Effect of micronutrients on growth, flower yield and flower quality of petunia (Petunia hybrida) Cv. purple star

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Abstract
The present investigation entitled “Effect of Micronutrients on Growth, Flower Yield and Flower Quality of Petunia (Petunia hybrida) cv. Purple star” was carried out during 2019-2020 at research field of Department of Horticulture, Allahabad School of agriculture, SHUATS, Prayagraj. The experiment included ten treatments and three replications. Treatment details were T₀ - (Control), T₁ - (ZNSO₄ @ 0.2%), T₂ - (ZNSO₄ @ 0.4%), T₃ - (ZNSO₄ @ 0.6%), T₄ - (FESO₄ @ 0.2%), T₅ - (FESO₄ @ 0.4%), T₆ - (FESO₄ @ 0.6%), T₇ - (CUSO₄ @ 0.2%), T₈ - (CUSO₄ @ 0.4%), T₉ - (CUSO₄ @ 0.6%). It was concluded that application of ZNSO₄ @ 0.6% in treatment T₁ was found to be superior on plant height, plant spread, number of branches, number of leaves, number of days required for 1st bud emergence from transplanting, number of days required for 1st flower opening, plant growth and flowering, number of flowers per plant and flower yield per plot. The results also indicated that T₁ showed the best yield per hectare.

Keywords: Micronutrients, ZNSO₄, FESO₄, CUSO₄, petunia (Petunia hybrida) etc.

Introduction
Petunia (petunia hybrida) is a winter annual flowering crop belongs to the family Solanaceae, and flowers vary from i.e. single to double in different colours like white, cream, pink, purple, magenta, mauve, salmon or bicoloured are available. Petunia is open pollinated winter flowering annual crop. The height of plant varies from 50-70 cm. The seedlings are transplanted in first week of November at 45 cm x 45 cm distance. Seeds are ready for harvesting from April to mid june. Harvest the pods as they began drying otherwise shattering will occur. It is native of south America and is very popular in Indian gardens due to its floriferous and hardy nature.

Petunia is commonly grown as bedding, pots, hanging baskets, window boxes, rockery and for mass planting. Plants grow about 30 to 40 cm and have spreading habit with trailing branches. Leaves are small, round and thick. The flowers have five petals which are joined and are trumpet shaped.

The single bedding petunia is one of the best and most valuable bedding ornamental flowers, as this has a long flowering season under favourable conditions. It flowers best as the hot weather approaches and can be continued till the rains in the hills. Petunias are also good for borders, mass planting edgings, rock gardens (especially the dwarf types), window boxes, and hanging basket (balcony type) and pots. Petunia is also good for vase decoration as cut flowers and when grown in mass under the shrubs they display a striking effect.

Materials and Methods
The Experiment was conducted in Randomized Block Design (RBD) with 10 treatments of Micronutrients i.e. Zinc Sulphate (ZNSO₄), Ferrous Sulphate (FESO₄) and Copper Sulphate (CUSO₄) with three replications in the Departmental Research field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during November 2019 to March 2020. Total number of treatments were ten viz. T₀ - (Control), T₁ - (ZNSO₄ @ 0.2%), T₂ - (ZNSO₄ @ 0.4%), T₃ - (ZNSO₄ @ 0.6%), T₄ - (FESO₄ @ 0.2%), T₅ - (FESO₄ @ 0.4%), T₆ - (FESO₄ @ 0.6%), T₇ - (CUSO₄ @ 0.2%), T₈ - (CUSO₄ @ 0.4%), T₉ - (CUSO₄ @ 0.6%).
Climatic condition in the experimental site
The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C - 48°C and seldom falls as low as 4°C -5°C. The relative humidity ranged between 20-94 percent. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

Results and Discussion
The present investigation entitled “Effect of Micronutrients on Growth, Flower Yield and Flower Quality of Petunia (Petunia hybrida) cv. Purple Star” was carried out during November 2019 to March 2020 in Departmental Research Field of Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) India. The results of the present investigation, regarding the effect of Micronutrients on growth, flower yield and flower quality of Petunia, have been discussed and interpreted in the light of previous research work done in India and abroad. The experiment was conducted in Randomized block design with 10 treatments, and three replications. The results of the experiment are summarized below.

A. Growth Parameters
Among all the treatments shown in Table -1, the maximum plant height (23.95 cm) was recorded in treatment T4 - ZNSO4 @ 0.6% followed by T1 - ZNSO4 @ 0.2% (22.73 cm). Minimum plant height (17.45 cm) was recorded in treatment T0 control. The maximum plant spread (72.41 cm) was recorded in treatment T1-ZNSO4 @ 0.6% followed by T1-ZNSO4 @ 0.2% (70.21 cm). Minimum plant spread (58.59 cm) was recorded in treatment T0 control. The maximum Number of branch per plant (22.13) was recorded in treatment T3-ZNSO4 @ 0.6% followed by T1-ZNSO4 @ 0.2% (21.42). Minimum Number of branch per plant (14.44) was recorded in treatment T0 control. The maximum Number of leaves per plant (561.75) was recorded in treatment T1-ZNSO4 @ 0.6% followed by T1-ZNSO4 @ 0.2% (542.12). Minimum Number of leaves per plant (381.63) was recorded in treatment T0 control.

