The Assessment of Different Rootstocks to the Pear Tree Cultivar ‘Carrick’

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Abstract
Low fruiting is the main problem related to the pear production in Brazil, which makes the country one of the major pear importers. This research aimed to evaluate different rootstocks to pear tree cultivar ‘Carrick’ to be used in commercial orchards. The experiment was carried out in Pelotas/RS, located at latitude 31°52’00”S, longitude 52°21’24”W Greenwich and altitude of 13.24 m. The orchard was set up in 2002 with a density of 2000 trees.ha^-1. The trees were conducted in slender spindle system trained on three-wire support with a dripping irrigation system. The treatments assessed were 13 quince rootstocks (Cydonia oblonga) cultivars ‘Adams’, ‘Alaranjado’, ‘BA 29’, ‘Bereczki’, ‘Champion’, ‘Du Lot’, ‘D’Vranja’, ‘EMC’, ‘Inta 267’, ‘Lageado’, ‘Melliforme’, ‘PineApple’ and ‘Portugal’ and one Pyrus calleryana. The experimental design utilized was a complete randomized block with 3 replications of 5 trees each. The variables assessed were rootstock/scion trunk diameter, tree height, canopy volume, pruning weight, productivity and productivity efficiency. ‘D’Vranja’ rootstock provided the highest vigor to the tree, whereas the rootstock cultivars ‘Du Lot’, ‘Lageado’ and ‘Bereczki’ the lesser vigor, however not differing from most of the rootstocks in the study. The highest productivity was verified by using the rootstock ‘Portugal’ (1.12 t.ha^-1), followed by ‘EMC’ that did not differ from ‘D’Vranja’ and ‘BA 29’. ‘D’Vranja’ showed the highest vigor and also had the highest productivity efficiency (9.53), but did not differ from ‘BA 29’. Although ‘D’Vranja’ provided more vigor to the tree, it is still a good rootstock alternative to the pear cultivar ‘Carrick’.

INTRODUCTION
According to the FAO (2007), the world fruit crop confirmed in 2005 a production around 507 million tons. Included in this, the European pear culture is pointed out as the ninth production country with 3.9% of the total. Italy, considered as the major producing country of the fruit, participates with 4.7% of the total, whereas Brazil has a little expressive production at about 0.11%.

As regards demand for pear fruits in Brazil, the culture shows a large expansion potential. However, there are some constraints caused by the inexistence of cultivars adapted to different regions as the lack of research and indetermination of adapted rootstocks.

Traditionally, the pear trees grown in the main world producing centers are grafted on quince rootstocks (Cydonia oblonga Mill.) or Pyrus communis and occasionally on Pyrus calleryana or Pyrus betulaefolia (Strydom, 1998). Nevertheless, in Brazil, it is only since 2002 that the use of quince tree as rootstock gained focus and was researched.

For Marangoni (1999) the modern pear culture is trending in the use of high density planting to reduce labor costs. Therefore, some concerns at the moment of rootstock purchase must be paid attention to. According to Strydom (1998), a good rootstock must show as main characteristics compatibility to the commercial cultivars, easy propagation, tree vigor control, induce large fruits and adaptability to different climate and soil conditions.

The indiscriminate use of quince rootstock, as said by Loreti (1994), has allowed
the diffusion of the pear culture to areas showing low aptitude to the culture development. Conversely, its use exhibited accentuated affinity problems to some pear cultivars. As cited by Giacobbo et al. (2007a), this problem could be eliminated by intergrafting cultivars compatible with both parts (scion/stock) for instance ‘Carrick’ and ‘Seleta’ that show good compatibility with quince rootstocks.

Therefore, the objective of this research was to evaluate different rootstocks to the pear cultivar ‘Carrick’ that could be used in commercial orchards.

MATERIALS AND METHODS

The research was carried out at the experimental field of Palma Agricultural Center and at the laboratory of Federal University of Pelotas (FAEM/UFPEL), Capão do Leão, RS, Brazil. It is located at latitude 31°52’00"S, longitude 52°21’24"W Greenwich and altitude of 13.24 m during July 2005 and July 2006. The soil belongs to the ‘Camaquã’ mapping unity and it is classed as Red-Yellow Podozolic (Brasil, 1973).


In August 2002, the pear trees were planted at 5×1 m (2000 trees/ha) and conducted in slender spindles system trained on three-wire support. A dripping irrigation system was set for four hours a day (2 L/h/tree).

The experimental design utilized was a complete randomized block with three replications of four trees each.

The variables evaluated were: a) development of trunk diameter - a digital paquimeter was used at 10 cm above and below the grafting point and the difference between scion and rootstocks was taken; b) tree height - measured from the ground to the top of the tree (cm); c) canopy volume - by multiplication of height, width and canopy thickness (m³); d) pruning weight - assessed by weighing the branches pruned during winter and summer time (g); e) yield - weighing all fruits harvested (ton/ha); f) yield efficiency - obtained by the relation between total yield and trunk diameter (kg/cm of T.D).

