

## Agronomic performance of 'BRS Kampai' peach on 15 clonal rootstocks and own-rooted trees in Pelotas-RS, Brazil

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**Abstract** - The clonal rootstocks allows preservation of mother tree genetic characteristics, such as vigor and produce a fasciculated root system, with an abundant thin roots. The objective of this research was to determine the effect of fifteen clonal genotypes as rootstocks on the agronomic performance of 'BRS Kampai' peach, as well as the technical feasibility of own-rooted trees (without rootstock) in a no-irrigated field conditions, in Pelotas-RS, Brazil. Bagged nursery trees were planted at the field in August, 2014, under a randomized block design with four replications of one tree per plot, and evaluations of trunk diameter, trunk cross-sectional area (TCSA), yield efficiency, annual and accumulated fruit yield per tree and per hectare were carried out until 2019. In the adopted experimental conditions, we conclude that 'Barrier' (*P. persica* x *P. davidiana*), 'Cadaman' (*P. persica* x *P. davidiana*), G x N.9 (*P. persica* x *P. dulcis*), 'Ishtara' [*(P. cerasifera* x *P. salicina*) x (*P. cerasifera* x *P. persica*)] and 'Santa Rosa' (*P. salicina*) do not have potential as a rootstock of 'BRS Kampai' peach due irregular bud breaking of scion, small fruits and/or low fruit yield. Clone 15 (*P. mume*) stands out for increasing fruit weight and maintaining satisfactory fruit yield per tree. 'Flordaguard' (*P. persica*) is the best rootstock tested, which is vigorous, do not present any undesirable agronomic characteristics and induce the highest yields per tree and per hectare, exceeding 50 t ha<sup>-1</sup> in accumulated yield. Own-rooted trees of 'BRS-Kampai' peach have technical feasibility, as long as pruning is properly carried out.

**Index terms:** *Prunus* spp., vegetative propagation, softwood cutting, interspecific budding.

## Performance agronômica do pessegueiro 'BRS Kampai' sobre 15 porta-enxertos clonais e de plantas autoenraizadas em Pelotas-RS, Brasil

**Resumo** – Os porta-enxertos clonais permitem a preservação das características genéticas da planta-matriz, tais como o vigor, e produzem um sistema radicular fasciculado, com abundante quantidade de radículas. O objetivo do presente trabalho foi determinar o efeito de quinze porta-enxertos clonais na performance agronômica de pessegueiros 'BRS Kampai', bem como a viabilidade técnica do uso de plantas autoenraizadas (sem porta-enxerto) em condição de campo sem irrigação, em Pelotas-RS, Brasil. Mudanças produzidas em sacos plásticos foram plantadas no campo, em agosto de 2014, sob delineamento de blocos casualizados, com quatro repetições, de uma planta por parcela, e avaliações de diâmetro do tronco, área da secção transversal do tronco, eficiência produtiva, produção de frutos por planta e por hectare anual e acumulada foram realizadas até 2019. Nas condições experimentais adotadas, conclui-se que 'Barrier' (*P. persica* x *P. davidiana*), 'Cadaman' (*P. persica* x *P. davidiana*), G x N.9 (*P. persica* x *P. dulcis*), 'Ishtara' [*(P. cerasifera* x *P. salicina*) x (*P. cerasifera* x *P. persica*)] e 'Santa Rosa' (*P. salicina*) não apresentam potencial como porta-enxerto do pessegueiro 'BRS Kampai' devido à irregular quebra de dormência das gemas da copa, frutos pequenos e/ou baixa produção. O Clone 15 (*P. mume*) destaca-se por aumentar o peso do fruto, mantendo satisfatória produção por planta. O 'Flordaguard' (*P. persica*) é o melhor porta-enxerto testado, que é vigoroso, não apresenta nenhuma característica agrônômica indesejável e induz as maiores produções por planta e por hectare, superando 50 t ha<sup>-1</sup> na produção acumulada. Pessegueiros autoenraizados de 'BRS-Kampai' apresentam viabilidade técnica de cultivo, desde que as podas sejam adequadamente realizadas.

**Termos para indexação:** *Prunus* spp., propagação vegetativa, estaquia herbácea, enxertia interespecífica.

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## Introduction

In grafted fruit trees, rootstock is a part of the tree whose purpose is to receive scion bud during nursery tree production. With this successful union, tree will be composed of two distinct genotypes that will coexist for entire life with the advantage that original genetic identity of each genotype remains preserved (DAVIES Jr., 2017). Since it is a root system of the grafted trees, rootstock must be adapted to live with physical, chemical and biological soil conditions, soil temperature and moisture variations, which are specific characteristics of each fruit producing area. Therefore, for rootstock recommendation purposes, local research should be done and considering climate and soil conditions diversity (LAYNE, 1987; REIGHARD; LORETI, 2008; MAYER et al., 2014a).

