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Response of different media and IBA on shoot sprouting and growth of hardwood cutting in pomegranate (*Punica granatum* L.) cv. Bhagwa

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Abstract
The field experiment entitled "Response of different media and IBA on rooting and survival of hardwood cutting in pomegranate (*Punica granatum* L.) cv. Bhagwa" was carried out at Fruit Research Station, Madhadi Baug 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 minimum days to shoot sprouting (8.78 days), maximum sprouting percentage (88.90%) at 30 DAP, number of leaves per main shoot (25.84, 57.68 and 90.40), number of shoots per cutting (6.32, 6.87 and 7.17), length of main shoot per cutting (23.71 cm, 33.47 cm and 51.56 cm), thickness of main shoot per cutting (1.18 mm, 2.35 mm and 3.38 mm). Among the factor IBA, I_3 (IBA 3000 ppm) recorded significantly the minimum days to shoot sprouting (7.82 days), maximum sprouting percentage (89.77%) at 30 DAP, number of leaves per main shoot (33.34, 63.73 and 101.05), number of shoots per cutting (5.68, 6.60 and 6.83), length of main shoot per cutting (20.94 cm, 29.08 cm and 45.82 cm), thickness of main shoot per cutting (1.12 mm, 2.24 mm and 3.42 mm) at 30, 60 and 90 DAP, respectively. The interaction effect between the media and IBA were found significant in parameters like; maximum sprouting percentage (95.96%) at 30 DAP, maximum number of leaves per main shoot (39.53, 70.29 and 108.20), length of main shoot per cutting (26.73 cm, 37.40 cm and 56.11 cm) at 30, 60 and 90 DAP, respectively. The interaction effect between the different media and IBA were found non significant in parameters like; days to shoot sprouting, thickness of main shoots per cutting and number of shoots per cutting.

Keywords: Pomegranate, media, IBA, hardwood cutting

Introduction
The pomegranate (*Punica granatum* L.) belongs to the family punicaceae which 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, while the other state like Uttar Pradesh, Andhra Pradesh, Gujarat, Rajasthan, Karnataka and Tamil Nadu share's the rest. 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. 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. It is glossy red in colour with soft seeds and high T.S.S. Rind of the fruit has medicinal value. The fruit is valued for its dietic and medicinal properties in India. Pomegranate is not very particular about its soil requirements and can be grown on diverse type of soil. The tree gives very good yield in deep loamy or alluvial soil, although it thrives well in comparatively poor soils where other fruits fail to grow. It can tolerate rainy and slightly alkaline soils and can also be grown in medium or light black soils.

Propagation of pomegranate is done by two methods (i) Sexual and (ii) Asexual. In sexual propagation, it is raised through a seed which takes long period for bearing which are propagation, pomegranate is generally propagated through air-layering and hardwood cuttings. Air-layering is cumbersome and expensive (Nagpal, 1954) [8], affects the growth of mother plants adversely (Joshi, 1935) [4] and reduces the bearing capacity of tree for 2 to 3 seasons (Cheema *et al*., 1954) [1]. Pomegranate is commercially propagated by cuttings. While propagation of plants through cuttings (vegetative) is easier, less time consuming, true to type and bears early. 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. Media is responsible for healthy and uniform growth. 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) [11]. 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) [2, 10]. 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. Normally it is propagated by cutting and air layering. But cutting is the better method for rapid multiplication. Rooting of cutting is difficult in pomegranate. 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. Numbers of leaves per main shoot and number of shoots were recorded at 30, 60 and 90 days after planting and average was calculated. The length and thickness of main shoot was recorded at 30, 60 and 90 days after planting and mean length of main shoot per cutting 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 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) [3] in kiwi and Ratna (2014) [9] 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) [7] in apple and Kaur (2015) [5] 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 3: 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) [3] in kiwi and Ratna (2014) [9] 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) [7] in apple and Kaur (2015) [5] 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) [7] in apple and Kaur (2015) [5] in peach.

