



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(6): 767-771
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www.thepharmajournal.com
Received: 20-02-2022
Accepted: 31-05-2022

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Effect of plant growth regulators on rooting, growth and survival of Semi hardwood cuttings in pomegranate (*Punica granatum* L.) cv. Bhagwa

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Abstract

The experiment was conducted at Fruits nursery, Department of Fruit Science, college of Horticulture, Banda University of Agriculture & Technology, Banda - 210001 (U. P.) during the year 2020-21. The experiment was laid out in a Randomized Block Design with 9 treatments and 3 replications. The experiment was conducted with semi hardwood stem cuttings of pomegranate cultivar cv. Bhagwa under open conditions. Root promoting chemicals, IBA and NAA each at four concentrations of 250, 500, 1000 and 1500 ppm were used independently. Among the roots sprouting, minimum number of days taken to first sprouts (10.26 days), the average total sprouted cuttings (89.30%), diameter of shoot (6.75 mm), shoot length of cutting (24.70 cm) at 90 DAP, number of leaves per cutting (5.66, 6.80, 9.96) at 30, 60, 90 DAP respectively, fresh weight of shoot (11.19 g) and dry weight of shoot (5.47 g) at 90 DAP was recorded in treatment T4- IBA 1000 ppm. The maximum rooting percentage of cutting (84.32) at 90 DAP, the length of root of cutting (10.80 cm, 18.16 cm, 27.15 cm), average number of roots per cutting (20.19, 24.53, 37.52) at 30, 60 and 90, DAP respectively, the fresh weight of root (1.39 g), dry weight of root (0.76 g), survival percentage of cutting (90.54%) at 90 DAP respectively was recorded under the treatment IBA- 1000 ppm. Therefore, it is concluded that the application of IBA-1000 ppm shows the best result for all parameters like, days taken to first sprouting, total sprouted cutting, shoot diameter and length, numbers of leaves per cutting, fresh and dry weight of shoot, rooting percentage of cutting, length of roots, fresh and dry weight of roots, survival percentage of cutting and number of roots per cutting. This research has been recognized as practical application by nursery man of pomegranate for preparation of better quality planting materials along with better survivability.

Keywords: Bhagwa, IBA 250 ppm, IBA 500 ppm, IBA 1000 ppm, IBA 1500 ppm, NAA 250 ppm, NAA 500 ppm, NAA 1000 ppm and NAA 1500 ppm

Introduction

Pomegranate (*Punica granatum* L.) belonging to family Punicaceae, is an ancient fruit originated in Persia, Afghanistan and Baluchistan (De Candolle, 1967) [2] and is also thought to be indigenous to the region of Iran, but later spread to Mediterranean countries. Pomegranate is the most popular fruit and cultivated in Tropical and Sub-Tropical parts of the world. Spain and Iran are the leading producers of pomegranate. In consideration to world scenario, production of pomegranate was 1439.1 thousand tonnes. The total area under cultivation of pomegranate in India is 261.00 thousand ha and production is around 2315.00 thousand MT (National Horticulture Board, 3rd Advance estimate, 2019 - 2020).

Plants raised from seeds show a great variability with respect to tree vigour, precocity and quality of fruits. Therefore, vegetative propagation by cuttings is the most commercial, convenient and cheap method to get true to type plants. In order to reduce the high mortality of rooted cuttings under field conditions, it is highly desirable to build a healthy and well developed root system for enabling better field establishment of pomegranate trees through the use of suitable plant growth regulator treatment. The agro-climatic conditions of Bundelkhanda have great potential for its commercial cultivation of pomegranate, due to its hardy nature, and rich nutritional value, hot and semi humid with the mean annual rainfall is around 100 cm that occur mainly monsoon months of June to September.

Plant Growth Regulators usually IBA and NAA are employed for stimulation and regulation of rooting in cuttings. It is to be noticed that optimum concentration of growth regulators used and biochemical constituents of mother cuttings would help in rapid multiplication of pomegranate cuttings.

