAR-AICRP on Fruits, Kittur Rani Channamma College of Horticulture, Arabhavi, Belagavi district, Karnataka during the year 2019-2020. The experiment was laid out in randomized complete block design with eight treatments with three replications. Among the different treatments, the treatment T1 (Foliar spray of 2% SOP and 1% of urea at 6, 7, 8 months after planting followed by bunch spray of 2% SOP and 1% Urea after denavelling and one month after denavelling) significantly improved the finger weight (113.30 g), finger length (13.71 cm), finger girth (12.35 cm), weight of third hand (1.71 kg), number of hands per bunch (9.01), bunch length (53.16 cm), bunch width (41.43 cm), bunch weight (15.30 kg), yield per hectare (47.21 t/ha) and B:C ratio (2.61:1) over control (T0).

Keywords: SOP, urea, foliar and bunch spray, banana, Rajapuri

Introduction

Banana (*Musa paradisiaca* L.) is one of the major fruit crops in the tropics and subtropics and make a vital contribution to the economies of a number of countries. It is an herbaceous, perennial, monocotyledonous and monocarpic crop and belongs to the family Musaceae in the order Scitamineae. It grows well in humid tropical low lands and is predominantly distributed in 30° N and 30° S of equator (Patil and Jagadeesh, 2016) [21]. Globally, banana is cultivated in 5.6 million ha with the annual production of 114 million tons and productivity of 20 tons/ha. In India, it is cultivated throughout the year and is the second most important fruit crops next to mango. It ranks first in production (30.48 million tons) and second in area (0.87 million ha) with the productivity of 30.17 tons/ha (Anon., 2019) [3]. Among the different varieties of banana grown in Karnataka, the cultivar Rajapuri belonging to AAB group and is very popular commercially grown in Belagavi, Vijaya Pura, Bagalkot and Dharwad districts of North Karnataka. It is also known as Jawari bale meaning local type. It fetches very good price in the market as compared to other varieties due to many desirable characters such as, the fruits are attractive colour with medium size, good, sweet and acid blend with unique flavour. It is also a hardy crop and withstand the strong winds.

Banana crop receives its last dose of fertilizer after 7th months of planting to fulfil the requirement of nutrients from shooting to harvest stage. Any limitation in the supply of nutrients at this stage leads to poor finger filling & development, reduce the bunch size and quality (Jeyakumar et al., 2010) [11]. However, it is not advisable to go for soil application of fertilizers at finger development stage, because the uptake of nutrients is very slow and low at this stage. Hence foliar application with fully water-soluble fertilizers at these critical stages increases yield and quality. As uptake of nutrients through the foliage is considerably faster than through roots (Sandhya et al., 2018) [24].

Post shooting spray of various nutrients during fruit development stage increases the fruit yield and quality of banana. It has been found to respond well to foliar spray of nitrogen and potassium sprays (Sandhya et al., 2018) [24]. Nitrogen is essential constituent of protein, nucleic acid, nucleotide, amino acid and chlorophyll. It plays important role in synthesis of auxin (Kannan, 1980) [12]. In banana, fruit quality is mainly judged by the sugar content and acidity in the pulp. The foliar and bunch spray of sulphate of potash appeared to be effective in enhancing various quality parameters such as TSS, reducing sugar, non-reducing sugar, total sugars and acidity (Gamit et al., 2017) [8]. The micronutrients are required by the plants in minute quantities, but they play a vital role in regulating the plant growth and also promotes
the physiological responses in plants. Zinc regulates the plant growth hormone and enzyme system, necessary for carbohydrate and starch formation. Iron promotes formation of chlorophyll pigment which acts as an oxygen carrier involving cell division and growth (Yadlod and Kadam, 2008) [27]. Bio stimulants are the substances obtained from natural origin that contribute to boosting plant yield, by stimulating the plant metabolism and improving nutrient use efficiency of the plant besides reducing the dependency on chemical fertilizers. Now a day’s bio stimulants such as humic acid and seaweed extract, have attracted the attention of fruit growers and researchers for commercial production and scientific studies (Haider et al., 2012) [10]. The considerable research work has been done on banana foliar and bunch nutrition on different varieties, but very meagre work has been done on foliar and bunch nutrition in Rajapuri variety. Keeping all these factors in consideration the present investigation was undertaken to study the “Foliar and bunch nutrition studies on yield and economics of banana (Musa paradisiaca L.) cv. Rajapuri”.

