EFFECT OF POST-SHOOTING SPRAY OF CERTAIN NUTRIENTS ON YIELD AND QUALITY OF BANANA CV. NEYPOOVAN (AB)

A. Ramesh Kumar and N. Kumar
Department of Fruit Crops, Horticulture College & Research Institute,
Tamil Nadu Agricultural University, Coimbatore- 641 003. India

ABSTRACT

In the post shooting spray experiments, foliar spray of potassium di hydrogen phosphate (0.5%) + urea (1%) + 2, 4-D (20ppm) and SOP at 1.5 per cent resulted in obtaining higher yield with good quality fruits and relatively higher cost :benefit ratio. Thus, the overall study clearly indicates the benefit of giving post shoot application. Hence, it can be concluded that either SOP at 1.5 % or combination of 0.5 % potassium di hydrogen phosphate + 1% urea + 20 ppm 2,4-D as foliar spray twice, first at the time of last hand emergence and repeated after 30 days so as to produce quality bunches, which is cost wise very economical.

Key words: Banana, Nutrient spray, SOP, Urea, 2,4-D, Potassium di hydrogen phosphate, Yield, Quality

Banana requires high amount of nutrients for proper growth and production. Its nutritional requirement is estimated to be around 320 kg N, 32 kg P₂O₅ and 925 kg K₂O per ha per year (Lahav and Turner, 1983). Under traditional farming system, banana crop receives its last dose of fertilizers (nitrogen and potassium) at 7th month after planting i.e. just before shooting, which has to support the requirement of nutrients until harvest since large quantity of photosynthates are to move from the source to the sink i.e. developing bunches at this phase. Any limitation in the supply of nutrients at this crucial stage affects the bunch size and quality. Because of this problem, poor filling and development of fingers is often reported. Hence an additional dose of fertilizer after shooting has become imperative. However, it is not advisable to go for soil application of fertilizers at finger development stage, since the uptake is slow and low at this stage (Veerannah et al ., 1976). Many reports have indicated the usefulness of post shooting spray of various nutrients during fruit development in influencing the fruit yield, shelf life and quality (Kannan, 1980). Banana has been found to respond well to potassium spray through muriate of potash (MOP) or potassium di-hydrogen phosphate (KH₂PO₄) (Mahalakshmi, and Sathiyamoorthy, 1999). However, the effect of sulphate of potash (SOP) and the combined effect of above nutrients as a post shooting applicant in banana has not been assessed earlier. With all these background, an investigation was carried out to study the influence of these nutrients on yield and quality of banana.

The experiment was conducted with cultivar Neypoovan (AB) in randomized block design (RBD) with four treatments and five replications. The treatment details are given below.

T₁ = Spraying of 0.5% KH₂PO₄ + 1% Urea + 20 ppm 2, 4-D;  
T₂ = Spraying of 1.5% SOP;  
T₃ = Spraying of 0.5% SOP;  
T₄ = Control (Water spray)

The spraying was done twice, first immediately after opening of the last hand and second, 30 days after the first spray. The total number of leaves retained at harvest was counted and expressed in number. The total chlorophyll content was estimated adopting the procedure of (Yoshida et al., 1971) and expressed as mg g⁻¹ of fresh weight. Number of days taken from shooting to harvest (maturity days) was recorded. Weight of the bunch was recorded including the peduncle upto first bract leaf node above the first hand and expressed in kilogram (kg). Total number of hands and fingers in a bunch were counted and expressed in number. The middle fingers in the top and bottom rows of the second hand were selected as representative fingers (Gottreich et al., 1964) to record average weight of the finger and expressed in gram (g). Fully ripe fruit was weighed and peeled. The peel was
weighed and pulp weight was arrived by the difference between the two. The pulp-peel ratio was computed.