So far, research work done on pomegranate propagation and optimum concentration of growth regulators is very meagre considering this, a study on propagation of using Bhagwa cultivar and concentrations of IBA and NAA Keeping in view of its potential and large distribution in Bundelkhanda region.

Methods and Materials

The main experimental site at the Fruit nursery, Department of fruit science, College of Horticulture, Banda university of Agriculture & Technology, which is located 6 km away from Banda city on Kanpur Road. The geographically, university is situated at 25.48° N latitude, 80.32° E longitude and at altitude of 214.96 meters from sea level in the southern Uttar Pradesh of India. The climate of main experimental site is predominantly characterized by typical Sub-tropical penetrated by long and intense summers. The soil is loose sediments as well as black cotton. Average annual rainfall is 90 cm and most of it about 88-90% received during only in three months i.e. July, August and September. However, June and October receive only 7-9% of total rainfall. The annual temperature is comparatively high and it ranges in between 35- 48 °C, 23-28 °C and 12-20 °C for summer, rainy and winter season respectively. The April, May and June are the hottest months and most time temperature goes beyond 45-48 °C. The average weekly rainfall, relative humidity, minimum and maximum temperature recorded during the experimental period. The experiment was conducted with semi hardwood stem cuttings of pomegranate cultivar cv. Bhagwa under open conditions. Root promoting chemicals, IBA and NAA each at four concentrations of 250, 500, 1000 and 1500 ppm were used independently. Source of cuttings and its preparation of pomegranate cuttings, the mature pomegranate trees were used as cutting sources. Trees were subjected to routine management operations in previous year. Semi-Hardwood cuttings were prepared from 8-12-month old wood about 0.8 cm to 1.2 cm in diameter and 16 to 20 cm in length with 4-5 nodes each. The leaves were removed from the cuttings and were trimmed to the convenient length by removing the portions from both the ends of cutting just above and below the nodes with the help of sharp secateurs. The basal end of the cuttings was given a slant cut to expose maximum absorbing surface for maximum rooting. Good quality red earth was used along with the farm yard manure in the ratio of 2:1 Potting mixture was filled into 20 x 10 cm sized perforated polythene bag of 200-gauge thickness. The required of the concentrations of growth regulators IBA (250 ppm, 500 ppm, 1000 ppm, 1500 ppm) and NAA (250 ppm, 500 ppm, 1000 ppm, 15000 ppm) were prepared by dissolving 2 g and 4 g of respective growth regulator in small quantity of ethanol and the volume is made up-to 1000 ml by the addition of distilled water. The basal 5 cm portion of the cutting was dipped in growth regulator formulation for 10 minutes and were allowed to dry in shade for 15 minutes under shade and planted in polythene bags containing rooting media. Cuttings were planted in inclined position at an angle approximately 45° to the horizontal to avoid dew or rain drops enter through cut surface and to a depth of 1-2 nodes below the soil. The medium was drenched with Bavistin (0.15%) at fortnightly intervals to check disease incidence.

The planted cuttings were allowed to root for 90 days. Polythene bags were watered well prior to removal of cuttings from them. The cuttings (Five Number per treatment per replication) were carefully removed from the polybags and

dipped in water to remove the sand particles adhering to roots to record the observations pertaining to roots. These five cuttings were Tags for recording observations throughout the study. After the cuttings were planted as per the treatments, the site of the experiment daily visited and the cuttings was sprouted in each replication was noted carefully. Then the calculation of the days taken for initiation of sprouting after the planting of cuttings was given by the difference between date of planting of cutting and the date of which the pomegranate cuttings were started to sprout. The total number of cuttings survived under each treatment in each replication was recorded and survival percentage of rooted cuttings was calculated. The data obtained during experimentation was statistically analyzed as per method given by Panse and Sukhatme (1985) and C.D. will be evaluating at 5% level of significance. Where MSE = Mean sum of squares due to error. The calculation of C.D. at 5% of table value will be carry out with the help of following formula. C.D. = Critical difference S.E. $m \pm$ = Standard error of mean.

