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Research Article

EFFECT OF DIFFERENT CONCENTRATIONS OF IBA AND CUT TYPE ON ROOT INDUCTION AND MORPHOLOGICAL PROPERTIES 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, ten cuttings were planted in any repetition. The results of experiment demonstrated that there were significant differences among treatments (at 1% and 5% level). The effect of Indole butric acid on rooting potentials, root lengths very significant and on root, wet weight of root, was significant and on dry weight root, shoot lengths and dry and wet weight shoot was not significant. The highest root lengths were achieved (14.19 cm) from 1500 mg/lit IBA and lesser root lengths with 10.33 cm from 50 mg/lit IBA were achieved. The highest and lesser wet weight root ordinal (22.27 and 4.2 mg) from 1500 mg/lit IBA and control were achieved.

Keywords: *Clove, IBA, Rooting Ability, Kind Cutting*

INTRODUCTION
All selected items of the grenadines are added in asexual method (Khoshkhoy, 2004). Many varieties of grenadine are easily propagated through cuttings. Stem cuttings can be divided into hardwood, semi-hard-wood and soft-wood cuttings depending on the part of the plant from which they are taken. The recognition of factors affecting rooting is very noticeable in the success or failure of this method for the propagation of many plants. 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 (Khoshkhoy, 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. This study was carried out to evaluate the effect of Indole Butyric Acid and the type of cuttings on rooting and morphological characteristics of grenadine.

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: rooting percentage, root length, root number, root fresh weight, and root dry weight. 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

The effect of Indole Butyric and type of cutting on rooting percentage the results of the variance analysis of Indole Butyric Acid independent effect on rooting percentage are shown in Table 1. According to the results, Indole Butyric acid concentrations have significant effect on rooting percentage. According to the mean comparison table (Table 2), the highest rooting percentage was obtained at the concentration of 1500 mg per liter of Indole Butyric acid with (89.26%) which shows significant difference with the control. The lowest percentage of rooting was related to a concentration of 50 mg per liter of Indole-Butyric acid with 72.37%, which was lower than the control.

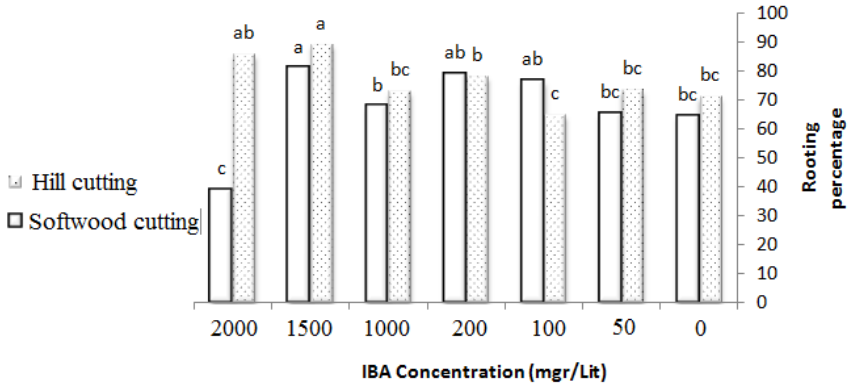

Chart 1: Interactive effects of type of cutting and Indole-Butyric acid on the rooting percentage of grenadine cuttings

Based on the results regarding the independent effect of type of cutting on rooting percentage (Table 1), a significant difference was obtained at the 5% level between different treatments of type of cuttings on rooting percentage. The highest percentage of rooting (87. 39 percent) was obtained in heel cuttings (Table 3). The results for the variance analysis of the interactive effect of type of cutting and Indole Butyric acid on rooting percentage are shown in Table 1. Based on the results for the variance analysis, it

can be seen that there is statistically significant difference at 1% level between type of cutting and Indole Butyric acid concentrations impacting rooting percentage. The highest rooting percentage (89.26%) was obtained in heel cuttings and 1,500 mg concentration per liter of Indole-Butyric acid. The lowest percentage of rooting (39%) was obtained in softwood stem cutting and concentration of 2000 mg per liter of Indole Butyric acid (chart 1).

