



ORIGINAL ARTICLE

Cíntia Borges Almeida¹
Aline das Graças Souza^{1*}
Josiane Carla Argenta¹
Jose Carlos Fachinello¹
Valmor João Bianchi¹

¹ Universidade Federal de Pelotas - UFPel, Campus Capão do Leão, Campus Universitário, s/n, 96160-000, Capão do Leão, RS, Brasil

*Corresponding Author:
E-mail: alineufra@hotmail.com

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The effect of rootstocks on the vigor, yield, and fruit quality of 'Maciel' peach trees

Influência do porta-enxerto no vigor, produtividade e qualidade dos frutos em pessegueiros 'Maciel'

ABSTRACT: This study was conducted aiming to evaluate the effect of rootstocks in plant vigor, yield, and fruit quality of 'Maciel' peach trees growing in a 7-8-year-old orchard in the municipality of Pelotas, Rio Grande do Sul state, Brazil. The experiment was performed with plants of the 'Maciel' cultivar grafted on the following eight *Prunus persica* rootstocks: 'Capdeboscq', 'Aldrighi', 'Tsukuba 1', 'Okinawa clone 1', 'Okinawa 'clone 12', 'Industry', 'Nemaguard', and 'Rubirà'. Trunk diameter, height and yield of plants, fruit mass, soluble solids content, and fruit classification by category were evaluated. The experimental design used randomized blocks with three replicates, with five plants per parcel. In two evaluation cycles (2011/2012 and 2012/2013), 'Aldrighi' presented the largest trunk diameter (75.5 and 80.4 mm, respectively) compared with 'Okinawa clone 1' (65.80 and 67.7 mm, respectively) and 'Rubirà' (63.4 mm and 65.8, respectively). Fruit mass was greater for 'Aldrighi' (118.6 g), 'Industry' (106.5 g) and 'Capdeboscq' (103.5 g) in the 2011/2012 cycle. The 'Maciel'/'Aldrighi' combination showed the highest yield, with the highest percentage of fruits in class I; however, the fruits showed the lowest soluble solids content among the tested scion/rootstock combinations (12.6 °Brix), differing only from 'Maciel'/'Okinawa clone 1' (15.2 °Brix). Under the conditions in which the experiment was conducted, we conclude that characteristics such as vigor, yield, and fruit quality of 'Maciel' peach trees are differentially influenced by the rootstocks used. The 'Okinawa Clone 1' rootstock induces less vigor and greater total soluble solids in fruits of 'Maciel' peach trees compared with the 'Aldrighi' rootstock, but it does not significantly influence the productive efficiency and yield of the plants.

RESUMO: O presente estudo foi conduzido com o objetivo de avaliar o efeito de porta-enxertos sobre o vigor das plantas, produtividade e qualidade de frutos de pessegueiros 'Maciel' durante o sétimo e oitavo anos de um pomar instalado em Pelotas, Estado do Rio Grande do Sul. O experimento foi conduzido com plantas da cultivar Maciel enxertadas sobre oito porta-enxertos de *Prunus persica*: 'Capdeboscq', 'Aldrighi', 'Tsukuba 1', 'Okinawa clone 1', 'Okinawa 'clone 12', 'Indústria', 'Nemaguard' e 'Rubirà'. As variáveis analisadas foram: o diâmetro do tronco, a altura e produtividade das plantas, massa média dos frutos, teor de sólidos solúveis totais e classificação de frutos por categoria. O delineamento experimental foi de blocos casualizados, com oito níveis para o fator porta-enxerto, cada qual constituído de três repetições com cinco plantas por parcela. Em dois ciclos de avaliação (2011/2012 e 2012/2013), 'Aldrighi' apresentou o maior diâmetro do tronco (75,5 e 80,4 mm, respectivamente) em relação à 'Okinawa clone 1' (65,8 e 67,7 mm) e 'Rubirà' (63,4 e 65,8 mm, respectivamente). A massa média dos frutos foi maior com 'Aldrighi' (118,6 g), 'Indústria' (106,5 g) e 'Capdeboscq' (103,5 g) no ciclo 2011/2012. A combinação 'Maciel'/'Aldrighi' foi a mais produtiva, com a maior porcentagem de frutos classe I, entretanto os frutos apresentaram o menor teor de sólidos solúveis dentre as combinações avaliadas (12,6 °Brix), porém diferindo apenas de 'Maciel'/'Okinawa 'clone 1' (15,2 °Brix). As condições nas quais o experimento foi conduzido, conclui-se que características como vigor, produtividade e qualidade de frutos de pessegueiros 'Maciel' são influenciadas pelos porta-enxertos. O porta-enxerto do 'clone 1' induz menor vigor e maior teor de sólidos solúveis totais em frutos de pessegueiros 'Maciel' em relação ao 'Aldrighi', não influencia significativamente a eficiência produtiva e produtividade das plantas.