Result and Discussion

The data related to number of days taken for first sprout to appear as influenced by plant growth regulators IBA and NAA. The data indicated that there were significant differences among different concentration of IBA and NAA for days taken to first sprout to appear (Table No -1). The T₄ (IBA 1000 ppm) to look lesser time for sprouting than T₉ (10.87). Among various concentrations of plant growth regulators, IBA 1000 ppm produced significantly early sprouting (10.26). It was followed by T₉ NAA 1500 ppm (10.87) which was on at par with T₉ (NAA) 1500 ppm (10.87). The interaction between different concentrations of plant growth regulators on days to first sprouting differed significantly. It was observed that cuttings of cv. Bhagwa treated with IBA 1000 ppm (10.26) sprouted significantly earlier followed by treated with NAA 1500 ppm (10.87), while maximum number of days taken for first sprout to appear was observed in T₁ control (15.60). The remaining treatments were in the range of 10.26-16.60 days. Better and early sprouting may be on account of an accumulation of endogenous growth promoting substances in the tissue of the materials. Kaur *et al.* (2020)^[6] in pomegranate cv. Bhagwa. Singh *et al.* (2014)^[15] found that 5000 ppm IBA best for early sprouting in cultivar, Ganesh under mist chamber. Tahseen *et al.*, (2005)^[20] reported to Better and early sprouting may be on account of an accumulation of endogenous growth promoting substances in the tissue of the materials.

The data have been recorded at 90 DAP of total sprouted cutting percentage ranged varies from (69.32-89.30%). The maximum sprouted cutting percentage was recorded in treatment T₄ IBA- 1000 ppm (89.30%), which was followed by T₃ IBA- 500 ppm (84.32) and T₇ NAA- 500 ppm (83.77). However, minimum sprouted cutting percentage was recorded under treatment T₁ Control (69.32). Remaining treatments like T₅ IBA- 1500 ppm (82.15) and T₆ NAA- 250 ppm (79.34). Significantly increased the sprouted cutting percentage as compared to T₁ control (69.32), Mehta *et al.* (2018)^[8] Studied on three sub factors (500 ppm, 1000 ppm and control). Observations were recorded on account of shoot diameter of cutting. The data have been recorded at 90 DAP, the shoot diameter ranged varies from (2.86-6.75 mm). Among the treatments maximum diameter of shoot was recorded in treatment T₄ IBA- 1000 ppm (6.75) which was followed by

Treatment T₅ IBA- 1500 ppm (5.39), T₃ IBA-500 ppm (5.13) and T₉ NAA-1500 ppm (4.22). However, minimum shoot diameter of cutting was recorded under treatment T₁ Control (2.86). Bhat *et al.* (2004) [1] noted T₁₀ (IBA 300 ppm + 2% borax) highest increased mean shoots diameter, Kaur *et al.* (2018) [6] reported that PHB (500 ppm, 750 ppm), to increase shoot diameter noted is maximum (1.29 cm).

Observations were recorded on account of shoot length of cutting. The data have been recorded at 90 DAP, the shoot length ranged varies from (9.53-24.70 cm). Among the treatments maximum shoot length of cutting was recorded in treatment T₄ IBA- 1000 ppm (24.70) which was followed by T₃ IBA- 500 ppm (21.30) and T₂ IBA 250 ppm (20.75). However, minimum shoot length of cutting was recorded under treatment T₁ Control (9.53). Barde *et al.* (2010) suggested that applied IBA 2000 ppm gave maximum shoots length (4.88 cm) in Pomegranate. Singh *et al.* (2014) [15] found that 5000 ppm IBA was best among all the concentration for maximum shoot length, Kaur *et al.* (2018) [6] reported that the results of the investigation indicated that IBA 1000 ppm + PHB 750 ppm proved to be the best in terms of increase to average length of shoot.

