Influence of Foliar Application of Micronutrients on Tomato (Lycopersicon Esculentum Mill.) CV. “Gujarat tomato 2”

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ABSTRACT

The present investigation was undertaken with the main objective to study the influence of foliar application of micronutrients on Tomato (Lycopersicon esculentum Mill.) cv. “Gujarat Tomato 2” at ASPEE, ARDF, Tansa during Rabi 2013-2014. The experiment consists of eight treatments involving T1 (RD NPK through chemical fertilizers N: P2O5 : K2O S kg ha-1 (75 : 37.5 : 62.5)), T2 (T1+100 ppm B; i.e. Boric acid 0.571 g 1-1), T3 (T1+100 ppm Zn; i.e. Zinc sulphate 0.246 g 1-1), T4 (T1 + 100 ppm Cu; i.e. Copper sulphate 0.420 g 1-1), T5 (T1+100 ppm Fe; i.e. Ferrous sulphate 0.515 g 1-1), T6 (T1 +100 ppm Mn; i.e. Manganese sulphate 0.320 g 1-1) and T7 (T1 + mixture of all micronutrients) and T8 (T1 + Multiplex 4 ml 1-1) by mixing with simple water were imposed. The foliar application was made by using equipment knapsack sprayer (ASPEE) in the evening hours. The three times foliar spray were made at 10 days intervals starting from 40 days after transplanting seedling. The data clearly showed that the yield obtained with treatment T7 had significantly plant height (132.77 cm), number of branches plant-1 (5.96), fresh weight of plants (25.70 t ha-1), dry matter yield of plants (7669.04 kg ha-1), maximum days to last picking (166.01), number of fruits plant-1 (34.43), fruit length (5.47 cm), fruit diameter (4.57 cm), fruit volume (65.94 cm3), single fruit weight (49.00 g), fruit weight plant-1 (1.69 kg), number of locules fruit-1 (3.01), pericarp thickness (6.27 mm), fruit yield plot-1 (70.86 kg), fruit yield ha-1 (46.87 t) and marketable fruit yield ha-1 (45.68 t). This treatment had maximum net return (1, 66,752 Rs/ ha) and B: C Ratio 2.71: 1 out all other treatments than control.

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INTRODUCTION

Tomato (Lycopersicon esculentum Miller, 2n = 2x = 24), popularly known as Wolf apple, Love of Apple or Vilayati haingan is one of the most important vegetable crop, belongs to family solanaceae, originated in Tropical America and was introduced in India by the Portuguese. It is a leading vegetable crop grown across the length and breadth of country due to its wide adaptability of various agro-climatic conditions. It is equally liked by both poor and rich and is quite high in nutritive value.

It is on the top of the list of processing vegetable and is a good source of vitamin A and C. Hence, it is called as “Poor Man’s Orange.” It also plays an important role in processing industries and hence in Indian economics. It is generally consumed as salad and mixed in vegetable curries to add taste, colour and flavour. It possesses many health benefits which include urinary tract infection, skin problems, diabetes, hypertension and various cancers. Micronutrients are not only essential for better growth, yield and quality, but also important like other major nutrients in spite of their requirement in micro quantity. It also helps in uptake of major nutrients and also vital to the growth of plants acting as catalyst in promoting various organic reaction from cell development to respiration, photosynthesis, chlorophyll
Table 1. Influence of foliar application of micronutrients on Tomato cv. GT-2