Representative fingers were allowed for natural and uniform ripening. Those fruits were utilized for determining different quality parameters. The TSS was determined by using Carl-Zeiss Hand Refractometer and the results were expressed in percentage. The total, reducing and non-reducing sugars were estimated as per the method suggested by (Somogyi, 1952) and expressed in percentage. Titrable acidity was estimated by adopting A.O.A.C., (1968) method and expressed in terms of malic acid equivalents in percentage. The sugar/acid ratio was computed by dividing the total sugars by the acidity.

Physiological loss in weight of fruits was calculated as per the formula given below and expressed in percentage.

\[ \text{Physiological Loss in weight (PLW) } = \frac{\text{Initial weight} - \text{weight at the end of shelf life}}{\text{Initial weight}} \times 100 \]

Number of days taken by the fruits to turn yellow after harvest was noted as green life. The sum of green and yellow life, upto edible fruit stage formed the total shelf life of fruits. The cost of cultivation was worked out taking into account the various inputs for cultivation during the entire experimental period. The following economic analyses were carried out.

Net return (Rs ha\(^{-1}\)) = Gross return - Cost of cultivation
Benefit cost ratio = \( \frac{\text{Gross return (Rs ha}\^{-1}\text{)}}{\text{Cost of cultivation (Rs ha}\^{-1}\text{)}} \)

The effect of post shooting spray of certain nutrients on improving the bunch weight and its quality of Neypoovan banana was assessed. Significant differences were observed among the treatments for number of leaves retained at harvest. In general, post shooting nutrient spray enhanced the leaf longevity than control, however T\(_1\) i.e. combined spray of KH\(_2\)PO\(_4\), urea and 2, 4-D produced the highest number of leaves (Table 1). In a determinate crop like banana, retention of more number of green leaves at post flowering phase contributes a sizeable portion of currently synthesized assimilates to the developing sink through current photosynthesis, especially when assimilate flow from other plant parts becomes limiting. Similarly, the leaf also contributes its own stored assimilates to the sink while senescing. Baruah and Mohan (1991) also indicated that the reduced longevity of banana leaves was due to high mobility of K from old leaves to other parts and as a result the leaf duration was severely hampered by low K content. In banana, retention of higher chlorophyll pigment during post shooting stage helps the bunches to accumulate more of photosynthates, thus reflecting in bunch size and yield. In other words, the higher chlorophyll content in leaves and developing fruits reflects the efficiency of photosynthesis. Post-shootng spray of nutrients significantly improved the chlorophyll contents of leaves at the time of harvest. Combination of nutrients with 2,4-D (T\(_1\)) recorded the highest values for total chlorophyll followed by T\(_2\) (i.e. SOP spray) whereas the least chlorophyll contents were recorded in control (water spray alone– T\(_4\)). This suggested that the nutrient sprayed plants were more efficient in maintaining a better photosynthetic status, which ultimately reflected on various bunch characters.

Post shooting spray of nutrients advanced the fruit maturity in Neypoovan. Combined spray of KH\(_2\)PO\(_4\), urea and 2, 4-D (T\(_1\)) recorded the least number of days for fruit maturity which is on par with post shooting spray of SOP alone. Control took the maximum number of days for fruit maturity