Observations were recorded on account of number of leaves per cutting. The data have been recorded at 30, 60 and 90 DAP. Among the treatments maximum number of leaves per cutting was recorded in treatment T₄ IBA- 1000 ppm (5.66, 6.80, 9.96), which was followed by T₅ IBA-1500 ppm (4.23, 5.65, 8.88), T₃ IBA-500 ppm (2.63, 5.36, 8.26), T₈ NAA-1000 ppm (4.33, 5.50, 7.66) and T₉ NAA 1500 ppm (3.61, 4.50, 7.63) respectively. However, minimum number of leaves per cutting was recorded under treatment T₁ Control (1.46, 3.43, 4.46) respectively. Singh, *et al.* (2014) [15] noted the effect of IBA 5000 concentration was best under mist chamber for number of leaves of pomegranate cv. Ganesh. Ram *et al.* (2005) [11] noticed that maximum number leaves were recorded with the application of (2500 ppm IBA + 1500 ppm PHB) in pomegranate cv. Ganesh and Kandhari. Pandey and Bisen (2010) [9] reported that guava cuttings treated with 4000 ppm IBA obtained maximum number of leaves (45.66).

The observation was recorded on account of fresh weight of shoot recorded at 90 DAP, Fresh weight of shoot ranged between (6.46-11.19 g). Among the treatments the maximum fresh weight of shoot recorded under the treatments T₄ IBA-1000 ppm (11.19). Which was followed by T₃ IBA- 500 ppm (8.25), T₇ NAA- 500 ppm (8.01) and T₉ NAA-1500 ppm (8.06)? However, minimum fresh weight of shoot was recorded under treatment T₁ control (6.46). Seran and Umadevi (2011) [12] noticed maximum fresh weights (4.21 mg) were recorded in cuttings of lemon dipped in 2500 ppm concentration of IAA. Seiar (2017) showed that highest fresh weight of sprout (9.03g) per cutting was recorded with IBA 1500 ppm + NAA 1000 ppm in pomegranate.

Observation on account of dry weight of shoot recorded at 90 DAPS, Dry weight of shoot ranged between (1.99-5.47 g). Among the treatments the maximum dry weight of shoot recorded under the treatments T₄ IBA- 1000 ppm (5.47), which was followed by T₃ IBA- 500 ppm (3.50), T₉ NAA-1500 ppm (3.01) and T₆ NAA- 250 ppm (2.74). However, minimum dry weight of shoot was recorded under treatment T₁ control (1.99). Seran and Umadevi (2011) [12] noticed maximum fresh weights of leaves (4.21 mg), shoots (0.76 mg) and roots (0.43 mg) and maximum dry weights of leaves (1.33 mg), shoots (0.102 mg) and roots (0.112 mg) were recorded in

cuttings of lemon dipped in 2500 ppm concentration of IAA. Siddiqua (2017) [14] reported in Dragon fruit maximum the dry weight of shoot (11.12 g) was recorded in cutting treated with IBA 7000 ppm, Seiar (2017) showed highest dry weight of shoot (4.66g) per cutting was recorded with IBA 1500 ppm + NAA 1000 ppm in pomegranate.

To find out the effect of plant growth regulators on survival of pomegranate cuttings

The observation was recorded on account of rooting percentage of cutting recorded at 90 DAP (Table No -2) rooting percentage of cutting ranged between (47.98-84.32%). Among the treatments the maximum rooting percentage of cutting recorded under the treatments T₄ IBA- 1000 ppm (84.32) which was statistically at par with T₅ IBA- 1500 ppm (80.96) and followed by T₉ NAA-1500 ppm (76.43), T₈ NAA -1000 ppm (74.80) and T₆ NAA- 250 ppm (74.44).

However, minimum rooting percentage of cutting was recorded under treatment T₁ control (47.98), Seiar (2017) showed highest rooting percentage (60.40%) were recorded in pomegranate cuttings treated with IBA 1500 ppm + NAA 1500 ppm, Singh *et al.* (2015) [16] was recorded maximum rooting in treatments combination with (IBA 400 ppm + NAA 200 ppm) by dipping in prepared solution for 24 hours, Ghosh, *et al.* (2017) [3] study of various concentrations of IBA and NAA recorded Maximum rooting (70.55%) was treated with IBA 200 ppm by dipping in prepared solution for 24 hours. Srivastava *et al.* (2005) [17] maximum percentage of rooted cuttings (65.42) was observed with 5000 ppm IBA in Kiwi fruit. Mehta *et al.* (2018) [8] recorded maximum percentage of rooted cuttings (73.33%) under IBA 500 ppm.

