# Assessment of Graft Compatibility of Different Rootstocks of Pomegranate (*Punica granatum* L.)

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**ABSTRACT**

*A study was undertaken with a view to assess the graft compatibility of various rootstocks with cv. Phule Bhagwa Super by adapting various propagation methods. Eleven genotypes (rootstocks) and two propagation methods viz., Wedge grafting and patch budding were used in present study. Rootstock Bedana Suri and Alandi took the minimum time for bud sprout (17.77 days). The highest bud sprout (80.00%) at 30 days after grafting (DAG)/ days after budding (DAB) was recorded in Bedana Suri. The maximum per cent survival (76.67%) of grafts/buds at 90 DAG/ DAB was recorded in Bedana Suri. The highest shoot growth rate was registered on Bedana Suri rootstock. Rootstock Bedana Suri gave the longest shoot length, highest number of shoots and number of internodes. Shoot length and internodal length also showed significant increase with respect of time. The maximum girth at graft/bud union was recorded in Bedana Suri. The highest stock/scion girth ratio (1.00) was recorded in the rootstocks, Ganesh, Bedana Suri and Kandhari with wedge grafting. Bedana Suri rootstock produced longer shoot and root and also highest fresh shoot and root weight. The highest shoot/root weight ratio was recorded in Kandhari.*

***Keywords :*** Pomegranate, rootstocks, wedge grafting, patch budding, success of grafts

## 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, multistem 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 are that they should be easily propagated, 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 minimising the root exposure in root rhizosphere and their by limiting infection of pathogen. But, very less 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 Graft Compatibility 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 ($M_1$) and Patch budding ($M_2$) and eleven rootstocks Ganesh ($R_1$), Bedana Suri ($R_2$), Alandi ($R_3$), Kandhari ($R_4$), Jallore Seedless ($R_5$), Jodhpur Red ($R_6$), Patna-5 ($R_7$), Muscat ($R_8$), Yercaud ($R_9$), Bedana Sedana ($R_{10}$) and Daru ($R_{11}$) Vander Plank (1963) reported that a long incubation period is an important component for host plants to have a partial resistance to *Fusarium oxysporium*. Genesis of moderately resistance rootstock is not yet clearly understood. However further research on molecular basis might be helpful to identify the responsible gene for resistsnce to wilt. Thus, total 22 treatments were replicated in 3 times. There were 20 grafts in each treatment and replication. About 15 cm long leafless scions of 6-9 months of Phule Bhagwa Super were used for grafting/budding. Almost one year old seedlings of different rootstocks 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 stick, 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 and the final survival percentage was computed. The number of sprouted shoots was counted treatment wise in each replication for each plant 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 from each plant separately after 180 days of grafting operation. Statistical analysis of the data was done by standards described by Panse and Sukhatme (1987).

## RESULTS AND DISCUSSION

### Days required for sprouting

The data presented in Table1 revealed that the mean numbers of day required for sprouting of grafts was significantly influenced by propagation methods (M) and different rootstocks (R) Considering two way interaction as given in (Table 2), the minimum (15.53) days required for sprouting of grafts were recorded in $M_1R_2$ and $M_1R_3$ followed by (15.70) days in $M_1R_1$ and $M_1R_5$. 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 spout 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), Visen-Amit *et al*. (2010).

### Percentage of sprouting after grafting/budding and survival of grafts

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 $M_1R_2$ and $M_1R_3$ slightly lower (76.67%) in $M_1R_1$ and $M_1R_5$. The maximum survival percentage were (80.00%) and (76.67%) recorded in Wedge grafting on Bedana Suri on 60$^{th}$ and 90$^{th}$ 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 specially 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 (4.53) shoots were recorded in $M_1R_3$ (Table 4).

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

It is observed from 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 $M_1R_1$ (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 15$^{th}$ 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 $M_1R_2$ (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 significant. The highest girths at graft/bud union (13.05 mm) were recorded in $M_1R_2$ (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 $M_1R_2$ (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 $M_1R_2$ (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 $M_1R_4$ (Table 6).

