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# Effects of rootstock and scion on graft success and vegetative parameters of pomegranate

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ABSTRACT

There are inadequate formations on the application of rootstocks in the propagation of pomegranate. The aim of the study was effects of rootstock, scion on the graft success of pomegranate. Three pomegranate cultivars namely 'Gorj-e-Dadashi', 'Gorj-e-Shahvar' and 'Post Ghermaz-e-Aliaghai' were used as rootstocks and two cultivars 'Rabab-e-Neyriz' and 'Khafr-e-Jahroom' were selected as scions. Omega grafting technique was applied as stenting method. The following parameters of grafted plants were recorded: graft success percentage, mortality percentage, growth parameters and photosynthetic parameters. The results showed that rootstock type affected on graft success percentage so that the most graft success percentage was obtained with 'Gorj-e-Dadashi' rootstock. Also results showed that the most shoot length, shoot diameter and leaf area were obtained when 'Ranab-e- Neyriz' grafted on to 'Gorj-e-Shahvar'. Correlation between phenolic compounds, soluble sugar of rootstock and scion with graft success percentage and mortality percentage showed that there was a positive correlation between soluble sugar rate of scion with graft success percentage whereas the phenolic compounds of rootstock had negative correlation with mortality percentage.



## 1. Introduction

Pomegranate (*Punica granatum* L.) from the family Punicaceae, is an important and exportable fruit crop in Iran (Karimi and Mirdehghan, 2013). At the present, Iran is the leading producer of this fruit followed by India, Turkey and Spain (Owis, 2010). As the main area under pomegranate cultivation in Iran are located in arid and semi-arid adjacent to desert regions. Low irrigation water quality, lime induced Fe chlorosis, soil salinity, nutrient imbalance and soil-borne diseases are the most limiting factors in this areas. Currently about 760 genotypes and cultivars of pomegranate have been identified, collected and growth in Pomegranate Research Institute in Yazd province, central Iran. In rich collection, it is likely that some genotypes are tolerant to adverse environmental conditions but neglected due to their low quality fruits. These genotypes could be evaluated and used as potential rootstocks (Karimi and Hasanpour, 2014; Nowrozy et al., 2016). Furthermore some traditional cultivars of pomegranate are sensitive to drought, salinity, sunburn, aril browning and soil borne diseases that they can controlled with grafting on tolerance rootstocks.

'Rabab-e-Neyriz' is one of the most important pomegranate cultivars in Iran, that it is widely cultivated in parts of south western of Iran. The fruits are big in size, with semi hard seeds, blood red arils and dark red skin. Gorj-e-Dadashi' and 'Post Ghermaz-e-Aliaghai are other cultivars that are cultivated in Iran. In study, Karimi and Eini Tari (2016) reported that Gorj-e-Dadashi' showed lower sensitive to $NaHCO_3$. In the last decades, there has been a tremendous towards using grafted/budded plants in fruit orchards. Moreover, the available reports indicate that rootstock could affect the tolerance of scion to soil borne diseases, lime-induced Fe-deficiency chlorosis and salinity stress (Rivero et al., 2003; Karimi and Hasanpour, 2014; Hasanpour et al., 2014, 2015; Karimi and Eini Tari, 2016; Karimi and Hasanpour, 2016). In a study, Karimi and Hasanpour (2016) studied effects of two salinity levels, 0 and 70 mM of sodium chloride and calcium chloride on pomegranate cv. 'Gabri' that grafted on 'Tab-o-larz' and 'Malas-e-yazdi' rootstocks and reported that 'Tab -o- Larz' rootstock restricts the uptake and transport of Na and Cl from root to shoot; furthermore, it can be used as a salt-tolerant rootstock for pomegranate cv. 'Gabri'.

Grafting technique, scion and rootstock type, age of scion and rootstock and environmental conditions are the most important

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**Table 1**
Variance analysis of measured parameters of grafted pomegranate plants.

| Variables | dF | MS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Success graft (%) | Mortality (%) | Shoot length (cm) | Shoot diameter (cm) | Leaf number | SPAD | *Fv/Fm* |
| Time | 2 | 0.264*** | 28.98.67* | 367.13** | 0.0543** | 323.84** | 5.84* | 0.000037* |
| Error | 3 | 4.524 | 10.77 | 3.93 | 0.00012 | 0.768 | 0.572 | 0.000003 |
| Rootstock | 2 | 201.85** | 190.74* | 252.52*** | 0.0221** | 420.43*** | 0.245 ns | 0.00045** |
| Scion | 1 | 46.29 ns | 324.07* | 86.65** | 0.0139*** | 359.46*** | 0.167 ns | 0.00040*** |
| Time × Rootstock | 4 | 1.85 ns | 43.51 ns | 61.15** | 0.0087*** | 16.44 ns | 0.060 ns | 0.00014 ns |
| Time × Scion | 2 | 1.85 ns | 201.85 ns | 4.15 ns | 0.0013 ns | 20.16 ns | 0.377 ns | 0.000002 ns |
| Rootstock × Scion | 2 | 79.62 ns | 35.18 ns | 189.46*** | 0.0078** | 208.42*** | 0.349 ns | 0.000002 ns |
| Time × Rootstock × Scion | 4 | 1.85 ns | 81.29 ns | 43.24 ns | 0.0012 ns | 16.11 ns | 0.294 ns | 0.00017* |
| Total error | 33 | 36.36 | 75.90 | 8.736 | 0.00064 | 11.90 | 0.1480 | 0.000062 |
| Cv | – | 6.25 | 13.16 | 8.56 | 7.056 | 6.64 | 0.7649 | 1.072 |

ns, non-significant.
* Significant at $p < 0.05$.
** Significant at $p < 0.01$.
*** Significant at $p < 0.001$.