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of leaves</th>
<th>Total chlorophyll (mg/100g)</th>
<th>Maturity days</th>
<th>Bunch weight (kg)</th>
<th>Number of hands</th>
<th>Total number of fingers</th>
<th>Finger weight (g)</th>
<th>Pulp:peel ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T(_1)</td>
<td>9.2</td>
<td>1.520</td>
<td>103.3</td>
<td>14.33</td>
<td>13.00</td>
<td>219.1</td>
<td>76.7</td>
<td>7.62</td>
</tr>
<tr>
<td>T(_2)</td>
<td>8.6</td>
<td>1.466</td>
<td>103.3</td>
<td>14.00</td>
<td>13.00</td>
<td>215.0</td>
<td>74.50</td>
<td>7.37</td>
</tr>
<tr>
<td>T(_3)</td>
<td>8.5</td>
<td>1.455</td>
<td>105.2</td>
<td>13.65</td>
<td>12.46</td>
<td>207.85</td>
<td>70.25</td>
<td>7.28</td>
</tr>
<tr>
<td>T(_4)</td>
<td>8.3</td>
<td>1.417</td>
<td>116.3</td>
<td>10.50</td>
<td>10.74</td>
<td>175.0</td>
<td>57.82</td>
<td>7.16</td>
</tr>
<tr>
<td>SEd</td>
<td>0.075</td>
<td>0.012</td>
<td>4.73</td>
<td>0.79</td>
<td>0.58</td>
<td>5.30</td>
<td>3.50</td>
<td>0.186</td>
</tr>
<tr>
<td>CD</td>
<td>0.159</td>
<td>0.025</td>
<td>10.03</td>
<td>1.68</td>
<td>1.23</td>
<td>11.23</td>
<td>7.42</td>
<td>0.394</td>
</tr>
</tbody>
</table>

(p=0.05)
In post shooting nutrient spray investigation, the reduction in bunch development phase was noticed due to faster growth rate of fingers that was evident from higher leaf chlorophyll contents owing to additional nutrient supply and faster rate of translocation of assimilates from source to sink, aided by additional nutrient supply particularly potassium. Potassium is a general metabolic activator, increasing the respiration and photosynthetic rate. Thus, additional K application as foliar spray induced faster development of bunches (Evans, 1971). Increased bunch weight is the culmination of all desirable traits that perform well under optimum conditions including balanced nutrition. Significant differences in bunch weight were obtained. Nutrient spray treatments (T₁ or T₂) produced the heavier bunches than no spray (T₄), however, these remained on par with one another (Table 1). Nutrient spray treatments produced more number of hands than no spray (T₄) and they were also on par with one another. Significant differences were obtained for total number of fingers due to nutrient spray. In Neyppovan though T₁ and T₂ were superior to T₄, they remained on par with one another. Perceptible differences were observed among the nutrient spray treatments. T₁ followed by T₂ registered higher finger weight than control. Perceptible differences were realized for pulp: peel ratio among the different concentrations of SOP. In Neyppovan, T₁ registered the highest ratio. In post shooting nutrient spray experiment, the increase in bunch weight is due to increase in finger characters, such as, number of fingers, finger weight and pulp: peel ratio, which have close bearing on general appeal of the hands tending to increase its marketable value.

In high value crop species like banana, quality standards have become the most important factor influencing monetary yield and farmer’s income. Any crop management practice should aim to produce quality fruits, besides maximizing the productivity. In banana, fruit quality is mainly judged by the sugar content and acidity in the pulp. Post shooting spraying of nutrients was effective in affecting total sugar content of fruits. Relatively higher total sugar was recorded by T₁ closely followed by T₂ while the least total sugar was registered with control (no spray) (Table 2). The effect of different nutrient spray on reducing sugar content of the fruits was similar as that of total sugars. The non-reducing sugar content of fruits showed significant differences due to nutrient spray. In Neyppovan, T₁ closely followed by T₂ did record higher contents than control which were also on par with one another. The TSS of fruits showed significant variation due to nutrient spray. The treatments T₁ and T₂ relatively registered higher TSS than no spray and were on par with one another. The nutrient sprays appeared to be the best for enhancing the various quality parameters such as TSS, reducing, non-reducing and total sugars and acidity. Venkatarayappa et al. (1979) obtained better quality parameters with foliar spray of potassium. The acidity of fruits was significantly affected by nutrient spray. The lowest acidity was recorded with T₁ followed by T₂. Post shooting spray of nutrients exerted significant influence on sugar: acid ratio and the trend observed was similar to that of acidity (Table 2). Higher fruit quality especially higher sugar content can be explained by the role of potassium which is involved in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966). Potassium is responsible for energy production in the form of ATP and NADPH in chloroplasts by maintaining balanced electric charges. Besides, K is involved in

