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Effects of Different Concentrations of IBA and NAA on Rooting of Pomegranate (*Punice granatum* L.) Cuttings.

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ABSTRACT:- This investigation was conducted to evaluate the effects of a range of indole-3-butric acid(IBA) and naphthalene acetic acid(NAA) concentrations on rooting of pomegranate cuttings. Concentrations were, IBA (200,400,600) and (2000,4000,6000), NAA (200,400,600) and(2000,4000,6000).Two methods of dipping, quick dip and slow dip.Hard wood cuttings were used.
The best result of length of roots was with 4000ppm IBA and 2000ppm IBA. IBA4000ppm gave the best result on number of cuttings. The larger number of leaves was obtained by the control and 200ppm IBA. Length of roots with 4000ppm IBA. The better result in number of roots was obtained by the concentration 6000ppm IBA.

Key Words: IBA, NAA, Wood Cutting. Pomegranate, Punice.

I. INTRODUCTION:

Pomegranate (*Punice granatum.* L.) :

Pomegranate is a dicotyledonous plant which belongs to the family Punicaceae. It is a Native to Iran and Himalayas of northern India **(Ibrar ,2012).**

Pomegranate is one of the deciduous plants. The tree tolerates cold when dormant, and it is resistant to temperatures less than 10^0F(-22^0), but sensitive to frost before complete dormancy. Good fruit quality of pomegranate are produced in areas with cool winter and hot, dry summers(Sharma,etal.2009).
It is grown in well-drained soil. In addition, it is tolerant to drought, salt, iron chlorosis and limestone**(Ibrar,2012).**

Karimi (2011) reported that pomegranate gardens are found in arid and semi-arid areas with low quality soil and water. Rootstock is tolerant to soil borne diseases and withstand chlorosis induced by calcareous soils
(Karimi,2011).

Pomegranate can be propagated by cuttings, commonly taken from suckers at the base of the stem**(Ibrar ,2012).**
Vegetative propagation is done to achieve the best desirable fruit qualities and true to type plants,(Sharma *et al*,**2009).**

The pomegranate plant is a shrub or small tree, about 8 meters high, most of them are small, deciduous trees with oblong leaves and short stems. The trunk is covered by a red brown bark which becomes gray by time.

While pomegranate trees may live up to 200 years, some pomegranate trees starts fruiting in the second year but normal production begins from 3 to 5 years(Glozer and Ferguson, 2011).
The formation of adventitious roots is genetic controlled and regulated by two factors, exogenous and endogenous (Druge and kadner,2008, Pop et al,2011).

The cutting forms new adventitious root system (Hartman *et al*, 2011). Ciampi and Gellini(1958) and Ciampi (1963) wrote about anatomy of rooting and relation between anatomical structure of stem and rooting ability in a wide range of plant species.Plant cutting removed from the stock plant normally passes through various anatomical changes accompanied by modification in metabolic activity and gene expression.
The cutting is exposed to physiological stress after severance from the mother plant. The cutting obtains little amount of water and insufficient nutrient absorption until root development is achieved(Druge and kadner, 2008, Pop et al 2011).
Okoro and Grace(1978) reported that cuttings of varieties with high native cytokinin levels have been more difficult to root than those with low cytokinin. Cytokinin and gibberellins play a role in inhibiting adventitious root formation. Hartman and Kester (1983) noted that high concentrations of gibberellins prevent adventitious root formation in cuttings.

Callus is a patchy mass of parenchyma cells in different phases of lignification that mostly grow at the basal end of cuttings placed under environmental conditions suitable for rooting (Hartman *et al*, 2011).Callus develops from cells at the base of the cutting, primarily from the vascular cambium, however cells of cortex and pith may also contribute to its formation(Hartman *et al*,2011).

In many types, rooting success has been related to endogenous auxin concentrations. Generally, auxin doses were greater in peach trees with a pillar (upright branches) than a standard (spreading branches) growth(Workoski and Takeda,2007) .

Hard wood, (sometimes called dormant or leafless), stem cuttings are taken from the previous season's growth. Leaves can be removed, without peeling the bark from the cutting. Cuttings are prepared in late fall, winter, or early spring. The cuttings must be healthy and free from disease or injury with at least two nodes when collected (Pijut, *et al*.2011).

