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The effect of different concentrations of IBA on hardwood and softwood cuttings of (*Punica granatum* L.)

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Abstract
The pomegranate, (*Punica granatum* L.) is a horticulture crop grown for profit. This crop's cultivation is increasing on a daily basis. Mostly because of its ability to survive, especially in arid or sparsely populated places. It may be propagated from seed; Pomegranate cuttings are also used for commercial propagation. To meet the expanding need for high-quality plant material, simple, rapid, dependable, and cost-effective multiplications are necessary, and cuttings are the ideal material for the job. Pomegranate plant is widely propagated through cuttings as it is the easiest and most suitable way of producing the plants on a very large scale. In pomegranates, cuttings are rapidly grown with the help of different types of PGR'S, among the PGRS widely used PGR'S are indole butyric acid (IBA) and NAA and they used to different concentrations as per the requirement where it ranges from 200ppm to 10000ppm, growing media also plays a key role in the growth of the cuttings as it provides the good aeration and helps in retaining the good amount of moisture. Humid weather conditions during the spring season increase the likelihood of roots and survival. As a result, the major purpose of this review study is to collect and synthesize data on the impact of various IBA treatments using pomegranate hardwood and softwood cuttings. in the past years along with the recent studies.

Keywords: IBA, NAA, PGRs, pomegranate, hardwood and softwood cuttings

Introduction
Pomegranate, (*Punica granatum* L.) is a member of the Lythraceae family, which includes just one genus Punica and two species: *Punica granatum* and *Punica Protopunica*. One of the most popular table fruits is the pomegranate. Due to its great edible fruits and pharmacological and ornamental purposes, it is an economically and nutritionally significant species of the world's tropical and subtropical regions. Pomegranate is considered to have originated in Iran. It is commonly cultivated in desert regions of Southeast Asia, Malaysia, the East Indies, tropical Africa, and India (Pawar and Pushparaj, 2020) [19] it quickly expanded to Mediterranean nations such as Spain, Morocco, Egypt, and Afghanistan. Baluchistan, Pakistan, Morocco, Iraq, China, India, Egypt, Iran, Spain, Afghanistan, Japan, and Russia are among the countries where it is widely grown. Pomegranate is Azerbaijan's and Iran's national fruit. It can be found from Kashmir to Kanyakumari, commercially it is grown in states like Rajasthan, Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh, Gujarat, Maharashtra, Haryana and Punjab also have small-scale plantations. It is regarded as an arid and semi-arid zone crop in India because to its resistance to various soil and climatic conditions. Pomegranates are one of the first domesticated fruit species, having been farmed for thousands of years (Still, 2006) [30]. The identification and quantification of a range of polyphenolic substances with significant antioxidant potential has increased pomegranate interest and production. (Gil *et al*., 2000) [8], which are expected to have health benefits for humans (Lansky and Newman, 2007) [16]. India produces the most pomegranates in the world. It is grown on over 234 thousand hectares in India, with a production of 2845 thousand MT (Anonymous, 2017-18). Air layering, hard-wood cuttings, and semi-hard wood cuttings are commonly used to grow pomegranates because cuttings of stem are the simplest, most effective, and most convenient form of propagation (Sharma *et al*., 2009) [26].
Softwood cuttings, Air layering, Tissue culture, dormant hardwood cuttings and Grafting are all methods for vegetative propagation of pomegranates. Commercial propagation, on the other hand, is frequently done with hardwood cuttings of stem because most growers and nurseries do not have access to tissue culture (micro propagation) equipment, it minimizes plant juvenility time (Karimi, 2011; Polat and Caliskan, 2006) [12, 20].

PGR'S and its Role in Cuttings
IBA (indole 3-butyric acid), a plant growth regulator, has long been used in agriculture to enhance root growth. It's an auxin derivative that regulates the size of the apical root meristem and plays an important role in root development, lateral root development and adventitious roots also (Frick *et al.*, 2018) [5].

