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KD Patel
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

AM Butani
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

BV Thummar
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

HP Purohit
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

RD Trambadiya
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Corresponding Author:
AM Butani
Assistant Professor, Department of Horticulture, Junagadh Agricultural University, Junagadh, Gujarat, India

Response of different media and iba on rooting and survival percentage of hardwood cutting in pomegranate (*Punicagranatum*L.) CV. Bhagwa

KD Patel, AM Butani, BV Thummar, HP Purohit and RD Trambadiya

Abstract
The field experiment entitled "Response of different media and IBA on rooting and survival of hardwood cutting in pomegranate (*Punicagranatum*L.) cv. Bhagwa" was carried out at Fruit Research Station, MadhadiBaug Farm, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during 2015-16. The experiment was laid out in a Completely Randomized Design with Factorial concept by three repetitions. The treatment consist of five level of different media M_1 (soil), M_2 [soil + FYM (1:1)], M_3 [soil + perlite (1:1)], M_4 [soil + sand + FYM (1:1:1)] and M_5 [soil + FYM + perlite (1:1:1)] and three level of IBA concentration I_1 (IBA 2000 ppm), I_2 (IBA 2500 ppm) and I_3 (IBA 3000 ppm). The mixture of media influenced on survival percentage (85.07%, 78.14% and 74.49%) at 30, 60 and 90 DAP, respectively and highest percentage (86.80%) of rooted cuttings were obtained with M_3 [soil + perlite (1:1)], whereas media M_4 [soil + sand + FYM (1:1:1)] showed maximum length (29.91 cm), fresh weight (2.64 g) and dry weight (0.66 g) of roots per cutting. Among the factor IBA, I_3 (IBA 3000 ppm) recorded highest percentage (87.10%) of rooted cuttings at 90 DAP, maximum length (31.47 cm) of roots per cutting, fresh weight (3.51 g) of roots per cutting, dry weight (0.89 g) of roots per cutting at 90 DAP and survival percentage (81.15%, 76.85% and 73.20%) at 30, 60 and 90 DAP, respectively. The interaction effect between the media and IBA were found significant. Highest percentage (90.66%) of rooted cuttings at 90 DAP and survival percentage (94.44%, 92.22% and 90.00%) at 30, 60 and 90 DAP, respectively were observed highest in M_3I_3 treatment combination, whereas, the highest length (32.93 cm), fresh weight (4.64 g) and dry weight (1.17 g) of roots per cutting were recorded under M_4I_3 treatment combination.

Keywords: Pomegranate, media, IBA, hardwood cutting

Introduction
The pomegranate (*Punicagranatum*L.) is one of the favourite table fruits of the tropical and subtropical regions. The fruit is native to Iran. As a cultivated crop, it is grown to a limited extent in selected areas in almost all the states of India. Maharashtra state accounts for more than two third of area, In Gujarat, area under pomegranate cultivation is nearly 9.38 thousand hectares with 99.33 thousand MT productions (Anon., 2014) [1]. The Important promising local varieties are Dholka, Bhagwa and Ganesh. Variety Dholka is mainly cultivated in Dholka district of Ahmadabad region along the river bank of Sabarmati and in Bhavnagar region along the bank of Satrunji River. Bhagwa variety is also known as Shendria or Sinduri, Astagandha and Kesar. It mostly cultivated in Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan and Madhya Pradesh. This is a selection from F_2 population of the cross Ganesh x Gulesha Red. Fruits are attractive, glossy, red rind. Arils are blood red in colour. It is a soft seeded variety. Pomegranate stands high among other fruits with regards to its nutritional value, taste and flavours. It is one of the richest sources of Riboflavin. Rind of the fruit has medicinal value. The fruit is valued for its dietic and medicinal properties in India.