<table>
<thead>
<tr>
<th>Treatment</th>
<th>TSS (%)</th>
<th>Reducing sugars (%)</th>
<th>Non-reducing sugars (%)</th>
<th>Total sugars (%)</th>
<th>Acidity (%)</th>
<th>Sugar:acid ratio (%)</th>
<th>PLW (%)</th>
<th>Green life (days)</th>
<th>Shelf-life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>27.90</td>
<td>19.96</td>
<td>3.04</td>
<td>23.00</td>
<td>0.26</td>
<td>88.46</td>
<td>10.03</td>
<td>5.3</td>
<td>9.0</td>
</tr>
<tr>
<td>T₂</td>
<td>27.20</td>
<td>19.80</td>
<td>3.00</td>
<td>22.80</td>
<td>0.29</td>
<td>78.62</td>
<td>11.00</td>
<td>5.3</td>
<td>7.8</td>
</tr>
<tr>
<td>T₃</td>
<td>26.7</td>
<td>19.49</td>
<td>2.96</td>
<td>22.45</td>
<td>0.31</td>
<td>72.42</td>
<td>11.32</td>
<td>5.1</td>
<td>7.5</td>
</tr>
<tr>
<td>T₄</td>
<td>24.20</td>
<td>18.60</td>
<td>1.95</td>
<td>20.85</td>
<td>0.38</td>
<td>54.87</td>
<td>13.51</td>
<td>4.3</td>
<td>6.2</td>
</tr>
<tr>
<td>SEd</td>
<td>1.42</td>
<td>0.47</td>
<td>0.105</td>
<td>0.63</td>
<td>0.009</td>
<td>4.17</td>
<td>0.50</td>
<td>0.34</td>
<td>0.94</td>
</tr>
<tr>
<td>CD</td>
<td>3.01</td>
<td>1.00</td>
<td>0.222</td>
<td>1.33</td>
<td>0.02</td>
<td>8.85</td>
<td>1.05</td>
<td>0.72</td>
<td>2.00</td>
</tr>
</tbody>
</table>

*(p=0.05)*
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 (Mengel and Kirkby, 1987). Post shooting application of K also favours the conversion of starch into simple sugars during ripening by activating sucrose synthase enzyme, resulting in higher sugar content in fruits. Oxalo acetate appeared to be preferentially formed from PEP in plants with low levels of K and this organic acid derivative accumulated. Neutralization of organic acids due to high K level in tissues could have also resulted in reduction in acidity (Tisdale and Nelson, 1966).

Weight loss from harvested fruits i.e. Physiological Loss in Weight (PLW), especially under tropical conditions causes severe loss to the producer and seller which also leads to quality deterioration with low consumer preference. Nutrient sprays via T1 and T2 registered the least PLW, however, they remained on par with each other. In the present study, there was extension of ripening duration, because of addition of nutrients (Table 2). In general the green life i.e. the preclimacteric life and yellow life were significantly influenced by maturity. It is obvious that once the climacteric phase commences the rate of respiration is at its maximum reducing the shelf life. It is interesting to note that fruits from post shooting spray extended the shelf-life in the present investigation. Neypoovan fruits kept their green life long in T1 which was significantly different from other treatments. The days from yellow life to edible ripening in fruits under ambient conditions took lesser days in treatments which received nutrients through spray. This might be due to the lesser PLW experienced in fruits of post shooting sprays (Table 2). Post shooting nutrient spray was found to alter the gross income, net income and benefit: cost ratio. The highest benefit cost ratio was recorded by T2 (SOP 1.5 per cent spray) whereas the least by T3 (control). Despite the better performance by T1 i.e. KH2PO4 + urea + 2, 4 – D, for all the parameters studied, the benefit: cost ratio was low in order, which was due to the higher cost of KH2PO4 which denoted the usefulness of post shooting nutrient spray in terms of economics (Table 3).

REFERENCES