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Effect of IBA concentration and time of planting on rooting in pomegranate (*Punica granatum*) cuttings

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Abstract
The present study was conducted to Effect of IBA Concentration and Time of Planting on Rooting in Pomegranate (*Punica granatum*) Cuttings during the Winter season 2016-17. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replication. Treatments main factor (25th December, 10th January and 25th January) and three sub factors (500ppm, 1000ppm and control). Results of the investigation showed that highest number of sprouted cuttings (7.11), number of sprouts per cutting (4.00), number of leaves on new shoots (10.89), percentage of rooted cuttings (71.11%) was recorded under T_3 (January 25th) planting time. In case of IBA concentration, highest number of sprouted cuttings (7.33), number of sprouts per cutting (4.66), length of longest sprout (7.28 cm), number of leaves on new shoots (10.66) and percentage of rooted cuttings (73.33%) was observed under C_1 (500ppm IBA) treatment.

Keywords: Cuttings, IBA, planting time, rooting

Introduction
Pomegranate (*Punica granatum* L.) belongs to family Punicaceae. It is cultivated in Mediterranean region of India and China. The maximum production of pomegranate in arid region can be obtained by adopting suitable agro techniques. Pomegranate is very much liked for its cool, refreshing juice with sweet acidic taste.

Pomegranate can be propagated by stem cuttings, layering and grafting. The success in stem cutting multiplication of fruits crops depend upon some factors such as condition of the mother plant, part of the tree, age of the tree from where the condition of the part of the tree from where the cuttings are made, time of planting, rainfall, humidity and rooting media, care while planting and after care Frey *et al*. (2006) [6]. Indole Butyric Acid (IBA) is the synthetic plant hormone. It is active in inhibiting axillary bud break on developing shoots, and it stimulates the root initiation. Some factors that affect the rooting of pomegranate cuttings are physiological condition of the parent plant, cutting type, season of cutting, rooting medium and use of rooting hormones (Polat and Caliskan, 2009) [11]. Ghosh *et al*. (1988) [7] reported that IBA is more effective than NAA on rooting and maximum rooting has occurred with 5,000 ppm IBA concentration. Saroj *et al*. (2007) [12] have reported the Pomegranate cultivar Jalore propagation both by hardwood and semi-hardwood cuttings in July followed by August and September was the best months for planting of cutting. The present investigation was, therefore, carried out with the following objectives: (1) To find out the appropriate time of planting (December 25th, January 10th and January 25th) for cuttings. (2) To find out the best Iba concentrations (500ppm, 1000ppm and control) for rooting.

Materials and Methods
The experiments were conducted at Department of Agriculture, career point university kota (rajasthan), India during the year 2016-17. The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replication. Treatments main factor (25th December, 10th January and 25th January) and three sub factors (500ppm, 1000ppm and control). Total number of 270 cuttings treated with IBA concentration. The basal portions of cuttings up to 2.5-3 cm were soaked with solution for 10 seconds. At the time of planting, 1/3 part of cutting was inserted in the rooting media. Each polythene bag consists of one cutting. The soil around the cuttings was tightly pressed and then light watering was given to the

cuttings. The number of sprouted cutting, percentage of rooted cutting, number of primary root, length of longest root, number of leaves, length of longest sprout and diameter of sprouts were recorded after three months. Data recorded during the course of investigations were subjected to statistical analysis under Factorial Randomized Block Design as described by Cochran and Cox (1992) [4].

Results and Discussion

Significantly the highest number of sprouted cuttings (7.11) was recorded when planted T_3 (January 25th) planting time. The highest number of sprouted cuttings (7.33) was recorded under C_1 (500ppm IBA) IBA concentration. The effect of interaction between IBA concentration and planting time were also found significant. The maximum number of sprouted cuttings (9.00) was recorded under T_2C_1 (January 10th with mist chamber) treatment combination. These finding also agree with the findings of Singh *et al*. (2003) in long pepper (*Piper longum L*.) cutting. The maximum average number of sprouts per cutting (4.00) was recorded when planted T_2 (January 10th) planting time. The highest average number of sprouts per cutting (4.66) was recorded under C_1 (500ppm IBA) treatments. The effect of interaction between IBA concentration and planting time were also found significant. The maximum average number of sprouts per cutting (2.44) was recorded under T_2C_1 (January 10th with 500 ppm IBA) treatment combination. The better number of sprouts per cutting with optimum IBA treatments might be due to better root growth which augmented absorption and translocation of nutrients from soil which take active part in various plant metabolic processes (Singh, 2001) [14]. Significantly the highest length of longest sprout (7.56 cm) was recorded when planted T_2 (January 10th) planting time followed by (5.71 cm) in T_3 (January 25th). The maximum length of longest sprout (7.28 cm) was recorded under C_1 (500ppm IBA) IBA concentration. The effect of interaction between IBA concentration and planting time were also found significant. The maximum length of longest sprout (12.0 cm) was recorded under T_2C_1 (January 10th with C_1 (500ppm IBA)) treatment combination. The auxins activated shoot growth which results the elongation of stems and leaves through cell division accounting in longest sprout. It may be due to species, favourable climatic conditions in mist to increase the length of sprout. Similar results were also reported by Bhatt and Tomar (2011) [2] in *Citrus aurantifolia* and Dutra and Kersten (1996) [5] in plum (*Prunus salicina* L.) cutting.