The propagation of this crop is of fundamental importance to the orchardist and also to the research workers. In sexual propagation, it is raised through a seed which takes long period for bearing which are not true to type. Among the different methods of vegetative propagation, pomegranate is generally propagated through air-layering and hardwood cuttings. Air-layering is cumbersome and expensive (Nagpal, 1954) [16], affects the growth of mother plants adversely (Joshi, 1935) [11] and reduces the bearing capacity of tree for 2 to 3 seasons (Cheema *et al.*, 1954) [4]. Multiplication of plants through stem cutting is the most convenient method and by this method a stronger plant can be developed considerably in less time. While propagation of plants through cuttings (vegetative) is easier, less time consuming, true to type and bears early. The rooting capability of cuttings varies from cultivar to cultivar, location to location, season to season and age of the branch. The success per cent of pomegranate cuttings

depends on many factors such as conditions of the mother plant, part of the tree from where the cuttings are made, time of operation, used of different media, rainfall, temperature fluctuation, aftercare etc. Besides, different environmental conditions growth regulators also play an important role in rooting and growth of pomegranate cutting.

Rooting media is one of the most important factors for better rooting of cutting and survival of plant. Apart from the selection of proper ingredients, it is necessary to maintain the porosity of the rooting media so that proper development of roots takes place. A good rooting media is characterized by light weight, friable, easy blend ability, good water holding capacity, good drainage, porosity, free from fungal spores and insect *etc*. The organic and inorganic compounds like sand, FYM, perlite, vermiculite improves the physical property viz. porosity, CEC (Cation Exchange Capacity), water holding capacity and maintain a balance ratio of carbon and nitrogen (Shrivastava *et al*., 1998) [21]. The growth substance most commonly used for better rooting in cutting of various plant parts are IAA, IBA, NAA etc. However, IBA has proved to be the best for proper root growth and are widely used for successful rooting of cuttings (Ghosh *et al*., 1988; Sarma and Sarma, 1991) [8, 20]. While IAA and NAA have also given good results and their effectiveness varied according to species. Availability of quality planting material is current issue in pomegranate. Rooting of cutting is difficult in pomegranate. Many techniques evolved for easy rooting in cutting however; there is further need for development of rooting technique. There is great role of various media as well as plant growth regulators particularly IBA for rooting as well as survival of cuttings.

Materials and methods

The experiment was laid out in a Completely Randomized Design with Factorial concept by three repetitions at the Fruit Research Station, Madhadi Baug Farm, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh. The treatment consist of five level of different media M_1 (soil), M_2 [soil + FYM (1:1)], M_3 [soil + perlite (1:1)], M_4 [soil + sand + FYM (1:1:1)] and M_5 [soil + FYM + perlite (1:1:1)] and three level of IBA concentration I_1 (IBA 2000 ppm), I_2 (IBA 2500 ppm) and I_3 (IBA 3000 ppm). Data is statically analyzed by factorial CRD with 3 replications. The cuttings of one year old healthy hardwood shoots having a thickness 0.8 to 1.0 cm and length of 20-25 cm were selected to find out response of different media and IBA on rooting and survival of hardwood cutting in pomegranate.

Observations recorded

Days taken by cuttings to new sprout after planting in each treatment were counted and mean number of days taken for sprouting were worked out. The total numbers of sprouted cutting under each treatment were recorded at 30 day after planting and mean number of sprouted cutting were worked out. The percentage of rooted cuttings were recorded after 90 days of planting and calculated by dividing the number of rooted cuttings with the total number of cuttings and multiplied by hundred. The length of root per cutting was recorded at 90 days after planting with the help of scale and mean length was worked out. Fresh roots were removed from cutting and weight of roots was obtained with the help of electronic balance. Dry roots were oven dried at 60 °C for 48 hours and dry weight was taken with the help of electronic balance. The number of living plant was counted at 30, 60 and 90 days after planting and the total survival percentage was calculated and their average was worked out.