The rooting medium has the function of holding the cutting in place during the growth and development, permit exchange of air at the base of the cutting and create dark environment by reducing light penetration to cutting base (Hartman *et al* ,2011).

II. MARTIALS AND METHODS:

Site of the Experiment:

This experiment was conducted at a nursery belonging to the Department of Horticulture, College of Agricultural Studies, Sudan University of Science Technology at Shambat (latitude 15-39N longitude 32-39E).

The experiment was conducted to study the effect of indole 3- butyric acid(IBA) and naphthalene acetic acid(NAA)at different concentrations, two methods of soaking and one type of stem cuttings (hard wood cutting).

3.3 Experimental Materials:

The cuttings were taken from Shambat Research Station Field and the Nursery of the College. Branches growing vigorously, medium to large in size, 8-years old trees and with spreading branches were used in the experiment.

Preparation of Cuttings:

Pomegranate stem cuttings were taken from mature wood of the previous season's growth and one type of stem cuttings was used. At least five nodes were included in each cutting, length of cuttings, 20cm. Thickness of cuttings range from thick, 1.5cm, medium,0.7mm and thin, 0.3mm.

Soaking Methods:

Slow -dip method(lower concentrations):

The basal part(2.5cm) of the cutting was soaked in dilute solution of IBA or NAA for 24 hours just before the cuttings were inserted into the rooting medium. Concentrations used for soaking the cuttings were: IBA, 200PPM, 400PPM, 600PPM) and NNA: 200PPM, 400PPM and 600PPM).

Cuttings were placed under shade in the nursery.

This slow method is a cumbersome technique that is not commercially popular. Equipments are needed for soaking cuttings and long time, 24 and 48 hours is required.

Quick-dip method (concentrated solution):

In the quick-dip method ,concentrations of solution were as follows: IBA: 2000PPM, 4000PPM, 6000PPM) and NNA: 2000PPM, 4000PPM, 6000PPM.Duration time of soaking or dipping was ten seconds.

The basal portion of the cutting, 0.5-1cm, was dipped in the solution for short time, 10 seconds.

Preparation of IBA and NAA:

The concentrations were prepared as follows:

1MG/L ----------1ppm

200ppm= 0.2GM/L.

2000ppm----------2000MG/L ==== 2GM/L.

4000ppm----------4000MG/L--------- 4GM/L.

These solutions were prepared at the tissue culture laboratory, Sudan University of Science and Technology, Shambat.

The material was dissolved in sodium hydrooxide(NaOH) and made to volume (1000ml)with potable water. 2mg IBA was weighed using precision balance and this furnished 200ppm solution.

In the second method the same steps for the preparation of contractions of indol-3-butyric acid(IBA) and naphthalene acetic acid (NAA) were followed.

Table 1: Type of hormones, concentrations, Time of dip and type of cuttings.

Concentration ppm	type of growth hormones	Type of cuttings	Dip period hours
200PPM	IBA	hard woodcutting	24
400PPM	IBA	hard woodcutting	24
600PPM	IBA	hardwood cutting	24
200PPM	NAA	hardwood cutting	24
400PPM	NAA	hardwood cutting	24
600PPM	NAA	hard woodcutting	24

Table (2): Quick Soaking:

Concentration ppm	Type of growth hormone	Type of cutting	Dip period second
2000	IBA	hard woodcutting	10
4000	IBA	hard wood cutting	10
6000	IBA	hard wood cutting	10
2000	NAA	hardwood cutting	10
4000	NAA	hard wood cutting	10
6000	NAA	hard wood cutting	10

Duration of Experiments:
The duration of the experiments was 12weeks.
The cuttings were placed under a lath house with 50% shade.

Plastic Bags:
Plastic bags with dimension of about 50-40-30cm with a number of drainage holes at the bottom were used. They were filled with a soil mixture of sand and silt(1:1).Each plastic bag contained 15 cuttings kept under the lath house under a covered frame in the nursery.

Irrigation:
Water was applied by putting a hose under the bags, the cutting absorb water through the holes at the bottom of the bag, The water was applied every other day.The pesticide(Apron star) was added with irrigation water to reduce any infection by pathogens.