The results indicate that the use of Indole-Butyric acid has caused a significant increase in the rooting percentage, which is consistent with the findings of other researchers (Sun and Basque, 1991). The positive effect of Indole Butyric acid on rooting is due to Oxin effect in stimulating the division of the first initiator cells of the root (Khoshkhoy, 2004). Oxin treatments and rooting in the mist system cause cell division and development in the cortex, xylem and the germinal layer, which breaks the Sclerotinia rings. In this study, not only did the increase in concentrations from 1,500 to 2,000 milligrams per liter fail to increase the rooting percentage, but also it reduced it. The best rooting percentage (89.26) was observed in the heel cuttings heel cuttings and concentration of 1,500 mg per liter of Indole-Butyric acid. The positive effect of heel cuttings heel cuttings in rooting of the cuttings under study is probably due to the substances stored in such cuttings, because in this kind of cuttings, there is a part of the older stem which has more food and facilitating substances available. This property is especially noticeable in the cuttings of easy-rooting plants. But in the cuttings of hard-rooting plants, the newer the stem is, the better it roots (Khoshkhoy, 2004). The least rooting percentage was observed in soft-wood cuttings and concentration of 2,000 mg per liter of Indole-Butyric acid, which is due to the increase in Indole Butyric acid and the type of the cutting, because the more delicate the plant tissue is, the more sensitive it grows to higher concentrations of Indole Butyric acid and this will reduce the rooting percentage.

Effect of Indole Butyric Acid and Type of Cuttings on Rooting

Based on the results of variance analysis (Table 1), regarding the independent effect of Indole-Butyric acid on root length, a significant difference at the 5% level was observed between different root concentration levels on root length. With respect to the results for the comparison of means (Table 2), the maximum root length (14.19 cm) was obtained at a concentration of 1,500 mg per liter of Indole-Butyric acid which was significantly different from the control. The lowest root length, too, was obtained at a concentration of 50 mg per liter of Indole-Butyric acid yielding 10.33 cm. As was seen, rapid treatment with a high concentration effects root elongation. The results for the independent effect of type cutting on root growth showed that there is a significant difference at the 5% level between different treatments of type of cuttings on root length (Table 1). With respect to the results for the comparison of means (Table 2), the root length of was in the soft-wood stem of cutting (12 cm) was more than that of heel cuttings (10.21 cm) which were significantly different from each other (Table 3).

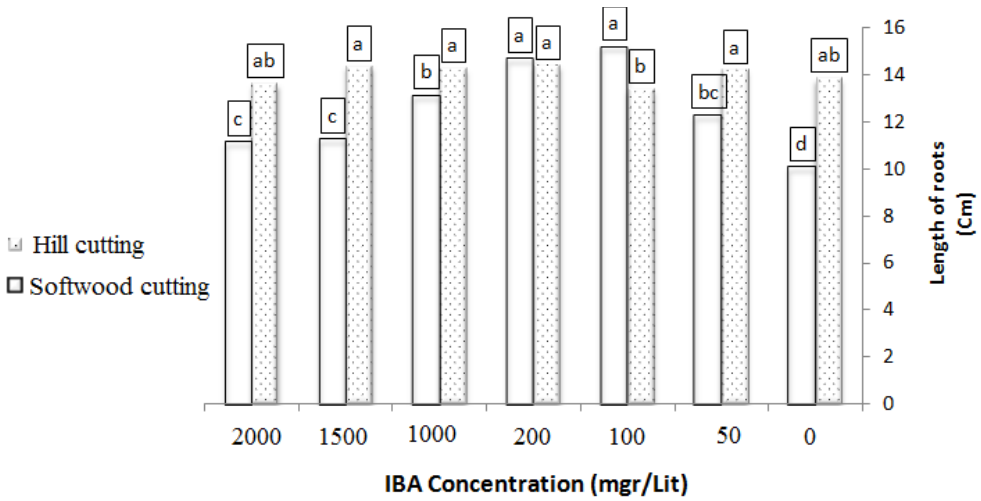

Chart 2: Interactive effect of Indole-Butyric acid concentrations and type of cuttings on grenadines cuttings

The results of variance analysis regarding the interactive effect of Indole-Butyric acid concentrations and type of cuttings are listed in Table 1. The investigation of the results for variance analysis of interactive effect of Indole-Butyric acid concentrations and type of cuttings showed no significant effect on root length. In comparing the means of the interactive effect of Indole-Butyric acid concentrations and type of cuttings, the maximum root length (15.23 cm) was obtained at a concentration of 1,500 mg per liter of Indole-Butyric acid (Chart 2). Second to it was heel cuttings with a root length of 14.37 cm and a concentration of 1500 mg per liter of Indole Butyric acid, which had no statistically significant difference. The lowest root length with 10.1 cm of root length cm was observed in softwood stem cuttings and control treatment (Chart 2).

The results indicate that the increase in Indole-Butyric acid concentration in delayed treatment and softwood stem cutting has caused a significant increase in the mean of root length and has a significant difference with other treatments, which is consistent with the findings of some of the researchers. Izadi *et al.*, (2012) also reported that an increase in Indole Butyric acid concentration increases the length of the rose root, which is consistent with the results of this study. Moallemi and Chehrazi (2003) 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.