Results and discussion

Table 1: Effect of different media and IBA on days to shoot sprouting of pomegranate cutting

Treatment	Days to shoot sprouting
Growing media (M)	
M_1: Soil	9.46
M_2: Soil + FYM (1:1)	9.14
M_3: Soil + Perlite (1:1)	8.78
M_4: Soil + Sand + FYM (1:1:1)	10.00
M_5: Soil + FYM + Perlite (1:1:1)	9.01
S.Em.±	0.20
C. D. at 5%	0.57
IBA Concentration (I)	
I_1: IBA 2000 ppm	10.38
I_2: IBA 2500 ppm	9.64
I_3: IBA 3000 ppm	7.82
S.Em.±	0.15
C. D. at 5%	0.44
Interaction (M×I)	
S.Em.±	0.34
C. D. at 5%	NS
C.V.%	6.33

Effect of different media on days to shoot sprouting

The effect of different growing media was found effective on days to shoot sprouting. The minimum days to shoot sprouting (8.78 days) were observed in media M_3 containing [soil + perlite (1:1)], which was found at par with media M_5 (9.01 days) and M_2 (9.14 days). Maximum days to shoot sprouting (10.00 days) were recorded in treatment M_4 [soil + sand + FYM (1:1:1)]. This result is in agreement with the finding of Irshad *et al.* (2014) [10] in kiwi and Ratna (2014) [18] in pomegranate.

Effect of IBA concentration on days to shoot sprouting

The minimum days to shoot sprouting (7.82 days) were observed in treatment I_3 (IBA 3000 ppm). Maximum days to shoot sprouting (10.38 days) were recorded in treatment I_1 (IBA 2000 ppm). This result might be due to the fact that, better utilization of stored carbohydrates, nitrogen and other factors with the help of growth regulators. It is supported by the finding of Mohammad *et al.* (1999) [15] in apple and Kaur (2015) [12] in peach.

Interaction effect of growing media and IBA concentration on days to shoot sprouting

An interaction effect of different media and IBA concentration were found non significant.

Table 2: Effect of different media and IBA on sprouting percentage of pomegranate cutting at 30 DAP

Treatment	Sprouting percentage
Growing media (M)	
M_1: Soil	81.78
M_2: Soil + FYM (1:1)	84.81
M_3: Soil + Perlite (1:1)	88.90
M_4: Soil + Sand + FYM (1:1:1)	85.00
M_5: Soil + FYM + Perlite (1:1:1)	87.50
S.Em.±	0.82
C. D. at 5%	2.37
IBA Concentration (I)	
I_1: IBA 2000 ppm	81.25
I_2: IBA 2500 ppm	85.78
I_3: IBA 3000 ppm	89.77
S.Em.±	0.64
C. D. at 5%	1.84
Interaction (M×I)	
S.Em.±	1.42
C. D. at 5%	4.11
C.V.%	2.88

Table 2.1: Interaction effect of different media and IBA on sprouting percentage of pomegranate cutting at 30 DAP

IBA Concentration (I) Growing media (M)	I1: IBA 2000 ppm	I2: IBA 2500 ppm	I3: IBA 3000 ppm	Mean (M)
M_1: Soil	78.80	81.14	85.40	81.78
M_2: Soil + FYM (1:1)	83.75	84.25	86.44	84.81
M_3: Soil + Perlite (1:1)	80.54	90.20	95.96	88.90
M_4: Soil + Sand + FYM (1:1:1)	80.45	86.18	88.37	85.00
M_5: Soil + FYM + Perlite (1:1:1)	82.70	87.13	92.69	87.50
Mean (I)	81.25	85.78	89.77	
S.Em.±	1.42			
C. D. at 5%	4.11			
C.V.%	2.88			

Effect of different media on sprouting percentage

The maximum sprouting percentage (88.90%) was reported in media M_3 [soil + perlite (1:1)] at 30 DAP, which was found at par with media M_5 (87.50%) [soil + FYM + perlite (1:1:1)] while, minimum sprouting percentage (81.78%) was recorded in treatment media M1 (soil). This result is in agreement with the finding of Irshad *et al.* (2014) [10] in kiwi and Ratna (2014) [18] in pomegranate.

Effect of IBA concentration on sprouting percentage

The maximum sprouting percentage (89.77%) was observed in I_3 (IBA 3000 ppm) at 30 DAP, while minimum sprouting percentage (81.25%) was recorded in I_1 (IBA 2000 ppm). This result might be due to the fact that, better utilization of stored carbohydrates, nitrogen and other factors with the help of growth regulators. It is supported by the finding of Mohammad *et al.* (1999) [15] in apple and Kaur (2015) [12] in peach.