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Days to 50 % flowering</th>
<th>Plant height (cm)</th>
<th>Number of branches plant&lt;sup&gt;−1&lt;/sup&gt;</th>
<th>Fresh weight of plant (t. ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>Dry matter content of plant (kg ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>Days to first picking</th>
<th>Days to last picking</th>
<th>Number of fruits plant&lt;sup&gt;−1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>32.00</td>
<td>81.70</td>
<td>3.42</td>
<td>19.16</td>
<td>5983.40</td>
<td>90.68</td>
<td>143.38</td>
<td>8</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>34.82</td>
<td>97.62</td>
<td>4.72</td>
<td>23.04</td>
<td>6853.84</td>
<td>81.43</td>
<td>156.84</td>
<td>18.68</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>34.11</td>
<td>112.66</td>
<td>4.26</td>
<td>23.32</td>
<td>7313.30</td>
<td>80.70</td>
<td>162.57</td>
<td>31.16</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>34.10</td>
<td>84.25</td>
<td>3.56</td>
<td>20.80</td>
<td>6596.03</td>
<td>86.60</td>
<td>146.54</td>
<td>25.63</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>33.88</td>
<td>84.65</td>
<td>3.54</td>
<td>21.51</td>
<td>6793.84</td>
<td>83.55</td>
<td>151.86</td>
<td>26.18</td>
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<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>31.88</td>
<td>89.83</td>
<td>3.94</td>
<td>22.56</td>
<td>6817.08</td>
<td>82.82</td>
<td>154.44</td>
<td>29.31</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>35.57</td>
<td>132.77</td>
<td>5.96</td>
<td>25.70</td>
<td>7669.04</td>
<td>75.20</td>
<td>166.01</td>
<td>34.43</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>35.44</td>
<td>129.06</td>
<td>5.92</td>
<td>25.18</td>
<td>7604.91</td>
<td>72.89</td>
<td>165.39</td>
<td>33.84</td>
</tr>
<tr>
<td>SEm ±</td>
<td>0.54</td>
<td>2.99</td>
<td>0.27</td>
<td>1.30</td>
<td>256.14</td>
<td>1.83</td>
<td>3.77</td>
<td>1.47</td>
</tr>
<tr>
<td>C. D. @ 0.05</td>
<td>1.58**</td>
<td>8.67**</td>
<td>0.77**</td>
<td>3.76**</td>
<td>742.01**</td>
<td>5.30**</td>
<td>10.92**</td>
<td>4.25**</td>
</tr>
<tr>
<td>C. V. (%)</td>
<td>3.58</td>
<td>6.59</td>
<td>13.54</td>
<td>12.82</td>
<td>8.23</td>
<td>5.00</td>
<td>5.41</td>
<td>11.20</td>
</tr>
</tbody>
</table>

Table 2. Effect Influence of foliar application of micronutrients on Tomato cv. GT-2

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit length (cm)</th>
<th>Fruit diameter (cm)</th>
<th>Fruit volume (cm&lt;sup&gt;3&lt;/sup&gt;)</th>
<th>Fruit weight (g)</th>
<th>Fruit yield (kg plant&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>No. of locules fruit&lt;sup&gt;−1&lt;/sup&gt;</th>
<th>Pericarp thickness (mm)</th>
<th>Fruit yield (ton ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>Total fruit yield (ton ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>Marketable fruit yield (tonne ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>TSS (Brix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>4.07</td>
<td>3.45</td>
<td>84.97</td>
<td>33.00</td>
<td>0.74</td>
<td>5.00</td>
<td>16</td>
<td>147</td>
<td>4.69</td>
<td>5.96</td>
<td>19</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>5.01</td>
<td>4.08</td>
<td>61.71</td>
<td>41.20</td>
<td>1.28</td>
<td>5.73</td>
<td>16</td>
<td>147</td>
<td>5.27</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>5.22</td>
<td>4.22</td>
<td>62.72</td>
<td>44.60</td>
<td>1.39</td>
<td>5.76</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>4.35</td>
<td>3.79</td>
<td>55.28</td>
<td>36.00</td>
<td>0.92</td>
<td>5.01</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
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<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>4.50</td>
<td>3.82</td>
<td>56.28</td>
<td>38.60</td>
<td>1.01</td>
<td>5.19</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
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<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>4.80</td>
<td>4.02</td>
<td>58.21</td>
<td>33.40</td>
<td>0.98</td>
<td>5.49</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>5.47</td>
<td>4.57</td>
<td>65.94</td>
<td>49.00</td>
<td>1.69</td>
<td>6.27</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>5.23</td>
<td>4.40</td>
<td>64.00</td>
<td>43.40</td>
<td>1.47</td>
<td>6.09</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>SEm ±</td>
<td>0.25</td>
<td>0.16</td>
<td>3.08</td>
<td>1.23</td>
<td>0.08</td>
<td>0.18</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>C. D. @ 0.05</td>
<td>0.74**</td>
<td>8.91**</td>
<td>3.56**</td>
<td>0.23</td>
<td>0.33**</td>
<td>0.51**</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
<tr>
<td>C. V. (%)</td>
<td>11.79</td>
<td>8.69</td>
<td>11.61</td>
<td>6.88</td>
<td>14.73</td>
<td>7.04</td>
<td>16</td>
<td>147</td>
<td>5.01</td>
<td>5.01</td>
<td>19</td>
</tr>
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</table>