Table 4: Effect of different media and IBA on number of leaves per main shoot of pomegranate cutting at 30, 60 and 90 DAP

Treatment	Number of leaves per main shoot		
	30 DAP	60 DAP	90 DAP
Growing media (M)			
M_1: Soil	18.92	50.33	79.28
M_2: Soil + FYM (1:1)	19.56	51.25	80.02
M_3: Soil + Perlite (1:1)	25.84	57.68	90.40
M_4: Soil + Sand + FYM (1:1:1)	22.30	53.40	83.72
M_5: Soil + FYM + Perlite (1:1:1)	24.94	55.47	85.60
S.Em.±	0.29	0.44	0.63
C. D. at 5%	0.84	1.28	1.82
IBA Concentration (I)			
I_1: IBA 2000 ppm	12.94	45.14	68.48
I_2: IBA 2500 ppm	20.67	52.00	81.88
I_3: IBA 3000 ppm	33.34	63.73	101.05
S.Em.±	0.23	0.34	0.49
C. D. at 5%	0.65	0.99	1.41
Interaction (M×I)			
S.Em.±	0.51	0.77	1.10
C. D. at 5%	1.46	2.22	3.16
C.V.%	3.92	2.48	2.26

Effect of different media on number of leaves per main shoot

Significantly highest number of leaves per main shoot (25.84) recorded in media M_3 [soil + perlite (1:1)] at 30 DAP. While,

at 60 and 90 DAP highest number of leaves per main shoot (57.68 and 90.40 respectively) were also recorded in media M_3. Whereas, the minimum number of leaves per main shoot (18.92, 50.33 and 79.28, respectively) were recorded in media M_1 (soil) at 30, 60 and 90 DAP, respectively. This may be attributed to general improvement in the physical and chemical properties of the rooting medium, so increased absorption of nutrition may also have accelerated the process of cell division, differentiation and better nutrients availability leading to higher production of photo synthetically functional leaves and growth of plant by media.

Effect of IBA concentration on number of leaves per main shoot

Significantly highest numbers of leaves per main shoot (33.34, 63.73 and 101.05) were recorded in I_3 (IBA 3000 ppm) at 30, 60 and 90 DAP, respectively. While, lowest number of leaves per main shoot (12.94, 45.14 and 68.48) were recorded in I_1 (IBA 2000 ppm) at 30, 60 and 90 DAP respectively. This may be attributed to the fact that growth attributes in term of root and shoot growth parameters affected by exogenous application of required growth regulators. This is depicted in lowest physiological activity for triggering root initiation and development and finally all other growth parameter of cuttings was seriously affected. This may be due low activity of growth substance and low physiological activity. It is supported by the finding of Mohammad *et al*. (1999) [7] in apple, Kishore *et al.* (2001) [6] in kiwi and Kaur (2015) [5] in peach.

Interaction effect of growing media and IBA concentration on number of leaves per main shoot

Interaction effect of different media and IBA concentration on number of leaves per main shoot at 30, 60 and 90 DAP are found to be significant. The maximum number of leaves per main shoot (39.53) at 30 DAP was recorded in the treatment M_3I_3. While, minimum number of leaves per main shoot (9.36) was recorded under the treatment M_1I_1. At 60 DAP maximum number of leaves per main shoot (70.29) was recorded in the treatment M_3I_3, which was found at par with the treatment M_5I_3 (68.25) whereas, the minimum number of leaves per main shoot (41.07) was recorded under the treatment M_1I_1.

Table 5: Interaction effect of different media and IBA on number of leaves per main shoot 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	9.36	19.80	27.60	18.92
M_2: Soil + FYM (1:1)	10.42	20.08	28.18	19.56
M_3: Soil + Perlite (1:1)	15.73	22.26	39.53	25.84
M_4: Soil + Sand + FYM (1:1:1)	11.23	20.30	35.37	22.30
M_5: Soil + FYM + Perlite (1:1:1)	17.93	20.90	36.00	24.94
Mean (I)	12.94	20.67	33.34	
S.Em.±	0.51			
C. D. at 5%	1.46			
C.V.%	3.92			

Table 6: Interaction effect of different media and IBA on number of leaves per main shoot 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	41.07	51.12	58.79	50.33
M_2: Soil + FYM (1:1)	47.62	50.68	55.45	51.25
M_3: Soil + Perlite (1:1)	48.39	54.35	70.29	57.68
M_4: Soil + Sand + FYM (1:1:1)	42.52	51.79	65.89	53.40
M_5: Soil + FYM + Perlite (1:1:1)	46.09	52.05	68.25	55.47
Mean (I)	45.14	52.00	63.73	
S.Em.±	0.77			
C. D. at 5%	2.22			
C.V.%	2.48			

At 90 DAP maximum number of leaves per main shoot (108.20) was recorded in the treatment M_3I_3, which was found at par with the treatment M_5I_3 (106.33) whereas, the minimum number of leaves per main shoot (63.37) was recorded under the treatment M_1I_1. This may be due to combination of a perfect media which is favourable for better growth of cutting by increasing the nutrients and water availability of the plant. IBA, which increase the number of shoots resulting in higher growth of cutting. Better nutrient availability and more number of shoots leading to higher production of photo synthetically functional leaves and growth of cutting by media. Similar finding were also reported by Mohammad *et al*. (1999) [7] in apple and Kaur (2015) [5] in peach.