Interaction effect of growing media and IBA concentration on sprouting percentage

An interaction effect of different media and IBA concentration were found to be significant for sprouting percentage. The maximum sprouting percentage (95.96%) at 30 DAP was recorded in the treatment M_3I_3, which was found at par with the treatment M_5I_3 (92.69%). The minimum sprouting percentage (78.80%) was recorded under the treatment combination M_1I_1. This might be due to the larger pore size and good aeration capacity of the media suitable for early sprouting and auxins, which are known to induce stimulus for regeneration of roots by promotion of hydrolysis, mobilization and utilization of nutritional reserves in the region of root and shoot formation. These results are also close conformity by Mohammad *et al.* (1999) [15] in apple and Kaur (2015) [12] in peach.

Table 3: Effect of different media and IBA on percentage of rooted cutting and length (cm) of roots per cutting of pomegranate at 90 DAP

Treatment	Percentage of rooted cutting	Length of roots per cutting (cm)
Growing media (M)		
M_1: Soil	79.52	25.09
M_2: Soil + FYM (1:1)	83.59	26.50
M_3: Soil + Perlite (1:1)	86.80	28.67
M_4: Soil + Sand + FYM (1:1:1)	81.22	29.91
M_5: Soil + FYM + Perlite (1:1:1)	84.76	27.83
S.Em.±	0.54	0.39
C. D. at 5%	1.56	1.11
IBA Concentration (I)		
I_1: IBA 2000 ppm	78.77	23.59
I_2: IBA 2500 ppm	83.66	27.73
I_3: IBA 3000 ppm	87.10	31.47

S.Em.±	0.42	0.30
C. D. at 5%	1.21	0.86
Interaction (M×I)		
S.Em.±	0.94	0.67
C. D. at 5%	2.70	1.93
C.V.%	1.95	4.19

Effect of different media on percentage of rooted cutting

The considerably maximum percentage of rooted cutting (86.80%) was observed in media M_3 [soil + perlite (1:1)] whereas, the minimum percentage of rooted cutting (79.52%) were recorded in media M_1 (soil). This result is in agreement with the finding of Ercisli *et al.* (2002) [7] in kiwi and Dvin *et al.* (2011) [6] in apple.

Effect of IBA concentration on percentage of rooted cutting

The maximum percentage of rooted cutting (87.10%) was recorded in treatment I_3 (IBA 3000 ppm). The lowest percentage of rooted cutting (78.77%) was observed in I_1 (IBA 2000 ppm). This may be due to enhanced hydrolytic activity in presence of applied IBA coupled with appropriate planting time might be responsible for the increased percentage of rooted cuttings. These finding agreed with the finding of Popovic *et al.* (1999) [17] in pomegranate.

Interaction effect of different media and IBA concentration on percentage of rooted cutting

The different media and IBA concentration had significant effect and treatment M_3I_3 gave maximum rooted cutting (90.66%) which was at par with treatment M_5I_3 (88.20%) however, lowest rooted cutting (75.03%) found in treatment M_1I_1. This might be due to the fact that growing media improve the physical properties as well as enhanced nutrient level in soil and more rooting percentage coupled with positive response of IBA. The results of present study are also in close conformity by Popovic *et al.* (1999) [17] in pomegranate and Ercisli *et al.* (2002) [7] in kiwi.

Table 3.1: Interaction effect of different media and IBA on percentage of rooted cutting of pomegranate at 90 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	75.03	80.22	83.30	79.52
M_2: Soil + FYM (1:1)	80.26	84.49	86.03	83.59
M_3: Soil + Perlite (1:1)	82.56	87.16	90.66	86.80
M_4: Soil + Sand + FYM (1:1:1)	75.21	80.73	87.71	81.22
M_5: Soil + FYM + Perlite (1:1:1)	80.52	85.57	88.20	84.76
Mean (I)	78.77	83.66	87.10	
S.Em.±	0.94			
C. D. at 5%	2.70			
C.V.%	1.95			