In the Rio Grande do Sul State, the largest Brazilian peach producer (AGRIANUAL, 2020), the scion cultivars Aldrighi and Capdeboscq, released for processing purposes, were also widely used in the past as rootstocks, due to seed availability in the processing industries, satisfactory seed germination and adaptation to the Pelotas peach growing area (FINARDI, 1998; MAYER et al., 2014a). However 'Capdeboscq' and 'Aldrighi' are susceptible to the nematode *Meloidogyne incognita* (MAUCH et al., 1991); 'Capdeboscq' is susceptible to *M. ethiopica* (SOMAVILLA, 2008), to the ring nematode *Mesocriconema xenoplax* (CARNEIRO et al., 1998) and to soil waterlogging (GUERRA et al., 1992). With the development of new peach cultivars for processing in Brazil (RASEIRA et al., 2014), 'Aldrighi' and 'Capdeboscq' were no longer planted since the 1980s, so its seed availability is now restricted to rare nurseries that keep mother trees for seed production (MAYER et al., 2014a). Nurseries in Southern Brazil that do not have their own rootstock mother trees blocks, make use of seed mixture from different scion peach cultivars obtained in the canning industry (residue from peach canning process), which increases genetic variability of rootstocks, prevents their standardization and reduces the useful orchards life (MAYER; UENO, 2012; MAYER et al., 2014a; MAYER et al., 2017).

Due to low yield of peach orchards in Rio Grande do Sul (11.1 t ha<sup>-1</sup>) (AGRIANUAL, 2020), problems with the Peach Tree Short Life syndrome (PTSL) and tradition of obtaining seed mixtures from canning industry to produce rootstocks (MAYER; UENO, 2012; MAYER et al., 2014a), new rootstock assessments in this state started to be developed in the last 20 years, however with some divergent results due to edaphoclimatic differences and scion/rootstock interactions (DE ROSSI et al., 2004; ROCHA et al., 2007; PICOLOTTO et al., 2009; GALARÇA et al., 2013; BARRETO et al., 2017; MAYER et al., 2019). In these studies, the genetic variability tested as a rootstock was quite limited, restricted to one selection

("Viamão") and eight cultivars of *P. persica* (Capdeboscq, Aldrighi, Tsukuba-1, Nemaguard, Flordaguard, Okinawa, GF305 and Pavia Moscatel), one interspecific hybrid ('Hamsen 2168') and Japanese apricot (*P. mume*), all seed propagated, which does not guarantee genetic fidelity of mother tree and preservation of its characteristics of interest, due to genetic segregation and cross-pollination (MILLER et al., 1989; BECKMAN, 1998).

Other *Prunus* species or interspecific hybrids have been studied and commercially used as rootstock for peach in several countries, being especially indicated for calcareous soils and/or replanting areas due to the lower toxicity of root exudates and biochemical inhibitors than those produced by *P. persica*. However, graft incompatibility is a limiting factor and interspecific crossings or assessments for each edaphoclimatic condition and scion/rootstock combination should be performed (BUSSI et al., 2002; REIGHARD; LORETI, 2008; DUVAL, 2015). *Prunus mume* has potential for use as a rootstock for peaches and nectarines (CAMPO DALL'ORTO et al., 1992), however, if propagated by seeds, genetic variability is very accentuated, which requires selection and vegetative propagation of the best clones (PEREIRA et al., 2007; MATHIAS et al., 2008; MAYER et al., 2015). Soil waterlogging is one of the main winter problems in Rio Grande do Sul (FINARDI, 1995), being plum trees more tolerant (GUERRA et al., 1992; DUVAL, 2015). However, they usually have graft incompatibility problems, if budded with peach (NEVES et al., 2017). 'Cadaman', 'GF 677', 'Penta', 'MrS 2/5', 'Julior', 'Nemaguard' and 'INIA Tsukuba n° 1' rootstocks has been successfully tested in Uruguay for peaches (CABRERA; RODRIGUEZ, 2014).

On the other hand, a common question is whether there is a need for rootstock when it does not have specific characteristics suitable for that edaphoclimatic condition and/or does not add any advantageous characteristics to the scion. Peach and nectarine scions can be easily propagated by softwood cuttings under intermittent mist system, eliminating the use of rootstock and reducing time for nursery tree production (COUVILLON, 1985; MAYER et al., 2017), with satisfactory field development of some cultivars (SANTANA et al., 2020; JIMENEZ et al., 2020). The objective of this research was to determine the effect of fifteen clonal genotypes as rootstocks on the agronomic performance of 'BRS Kampai' peach, as well as the technical feasibility of own-rooted trees (without rootstock) in a no-irrigated field conditions, in Pelotas-RS, Brazil.

## Material and Methods

Fifteen genotypes (selections, cultivars, species or interspecific hybrids) were propagated vegetatively by softwood cuttings from November, 2012 to February, 2013, to be tested as rootstocks for 'BRS Kampai' peach. The identification, main features and references can be found in Table 1. Softwood shoots were collected from mother trees of the "Prunus rootstock collection" of Embrapa Clima Temperado (Pelotas-RS), managed for this purpose, with drastic winter pruning to stimulate new and intense sprouting. Softwood cuttings with 15 cm-long were prepared, keeping three distal nodes with all their leaves cut in half to reduce leaf transpiration. The cutting base (3 cm) was treated with indolbutyric acid at 3,000 mg.L<sup>-1</sup> and placed in fine vermiculite for rooting under intermittent mist system inside a greenhouse (MAYER et al., 2013).