According to Singh *et al.*, 2011 [29], cuttings treated with IBA 100ppm (slow dip) and 2000ppm (quick dip) sprouted the most (90.96 percent) compared to the Control (47.32 percent). In comparison to the control, the IBA treatment increased the proportion of sprouting. This might be linked to auxin-stimulated cell division during the onset of sprout-union formation.

Seir, 2017, found that cuttings that are treated with NAA 1500ppm + IBA 1000ppm and NAA1500ppm + IBA 1500ppm results in the early sprouting i.e. 25 days and 26 days respectively and the ones that are sprouted lastly are the control ones i.e. of 36 days. Cuttings treated with NAA 1500ppm + IBA 1500ppm had the highest percentage of rooting, next by NAA 1500ppm + IBA 1000ppm, while cuttings treated with NAA 500ppm+ IBA 500ppm had the lowest percentage as shown in Table 1and Table 2.

According to Damar *et al*., 2014 [3], IBA 2000ppm-treated pomegranate cuttings generated the most shoots per cutting, whereas control cuttings produced the fewest. Higher IBA concentrations resulted in enhanced cell division and elongation, as well as greater shoot growth activation, which presumably increased the number of nodes and led to the development of additional leaves.

Pomegranate *cv*. Ganesh hard wood cuttings soaked in IBA 100 ppm had the highest rate of rooting in cuttings, the most amount and length of roots per cutting, the most plant height, stem girth, and plant weight, according to Dhillon and Sharma (1992) [4]. The lower the IBA content, the poorer the rooting and growth qualities of the cuttings.

The shooting response of pomegranate (*Punica granatum*) *cv*. "Kandhari" stem cuttings planted with many types of growth medium and from those media, Vermiculite treatment resulted in the highest proportion of sprouted cuttings (76.67%). Under control, the lowest proportion of sprouted cuttings (26.67%) was reported. This finding matched with According to Ratna Kamari's (2014) research, pomegranate (*Punica granatum* L.) *cv.* "Bhagwa" cuttings fed with medium vermiculite sprouted the best.

In plants growing in river silt, Jain and Parmar (1993) [10] discovered more roots in pomegranate cuttings treated with IBA 1000 ppm + Boron 50 ppm, as well as an increase in the number of roots in IBA treated cuttings.

Alikhani *et al.* (2011) [1] observed that different IBA concentrations had a substantial effect on pomegranate shoot number but that medium type had no effect. Superior root system development with exceptional quality roots may have promoted more growth, leading in maximal survivorship in rooted cuttings.

The effects of IBA concentration and planting season on pomegranate (Punica granatum) cutting roots were studied by Mehta *et al*., (2018) they looked at three different cutting planting dates. (December 25th, January 10th, and January 25th) and treated with (500 ppm, 1000 ppm) IBA. The planting on January 25th produced the most Number of sprouted cuttings (7.11), number of sprouts per cutting (4.00), number of leaves on new shoots (10.89), and percentage of roots grown from cuttings (10.89).

Netam *et al.*, 2020 studies reported that in comparison to other growing media, the treatment T8 - sand + coco peat (1:1) (1.52) had a Root diameter per pomegranate cutting is substantially larger. However, its comparable to T3 – coco peat treatment (1.46). Under treatment T0 – control, the diameter of pomegranate roots per cutting was significantly reduced (1.08). The treatment T8 - sand + coco peat (1:1) (4.15) had the highest fresh root weight per pomegranate cuttings, which was equivalent to the T3 – coco peat treatment (3.95). The minimum fresh weight of roots per pomegranate cuttings was recorded after treatment T0 – control (2.68).

According to Singh *et al*., 2021 [29], treatment I3 demonstrated the largest root length (21.56 cm), preceded by treatment I2 (18.47 cm), and I1 demonstrated shortest length of roots (21.56 cm) (13.43 cm). An increase in IBA concentrations was found to increase root production per rooted cutting. However, as IBA concentrations rise above 3000 ppm (I3), As the number of roots generated per rooted cutting reduces, the number of roots produced per rooted cutting lowers as well. In comparison to I2 (18.22), I3 had the most roots (23.33) per rooted cutting, while I1 had the least (12.17). In comparison to I2 (73.48 percent), I3 induced the highest rooting percentage (78.13 percent), while I1 induced the lowest rooting percentage (48.13 percent) (64.48 percent).