The data were submitted to analyses of variance F-test and the comparison of means between treatments was applied when the comparative data were statistically significant. The means differences were separated with Duncan test at 5% level of significance. The statistical analyses were performed by using the WinStat program (Machado and Conceição, 2002).

RESULTS AND DISCUSSION

Regarding trunk diameter (Figs. 1 and 2) the rootstock ‘D’Vranja’ that showed the largest diameter (36.38 mm) also increased the diameter of ‘Carrick’ (32.76 mm), but it did not differ from ‘Inta 267’ as shown in Figure 1. Similar results with the same rootstock were verified to the variables pruning weight (Fig. 5) and yield efficiency (Fig. 7), showing 37.41 g and 9.53 kg/cm of trunk diameter, respectively. The smallest trunk diameters of the rootstocks were verified for cultivars ‘Berezcki’, ‘Alaranjado’, ‘Du Lot’ and ‘Adam’s’, which did not differ from ‘Lageado’, ‘Champion’, ‘Mellifrome’ and ‘EMC’. However, looking at the diameter of the scion ‘Carrick’, the smallest diameter was provided when grafted on ‘Berezcki’, ‘Alaranjado’, ‘Du Lot’, ‘Adam’s’, ‘Lageado’, ‘Melliforme’ and ‘Champion’ (Fig. 1). These results are backed up by Marangoni and Malaguti (2002) and Giacobbo (2006), who, studying some pear rootstocks for Italian conditions, found that the rootstocks that showed large trunk cross-sectional area also provided more vigor to the grafted tree and, consequently, large weight gains of pruned branches.

Observing Figure 3, ‘Du Lot’ that also had allow trunk diameter, provided lower trees (54.27 cm), but not differing to ‘Lageado’, ‘Alaranjado’ and ‘Berezckzi’. The trees raised on ‘Inta 267’ were higher (158.07 cm) but they were not statistically different from
‘D’Vranja’. Similar results were verified to canopy volume, where the more developed trees were expressed on rootstocks *Pyrus calleryana* and ‘Inta 267’, not being different from ‘D’Vranja’ (Fig. 4).

Under the conditions of this experiment, the results indicated new promising rootstocks for orchards under medium/high density planting, and quince ‘EMC’ considered as having intermediated behavior. Colombo (2003), by studying different rootstocks for pear tree, found ‘EMC’ the only truly dwarfing rootstock designated for medium/high density plantings.

In order, the best results referred to yield was found when ‘Carrick’ was grafted on ‘Portugal’ (1.12 ton/ha), and then on ‘EMC’ which did not differ from ‘D’Vranja’ and ‘BA 29’. The other rootstock did not produce until the fourth year from planting. However, analyzing the yield efficiency the rootstock showing large production did not necessarily show the best yield efficiency. For instance ‘D’Vranja’ was the rootstock that showed the highest yield efficiency (9.53 kg/cm of T.D.) followed by ‘BA 29’. The other combinations rootstocks/scion did not differ from ‘BA 29’ (Figs. 6 and 7).

The rootstocks that provided more vigor to the trees did not perform in the same way with regards to yield, showing an intermediate behavior. Giacobbo et al. (2007b) found different results when studying some rootstocks to the pear cultivar ‘Seleta’. They observed that the rootstocks that increased vigor also improved yield to the scion.

As regards to yield efficiency the encountered data agree with Sansavini et al. (1997), Loreti et al. (2000) and Giacobbo (2006) who analyzing different rootstocks verified that the high yield efficiency is not always directly related to high production, once the rootstocks that increased production did not improve yield efficiency.

**CONCLUSIONS**

Under the conditions of this experiment, it was concluded that the rootstocks showing large trunk diameter provided both large weight gains of pruned branches and yield efficiency. Also, the pear tree cultivar ‘Carrick’ was smaller when grafted on quince ‘Dulot’. Comparing ‘Dulot’ to quince ‘EMC’ which is considered a dwarfing rootstock, the height reduction was about 44.62%, and compared to ‘Inta 267’, the highest tree combination, the decrease was 65.67%.

**Literature Cited**


Figures

![Graph 1](image1.png)

Rootstock

Fig. 1. Rootstock trunk diameter ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. R.T.D. = rootstock trunk diameter. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).

![Graph 2](image2.png)

Rootstock

Fig. 2. Scion trunk diameter ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. S.T.D. = Scion trunk diameter. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).
Fig. 3. Tree height of ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).

Fig. 4. Canopy volume of ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).
Fig. 5. Pruning weight of ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).

Fig. 6. Yield of ‘Carrick’ grafted on 14 different rootstocks. Pelotas, 2007. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).

Fig. 7. Yield efficiency of ‘Carrick’, grafted on 14 different rootstocks. Pelotas, 2007. *Different letters on the columns are significantly different by Duncan test ($\alpha = 0.05$).