Table 3.2: Interaction effect of different media and IBA on length (cm) of roots per cutting of pomegranate at 90 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	20.04	25.57	29.65	25.09
M_2: Soil + FYM (1:1)	21.22	27.01	31.26	26.50
M_3: Soil + Perlite (1:1)	25.75	28.39	31.86	28.67
M_4: Soil + Sand + FYM (1:1:1)	27.10	29.69	32.93	29.91
M_5: Soil + FYM + Perlite (1:1:1)	23.84	28.01	31.65	27.83
Mean (I)	23.59	27.73	31.47	
S.Em.±	0.67			
C. D. at 5%	1.93			
C.V.%	4.19			

Effect of different media on length (cm) of roots per cutting

The maximum length of root per cutting (29.91 cm) was observed in media M_4 [soil + sand + FYM (1:1:1)] whereas, the minimum length of root per cutting (25.09 cm) were recorded in media M_1 (soil). The increase in root length, fresh weight and dry weight of roots was result of a favourable rooting media for better growth of a root. The possible reason of this is the present of sand in M_4 media, sand may provide porous and well aerated soil with adequate moisture. These results were supported by finding of Baghel and Sarawat (1989) [3], Deol and Uppal (1993) [5], Gurjar and Patel (2007) [9], Ansari (2013) [2] and Khalis (2013) [13] in pomegranate. This may be attributed to general improvement the physical properties of the media, which improve length, fresh weight and dry weight of roots. The above results are also corroborated with the findings of Rodrigues *et al.* (2004) [19] in peach and Kishore *et al.* (2001) [14] in kiwi cuttings.

Effect of IBA concentration on length (cm) of roots per cutting

The maximum length of root per cutting (31.47 cm) was recorded in treatment I_3 (IBA 3000 ppm). The lowest length of root per cutting (23.59 cm) was observed in I_1 (IBA 2000 ppm). This might be due to the fact that positive response of plant growth regulator induces an accelerated rate for initiation and consequent production of more number of roots and length of roots. The better performance of IBA 3000 ppm from the other concentration like, 2000 ppm and 2500 ppm may be attributed to their synergistic effect. These results were supported by finding of Mohammad *et al.* (1999) [15] in apple, Kaur (2015) [12] in peach and Kishore *et al.* (2001) [14] in kiwi.

Interaction effect of different media and IBA concentration on length (cm) of roots per cutting

The data revealed that treatment M_4I_3 gave maximum length of root per cutting (32.93 cm), which was at par with treatment M_3I_3 (31.86 cm), M_5I_3 (31.65 cm) and M_2I_3 (31.26 cm) while, lowest length (20.04 cm) of root per cutting observed in treatment M_1I_1.This may be due to combination of media which is favourable for better growth of a root and IBA at higher concentration improve root growth. Similar finding were also reported by Kishore *et al.* (2001) [14] in kiwi.

Table 4: Effect of different media and IBA on fresh weight (g) and dry weight (g) of roots per cutting of pomegranate at 90 DAP

Treatment	Fresh weight of roots per cutting (g)	Dry weight of roots per cutting (g)
Growing media (M)		
M_1: Soil	1.89	0.47
M_2: Soil + FYM (1:1)	2.19	0.54
M_3: Soil + Perlite (1:1)	2.51	0.62
M_4: Soil + Sand + FYM (1:1:1)	2.64	0.66
M_5: Soil + FYM + Perlite (1:1:1)	2.45	0.58
S.Em.±	0.04	0.01
C. D. at 5%	0.11	0.03
IBA Concentration (I)		
I_1: IBA 2000 ppm	1.26	0.27
I_2: IBA 2500 ppm	2.25	0.57
I_3: IBA 3000 ppm	3.51	0.89
S.Em.±	0.03	0.01
C. D. at 5%	0.09	0.02
Interaction (M×I)		
S.Em.±	0.07	0.02
C. D. at 5%	0.20	0.05
C.V.%	5.04	5.60