B. Floral Parameters
Micronutrients significantly affected the number of days required for first flower bud emergence from transplanting. However, it was seen that minimum days (21.92) were taken by treatment T1-ZNSO4 @ 0.6% which was remarkably better than T8- CUSO4 @ 0.4% (34.42 days). The increase in the number of days was seen between the various treatments. Treatment T8 - FESO4 @ 0.2%, (24.00 days), T8- CUSO4 @ 0.2%. (26.25 days), T8-ZNSO4 @ 0.2% (27.58 days), T8-FESO4 @ 0.6% (29.42 days) T8 – FESO4 @ 0.4% (30.67 days) were and control T0 – Control (37.58 days).

Micronutrients significantly affected the number of days required for first flower opening. However, it was seen that minimum days (30.83) were taken by treatment T2-ZNSO4 @ 0.6% which was remarkably better than T8- CUSO4 @ 0.4% (42.50 days). The increase in the number of days was seen between the various treatments. Treatment T8 - FESO4 @ 0.2%, (32.25 days), T8- CUSO4 @ 0.2%. (35.33 days), T8-ZNSO4 @ 0.2% (36.25 days), T8 – FESO4 @ 0.6% (37.25 days) T8 – FESO4 @ 0.4% (38.25 days) were and control T0 – Control (49.25 days).

It is evident from the data that flower stalk length (cm) of flower was significantly affected by Micronutrients. The highest flower stalk length (cm) was found in treatment T1-ZNSO4 @ 0.2% (6.78 cm) followed by T3-ZNSO4 @ 0.6% (6.72 cm), T2-ZNSO4 @ 0.4% (6.62 cm) and T8 – CUSO4 (6.59 cm). Lowest flower stalk length (cm) was found in treatment T0- (4.68 cm) control.

It is evident from the data that Dry weight of flower was significantly affected by Micronutrients. The highest Dry weight was found in treatment T3-ZNSO4 @ 0.6% (0.78 g) followed by T2-ZNSO4 @ 0.2% (0.86 g), T2-ZNSO4 @ 0.4% (0.83 g) and T1 – CUSO4 (0.80 g). Lowest dry weight was found in treatment T0- (0.61 g) control.

C. Quality Parameters
significant use of treatment T3-ZNSO4 @ 0.6% produced flowers of larger size i.e. Diameter of flower (9.26 cm), other treatments which produced significant results over control were T1-ZNSO4 @ 0.2% (9.05 cm), T2-ZNSO4 @ 0.4% (8.96 cm), T8-CUSO4 @ 0.4%. (8.88cm) and diameter of flower (8.42 cm) was found minimum in treatment T0 (Control). It is evident from the data that flower length (cm) of flower was significantly affected by Micronutrients. The highest flower length (cm) was found in treatment T1-ZNSO4 @ 0.2% (7.70 cm) followed by T3-ZNSO4 @ 0.6% (7.47 cm), T2-ZNSO4 @ 0.4% (6.98 cm) and T8-CUSO4 (6.79 cm). Lowest flower length (cm) was found in treatment T0- (5.06 cm) control.

D. Yield Parameters
Micronutrients had significant influence on total number of flower per plant. Significantly highest number of flowers plant was recorded in treatment T3-ZNSO4 @ 0.6% (106.47) compared to other treatments. This treatment was followed by T2-ZNSO4 @ 0.2%. (94.63), T3-ZNSO4 @ 0.4% (92.71), T8-CUSO4 @ 0.2% (89.62) and T8-FESO4 @ 0.2% (88.40) which were superior over control. Lowest number of flowers (72.42) was observed in treatment T0 Control. Significantly highest yield of flower per plant (g) was recorded in treatment T3-ZNSO4 @ 0.6% (122.35 g) than all other treatment. This treatment was followed by T3-ZNSO4 @ 0.2% (104.53 g), T2-ZNSO4 @ 0.4%. (98.75 g), T8-CUSO4 @ 0.2% (91.74 g) and minimum flower yield (57.43g) was obtained in treatment T0 Control. Significantly highest yield of flower per plot (g) was recorded in treatment T3-ZNSO4 @ 0.6% (489.40 g) than all other treatment. This treatment was followed by T1-ZNSO4 @
On the basis of present investigation it is concluded that the application of treatment T₁ - ZNSO₄ @ 0.6% found best in terms of Growth, Flower Quality and Flower Yield, Economics of Treatments, Gross return, net profit and Maximum Cost Benefit ratio (1:2.16) of Petunia followed by T₁ - ZNSO₄ @ 0.2%. In terms of Flower stalk length (cm) and Flower length (cm) application of treatment T₁-ZNSO₄ @ 0.6% found best.