Weeding:
Shallow weeding was done when required by hand.

Parameters:
Experiment parameters measured included the number of leaves, number of branches, the number of roots and root length, after three months.

Experimental design and statistical analysis:
The experimental units were in complete randomized block design. The data were analyzed using GenStat(computer program) versions 4 and the means were separated using Duncan's multiple Range Test(DMRT) at $p<0.05$(Gomez and Gomez 1984).

Results and discussion:

Table 1: Effects of low concentrations and slow soaking of IBA and NAA on number of branches;-

	Concentrations	**length of branches:**	**Time of soaking**
1-IBA200ppm	48.77abc	24 hour	
2-IBA400ppm	66.17ab	24 hour	
3-IBA600ppm	63.00ab	24hour	
4-NAA200ppm	2.00c	24 hour	
5-NAA400ppm	9.50c	24 hour	
6-NAA600ppm	18.00bc	24 hour	
7-CONTROL	77.50a		
CV%	62.9		

depicted in table 1 The results revealed that the best result for number of leaves was obtained by the control followed by the low concentration 400ppm, then 600ppm IBA. Comparison between IBA and NAA, in low concentrations and slow soaking, showed that NAA has negative effects on number of leaves This maybe due to an inhibitive effect of this growth regulator on pomegranate branching. IBA has neither promoting nor inhibitive role.

Table (2) Effect of high concentrations of IBA and NAA, quick dipping on length of branches:

Concentrations	length of branches:	Time of dipping
4-IBA2000ppm	73.00a	10sec
5-IBA4000ppm	73.07a	10sec
6-IBA6000ppm	64.60ab	10sec
10-NAA2000ppm	28.50abc	10 sec
11-NAA4000ppm	35.33abc	10sec
12-NAA6000ppm	5.00c	10sec
13-CONTROL	77.50a	
CV%	62.9	

AS shown in table 2, the results reflect that the concentrations of IBA,2000 ppm and 4000ppm gave the best result in length of branches compared with NAA, while the control was superior to all of them. This result showed an inhibitive effect of NAA on length of branches while IBA had no effect. According to Donald(1976) and Hartman(2011), high concentrations of IBA (2500 and 6000) with quick soaking of apple cuttings is preferred. They also found that NAA had an inhibitive effect. These results are in conformity with our findings.

Table 3:Effects of low concentrations and slow dipping on number of rooted cuttings:

Low concretions	Number of rooted cuttings	Time of soaking
1-IBA200ppm	1.66bcd	24 hour
2-IBA400ppm	2.33abcd	24 hour
3-IBA600ppm	4.00ab	24hour
4-NAA200ppm	0.77d	24 hour
5-NAA400ppm	0.33d	24 hour
6-NAA600ppm	1.66bcd	24 hour
7-CONTROL	2.66abcd	
CV%	53.9	

The results presented in table 3 show that the concentration 600ppm of IBA gave the highest number of rooted cuttings compared with other concentrations. NAA also had an inhibitive effect on number of rooted cuttings. So IBA is preferred than **NAA for rooting of pomegranate cuttings.**

Table 4: Effects of high hormone concentrations and quick dipping on number of rooted cuttings.

Concentrations	Number of rooted cuttings	Time of soaking
4-IBA2000ppm	2.66abcd	10sec
5-IBA4000ppm	4.33a	10sec
6-IBA6000ppm	3.66ab	10sec
10-NAA2000ppm	1.66bcd	10 sec
11-NAA4000ppm	3.33abc	10sec
12-NAA6000ppm	1.00cd	
13-CONTROL	2.66abcd	
CV%	53.9	

As depicted in Table 4, the number of rooted cuttings was higher due to the treatment with 4000ppm IBA.This finding is in conformity with *Goshetal(* 1988) who reported that good rooting in both semi hard wood cuttings and hard wood cuttings of pomegranate was due to treatment with IBA, 5000 ppm. It is also evident from the results that IBA is much more effective to stimulate rooting in the two groups of cuttings of pomegranate as compared to NAA. Purohit and Shekharappa(1985) reported that treatments with high concentrations and quick dipping on hardwood cuttings of pomegranate were more effective in inducing rooting. This is in agreement

with our results. It is also in conformity with Hartman(2011) who said that IBA is the best auxin for general use because it is non-toxic to plants over a wide range of concentrations and it is effective in promoting rooting of a large number of plant species.