Material & Methods
The experiments were carried at ICAR- AICRP on Fruits, Kittur Rani Channamma College of Horticulture, Arabhavi, UHS, Bagalkot, Karnataka, India. The experiment was laid out in randomized complete block design (RCBD) with eight treatments, three replications and twelve plants per treatment. The five plants are selected randomly for recording observations from each treatment. The treatment details given below.

T1: Foliar spray of 2% Sulphate of Potash (SOP) + 1% Urea @ 6, 7 and 8 months after planting (MAP) followed by, bunch spray of 2% SOP + 1% Urea after denavelling and one month after denavelling (MAD).

T2: Bunch feeding with 500 ml cow dung slurry with 1.5% Sulphate of Potash (SOP) immediately after denavelling.

T3: Foliar spray of IIHR Arka Banana Special @ 0.5% at 6, 7 and 8 MAP followed by, bunch spray of IIHR Arka Banana Special @ 0.5% after denavelling and one MAD.

T4: Foliar spray of Banana Sakti @ 2% at 6, 7 and 8 MAP followed by, bunch spray of Banana Sakti @ 2% after denavelling and one MAD.

T5: Foliar spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 6, 7 and 8 MAP followed by, bunch spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% after denavelling and one MAD.

T6: Foliar spray of Seaweed extract @ 0.3% at 6, 7 and 8 MAP followed by, bunch spray of Seaweed extract @ 0.3% after denavelling and one MAD.

T7: Foliar spray of Humic acid @ 1% at 6, 7 and 8 MAP followed by, bunch spray of Humic acid @ 1% after denavelling and one MAD.

T8: Control

The data on different yield parameters were recorded and was subjected to statistical analysis for meaningful conclusions.

Results and Discussion

Finger weight (g)
Finger weight of banana has significantly influenced by foliar and bunch sprays (Table 1). Increased finger weight (113.30 g) was recorded in treatment T1 (Foliar spray of 2% SOP + 1% urea at 6,7 and 8 months after planting (MAP) followed by bunch sprays of 2% SOP + 1% urea after denavelling and one after denavelling (MAD) whereas, the lowest finger weight (85.96 g) was recorded in T8 (Control). The results of present study close conformity Nandankumar et al. (2011) [19] in cv. Nanjanagud Rasabale and Rao and Swamy (2017) [23], Devkate et al. (2018) [19]. The increased weight of finger might be due to fast growth and development of cells leads to more accumulation of sugars, carbohydrate and water in expanded cells (Kumar and Kumar, 2007) [14].

Finger length (cm)
The finger length was significantly influenced by foliar and bunch nutrition (Table 1). Among all the treatments, the maximum finger length (13.71 cm) was recorded in treatment T1 (Foliar spray of 2% SOP + 1% urea at 6.7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) whereas, the minimum finger length (10.75 cm) was reported in T8 (control). The results of present study are close conformity with Sarma et al. (2014) [25] in cv. Borjahaji and Dombale et al. (2018) [7] in Grand Naine. The increase in finger length is may due to the nitrogen supplied in the form of urea was mainly utilized for cell elongation of the fruits rather than cell multiplication (Ancy and Kurien, 2000) [2].

Finger girth (cm)
The results on finger girth and diameter were significantly differed among the treatments is presented in Table 1. The treatment T1 (Foliar spray of 2% SOP + 1% urea at 6,7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) recorded the maximum finger girth and diameter (12.35 cm) Whereas, the minimum (9.13 cm) was reported in T8 (control). Similar observations were reported in banana by Kumar and Kumar (2007) [14] cv. Ney Poovan, Nandankumar et al. (2011) [19] in cv. Nanjanagud Rasabale, Sarma et al. (2014) [25] in cv. Borjahaji and Garasangi et al. (2018) [9] in cv. Rajapuri. This is due to the presence of sulphur in SOP has a complimentary action with zinc which is essential for auxin synthesis. The auxin is responsible for inducing the synthesis of specific DNA dependent new m-RNA and specific enzymatic proteins that increases the cell plasticity resulting ultimately in cell enlargement (Ahmed et al., 1998) [1].