Effect of Indole Butyric Acid and Type of Cuttings on the Number of Rooted Cuttings

Based on the results of variance analysis (Table 1) regarding the independent effect of Indole-Butyric acid on root length, a significant difference at the 5% level was observed between different root concentration levels on the number of roots (Table 1). According to Table 2, the concentration of 200 mg per liter of Indole-Butyric acid, with the number of 13.63, had the greatest effect on the number of roots compared to other concentrations, which was not statistically significant different from the control. A minimum of 8.83 roots was obtained at a concentration of 2000 mg per liter of Indole Butyric acid. The variance analysis of the independent effect of the type of cutting on the number of roots is shown in Table 1. On investigating the variance analysis, there was no significant difference for the interactive effect of the type of cutting and Indole Butyric acid on the number of roots. According to the comparison table of means (Table 3), the greatest number of roots was observed with a mean of 12.16 in heel cuttings, although it did not maintain a statistically significant difference with softwood stem cuttings. The results for variance analysis of the interactive effect of type cutting and Indole Butyric acid on the number of root are shown in Table 1. Through the investigation of variance analysis, the largest number of roots (17.14) was obtained in heel cuttings and the concentration of 1500 mg per liter of Indole Butyric acid, and the least number of roots (8.2) was obtained in softwood stem cuttings and the control (Chart 3).

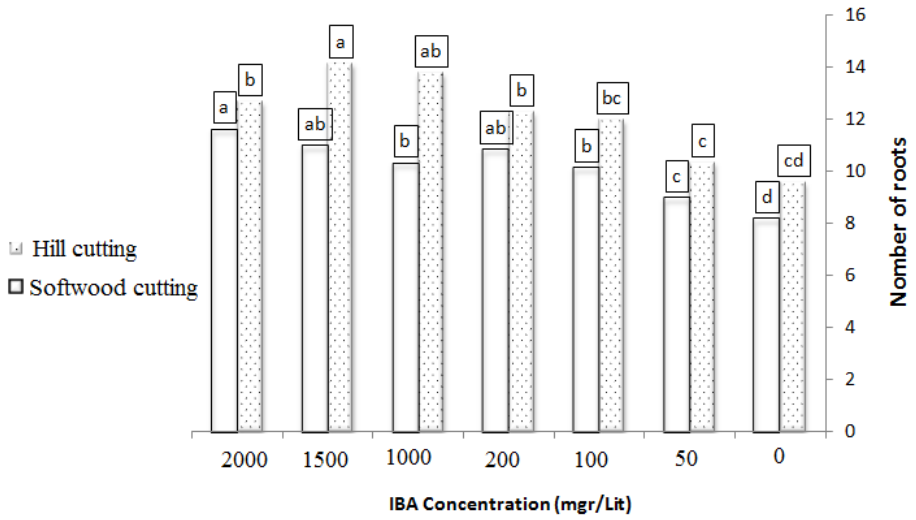

Chart 3: Interactive effect of Indole-Butyric acid concentrations and type of cuttings on the number of roots in grenadine cuttings

The results of this study indicate that with an increase in the concentration of Indole-Butyric acid, the number of the roots has increased. It seems that this is due to the effect of this regulator in stimulating the abnormal roots and helping the development of root initiators.

Effect of Indole Butyric Acid and Type of Cuttings on the Fresh Root Weight in Grenadines

Based on the results of variance analysis (Table 1) regarding the independent effect of Indole-Butyric acid on fresh root weight, a significant difference at the 5% level was observed between different concentrations levels applied on fresh root weight. With respect to the results for the comparison of means (Table 2), the maximum fresh root weight (22.27 mg) was obtained at a concentration of 1,500 mg per liter of Indole-Butyric acid which was significantly different from the control.

The lowest fresh root weight is related to the treatment of the control with 4.2 mg per liter of Indole-Butyric acid. The independent effect of type cutting on fresh root weight showed no significant difference (Table 1).

According to the results for the comparison of means (Table 2), the fresh root weight in heel cuttings (with a mean of 15.93 mg) was more than that of the soft-wood stem cutting (8.2 mg) (Table 3). The results for variance analysis of the interactive effect of type cutting and Indole Butyric acid on fresh root weight are shown in Table 1.

Through the investigation of variance analysis, a significant effect at the 5% level was observed between concentrations of Indole Butyric acid and type of cutting on fresh root weight. The maximum fresh root weight (22.86 mg) was obtained in heel cuttings at the concentration of 1000 mg per liter of Indole Butyric acid.

Next was a fresh root weight of 19.14 mg obtained in heel cuttings at the concentration of 200 mg per liter of Indole Butyric acid, and the least fresh root weight (4.1 mg) was obtained in softwood stem cuttings and the control (Chart 4).