The highest number of leaves on new shoots (10.89) was recorded when planted T_3 (January 25th) planting time. It may be due to favourable climatic conditions to the higher number of leaves. The highest number of leaves on new shoots (10.66) was recorded under C_1 (500ppm IBA) IBA concentration followed by (8.44) in C_2 (1000ppm IBA). The effect of interaction between planting time and IBA concentration were also found significant. The maximum number of leaves on new shoots (15.33) was recorded under T_2C_1 (January 10th with 500ppm IBA) treatment combination. It may be due to wood maturity of cutting which probably reserves high starch and sugar. Favourable climatic conditions play an important role to increase the number of leaves. These findings are in close agreement with the findings of Ansari (2013) [1]. in pomegranate. The highest percentage of rooted cuttings (71.11%) was recorded when planted T_3 (January 25th) planting time followed by (66.66%) in T_2 (January 10th). The minimum percentage of rooted cuttings (64.44%) was recorded under T_1 (December 25th) planting time. The highest percentage of rooted cuttings (73.33%) was recorded under C_1 (500ppm IBA) IBA concentration. The enhanced hydrolytic activity in presence of applied IBA coupled with appropriate planting time might be responsible for the increased percentage of rooted cuttings. High carbohydrate and low nitrogen have been reported to favour root formation (Carlson, 1929) [3]. The effect of interaction between planting time and IBA concentration were also found significant. Similar findings are also supported by Pirlak (2000) [10] in Cornelian cherry (*Cornus mas* L.) and Sharma *et al*. (2009) [13] in pomegranate cv. Ganesh**.**

The highest number of primary roots (11.66) was recorded when planted T_2 (January 10th) planting time followed by (6.55) in T_1 (December 25th). The highest number of primary roots (9.00) was recorded under C_1 (500ppm IBA). It may be due to the action of auxin which might have caused hydrolysis and translocation of carbohydrates and nitrogenous substances at the base of cuttings and resulted in accelerated cell elongation and cell division in suitable environment (Hartmann *et al*., 2007) [8]. The effect of interaction between planting time and IBA concentration were also found significant. The maximum number of primary roots (16.00) was recorded under T_2C_1 (January 10th with 500ppm IBA) treatment combination followed by (10.66) in T_2C_3 (January 10th with Control).

Significantly the highest length of longest root (11.44 cm) was recorded when planted T_2 (January 10th) planting time. It may be due to the species, favourable climatic conditions to the length of root. The highest length of longest root (13.11 cm) was recorded under C_1 (December 25th) IBA concentration. The increase in length of roots in cuttings treated with growth regulators may be due to the enhanced hydrolysis of carbohydrates, accumulation of metabolites at the site of application of auxins, synthesis of new proteins, cell enlargement and cell division induced by the auxins (Strydem and Hartman, 1960) [15]. The effect of interaction between IBA concentration and growing condition were also found significant. The maximum length of longest root (14.66 cm) was recorded under T_2C_1 (January 10th with 500ppm IBA). The present findings are similar to the findings of Panwar *et al.* (2001) [9] in pomegranate cuttings.

Table 1: Effect of IBA concentration and time of planting on survival performance of Pomegranate (*Punica granatum*)

Planting Time	Number of sprouted cutting				Number of sprouts per cutting				Length of longest sprout (cm)				Number of leaves on new shoots			
	IBA concentrations															
	C_1 (500ppm IBA)	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**	**C_1 (500ppm IBA)**	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**	**C_1 (500ppm IBA)**	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**	**C_1 (500ppm IBA)**	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**
T_1 (December 25th)	5.66	7.33	6.33	6.44	2.33	4.66	1.00	2.66	4.56	4.45	7.40	5.47	6.66	6.66	5.00	6.11
T_2 (January 10th)	9.00	4.66	6.33	6.66	7.66	2.33	2.00	4.00	12.0	5.38	5.30	7.56	15.33	8.00	5.33	9.55
T_3 (January 25th)	7.33	6.33	7.66	7.11	4.00	2.66	4.33	3.66	5.28	5.74	6.10	5.71	10.00	10.66	12.00	10.89
Mean	7.33	6.11	6.77		4.66	3.22	2.44		7.28	5.19	6.27		10.66	8.44	7.44	
	T	C	T x G		T	C	T x G		T	C	T x G		T	C	T x G	
S.Em±	0.361	0.361	0.626		0.663	0.663	1.148		0.589	0.589	1.021		0.852	0.852	1.476	
CD at 5%	1.060	1.060	1.836		1.945	1.945	3.369		1.729	1.729	2.995		2.499	2.499	4.329	

Table 2: Effect of IBA concentration and time of planting on rooting performance of Pomegranate (*Punica granatum*)

Planting Time	Percentage of rooted cuttings				Number of primary roots				Length of longest root (cm)			
					IBA concentrations							
	C_1 (500ppm IBA)	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**	**C_1 (500ppm IBA)**	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**	**C_1 (500ppm IBA)**	**C_2 (1000ppm IBA)**	**C_3 (Control)**	**Mean**
T_1 (December 25th)	56.66	73.33	63.33	64.44	5.66	7.33	6.66	6.55	11.66	9.00	11.33	10.66
T_2 (January 10th)	90.00	46.66	63.33	66.66	16.00	8.33	10.66	11.66	14.66	9.00	10.66	11.44
T_3 (January 25th)	73.33	63.33	76.66	71.11	5.33	7.33	6.00	6.22	13.00	9.33	6.00	9.44
Mean	73.33	61.11	67.77		9.00	7.66	7.77		13.11	9.11	9.33	
	T	C	T x G		T	C	T x G		T	C	T x G	
S.Em±	3.614	3.614	6.260		1.061	1.061	1.837		0.394	0.394	0.682	
CD at 5%	10.602	10.602	18.363		3.112	3.112	5.390		1.156	1.156	2.002	

Conclusion

Among various IBA concentration and time of planting, it may be concluded that 500 ppm IBA concentration shows the best performance of cutting of mulberry in terms of root and shoot parameters when planted on January 10th.

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