After rooting period, the rooted cuttings classified as suitable were transplanted into perforated plastic bags (30 cm x 18 cm) containing commercial substrate based on pine bark and peat, and conducted on a single stem. In the subsequent Summer (January, 2014), rootstocks were budded by "T-inverted" method with 'BRS Kampai' peach [*Prunus persica* (L.) Batsch] (RASEIRA et al., 2010). Own-rooted nursery trees (without rootstock) of 'BRS Kampai' were also produced by softwood cuttings to be tested (MAYER et al., 2013).

The experiment was installed at no-irrigated field conditions, altitude of 45-48 m.a.s.l. at Embrapa Clima Temperado (9<sup>th</sup> district of Pelotas, Rio Grande do Sul State, Brazil). Pre-planting soil samples showed, in general, satisfactory pH and nutrient levels, except for very low or low values of P, K and Mn, which were corrected with pre-planting and growing fertilization. Soil organic matter contents were also low (<1.3%) and remained stable throughout the experiment (CQFS, 2004; CQFS, 2016). Bagged nursery trees were planted on August, 21<sup>th</sup>, 2014, with 6.0 x 3.0m spacing (555 trees ha<sup>-1</sup>) and conducted in "open vase" training system, with 5 to 7 main scaffolds (PEREIRA; RASEIRA, 2014a). Hand fruit thinning was carried out using the criterion of minimum distance between fruits, being 8 to 10 cm for vigorous shoots, and 12 to 15 cm for short shoots (PEREIRA; RASEIRA, 2014b). A randomized block design was adopted, with four replications of one tree per plot, with treatments consisting of fifteen clonal rootstocks and the own-rooted scion trees, totaling 16 treatments (Table 1) and 64 plots.

Rainfall distribution was uneven throughout the months, however, in the six years of this trial, annual rainfall volumes were greater than the annual historical average. Chilling hours accumulation was below than historical average in all six years, but it was even lower in 2015 (87 hours ≤7.2°C) and 2017 (77 hours ≤7.2°C) (AGROMET, 2020), when accumulated chilling hours did

not reach a half of the 'BRS Kampai' necessity, which is estimated at 200 hours per year (RASEIRA et al., 2010).

Trunk diameter (TD) evaluations were performed at planting and annually during their Winter (July), with a digital caliper, taking measurement 5 cm above the grafting point. In own-rooted trees, evaluation was made 5 cm above the insertion of trunk on original cutting. Trunk cross-sectional area (TCSA) was calculated, as follows:  $TCSA = \pi \times R^2$ , where TCSA is expressed in cm<sup>2</sup>;  $\pi = 3.1416$ ; R = radius, in cm. The following variables were evaluated along four years (2016, 2017, 2018 and 2019): a) fruit number per tree (FNT), determined annually some days before fruit ripening (at the end of October or beginning of November), by counting all fruits per tree. The accumulated fruit number per tree (four crops) were also calculated; b) fruit weight (FW), at harvest time, a sample of fruits per plot was collected and weighed on a digital scale, determining average fruit weight (g) for each year and average for the four crops; c) fruit yield per tree (FYT), calculated by fruit number per tree and fruit weight, and expressed as kg tree<sup>-1</sup>; d) accumulated fruit yield per tree (AFYT), determined by the sum of four years of yield per tree and expressed as kg tree<sup>-1</sup>; e) yield efficiency (YE), determined by  $YE = FYT/TCSA$ , expressed as kg cm<sup>2</sup>; f) fruit yield per hectare (FYH): determined by  $FYH = (FYT \times n^\circ \text{ of trees per hectare})/1000$ , and expressed in t ha<sup>-1</sup>; g) accumulated fruit yield per hectare (AFYH) determined by the sum of four years of yield per hectare and expressed as t ha<sup>-1</sup>. The results were subjected to analysis of variance by the F test and the means compared by the Scott-Knott test, using the SASM-Agri software (CANTERI et al., 2001).