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1 Introduction

In Brazil, both the production and the area cultivated with temperate fruit trees have grown in the past decades. Stone fruits are included in this group of plants, especially peaches, which represent more than 80% of the area cultivated with stone fruits in the country (Fachinello et al., 2011). Peach production is of great socioeconomic importance in the south and southeast regions of Brazil, especially in the state of Rio Grande do Sul (RS), accounting for approximately 60% of the Brazilian peach harvest which is mainly cultivated by small producers (Barbosa et al., 2010; Oliveira et al., 2011; Timm et al., 2007). However, orchard productivity in RS is the lowest in country, being associated with several factors such as the uncertainty about the best rootstocks to be used. Studies aimed at selecting and evaluating rootstocks to identify the best genotypes that provide better cultivar yield performance under different growing conditions are still incipient (Picolotto et al., 2012).

The success of temperate fruit cultivation in subtropical regions depends on the farming practices adopted and on the scion/rootstock combination chosen; the latter being a factor that can influence several bioagronomic parameters such as plant development, by changing the trunk section area, height, shape and volume of the canopy, as well as plant nutrition, xylem water potential, phenology, fruit quality, productive earliness, yield, disease resistance, longevity, and survival of plants (Rato et al., 2008; Remorini et al., 2008; Nava et al., 2009; Comiotto et al., 2012).

The knowledge about the responses induced by different rootstocks in the bioagronomic characteristics of peach cultivars is still at a very early stage in Brazil, with a small number of works evaluating plant yield only in the first years of the orchards (Comiotto et al., 2012; Schmitz et al., 2012; Picolotto et al., 2012; Galarça et al., 2013). Therefore, the evaluation of bioagronomic responses induced by different rootstocks over time, in adult orchards, is very important to identify the best scion/rootstock combinations to be used in some production sites and the production stability induced by each plant combination. In this work, we present data on the evaluation of bioagronomic characters in an adult orchard of 'Maciel' peach trees grafted on eight *P. persica* rootstocks.

2 Materials and Methods

The experiment was conducted at the Agricultural Center of Palma (31° 52' 00" S, 52° 21' 24" W), Faculty of Agronomy 'Eliseu Maciel' (FAEM), Federal University of Pelotas (UFPEL). The soil of the orchard is moderately deep, with medium texture (4) in the A horizon and clayey texture in the B horizon, classified a Red-Yellow Ultisol (Schmitz et al., 2012), 1.5% organic matter and 16% clay. In the region, the cold accumulation, below 7.2 °C, is approximately 400 hours. The average annual rainfall is 1,367 mm, and means of minimum and maximum annual temperatures are 13.8 °C and 22.9 °C, respectively (EAP, 2015).

Seedlings of the rootstocks 'Capdeboscq', 'Aldrighi', 'Industry', 'Tsukuba 1', 'Okinawa clone 1', 'Okinawa clone 12', 'Nemaguard', and 'Rubirà' were used to be grafted with the cv. Maciel scion. The rootstock identified as 'Industry' was obtained from stones in a canning industry of Pelotas

(RS), Brazil, and has unknown genetic identity; it was chosen because it represents the typical plant material used to produce rootstocks by the majority of the nurserymen in southern Brazil.