Singh *et al*., 2020 s[19] experiment showed that the highest percentages of rooting were found in 3000 ppm IBA T1 (64.10 percent), while the lowest were found in T8 (distilled water) (36.11 percent). Treatment T1 (3000 ppm) IBA (59.55 percent) had the highest percentage of rooting survival, while treatment T8 pure water had the lowest (45.46 percent). Treatment T1 3000 ppm IBA (12.28) had the highest number of roots per cutting, whereas treatment T8 pure water had the lowest (6.41). Treatment T1 3000 ppm IBA (8.79) had the largest length of the longest root per cutting, whereas treatment T8 distilled water had the shortest (3.49).

IBA was shown to be more effective than NAA at inducing roots in pomegranate hardwood, semi-hardwood, and softwood cuttings by Ghosh *et al*. (1988) [7]. At 5000 ppm, IBA had an 83.33 percent rooting success rate, while at 10000 ppm, it had a success percentage of 83.33 percent when it came to rooting. There were more roots and a longer root length. With the aid of IBA, hardwood cuttings had greater rooting success than semi-hardwood and softwood cuttings.

Reddy & Reddy (1990) [23] used IBA and NAA at 2500 ppm to hardwood cuttings of pomegranate *cv*. Bassein Seedless. The cuttings were stored in the shade and either wrapped in polyethylene film or left unprotected. Polyethylene covering produced the highest rooting percentage, number of roots/cutting, and mean root length of all treatments.

Tanwar *et al*., 2020 [31] discovered that the minimum number of days required for first sprouting on pomegranate *cv*. Bhagwa Coco peat, Vermiculite, Perlite, and 2000 ppm IBA were used to cultivate cuttings recorded in an experiment on pomegranate cv. Bhagwa Coco peat, Vermiculite, Perlite, and 2000 ppm IBA were used to

cultivate cuttings. (11.63). The largest number of days required for initial sprouting (16.23) was reported in cuttings cultivated in Sand + Vermiculite + 1000 ppm IBA (T8).

Sandhu *et al*., (1991) [24] examined rhizogenesis in pomegranate hardwood cuttings. Kandhari and Malas, five-year-old pomegranate varieties, provided hardwood cuttings of 20 cm in length. The cuttings were soaked for 24 hours in 50, 100, 150, and 200 ppm IBA before being planted in nursery beds. In both cultivars, 100 ppm IBA resulted in the greatest rooting and quantity of roots. The 100 ppm IBA treatment resulted in the longest root length (24.3 cm) in Kandhari and the tallest plant height (167.8 cm) in Malas Kandhari had the largest plant girth (3.96 cm), plant height (157.0 cm), and root length (22.5 cm) after receiving the 50 ppm IBA treatment and the shortest root length (22.5 cm) in Malas. Purohit and Shekharappa (1985) [21] investigated the effect of IBA on the rooting of pomegranate hardwood cuttings. By using the rapid dip procedure, cuttings were treated with 2500, 5000, 7500, and 10000 ppm IBA. Cuttings treated with 5000 ppm IBA had the best percentage of survival, root length, and number of shoots. Tofanelli *et al*., 2003 [32] discovered that vermiculite had the best rooting percentage when six rooting substrates were evaluated for rooting in peach hardwood cuttings: carbonised rice husk, sand, vermiculite, and carbonised rice husk + vermiculite, sand + carbonised rice husk, sand + vermiculite

In the T6 treatment combination of sand + soil + FYM, *Ghani et al*., 2019 [6] discovered that the impact of rooting media and their mixtures significantly influenced the amount of days taken to begin growing, the least days taken to begin growing, and the days taken to fifty percent sprouting (17.66) and (19.96), respectively.

Kaur *et al*., (2016) [13] studied pomegranate cultivar Ganesh cuttings, varied dosages of P-hydroxybenzoic acid (PHB) and IBA to find the optimum effect of PHB and IBA, as well as the best planting period, and discovered that PHB 750ppm + IBA 1000ppm and August planting time were the best.