**Table 1.** Fifteen *Prunus* spp. genotypes as clonal rootstocks for ‘BRS Kampai’ peach, and own-rooted scion trees, with main features and references. Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstocks and own-rooted scion trees	Species	Main features	References
Barrier	<i>P. persica</i> x <i>P. davidiana</i>	Waterlogging tolerance; drought tolerance better than peach seedlings.	Reighard (2002); Reighard and Loreti (2008).
Cadaman	<i>P. persica</i> x <i>P. davidiana</i>	Waterlogging tolerance; resistant to <i>Meloidogyne incognita</i> , <i>M. arenaria</i> and <i>M. hispanica</i> ; drought tolerance better than peach seedlings; suitable for replanting areas.	Di Vito et al. (2002); Bussi et al. (2002); Reighard (2002); Reighard and Loreti (2008).
G x N.9	<i>P. persica</i> x <i>P. dulcis</i>	Resistant to <i>M. javanica</i> and <i>M. incognita</i> race 2; red leaf.	Rossi et al. (2002).
Capdeboscq	<i>P. persica</i>	Adaptation to climate and soil conditions of Rio Grande do Sul State.	Finardi (1998).
Rigitano	<i>P. mume</i>	Easy propagation by softwood cuttings; resistance to <i>M. javanica</i> and <i>M. incognita</i> ; less vigor than ‘Okinawa’; induces greater fruit weight, size and soluble solids for ‘Aurora-1’ peach.	Mayer et al. (2006); Pereira et al., 2007; Mathias et al. (2008).
Clone 15	<i>P. mume</i>	Easy propagation by softwood cuttings; resistance to <i>M. javanica</i> and <i>M. incognita</i> ; induces greater fruit weight, size and soluble solids for ‘Aurora-1’ peach.	Mayer et al. (2006); Mathias et al. (2008).
I-67-52-4	<i>P. persica</i>	Increase genetic variability of the species.	No information.
Tsukuba-1	<i>P. persica</i>	Waterlogging tolerance; resistance to <i>M. incognita</i> race 2 and <i>M. javanica</i> ; red leaf.	Reighard (2002); Rossi et al. (2002).
Tsukuba-2	<i>P. persica</i>	Waterlogging tolerance; resistance to <i>M. incognita</i> race 2 and <i>M. javanica</i> ; red leaf.	Reighard (2002); Rossi et al. (2002).
Tsukuba-3	<i>P. persica</i>	Waterlogging tolerance; resistance to <i>M. incognita</i> race 2 and <i>M. javanica</i> ; red leaf.	Reighard (2002); Rossi et al. (2002).
Okinawa	<i>P. persica</i>	Easy propagation by softwood cuttings; freestone and good seed germination; low chill requirement; resistance to <i>M. incognita</i> and <i>M. javanica</i> ; tolerant to <i>M. floridensis</i> .	Nachtigal (1999); Rossi et al. (2002); Mayer et al. (2003); Mayer et al. (2005); Ferguson and Chaparro (2008).
Flordaguard	<i>P. persica</i> (6 <sup>th</sup> generation of ‘Chico 11’ x <i>P. davidiana</i> )	Resistant to <i>M. javanica</i> , <i>M. floridensis</i> and <i>M. incognita</i> races 1 and 3; low chill requirement; freestone and good seed germination; red leaf; high vigor.	Sherman et al. (1991); Ferguson and Chaparro (2008); Duval (2015).
Nemared	<i>P. persica</i>	Resistant to root-knot nematodes; red leaf; vigorous growth; good anchorage.	Ramming and Tanner (1983); Layne (1987).
Ishtara	( <i>P. cerasifera</i> x <i>P. salicina</i> ) x ( <i>P. cerasifera</i> x <i>P. persica</i> )	Resistant to <i>M. incognita</i> , <i>M. javanica</i> , <i>M. arenaria</i> , <i>M. hapla</i> and <i>M. hispanica</i> ; less vigor than GF 677; waterlogging tolerance; resistant to <i>Armillaria mellea</i> .	Di Vito et al. (2002); Loreti and Massai (2002); Beckman and Lang (2003); Reighard (2002).
Santa Rosa	<i>P. salicina</i>	Waterlogging tolerance.	Guerra et al. (1992).
Own-rooted ‘BRS Kampai’	<i>P. persica</i>	High vigor; easy propagation by softwood cuttings; to check the technical feasibility of nursery trees without rootstock.	Mayer et al. (2013); Neves et al. (2017).

## Results and Discussion

The bagged nursery trees were homogeneous at planting, with no differences in trunk diameter and TCSA. Over the years, differences in these two variables

have been detected (exception in 2018), being normally greater on Clone 15 and 'Flordaguard' (Tables 2 and 3). At the end of this study, trees on Clone 15, 'Tsukuba-1', 'Okinawa' and 'Flordaguard', as well as own-rooted trees, were significantly more vigorous (Table 3).

**Table 2.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) in trunk diameter (mm). Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Trunk diameter (mm)					
	2014	2015	2016	2017	2018	2019
Barrier	4.96 a	32.20 b	63.66 c	79.42 b	96.79 a	104.07 b
Cadaman	4.57 a	36.26 a	70.89 c	93.61 b	100.94 a	108.71 b
GxN.9	4.40 a	34.93 a	70.34 c	92.72 b	107.56 a	110.54 b
Capdeboscq	4.88 a	35.46 a	77.94 b	99.81 a	118.26 a	123.23 a
Rigitano	4.60 a	34.40 a	76.02 b	84.61 b	99.75 a	116.74 b
Clone 15	5.13 a	40.32 a	97.06 a	110.24 a	124.66 a	130.89 a
I-67-52-4	4.29 a	32.29 b	63.47 c	83.80 b	94.41 a	113.11 b
Tsukuba-1	4.88 a	32.97 b	70.50 c	90.18 b	109.40 a	130.03 a
Tsukuba-2	4.37 a	26.32 b	64.47 c	78.66 b	92.73 a	104.61 b
Tsukuba-3	4.49 a	26.89 b	64.35 c	87.28 b	110.62 a	117.80 b
Okinawa	4.36 a	31.03 b	74.51 c	93.08 b	107.77 a	125.38 a
Flordaguard	5.24 a	42.33 a	88.13 a	107.65 a	113.95 a	153.00 a
Nemared	3.45 a	32.53 b	70.87 c	101.00 a	107.28 a	121.34 a
Ishtara	4.39 a	25.56 b	52.57 c	66.64 b	81.96 a	91.28 b
Santa Rosa	4.42 a	28.50 b	61.33 c	85.06 b	97.09 a	109.05 b
Own-rooted 'BRS Kampai'	5.33 a	36.52 a	82.39 b	116.89 a	129.24 a	142.07 a
F <sub>rootstock</sub>	1.6654 <sup>ns</sup>	3.7422**	5.2501**	2.7810**	1.8095 <sup>ns</sup>	2.4718**
F <sub>block</sub>	0.4745 <sup>ns</sup>	2.0166 <sup>ns</sup>	8.7211**	5.8475**	4.9982**	8.4060**
CV (%)	15.44	14.86	13.36	16.91	17.25	16.42