The orchard was planted in the winter of 2005 with plants spaced 5.0 × 1.5 m, totaling 1,333 plants ha⁻¹ conducted in 'Y' system without irrigation. The orchard was managed according to the Peach Plant Integrated Management (Fachinello et al., 2003). The experimental design used randomized blocks with three replications, with eight levels for the rootstock factor, each one with of five plants per parcel.

During the 2011/2012 and 2012/2013 production cycles (the seventh and eighth years after orchard plantation, respectively) the following variables were evaluated: trunk diameter at 20 cm from ground level (mm) and plant height (m) from the base of the trunk to the branch located at the highest level of the plant, before the pruning period. The following yield characters were registered only in the cycle (2011/2012): average number of fruits per plant; yield per plant (PP, kg/plant); fruit mass mean (g), determined from the ratio of the mean yield of each plant and the total number of fruits of each plant; productive efficiency (PE - kg cm⁻¹), obtained on the basis of the ratio of the yield per plant (kg/plant) and the trunk diameter (cm); and crop yield (CY, in t ha⁻¹).

The fruit soluble solids content (Brix) from three replicates of 10 fruits of each scion/rootstock combination was recorded. Also, the classification of the fruits by the size (classes I, II, III, as being > 57; 47 to 57; < 47 mm diameter, respectively) was conducted. The yield data concerning the 2012/2013 yield cycle were not possible to be obtained due to occurrence of strong winds one week before harvest, resulting in almost total fruit drop. The data obtained were subjected to analysis of variance (ANOVA), F test, and the significant means were compared by the Tukey test ($p \leq 0.05$).

3 Results and Discussion

The vegetative development and yield of cv. Maciel were significantly influenced by the different peach rootstocks. The vigor, expressed by trunk diameter, according to Tomaz et al. (2010) and Rossi et al. (2004), can also be used to correlate with the yield potential of plants, and it was greater in 'Aldrighi' rootstock at the end of the 2011/2012 cycle (April/2012) compared with 'Nemaguard', 'Tsukuba 1', 'Okinawa clone 1' and 'Rubirà' rootstocks, and a similar result was recorded in Jan/2013 (Table 1), whereas 'Rubirà' rootstock induced the smallest trunk diameter in the two production cycles.

The largest trunk diameter induced by 'Aldrighi' was also accompanied by increased plant height in the two productive cycles. Although differentiated from 'Industry', 'Nemaguard' and 'Tsukuba 1' rootstocks, in the first and last evaluation, it was found that 'Aldrighi' presented higher vigor compared with 'Nemaguard', which is considered a vigorous rootstock (Loreti, 2008). On the other hand, 'Rubirà' has induced smaller height in 'Maciel' plants, suggesting to be the lowest vigor among the genotypes evaluated under the local experimental conditions, although it has not differed in height and trunk diameter from 'Okinawa clone 1' in all the evaluations performed.

In the present study, the largest trunk diameters in both yield cycles were found when 'Aldrighi', 'Industry' and 'Okinawa

Table 1. Trunk diameter and height of the plants of 'Maciel' peach trees grafted on different rootstocks in two yield cycles. FAEM/UFPel – Pelotas, Rio Grande do Sul state, Brazil, 2013.**Tabela 1.** Diâmetro do tronco e altura das plantas de pessegueiro cv. 'Maciel' enxertadas sobre diferentes porta-enxertos no ciclo produtivo 2011/2013. FAEM/UFPel -Pelotas-RS, 2013.