In pomegranate *cv.* Ganesh cuttings, Kaur *et al*., (2018) [14] discovered that PHB 750ppm + IBA 1000ppm offers the perfect outcomes for both supporting rooted and strong shoot growth.

The vegetative metrics of pomegranate cuttings given with IBA 1000ppm performed best, and the observing intervals are three months and four months. (Kamboj *et al*., 2017).

Hakim *et al*., (2018) [9] investigated *cv.* Ruby and Bhagwa with 2 types of auxins (NAA & IBA) and bio fertilizers, found that the NAA 1500 ppm + IBA 1500 ppm + Bio mix treatment generated the best results in terms of total chlorophyll content and leaf area.

Table 1: shows the effect of growth regulators on days to sprouting and shoot characteristics in pomegranate (Punica granatum L.) cv. 'Bhagwa' cuttings.

Treatment	No of days taken for the last sprout to appear	Sprouting (%)	Total no of sprouts/ cuttings	Sprout diameter(cm)	The longest sprout's length(cm)	Total no of leaves per cutting	Fresh weight of shoot(g)	Dry weight of shoot(g)
T1 = Control	36	44.00(41.55)	1.3	0.37	23.4	20.1	4.8	2.4
T2 = IBA500ppm +NAA500pp m	33	46.50(43.00)	1.5	0.39	25.4	20.9	5.43	2.8
T3 = IBA 500ppm+NAA 1000ppm	33.3	49.60(44.77)	1.9	0.43	26.5	20.2	5.5	2.86
T4 = IBA 500ppm + NAA 1500ppm	32.3	53.30(48)	1.9	0.41	27	20.7	5.96	3.1
T5 = IBA 1000ppm + NAA 500ppm	31	51.66(46.77)	1.8	0.39	27.1	26.5	6.33	3.46
T6 = IBA 1000ppm + NAA 1000ppm	32	55.30(48.04)	1.9	0.39	26.1	32.4	6.96	3.73
T7 = IBA 1000ppm + NAA 1500ppm	30	56.50(48.73)	1.8	0.41	25.3	33.9	7.26	3.8
T8 = IBA 1500ppm + NAA 500ppm	29	59.80(50.65)	1.9	0.51	28.1	32.3	7.3	4.1
T9 = IBA 1500ppm + NAA 1000ppm	25	67.10(55.00)	1.9	0.52	34.5	32.3	9.03	4.66
T10 = IBA 1500ppm + NAA 1500ppm	26	68(55.55)	2.09	0.59	32.4	33.7	8.73	4.53

-Seir (2017)

Table 2: Growth regulators' influence on root characteristics in pomegranate (Punica granatum L.) cv. 'Bhagwa' cuttings.

Treatment	rooting %	Total no of 1^0 roots	Total no secondary roots	length of the longest sprouts(cm)	Diameter of the longest root(mm)	Fresh weight of roots(g)	Dry weight of roots(g)
T1 = Control	40.50(39.52)	6.01	29.2	8.3	1.39	1.5	0.85
T2 = IBA 500ppm + NAA 500ppm	40.10(39.28)	6.03	41.1	8.6	1.49	1.6	0.91
T3= IBA 500ppm + NAA 1000ppm	46.00(42.70)	6.9	45.9	9.9	1.53	2	1.16
T4= IBA 500ppm + NAA 1500ppm	47.30(43.45)	7.04	42.93	11.2	1.41	2	1.1
T5= IBA 1000ppm + NAA 500ppm	49.10(44.48)	7	45.7	16.1	1.45	2.1	1.26
T6= IBA 1000ppm + NAA 1000ppm	48.10(43.90)	7.09	55.2	15.5	1.42	2.2	1.3
T7= IBA 1000ppm + NAA 1500ppm	50.30(45.20)	8.9	60.12	16.1	1.47	2.2	1.3
T8= IBA 1500ppm + NAA 500ppm	53.10(46.77)	9.2	60.08	17.9	1.51	2.4	1.56
T9 = IBA 1500ppm + NAA 1000ppm	57.60(49.37)	10.3	62.7	17.8	1.55	2.7	1.63
T10 = IBA 1500ppm + NAA 1500ppm	60.40(51.00)	10.2	61.9	18.9	1.62	2.5	1.56