Effect of different media on fresh weight (g) of roots per cutting

The media M_4 [soil + sand + FYM (1:1:1)] had significantly more fresh weight of roots per cutting (2.64 g) whereas, the low fresh weight of roots per cutting (1.89 g) were observed in media M_1 (soil). The increase in root length, fresh weight and dry weight of roots was result of a favourable rooting media for better growth of a root. The possible reason of this is the present of sand in M_4 media, sand may provide porous and well aerated soil with adequate moisture. These results were supported by finding of Baghel and Sarawat (1989) [3], Deol and Uppal (1993) [5], Gurjar and Patel (2007) [9], Ansari (2013) [2] and Khalis (2013) [13] in pomegranate. This may be attributed to general improvement the physical properties of the media, which improve length, fresh weight and dry weight of roots. The above results are also corroborated with the findings of Rodrigues *et al.* (2004) [19] in peach and Kishore *et al.* (2001) [14] in kiwi cuttings.

Effect of IBA concentration on fresh weight (g) of rootsper cutting

Higher fresh weight of roots per cutting (3.51 g) was recorded in I_3 (IBA 3000 ppm) whereas, I_1 (IBA 2000 ppm) had lowest fresh weight of roots per cutting (1.26 g). This might be due to the fact that positive response of plant growth regulator induces an accelerated rate for initiation and consequent production of more number of roots and length of roots. The better performance of IBA 3000 ppm from the other concentration like, 2000 ppm and 2500 ppm may be attributed to their synergistic effect. These results were supported by finding of Mohammad *et al.* (1999) [15] in apple, Kaur (2015) [12] in peach and Kishore *et al.* (2001) [14] in kiwi.

Interaction effect of different media and IBA concentration on fresh weight (g) of roots per cutting

The interaction effect of different media and IBA concentration on fresh weight of roots per cutting were found significant. The treatment M_4I_3 gave higher fresh weight of roots per cutting (4.64 g). The lowest fresh weight (0.85 g) of roots per cutting was observed in treatment M_1I_1. This may be due to combination of media which is favourable for better growth of a root and IBA at higher concentration improve root growth. Similar finding were also reported by Kishore *et al.* (2001) [14] in kiwi.

Table 4.1: Interaction effect of different media and IBA on fresh weight of roots (g) per cutting of pomegranate at 90 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	0.85	1.93	2.88	1.89
M_2: Soil + FYM (1:1)	1.25	2.22	3.10	2.19
M_3: Soil + Perlite (1:1)	1.15	2.82	3.55	2.51
M_4: Soil + Sand + FYM (1:1:1)	1.09	2.20	4.64	2.64
M_5: Soil + FYM + Perlite (1:1:1)	1.93	2.06	3.37	2.45
Mean (I)	1.26	2.25	3.51	
S.Em.±	0.07			
C. D. at 5%	0.20			
C.V.%	5.04			

Effect of different media dry weight (g) of roots per cutting

Media M_4 [soil + sand + FYM (1:1:1)] recorded significantly more dry weight of roots per cutting (0.66 g) whereas, the low dry weight of roots per cutting (0.47 g) were observed in media M_1 (soil). The increase in root length, fresh weight and dry weight of roots was result of a favourable rooting media for better growth of a root. The possible reason of this is the

present of sand in M_4 media, sand may provide porous and well aerated soil with adequate moisture. These results were supported by finding of Baghel and Sarawat (1989) [3], Deol and Uppal (1993) [5], Gurjar and Patel (2007) [9], Ansari (2013) [2] and Khalis (2013) [13] in pomegranate. This may be attributed to general improvement the physical properties of the media, which improve length, fresh weight and dry weight of roots. The above results are also corroborated with the findings of Rodrigues *et al.* (2004) [19] in peach and Kishore *et al.* (2001) [14] in kiwi cuttings.