**Table 1. Effect of grafting method and rootstock genotype individual factor 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 |
| $M_1$ | 17.32 | 73.03 | 70.30 | 69.09 |
| $M_2$ | 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** |
| $R_1$ | 18.02 | 75.00 | 75.00 | 75.00 |
| $R_2$ | 17.77 | 80.00 | 78.34 | 76.67 |
| $R_3$ | 17.77 | 71.67 | 70.00 | 70.00 |
| $R_4$ | 18.17 | 71.67 | 70.00 | 70.00 |
| $R_5$ | 17.88 | 75.00 | 73.33 | 73.33 |
| $R_6$ | 18.25 | 71.67 | 68.34 | 68.34 |
| $R_7$ | 21.63 | 66.67 | 63.34 | 63.34 |
| $R_8$ | 21.30 | 71.67 | 68.34 | 68.34 |
| $R_9$ | 21.33 | 66.67 | 63.34 | 61.67 |
| $R_{10}$ | 21.28 | 66.67 | 63.34 | 61.67 |
| $R_{11}$ | 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** |

**Table 2. Interaction effect of grafting method and rootstock genotype 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 |
| $M_1R_1$ | 15.70 | 76.67 | 76.67 | 76.67 |
| $M_1R_2$ | 15.53 | 80.00 | 80.00 | 76.67 |
| $M_1R_3$ | 15.53 | 73.33 | 70.00 | 70.00 |
| $M_1R_4$ | 15.80 | 73.33 | 70.00 | 70.00 |
| $M_1R_5$ | 15.70 | 76.67 | 73.33 | 73.33 |
| $M_1R_6$ | 15.90 | 73.33 | 70.00 | 70.00 |
| $M_1R_7$ | 19.60 | 70.00 | 66.67 | 66.67 |
| $M_1R_8$ | 19.30 | 73.33 | 70.00 | 70.00 |
| $M_1R_9$ | 19.30 | 70.00 | 66.67 | 63.33 |
| $M_1R_{10}$ | 19.20 | 70.00 | 66.67 | 63.33 |
| $M_1R_{11}$ | 19.00 | 66.67 | 63.33 | 60.00 |
| $M_2R_1$ | 20.33 | 73.33 | 73.33 | 73.33 |
| $M_2R_2$ | 20.00 | 80.00 | 76.67 | 76.67 |
| $M_2R_3$ | 20.00 | 70.00 | 70.00 | 70.00 |
| $M_2R_4$ | 20.53 | 70.00 | 70.00 | 70.00 |
| $M_2R_5$ | 20.07 | 73.33 | 73.33 | 73.33 |
| $M_2R_6$ | 20.60 | 70.00 | 66.67 | 66.67 |
| $M_2R_7$ | 23.65 | 63.33 | 60.00 | 60.00 |
| $M_2R_8$ | 23.30 | 70.00 | 66.67 | 66.67 |
| $M_2R_9$ | 23.35 | 63.33 | 60.00 | 60.00 |
| $M_2R_{10}$ | 23.35 | 63.33 | 60.00 | 60.00 |
| $M_2R_{11}$ | 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 individual factor 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 |
|---|---|---|---|---|
| $M_1$ | 3.96 | 78.66 | 22.28 | 12.08 |
| $M_2$ | 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** |
| $R_1$ | 3.47 | 81.00 | 22.83 | 12.19 |
| $R_2$ | 3.30 | 85.25 | 23.06 | 12.96 |
| $R_3$ | 3.43 | 77.63 | 22.13 | 12.17 |
| $R_4$ | 2.90 | 79.80 | 22.26 | 12.28 |
| $R_5$ | 2.80 | 71.75 | 21.32 | 12.34 |
| $R_6$ | 2.90 | 68.83 | 20.88 | 12.03 |
| $R_7$ | 2.77 | 64.58 | 19.38 | 11.76 |
| $R_8$ | 2.93 | 67.70 | 20.61 | 11.55 |
| $R_9$ | 2.97 | 67.58 | 20.05 | 11.56 |
| $R_{10}$ | 2.90 | 67.00 | 19.93 | 11.72 |
| $R_{11}$ | 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 method and rootstock genotype 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 |
|---|---|---|---|---|
| $M_1R_1$ | 4.53 | 88.50 | 24.50 | 12.24 |