Means followed by different letters in the column differ from each other by Scott-knott test. \*\* significant at 99% confidence; <sup>ns</sup> not significant.

**Table 3.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) in trunk cross-sectional area (cm<sup>2</sup>). Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Trunk cross-sectional area (cm <sup>2</sup> )					
	2014	2015	2016	2017	2018	2019
Barrier	0.20 a	8.65 c	33.56 c	53.19 b	76.35 a	87.71 b
Cadaman	0.17 a	10.34 b	39.88 c	70.41 b	83.31 a	93.96 b
GxN.9	0.15 a	9.83 b	40.86 c	72.70 b	92.36 a	100.69 b
Capdeboscq	0.19 a	9.97 b	49.13 c	80.78 a	114.23 a	122.75 b
Rigitano	0.17 a	9.42 b	45.58 c	58.33 b	81.40 a	107.89 b
Clone 15	0.21 a	13.13 a	75.52 a	98.92 a	125.32 a	141.91 a
I-67-52-4	0.15 a	8.22 c	32.11 c	56.15 b	72.57 a	108.06 b
Tsukuba-1	0.19 a	8.58 c	39.39 c	64.11 b	99.00 a	134.40 a
Tsukuba-2	0.16 a	5.48 c	32.92 c	49.50 b	67.81 a	87.49 b
Tsukuba-3	0.16 a	5.76 c	33.49 c	61.26 b	99.60 a	113.80 b
Okinawa	0.16 a	7.76 c	45.25 c	70.44 b	95.42 a	129.07 a
Flordaguard	0.22 a	14.35 a	61.68 b	92.79 a	103.79 a	187.76 a
Nemared	0.09 a	8.50 c	40.28 c	81.24 a	90.64 a	119.35 b
Ishtara	0.16 a	5.22 c	21.71 c	34.94 b	53.14 a	66.03 b
Santa Rosa	0.16 a	6.39 c	29.85 c	57.22 b	75.79 a	95.73 b
Own-rooted 'BRS Kampai'	0.23 a	10.59 b	53.35 b	109.10 a	132.21 a	159.15 a
F <sub>rootstock</sub>	1.5821 <sup>ns</sup>	3.7420**	5.6123**	2.8613**	1.7511 <sup>ns</sup>	2.5240**
F <sub>block</sub>	0.4805 <sup>ns</sup>	1.6665 <sup>ns</sup>	8.1787**	5.2281**	4.4636**	7.6036**
CV (%)	30.17	29.78	26.43	33.09	34.79	32.71

Means followed by different letters in the column differ from each other by Scott-knott test. \*\* significant at 99% confidence; <sup>ns</sup> not significant.

Fruit number per tree (FNT) was influenced by treatments in all evaluated crops, as well in the accumulated fruit number, where 'Capdeboscq' was found in the group with the lowest averages, together with 'Barrier', 'Ishtara' and 'Santa Rosa' (Table 4). Fruit weight (FW) was influenced by treatments in three crops (2017, 2018 and 2019), as well in the average of four crops (Table 5). So that, fruit yield per tree (FYT) was significantly influenced by the treatments in all the four crops evaluated (Table 6). 'Flordaguard' stood out for being one of those that presented the highest fruit number per tree, with good regularity along the years (Table 4) and fruit weight in the average or above than typical fruit

weight of the cultivar (RASEIRA et al., 2010), which resulted in one of the largest annual and accumulated fruit yield per tree (Table 6). Another highlight was the Clone 15, for significantly increasing fruit weight of 'BRS Kampai' in all four evaluated crops (Table 5), maintaining a satisfactory amount of fruits per tree, which resulted in one of the highest average accumulated fruit yield (96.49 kg tree<sup>-1</sup>) in the four crops (Table 6). Own-rooted trees also stood out positively, with good to excellent amount of fruit in all four crops (Table 4), fruit weight equivalent to those trees grafted on the traditional 'Capdeboscq' (Table 5), but with accumulated fruit yield per tree 31.5% higher (Table 6).