References

Table 1: Effect of Micronutrients on Plant height (cm), Plant spread (cm), Number of branches per plant, and Number of leaves per plant of Petunia cv. Purple Star

<table>
<thead>
<tr>
<th>Treatment symbols</th>
<th>Treatment Combination</th>
<th>Plant height (cm) 120 DAT</th>
<th>Plant spread (cm) 120 DAT</th>
<th>Number of branches per plant 120 DAT</th>
<th>Number of leaves per plant 120 DAT</th>
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</thead>
<tbody>
<tr>
<td>T₀ Control</td>
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<td>58.59</td>
<td>14.44</td>
<td>381.63</td>
</tr>
<tr>
<td>T₁ ZNSO₄ @ 0.2%</td>
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<td>22.73</td>
<td>70.21</td>
<td>21.42</td>
<td>542.12</td>
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<td>T₂ ZNSO₄ @ 0.4%</td>
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<td>21.64</td>
<td>69.39</td>
<td>20.32</td>
<td>523.22</td>
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<tr>
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<td>23.95</td>
<td>72.41</td>
<td>22.13</td>
<td>561.75</td>
</tr>
<tr>
<td>T₄ FESO₄ @ 0.2%</td>
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<td>20.65</td>
<td>66.63</td>
<td>19.23</td>
<td>516.59</td>
</tr>
<tr>
<td>T₅ FESO₄ @ 0.4%</td>
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<td>18.12</td>
<td>61.72</td>
<td>15.75</td>
<td>434.73</td>
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<tr>
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<td>19.85</td>
<td>64.35</td>
<td>17.46</td>
<td>492.37</td>
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<tr>
<td>T₇ CUSO₄ @ 0.2%</td>
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<td>20.97</td>
<td>68.42</td>
<td>19.72</td>
<td>509.72</td>
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<tr>
<td>T₈ CUSO₄ @ 0.4%</td>
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<td>20.23</td>
<td>65.53</td>
<td>18.33</td>
<td>513.42</td>
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<tr>
<td>T₉ CUSO₄ @ 0.6%</td>
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<td>19.45</td>
<td>62.53</td>
<td>16.85</td>
<td>462.65</td>
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<td>F-test</td>
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<td>0.01</td>
</tr>
<tr>
<td>CD at 5%</td>
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<td>0.06</td>
<td>0.22</td>
<td>0.03</td>
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</table>

Table 2: Effect of Micronutrients on No. of days for first flower bud emergence, No. of days for 1st flower opening, fresh weight (gm), Dry weight (gm), Flower stalk length (cm), Flower length (cm), and Diameter of flower (cm) of Petunia cv. Purple Star

<table>
<thead>
<tr>
<th>Treatment symbols</th>
<th>Treatment Combination</th>
<th>No. of days for first flower bud emergence</th>
<th>No. of days required for 1st Flower Opening</th>
<th>Fresh weight (gm)</th>
<th>Dry weight (gm)</th>
<th>Flower stalk length (cm)</th>
<th>Flower length (cm)</th>
<th>Diameter of flower (cm)</th>
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<tr>
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<td>37.58</td>
<td>49.25</td>
<td>0.86</td>
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<td>4.68</td>
<td>5.06</td>
<td>8.42</td>
</tr>
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<td>27.58</td>
<td>36.25</td>
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<td>0.86</td>
<td>6.78</td>
<td>7.70</td>
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<td>32.08</td>
<td>41.25</td>
<td>1.05</td>
<td>0.83</td>
<td>6.62</td>
<td>6.98</td>
<td>8.96</td>
</tr>
<tr>
<td>T₃ ZNSO₄ @ 0.6%</td>
<td></td>
<td>21.92</td>
<td>30.83</td>
<td>1.16</td>
<td>0.89</td>
<td>6.72</td>
<td>7.47</td>
<td>9.26</td>
</tr>
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<td>24.00</td>
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<td>6.52</td>
<td>6.59</td>
<td>8.77</td>
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<td>37.25</td>
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<td>0.71</td>
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<td>6.34</td>
<td>8.82</td>
</tr>
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<td>0.80</td>
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<td>8.79</td>
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<td>34.42</td>
<td>42.50</td>
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<tr>
<td>CD at 5%</td>
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<td>0.31</td>
<td>0.46</td>
<td>0.003</td>
<td>0.003</td>
<td>0.02</td>
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Table 3: Effect of Micronutrients on Diameter of flower(cm), Number of flowers per plant, Flower yield per plant (g), Flower yield per plot (g), Flower yield per ha (t) and Benefit cost Ratio of Petunia cv. Purple Star

<table>
<thead>
<tr>
<th>Treatment symbols</th>
<th>Treatment combination</th>
<th>Number of flowers per plant</th>
<th>Flower yield Per plant (g)</th>
<th>Flower yield Per plot (g)</th>
<th>Flower yield Per ha (t)</th>
<th>Benefit Cost Ratio</th>
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<td>57.43</td>
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<td>394.98</td>
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<td>CD at 5%</td>
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<td>0.07</td>
<td>0.26</td>
<td>0.003</td>
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</table>
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