Table 5:Effects of low concentrations and slow dipping on number of branches:

Concentrations	Number of branches	Time of soaking
1-IBA200ppm	4.00cde	24 hour
2-IBA400ppm	4.00cde	24 hour
3-IBA600ppm	7.00bc	24hour
4-NAA200ppm	0.33e	24 hour
5-NAA400ppm	0.66e	24 hour
6-NAA600ppm	3.33cde	24 hour
13-CONTROL	6.33bcd	
CV%	48.5	

As shown in table 5, there were highly significant differences between low concentration of IBA, slow dipping. and NAA, same concentration and dipping. The highest number of branches was obtained by 600ppm IBA followed by both 400ppm and 200ppm IBA. The lowest number of branches was obtained by 200ppm NAA followed by 400ppm NAA. These results indicated that 600ppm IBA had promotive effect on number of branches of pomegranate cuttings while lower concentrations of IBA and all concentrations of NAA had inhibitive effect compared to the control.

Auxin is required for initiation of adventitious roots on stems but divisions of the first root initial cells are dependent upon either applied or endogenous auxin(Hartman*etal*,2011). IBA is superior than NAA and the high concentrations are best when compared to low concentrations

Table 6:Effectsof high concentrations and quick dipping on number of branches:

Concentrations	**Number of branches**	**Tim of soaking**
4-IBA2000ppm	7.33bc	10sec
5-IBA4000ppm	12.00a	10sec
6-IBA6000ppm	10.33ab	10sec
10-NAA2000ppm	2.33de	10 sec
11-NAA4000ppm	4.33cde	10sec
12-NAA6000ppm	0.66e	10sec
13-CONTROL	6.33bcd	
CV%	48.5	

As depicted in Table 6, IBA 4000ppm recorded the highest number of btranches then 6000ppm and 2000ppm, all higher than the control and than all concentrations of NAA which recorded the lowest numbers than the control. This indicates the inhibitive effect of NAA on number of branches of pomegranate cuttings.

Table(7): Effect of low concentrations of hormones and slow dipping on number of leaves:

Concentrations	Number of leaves	Time of soaking
1-IBA200ppm	42.11a	24 hour
2-IBA400ppm	29.25abc	24 hour

3-IBA600ppm	25.07abcd	24hour
4-NAA200ppm	3.00d	24 hour
5-NAA400ppm	1.07d	24 hour
C-NAA600ppm	19.00abcd	24 hour
7-CONTROL	42.77a	
CV%	56.6	

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The results depicted in Table 7 revealed highly significant differences between IBA and NAA treatments except 600ppm. The best result was due to treatment with 200 ppm IBA and the control.

Table 8: Effects of high concentrations of hormones on number of leaves:

Concretions	Number of leaves	Time of soaking
1-IBA2000ppm	27.94abc	10sec
2-IBA4000ppm	36.60ab	10sec
3-IBA6000ppm	35.77ab	10sec
6-NAA2000ppm	13.17bcd	10 sec
5-NAA4000ppm	13.15bcd	10sec
6-NAA6000ppm	7.33cd	10sec
7-CONTROL	42.77a	
CV%	56.6	

The control recorded the best result followed by IBA4000ppm and 6000ppm, without significant difference between them (table 8). This revealed that IBA had no augmenting effect on number of leaves, in contrast to Singhh and Singhh (2002) findings who reported that application of IBA played some role in augmenting the number of leaves per cutting. All IBA concentrations and the control were significantly different from NAA treatments.

Table 9: Effects of low hormone concentrations and slow dipping on length of roots;

Concretion	Length of root	Time of soaking
1-IBA200ppm	8.74ab	24 hour
2-IBA400ppm	5.92b	24 hour
3-IBA600ppm	10.51ab	24hour
4-NAA200ppm	0.13b	24 hour
5-NAA400ppm	0.66b	24 hour
6-NAA600ppm	1.33b	24 hour
13-CONTROL	9.83ab	
CV%	91.6	

As depicted in table 9 the best result was obtained by the control followed by treatment with IBA600ppm. This indicates that IBA had no significant difference from the control while NAA had a significant inhibitive effect on length of roots in pomegranate cuttings.

