EFFECTS OF INDOLEBUTYRIC ACID AND TYPES OF CUTTINGS ON SOME CHARACTERS OF CLOVE (DIANTHUS CARYOPHYLLUS)

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ABSTRACT
These studies were conducted to evaluate the effect of different treatments of Indole butric acid and kind cutting on the rooting ability and morphological properties of Clove. The studies were performed in completely randomized design with two factors and tree replications. The two factors were seven distinct levels of Indol butyric acid (0, 50, 100, 200, 1000, 1500 and 2000) and two different levels of cutting (Hill cutting and Softwood cutting), respectively. Moreover, en cuttings were planted in any repetition. The results of experiment demonstrated that Concentrations of IBA had significant effects on plant height at the 5% probability level. The tallest plants (48 cm) were achieved in the treatment of heel cuttings with IBA at 1500 mg/l, and the shortest plants (24 cm) in the treatment of heel cuttings with IBA at 50 mg/l (Diagram 3). Effects of various IBA concentrations on number of flowers per plant were significantly different at the 5% probability level. Comparison of the means of the interaction affects the types of cuttings and IBA had on the number of flowers per plant shows the maximum number of flowers per plant (Sun and Bassuk, 1991) was achieved in the treatment of using heel cuttings with IBA at 1500 mg/l.

Keywords: Indolebutyric Acid, Clove

INTRODUCTION
Vegetative propagation is not a breeding method but a way to rapidly multiply desired genetic/clonal material and capturing most of the genetic potential. When vegetative propagation is used, most of the genetic potential including the non-additive variance is transferred to the new plant (Libby, 1974). For the production of fast growing high quality timber and resistant varieties, it is essential to start by superior clones from which the shoot and root cuttings are to be taken. According to Ofori-Gyamfi (1998), rooting performance depends on the type of medium used in the propagating structure. This is so because the various materials and mixes of materials that can be used in rooting of cuttings provide physical support, oxygen and water (Kester et al., 1990; Larsen and Guse, 1997). Larsen and Guse (1997) and Kester et al., (1990) reported that the most reliable rooting hormone is indolebutyric acid (IBA) although others such as naphthalene acetic acid (NAA) can also be used. Although there are reports that it may also be toxic to young/ succulent cuttings of certain species, IBA is still probably the best hormone for general use because of being non-toxic to plants over a wide range of concentration levels (Kester et al., 1990). This study therefore aimed at determining the most appropriate rooting medium and IBA hormone concentration for propagating stem cuttings of W. ugandensis. Various genetic, environmental, and chemical factors are involved in the successful rooting of the cuttings. Excitatory effect of Oxin on the rooting of rose cuttings was reported in 1940 by Kirkpatryk (Matlubi, 1999). Oxin positively effects the roses’ rooting following the increase in root initiators and a slight elongation of the roots. Ersishly et al., (2005) reported 3500 mg as the best concentration of Indole butyric acid for rose rooting. Fuchs (2001) reported that the rooting of multi-flora rose increased as the concentrations of Indole butyric acid increased to 11,000 mg per liter. The positive effect Indole Butyric acid on rooting can be associated with the Oxin effect in stimulating the initial division of the first root cells (Khoskhkoy, 2004). (Gasper and Heffinger, 1988) have shown that the initial division of the root cells is related to applied or internal Oxin. Izadi et al., (2012) reported in their study that the increase in Indole Butyric acid concentration causes a root length in rose, which are consistent with the results of the present study. Moallemi and Chehrazi (2003) argue that increased concentrations of naphthalene acetic acid and Indole-Butyric acid increase the length of roots in the cuttings of rosette plants and shrubs. The present study was initiated to determine the proper concentration of IBA for enhancing the rooting in cuttings of Dianthus caryophyllus.
MATERIALS AND METHODS
This research was carried out in March 2014 in Mr. Pishevar’s floriculture greenhouse in the new belt way of Shirvan city 37o and 40 minutes of latitude and 57o and 93 minutes of longitude with the height of 1097 meters above sea level. For this study, a factorial experiment was used in a completely randomized design with 3 replications in which the first factor included Indole Butyric acid concentration at four levels: 0, 50, 100 and 200 mg per liter for 10 minutes (delayed treatment method) and IBA at 0, 1000, 1500 and 2000 mg per liter for 5 seconds (rapid treatment method), and the second factor includes: softwood stem cuttings and heel cuttings. In each repetition, there were 10 cuttings of grenadine in a way that 5 cuttings were used to analyze the properties related to the root and 5 were used to analyze the properties related to the flower. Cuttings were obtained from the healthy virus-free mother plants on April 17, 2014. The cuttings were selected in 10 cm items and were planted after bed disinfection and treatment. The culture bed included perlite and cocopeat which was poured into special culture place. For disinfection and prevention of contamination with pathogenic microorganisms, all gardening tools such as clippers were disinfected with alcohol and heat before the treatment. Before planting, the cuttings were washed with water and then dried and finally they were disinfected with the fungicide Benomyl with a proportion of 2 in a thousand. In this method, the prepared solution was poured into a container and the cuttings were put in bunches into Indole Butyric acid and, after drying, they were out in the fungicide. The rapid submergence method and delayed treatment method were used. In rapid submergence method, the cuttings were bunched in 10 and their studs were put in Indole Butyric acid for 5 minutes; however, in delayed treatment method, they were put in rooting solution for 10 minutes. After hormone treatment, the cuttings were dried for 20 minutes, then, by observing pole orientation, they were placed in the culture bed. After 30 days from the culture, 5 cuttings from each treatment were removed from the culture bed and the following properties were evaluated: Plant height, Number of flower per plant, Number of petals, Fresh weight of plant, and Dry weight of plant. The obtained data were statistically analyzed by the software MSTATC. The comparison of the means was also done using Duncan Multiple range test and Excel software was used to depict the graphs.