**Table 4.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) on fruit number per tree. Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Fruit number per tree				Accumulated (2016+2017+2018+2019)
	2016	2017	2018	2019	
Barrier	107.75 a	119.25 b	127.00 b	187.75 b	541.75 b
Cadaman	62.25 b	109.75 b	196.50 a	234.25 b	602.75 a
GxN.9	60.25 b	109.25 b	161.50 b	229.75 b	560.75 a
Capdeboscq	66.25 b	114.00 b	145.75 b	169.50 b	495.50 b
Rigitano	98.25 a	131.00 b	224.00 a	134.25 b	587.50 a
Clone 15	102.50 a	223.25 a	166.75 b	174.25 b	666.75 a
I-67-52-4	59.75 b	155.50 a	209.25 a	243.50 b	668.00 a
Tsukuba-1	110.00 a	112.25 b	139.25 b	235.00 b	596.50 a
Tsukuba-2	88.75 a	131.25 b	185.50 a	201.50 b	607.00 a
Tsukuba-3	67.50 b	125.25 b	226.25 a	187.00 b	606.00 a
Okinawa	108.00 a	171.25 a	159.25 b	202.75 b	641.25 a
Flordaguard	90.25 a	156.50 a	236.50 a	246.00 b	729.25 a
Nemared	55.75 b	134.50 b	209.00 a	364.00 a	763.25 a
Ishtara	50.25 b	72.25 b	135.25 b	108.50 b	366.25 b
Santa Rosa	54.25 b	106.00 b	116.00 b	189.50 b	465.75 b
Own-rooted 'BRS Kampai'	92.00 a	142.75 b	231.75 a	192.25 b	658.75 a
F <sub>rootstock</sub>	3.7684**	2.6884**	2.3046*	3.2930**	3.0554**
F <sub>block</sub>	5.7613**	5.0371**	7.2215**	2.2900 <sup>ns</sup>	10.7913**
CV (%)	28.38	31.37	29.77	30.34	18.91

Means followed by different letters in the column differ from each other by Scott-knott test. \* significant at 95% confidence; \*\* significant at 99% confidence; <sup>ns</sup> not significant.

**Table 5.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) on fruit weight (g). Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Fruit weight (g)				Average fruit weight (four crops)
	2016	2017	2018	2019	
Barrier	104.45 a	110.10 b	143.63 a	129.00 c	121.79 b
Cadaman	111.12 a	101.66 b	101.40 c	94.33 d	102.13 d
GxN.9	119.40 a	102.29 b	110.48 c	112.92 d	111.27 c
Capdeboscq	104.66 a	118.66 a	143.81 a	143.65 c	127.70 b
Rigitano	106.27 a	128.79 a	123.02 b	158.13 b	129.05 b
Clone 15	119.26 a	122.66 a	138.18 a	196.96 a	144.27 a
I-67-52-4	103.63 a	99.07 b	111.63 c	131.33 c	111.41 c
Tsukuba-1	110.80 a	112.55 a	117.97 b	130.53 c	117.96 b
Tsukuba-2	107.73 a	109.11 b	122.79 b	136.86 c	119.12 b
Tsukuba-3	102.33 a	107.62 b	121.02 b	130.05 c	115.25 c
Okinawa	98.47 a	107.00 b	119.64 b	134.37 c	114.87 c
Flordaguard	106.15 a	114.32 a	126.75 b	140.52 c	121.93 b
Nemared	78.96 a	98.48 b	105.61 c	109.27 d	98.08 d
Ishtara	112.52 a	96.44 b	94.85 c	134.63 c	109.61 c
Santa Rosa	115.74 a	86.29 b	84.45 c	104.06 d	97.64 d
Own-rooted 'BRS Kampai'	104.05 a	122.98 a	136.61 a	138.92 c	125.64 b
F <sub>rootstock</sub>	1.6415 <sup>ns</sup>	3.9366 <sup>**</sup>	5.3901 <sup>**</sup>	11.1213 <sup>**</sup>	9.3478 <sup>**</sup>
F <sub>block</sub>	0.9349 <sup>ns</sup>	1.3998 <sup>ns</sup>	3.9259 <sup>*</sup>	1.0354 <sup>ns</sup>	1.1927 <sup>ns</sup>
CV (%)	13.92	10.43	12.40	10.61	6.80

Means followed by different letters in the column differ from each other by Scott-knott test. \* significant at 95% confidence; \*\* significant at 99% confidence; <sup>ns</sup> not significant.

**Table 6.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) in fruit yield (kg tree<sup>-1</sup>). Embrapa Clima Temperado, Pelotas-RS.