Table 4.2: Interaction effect of different media and IBA on dry weight of roots (g) per cutting of pomegranate at 90 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	0.20	0.50	0.71	0.47
M_2: Soil + FYM (1:1)	0.25	0.53	0.84	0.54
M_3: Soil + Perlite (1:1)	0.28	0.69	0.89	0.62
M_4: Soil + Sand + FYM (1:1:1)	0.27	0.55	1.17	0.66
M_5: Soil + FYM + Perlite (1:1:1)	0.35	0.57	0.83	0.58
Mean (I)	0.27	0.57	0.89	
S.Em.±	0.02			
C. D. at 5%	0.05			
C.V.%	5.60			

Effect of IBA concentration dry weight (g) of roots per cutting

The IBA concentration I_3 (IBA 3000 ppm) recorded significantly maximum dry weight of roots per cutting (0.89 g) whereas, minimum dry weight of roots per cutting (0.27 g) was observed in I_1 (IBA 2000 ppm). This might be due to the fact that positive response of plant growth regulator induces an accelerated rate for initiation and consequent production of more number of roots and length of roots. The better performance of IBA 3000 ppm from the other concentration like, 2000 ppm and 2500 ppm may be attributed to their synergistic effect. These results were supported by finding of Mohammad *et al.* (1999) [15] in apple, Kaur (2015) [12] in peach and Kishore *et al.* (2001) [14] in kiwi.

Interaction effect of different media and IBA concentration dry weight (g) of roots per cutting

The interaction effect of different media and IBA concentration on dry weight of roots per cutting was found significant. The treatment M_4I_3 gave higher dry weight of roots per cutting (1.17 g). The lowest dry weight (0.20 g) of roots per cutting was observed in treatment M_1I_1.This may be due to combination of media which is favourable for better growth of a root and IBA at higher concentration improve root growth. Similar finding were also reported by Kishore *et al.* (2001) [14] in kiwi.

Effect of different media on survival percentage

The highest survival percentage (85.07%) of cutting recorded in media M_3 [soil + Perlite (1:1)] at 30 DAP while, lowest survival percentage (70.71%) of cutting recorded in media M_1 (soil).At 60 DAP highest survival percentage (78.14%) of cutting was recorded in M_3 [soil + Perlite (1:1)] whereas, the lowest survival percentage (62.17%) of cutting was recorded under the media M_1 (soil). At 90 DAP highest survival percentage (74.49%) of cutting was recorded in M_3 [soil + Perlite (1:1)] whereas, the lowest survival percentage (52.79%) of cutting was recorded under the media M_1 (soil).Higher survival percentage of cutting might be due to better aeration, temperature, humidity, drainage and porosity in M_3 media. The results are also confirmed with Dvin *et al.* (2011) [6] in apple.

Table 5: Effect of different media and IBA on survival percentage of pomegranate at 30, 60 and 90 DAP

Treatment	Survival percentage		
	30 DAP	60 DAP	90 DAP
Growing media (M)			
M_1: Soil	70.71	62.17	52.79
M_2: Soil + FYM (1:1)	74.93	66.05	56.43
M_3: Soil + Perlite (1:1)	85.07	78.14	74.49
M_4: Soil + Sand + FYM (1:1:1)	77.03	67.90	59.26
M_5: Soil + FYM + Perlite (1:1:1)	80.29	71.11	67.52
S.Em.±	1.00	0.90	0.80
C. D. at 5%	2.88	2.61	2.30
IBA Concentration (I)			
I_1: IBA 2000 ppm	74.73	62.23	51.79
I_2: IBA 2500 ppm	76.94	68.14	61.29
I_3: IBA 3000 ppm	81.15	76.85	73.20
S.Em.±	0.77	0.70	0.62
C. D. at 5%	2.23	2.02	1.78
Interaction (M×I)			
S.Em.±	1.73	1.57	1.38
C. D. at 5%	4.98	4.52	3.98
C.V.%	3.85	3.92	3.84

Effect of IBA concentration on survival percentage

Maximum survival percentage of cutting 81.15%, 76.85% and 73.20% were recorded at 30, 60 and 90 DAP, respectively in I_3 (IBA 3000 ppm). While, minimum survival percentage of cutting 74.73%, 62.23% and 51.79% were recorded at 30, 60 and 90 DAP, respectively in I_1 (IBA 2000 ppm). These results maximum survival percentage of rooted cutting were associated when cuttings were treated with IBA 3000 ppm might have resulted from development of effective root system and length of roots per cutting which might have influenced the uptake of nutrients and water. These results were supported by finding of Mohammad *et al.* (1999) [15] in apple and Kaur (2015) [12] in peach.