Rootstocks	Trunk diameter (mm)			
	2011*	2012**	2012***	2013****
Aldrichi	75.5 a ¹	77.5 a	78.2 a	80.4 a
Industria	71.9 ab	74.9 ab	74.9 abc	74.9 abc
Okinawa clone 12	67.7 abc	69.3 abc	78.0 ab	78.0 ab
Capdeboscq	63.7 bc	69.2 abc	73.2 abc	73.2 abc
Nemaguard	66.4 abc	68.1 bc	70.4 bc	70.4 bc
Tsukuba 1	64.8 abc	67.4 bc	69.7 bc	69.7 bc
Okinawa clone 1	64.2 bc	65.8 c	67.7 c	67.7 c
Rubirã	61.0 c	63.4 c	65.8 c	65.8 c
Mean	66.9	69.5	70.5	75.5
C.V. (%)	5.62	4.24	4.34	4.41
Rootstocks	Plant height (m)			
	2011*	2012**	2012***	2013****
Aldrichi	2.6 a	3.1 a	3.1 a	3.1 a
Industria	2.4 ab	2.7 bc	2.7 bc	2.8 ab
Okinawa clone 12	2.0 b	2.6 c	2.6 c	2.6 b
Capdeboscq	2.2 ab	2.6 c	2.6 c	2.7 b
Nemaguard	2.5 ab	2.8 bc	2.8 bc	2.8 ab
Tsukuba 1	2.5 ab	3.0 ab	3.0 ab	3.0 ab
Okinawa clone 1	2.1 ab	2.5 c	2.5 c	2.6 b
Rubirã	2.3 ab	2.5 c	2.5 c	2.6 b
Mean	2.3	2.7	2.7	2.8
CV (%)	7.44	4.17	4.17	4.85

¹ Means followed by the same letter do not differ by the Tukey's test ($p \leq 0.05$). ns: non-significant values by the F test ($p \leq 0.05$). * August. ** April. *** August. **** January.

12' rootstocks were used. This trend was also verified by Picolotto et al. (2012) during the first years of evaluation, from 2006 to 2008, when 'Industry' and 'Tsukuba 1' showed greater trunk diameters, but they did not differ from 'Aldrichi', 'Okinawa clone 1' and 'Nemaguard'.

In a similar experiment conducted by Galarça et al. (2013), variations in the trunk diameter induced by different rootstocks were also reported, with the largest trunk diameters induced by 'Aldrichi', 'Capdeboscq' and 'Nemaguard'. These results were associated with the high vigor and affinity of these rootstocks with 'Maciel' cultivar, and the good adaptation to the edaphoclimatic conditions of Pelotas and its surroundings. Comiotto et al. (2013) reported the largest trunk diameter in 'Maciel' cultivar grafted with the 'Nemaguard' and 'Okinawa' rootstocks, which differed from 'Aldrichi' and '*P. mume*' in the first yield cycle (2008). These results were partly different from those found in this study, suggesting that factors such as orchard site, soil, and climatic condition can be determinant to the differences in vigor found between the experiments.

Fruit yield per plant and estimated crop yield were also influenced by the rootstocks. The greatest yield was obtained with the 'Maciel'/'Aldrichi' combination, presenting a yield 57% higher than 'Rubirã' (Table 2). Considering that the orchard was installed in a replanting area with peach tree, this difference can be explained in part by the high susceptibility of 'Rubirã'

Table 2. Yield per plant (PP), estimated crop yield (YC), and yield efficiency (PE) of 'Maciel' peach trees grafted on eight rootstocks, in the 2011/2012 yield cycle. FAEM/UFPel – Pelotas, Rio Grande do Sul state, Brazil, 2013.**Tabela 2.** Produção, produtividade média estimada (PE) e eficiência produtiva (EP) da cultivar de pessegueiro 'Maciel' enxertada sobre diferentes porta-enxertos, no ciclo produtivo 2011/2012. FAEM/UFPel – Pelotas-RS, 2013.

Rootstocks	PP (kg/plant)	YC (t ha ⁻¹)	PE (kg cm ⁻¹)
Aldrichi	8.2 a ¹	18.1 a ¹	1.1 ^{ns}
Industria	7.8 ab	17.2 ab	1.0
Okinawa clone 12	4.3 ab	9.6 ab	0.6
Capdeboscq	5.8 ab	12.9 ab	0.8
Nemaguard	4.2 ab	9.2 ab	0.6
Tsukuba 1	6.8 ab	15.0 ab	1.0
Okinawa clone 1	4.8 ab	10.7 ab	0.7
Rubirã	3.5 b	7.7 b	0.6
Mean	5.7	12.6	0.8
CV (%)	28.47	28.46	27.46

¹ Means followed by the same letter do not differ by Tukey's test ($p \leq 0.05$). ns: non-significant values by the F test ($p \leq 0.05$).

to root-knot nematodes (*Meloidogyne* spp.) present in the area, which coincided with the death of some plants grafted on this rootstock 6 to 8 years after planting; a fact also observed in orchards in France and Italy (Loreti, 2008).

