

Effect of different grafting methods and rootstocks on growth and survival of pomegranate (*Punica granatum* L.)

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ABSTRACT

Investigation on “Assessment of different rootstocks of pomegranate (*Punica granatum* L.)” was undertaken with a view to assess the graft compatibility of various rootstocks with cv. Phule Bhagwa Super by adapting various propagation methods at the Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra during 2012 to 2015. There were two propagation methods viz., Wedge grafting (M₁) and Patch budding (M₂) and eleven rootstocks viz., Ganesh (R₁), Bedana Suri (R₂), Alandi (R₃), Kandhari (R₄), Jalore Seedless (R₅), Jodhpur Red (R₆), Patna-5 (R₇), Muscat (R₈), Yercaud (R₉), Bedana Sedana (R₁₀) and Daru (R₁₁) having total 22 treatments combinations and were replicated thrice. For present study 50 grafts in each treatment and replication were taken as sample size. While, 15 cm long leafless scions of 6-9 months old from cv. Phule Bhagwa Super were used for grafting/budding on one year old seedlings of different rootstocks raised in black polythene bags (30 x 18”) filled with soil, sand, vermi-compost and FYM mixture in 1:1:1:1 ratio. From results of the investigation it was concluded that the better graft compatibility of cv. Phule Bhagwa Super was found with the rootstocks, Bedana Suri, Ganesh, Kandhari, Jalore Seedless and Alandi either by wedge grafting or patch budding method to obtained higher percentage of success and better stionic growth of pomegranate grafts.

Key words: Pomegranate, rootstocks, grafting, budding, success, compatibility

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the important fruit crops grown on commercial scale in Deccan Plateau of India and is gaining a lot of popularity worldwide in recent years owing to its high economic, nutraceutical and therapeutic values (Marathe *et al.* 2010). It is mainly propagated by air layering in Maharashtra, Karnataka and Andhra Pradesh. Unlike other perennial fruit crops, multi-stem training system is very common in pomegranate (Chandra *et al.* 2008). Recently, wilt has emerged as an important threat in major pomegranate growing belts of India and to combat this problem neither any standard grafting/budding technique nor suitable rootstock is available. Rootstocks have been used in fruit crops to protect against soil born diseases and pests since long time. The important characteristics in the selection of rootstocks that they should be easily propagated having good graft compatibility with scion varieties and adoption to a range of soil conditions (Reisch *et al.*, 2012).

Development of tap and secondary root is possible through seedling propagation. This may help in minimizing the root exposure in

rhizosphere and their by limiting entry of pathogen. However, scanty information on graft compatibility of different rootstocks with scion varieties by various propagation methods in pomegranate is available. Thus, with view to study the suitable method of propagation by using different rootstocks the present investigations entitled “Assessment of different rootstocks of pomegranate (*Punica granatum* L.)” was conducted.

MATERIALS AND METHODS

The experiment was carried out during September 2014 to February 2015 under 50% green coloured shade net house at "Instructional-cum-Demonstration Farm," Department of Horticulture, MPKV., Rahuri, Maharashtra. The experiment was conducted in factorial randomized block design. There were two propagation methods viz., Wedge grafting (M₁) and Patch budding (M₂) and eleven rootstocks Ganesh (R₁), Bedana Suri (R₂), Alandi (R₃), Kandhari (R₄), Jalore Seedless (R₅), Jodhpur Red (R₆), Patna-5 (R₇), Muscat (R₈), Yercaud (R₉), Bedana Sedana (R₁₀) and Daru (R₁₁). Thus, total 22 treatments were replicated in 3 times with 20 grafts in each replication. About 15 cm long, leafless scions of 6-9 months old of Phule