factors that can affect on graft success. (Karimi, 2011). The favorable temperature for cellular activity varies from 12 °C to 35 °C, therefore grafting operation should be carried out when the temperatures are favorable for cambial activity and there is high humidity in vicinity of the cambial region of graft union. In a study, Rahman (2011) carried out an experiment on the effect of cleft grafting growing condition and rootstock growing containers on success, survivability and growth of mango grafts. The experiment results reported that February operation in earthen pot growing rootstock under poly tunnel condition can be followed with the highest success (86.67%) and survivability (86.33%) and growth of mango graft in off season. In another research, Ebrahimi et al. (2007) evaluated different budding methods (Patch, shield and chip) in propagation of walnut under controlled and field conditions and reported that the highest success rate obtained with Patch budding (91.0%) under greenhouse with the mean temperature 25 °C and 21 °C during the day and night and mean humidity 39 and 70% respectively. The findings showed that variety have significant effect on growth parameters and graft success percentage of different fruit crops (Ebrahimi et al., 2007; Shatial, 2011; Nowrozy et al., 2016). Shatial (2011) conducted a study on the effect of variety on success of cleft grafting of 9 Guava varieties. BAU guava-9 gave the highest graft success percentage. Chattopadhayay and Sawarnakar (1995) also studied methods of budding and grafting in local Pummelo cultivars and reported that the highest success graft percentage was obtained with T budding and the lowest it with cleft grafting.

Pomegranate trees are propagated in different ways such as, seeds, cuttings, layering method and sucker but the common and appropriate method is the use of cuttings (Karimi, 2011; Karimi and Farahmand, 2011). Pomegranate also can propagate using bench grafting (Karimi and Farahmand, 2011). In this method require a fair amount of skill, and time. An alternative method is the cutting and grafting method which is sometimes called a stenting method. Stenting is a method for quick propagation of plants. Cutting and grafting is performed simultaneously. The scion is grafted onto a non-rooted rootstock. The formation of the union and adventitious roots on the rootstock occur simultaneously. Stenting is now being used worldwide by rose growers and is also a valuable technique in propagating species of conifers and also rhododendron, apple, plum and pear (Izadi et al., 2013; Hartmann et al., 2002). Therefore, the objective of this research was study of effects rootstock, scion on commercial propagation of pomegranate grafted cutting using stenting method.

## 2. Materials and methods

This study was conducted in a greenhouse of the Department of Horticulture, College of Agriculture, Vali-e-Asr university of Rafsanjan, Iran, over 2013–2014.

### 2.1. Stenting method with omega grafting

Stem cutting with 1–1.2 cm in diameter and 15–20 cm in length of three pomegranate cultivars namely 'Gorj-e-Dadashi', 'Gorj-e-Shahvar' and 'Post Ghermaz-e-Aliaghai' were selected and used as rootstocks. The scions with 1–1.2 cm in diameter and 5–7 cm in length were selected from 'Rabab-e-Neyriz' and 'Khafr-e-Jahroom' cultivars. Rootstocks and scions were cut with omega grafting Knife (model: Zenport; PK250) and then the scions placed into a rootstock gap such a way that the cambium layers of scion and rootstock have the maximum area of contact. The grafted area was wrapped using a cotton band and bottom of rootstock were treated with IBA hormone in 500 mg $L^{-1}$ concentration and were planted in moist perlite medium. Then the whole system (scion and rootstock) was covered in a layer of perlite. Grafting of cuttings was performed in early March. Grafted cuttings were kept under this condition for 4 weeks and then the perlite layer was removed from grafting area for inhibiting of adventitious root on scion.

### 2.2. Successful graft and growth parameters

During experiment parameters graft success percentage and growth parameters such as shoot length, shoot diameters, leaf number, leaf area, root number, root length, root and shoot fresh and dry weight were measured. The shoot length growth from scion was measured using the ruler and its diameter was measured using the digital caliper.

### 2.3. Photosynthetic parameters measurement

Leaf chlorophyll index (SPAD index), chlorophyll fluorescence (*Fv/Fm*) was measured in the end of the experiment on the three expanded leaves by using a portable chlorophyll meter (SPAD MINOLTA 502, Japan) and a portable pocket Plant Efficiency Analyzer (PEA, Hansatech Instruments Ltd., Norfolk, UK) respectively. The plant leaves was dark-adapted for 20 min by fixing special tags on each leaf blade before fluorescence measurement (Karimi and Eini Tari, 2016).