In the yield cycle of 2011/2012, the estimated mean yield in the orchard was 12.57 ton ha⁻¹, which is close to the RS and Brazilian yield means, 10.2 and 10.9 ton ha⁻¹, respectively (Brazilian Institute of Geography and Statistics – IBGE, 2012). The 'Maciel' peach trees grafted on 'Aldrichi', 'Industry' and 'Tsukuba 1' rootstocks showed the best estimated yield, higher than the national mean, whereas the plants grafted with 'Rubirã' produced only 7.7 ton ha⁻¹, approximately 24% below the RS mean (Table 2). This trend was also observed in the first years of orchard yield of cv. 'Maciel', where Picolotto et al. (2012) recorded the highest yield induced by 'Aldrichi' in 2007 (3.2 ton ha⁻¹), while 'Industry' provided the highest yield (8.6 ton ha⁻¹) in 2008. This performance of the rootstocks derived from the stone of 'Industry', in part, may be explained by their high initial vigor, due to the high degree of heterozygosity, unlike that observed in other rootstocks which were selected for specific characteristics such as population homogeneity and resistance to nematodes ('Tsukuba 1', 'Okinawa clone 1 and clone 12' and 'Nemaguard'), which present less vigor and influence the vegetative development and yield performance of the orchard.

Regarding productive efficiency, no significant difference was observed among the rootstocks in the 2011/2012 yield cycle, although a variation of 50.9% between the productive efficiency of 'Aldrichi' in relation to 'Rubirã' (Table 2) was found. Similar result was reported by Galarça et al. (2012) in experiments conducted in three different sites in Rio Grande do Sul state (Capão do Leão, Eldorado do Sul, and Bento Gonçalves) evaluating 'Maciel' peach trees grafted on six rootstocks, but only in the first years of orchard yield.

Among the rootstocks studied, there was no significant influence in the mean mass of fruits for the combination

Table 3. Number of fruits per tree, mean fruit mass, and soluble solids content of cv. Maciel peach tree grafted on different rootstocks in the 2011/2012 yield cycle. FAEM/UFPe – Pelotas, Rio Grande do Sul state, Brazil, 2013.**Tabela 3.** Número de frutos, massa média dos frutos e teor de sólidos solúveis do pessegueiro cv. ‘Maciel’ enxertado sobre diferentes porta-enxertos, no ciclo produtivo 2011/2012. FAEM/UFPe – Pelotas-RS, 2013.

Rootstocks	Number of Fruits	Mean Fruit Mass (g)	SS (° Brix)
Aldrighi	70.7 ^{ns}	118.6 ^{ns}	12.6 b ^{1/}
Indústria	74.7	106.5	14.1 ab
Okinawa clone 12	56.0	86.9	13.7 ab
Capdeboscq	56.0	103.5	13.9 ab
Nemaguard	54.3	85.0	14.8 ab
Tsukuba 1	66.3	86.7	13.8 ab
Okinawa clone 1	62.3	82.4	15.2 a
Rubirã	51.0	84.2	14.9 ab
Mean	61.4	94.2	14.1
CV (%)	18.02	16.17	5.89

¹ Means followed by the same letter do not differ by the Tukey's test ($p \leq 0.05$). ns: non-significant values by the F test ($p \leq 0.05$).

‘Maciel’/‘Nemaguard’ (85.0 g) recorded in the present study (Table 3), being comparable to that obtained by Picolotto et al. (2012) utilizing the same rootstock (82.0 g) in the 2008/2009 cycle. In the plants grafted on ‘Capdeboscq’, the mean mass of fruits was 103.5 g, higher than the 83.0 g described by Picolotto et al. (2012), and lower than those reported by Galarça et al. (2012) and Alves et al. (2012), 117.9 g and 197.2 g, respectively, suggesting that factors such as thinning management and adequate water input during the fruit development period can be determinant of the mean mass of fruits for the same grafting combination.