Weight of third hand (kg)
The result showed that the maximum weight of third hand (1.71 kg) was observed in treatment, T1 (Foliar spray of 2% SOP + 1% urea at 6,7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) as against minimum (1.10 kg) was reported in T8 (control) is presented in Table 1 and Fig. 1. The findings are on parallel with study of Kotur and Murthy (2008) [13] in Robusta, Millik et al. (2018) [16] in cv. Barjahaji and Patil et al. (2018) [22] in cv. Grand Naine. The potassium plays an important role in many biological activities of plant which reflects on nutritional status of plant and the sulphur helps in activation of enzymes during carbohydrate metabolism and energy transformation leads to greater accumulation and translocation of carbohydrates to fruits from other reproductive parts during bunch development stage (Ahmed et al., 1998) [1].

Number of hands per bunch
The results showed, the highest number of hands per bunch and number of fingers per hand (9.01) was observed in treatment T1 (Foliar spray of 2% SOP + 1% urea at 6.7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) as against lowest (7.12) was recorded in T8 (control) is presented in Table1. Potassium increases the cell division and cell expansion by their action
on DNA and RNA synthesis leads to internodal length between hands and bunch length was increases which in turns increases the number of hands per bunch (Mustaffa, 2005) \[17\].

**Bunch length and width (cm)**

The data on length and width of bunch were significantly influenced by foliar and bunch nutrition (Table. 2). The treatment T1 (Foliar spray of 2% SOP + 1% urea at 6, 7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling) reported the highest bunch length and bunch width (53.16 cm and 41.33 cm) as against minimum bunch length and width (42.87 and 34.55 cm) was reported in T8 (Control). Similar observations were reported by Shetty et al. (2015) \[16\] and Devraj et al. (2019) \[6\] in cv. Grand Naine. The increase in length and width of bunch is due to additional dose of nitrogen provided in the form of urea exploited mainly for cell elongation rather than cell multiplications as reported by Kumar and Kumar (2007) \[14\] in banana cv. Ney Poovan.

**Bunch weight (kg)**

The results depicted that the weight of bunch was significantly influenced by foliar and bunch nutrition (Table. 2 and Fig. 2). Among all the treatments, the treatment T1 (Foliar spray of 2% SOP + 1% urea at 6, 7 and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) was recorded the highest bunch weight (15.30 kg) whereas, the lowest bunch weight (7.81 kg) was reported in T8 (control). Similar results were found in banana by Kotur and Murthy (2008) \[13\] and Kumar et al. (2008) \[15\] in cv. Robusta. Increase in bunch weight is accompanying with the corresponding increase in the number of hands, total number of fingers, finger weight, length and girth (Kumar and Kumar, 2007) \[14\].

**Yield per hectare (t/ha)**

The results on yield per plot and yield hectare was significantly influenced by foliar and bunch nutrition (Table. 2). Among all the treatments, the treatment T1 (Foliar spray of 2% SOP + 1% urea at 6, 7, and 8 MAP followed by bunch sprays of 2% SOP + 1% urea after denavelling and one MAD) recorded the maximum yield per plot and yield per hectare (47.21 t/ha) as against minimum yield per plot and hectare (24.10 t/ha) was recorded in T8 (control). The similar reports were reported by Dombale et al (2018) \[7\] and Devraj et al. (2019) \[8\] in Grand Naine. This might be due to sulphur present in SOP helps in energy transformation and activation of enzymes in carbohydrate metabolism leads to more partitioning of photosynthates which increases the yield of banana (Millik et al. 2018) \[16\] in banana cv. Barjahaji.

**Benefit: Cost ratio**

The benefit: cost ratio was significantly influenced by foliar and bunch nutrition (Table 3). The highest benefit cost ratio (2.61:1) was recorded in T1(Foliar spray of 2% SOP + 1% urea at 6, 7, 8 MAP, followed by bunch spray of 2% SOP + 1% urea after denavelling and one MAD) whereas, the lowest (0.98:1) was recorded in T8 (control). The parallel results were reported by Garasangi et al. (2018) \[9\] in cv. Rajapuri, Avani et al. (2017) \[4\] and Patil et al. (2018) \[22\] in Grand Naine.