Rootstock	Fruit yield (kg tree <sup>-1</sup> )				Accumulated (2016+2017+2018+2019)
	2016	2017	2018	2019	
Barrier	11.75 a	13.07 c	18.08 b	25.34 b	68.25 a
Cadaman	6.91 b	11.03 c	20.01 b	21.92 b	59.88 b
GxN.9	6.78 b	11.22 c	18.06 b	26.30 b	62.35 b
Capdeboscq	6.94 b	12.81 c	20.68 b	24.15 b	64.57 b
Rigitano	10.45 a	16.74 b	26.61 a	21.02 b	74.81 a
Clone 15	12.29 a	27.33 a	22.68 a	34.19 a	96.49 a
I-67-52-4	6.22 b	15.35 c	23.48 a	32.11 a	77.15 a
Tsukuba-1	12.46 a	12.40 c	16.42 b	30.72 a	71.99 a
Tsukuba-2	9.61 a	14.35 c	23.08 a	27.22 b	74.26 a
Tsukuba-3	6.91 b	13.34 c	27.75 a	24.22 b	72.23 a
Okinawa	10.59 a	18.18 b	19.19 b	27.24 b	75.19 a
Flordaguard	9.64 a	17.61 b	30.03 a	34.24 a	91.52 a
Nemared	4.74 b	13.11 c	22.07 a	39.20 a	79.11 a
Ishtara	5.94 b	6.83 c	12.84 b	14.21 b	39.81 c
Santa Rosa	6.30 b	9.11 c	9.40 b	19.61 b	44.41 c
Own-rooted 'BRS Kampai'	9.54 a	17.08 b	32.01 a	26.30 b	84.93 a
F <sub>rootstock</sub>	2.6795 <sup>**</sup>	4.7314 <sup>**</sup>	2.9059 <sup>**</sup>	2.5521 <sup>**</sup>	3.7326 <sup>**</sup>
F <sub>block</sub>	4.5167 <sup>**</sup>	5.3048 <sup>**</sup>	6.9867 <sup>**</sup>	3.5032 <sup>*</sup>	9.9958 <sup>**</sup>
CV (%)	35.60	29.75	32.76	29.39	21.74

Means followed by different letters in the column differ from each other by Scott-knott test. \* significant at 95% confidence; \*\* significant at 99% confidence.

When trees were still young (2016 and 2017), yield efficiency (YE) was significantly influenced by rootstocks. However, upon reaching the fourth year at the field (2018), this variable was no longer influenced by rootstocks (Table 7). Fruit yield per hectare (FYH) was also significantly affected by the rootstocks along the four evaluated crops (Table 8), with emphasis for Clone 15 and 'Flordaguard', which were the most productive in at least three crops. In accumulated fruit yield per hectare (AFYH), statistical

analysis allows to form three groups, with ten rootstocks ('Barrier', 'Rigitano', Clone 15, I-67-52-4, 'Tsukuba-1', 'Tsukuba-2', 'Tsukuba-3', 'Okinawa', 'Flordaguard' and 'Nemared') and own-rooted trees in group with the highest averages, three rootstocks in intermediate group ('Cadaman', G x N.9 and 'Capdeboscq') and two rootstocks ('Ishtara' and 'Santa Rosa') in the group with the lowest accumulated fruit yields per hectare.

**Table 7.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) on yield efficiency (kg cm<sup>2</sup>). Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Yield efficiency (kg cm <sup>2</sup> )			
	2016	2017	2018	2019
Barrier	0.3616 a	0.2716 a	0.1988 a	0.2790 a
Cadaman	0.1723 b	0.1628 b	0.2907 a	0.2404 a
GxN.9	0.1753 b	0.1896 b	0.2046 a	0.2868 a
Capdeboscq	0.1613 b	0.1574 b	0.2110 a	0.2233 a
Rigitano	0.2308 b	0.3211 a	0.4125 a	0.1912 a
Clone 15	0.1671 b	0.3146 a	0.2011 a	0.2600 a
I-67-52-4	0.1949 b	0.2925 a	0.3210 a	0.3559 a
Tsukuba-1	0.3115 a	0.1990 b	0.2002 a	0.2388 a
Tsukuba-2	0.2993 a	0.2962 a	0.3410 a	0.3325 a
Tsukuba-3	0.2222 b	0.2145 b	0.2725 a	0.2517 a
Okinawa	0.2505 a	0.2891 a	0.2362 a	0.2515 a
Flordaguard	0.1587 b	0.1838 b	0.3150 a	0.1954 a
Nemared	0.1375 b	0.1711 b	0.2475 a	0.3425 a
Ishtara	0.2725 a	0.1979 b	0.2500 a	0.2420 a
Santa Rosa	0.2056 b	0.1672 b	0.1231 a	0.2147 a
Own-rooted 'BRS Kampai'	0.1806 b	0.1812 b	0.2588 a	0.1707 a
F <sub>rootstock</sub>	2.2736*	1.9565*	1.2255 <sup>ns</sup>	1.4325 <sup>ns</sup>
F <sub>block</sub>	0.8967 <sup>ns</sup>	2.1022 <sup>ns</sup>	1.0861 <sup>ns</sup>	2.8189*
CV (%)	38.95	38.10	49.43	35.32

Means followed by different letters in the column differ from each other by Scott-knott test. \* significant at 95% confidence; <sup>ns</sup> not significant.

**Table 8.** Effects of clonal rootstocks used for 'BRS Kampai' peach and own-rooted trees (without rootstock) on fruit yield per hectare (t ha<sup>-1</sup>). Embrapa Clima Temperado, Pelotas-RS, Brazil.