were used. The rootstock were raised in black polythene bags (30 x 18") filled with soil, sand, vermicompost and FYM mixture in 1:1:1:1 ratio. A long and smooth vertical slit of about 4 to 5 cm downward was given with sharp budding knife. Wedge shaped scion was inserted into vertical slit on rootstock without damaging the cambium layer and was tied with polythene strip. For budding on the selected rootstock, bark of similar in size and shape was removed about 3 to 4 cm from top. The patch was fitted perfectly into the notch and was tied firmly with a polythene strip exposing the bud out. Polythene cap of 100 gauge thickness in 3cm x 15 cm size were used in both methods to cover the grafts-scions. The number of days required for sprouting of grafts from the date of grafting/budding were recorded treatment wise for each plant and average values were reported. The grafts, in which the growth of scion stick observed, were considered as successful grafts. The sprouting of grafted scion was considered as initial success and percentage of sprouting was computed after 30 days after grafting/budding. Survival of prepared grafts was also recorded at 60 and 90 days after grafting/budding operation as a final survival percentage was computed. The number of sprouted shoots was counted treatment wise in each replication and the average number of shoots per plant was recorded after 180 days of grafting operation. The average number of internodes, length of shoot and length of internodes per shoot counted treatment and replication wise separately after 180 days of grafting operation. Statistical analysis of the data was done by standard methods, described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect on days required for sprouting

The data regarding mean numbers of days required for sprouting of grafts, presented in Table 1, was significantly influenced by propagation methods (M) and different rootstocks (R). Considering two way interaction as given in (Table 2), the minimum days required for sprouting of grafts were recorded in M_1R_2 and M_1R_3 (15.53) followed by in M_1R_1 and M_1R_5 (15.70). Minimum number of days required for sprouting associated with more availability of food material in the scion i.e. wedge as compared to patch of the scion, secondly, the time required for compatibility and making availability of food material to the scion

for sprouting might have required more days. The lesser time taken in wedge graft to sprout might be due to better contact of cambial layers of stock and scion resulting early callus formation and initiation of early subsequent growth. These results are in agreement with Singh and Chaudhari (1984) in grapes, Visen *et al.* in guava (2010).

Effect on sprouting and survival percentage

The data regarding percentage of sprouting up to 30 days after grafting significantly influenced by propagation methods (M) and different rootstocks (R) and it is given in (Table 1). The interaction effects of propagation methods and different rootstocks on sprouting up to 30 days after grafting/budding recorded statistically non significant differences on success and survival of grafts. However, numerically the maximum (80.00%) sprouting recorded in M_1R_2 followed by M_1R_3 and M_1R_5 (76.67%). The maximum survival percentage were recorded in wedge grafting on Bedana Suri (80.00%) and (76.67%) on 60th and 90th days after grafting/budding respectively. This might be due to having optimum nutrient and hormonal status of longer scion as well as good callusing capability of scion. High wedge graft success on 60 and 90 DAG/DAB might be associated with the better healing process of the graft union. In fruit crops, wedge graft offers very high graft success with greater stability than other grafting techniques due to the full balance between stock and scion (Tabora and Atienza 2006, Selvi *et al.* 2008, Somkuwar *et al.* 2009). This results is in accordance with Chandra and Jadhav (2012) who reported that wedge grafting in pomegranate in the month of January recorded maximum (90.00%) survival.

Average number of sprouted shoots 180 days after grafting/budding

It is observed from (Table 3) that individual effects of propagation method and different rootstocks on average number of sprouted shoot 180 days after grafting recorded statistically significant and the interaction effects of propagation method and different rootstocks recorded statistically non significant differences however, numerically the maximum (4.60) shoots were recorded in M_1R_3 (Table 4).

Average length of sprouted shoots (cm) 180 days after grafting/budding

It is observed from (Table 3) that individual effects of propagation method and different rootstocks on average length of sprouted shoot 180 days after grafting recorded statistically significant and the interaction effects of propagation method and different rootstocks recorded statistically non significant differences however, numerically the maximum length of shoots (90.00 cm) were recorded in M₁R₁ (Table 4). This might be due to better/earlier stock and scion union and better graft union. These results in the present study were in contradictory with the findings of Karibasappa (1999) who reported that chip/patch budding grafts made on 15th September showed the highest shoot length in grape.