Table 10: Effects of high concentrations of hormones and quick dipping on length of roots:

Concentrations	Length of root	Time of soaking quick
1-IBA2000ppm	7.62ab	10sec
2-IBA4000ppm	19.20a	10sec
3-IBA6000ppm	18.21a	10sec
4-NAA2000ppm	1.52b	10 sec
5-NAA4000ppm	4.42b	10sec
6-NAA6000ppm	0.32b	10sec
7-CONTROL	9.83ab	
CV%	91.6	

The results shown in table 10 indicates that there were significant differences in root length due to the treatments 4000 ppm and 6000 ppm IBA which gave the highest root length, while the 4000 NAA and 200 NAA recorded the lowest root length. This might be explained by the analogy of Pearse(1948) who noted that the auxin IBA generally has distinct advantage over NAA as it is slowly destroyed by the auxin destroying enzyme linked system. Likewise, Atman *et al* (2022) found that the highest rooting percentage in hardwood cuttings was obtained by 3000^{00}mg IBA concentration. Conversely, NAA has an inhibitive effect.

Table 11: Effects of low concentrations of hormones and slow dipping on number of roots;

Concentrations	Length of root	Time of soaking
1-IBA200ppm	4.67cde	24 hour
2-IBA400ppm	10.88cde	24 hour
3-IBA600ppm	14.66bcd	24hour
4-NAA200ppm	0.22e	24 hour
5-NAA400ppm	3.11de	24 hour
6-NAA600ppm	3.89de	24 hour
13-CONTROL	14.11bcd	
CV%	59.8	

The results shown in table 11 indicates that 600ppm IBA gave the highest length of roots followed by the control and 400ppm IBA. These results are significantly different from all concentrations of NAA which recorded the lowest length of roots.

Table (12): Effects of high concentrations of hormones and dipping on length of roots :

Concentrations	Length of root	Time of soaking
1-IBA2000ppm	15.88bc	10sec
2-IBA4000ppm	23.99ab	10sec
3-IBA6000ppm	31.11a	10sec
4-NAA2000ppm	2.44e	10 sec
5-NAA4000ppm	6.22cde	10sec
6-NAA6000ppm	0.66e	10sec
7-CONTROL	14.11bcd	
CV%	59.8	

As presented in table12, there were highly significant differences among the treatments, 6000 IBA gave the highest number of roots. This result is in agreement with Kumar(1995) who reported that the highest rooting of lemon cuttings were by treatment with 2000ppm IBA in combination with 200ppm p-hydroxybenzioc acid. These results are also in agreement with Panda *et al*(1990) who found that highest ratio of rooting and length of

roots of pomegranate cuttings were obtained by treatments by high concentrations of IBA. This is also in agreement with the findings of Bharad and Bhogave(2015).

V. CONCLUSION:

Treatment of pomegranate cuttings with high concentrations of IBA promote formation of rooted cuttings, number and length of roots, ,number of branches and number of leaves. On the other hand all concentrations of NAA were inhibitive to all these parameters. So it is recommended to use the growth regulator IBA rather than NAA in pomegranate cuttings root formation.

REFERENCES

[1]. Adiba, Atman, et al. Evaluation of cuttings ability of eighteen pomegranate cultivars from an ex-situ collection under influence of stem age and IBA treatment. *Scientia Horticulturae* 2022, 304: 111281.

[2]. Ciampi, C. and . Gellini. An anatomical study on the relationship between structure and rooting capacity in Olive cuttings. Nuovo Giorn Bot.ital. 1958. 65:417-424.

[3]. Ciampi, Clara, and Romano Gellini. "In S Orgen ZAES Viluppo Delle Radici Avventi Z In Olea europaea L.: Importance ZA Della S Truttura Anatomica Agli Effetti Dello S Viluppo Delle Radichette." Plant Biosystem. 1963.70.1:62-74.