Table 3. Economics of different treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Marketable fruit yield (kg ha&lt;sup&gt;−1&lt;/sup&gt;)</th>
<th>Treatment cost (Chemical + spraying + harvesting charge) (Rs.)</th>
<th>Operation cost (Rs.)</th>
<th>Total cost of cultivation, (Rs.) (=Col. 21 + Col. 22)</th>
<th>Gross returns (Rs.) (=Col. 20 x 5)</th>
<th>Net returns, (Rs.) (=Col. 24 - Col. 23)</th>
<th>C: B ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>18,790.17</td>
<td>9,820</td>
<td>39427</td>
<td>49,247</td>
<td>93,951</td>
<td>44,704</td>
<td>1.0:91</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>32,926.89</td>
<td>15,985</td>
<td>39427</td>
<td>55,412</td>
<td>164,634</td>
<td>109,222</td>
<td>1.1:97</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>37,082.06</td>
<td>17,900</td>
<td>39427</td>
<td>57,327</td>
<td>185,410</td>
<td>128,083</td>
<td>1.2:23</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>23,173.31</td>
<td>12,500</td>
<td>39427</td>
<td>51,927</td>
<td>115,867</td>
<td>63,940</td>
<td>1.1:23</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>26,156.22</td>
<td>13,300</td>
<td>39427</td>
<td>52,727</td>
<td>130,781</td>
<td>78,054</td>
<td>1.1:48</td>
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<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>24,658.78</td>
<td>13,100</td>
<td>39427</td>
<td>52,527</td>
<td>123,284</td>
<td>70,757</td>
<td>1.1:35</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;</td>
<td>45,675.89</td>
<td>22,200</td>
<td>39427</td>
<td>61,627</td>
<td>228,379</td>
<td>166,752</td>
<td>1.2:71</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;</td>
<td>39,572.83</td>
<td>19,100</td>
<td>39427</td>
<td>58,527</td>
<td>197,864</td>
<td>139,337</td>
<td>1.2:38</td>
</tr>
</tbody>
</table>
formation, enzyme activity, hormones synthesis and nitrogen fixation. The production and productivity of crop is being adversely affected in areas due to deficiencies of micronutrients. The micronutrient deficiencies have appeared in recent years due to intensive cropping, loss of top soil by erosion, loss due to leaching, limiting soils and decreased availability and use of organic matter. One way of overcoming micronutrient deficiency in crop instantly is foliar application of micronutrients. Looking to the importance of the crop, future scope and heavy demand of tomato fruits for the domestic as well as export business and for processing industry, a field trial entitled “influence of foliar application of micronutrients on Tomato (Lycopersicon esculentum Mill.) cv. Gujarat Tomato 2” was conducted at ASPEE, Agricultural Research Development Foundation (ARDF), Farm during the year Rabi 2013-14.

**MATERIALS AND METHODS**

The investigation was carried out at ASPEE, Agricultural Research Development Foundation (ARDF), Farm during the year Rabi 2013-14. In all eight treatments viz., T₁ (RD NPK through chemical fertilizers 75 : 37.5 : 62.5); T₂ (T₁ + 100 ppm B); T₃ (T₁ +100 ppm Zn); T₄ (T₁ + 100 ppm Cu); T₅ (T₁+100 ppm Fe); T₆ (T₁ +100 ppm Mn); T₇ (T₁ + Mixture of all micronutrients) and T₈ (T₁ + Multiplex 4 ml l⁻¹) were evaluated in a Randomized Block Design with five replications. The tomato cv. GT-2 seedlings nursery was raised at 15 cm x 7 cm distance in a plot size 3 x 1 m and

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**Table 4. Cost of inputs**

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Inputs</th>
<th>Cost (`)</th>
<th>Sr. No</th>
<th>Inputs</th>
<th>Cost (`)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sale price of 1 kg. fruit of tomato</td>
<td>5</td>
<td>10</td>
<td>Cost of 1kg seed of “Gujarat Tomato-2”</td>
<td>1800</td>
</tr>
<tr>
<td>2</td>
<td>Cost of 1 tonne of FYM</td>
<td>750</td>
<td>11</td>
<td>Boric acid (1kg)</td>
<td>696</td>
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<tr>
<td>3</td>
<td>Cost of 1 kg N as Urea</td>
<td>12.08</td>
<td>12</td>
<td>Zinc sulphate (1kg)</td>
<td>960</td>
</tr>
<tr>
<td>4</td>
<td>Cost of 1 kg P₂O₅ as SSP</td>
<td>18.75</td>
<td>13</td>
<td>Copper sulphate (1kg)</td>
<td>1062</td>
</tr>
<tr>
<td>5</td>
<td>Cost of 1 kg K₂O as MOP</td>
<td>10.51</td>
<td>14</td>
<td>Ferrous sulphate (1kg)</td>
<td>320</td>
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<tr>
<td>6</td>
<td>Labour cost head⁻¹</td>
<td>120</td>
<td>15</td>
<td>Manganese sulphate (1kg)</td>
<td>896</td>
</tr>
<tr>
<td>7</td>
<td>Ploughing hr⁻¹</td>
<td>200</td>
<td>16</td>
<td>Multiplex (Commercial formulation 1litre)</td>
<td>300</td>
</tr>
<tr>
<td>8</td>
<td>Harrowing hr⁻¹</td>
<td>150</td>
<td>17</td>
<td>Manganese sulphate (1kg)</td>
<td>896</td>
</tr>
<tr>
<td>9</td>
<td>Planking hr⁻¹</td>
<td>100</td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Plate 1. View of tomato fruits of different treatments**
transplanted in plot size 4.2 m X 3.6 m. All agronomical
practices in virgue were employed from time to time. The
statistical analysis was done by using method of Panse and
Sukhatne, (1967).