**Table 1: Effect of foliar and bunch nutrition on finger characteristics of banana cv. Rajapuri**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Finger weight (g)</th>
<th>Finger length (cm)</th>
<th>Finger girth (cm)</th>
<th>Weight of third hand (kg)</th>
<th>No. of hands/bunch</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>113.30</td>
<td>13.71</td>
<td>12.35</td>
<td>1.71</td>
<td>9.01</td>
</tr>
<tr>
<td>T2</td>
<td>97.33</td>
<td>12.30</td>
<td>11.28</td>
<td>1.35</td>
<td>8.15</td>
</tr>
<tr>
<td>T3</td>
<td>103.30</td>
<td>13.41</td>
<td>11.06</td>
<td>1.40</td>
<td>8.64</td>
</tr>
<tr>
<td>T4</td>
<td>94.63</td>
<td>11.71</td>
<td>10.89</td>
<td>1.31</td>
<td>8.54</td>
</tr>
<tr>
<td>T5</td>
<td>101.59</td>
<td>12.73</td>
<td>10.92</td>
<td>1.32</td>
<td>7.75</td>
</tr>
<tr>
<td>T6</td>
<td>93.49</td>
<td>12.42</td>
<td>11.33</td>
<td>1.35</td>
<td>7.89</td>
</tr>
<tr>
<td>T7</td>
<td>103.67</td>
<td>13.53</td>
<td>11.67</td>
<td>1.51</td>
<td>8.64</td>
</tr>
<tr>
<td>T8</td>
<td>Control (without any spray)</td>
<td>85.96</td>
<td>10.75</td>
<td>9.13</td>
<td>1.10</td>
</tr>
<tr>
<td>S. Em +</td>
<td>2.94</td>
<td>0.38</td>
<td>0.43</td>
<td>0.04</td>
<td>0.24</td>
</tr>
<tr>
<td>C. D. at 5%</td>
<td>8.94</td>
<td>1.15</td>
<td>1.32</td>
<td>0.14</td>
<td>0.73</td>
</tr>
<tr>
<td>CV (%)</td>
<td>5.15</td>
<td>5.25</td>
<td>6.80</td>
<td>5.64</td>
<td>5.09</td>
</tr>
</tbody>
</table>

SOP - Sulphate of potash, MAP- Months after planting, MAD - Month after denavelling

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Table 2: Effect of foliar and bunch nutrition on yield attributes of banana cv. Rajapuri

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Bunch characteristics</th>
<th>Benefit / ha (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bunch length (cm)</td>
<td>Bunch width (cm)</td>
</tr>
<tr>
<td>T1  Foliar spray of 2% SOP + 1% Urea @ 6,7 and 8 MAP followed by bunch spray of 2% SOP + 1% Urea after denavelling and one MAD</td>
<td>53.16</td>
<td>41.43</td>
</tr>
<tr>
<td>T2  Bunch feeding with 500 ml cow dung slurry with 1.5% SOP immediately after denavelling</td>
<td>47.43</td>
<td>37.34</td>
</tr>
<tr>
<td>T3  Foliar spray of IIHR Arka Banana Special @ 0.5% at 6, 7 and 8 MAP followed by bunch spray of IIHR Arka Banana Special @ 0.5% after denavelling and one MAD</td>
<td>52.57</td>
<td>39.87</td>
</tr>
<tr>
<td>T4  Foliar spray of Banana Sakhti @ 2% at 6, 7 and 8 MAP followed by bunch spray of Banana Sakhti @ 2% after denavelling and one MAD</td>
<td>49.25</td>
<td>38.67</td>
</tr>
<tr>
<td>T5  Foliar spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 6, 7 and 8 MAP followed by bunch spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% after denavelling and one MAD</td>
<td>50.68</td>
<td>37.47</td>
</tr>
<tr>
<td>T6  Foliar spray of Seaweed extract @ 0.3% at 6, 7 and 8 MAP followed by bunch spray of Seaweed extract @ 0.3% after denavelling and one MAD</td>
<td>48.04</td>
<td>38.48</td>
</tr>
<tr>
<td>T7  Foliar spray of Humic acid @ 1% at 6, 7 and 8 MAP followed by bunch spray of Humic acid @ 1% after denavelling and one MAD</td>
<td>51.47</td>
<td>40.83</td>
</tr>
<tr>
<td>T8  Control (without any spray)</td>
<td>42.87</td>
<td>34.55</td>
</tr>
</tbody>
</table>

S. Em ± C. D. at 5% CV (%)

SOP - Sulphate of potash, MAP - Months after planting, MAD - Month after denavelling

Table 3: Effect of foliar and bunch nutrition on Benefit Cost ratio of banana cv. Rajapuri

