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Production of quince nursery trees by different grafting methods

Produção de mudas de marmeleiro por diferentes métodos de enxertia

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ABSTRACT

*Cutting propagation was the system to produce quince nursery trees (**Cydonia oblonga**). Experiments have been carried out in order to identify news propagations methods. As a result of this research, the 'Japonês' quince (**Chaenomeles sinensis**) was selected with rootstock, due to its good plant vigor for grafting, rusticity, and adequate performance in the field, mainly in the first years after planting. However, the best grafting period and grafting method must be determined for this rootstock. This research evaluated three grafting methods and five quince scion cultivars on 'Japonês' rootstock. The quince cultivars 'Provence', 'Mendoza Inta-37', 'Portugal', 'Smyrna', and 'Japonês' were grafted by winter cleft grafting, winter budding, and summer budding on 90cm long plants of 'Japonês' quince rootstock seedlings, cultivated in 3-liter plastic bags. Plant growth evaluations started as early as 60 days, and were concluded 150 days after grafting. Cleft grafting resulted in the highest graft survival rate for 'Smyrna', 'Mendoza Inta-37' and 'Japonês' cultivars. Although the higher graft survival rate was recorded in the winter, the buds grafted in the summer had better development.*

Key words: ***Chaenomeles sinensis***, ***Cydonia oblonga***, *propagation, rootstock.*

RESUMO

*Propagação por estaquia foi o sistema adotado no passado para produzir mudas de marmelo (**Cydonia oblonga**). Atualmente, pesquisas têm sido desenvolvidas para identificar novos métodos de propagação. A partir dos resultados dessas pesquisas, neste trabalho, o marmelo Japonês (**Chaenomeles sinensis**) foi selecionado como porta-enxerto, pelo seu bom vigor, pela sua rusticidade e pelo seu desempenho adequado no campo, principalmente nos primeiros anos depois do plantio. Porém, devem ser determinados a melhor época para a realização da enxertia e o método mais adequado quando se utiliza esse porta-enxerto. O presente trabalho avaliou três métodos de enxerto e cinco cultivares de marmelo enxertadas no porta-enxerto 'Japonês'. As cultivares de marmelo 'Provence', 'Mendoza Inta-37', 'Portugal', 'Smyrna' e 'Japonês' foram enxertadas por meio de três métodos: por garfagem em fenda cheia (julho), borbulhia de inverno (julho) e borbulhia de verão (janeiro), em mudas do porta-enxerto 'Japonês', com 90cm de comprimento e diâmetro próximo a 8mm, 15cm acima do colo da planta, mantidas em sacos plásticos com capacidade de 3L. As avaliações de crescimento tiveram incício aos 60 dias e foram concluídas 150 dias depois da enxertia. A enxertia realizada pelo processo de garfagem favorece a maior porcentagem de enxertos brotados, chegando próximo a 100% de sucesso para 'Smyrna', 'Mendoza Inta-37' e 'Japonês'. Embora a taxa de sobrevivência de enxerto mais alta tenha sido registrada na enxertia por borbulhia realizada no inverno, os enxertos realizados no verão tiveram melhor desenvolvimento.*

Palavras-chave: ***Chaenomeles sinensis***, ***Cydonia oblonga***, *propagação, porta-enxerto.*

INTRODUCTION

Quince trees are normally propagated by cuttings taken during the pruning season at the end of the hibernation. However, the low vigor of this material

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has resulted in slow initial development of these plants obtained through rooted cuttings, leading to difficulties in quince cultivation in Southern Brazil (ABRAHÃO et al., 1996).

The 'Japonês' quince (***Chaenomeles sinensis*** Koehne) has been evaluated for over 20 years in Brazil, and has become an adequate alternative for quince growers, especially because of its rusticity. A protocol of quince seedlings production was developed by grafted in the 'Japonês' rootstock (ABRAHÃO et al., 1996; CELANT et al., 2010).

Preliminary research carried out in order to define a propagation protocol for 'Japonês' quince through cutting, indicated low rooting capacity (PIO et al., 2004; 2007b). Nevertheless, because of the high seed number per fruit (above 180), high seed germination and seed emergency (above 90 and 70%, respectively), and high seedling vigor in the nursery, 'Japonês' quince rootstock plants have been routinely produced through seeds (ABRAHÃO et al., 1996).

Until the moment the grafting is accomplished in the winter by cleft grafting (PIO et al., 2008a). Quince 'Japonês' shows high vigor throughout the rootstocks growing, requiring only nine months to be ready for grafting (PIO et al., 2007a). Once the seeds are extracted from the fruits in April, in January the grafting could be carried and the seedlings are then able to be brought to the field in May, thus reducing the demanded time to produce dumb and the period of the orchard formation. However, the best grafting period and grafting method must be determined for this rootstock.