Average number of internodes per plant 180 days after grafting/budding

It is observed from (Table 3) that individual effects of propagation method and different rootstocks and interaction effects on average number of internodes per plant 180 days after grafting recorded statistically significant, the maximum number of internodes (24.62) per plant were recorded in M₁R₂ (Table 4). Maximum number of internodes per plant was recorded in wedge grafting as compared to patch budding. This might be due to more increased shoot length in wedge grafting than patch budding.

Girth at graft/bud union (mm) 180 days after grafting/budding

The interaction effects of propagation method and different rootstocks recorded statistically non-significant. The highest girths at graft/bud union (13.05 mm) were recorded in M₁R₂ (Table 4).

Average fresh root weight (g) 180 days after grafting/budding

It is observed from (Table 5) that individual effects of propagation method and different rootstocks on average fresh root weight 180 days after grafting recorded statistically significant and the interaction effects of propagation method and different rootstocks

recorded statistically non significant differences however, numerically the maximum fresh root weight (39.40 g) was recorded in M₁R₂ (Table 6). The maximum fresh root weight of grafts was recorded in wedge grafting than patch budding. The maximum fresh root weight was recorded in Bedana Suri. This might be due to varietal characteristics of the rootstocks.

Average fresh shoot weight (g) 180 days after grafting/budding

It is observed from (Table 5) that individual effects of propagation method and different rootstocks on average fresh shoot weight 180 days after grafting recorded statistically significant and the interaction effects of propagation method and different rootstocks recorded statistically non significant differences however, numerically the maximum fresh shoot weight (66.40 g) was recorded in M₁R₂ (Table 6). The maximum fresh shoot weight of grafts was recorded in wedge grafting than patch budding. The higher fresh shoot weight in wedge grafting could be pertained to sooner bud take possibly resulting in better connection between scion and stock and consequently better water and nutrient uptake. These results are similar to those reported by Kayane *et al.* (1981) and Hamdi *et al.* (2007) on other fruit crops.

Shoot/root weight ratio 180 days after grafting/budding

It is observed from (Table 5) that individual effects of propagation method and different rootstocks on shoot/root weight ratio 180 days after grafting recorded statistically significant and the interaction effects of propagation method and different rootstocks recorded statistically non significant differences however, numerically the maximum shoot/root weight ratio (1.77) was recorded in M₁R₄ (Table 6).

It can be concluded from the afore mentioned investigation that the better graft compatibility of pomegranate cv. Phule Bhagwa Super was found with the rootstocks, Bedana Suri, Ganesh, Kandhari, Jalore Seedless and Alandi either by wedge grafting or patch budding method for obtaining higher percentage of success and better stionic growth of grafts.

Table 1. Effect of methods of grafting and root stocks on sprouting and survival of grafts

Treatments	Days required for sprouting	Percentage of sprouting up to 30 DAG/DAB	Survival of grafts percent (%)	
			60 days	90 days
M ₁ -Wedge grafting	17.32	73.03	70.30	69.09
M ₂ - Patch budding	21.65	68.79	66.97	66.97
SEm (±)	0.25	0.74	0.57	0.71
CD at 5%	0.73	2.11	1.64	2.04
R ₁ - Ganesh	18.02	75.00	75.00	75.00
R ₂ - Bedana Suri	17.77	80.00	78.34	76.67
R ₃ - Alandi	17.77	71.67	70.00	70.00
R ₄ - Kandhari	18.17	71.67	70.00	70.00
R ₅ - Jalore Seedless	17.88	75.00	73.33	73.33
R ₆ - Jodhpur Red	18.25	71.67	68.34	68.34
R ₇ - Patna-5	21.63	66.67	63.34	63.34
R ₈ - Muscat	21.30	71.67	68.34	68.34
R ₉ - Yercaud	21.33	66.67	63.34	61.67
R ₁₀ - Bedana Sedana	21.28	66.67	63.34	61.67
R ₁₁ - Daru	21.00	63.33	61.67	60.00
SEm (±)	0.24	0.70	0.55	0.68
CD at 5%	0.70	2.02	1.57	1.95

DAG-Days after grafting DAB-Days after budding

Table 2. Interaction effect of grafting methods and root stocks on sprouting and survival of grafts

