Effect of rooting hormones on growth of tomato cuttings

EFFECT OF DIFFERENT CONCENTRATIONS OF ROOTING HORMONES ON GROWTH OF TOMATO CUTTINGS
(SOLANUM ESCULENTUS L.)

Taj Naseeb Khan, Ghulam Jeelani*, Sudheer Tariq**, Tariq Mahmood and Syed Ijaz Hussain*

ABSTRACT

A study was conducted at Horticultural Research Institute, NARC, Islamabad, Pakistan during 2009. The axillary/lateral shoots (3-4 inches long) were taken from tomato (cv. Kurihara). The cuttings were dipped for 30 seconds in 0.25, 0.50, and 1.00 percent solutions of Indole Butyric Acid (IBA), Chinese Hormones (ABT), Naphthalene Acetic Acid (NAA), 4-Chlorophenyl Acetic Acid (4-CPAD) and control, planted in multi-pot trays filled with a mixture of well decomposed farm yard manure (FYM) and soil (1:1). All the treatments were triplicated using complete randomized design. The data were recorded on survival percentage, seedling height (cm), stem diameter (cm), shoot and root fresh weight (g), shoot and root dry weight (g), root and shoot ratio, root length (cm) and number of roots per cutting. Maximum seedling height (32.22 cm), root length (17.40 cm), number of roots (27.20), root/shoot fresh weight (0.78 and 9.65 g) and dry weight (0.23 and 1.87 g), was noted in control. It proved that tomato axillary/lateral shoots can be grown successfully in a media prepared with soil and well decomposed FYM in 1:1 ratio. This technology can be successfully utilized to grow the second crop of the same variety/hybrid saving the seed cost.

KEYWORDS: Solanum esculentus; stems; cuttings; farmyard manure; iba; naa; Pakistan.

INTRODUCTION

Tomato (Solanum esculentus L.) is native to South America and belongs to the family Solanaceae. It is perennial in nature but is grown as an annual crop in Pakistan. It is cultivated on an area of 47100 hectares with annual production of 502300 tons in Pakistan (1). The average height of the plant is

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100-300 cm, with a weak and woody stem that often vines over other plants (indeterminate in nature). The leaves are 10-25 cm long, odd pinnate, with 5-9 leaflets on petioles, each leaflet up to 8 cm long, with a serrated margin. The stem and leaves are densely glandular and hairy. The flowers are 1-2 cm across, yellow in colour (12). Tomatoes are commonly classified as determinate (bush type bears fruit all at once and top off at a specific height) or indeterminate (develops into a vine that never top off and continues producing fruit until killed by frost). Determinate tomatoes are preferred by commercial growers as they wish to harvest the whole field at once. Indeterminate tomatoes are preferred by home growers and small farmers who like to sell ripened fruit in the market throughout season (15). It is widely grown in most of the tropical areas but few cultivars are selected for cultivation in both temperate and tropical areas of Pakistan (16).

Singh (17) stated that tomato cuttings required plant growth regulators to promote rooting. Chao et al. (4) and Najma and Saima (11) observed that existence of various types of hormones in tomato plant provides a regulatory control through which different forms of growth in plant are achieved. Auxin plays an important role in cell elongation, cell division, initiation of cambium and early differentiation of xylem and phloem tissues in tomato. Botau et al. (3) noted that Indole-3-Acetic Acid (IAA) at the lowest concentration stimulated stem elongation as well as root numbers in cv. Tracy (Solanum esculentus L.). Tyburski et al. (20) found that IAA is an essential factor for growth of floral stem; tomato shoot cuttings treated with IAA formed more roots than control, whereas Rao et al. (14) investigated that Indole Butyric Acid (IBA) is the leading plant hormone used to promote the formation of roots and to generate new roots in the cloning of tomato plants through cuttings, however, IAA promotes the shoot growth. It had a very positive effect on the number of adventitious roots formation in tomato cuttings. Lopez et al. (9) studied the effect of different concentrations (1500, 3000, 45000 and 10,000 ppm) of IBA on ten tomato cultivars. Naphthalene Acetic Acid (NAA) can significantly increase the number of root and root length, but the effect of NAA on fruit yield in bell pepper was less than that of the application of mepiquat chloride (18). Cvetanovska and Kratovalieva (6) observed that NAA and IAA @ 0.10 mg per litre performed better along with thick and strong roots. Gad and Atta- Ali (7) found that the adventitious root formation in tomato cuttings was totally suppressed with the application of IAA and IBA combination. They further observed the best root formation in tomato cuttings in 1.00 mg NAA/litre. Similar effect of IBA and NAA (250-500 ppm) was found by Gul et al. (8) on survival and rooting in tomato cv. Karantaka in summer and winter seasons while in some other studies (1, 4)
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use of IAA and IBA concentrations (500 and 1000 ppm) on tomato side shoots alongwith control showed enhancement in rooting and growth of side shoots.

Raising of tomato seedlings had some difficulties especially in early spring and winter because of lack of appropriate method (10). Therefore, there was a dire need of exploring an efficient method of vegetative propagation of tomato plant for its cheaper multiplication and cultivation throughout the year. Growing hybrid tomato through seed is very much expensive due to high prices of the hybrid seeds (Rs. 5-6/seed) which a poor farmer cannot afford.

