STUDY OF POMEGRANATE (*Punica granatum* L.) PROPAGATION USING BENCH GRAFTING

Hamid Reza Karimi[1*] and Homayoun Farahmand[2]

[1]Department of Horticultural Science, Faculty of Agriculture
University of Vali-e-Asr, Rafsanjan, Kerman, IRAN
[2]Department of Horticultural Science College of Agriculture
University of Shahid Bahonar, Kerman, IRAN
*Corresponding author: e-mail: h_karimi1019@yahoo.com

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A B S T R A C T

There is inadequate information in the case of rootstock application in pomegranate. In this study, propagation of pomegranate was investigated using bench grafting. The experiment was conducted as factorial in the framework of CRD design with three replications. The rootstocks were R_1, R_2 and R_3 and the scions included 'Gorj-e-Dadashi' (S_1) and 'Gorj-e-Shahvar' (S_2). At the end of experiment, successful callus formation at graft union, bud take percentage (BT), bud take stem length, internodes length and shoot fresh and dry weight were measured. The results indicated that rootstock influenced all measured characters including bud take and consequently the highest and lowest BT were obtained in R_1 and R_3, respectively. The interaction between rootstock/scion indicated the highest BT in R_3S_1 and R_2S_2.

Key words: bench grafting, pomegranate, rootstock, scion

INTRODUCTION

Pomegranate (*Punnica granatum* L.) from Punicaceae family is an important and exportable fruit crop of Iran cultivated since old times. Iran is the central of origin of pomegranate according to old documents and its cultivation has been extended from Iran to other parts of the world (Levin, 1994). At the present time, 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 located in arid and semi-arid areas adjacent to desert regions, low irrigation water quality, lime-induced Fe chlorosis, soil salinity, nutrient imbalance and soil-born diseases are among the most limiting factors in these areas. Currently about 760 genotypes and cultivars of pomegranate have been identified, collected and grown in Pomegranate Research Institute in Yazd province, central Iran. In this rich collection, it is likely that some genotypes are tolerant to adverse environmental conditions and disease, but neglected due to their low quality fruits. These genotypes could be evaluated and used as potential rootstocks (Zamani et al., 2006).

In the last decades, there has been a tremendous tendency 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). Thus, the evaluation of pomegranate propagation through grafting and budding techniques seems necessary. Almost all reports about pomegranate propagation restricted to rooting of cuttings (Ghosh et al., 1988; Sandhu et al., 1991; Singh, 1994; Olmez et al., 2007) and there is only one report presented by Vazifeshenas et al. (2009) about the effect of rootstock on vegetative and reproductive characters of scion. The present study was conducted to evaluate bench grafting method on two pomegranate cultivars.

MATERIAL AND METHODS

Rootstock and scion production

This experiment was conducted at the greenhouse of Department of Horticulture, College of Agriculture, Vali-e-Asr University of Rafsanjan over 2009-2010. Three rooted stem cutting rootstocks of pomegranate namely R_1, R_2 and R_3 were used. The scions included 'Gorj-e-Dadashi' and 'Gorj-e-Shahvar' provided from University Pomegranate Collection. The rooted cuttings (rootstocks) were gently taken out from bed and after removing of damaged roots, were treated with Benomyl at 1000 mg/l.

Technique of grafting

The rootstocks were then transferred to greenhouse and bench grafting was made. The grafted plants were then planted subsequently a substrate of moist sawdust and the temperature kept at 18 ±2 °C till callus formation and finally planted in nursery bed. Successful callus formation at graft union, bud take percentage (BT), scion shoot length, internodes length and shoot fresh and dry weight were measured during the experiment period. This experiment was conducted as factorial in the framework of CRD design with three replications each included 10 plants. The data were analyzed using MSTAT-C software and the means compared by DNMRT at 5%.

RESULTS AND DISCUSSION

Rootstock effects

The present results indicated that rootstocks affected all measured characters; so that, the highest and lowest bud take percentage (BT) was observed in R_1 and R_3, respectively (Tab. 1). The highest shoot length, internodes' length and shoot fresh

Table 1. The effect of rootstock/scion interaction on successful callus production percentage and bud take percentage

Scion	Rootstock			Mean
	R_1	R_2	R_3	
Successful callus formation [%]				
Gorj-e-Dadashi (S_1)	80.00 ab*	90.00 a	46.66 c	72.22 A
Gorj-e-Shahvar (S_2)	73.33 ab	70.00 b	80.00 ab	74.44 A
Mean	76.60 A	80 A	63.33 b	
Bud take [%]				
Gorj-e-Dadashi (S_1)	70.00 a	35.00 b	73.33 a	59.44 A
Gorj-e-Shahvar (S_2)	60.00 a	70.00 a	6.66 c	45.55 B
Mean	65.00 A	52.50 B	40.00 C	

*Means with common letter in each column are not significantly different (Duncan test, p = 0.05)

and dry weight were observed in R_2 and the lowest in R_3, although considering other characters, no significant difference was observed between these rootstocks with the exception of BT. These results correspond to Orlova (2007) and Pool and Nyirenda (1981) who reported the influence of rootstocks on BT and shoot length in plum and tea.

