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Influence of different shoot portion and media on vegetative propagation of pomegranate (*Punica granatum*)

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Abstract
An experiment entitled, influence of different shoot portion and media on vegetative propagation of pomegranate was carried out with two factors *viz*; shoot portion with three levels and media with seven levels making total twenty one treatment combinations. Experiment was laid out in Factorial Completely Randomized Design with three replications. The results of the present investigation on the basis of pooled data revealed that, minimum days to sprouting (11.33) was recorded with treatment s_1 (Apical) whereas, significantly highest length of shoot (9.79 cm), maximum number of roots (8.92) and length of root (8.96 cm) was recorded with treatment s_2 (Sub-apical). Among different treatments of media, significantly early sprouting (11.14 days), maximum number of roots per cutting (8.40) and highest length of roots per cutting (8.81 cm) and highest shoot length (9.36 cm) at 60 DAP were observed with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas*). Use of sub-apical cutting with Vermiculite: Poultry Manure [1:1]+ *Pseudomonas* media in plug tray for early sprouting, highest shoot and root parameters of pomegranate under greenhouse condition.

Keywords: Media, pomegranate, propagation, shoot portion, survival

Introduction
Pomegranate *(Punica granatum)* is one of the important fruit crop gaining popularity in arid and semi-arid regions of India. Pomegranate is largely used as a table fruit and it has a high demand in local and export market as it is rich in Potassium, vitamin C, and antioxidants. They are a good source of sugars (14-16%), minerals (0.7- 1.0%), and iron (0.3-0.7mg/100g) (Chundawat, 1990) [3]. Pomegranate *(Punica granatum)* is gaining popularity in Gujarat by occupying 9,380 ha area leads to production of 99,330 tonnes (Anon, 2014) [1].
Pomegranate could be propagated either sexually by seeds or vegetatively using stem cuttings. Layering and grafting of pomegranate trees is rarely done, because many different types of grafts have not been successful enough for use in commercial production (Hartmann *et al*., 1997) [5]. Pomegranate is commercially propagated by cuttings. Cuttings are the easiest method for pomegranate propagation and in which hardwood or semi-hardwood cutting with rooting hormone were used.
Pomegranate is commercially propagated by cuttings. Use of optimum concentration of IBA, type of cutting and optimum rooting media would help in rapid multiplication of pomegranate cuttings. The success percent of pomegranate cuttings depends on many factors such as conditions of the mother plant, rainfall, time of operation, temperature fluctuation, aftercare etc. Different environmental conditions, planting time also play an important role in rooting and growth of pomegranate cutting (Singh, K.K. 2017) [11].
In Gujarat, air layered planting material of pomegranate from nearby states were adopted by farmers but it is costlier and having higher mortality rate. Propagation by stem cutting is of paramount importance because it is cheapest, rapid and simple than any other propagation methods but scant work was done for effect of shoot portions in pomegranate. Although, pomegranate is traditionally propagated through cuttings in polythene bags, no proper media has been recommended to achieve higher success rate under plug tray. Therefore, present experiment was executed on influence of different shoot portion and media on vegetative propagation of pomegranate.

Material and Methods

A present investigation was carried out under fan and pad cooling system greenhouse at Department of Horticulture, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. Present experiment were evaluated with two factors viz., shoot portion with three levels and media with seven levels thus making total twenty one treatment combinations *viz*; Apical (s_1), sub-apical (s_2), basal (s_3) and different media *viz*., Vermiculite: Poultry Manure [1:1] (m_1), Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride* (m_2), Vermiculite: Poultry Manure [1:1]+ PSB (m_3), Vermiculite: Poultry Manure [1:1]+ *Pseudomonas* (m_4), Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride* + PSB (m_5), Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*+ *Pseudomonas* (m_6), Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*+ PSB+ *Pseudomonas* (m_7).

The three trials were carried out viz., First trial: 1st June to 1st August 2015, Second trial: 5th August to 5th October 2015, Third trial: 10th October to 10th December 2015 were carried out in plug tray under greenhouse condition. The cutting was taken of 10 cm length and common IBA treatment @ 2000 ppm was applied to cuttings through quick dip method. Media treated @50ml/10 kg with *Trichoderma viride*, *Pseudomonas* and PSB as per treatment.

The experiment was laid out in Factorial Completely Randomized Design as described by Nigam and Gupta (1979) [7] with three replications. The treatments evaluated and observations were recorded periodically in relation to days taken for sprouting, number of shoots and roots, length of shoot and root.

Results And Discussion

Effect of shoot portion

On the basis of pooled data it was observed that minimum days to sprouting (11.33) was recorded with treatment s_1 (Apical) and it was found significantly superior over remaining treatments. The significantly maximum number of roots (8.92) and length of root (8.96 cm) was recorded with treatment s_2 (Sub-apical) and it was found significantly superior over remaining treatments.

Pooled data found significantly maximum survival percentage (77.19) at 45 days after planting was recorded with treatment s_3 (Basal) and it was found significantly superior over remaining treatments.