Therefore, this research evaluated three grafting methods of five quince scion cultivars on 'Japonês' quince rootstock.

MATERIALS AND METHODS

Seeds of ripe fruits of 'Japonês' quince trees cultivated (***Chaenomeles sinensis*** Koehne) at Unioeste germplasm collection, Marechal Cândido Rondon, PR, Brazil, were extracted in April 2007, washed in tap water, and dried in the shade for 48 hours. Seeds were then placed between two thin wet cotton layers, in 90x15mm Petri dishes, and maintained in Biological Oxigen Demand (BOD) chamber for 30 days, at 4ºC, as ENTELMANN et al. (2009). After this period, seeds were distributed in 72-cell polystyrene trays (120cm^3 of capacity) filled with vermiculite-derived potting mix. After 60 days, seedlings were transferred to 3-liter plastic bags (30x18cm), filled with potting mix containing soil, sand, and manure (1:1:1 v/v/v).

Seedlings were maintained in the nursery covered with a 50% shade-screen and were irrigated periodically. The seedlings stayed in nursery for six months and were grafted in the summer, in the middle of January, with 90cm of minimum height and around 8mm of diameter, 15cm above the potting mix surface.

The experiment design was a 3x5 factorial (grafting methods - summer budding, winter budding and cleft grafting x quince cultivars - 'Provence', 'Mendoza Inta-37', 'Portugal', 'Smyrna' and 'Japonês'), in randomized blocks with four replicates of ten grafts per plot.

Part of the rootstocks were bud grafted (summer budding) with the quince cultivars 'Provence' (***Cydonia oblonga*** Mill.), 'Mendoza Inta-37' (***C. oblonga***), 'Portugal' (***C. oblonga***), 'Smyrna' (***C. oblonga***), and 'Japonês' (***Chaenomeles sinensis***). Buds were tied with transparent plastic strips. After 30 days, strips were removed and the aerial part of rootstocks was cut above the grafting point.

In July 2008, another group of 'Japonês' rootstock quince plants were bud grafted according with the same protocol (winter budding). At that time, another batch of rootstock plants were also grafted by cleft grafting method, using three-bud scion sticks. Grafts were tied with plastic strips and protected with transparent plastic bags (15cm of length and 3cm of diameter). Scion sticks were kept covered for 30 days to avoid water loss.

Graft survival rate, expressed as the percentage of sprouted grafts or buds, was evaluated 60 days after grafting for the three grafting methods. Scion shoot length and diameter were recorded 90 and 150 days after grafting. All data collected were submitted to analysis of variance and the means were compared by the Tukey test (P=0.05).

RESULTS AND DISCUSSION

Cleft grafting resulted in the highest graft survival rate, as compared with the budding method in the winter and in the summer for most scion cultivars, except 'Provence' cultivar, which presented graft survival rate of 72% when grafted by cleft grafting, and graft survival rate of 75% by winter budding (Table 1). 'Provence' cultivar presented no sprouted bud when the summer budding method was performed.

However, Provence cultivar showed a better development when grafted by cleft grafting, in comparison with the winter budding method. Ninety days after grafting, the average length of the shoot was 26.5cm by cleft grafting and only 6.1cm by winter budding (Table 1). In general, the quince cultivars

Table 1 - Scion graft survival rate 60 days after grafting, and scion graft length 90 and 150 days after grafting of five quince cultivars grafted by cleft grafting (CG), winter budding (WB) and summer budding (SB) on 'Japonês' quince rootstock. Marechal Cândido Rondon, PR, Brazil, Unioeste, 2009.

Quince cultivars	Scion graft survival rate			Scion graft length					
	60 days after grafting			90 days after grafting			150 days after grafting		
	CG	WB	SB	CG	WB	SB	CG	WB	SB
	%			cm					
'Smyrna'	100 Aa	20 Bb	5 Ca	28.2 Aa	1.1 Ca	10.5 Bb	35.0 Ab	7.3 Cc	20.7 Ba
'M. I-37'	97 Aa	15 Bb	7 Ba	24.0 Aa	1.5 Ba	20.6 Aa	39.2 Ab	14.8 Bb	32.5 Aa
'Provence'	72 Ab	75 Aa	0 Ba	26.5 Aa	6.1 Ba	0 Bb	43.0 Ab	26.2 Ba	0 Cb
'Portugal'	90 Aa	25 Bb	25 Ba	32.6 Aa	5.1 Ba	26.0 Aa	48.2 Ab	14.3 Bb	47.5 Aa
'Japonês'	100 Aa	30 Bb	10 Ba	39.7 Aa	2.3 Ca	20.3 Ba	65.7 Aa	20.0 Bb	27.8 Ba
CV (%)		17.1			23.7			21.2	

Means followed by the same capital letters (lines) or by the same lower case letters (columns) do not differ by Tukey Test (P=0.05)

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grafted by cleft grafting presented better development reaching average shoots length, higher than 35cm, 150 days after grafting. Only Mendoza Inta-37 and Portugal cultivars presented shoots length not significantly different 150 days after grafting, when grafted by cleft grafting and summer budding. However, the summer budding methods should not be recommended, once it showed only a 7% graft survival rate for the Mendonza Inta-37 quince and 25% for the 'Portugal' cultivar (Table 1).