Table 7: Interaction effect of different media and IBA on number of leaves per main shoot 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	63.37	78.20	96.27	79.28
M_2: Soil + FYM (1:1)	69.83	79.37	90.87	80.02
M_3: Soil + Perlite (1:1)	74.77	88.23	108.20	90.40
M_4: Soil + Sand + FYM (1:1:1)	66.13	81.43	103.60	83.72
M_5: Soil + FYM + Perlite (1:1:1)	68.30	82.17	106.33	85.60
Mean (I)	68.48	81.88	101.05	
S.Em.±	1.09			
C. D. at 5%	3.16			
C.V.%	2.26			

Table 8: Effect of different media and IBA on number of shoots per cutting of pomegranate at 30, 60 and 90 DAP

Treatment	Number of shoots per cutting		
	30 DAP	60 DAP	90 DAP
Growing media (M)			
M_1: Soil	4.58	5.39	6.03
M_2: Soil + FYM (1:1)	4.60	5.54	6.18
M_3: Soil + Perlite (1:1)	6.32	6.87	7.17
M_4: Soil + Sand + FYM (1:1:1)	5.34	6.18	6.30
M_5: Soil + FYM + Perlite (1:1:1)	5.87	6.65	6.89
S.Em.±	0.10	0.08	0.11
C. D. at 5%	0.28	0.24	0.31
IBA Concentration (I)			
I_1: IBA 2000 ppm	5.01	5.74	6.23
I_2: IBA 2500 ppm	5.33	6.04	6.47
I_3: IBA 3000 ppm	5.68	6.60	6.83
S.Em.±	0.07	0.07	0.08
C. D. at 5%	0.21	0.19	0.24
Interaction (M×I)			
S.Em.±	0.17	0.15	0.18
C. D. at 5%	NS	NS	NS
C.V.%	5.4	4.15	4.87

Effect of different media on number of shoots per cutting

The maximum number of shoots per cutting (6.32) recorded in media M_3 [soil + perlite (1:1)] at 30 DAP. While, minimum number of shoots per cutting (4.58) recorded inmedia M_1. At 60 DAP maximum number of shoots per cutting (6.87) was recorded in M_3 [soil + perlite (1:1)], which was found at par with the media M_5 (6.65) whereas, the minimum number of shoots per cutting (5.39) was recorded under the media M1. At 90 DAP maximum number of shoots per cutting (7.17) was recorded in M_3 [soil + perlite (1:1)], which was found at par with the media M_5 (6.89) whereas, the minimum number of shoots per cutting (6.03) was recorded under the media M_1. This may be attributed to general improvement in the physical and chemical properties of the rooting medium, so increased absorption of nutrition may also have accelerated the process of cell division, differentiation and better nutrients availability leading to higher production of photo synthetically functional leaves and growth of plant by media.

Effect of IBA concentration on number of shoots per cutting

Significantly highest number of shoots per cutting (5.68, 6.60 and 6.83) recorded in I_3 (IBA 3000 ppm) at 30, 60 and 90 DAP, respectively. While, lowest number of leaves per shoot (5.01, 5.74 and 6.23) recorded in I_1 (IBA 2000 ppm) at 30, 60 and 90 DAP, respectively. This may be attributed to the fact that growth attributes in term of root and shoot growth parameters affected by exogenous application of required growth regulators. This is depicted in lowest physiological activity for triggering root initiation and development and finally all other growth parameter of cuttings was seriously affected. This may be due low activity of growth substance and low physiological activity. It is supported by the finding of Mohammad *et al.* (1999) [7] in apple, Kishore *et al.* (2001) [6] in kiwi and Kaur (2015) [5] in peach.

Interaction effect of growing media and IBA concentration on number of shoots per cutting

An interaction effect of different media and IBA concentration were found non significant for number of shoots per cutting at 30, 60 and 90 DAP.