As callus formation at graft union is a prerequisite for successful graft/bud take, rootstock type might play an important role in this regard. These results are similar to those reported for apple and plum (Sadowski and Gorski, 2003; Orlova, 2007; Tuwel et al., 2008). Sadowski and Gorski (2003) reported that BT was higher in bench – grafted seedlings formerly produced callus than those without preformed callus.

Scion effects

Mean comparison of scion effects was indicated that scion type had significant effect just on BT and the other characters were not affected significantly. The highest BT was obtained in Gorj-e-Shahvar cultivar.

The interaction of rootstock/scion showed that the highest successful callus formation at graft union was obtained in R_2S_1, although there was no significant difference between this graft combination and R_1S_1 at 5% of probability using DNMRT.

The lowest successful callus formation at graft union was gained in R_3S_1. The highest BT was obtained in R_3S_1 not significantly different compared to R_1S_1 and R_2S_2. The lowest BT was observed in R_3S_2 (Tab. 1). Rootstock/ scion interaction on shoot length and internodes length was not considerable and only R_3S_2 showed significant difference with other graft combinations (Tab. 2). As the highest successful callus formation at graft union was observed in R_2S_1 and R_3S_1, and simultaneously the lowest BT was obtained in the same graft combinations, thus, the failure would be most possibly associated with the sensitivity of callus to environmental conditions in the nursery.

Table 2. The effect of rootstock/scion interaction on shoot fresh and dry weight

Scion	Rootstock			Mean
	R_1	R_2	R_3	
Shoot fresh weight [g]				
Gorj-e-Dadashi (S_1)	5.80 bc*	11.52 a	10.95 ab	9.42 A
Gorj-e-Shahvar (S_2)	11.50 a	8.50 abc	3.36 c	7.78 A
Mean	8.65 A	10.01 A	7.15 A	
Shoot dry weight [g]				
Gorj-e-Dadashi (S_1)	3.33 b	8.93 a	6.72 ab	6.33 A
Gorj-e-Shahvar (S_2)	8.98 a	6.49 ab	1.48 c	5.32 B
Mean	6.15 A	7.71 A	4.10 C	

*Explanation: see Table 1

Callus bridge derived from parenchyma cells is sensitive to relative humidity (RH) reduction and the physical connection between rootstock/scion is impaired by callus deterioration due to adverse environmental conditions such as high temperature and low RH.

The highest shoot fresh and dry weight was obtained in R_2S_1 not significantly different compared to R_1S_2. The lowest shoot fresh and dry weight was gained in R_3S_2 (Tab. 2). The higher shoot fresh and dry weight in the above mentioned graft combinations could be pertained to sooner BT possibly resulting in better connection between rootstock and scion and consequently better water and nutrient uptake. These results are similar to those reported by Kayane et al. (1981), Polat and Kaska (1992) and Hamdi et al. (2007) on other fruit crops.

In conclusion, results of this research indicated that grafting is practical and could be optimized for pomegranate propagation, thus further research by other grafting and budding methods and some other potential rootstocks and scions may be suggested.

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BADANIA MOŻLIWOŚCI ROZMNAŻANIA GRANATU (*Punica granatum* L.) METODĄ SZCZEPIENIA W RĘKU

Hamid Reza Karimi i Homayoun Farahmand

S T R E S Z C Z E N I E

Jest mało informacji na temat stosowania podkładek w rozmnażaniu granatu. W niniejszych badaniach rozmnażanie granatu badano z użyciem metody szczepienia w ręku (*ang.* bench grafting). Doświadczenie przeprowadzono jako czynnikowe w układzie kompletnie zrandomizowanym w trzech powtórzeniach. Podkładkami były R_1, R_2 i R_3, a zrazami odmiany Gorj-e-Dadashi (S_1) i Gorj-e-Shahvar (S_2). Pod koniec doświadczenia określano skuteczność tworzenia kalusa w miejscu zespolenia szczepienia, procent oczek przyjętych, długość łodygi przyjętych oczek, długość międzywęźli oraz świeżą i suchą masę pędów. Badania wykazały, że rodzaj podkładki ma wpływ na wszystkie mierzone cechy, w tym przyjmowanie się oczek, a w rezultacie najwyższy i najniższy procent przyjętych oczek uzyskano odpowiednio z podkładkami R_1 i R_3. Interakcja podkładka/zraz spowodowała, że największy procent przyjętych oczek otrzymano w kombinacjach R_3S_1 i R_2S_2.

Słowa kluczowe: szczepienie w ręku, podkładka, zraz