Treatments	Days required for sprouting	Percentage of sprouting up to 30 DAG/DAB	Survival of grafts percent (%)	
			60 days	90 days
M ₁ R ₁	15.70	76.67	76.67	76.67
M ₁ R ₂	15.53	80.00	80.00	76.67
M ₁ R ₃	15.53	73.33	70.00	70.00
M ₁ R ₄	15.80	73.33	70.00	70.00
M ₁ R ₅	15.70	76.67	73.33	73.33
M ₁ R ₆	15.90	73.33	70.00	70.00
M ₁ R ₇	19.60	70.00	66.67	66.67
M ₁ R ₈	19.30	73.33	70.00	70.00
M ₁ R ₉	19.30	70.00	66.67	63.33
M ₁ R ₁₀	19.20	70.00	66.67	63.33
M ₁ R ₁₁	19.00	66.67	63.33	60.00
M ₂ R ₁	20.33	73.33	73.33	73.33
M ₂ R ₂	20.00	80.00	76.67	76.67
M ₂ R ₃	20.00	70.00	70.00	70.00
M ₂ R ₄	20.53	70.00	70.00	70.00
M ₂ R ₅	20.07	73.33	73.33	73.33
M ₂ R ₆	20.60	70.00	66.67	66.67
M ₂ R ₇	23.65	63.33	60.00	60.00
M ₂ R ₈	23.30	70.00	66.67	66.67
M ₂ R ₉	23.35	63.33	60.00	60.00
M ₂ R ₁₀	23.35	63.33	60.00	60.00
M ₂ R ₁₁	23.00	60.00	60.00	60.00
SEm (±)	0.85	2.45	1.90	2.37
CD at 5%	NS	NS	NS	NS

Table 3. Effect of of methods of grafting and root stocks on average growth parameters of grafts.

Treatments	Average number of sprouted shoots 180 DAG/DAB	Average length of sprouted shoots (cm) 180 DAG/DAB	Average number of internodes per plant 180 DAG/DAB	Girth at graft/bud union 180 DAG/DAB
M ₁ - Wedge grafting	3.96	78.66	22.28	12.08
M ₂ - Patch budding	1.99	66.18	19.91	11.94
SEm (±)	0.07	1.18	0.11	0.10
CD at 5%	0.21	3.38	0.34	NS
R ₁ - Ganesh	3.47	81.00	22.83	12.19
R ₂ - Bedana Suri	3.30	85.25	23.06	12.96
R ₃ - Alandi	3.43	77.63	22.13	12.17
R ₄ - Kandhari	2.90	79.80	22.26	12.28
R ₅ - Jalore Seedless	2.80	71.75	21.32	12.34
R ₆ - Jodhpur Red	2.90	68.83	20.88	12.03
R ₇ - Patna-5	2.77	64.58	19.38	11.76
R ₈ - Muscat	2.93	67.70	20.61	11.55
R ₉ - Yercaud	2.97	67.58	20.05	11.56
R ₁₀ - Bedana Sedana	2.90	67.00	19.93	11.72
R ₁₁ - Daru	2.50	65.50	19.64	11.57
SEm (±)	0.07	2.78	0.11	0.09
CD at 5%	0.21	7.94	0.32	0.27

Table 4. Interaction effect of grafting methods and root stocks on growth parameters of grafts.