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total cost (Rs/ha)</th>
<th>Fruit yield (t/ha)</th>
<th>Gross income (Rs/ha)</th>
<th>Net income (Rs/ha)</th>
<th>Benefit: Cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1  Foliar spray of 2% SOP + 1% Urea @ 6,7 and 8 MAP followed by bunch spray of 2% SOP + 1% Urea after denavelling and one MAD</td>
<td>3,92,199</td>
<td>47.21</td>
<td>14,16,300</td>
<td>10,24,101</td>
<td>2.61</td>
</tr>
<tr>
<td>T2  Bunch feeding with 500 ml cow dung slurry with 1.5% SOP immediately after denavelling</td>
<td>3,72,063</td>
<td>33.98</td>
<td>10,19,400</td>
<td>6,47,336</td>
<td>1.74</td>
</tr>
<tr>
<td>T3  Foliar spray of IIHR Arka Banana Special @ 0.5% at 6, 7 and 8 MAP followed by bunch spray of IIHR Arka Banana Special @ 0.5% after denavelling and one MAD</td>
<td>3,74,378</td>
<td>37.19</td>
<td>11,15,400</td>
<td>7,41,022</td>
<td>1.97</td>
</tr>
<tr>
<td>T4  Foliar spray of Banana Sakhti @ 2% at 6, 7 and 8 MAP followed by bunch spray of Banana Sakhti @ 2% after denavelling and one MAD</td>
<td>3,99,452</td>
<td>34.47</td>
<td>10,34,100</td>
<td>6,34,648</td>
<td>1.58</td>
</tr>
<tr>
<td>T5  Foliar spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% at 6, 7 and 8 MAP followed by bunch spray of ZnSO₄ @ 0.5% + FeSO₄ @ 0.5% after denavelling and one MAD</td>
<td>4,45,742</td>
<td>31.29</td>
<td>9,38,700</td>
<td>4,92,958</td>
<td>1.10</td>
</tr>
<tr>
<td>T6  Foliar spray of Seaweed extract @ 0.3% at 6, 7 and 8 MAP followed by bunch spray of Seaweed extract @ 0.3% after denavelling and one MAD</td>
<td>3,84,006</td>
<td>31.63</td>
<td>9,48,900</td>
<td>5,64,894</td>
<td>1.47</td>
</tr>
<tr>
<td>T7  Foliar spray of Humic acid @ 1% at 6, 7 and 8 MAP followed by bunch spray of Humic acid @ 1% after denavelling and one MAD</td>
<td>4,05,624</td>
<td>40.11</td>
<td>12,03,300</td>
<td>7,97,676</td>
<td>1.96</td>
</tr>
<tr>
<td>T8  Control (without any spray)</td>
<td>3,64,842</td>
<td>24.10</td>
<td>7,23,000</td>
<td>3,58,158</td>
<td>0.98</td>
</tr>
</tbody>
</table>

SOP - Sulphate of potash, MAP - Months after planting, MAD - Month after denavelling
Fig 1: Effect of foliar and bunch nutrition on hand weight of banana cv. Rajapuri (AAB) T1: Foliar spray of 2% SOP + 1% urea T2: Bunch feed with 500 ml cow dung slurry + 1.5% SOP immediately after denavelling T3: Foliar spray of 0.5% Banana special T4: Foliar spray of 0.3% Sea weed extract T5: Foliar spray of 2% Banana shakti T6: Foliar spray of 1% Humic acid T7: Foliar spray of 0.5% ZnSO\(_4\)+0.5% FeSO\(_4\) T8: Control

*All the treatments were imposed at 6, 7, 8 MAP, followed by, bunch sprays after denavelling and one MAD except T2 and T8.
Fig 2: Effect of foliar and bunch nutrition on bunch characteristics of banana cv. Rajapuri (AAB) T1: Foliar spray of 2% SOP +1% urea T2: Bunch feed with 500 ml cow dung slurry + 1.5% SOP immediately after denavelling T3: Foliar spray of 0.5% Banana special T4: Foliar spray of 0.3% Sea weed extract T5: Foliar spray of 0.5% ZnSO4+0.5% FeSO4 T6: Foliar spray of 2% Banana shakti T7: Foliar spray of 1% Humic acid T8: Control *All the treatments were imposed at 6,7,8 MAP, followed by bunch sprays after denavelling and one MAD except T2 and T8.

Conclusion
The results indicated that foliar spray of 2% sulphate of potash +1% Urea at 6, 7 and 8 months after planting followed by bunch spray of 2% sulphate of potash + 1% Urea after denaelling and one month after denaelling significantly enhances the yield and economics of banana cv. Rajapuri which attracts the consumers and ensures highest profit.

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References