The data was recorded on account of length of roots of cutting. Among the treatments maximum length of root of cutting was recorded in treatment T₄ IBA- 1000 ppm (10.80, 18.16, 27.15), which was followed by T₉ NAA-1500 ppm (9.16, 16.13, 22.80), T₈ NAA -1000 ppm (8.83, 13.56, 21.16), and T₅ IBA- 1500 ppm (7.73, 15.1, 20.06) respectively. However, minimum length of roots of cutting was recorded under treatment T₁ Control (4.71, 8.05, 12.16) respectively. Siddiqua (2017) [14] observed in Dragon fruit that average length of roots per cuttings (12.41 cm) was recorded in cutting treated with IBA 7000 ppm. Alikhani *et al.* (2011) observed that Pomegranate cutting treated with 4000 ppm NAA gave maximum root length of 41.56 cm. Bhat *et al.* (2004) [1] observed that the treatments T₁₀ 300 ppm IBA + 2% Borax for 15 minutes gave maximum root length.

The observations were recorded on account of number of roots per cutting Among the treatments maximum number of roots per cutting was recorded in treatment T₄ IBA- 1000 ppm (20.19, 24.53, 37.52), which was followed by T₇ NAA- 500 ppm (15.45, 18.66, 32.08), T₆ NAA- 250 ppm (14.50, 17.33, 29.42) and T₃ IBA- 500 ppm (16.55, 20.66, 28.91) respectively. However, minimum number of roots per cutting was recorded under treatment T₁ Control (12.81, 13.50, 19.31) respectively. Bhat *et al.* (2004) [1] observed that in pomegranate (500 ppm IBA + 1% Borax) for 15 minutes gave the maximum root number, Kaur *et al.* (2018) [6] reported that IBA 1000 ppm + PHB 750 ppm gave maximum number of roots (24.65) in pomegranate cv. Ganesh. Kumar *et al.* (2016) [7] experiment was conducted to optimize the concentration of growth regulator IBA. In pomegranate cv. Phule Arakta recorded the maximum numbers roots per cutting under the treatments IBA 2500 ppm with vermiculite substrate.

The observations were recorded on account of fresh weight of root at 90 DAP, Fresh weight of root ranged between (0.64 - 1.39 g). Among the treatments the maximum fresh weight of root was recorded under the treatments T₄ IBA- 1000 ppm (1.39) which was followed by T₃ IBA- 500 ppm (1.17), T₅ IBA- 1500 ppm (1.10) and T₂ IBA- 250 ppm (1.00). However, minimum fresh weight of root was recorded under treatment T₁ control (0.64). Bhat *et al.* (2004)^[1] observed that in pomegranate 500 ppm IBA + 1% Borax for 15 minutes gave the highest fresh weight of root. Kumar *et al.* (2016)^[7] recorded those treatments IBA 2500 ppm with vermiculite substrate gave maximum fresh weights of roots in pomegranate cv. Phule Arakta.

Observations on account of dry weight of root recorded at 90 DAP, Dry weight of shoot ranged between (0.31-0.76 g). Among the treatments the maximum dry weight of root recorded under the treatments T₄ IBA-1000 ppm (1.39) which was followed by T₇ NAA -500 ppm (0.54), T₃ IBA 500 ppm (0.47), T₂ IBA 250 ppm (0.44) and T₈ NAA-1000 ppm (0.43). However, minimum dry weight of root was recorded under treatment T₁ control (0.31). Bhat *et al.* (2004)^[1] observed that in pomegranate 500 ppm IBA + 1% Borax for 15 minutes gave maximum dry weight of root. Kumar R. *et al.* (2016)^[7] concluded that maximum dry weights of roots were recorded with IBA 2500 ppm in pomegranate cv. Phule Arakta.