Table 9: Effect of different media and IBA on length of main shoot (cm) per cutting of pomegranate at 30, 60 and 90 DAP

Treatment	Length of main shoot per cutting (cm)		
	30 DAP	60 DAP	90 DAP
Growing media (M)			
M_1: Soil	14.34	22.72	39.23
M_2: Soil + FYM (1:1)	17.24	24.51	40.40
M_3: Soil + Perlite (1:1)	23.71	33.47	51.56
M_4: Soil + Sand + FYM (1:1:1)	16.33	24.10	41.89
M_5: Soil + FYM + Perlite (1:1:1)	18.81	27.39	45.16
S.Em.±	0.23	0.34	0.53
C. D. at 5%	0.65	0.99	1.52
IBA Concentration (I)			
I_1: IBA 2000 ppm	15.51	24.08	41.99
I_2: IBA 2500 ppm	17.81	26.16	43.13
I_3: IBA 3000 ppm	20.94	29.08	45.82
S.Em.±	0.17	0.26	0.41
C. D. at 5%	0.51	0.77	1.18
Interaction (M×I)			
S.Em.±	0.39	0.59	0.91
C. D. at 5%	1.13	1.71	2.63
C.V.%	3.74	3.88	3.61

Effect of different media on length of main shoot (cm) per cutting

The highest length of main shoots 23.71 cm, 33.47 cm and 51.56 cm were recorded at 30, 60 and 90 DAP, respectively with media M_3 [soil + perlite (1:1)]. The lowest lengths of main shoot 14.34 cm, 22.72 cm and 39.23 cm was recorded in media M_1 (soil) at 30, 60 and 90 DAP, respectively. This may be attributed to general improvement in the physical and chemical properties of the rooting medium, so increased absorption of nutrition may also have accelerated the process of cell division, differentiation and better nutrients availability leading to higher production of photo synthetically functional leaves and growth of plant by media.

Table 10: Interaction effect of different media and IBA on length of main shoot (cm) per cutting of pomegranate 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	12.07	14.00	16.97	14.34
M_2: Soil + FYM (1:1)	13.56	17.50	20.67	17.24
M_3: Soil + Perlite (1:1)	21.03	23.37	26.73	23.71
M_4: Soil + Sand + FYM (1:1:1)	14.70	16.13	18.17	16.33
M_5: Soil + FYM + Perlite (1:1:1)	16.20	18.07	22.17	18.81
Mean (I)	15.51	17.81	20.94	
S.Em.±	0.39			
C. D. at 5%	1.13			
C.V.%	3.74			

Effect of IBA concentration on length of main shoot (cm) per cutting

The data indicated that the IBA concentration reflected its significant effect on length of main shoot per cutting. The highest length of main shoots 20.94 cm, 29.08 cm and 45.82 cm were recorded at 30, 60 and 90 DAP, respectively in I_3 (IBA 3000 ppm). The lowest length of main shoots 15.51 cm, 24.08 cm and 41.99 cm were recorded at 30, 60 and 90 DAP, respectively in I_1 (IBA 2000 ppm). This may be attributed to the fact that growth attributes in term of root and shoot growth parameters affected by exogenous application of required growth regulators. This is depicted in lowest physiological activity for triggering root initiation and development and finally all other growth parameter of cuttings was seriously affected. This may be due low activity of growth substance and low physiological activity. It is supported by the finding of Mohammad *et al.* (1999) [7] in apple, Kishore *et al.* (2001) [6] in kiwi and Kaur (2015) [5] in peach.

Table 11: Interaction effect of different media and IBA on length of main shoot (cm) per cutting of pomegranate 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	20.63	22.30	25.23	22.72
M_2: Soil + FYM (1:1)	21.89	24.61	27.04	24.51
M_3: Soil + Perlite (1:1)	29.70	33.30	37.40	33.47
M_4: Soil + Sand + FYM (1:1:1)	22.97	24.33	25.00	24.10
M_5: Soil + FYM + Perlite (1:1:1)	25.20	26.27	30.70	27.39
Mean (I)	24.08	26.16	29.08	
S.Em.±	0.59			
C. D. at 5%	1.71			
C.V.%	3.88			

Interaction effect of growing media and IBA concentration on length of main shoot (cm) per cutting

The interaction effect of different media and IBA concentration found significant on length of main shoot per cutting. The maximum length of main shoots 26.73 cm, 37.40 cm and 56.11 cm were recorded at 30, 60 and 90 DAP, respectively in treatment M_3I_3. The lowest length of main shoots 12.07 cm, 20.63 cm and 37.70 cm were recorded at 30, 60 and 90 DAP, respectively in M_1I_1. This may be due to combination of a perfect media which is favourable for better growth of cutting by increasing the nutrients and water availability of the plant. IBA, which increase the number of shoots resulting in higher growth of cutting. Better nutrient availability and more number of shoots leading to higher production of photo synthetically functional leaves and growth of cutting by media. Similar finding were also reported by Mohammad *et al.* (1999) [7] in apple and Kaur (2015) [5] in peach.