The best results observed for soluble solid contents (SS) was observed in the combination ‘Maciel’/‘Okinawa clone 1’, differing only from the combination ‘Maciel’/‘Aldrighi’ (Table 3). The ‘Maciel’ fruit presented, on average, 14.1 Brix, lying within the range described by Raseira & Nakasu (1998), which is from 12 to 15 °Brix. These results are similar to those described by Picolotto et al. (2012) surveying the soluble solids content in fruits of cv. Maciel on different rootstocks over three yield cycles.

SS contents are related to the acceptability of the fruit, with sugars being the major components related to flavor, where peaches with high values of SS have greater acceptance by the consumer (Chitarra & Chitarra, 2005). According to Trevisan et al. (2006), significant variation in SS content can be found between fruits of the same cultivar, influenced by the rootstock. In addition to the characteristics intrinsic to each cultivar, this variation can be influenced by management practices adopted at pre- and post-harvest, as well as by climate factors, especially rainfall at the end period of fruit development.

Silva et al. (2014) showed that high temperatures during the day and mild temperatures at night, especially during the maturation period, provide increased sugar content in peaches, which may favor mainly late cultivars harvested in December and January. According to Picolotto et al. (2009) and Gonçalves et al. (2014), the SS content of peaches are more influenced by some factors, such as position of the fruit in the plant, light interception into the canopy, branch and pruning type, than by the rootstock, and therefore may vary from one production cycle to another, being dependent on

edaphoclimatic conditions. However, with the data obtained, there is a trend that cultivars that present poorer vigor under certain growing conditions, such as ‘Rubirã’ and ‘Okinawa clone 1’, induce greater accumulation of sugars in the fruit, which is an important feature from the qualitative standpoint and need to be further investigated aiming to add quality to production (Giovanaz et al., 2014).

Regarding the classification of fruits by size, a larger number of fruits in class I was found in the ‘Maciel’/‘Aldrighi’ combination (68.9%), differing only from ‘Maciel’/‘Okinawa clone 1’ (24.3%). The ‘Maciel’/‘Tsukuba 1’ combination presented the largest number of fruits in class II (63.8%), differing from ‘Industry’ (43.3%), ‘Aldrighi’ (42.3%), ‘Capdeboscq’ (40.8%), and ‘Nemaguard’ (32.7%), with the latter, in turn, presenting the lowest value. As for Class III, the highest value for the number of fruits was observed in the ‘Maciel’/‘Nemaguard’ combination (33.0%) (Figure 1).

Silva et al. (2014), evaluating the yield and quality of bagged and non-bagged peaches grown in the southern region of Minas Gerais state, Brazil, found results that corroborate those obtained in this study - the ‘Maciel’/‘Aldrighi’ combination induced a greater number of fruits in Class I. On the other hand, Souza et al. (2013), evaluating the adaptation of new peach genotypes to the ‘Mantiqueira Range’, obtained greater yield of Class I fruits with the ‘Maciel’/‘Okinawa’ combination.

Characteristics that express fruit quality such as taste, flavor and size are of great importance in determining the acceptance of the product by consumers, having great influence on the price obtained in the markets (Raseira et al., 2010). Cultivar Maciel is of dual purpose, with excellent quality for industrialization and good acceptance for fresh consumption; it also stands out for productivity, fruit size, appearance and resistance of fruits to transportation (Raseira & Nakasu, 1998). The fruits of this cultivar are large in size, reaching 120.0 g, and present yellow and firm pulp (Raseira & Nakasu, 1998; Biasi et al., 2004). For the ‘Maciel’/‘Aldrighi’ combination, Galarça et al. (2012) obtained a mean of fruit mass of 126.8 g, with mean diameter of 61.4 mm, which places them within Class I, a key attribute for peaches for fresh consumption. In the present study, the greatest percentage of fruits in class I (68%) was reached with the ‘Maciel’/‘Aldrighi’ combination, followed