Treatments	Average number of sprouted shoots 180 DAG/DAB	Average length of sprouted shoots (cm) 180 DAG/DAB	Average number of internodes per plant 180 DAG/DAB	Girth at graft/bud union 180 DAG/DAB
M ₁ R ₁	4.53	90.00	24.50	12.24
M ₁ R ₂	4.07	88.50	24.62	13.05
M ₁ R ₃	4.60	82.65	23.50	12.25
M ₁ R ₄	3.73	84.60	23.85	12.36
M ₁ R ₅	3.60	79.00	22.73	12.39
M ₁ R ₆	3.73	75.00	22.26	12.04
M ₁ R ₇	3.73	70.50	20.25	11.88
M ₁ R ₈	4.07	74.50	21.00	11.63
M ₁ R ₉	4.20	74.50	21.00	11.58
M ₁ R ₁₀	3.93	74.00	20.85	11.78
M ₁ R ₁₁	3.40	72.00	20.50	11.64
M ₂ R ₁	2.40	73.50	21.16	12.14
M ₂ R ₂	2.53	80.50	21.50	12.86
M ₂ R ₃	2.27	72.60	20.75	12.09
M ₂ R ₄	2.07	75.00	20.67	12.19
M ₂ R ₅	2.00	64.50	19.90	12.28
M ₂ R ₆	2.07	62.65	19.50	12.02
M ₂ R ₇	1.80	58.65	18.50	11.63
M ₂ R ₈	1.80	60.90	20.21	11.47
M ₂ R ₉	1.73	60.65	19.09	11.53
M ₂ R ₁₀	1.87	60.00	19.00	11.65
M ₂ R ₁₁	1.60	59.00	18.78	11.50
SEm (±)	0.25	3.93	0.39	0.33
CD at 5%	NS	NS	1.12	NS

Table 5. Effect of methods of grafting and root stocks on fresh root, shoot weight (g) and shoot/root weight ratio

Treatments	Average fresh root weight (g) 180 DAG/DAB	Average fresh shoot weight (g) 180 DAG/DAB	Shoot/root fresh weight ratio 180 DAG/DAB
M ₁ - Wedge grafting	35.79	58.80	1.64
M ₂ - Patch budding	31.90	40.31	1.26
SEm (±)	0.35	0.63	0.01
CD at 5%	1.01	1.80	0.04
R ₁ - Ganesh	35.06	54.03	1.53
R ₂ - Bedana Suri	36.50	56.10	1.52
R ₃ - Alandi	34.88	53.33	1.52
R ₄ - Kandhari	34.38	54.03	1.57
R ₅ - Jalore Seedless	34.68	52.37	1.50
R ₆ - Jodhpur Red	34.73	54.38	1.55
R ₇ - Patna-5	31.25	42.25	1.34
R ₈ - Muscat	33.20	44.97	1.34
R ₉ - Yercaud	32.39	46.60	1.43
R ₁₀ - Bedana Sedana	33.13	44.52	1.34
R ₁₁ - Daru	32.10	42.50	1.31
SEm (±)	0.33	0.60	0.01
CD at 5%	0.96	1.72	0.04

Table 6. Interaction effect of grafting methods and root stocks on fresh root and shoot weight

Treatments	Average fresh root weight (g) 180 DAG/DAB	Average fresh shoot weight (g) 180 DAG/DAB	Shoot/root fresh weight ratio 180 DAG/DAB
M ₁ R ₁	37.67	63.87	1.70
M ₁ R ₂	39.40	66.40	1.69
M ₁ R ₃	36.77	61.00	1.66
M ₁ R ₄	35.27	62.53	1.77
M ₁ R ₅	36.60	60.53	1.65
M ₁ R ₆	37.13	63.60	1.71
M ₁ R ₇	33.70	52.00	1.54
M ₁ R ₈	35.40	55.33	1.56
M ₁ R ₉	34.45	55.00	1.60
M ₁ R ₁₀	33.67	54.50	1.62
M ₁ R ₁₁	33.67	52.00	1.54
M ₂ R ₁	32.45	44.20	1.36
M ₂ R ₂	33.60	45.80	1.36
M ₂ R ₃	33.00	45.67	1.38
M ₂ R ₄	33.50	45.53	1.36
M ₂ R ₅	32.75	44.20	1.35
M ₂ R ₆	32.33	45.15	1.40
M ₂ R ₇	28.80	32.50	1.13
M ₂ R ₈	31.00	34.60	1.12
M ₂ R ₉	30.33	38.20	1.26
M ₂ R ₁₀	32.60	34.53	1.06
M ₂ R ₁₁	30.53	33.00	1.08
SEm (±)	1.17	2.09	0.05
CD at 5%	NS	NS	NS

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