Table 12: Interaction effect of different media and IBA on length of main shoot (cm) 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	37.70	39.65	40.34	39.23
M_2: Soil + FYM (1:1)	39.90	40.06	41.24	40.40
M_3: Soil + Perlite (1:1)	48.00	50.56	56.11	51.56
M_4: Soil + Sand + FYM (1:1:1)	41.09	41.09	43.49	41.89
M_5: Soil + FYM + Perlite (1:1:1)	43.24	44.32	47.91	45.16
Mean (I)	41.99	43.13	45.82	
S.Em.±	0.91			
C. D. at 5%	2.63			
C.V.%	3.61			

Effect of different media on thickness of main shoot (mm) per cutting

The maximum thickness of main shoot per cutting (1.18 mm) recorded in media M_3 [soil + perlite (1:1)] at 30 DAP while, minimum thickness of main shoot per cutting (0.87 mm) recorded in media M_1 (soil) and M_2 [soil + FYM (1:1)]. At 60 and 90 DAP maximum thickness of main shoot per cutting 2.35 mm and 3.38 mm was recorded in M_3 [soil + perlite (1:1)], respectively. Whereas, minimum thickness of main shoot per cutting 1.74 mm and 2.64 mm was recorded under the media M_1 (soil), respectively. This may be attributed to general improvement in the physical and chemical properties of the rooting medium, so increased absorption of nutrition may also have accelerated the process of cell division, differentiation and better nutrients availability leading to higher production of photo synthetically functional leaves and growth of plant by media.

Effect of IBA concentration on thickness of main shoot (mm) per cutting

The maximum thickness of main shoot per cutting (1.12 mm, 2.24 mm and 3.42 mm) recorded in I_3 (IBA 3000 ppm) at 30, 60 and 90 DAP, respectively. While, minimum thickness of main shoot per cutting (0.87 mm, 1.75 mm and 2.57 mm) recorded in I_1 (IBA 2000 ppm) at 30, 60 and 90 DAP, respectively. This may be attributed to the fact that growth attributes in term of root and shoot growth parameters affected by exogenous application of required growth regulators. This is depicted in lowest physiological activity for triggering root initiation and development and finally all other growth parameter of cuttings was seriously affected. This may be due low activity of growth substance and low physiological activity.

It is supported by the finding of Mohammad *et al.* (1999) [7] in apple, Kishore *et al.* (2001) [6] in kiwi and Kaur (2015) [5] in peach.

Interaction effect of growing media and IBA concentration on thickness of main shoot (mm) per cutting

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

Table 13: Effect of different media and IBA on thickness of main shoot (mm) per cutting of pomegranate at 30, 60 and 90 DAP

Treatment	Thickness of main shoot per cutting (mm)		
	30 DAP	60 DAP	90 DAP
Growing media (M)			
M_1: Soil	0.87	1.74	2.64
M_2: Soil + FYM (1:1)	0.87	1.85	2.81
M_3: Soil + Perlite (1:1)	1.18	2.35	3.38
M_4: Soil + Sand + FYM (1:1:1)	0.98	1.92	2.92
M_5: Soil + FYM + Perlite (1:1:1)	1.03	2.07	3.19
S.Em.±	0.02	0.04	0.05
C. D. at 5%	0.05	0.11	0.16
IBA Concentration (I)			
I_1: IBA 2000 ppm	0.87	1.75	2.57
I_2: IBA 2500 ppm	0.97	1.98	2.97
I_3: IBA 3000 ppm	1.12	2.24	3.42
S.Em.±	0.01	0.03	0.04
C. D. at 5%	0.04	0.08	0.12
Interaction (M×I)			
S.Em.±	0.03	0.06	0.09
C. D. at 5%	NS	NS	NS
C.V.%	5.71	5.61	5.47

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 all the morphological parameter of vegetative growth *viz*. days to shoot sprouting, sprouting percentage, number of leaves per main shoot, number of shoots per cutting, length of main shoot per cutting, thickness of main shoot 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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