The present study was designed to explore a suitable technique for root development in tomato cuttings, minimizing the cost incurred on the purchase of hybrid seeds each time for a new crop and to get one or two extra crops through cuttings.

**MATERIALS AND METHODS**

This study was conducted at Horticultural Research Institute, NARC, Islamabad, Pakistan in November, 2009. The axillary shoots/lateral shoots (3-4 inches long) were taken from tomato cv. Kurihara (indeterminate). The cuttings were dipped for 30 seconds in 0.25, 0.50, and 1.00 percent solutions of Indole Butyric Acid (IBA), Chinese Hormones (ABT), Naphthalene Acetic Acid (NAA), 4-Chlorophenyl Acetic Acid (4CPAD) and control, planted in multi-pot trays filled with a mixture of well decomposed farm yard manure (FYM) and soil (1:1), making 13 number of treatments. All treatments were triplicated using complete randomized design. The data were recorded after 30 days of transplantation in multi-pots; on survival percentage, seedling height (cm), stem diameter (cm), shoot and root fresh weight (g), shoot and root dry weight (g), root and shoot ratio, root length (cm) and number of roots per cutting. The data collected were analyzed with MSTAT-C software (19).

**RESULTS AND DISCUSSION**

The analysis of variances revealed highly significant differences among the treatments (P< 0.01) (Table 2). The survival percentage was higher in case of control (99.33 %) followed by NAA @ 0.50 percent solution (86.66 %) and IBA @ 0.25 percent (84.56 %) (Table 2). The lowest survival rate was observed in 4 - CPAD @ 1.00 percent (42.85 %). The results are in agreement to those of Singh (17) and Gul et al. (8), who found better
Table 1. Mean squares of different parameters studied for tomato cuttings.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Survival (%)</th>
<th>Seedling height (cm)</th>
<th>Stem diameter (cm)</th>
<th>Root length (cm)</th>
<th>No. of roots</th>
<th>Root fresh weight (g)</th>
<th>Shoot fresh weight (g)</th>
<th>Root dry weight (g)</th>
<th>Shoot dry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>12</td>
<td>597.216**</td>
<td>125.953**</td>
<td>0.93**</td>
<td>32.337**</td>
<td>96.634**</td>
<td>0.133**</td>
<td>27.014**</td>
<td>0.149**</td>
</tr>
<tr>
<td>Error</td>
<td>26</td>
<td>0.220</td>
<td>0.686</td>
<td>0.001</td>
<td>0.036</td>
<td>0.005</td>
<td>0.002</td>
<td>0.013</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 2. Effect of different hormonal concentrations on tomato cuttings.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Survival %</th>
<th>Seedling height (cm)</th>
<th>Stem diameter (cm)</th>
<th>Root length (cm)</th>
<th>No. of roots</th>
<th>Root fresh weight (g)</th>
<th>Shoot fresh weight (g)</th>
<th>Root dry weight (g)</th>
<th>Shoot dry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3299.33</td>
<td>0.38</td>
<td>17.40</td>
<td>27.20</td>
<td>0.78</td>
<td>9.65</td>
<td>0.23</td>
<td>1.87</td>
<td></td>
</tr>
<tr>
<td>IBA (0.25%)</td>
<td>84.56</td>
<td>9.50</td>
<td>1.63</td>
<td>7.37</td>
<td>8.25</td>
<td>0.51</td>
<td>1.66</td>
<td>0.05</td>
<td>0.52</td>
</tr>
<tr>
<td>IBA (0.50%)</td>
<td>75.00</td>
<td>9.83</td>
<td>0.19</td>
<td>4.60</td>
<td>5.10</td>
<td>0.10</td>
<td>0.68</td>
<td>0.09</td>
<td>0.33</td>
</tr>
<tr>
<td>IBA (1%)</td>
<td>81.80</td>
<td>6.87</td>
<td>0.60</td>
<td>6.22</td>
<td>5.20</td>
<td>0.11</td>
<td>0.75</td>
<td>0.04</td>
<td>0.35</td>
</tr>
<tr>
<td>ABT (0.25%)</td>
<td>64.20</td>
<td>14.20</td>
<td>0.30</td>
<td>5.94</td>
<td>12.60</td>
<td>0.41</td>
<td>1.91</td>
<td>0.06</td>
<td>0.40</td>
</tr>
<tr>
<td>ABT (0.50%)</td>
<td>80.00</td>
<td>17.10</td>
<td>0.62</td>
<td>10.61</td>
<td>13.70</td>
<td>0.10</td>
<td>2.10</td>
<td>0.14</td>
<td>0.33</td>
</tr>
<tr>
<td>ABT (1%)</td>
<td>63.60</td>
<td>20.14</td>
<td>1.96</td>
<td>7.21</td>
<td>13.40</td>
<td>0.20</td>
<td>7.00</td>
<td>0.17</td>
<td>0.98</td>
</tr>
<tr>
<td>NAA (0.25%)</td>
<td>77.77</td>
<td>18.71</td>
<td>1.03</td>
<td>7.87</td>
<td>7.00</td>
<td>0.28</td>
<td>4.48</td>
<td>0.08</td>
<td>0.50</td>
</tr>
<tr>
<td>NAA (0.50%)</td>
<td>86.66</td>
<td>20.00</td>
<td>3.35</td>
<td>9.30</td>
<td>10.90</td>
<td>0.13</td>
<td>7.73</td>
<td>0.05</td>
<td>0.93</td>
</tr>
<tr>
<td>NAA (1%)</td>
<td>73.33</td>
<td>21.80</td>
<td>2.44</td>
<td>9.11</td>
<td>12.44</td>
<td>0.38</td>
<td>7.42</td>
<td>0.08</td>
<td>1.05</td>
</tr>
<tr>
<td>4-CPAD (0.25%)</td>
<td>58.82</td>
<td>19.66</td>
<td>2.22</td>
<td>6.80</td>
<td>6.71</td>
<td>0.45</td>
<td>1.83</td>
<td>0.70</td>
<td>0.37</td>
</tr>
<tr>
<td>4-CPAD (0.50%)</td>
<td>77.77</td>
<td>1.93</td>
<td>1.36</td>
<td>13.57</td>
<td>5.00</td>
<td>0.12</td>
<td>1.32</td>
<td>0.52</td>
<td>0.14</td>
</tr>
<tr>
<td>4-CPAD (1%)</td>
<td>42.85</td>
<td>20.60</td>
<td>0.25</td>
<td>9.00</td>
<td>10.66</td>
<td>0.13</td>
<td>2.55</td>
<td>0.12</td>
<td>0.50</td>
</tr>
<tr>
<td>LSD (0.01)</td>
<td>0.78</td>
<td>1.39</td>
<td>0.05</td>
<td>0.31</td>
<td>0.12</td>
<td>0.07</td>
<td>0.06</td>
<td>0.07</td>
<td>0.12</td>
</tr>
<tr>
<td>CV %</td>
<td>0.66</td>
<td>4.94</td>
<td>4.69</td>
<td>2.11</td>
<td>0.68</td>
<td>14.23</td>
<td>3.05</td>
<td>19.44</td>
<td>11.44</td>
</tr>
</tbody>
</table>
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Survival percentage in case of IBA and NAA treatments. Seedling height was also found maximum in control (32.22 cm) followed by the cuttings treated with NAA 1.00 percent (21.80 cm). However, seedling height of the cuttings treated with ABT 1.00 percent (20.14 cm) and NAA 0.50 percent (20.00 cm) were non-significant. The lowest response of seedling height was observed in 4CPAD 0.50% percent (1.93 cm). These results supported the findings of Chao et al. (3), Najma and Aisha (12) and Botau et al. (2). The highest stem diameter of 3.35 cm followed by 2.44 and 2.22 cm were recorded in cuttings treated with NAA@ 0.50, 1.00 and 4-CPAD 0.25 percent, respectively, Tyburski et al. (20) have reported similar results. The lowest stem diameter was observed in the cuttings treated with IBA @ 0.50 percent (0.19 cm) (Table 2).