Interaction effect of growing media and IBA concentration on survival percentage

The maximum survival percentage (94.44%) of cutting at 30 DAP was recorded in the treatment M_3I_3. While, minimum survival percentage (71.41%) of cutting was recorded under the treatment M_1I_1. At 60 DAP maximum survival percentage (92.22%) of cutting was recorded in the treatment M_3I_3. While, minimum survival percentage (55.99%) of cutting was recorded under the treatment M_1I_1. At 90 DAP maximum survival percentage (90.00%) of cutting was recorded in the treatment M_3I_3. While, minimum survival percentage (42.82%) of cutting was recorded under the treatment M_1I_1. This might be due to better aeration, temperature, humidity, drainage and porosity in M_3 media which in turn increase root number and root length coupled with IBA treatment which developed effective root system and increase the uptake of nutrients and water. The results of present study are also in close conformity by Mohammad *et al.* (1999) [15] in apple and Swathi (2012) [22] in pomegranate.

Table 5.1: Interaction effect of different media and IBA on survival percentage of pomegranate cutting at 30 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	71.41	68.89	71.85	70.71
M_2: Soil + FYM (1:1)	73.70	74.81	76.29	74.93
M_3: Soil + Perlite (1:1)	79.65	81.11	94.44	85.07
M_4: Soil + Sand + FYM (1:1:1)	72.22	77.77	81.11	77.03
M_5: Soil + FYM + Perlite (1:1:1)	76.66	82.13	82.08	80.29
Mean (I)	74.73	76.94	81.15	
S.Em.±	1.73			
C. D. at 5%	4.98			
C.V.%	3.85			

Table 5.2: Interaction effect of different media and IBA on survival percentage of pomegranate cutting at 60 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	55.99	61.08	69.44	62.17
M_2: Soil + FYM (1:1)	61.85	64.07	72.22	66.05
M_3: Soil + Perlite (1:1)	65.55	76.66	92.22	78.14
M_4: Soil + Sand + FYM (1:1:1)	63.33	65.55	74.81	67.90
M_5: Soil + FYM + Perlite (1:1:1)	64.44	73.33	75.55	71.11
Mean (I)	62.23	68.14	76.85	
S.Em.±	1.57			
C. D. at 5%	4.52			
C.V.%	3.92			

Table 5.3: Interaction effect of different media and IBA on survival percentage of pomegranate cutting at 90 DAP

IBA Concentration (I) Growing media (M)	I_1: IBA 2000 ppm	I_2: IBA 2500 ppm	I_3: IBA 3000 ppm	Mean (M)
M_1: Soil	42.82	52.22	63.33	52.79
M_2: Soil + FYM (1:1)	46.14	56.00	67.14	56.43
M_3: Soil + Perlite (1:1)	62.22	71.26	90.00	74.49
M_4: Soil + Sand + FYM (1:1:1)	45.56	59.99	72.22	59.26
M_5: Soil + FYM + Perlite (1:1:1)	62.22	67.00	73.33	67.52
Mean (I)	51.79	61.29	73.20	
S.Em.±	1.38			
C. D. at 5%	3.98			
C.V.%	3.84			

Conclusion

It can be concluded that different media and IBA concentration significantly influenced the growth and development of the pomegranate cutting. The better growth of cutting found in Soil + Perlite (1:1) with the application of IBA 3000 ppm. The media Soil + Perlite (1:1) with the application of IBA 3000 ppm was better for percentage of rooted cutting and survival percentage of cutting while, media Soil + Sand + FYM (1:1:1) with the application of IBA 3000 ppm was better for root parameters *viz.* length of root per cutting, fresh weight of roots per cutting and dry weight of roots per cutting. So, hardwood cutting of pomegranate should be planted in media Soil + Perlite (1:1) with the application of 3000 ppm IBA.

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