The pooled data revealed that, maximum number of shoots per cutting (3.09) at 60 days after planting was found in treatment s_2 (Sub-apical) and minimum (2.23) was recorded that s_1 (Apical) treatment.

In pooled data it was observed significantly maximum length of shoot per cutting (9.79 cm) at 60 days after planting was observed in treatment s_2 (Sub-apical) which was atpar with s_3 (Basal) treatment.

However, contrary to the present results Purohit and Shekharappa (1985) [9] in pomegranate reported that basal cuttings sprouted better than the cuttings taken from any other portion of the shoot. Arumugam *et al.* (1996) [2] got the best rooting in softwood, semi-soft wood and hardwood cuttings of pomegranate with IBA (quick dip) treatments.

The maturity of cutting play a vital role in initiating and producing better rooting in pomegranate cuttings as is evident from the data given where hard wood cuttings produced significantly higher rooting as compared to semi hard wood cuttings. These results are in agreement with the findings of Ghosh *et al.* (1980), Panda and Das (1990) [8], Sandhu *et al*. (1991) [10] in pomegranate.

Effect of media

Three trial pooled data revealed that significantly early sprouting (11.14 days) were observed with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas)* and it was found statistically at par (11.48 and 11.66 days) with treatments m_6 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*+ *Pseudomonas*) and m_7 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*+ PSB+ *Pseudomonas*), respectively.

The pooled data revealed, that maximum survival percentage at 45 days after planting (65.77 days) were observed with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas*) and minimum (62.55 days) was recorded with treatment m_1 (Vermiculite: Poultry Manure 1:1).

The maximum number of shoots (2.77) per cutting at 60 days after planting were observed with treatment m_2 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*) whereas minimum (2.51) were observed with m_1 (Vermiculite: Poultry Manure 1:1) treatment.

Pooled data shows the maximum length of shoot per cutting (9.36 cm) at 60 days after planting was recorded with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas)* and minimum length (7.85 cm) was recorded with m_1 (Vermiculite: Poultry Manure 1:1) treatment.

The maximum number of roots per cutting (8.40) was recorded with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas*) and it was found statistically at par with treatment m_6 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride*+ *Pseudomonas*). Whereas, highest length of roots per cutting at 60 DAP (8.81 cm) also recorded with treatment m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas*) and it was found statistically at par with treatments m_6 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*+ *Pseudomonas*) and m_2 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*).

The possible explanation to this lies in better development of root system with good quality root and shoot parameters enabling the rooted cuttings to make better growth under field conditions after plantation and thereby accounted the highest field survivability. However, the plants raised from hardwood cuttings found to render better and healthy vegetative growth than the ones raised from semi hard wood cuttings Kumari *et al.* (2013) [6].

Interaction effect

The interaction effect of shoot portion and media was found significant for number of roots per cutting at 60 days after planting. Whereas, days taken to sprouting, survival percentage at 45 days after planting, number of shoots and length of shoot per cutting at 60 days after planting and length of root per cutting at 60 days after planting, were found non-significant.

Table 1: Influence of different shoot portion and media on days taken to sprouting and survival percentage at 45 DAP of pomegranate

Treatments	Days taken to sprouting				Survival percentage at 45 days after planting			
Levels of shoot portion (S)	Trial I	Trial II	Trial III	Pooled	Trial I	Trial II	Trial III	Pooled
s_1 (Apical)	11.57	10.71	11.71	11.33	46.23	48.90	47.57	47.57
s_2 (Sub-apical)	12.38	11.85	12.95	12.39	65.95	68.61	67.28	67.28
s_3 (Basal)	12.80	12.14	13.38	12.77	75.85	78.52	77.19	77.19
S.Em.±	0.30	0.26	0.39	0.19	0.84	0.70	0.98	0.49
C.D. at 5%	0.87	0.76	1.13	0.53	2.39	2.00	2.81	1.38
Levels of media (M)								
m_1 (Vermiculite: Poultry Manure 1:1)	13.44	12.66	13.66	13.25	61.22	63.88	62.55	62.55
m_2 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*)	13.11	12.22	13.44	12.92	63.55	66.22	64.88	64.88
m_3 (Vermiculite: Poultry Manure [1:1]+ PSB)	12.33	11.66	13.00	12.33	62.22	64.88	63.55	63.55
m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas)*	11.22	10.44	11.77	11.14	64.44	67.11	65.77	65.77
m_5 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride* + PSB)	12.44	11.88	12.77	12.37	61.88	64.55	63.22	63.22
m_6 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride*+ *Pseudomonas*)	11.44	11.00	12.00	11.48	63.00	65.66	64.33	64.33
m_7 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride*+ PSB+ *Pseudomonas*)	11.77	11.11	12.11	11.66	62.44	65.11	63.77	63.77
S.Em.±	0.46	0.41	0.60	0.29	1.28	1.07	1.50	0.75
C.D. at 5%	1.33	1.17	NS	0.81	NS	NS	NS	NS
S X M								
S.Em.±	0.81	0.71	1.05	0.50	2.22	1.86	2.61	1.30
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Season x Treatment								
S.Em.±				0.87				2.25
C.D. at 5%				NS				NS
CV %	11.45	10.67	14.40	12.39	6.14	4.93	7.07	6.09