Maximum root length (17.40 cm) was also recorded in control followed by 4-CPAD @ 0.50 percent (13.57 cm) and ABT @ 0.50 percent solution (10.61 cm), favouring the research work of Cvestanovska and Kratovalieva (6). Control treatment also excelled in number of roots (27.20) followed by ABT @ 0.50 (13.70) and 1.00 percent solution (13.40). Minimum number of roots was observed in case of 4-CPAD @ 0.50 percent (5.00), IBA @ 0.50 percent (5.10) and 1.00 percent (5.20). The results confirmed the findings of earlier workers (2, 6, 13, 20). The highest root fresh weight was observed in control (0.78 g) followed by IBA @ 0.25 percent (0.51 g) while the lowest root fresh weight was recorded in IBA @ 0.50 percent and ABT @ 0.50 percent (0.10 g each) (Table 2). Similar results were interpreted by Cvestanovska and Kratovalieva (6) and Gul et al. (8). The highest shoot fresh weight of tomato cutting was also observed in control (9.65 g) and NAA@ 0.5 percent (7.73 g) and 1.00 percent (7.42 g) solutions. All treatments showed variable behaviour regarding root and shoot dry weight of tomato cuttings (Table 2) as observed by Gad and Atta-Ali (7) and Basu et al. (2).

CONCLUSION

The study concludes that tomato axillary/lateral shoots can be grown successfully in a media prepared with soil and well decomposed FYM in the ratio of 1:1. Hormonal concentrations had no significant impact on the growth of tomato cuttings compared with control. Growing tomato cuttings in an ordinary soil and well decomposed FYM is much cheaper and easily adoptable for the tomato growers compared to growing of tomato cuttings with the use of growth hormones. Growing hybrid/improved cultivars of tomato through seed is expensive (Rs. 5-6/seed) which a poor farmer cannot afford. So, minimization of cost incurred on the purchase of hybrid seed for

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every new tomato crop will enable the tomato growers to get one extra crop of tomato through cuttings of same hybrids grown in soil and manure media as discussed above.

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