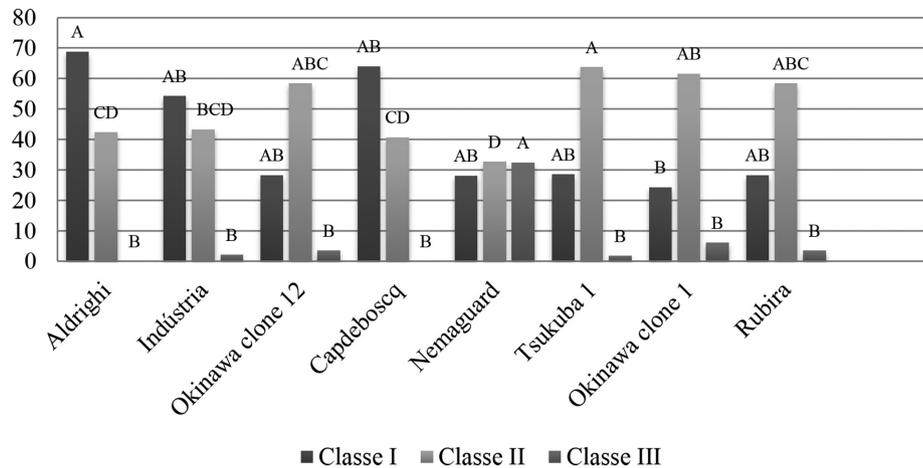


Figure 1. Classification of the fruit by size (classes I, II and III) of cv. 'Maciel' grafted on eight rootstocks in the 2011/2012 yield cycle. FAEM/UFPe – Pelotas, Rio Grande do Sul state, Brazil, 2013. Values followed by the same letter within each fruit class for the different rootstocks do not differ by the Tukey's test ($p \leq 0.05$).

Figura 1. Classificação dos frutos por calibre (classes I, II e III) da cv. 'Maciel' enxertada sobre oito porta-enxertos no ciclo produtivo 2011/2012. FAEM/UFPe/RS, 2013. Valores seguidos de mesma letra, dentro de cada classe de fruto, para os diferentes porta-enxertos, não diferem entre si pelo teste de Tukey ($p \leq 0,05$).

by 'Maciel'/'Industry', and 'Maciel'/'Capdeboscq', which did not differ between them (Figure 1).

Finally, the results showed that the rootstocks evaluated induce distinct characteristics in the Maciel cultivar, such as differences in vigor, yield, and fruit quality (fruit size and sugar content in the pulp). Considering that the orchard was established in a replanting area, it was possible to observe a good performance of 'Aldrichi', which even being a genotype susceptible to root-knot nematodes, proved to be well adapted to the local conditions; the same was verified for 'Capdeboscq', probably due to vigor. Although these genotypes have the pulp adhered to the stone and are currently little cultivated, both 'Aldrichi' and 'Capdeboscq' present potential for use in breeding programs, aiming to integrate their vigor and adaptation to the climate conditions of Rio Grande do Sul state, with resistance to root-knot nematodes and free stone.

Among the genotypes resistant to root-knot nematodes, 'Tsukuba 1' stood out for presenting poorer vigor in relation to 'Aldrichi', but with similar productivity and yield efficiency, proving a promising rootstock for use. On the other hand, although 'Rubira' is resistant to green peach aphid, it was the rootstock with the worst performance in crop yield and productive efficiency, proving not to be very useful for replanting soils and with presence of root-knot nematodes (*Meloidogyne* spp.).

4 Conclusions

Characteristics such as vigor, yield, and fruit quality of 'Maciel' peach trees are differentially influenced by the rootstocks used. The 'Aldrichi' rootstock induces greater vigor and yield in 'Maciel' peach trees compared with the 'Rubira' rootstock. The 'Okinawa Clone 1' rootstock induces less vigor and greater content of total soluble solids in fruits of 'Maciel' peach trees compared with the 'Aldrichi' rootstock, but it does not significantly influence the production efficiency and yield of the plants.

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