RESULTS AND DISCUSSION

The data clearly indicated that the growth and yield of crop
obtained with treatment T_7 (T_1 + mixture of all micronutrients
thrice times foliar spray at 10 days interval starting from 40
days after transplanting seedling) had showed significantly
higher plant height (132.77 cm), number of branches plant$^{-1}$
(5.96), fresh weight of plants ha$^{-1}$ (25.70 t), dry matter yield
of plant ha$^{-1}$ (7669.04 kg), maximum harvesting period of
days to last picking (166.01), number of fruits plant$^{-1}$ (34.43),
fruit length (5.47 cm), fruit diameter (4.57 cm), fruit volume
(65.94 cm$^3$), single fruit weight (49 g), fruit weight plant$^{-1}$
(1.69 kg), number of locules fruit$^{-1}$ (3.01), pericarp thickness
(6.27 mm), fruit yield plot$^{-1}$ (70.86 kg), fruit yield ha$^{-1}$
(46.87 t) and marketable fruit yield ha$^{-1}$ (45.68 t), respectively in
tables 1 and 2. It had highest high maximum realization of
Rs 1, 66,752.00 / ha and B:C Ratio of 2.71:1. (2008), who obtained maximum benefit: cost ratio
with foliar application of mixture of all micronutrients.

The T_8 (T_1 + (Zn 3 %, Mn 1%, B 0.5% and Fe 2%)
multiplex 4 ml/lit of simple water) foliar thrice times foliar
spray at 10 days intervals starting from 40 days after
transplanting seedling had positive effects next to T_7,
consisting of the combination of inorganic fertilizer plus
mixture of all micronutrients produced for particularly higher
plant height (129.06 cm), number of branches plant$^{-1}$ (5.92),
fresh weight of plant ha$^{-1}$ (25.18 t), dry matter yield of plant
ha$^{-1}$ (7604.91 kg), maximum harvesting period of days to last
picking (165.39), number of fruits plant$^{-1}$ (33.84), fruit size
(5.423 cm) (plate 1), fruit diameter (4.40 cm), fruit volume
(64.00 cm$^3$), single fruit weight (43.40 g), fruit weight plant$^{-1}$
(1.47 kg), number of locules fruit$^{-1}$ (2.65), pericarp thickness
(6.09 mm), fruit yield plot$^{-1}$ (61.77 kg), fruit yield ha$^{-1}$
(40.85 t) and marketable fruit yield ha$^{-1}$ (40.85 t) than the remaining
treatments. This might due to the enhancement in photosynthesis and other metabolic activity which led to an
increase in various plant metabolites responsible for cell
division and elongation results improvement in growth
characters (Hatwar et al., 2003). Increased yield due to
micronutrients application may be attributed to enhanced
photosynthetic activity, resulting into the increased production
and accumulation of carbohydrate and favourable effect on
vegetative growth and retention of flower and fruits which
might have increased number of fruits per plant besides
improvement in the fruit size. The increase in dry matter
production of fruits may be attributed to greater accumulation
of photosynthates by vegetative parts and its subsequent
translocation to the sink. Also role of boron which enhance
the movement of sugar borate complex from the leaves to the fruit
and ultimately increased the fruit yield according to result
given by Pandita et al. (1976); Singh et al. (2003).

Conclusion

From the forgoing discussion, it can be concluded that foliar
spray of T_1 (T_1 + mixture of all micronutrients) effective
which much more effective than control. Also observed much
enhance maximum plant height, number of branches plant$^{-1}$,
fresh weight of plant ha$^{-1}$, dry matter yield of plant$^{-1}$, minimum
days to first picking and maximum days to last picking,
number of fruits plant$^{-1}$, fruit length (cm), fruit diameter (cm),
single fruit weight (g), fruit weight plant$^{-1}$, number of locules
fruit$^{-1}$, pericarp thickness (mm), fruit yield plot$^{-1}$, fruit yield ha$^{-1}$
and marketable fruit yield ha$^{-1}$, net returns ha$^{-1}$ and B:C ratio
out all other treatments than control. The growth and yield
attributes of tomato cv. GT-2 showed positive results for
spraying of T_7 (T_1 + mixture of all micronutrient thrice times
folic spray at 10 days interval starting from 40 days after
transplanting seedling) treatment then followed by T_8 (T_1 +
multiplex 4 ml/lit of simple water) treatment.

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