Observation on account of survival percentage of cutting was recorded at 90 DAP Survival percentage of cutting ranged between (69.41-90.54%). Among the treatments the maximum survival percentage of cutting was recorded under the treatments T₄ IBA-1000 ppm (90.54) which was statistically at par with treatment T₈ NAA-1000 ppm (83.71) and followed by T₉ NAA-1500 ppm (82.23) and T₃ IBA-500 ppm (81.0) and T₇ NAA-500 ppm (79.96) However, minimum survival percentage of cutting was recorded under treatment T₁ control (69.41). Kaur *et al.* (2018)^[6] reported that treatment (IBA 1000 ppm + PHB 750 ppm) proved to be the best in terms survival percentage (86.73%). Kumar *et al.* (2016)^[7] recorded that the maximum survival percentages were recorded in IBA 2500 ppm with vermiculite substrate in pomegranate cv. Phule Arakta. Hiral (2017)^[4] reported different levels of IBA and NAA, IBA 4000 ppm recorded maximum survival percentage. Thus, Fig can be propagated by hardwood cuttings treated with IBA 4000 ppm. Shukla *et al.* (2004)^[19] studied that, the effects of IBA (0, 50, 100, 200 and 400 ppm for 24 h) on rooting of pomegranate (cultivars Ganesh, Dholka and Kandhari) hardwood cuttings. The

highest survival percentage of cuttings was observed in Dholka treated with 100 or 200 ppm IBA. Tripathi *et al.* (2004)^[19] reported pomegranate's rooted cutting was recorded after 90 days of planting. Survival percentage was highest with 1000 ppm PHB + 5000 ppm IBA, followed by 1000 ppm PHB + 7500 or 10 000 IBA. Tanwar *et al.* (2012)^[18] showed that the treatment combination (T13) comprising Coco peat: Perlite: Vermiculite with 2000 ppm IBA recorded highest values in terms survival of rooted cuttings (93.78%).

The maximum rooting percentage of cutting recorded under the treatments T₄ IBA- 1000 ppm (84.32) which was statistically at par with T₅ IBA- 1500 ppm (80.96) and followed by T₉ NAA-1500 ppm (76.43), T₈ NAA -1000 ppm (74.80) and T₆ NAA- 250 ppm (74.44). However, minimum rooting percentage of cutting was recorded under treatment T₁ Control (47.98).

The maximum length of root of cutting was recorded in treatment T₄ IBA- 1000 ppm (10.80, 18.16, 27.15), which was followed by T₉ NAA-1500 ppm (9.16, 16.13, 22.80), T₈ NAA -1000 ppm (8.83, 13.56, 21.16), and T₅ IBA- 1500 ppm (7.73, 15.1, 20.06) respectively. However, minimum length of roots of cutting was recorded under treatment T₁ Control (4.71, 8.05, 12.16) respectively. The maximum number of roots per cutting was recorded in treatment T₄ IBA- 1000 ppm (20.19, 24.53, 37.52), which was followed by T₇ NAA- 500 ppm (15.45, 18.66, 32.08), T₆ NAA- 250 ppm (14.50, 17.33, 29.42) and T₃ IBA- 500 ppm (16.55, 20.66, 28.91) respectively. However, minimum number of roots per cutting was recorded under treatment T₁ Control (12.81, 13.50, 19.31) respectively. The maximum fresh weight of root was recorded under the treatments T₄ IBA- 1000 ppm (1.39) which was followed by T₃ IBA- 500 ppm (1.17), T₅ IBA- 1500 ppm (1.10) and T₂ IBA- 250 ppm (1.00). However, minimum fresh weight of root was recorded under treatment T₁ Control (0.64). The maximum dry weight of root recorded under the treatments T₄ IBA-1000 ppm (1.39) which was followed by T₇ NAA -500 ppm (0.54), T₃ IBA 500 ppm (0.47), T₂ IBA 250 ppm (0.44) and T₈ NAA-1000 ppm (0.43). However, minimum dry weight of root was recorded under treatment T₁ Control (0.31). The maximum survival percentage of cutting was recorded under the treatments T₄ IBA-1000 ppm (90.54) which was statistically at par with treatment T₈ NAA-1000 ppm (83.71) and followed by T₉ NAA-1500 ppm (82.23) and T₃ IBA-500 ppm (81.0) and T₇ NAA-500 ppm (79.96) However, minimum survival percentage of cutting was recorded under treatment T₁ control (69.41).