[4]. Druege, Uwe, and Roland Kadner. Response of post-storage carbohydrate levels in pelargonium cuttings to reduce air temperature during rooting and the relationship with leaf senescence and adventitious root formation. Postharvest Biology and Technology.2008. 47.1:126-135.

[5]. Ghosh, D., A. Bandyopadhyay, and S. K. Sen. Effect of NAA and IBA on adventitious root formation in stem cuttings of pomegranate (*Punic granatum* L.) under intermittent mist. Journal : Indian Agriculturist, 1988, Vol. 32, No. 4, 239-243.

[6]. Glozer ,K and Ferguson, Department of Plant Sciences .3011. http/ip.ucdavis.edu.pege3-4.

[7]. Hartmann, H. T., and D. E. Kester. Plant propagation. Principles and practices.1983 : viii+-7viii . Prentice Hall

[8]. Hartmann, H. T., Kester, D. E., &Geneve, R. L. "Plant propagation principles and practices". 2011. (No. 631.53 H2555p Ej. 1 025385). Prentice Hall .

[9]. Hussain, I., Khattak, .A.M. and Amin, N. Response of pomegranate cuttings types to different environmental conditions. 2012. Sarhad Journal Agriculture, Univ Peshawa. 2013 : Vol. 28 no.1. Pp15-18.

[10]. Karimi, H.R.Stenting cutting and grafting, a technique for propagating pomegranate(*Punic granatum* L*)*. Journal of fruit and ornamental plant research. 2011:19(2)73-79.

[11]. Nirmal, S. ,Roshan, A. and Kumar. Standardization of Pomegranate(*Punice granatum* L.*)* propagation through cuttings. Biological forum- An International Journal.2009:1(1):75-80. University of Horticulture and Forestry. Solan.(H.P).

[12]. Okoro, O. , and Grace, J. The Physiology of Rooting, Populus Cuttings: II. Cytokinin Activity in Leafless Hardwood Cuttings. Physiologia Plantarum.1978: 44.3 : 167-170.

[13]. Panda, J. M., and Das R.C. Regeneration of pomegranate stem cuttings treated with IAA and IBA under intermittent mist. Journal: Orissa Journal of Horticulture, 1990: Vol. 18, No. 1-2, 32-37 ref. 8 : 32-37.

[14]. Pearse, Harold Leslie. Growth substances and their practical importance in Horticulture. Technical communication. No.2. Common Wealth Bureau of Horticulture and Plantation Crops. Est Malling England.1948.

[15]. Pijut, Paula M., Keith E. Woeste, and Charles H. Michler. Promotion of adventitious root formation of difficult-to-root hardwood tree species. *Horticultural reviews.* 2011: 38: 213.

[16]. Purohit, A. G., and Shekharappa, K.E. Effect of type of cutting and indole butyric acid on rooting of hardwood cuttings of pomegranate (*Pumice granatum* L.) *Indian Journal of Horticu*India.1985: 42.1and2 : 30-36

[17]. Rakesh Kumar, D. S. Gill, and Kaushik, R.A. Effect of indole butyric acid، and p-hydroxybenzoic acid and season on the propagation of lemon cv. Baramasi from cuttings. Haryana journal of Horticulture Scence. 1995): 13-18.

[18]. Raut, U. A., Bharad, S.G., and Bhogave, A.F. Effect of different types of cuttings and IBA levels on pomegranate cuttings. *Research on Crops* 16.3. 2015: 526-530.

[19]. Singh, A. K., and Singh, V.B.. Influence of wood maturity and auxins regeneration of Bougainvillea cuttings. Progressive Horticulture, 2002: Vol. 34, No. 2, 196-199 ref. 7

[20]. Tustin, Donald Stuart. Some endogenous factors affecting root formation *on* hardwood cuttings *of two clones of apple (Malus sylvestris* Mill.*)* rootstocks*: a* thesis submitted *in* partial fulfilment *of* the requirements for *the* degree *of* Doctor *of* Philosophy *at* Massey University. Diss. Massey University, 1976.

[21]. Tworkoski, Thomas, and Fumiomi Takeda. Rooting response of shoot cuttings from three peach growth habits. *Scientia Horticulturae*. 2007:115.1 : 98-100.

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