-Seir (2017)

References

1. Alikhani L, Ansari K, Jamnejad M, Tabatabaie Z. The effect of different mediums and cuttings on growth and rooting of pomegranate cuttings. Iranian journal of plant physiology spring,2011:1(3):199-203.
2. Anonymous. Indian Horticulture Database. National horticulture board, Ministry of Agriculture, Government of India, New Delhi, 2017.
3. Damar D, Barholia AK, Lekhi R, Haldar A. 9 Effect of growth regulators and biofertilizers on survival of pomegranate (Punica granatum L.) stem cuttings. Plant Archives,2014:14(1):347-350.
4. Dhillon WS, Sharma KK. Effect of Indole butyric acid on rooting of cuttings in Pomegranate. J. Punjab Agri. Uni,1992:29(3):350-353.
5. Frick EM, Strader LC. Roles for IBA-derived auxin in plant development. Journal of Experimental Botany,2018:69(2):169-177.
6. Ghani M, Sharma MK, Habibi HK. Effect of Growing Media on Rhizogenesis and Growth of Rooted Stem Cuttings of Pomegranate (Punica granatum) cv. Phule Bhagwa Super. Under Open Field Condition. Int.J.Curr.Microbiol.App.Sci,2019:8(07):915-923.doihttps://doi.org/10.20546/ijcmas.2019.807.110.
7. Ghosh D, Bandyopadhyay A, Sen SK. Effect of NAA and IBA on adventitious root formation in stem cuttings of Pomegranate (Punica granatum L.) under intermittent mist. Indian Agriculturist,1988:32(4): 329-342.
8. Gil M, Tomás-Barberán F, Hess-Pierce B, Holcroft D, Kader A. Antioxidantactivity of pomegranate juice and its relationship with phenolic composition and processing. J. Agric. Food Chem,2000:48(10):4581-4589.
9. Hakim A, Jaganath S, Honnabyraiah MK, Kumar SM, Kumar SA, Dayamani KJ. Effect of bio fertilizers and auxin on total chlorophyll content of leaf and leaf area in pomegranate (Punica granatum L.) cuttings. International Journal of Pure and Applied Bioscience,2018:6(1):987-991.
10. Jain PK, Parmar KL. Response in hardwood cuttings of pomegranate treated with rooting media, IBA and Boron. JNKVV Res J,1993:27(1):56-58.
11. Kamboj S, Singh K, Singh S, Gandhi N. Department of Agriculture, DAV College, Abohar (India). Effect of Indole Butyric Acid on Rooting and Vegetative Parameters of Pomegranate (Punica granatum L.) Cuttings. International journal of advance research in science, 2017, 6(01).
12. Karimi HR. Stenting (Cutting and Grafting) - a technique for propagation pomegranate (Punica granatum L.). J. Fruit Ornam. Plant Res,2011:19(2):73-79.
13. Kaur S, Kaur A, Kaur G. Effect of IBA, PHB and time of planting on rooting of pomegranate (Punica granatum L.) cuttings cv. Ganesh. Asian Journal of Science and Technology,2016:7(11):3757-3761.
14. Kaur S, Kumar D, Kumar A, Yadav JK. Effect of IBA and PHB on roots and shoots of pomegranate (Punica granatum L.) cuttings cv. Ganesh. Journal of Pharmacognosy and Phytochemistry,2018:7(6):1251-1254.
15. Koteswara Rao GS, Bisati IA, Sharma A, Kosser S, Bhat SA. Effect of IBA concentration and cultivars on number of leaves, leaf area and chlorophyll content of leaf in Pomegranate (Punica granatum L.)