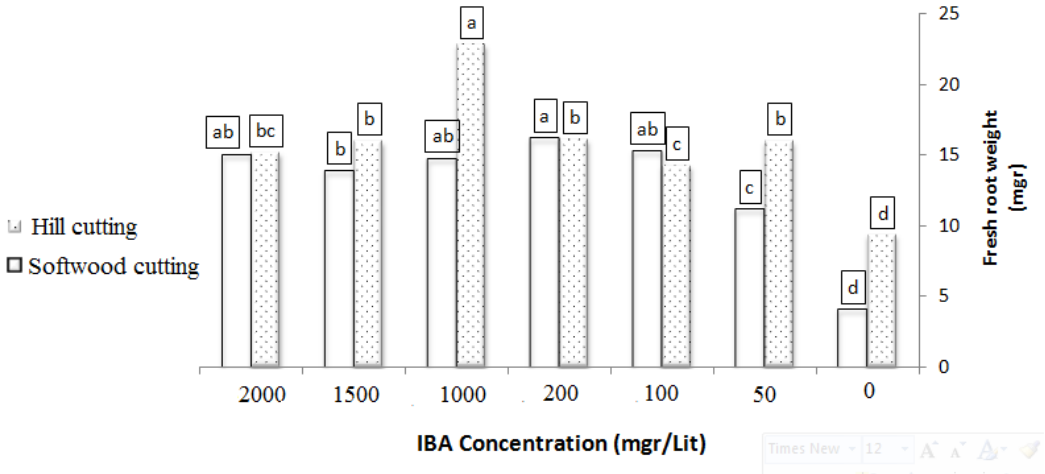

Chart 4: Interactive effect of Indole-Butyric acid concentrations and type of cuttings on fresh root weight in grenadine cuttings

Discussion

The results showed that the best percentage of rooting was observed in the treatment with 1,500 mg of Indole Butyric acid, in which 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 (Khoshkhoy, 2004). In this study, not only did the increase in concentrations from 1,500 to 2,000 milligrams per liter fail to increase the rooting percentage, but also it reduced it. This finding is consistent with the study results of some researchers in those high concentrations of Oxin causes tissue destruction of the cutting bottom (Puri and Verma, 1994).

Table 1: Variance analysis of different properties in rooting test of grenadine cuttings

		Mean Square				
SOV	**df**	**Dry weight of roots (mgr)**	**Fresh weight of roots (mgr)**	**Number of roots**	**Length of roots (Cm)**	**Rooting percentage**
Replication	2	0.124	0.881	4.851	1.921	73.68
Type of cut	1	1.983**	15.231 ^{ns}	0.32 ^{ns}	22.361*	3124.235*
Concentration	6	1.681 ^{ns}	19.864*	329.213*	43.974**	3851.972**
Type of cut× Concentration	6	1.311*	4.548*	10683 ^{ns}	1.109 ^{ns}	1236.943**
Error		0.091	1.347	4.681	1.711	267.768

*ns, * and ** are respectively non-significant and significant at 5% and 1% level of probability*

Table 2: Mean comparison of the effects of Indole Butyric acid on rooting properties of using Duncan method

IBA	**Dry weight of roots mgr)**	**Fresh weight of roots (mgr)**	**Number of roots**	**Length of roots (Cm)**	**Rooting percentage**
0	0.89 ^{e}	4.2 ^{e}	12.48 ^{ab}	11 ^{b}	77.83 ^{b}
50	1.36 ^{d}	6.45 ^{d}	13 ^{a}	10.33 ^{b}	72.37 ^{c}
100	3.39 ^{b}	12.44 ^{b}	11.19 ^{b}	12.26 ^{ab}	77.61 ^{b}
200	2.31 ^{c}	9.68 ^{c}	13.63 ^{a}	11.24 ^{b}	81.13 ^{ab}
1000	4.6 ^{ab}	19.21 ^{ab}	9 ^{c}	12.19 ^{ab}	81.09 ^{ab}
1500	6.45 ^{a}	22.27 ^{a}	12 ^{ab}	14.19 ^{a}	89.26^{a}
2000	3.62 ^{ab}	17.61 ^{ab}	8.83 ^{c}	12.62 ^{ab}	84.19 ^{ab}

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 rooting properties of grenadines cutting root by Duncan's method

Type of cutting	**Dry weight of roots mgr)**	**Fresh weight of roots (mgr)**	**Number of roots**	**Root length (Cm)**	**Rooting percentage**
Softwood stem cutting	0.91 ^{b}	8.2 ^{b}	11.23 ^{a}	12 ^{a}	75.63 ^{b}
Heel cutting	1.78 ^{a}	15.93 ^{a}	12.16 ^{a}	10.21 ^{b}	87.39 ^{a}

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

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