Table 1: Effect of plant growth regulators on shoot growth and of Semi hardwood cuttings in pomegranate cv. Bhagwa.

Treatments	Days taken to first sprouting	Total sprouted cuttings (%) at 90 DAP	Shoot diameter (mm) at 90 DAP	Shoot length (cm) at 90 DAP	Numbers of leaves per cutting			Fresh weight of shoots (g) at 90 DAP	Dry weight of shoot (g) at 90 DAP
					30 Days DAP	60 Days DAP	90 Days DAP		
T1 – Control	15.60	69.32	2.86	9.53	1.46	3.43	4.46	6.46	1.99
T2 IBA- 250 ppm	12.86	78.85	4.26	20.75	2.03	4.81	7.74	7.37	2.39
T3 IBA- 500 ppm	11.05	84.32	5.13	21.30	2.63	5.36	8.26	8.25	3.50
T4 IBA- 1000 ppm	10.26	89.30	6.75	24.70	5.66	6.80	9.96	11.19	5.47
T5 IBA- 1500 ppm	11.40	82.15	5.39	20.30	4.23	5.65	8.88	7.18	2.16
T6 NAA- 250 ppm	12.30	79.34	3.26	15.31	3.46	4.46	6.53	6.78	2.74
T7 NAA- 500 ppm	12.56	83.77	3.52	14.16	3.83	4.83	6.86	8.01	2.43
T8 NAA -1000 ppm	11.16	74.10	3.70	10.96	4.33	5.50	7.66	7.61	2.67
T9 NAA-1500 ppm	10.87	71.31	4.22	12.25	3.61	4.50	7.63	8.06	3.01
SE(m)±	0.34	1.22	0.32	0.55	0.16	0.23	0.51	0.36	0.16
C. D. at 5%	1.03	3.68	0.97	1.67	0.51	0.71	1.55	1.08	0.51

Table 2: Effect of plant growth regulators on rooting and survival of Semi hardwood cuttings in pomegranate cv. Bhagwa

Treatments	Rooting percentage of cutting at 90 DAP	Length of roots (cm) at 30, 60 and 90 days			Fresh weight of root(g) at 90 DAP	Dry weight of root(g) at 90 DAP	Survival percentage of cutting at 90 DAP	Number of roots per cutting		
		30 days	60 days	90 days				30 Days	60 Days	90 Days
T1 – Control	47.98	4.71	8.05	12.16	0.64	0.31	69.41	12.81	13.50	19.31
T2 IBA- 250 ppm	69.70	6.20	10.16	14.16	1.00	0.44	79.42	15.45	19.66	24.36
T3 IBA- 500 ppm	74.06	6.96	12.16	17.23	1.17	0.47	81.00	16.55	20.66	28.91
T4 IBA- 1000 ppm	84.32	10.80	18.16	27.15	1.39	0.76	90.54	20.19	24.53	37.52
T5 IBA- 1500 ppm	80.96	7.73	15.16	20.06	1.10	0.38	77.06	17.58	21.16	27.11
T6 NAA- 250 ppm	74.44	8.16	10.92	16.09	0.77	0.35	76.96	14.50	17.33	29.42
T7 NAA- 500 ppm	69.59	7.61	12.76	18.68	0.98	0.54	79.96	15.45	18.66	32.08
T8 NAA -1000 ppm	74.80	8.83	13.56	21.16	0.92	0.43	83.71	13.99	21.33	28.72
T9 NAA-1500 ppm	76.43	9.16	16.13	22.80	1.01	0.37	82.23	17.43	22.00	26.82
SE(m)±	1.60	0.49	0.32	0.21	0.03	0.04	2.69	0.57	0.74	1.20
C. D. at 5%	4.84	1.49	0.97	0.65	0.10	0.14	8.14	1.73	2.26	3.65

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