Table 2: Influence of different shoot portion and media on number of shoots and length of shoot per cutting at 60 DAP of pomegranate

Treatments	Number of shoots per cutting at 60 days after planting				Length of shoot per cutting (cm) at 60 days after planting			
Levels of shoot portion (S)	Trial I	Trial II	Trial III	Pooled	Trial I	Trial II	Trial III	**Pooled**
s_1 (Apical)	2.00	2.14	2.57	2.23	5.76	7.04	6.09	6.30
s_2 (Sub-apical)	3.42	3.19	2.66	3.09	9.33	10.0	10.04	9.79
s_3 (Basal)	2.42	2.52	2.57	2.50	8.81	9.52	9.47	9.27
S.Em.±	0.09	0.18	0.21	0.20	0.29	0.37	0.27	0.27
C.D. at 5%	0.28	0.51	NS	NS	0.85	1.05	0.78	0.77
Levels of media (M)								
m_1 (Vermiculite: Poultry Manure 1:1)	2.55	2.44	2.55	2.51	7.33	8.22	8.00	7.85
m_2 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*)	2.66	3.00	2.66	2.77	8.55	9.44	9.11	9.03
m_3 (Vermiculite: Poultry Manure [1:1]+ PSB)	2.55	2.66	2.44	2.55	7.44	8.33	8.00	7.92
m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas)*	2.55	2.55	2.77	2.62	8.88	9.77	9.44	9.36
m_5 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride* + PSB)	2.55	2.66	2.44	2.55	7.55	8.44	8.11	8.03
m_6 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride*+ *Pseudomonas*)	2.66	2.44	2.66	2.59	8.11	9.00	8.66	8.59
m_7 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride*+ PSB+ *Pseudomonas*)	2.77	2.55	2.66	2.66	7.88	8.77	8.44	8.36
S.Em.±	0.15	0.27	0.32	0.15	0.45	0.56	0.41	0.41
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
S X M								
S.Em.±	0.26	0.47	0.55	0.26	0.79	0.97	0.72	0.71
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Season x Treatment								
S.Em.±				0.45				0.79
C.D. at 5%				NS				NS
CV %	17.34	31.54	37.18	29.84	8.67	12.19	7.28	7.04

Table 3: Influence of different shoot portion and media on number of roots and length of roots per cutting at 60 DAP of pomegranate

Treatments	Number of roots per cutting at 60 days after planting				Length of roots per cutting (cm) at 60 days after planting			
Levels of shoot portion (S)	**Trial I**	**Trial II**	**Trial III**	**Pooled**	**Trial I**	**Trial II**	**Trial III**	**Pooled**
s_1 (Apical)	5.90	8.14	6.52	6.85	6.23	7.52	6.90	6.88
s_2 (Sub-apical)	8.04	10.33	8.38	8.92	8.23	9.71	8.95	8.96
s_3 (Basal)	6.38	8.71	6.71	7.26	7.00	8.19	7.66	7.61
S.Em.±	0.18	0.20	0.20	0.11	0.21	0.29	0.15	0.13
C.D. at 5%	0.52	0.59	0.59	0.32	0.61	0.83	0.44	0.37
Levels of media (M)								
m_1 (Vermiculite: Poultry Manure 1:1)	5.88	8.22	6.33	6.81	6.22	7.55	6.88	6.88
m_2 (Vermiculite: Poultry Manure [1:1]+ *Trichoderma viride*)	7.33	9.66	7.77	7.25	7.88	9.44	8.55	8.62
m_3 (Vermiculite: Poultry Manure [1:1]+ PSB)	6.44	8.77	6.88	7.37	6.33	7.44	7.00	6.92
m_4 (Vermiculite: Poultry Manure [1:1]+ *Pseudomonas)*	7.55	9.66	8.00	8.40	8.22	9.22	9.00	8.81
m_5 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride* + PSB)	6.55	8.77	6.88	7.40	6.66	8.11	7.33	7.37
m_6 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride+ Pseudomonas*)	7.00	9.33	7.44	7.92	7.66	9.00	8.33	8.33
m_7 (Vermiculite: Poultry Manure [1:1]+*Trichoderma viride+* PSB+ *Pseudomonas*)	6.66	9.00	7.11	7.59	7.11	8.55	7.77	7.81
S.Em.±	0.28	0.31	0.31	0.17	0.32	0.44	0.23	0.20
C.D. at 5%	0.80	0.90	0.90	0.49	0.93	1.27	0.67	0.56
S X M								
S.Em.±	0.48	0.54	0.54	0.30	0.56	0.77	0.41	0.34
C.D. at 5%	NS	NS	NS	0.86	NS	NS	NS	NS
Season x Treatment								
S.Em.±				0.53				0.60
C.D. at 5%				NS				NS
CV %	12.47	10.49	13.20	11.94	13.75	15.80	9.09	13.34

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