Int.J.Curr.Microbiol.App.Sci,2021:10(11):207-217 216 cuttings under temperate conditions of Kashmir. Journal of Pharmacognosy and Phytochemistry,2020:6:86-90.
16. Lansky EP, Newman RA. Punica granatum (pomegranate) and its potential for prevention and treatment of inflammation and cancer. J. Ethnopharmacol,2007:109(2):177-206.
17. Mehtha SK, Singh KK, Harsana AS. Effect of IBA concentration and time of planting on rooting in pomegranate (Punica granatum) cuttings. Journal of Medicinal Plants Studies,2018:6(1):250-253.
18. Netam SR, Sahu GD, Markam PS, Minz AP. Effect of different growing media on rooting and survival percentage of pomegranate (Punica granatum L.) cuttings cv. Super Bhagwa under Chhattisgarh plains condition. International Journal of Chemical Studies,2020:8(5):1517-1519.
19. Pawar YD, Pushparaj Singh. Advances in Propagation Techniques of Pomegranate. International Journal of Current Microbiology and Applied Sciences, 2020.
20. Polat AA, Caliskan O. Effect of indole butyric acid (IBA) on rooting of cutting in various pomegranate genotypes. ActaHortic,2006:818:187-192.
21. Purohit AG, Shekharappa KE. Effect of type of cutting and IBA on rooting of hard wood cuttings of pomegranate (Punica granatum L.). Indian J. Hort,1985:42(1-2):30-36.
22. Ratna, Kumari K. Studies on the effect of IBA and rooting media on rhizogenesis of cuttings of pomegranate (Punica granatum L.) cv. Bhagwa under shade net conditions, 2014. http://krishikosh.egranth.ac.in/handle/1/69935.
23. Reddy YN, Reddy YTN. Effects of basal wounding, growth regulator and polythene covering on rooting of pomegranate cutting. J. Maharashtra Agric.Uni,1990:15(2):153-155.
24. Sandhu AS, Minhas PPS, Singh SN, Kambhoi JS. Studies on rhizogenesis in hard wood cuttings of pomegranate. Indian Journal of Horticulture,1991:48(4):302-304.
25. Seiar YA. Effect of growth regulators on rooting of cuttings in pomegranate (Punica granatum L.) cv. 'Bhagwa'. Journal of Horticultural Science,2017:11(2):156-160.
26. Sharma N, Anand R, Kumar D. Standardization of pomegranate (Punica granatum L.) propagation through cuttings. Biological Forum – An International J,2009:1(1):75-80.
27. Singh B, Singh S, Singh G. Influence of planting time and IBA on rooting and growth of pomegranate (Punica Granatum L.) 'Ganesh' cutting. ActaHortic,2011:890:183-188. DOI: 10.17660/ActaHortic.2011.890.24, International Symposium on Pomegranate and Minor - including Mediterranean – Fruits.
28. Singh G, Kachwaya DS, Gurbir Singh. Studies on the Different Concentration of IBA on Hardwood Cuttings of Pomegranate (Punica granatum L.) cv. Wonderful. Res. Jr. of Agril. Sci,2020:12(1):42-50.
29. Singh SD, Dilip Singh RK, Basu Langpoklakpam, Ranjan Hijam. Effect of IBA Concentrations and Length of Hardwood Cuttings on Rooting Performance of Pomegranate (Punica granatum L.) cv. Bedana. Int.J.Curr.Microbiol.App.Sci,2021:10(01):1540-1547. doi: https://doi.org/10.20546/ijcmas.2021.1001.180.
30. Still DW. Pomegranates: A botanical perspective. In: Heber, D., Schulman, R.N and Seeram, N.P. (Eds.), Pomegranates: Ancient Roots to Modern Medicine. CRC Press, Florida, 2006, 199-207.
31. Tanwar DR, Bairwa HL, Lakhawat SS, Mahawer LN, Jat RK, Choudhary RC. Effect of IBA and Rooting Media on Hardwood Cuttings of Pomegranate (Punica granatum L.) cv. Bhagwa. International Journal of Environment and Climate Change,2020:10(12):609-617.
32. Tofanelli M, Rodrigues J, Ono E. Rooting of peach cv. 'Okinawa' hardwood cuttings at different stem diameters, substrates, and pots. Ciencia Rural,2003:33:437-4.