No major differences were registered in scion stem length and scion stem diameter between cleft grafting and budding methods 90 days after grafting (Tables 1 and 2). However, 150 days after grafting, 'Japonês' quince had higher scion stem length when cleft grafted as compared with the other cultivars (Table 1). 'Japonês' quince cleft grafted on itself also had higher scion stem diameter when compared to other grafting methods (winter and summer methods) (Table 2).

Grafting is one of the critical stages in the nursery tree production, in which the efficiency is dependent on the quality of the rootstock, scion sticks and buds, grafting manual efficiency, and climatic conditions. The grafting season and grafting methods are among the external factors that can affect the graft survival rate. Usually, temperate fruit crops have better graft survival rate when the process is performed by cleft grafting during the hibernal period (HARTMANN et al., 2002). In this context, the current paper results are in agreement with the cited authors, once the cleft grafting performed in winter has propitiated better development of the quince shoots. Besides, grafting performed in winter makes possible to harvest the scions simultaneously with the pruning usually performed in other temperate fruits at this season.

Other temperate fruits are also grafted by the same winter grafting method. For pear trees grafted

Table 2 - Scion graft stem diameter of five quince cultivars grafted by cleft grafting (CG), winter budding (WB) and summer budding (SB) on 'Japonês' quince rootstock 90 and 150 days after grafting. Marechal Cândido Rondon, PR, Brazil, Unioeste, 2009.

Quince cultivars	Scion graft stem diameter					
	90 days after grafting			150 days after grafting		
	CG	WB	SB	CG	WB	SB
	mm					
'Smyrna'	3.5 Aa	1.0 Ba	1.3 Bb	4.6 Aa	1.8 Ba	2.5 Ba
'M. I-37'	3.0 Aa	0.8 Ba	1.9 Aa	4.9 Aa	2.1 Ba	3.0 Ba
'Provence'	3.3 Aa	1.7 Ba	0 Cb	5.3 Aa	3.3 Ba	0 Cb
'Portugal'	3.3 Aa	0.9 Ba	3.3 Aa	5.3 Aa	2.1 Ba	5.0 Aa
'Japonês'	3.7 Aa	1.0 Ca	2.1 Ba	5.7 Aa	2.0 Ba	3.0 Ba
CV (%)		25.6			27.0	

Means followed by the same capital letters (lines) or by the same lower case letters (columns) do not differ by Tukey Test (P=0.05).

onto 'Taiwan Nashi-C' rootstock, grafting is usually accomplished in the winter (cleft grafting) or in the summer (budding). However, the cleft grafting favors higher graft survival rate and faster shoot development (BARBOSA et al., 1996; 1998). Other studies have reported the production of pear trees grafted onto quince by budding in the winter (ERMEL et al., 1999).

On the other hand, in this research, budding accomplished in the summer led to higher sprout length, in spite of the smaller bud sprout percentage. The higher scion sprout vigor in summer can be explained by higher temperatures in that season considering that trees were cultivated in an open-field nursery, protected only with a shade-screen.

When 'Japonês' quince was grafted on itself, cleft grafting lead to 100% graft survival rate, as compared with 30 and 10% for winter budding and summer budding, respectively. Moreover, in this case, scion length and scion diameter were also significantly higher in grafts accomplished by cleft grafting 150 days after grafting (Tables 1 and 2).

These results observed for the quince 'Japonês', indicates that quince trees should be grafted by the cleft grafting method, equal PIO et al. (2009). Quince 'Japonês' shows high vigor throughout the rootstocks growing, requiring only nine months to be ready for grafting (PIO et al., 2007a). Once the seeds are extracted from the fruits in April, they should be stored until October when the dormancy break will be performed, so the rootstocks will be ready in July to be grafted by the cleft grafting method. The cleft grafting method will depend on the cultivar, but in general all cultivars will present a proper development at nursery (PIO et al., 2008a; 2008b).

CONCLUSION

The results obtained herein show that cleft grafting is an appropriate method for grafting quince seedlings, leading to higher graft survival rate and better scion shoot development for all quince cultivars as compared to budding. On the other hand, winter budding showed higher graft survival rate, but slower scion development as compared with summer budding. Follow-up studies may indicate better alternatives for improve scion sprouting on trees grafted by budding.

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