RESULTS AND DISCUSSION
Results
Table 1 shows the results of ANOVA related to the individual effects indolebutyric acid (IBA) had on plant height. Concentrations of IBA had significant effects on plant height at the 5% probability level. Based on the table of comparison of the means (Table 2), the maximum plant height (42 cm) observed in the treatment of applying IBA at 200 mg/l had statistically significant differences with that of the plants in the control. The minimum height of plants (19 cm) was obtained with IBA applied at 50mg/l.

<table>
<thead>
<tr>
<th>SOV</th>
<th>Df</th>
<th>Plant height (cm)</th>
<th>Mean Square</th>
<th>No. of flowers per plant</th>
<th>No. of petals</th>
<th>Fresh weight of plant (mg)</th>
<th>Dry weight of plant (mg)</th>
<th>Flower diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication</td>
<td>2</td>
<td>148.14</td>
<td>Mean Square</td>
<td>6.41</td>
<td>26</td>
<td>12.24</td>
<td>1.547</td>
<td>284.68</td>
</tr>
<tr>
<td>Type of cut</td>
<td>1</td>
<td>949.37*</td>
<td>Mean Square</td>
<td>8.23*</td>
<td>32.53ns</td>
<td>328.62*</td>
<td>27.53ns</td>
<td>491.88ns</td>
</tr>
<tr>
<td>Concentration</td>
<td>6</td>
<td>983.79ns</td>
<td>Mean Square</td>
<td>6.74*</td>
<td>52.95*</td>
<td>451.54*</td>
<td>36.31ns</td>
<td>573.64*</td>
</tr>
<tr>
<td>Type of cut x</td>
<td>6</td>
<td>124.53*</td>
<td>Mean Square</td>
<td>3.49*</td>
<td>21.0*</td>
<td>125.3*</td>
<td>6.64ns</td>
<td>197.21ns</td>
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<tr>
<td>Concentration</td>
<td></td>
<td></td>
<td></td>
<td>4.36</td>
<td>10.37</td>
<td>192.87</td>
<td>16.64</td>
<td>236.96</td>
</tr>
</tbody>
</table>

ns, * and ** are respectively non-significant and significant at 5% and 1% level of probability
Table 2: Mean comparison of the effects of IBA concentration on quality characters of carnations based on Duncan’s method

<table>
<thead>
<tr>
<th>IBA</th>
<th>Flower diameter (mm)</th>
<th>Dry weight of plant (mg)</th>
<th>Fresh weight of plant (mg)</th>
<th>No. of petals</th>
<th>No. of flowers per plant</th>
<th>Plant height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>47bc</td>
<td>1.24c</td>
<td>256c</td>
<td>23bc</td>
<td>4bc</td>
<td>28b</td>
</tr>
<tr>
<td>50</td>
<td>53b</td>
<td>3.29bc</td>
<td>314bc</td>
<td>25bc</td>
<td>3c</td>
<td>19b</td>
</tr>
<tr>
<td>100</td>
<td>42c</td>
<td>3.77b</td>
<td>319.42bc</td>
<td>24bc</td>
<td>5bc</td>
<td>31ab</td>
</tr>
<tr>
<td>200</td>
<td>49bc</td>
<td>4.193a</td>
<td>417.67 ab</td>
<td>34a</td>
<td>8b</td>
<td>42a</td>
</tr>
<tr>
<td>1000</td>
<td>61a</td>
<td>3.981ab</td>
<td>432.5a</td>
<td>31ab</td>
<td>7b</td>
<td>32ab</td>
</tr>
<tr>
<td>1500</td>
<td>60.5a</td>
<td>4.143a</td>
<td>397.41b</td>
<td>32ab</td>
<td>11a</td>
<td>34ab</td>
</tr>
<tr>
<td>2000</td>
<td>58 ab</td>
<td>3.347b</td>
<td>382.53b</td>
<td>28 b</td>
<td>10ab</td>
<td>37.24ab</td>
</tr>
</tbody>
</table>