| $M_1R_2$ | 4.07 | 90.00 | 24.62 | 13.05 |
| $M_1R_3$ | 4.60 | 82.65 | 23.50 | 12.25 |
| $M_1R_4$ | 3.73 | 84.60 | 23.85 | 12.36 |
| $M_1R_5$ | 3.60 | 79.00 | 22.73 | 12.39 |
| $M_1R_6$ | 3.73 | 75.00 | 22.26 | 12.04 |
| $M_1R_7$ | 3.73 | 70.50 | 20.25 | 11.88 |
| $M_1R_8$ | 4.07 | 74.50 | 21.00 | 11.63 |
| $M_1R_9$ | 4.20 | 74.50 | 21.00 | 11.58 |
| $M_1R_{10}$ | 3.93 | 74.00 | 20.85 | 11.78 |
| $M_1R_{11}$ | 3.40 | 72.00 | 20.50 | 11.64 |
| $M_2R_1$ | 2.40 | 73.50 | 21.16 | 12.14 |
| $M_2R_2$ | 2.53 | 80.50 | 21.50 | 12.86 |
| $M_2R_3$ | 2.27 | 72.60 | 20.75 | 12.09 |
| $M_2R_4$ | 2.07 | 75.00 | 20.67 | 12.19 |
| $M_2R_5$ | 2.00 | 64.50 | 19.90 | 12.28 |
| $M_2R_6$ | 2.07 | 62.65 | 19.50 | 12.02 |
| $M_2R_7$ | 1.80 | 58.65 | 18.50 | 11.63 |
| $M_2R_8$ | 1.80 | 60.90 | 20.21 | 11.47 |
| $M_2R_9$ | 1.73 | 60.65 | 19.09 | 11.53 |
| $M_2R_{10}$ | 1.87 | 60.00 | 19.00 | 11.65 |
| $M_2R_{11}$ | 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 individual factor 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 |
|---|---|---|---|
| $M_1$ | 35.79 | 58.80 | 1.64 |
| $M_2$ | 31.90 | 40.31 | 1.26 |
| **SEm (±)** | **0.35** | **0.63** | **0.01** |
| **CD at 5%** | **1.01** | **1.80** | **0.04** |
| $R_1$ | 35.06 | 54.03 | 1.53 |
| $R_2$ | 36.50 | 56.10 | 1.52 |
| $R_3$ | 34.88 | 53.33 | 1.52 |
| $R_4$ | 34.38 | 54.03 | 1.57 |
| $R_5$ | 34.68 | 52.37 | 1.50 |
| $R_6$ | 34.73 | 54.38 | 1.55 |
| $R_7$ | 31.25 | 42.25 | 1.34 |
| $R_8$ | 33.20 | 44.97 | 1.34 |
| $R_9$ | 32.39 | 46.60 | 1.43 |
| $R_{10}$ | 33.13 | 44.52 | 1.34 |
| $R_{11}$ | 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 method and rootstock genotype 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 |
|---|---|---|---|
| $M_1R_1$ | 37.67 | 63.87 | 1.70 |
| $M_1R_2$ | 39.40 | 66.40 | 1.69 |
| $M_1R_3$ | 36.77 | 61.00 | 1.66 |
| $M_1R_4$ | 35.27 | 62.53 | 1.77 |
| $M_1R_5$ | 36.60 | 60.53 | 1.65 |
| $M_1R_6$ | 37.13 | 63.60 | 1.71 |
| $M_1R_7$ | 33.70 | 52.00 | 1.54 |
| $M_1R_8$ | 35.40 | 55.33 | 1.56 |
| $M_1R_9$ | 34.45 | 55.00 | 1.60 |
| $M_1R_{10}$ | 33.67 | 54.50 | 1.62 |
| $M_1R_{11}$ | 33.67 | 52.00 | 1.54 |
| $M_2R_1$ | 32.45 | 44.20 | 1.36 |
| $M_2R_2$ | 33.60 | 45.80 | 1.36 |
| $M_2R_3$ | 33.00 | 45.67 | 1.38 |
| $M_2R_4$ | 33.50 | 45.53 | 1.36 |
| $M_2R_5$ | 32.75 | 44.20 | 1.35 |
| $M_2R_6$ | 32.33 | 45.15 | 1.40 |
| $M_2R_7$ | 28.80 | 32.50 | 1.13 |
| $M_2R_8$ | 31.00 | 34.60 | 1.12 |
| $M_2R_9$ | 30.33 | 38.20 | 1.26 |
| $M_2R_{10}$ | 32.60 | 34.53 | 1.06 |
| $M_2R_{11}$ | 30.53 | 33.00 | 1.08 |
| **SEm (±)** | **1.17** | **2.09** | **0.05** |
| **CD at 5%** | **NS** | **NS** | **NS** |

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

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