Means with the same letters in each column are significantly different at 5% of probability

Table 3: Comparison of the mean of effect of type of cutting on some of the characteristics of the aerial organs of carnations based on Duncan’s method

<table>
<thead>
<tr>
<th>Type of cutting</th>
<th>Flower diameter (mm)</th>
<th>Dry weight of plant (mg)</th>
<th>Fresh weight of plant (mg)</th>
<th>No. of petals</th>
<th>No. of flowers per plant</th>
<th>Plant height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softwood cutting</td>
<td>39b</td>
<td>2.28 b</td>
<td>317a</td>
<td>21b</td>
<td>6a</td>
<td>26a</td>
</tr>
<tr>
<td>Heel cutting</td>
<td>54a</td>
<td>3.29a</td>
<td>293a</td>
<td>25a</td>
<td>4b</td>
<td>18b</td>
</tr>
</tbody>
</table>

Means with the same letters in each column are significantly different at 5% of probability

Table 1 shows results concerning the individual effects types of cuttings had on plant height. These effects were significantly different at the 5% probability level. The tallest plants (26 cm) were that of the treatment in which softwood cuttings were used (Table 3). Table 1 shows ANOVA related to the interaction effects of types of cuttings and various IBA concentrations on plant height. These effects were significant different at the 5% probability level. The tallest plants (48 cm) were achieved in the treatment of heel cuttings with IBA at 1500 mg/l, and the shortest plants (24 cm) in the treatment of heel cuttings with IBA at 50 mg/l (Diagram 1).
Research Article

The Effects IBA and Types of Cuttings had on Number of Flowers per Plant

Based on results of ANOVA (Table 1), the individual effects of various IBA concentrations on number of flowers per plant were significantly different at the 5% probability level. As shown by the results in Table 2, the maximum number of flowers per plant (Puri and Thompson, 2003) was achieved in the treatment of applying IBA at 1500 mg/l (and this number was significantly different from that of the control). The minimum number of flowers per plant (Fuches, 2001) was obtained in the treatment of applying IBA at 50 mg/l. As can be seen in the table, the rapid submergence treatment at high concentrations increased the number of flowers per plant. Results related to the independent effects types of cuttings had on number of flowers per plant indicate there were significant differences between these effects on number of flowers per plant at the 5% probability level (Table 1). Considering results obtained from comparing the means, the number of flowers per plant in the softwood cuttings, which was 6, showed statistically significant differences with that of the heel cuttings, which was 4 (Table 3). Table 2 shows results related to ANOVA concerning the interaction effects types of cuttings and IBA had on number of flowers per plant. These effects were significant at the 5% probability level. Comparison of the means of the interaction affects the types of cuttings and IBA had on the number of flowers per plant shows the maximum number of flowers per plant (Sun and Bassuk, 1991) was achieved in the treatment of using heel cuttings with IBA at 1500 mg/l (Diagram 2). In the treatment of using heel cuttings with IBA at 2000 mg/l, the number of flowers per plant was 11, which was not significantly different from that of the treatment of using heel cuttings with IBA at 1500 mg/l (which was 12) (Diagram 2).

Obtained results show that increasing IBA concentration in the rapid submergence treatment of heel cuttings increased the number of flowers per plant, and that the effects of this treatment were significantly different from those of others. These results conform to those obtained by some researchers. Izadi et al., (2012) also reported that increasing the concentration of IBA in their research increased the number of rose flowers per plant (a result that agrees with that of this study). Moallemi and Chehrazi (2013) concluded in their research that increasing the concentration of naphthalene acetic acid and indolebutyric acid raised the number of flowers per plant in cuttings of Bougainvillea spectabilis.

The Effects IBA and Types of Cuttings had on Number of Petals

Based on the results of ANOVA concerning the individual effects of IBA on number of petals, various levels of IBA treatments had significantly different effects on number of petals at the 5% probability level (Table1). As shown in Table 2, IBA at 200 mg/l had the maximum effect on number of petals (34 petals), while the minimum number of petals (23) belonged to the control (and the difference between these two numbers was significant). Results of ANOVA (Table 1) indicate the interaction effects types of cuttings and IBA concentration on number of petals were not significant. According to the table of comparison of the means (Table 3), the largest number of petals (with an average of 25) was observed in

Diagram 2: Interaction effects of types of cuttings and IBA on number of flowers per carnation plant
the heel cuttings, which was significantly different from the corresponding number in the softwood cuttings. Table 2 shows results of ANOVA regarding the interaction effects of types of cuttings and IBA on number of petals. The maximum number of petals (34) was observed in the treatment of heel cuttings with IBA at 200 mg/l, and the minimum (21) in the treatment of softwood cuttings with IBA at 50 mg/l (Diagram 3).

Diagram 3: The interaction effects of types of cutting and IBA on number of petals in carnations

The Effects of IBA and Types of Cuttings on Fresh Weight of Aerial Organs of Carnations

Based on results of ANOVA (Table 1) concerning the individual effects of IBA on fresh weight of aerial organs of carnations, no significant differences were found among the various applied concentrations of IBA. Comparison of the means (Table 2) indicates the largest fresh weight of aerial organs (432.5 mg) was achieved with IBA at 1000 mg/l (which was significantly different from that of the control), and the smallest (265 mg) was that of the control.

Results of the individual effects of the types of cuttings on fresh weight of aerial organs showed significant differences at the 5% probability level (Table 1). Comparison of the means indicated that the fresh weight of the aerial organs in the treatment of heel cuttings (with an average of 317 mg) was greater than that of softwood cuttings (with an average of 202 mg), but that this difference was not statistically significant (Table 3). Table 1 lists the results of ANOVA concerning the interaction effects of types of cuttings and IBA on fresh weight of aerial organs. These effects on the fresh weight of the aerial organs were not significant. Softwood cuttings with IBA at 1500 mg/l had the maximum fresh weight of aerial organs (434 mg), while softwood cuttings with IBA at 1000 mg/l and heel cuttings with IBA at 1000 mg/l had the second largest fresh weights of aerial organs (428 and 421 mg, respectively). Softwood cuttings with no IBA application had the minimum fresh weight of aerial organs (248 mg) (Diagram 4).

Diagram 4: The interaction effects of the types of cuttings and IBA on fresh weight of aerial organs in carnations
The Effects of Types of Cuttings and IBA on Dry Weight of Aerial Organs in Carnations

Based on results of ANOVA (Table 1), the individual effects of IBA application at various concentrations on dry weight of aerial organs were not significant. Comparison of the means revealed that the maximum dry weight of aerial organs (4.193 mg) was achieved with IBA at 200 mg/l (which was significantly different from that of the control), and that the minimum (1.24 mg) belonged to the control. The individual effects of the types of cuttings on the dry weight of the aerial organs in various treatments were not significantly different (Table 1). Comparison of the means indicated that the dry weight of aerial organs in the heel cuttings (3.29 mg) was greater than that of the softwood cuttings (2.28 mg) (Table 3). Table 1 shows results of ANOVA concerning the interaction effects of types of cutting and various concentrations of IBA on the dry weight of aerial organs. These effects were not significant. The maximum dry weight of aerial organs (4.34 mg) was achieved in the treatment of heel cuttings with IBA at 1000 mg/l, and the second largest dry weight of aerial organs (4.18 mg) in the treatment of heel cuttings with IBA at 1500 mg/l. Softwood cuttings with no IBA application yielded the minimum dry weight of aerial plants (1.31 mg) (Diagram 5).

Diagram 5: The interaction effects of types of cuttings and IBA on dry weight of aerial organs in carnations

The Effects of Types of Cuttings and IBA on Bloom Diameter in Carnations

Based on results of ANOVA (Table 1), various concentrations of IBA had significant effects on bloom diameter in carnations at the 5% probability level. Comparison of the means (Table 2) shows the largest bloom diameter (61 mm) was achieved with IBA at 1000 mg/l (which was significantly different from that of the control), and the minimum (42 mm) was obtained with IBA at 100 mg/l. Individual effects of the types of cuttings on bloom diameter were not significant (Table 1).

Diagram 6: The interaction effects of types of cuttings and IBA on bloom diameter in carnations
Comparison of the means indicated bloom diameter in heel cuttings (54 mm) was larger than that in softwood cuttings (39 mm) (Table 3). ANOVA concerning the interaction effects types of cuttings and various IBA concentrations on bloom diameter shows these effects were not significant. The largest bloom diameter (66 mm) was that of heel cuttings with IBA at 200 mg/l, and the second largest (64 mm) that of heel cuttings with IBA at 50 mg/l. The smallest bloom diameter (42 mm) belonged to the softwood cuttings with no IBA application (Diagram 6).

Obtained results show IBA application increased bloom diameter in carnations. These results are in agreement with result of Izadi et al., (2012)

REFERENCES