Rootstock	Fruit yield per hectare (t ha <sup>-1</sup> )				
	2016	2017	2018	2019	Accumulated (2016+2017+2018+2019)
Barrier	6.52 a	7.26 c	10.04 b	14.06 b	37.88 a
Cadaman	3.84 b	6.13 c	11.11 b	12.16 b	33.23 b
GxN.9	3.76 b	6.23 c	10.03 b	14.60 b	34.61 b
Capdeboscq	3.85 b	7.11 c	11.48 b	13.40 b	35.84 b
Rigitano	5.80 a	9.30 b	14.76 a	11.67 b	41.53 a
Clone 15	6.82 a	15.17 a	12.59 a	18.98 a	53.55 a
I-67-52-4	3.45 b	8.52 c	13.03 a	17.82 a	42.82 a
Tsukuba-1	6.92 a	6.88 c	9.11 b	17.05 a	39.96 a
Tsukuba-2	5.33 a	7.96 c	12.81 a	15.11 b	41.21 a
Tsukuba-3	3.84 b	7.40 c	15.40 a	13.44 b	40.09 a
Okinawa	5.87 a	10.09 b	10.65 b	15.12 b	41.73 a
Flordaguard	5.35 a	9.77 b	16.67 a	19.01 a	50.80 a
Nemared	2.63 b	7.28 c	12.25 a	21.76 a	43.91 a
Ishtara	3.30 b	3.79 c	7.12 b	7.89 b	22.10 c
Santa Rosa	3.50 b	5.06 c	5.21 b	10.88 b	24.65 c
Own-rooted 'BRS Kampai'	5.30 a	9.48 b	17.77 a	14.60 b	47.14 a
F <sub>rootstock</sub>	2.6774**	4.7305**	2.9071**	2.5524**	3.7327**
F <sub>block</sub>	4.5165**	5.3027**	6.9855**	3.5041*	9.9972**
CV (%)	35.61	29.74	32.76	29.38	21.74

Means followed by different letters in the column differ from each other by Scott-knott test. \* significant at 95% confidence; \*\* significant at 99% confidence.

With evaluations carried out from 2014 to 2019, rootstocks influenced all variables, in practically every year (Tables 2, 3, 4, 5, 6, 7 and 8). These significant effects are attributed to the several rootstocks (15) and considerable genetic variability tested, composed of *P. persica* (eight genotypes), *P. mume* (two genotypes), *P. salicina* (one genotype), four rootstock interspecific hybrids, in addition to own-rooted trees, which allowed to obtain a wider range of effects. Like what has been done for many decades in other fruit species (such as citrus, apple, pear, passion fruit and grape, among others), strategy to expand genetic variability to be tested as a peach rootstock in Southern Brazil is also necessary. The traditional 'Capdeboscq' and 'Aldrighi' (*P. persica*), widely used as rootstocks until the 1980s, do not provide resistance to root-knot nematodes, soil waterlogging or PTSL syndrome (MAUCH et al., 1991; GUERRA et al., 1992; CARNEIRO et al., 1998; SOMAVILLA, 2008; MAYER et al., 2014a). Several interspecific hybrids and species are commercially used as peach rootstocks in Europe, mainly to tolerate soil water stress, physical or chemical problems. However, in the United States, *P. persica* cultivars (Lovell, Halford, Nemaguard, Nemared, Bailey and Guardian®) still predominate (REIGHARD; LORETI, 2008; DUVAL, 2015).

The vigor of the rootstocks is a relative characteristic, because it depends, in addition to the

genetic effects, on soil and climatic conditions, cultural treatments, fertilization (mainly nitrogen), spacing between trees, number of tested rootstocks and the genetic variability being evaluated in the trial, the reference rootstock and the scion/rootstock interaction (LAYNE, 1987; LORETI and MASSAI, 2002; MAYER et al., 2006; REIGHARD; LORETI, 2008; DAVIES Jr., 2017). Rootstock vigor can be assessed by trunk diameter, TCSA, tree height, canopy volume, fresh and dry pruning mass (DE ROSSI et al., 2004; REIGHARD and LORETI, 2008; BARRETO et al., 2017). In the present study, although Clone 15 (*P. mume*) had one of the largest trunk diameter and TCSA, trees on this rootstock had shoots with a shorter internodes and compact tree shape, aspects also conferred by trees on 'Rigitano' (*P. mume*). Both rootstocks were also the only ones to produce root suckers all over the years (until three per tree/year) and trees were apparently more susceptible to leaf diseases and phytotoxicity. As both induces a more compact tree, Clone 15 and 'Rigitano' are interesting for high density (>800 trees per hectare), especially in regions with low chilling accumulation (<50 chilling hours ≤7.2°C) where the sun usually causes burns on scaffolds (MAYER et al., 2014b). At those edaphoclimatic conditions (Jaboticabal region, São Paulo State), 'Aurora-1' peach on Clone 15 or on 'Rigitano' with micro-sprinkler irrigation system showed satisfactory root anchorage and increased fruit

size and weight, when compared to those on 'Okinawa' (MAYER et al., 2006; MAYER et al., 2007; MATHIAS et al., 2008). So, rootstock recommendation must be specific for each scion/rootstock combination and edaphoclimatic condition.

The 'Flordaguard' was the only rootstock having the highest fruit number per tree in three harvests (2016, 2017 and 2018), which is attributed to the high tree size it induces to the scion. The G x N.9, 'Ishtara' and 'Santa Rosa', as well as the traditional 'Capdeboscq', were negative highlights, with the lowest amounts of fruit per tree in all the four evaluated crops (Table 4). By another criterion for defining hand fruit thinning (leaving 5 fruit/cm<sup>2</sup> of TCSA) (PEREIRA; RASEIRA, 2014b), the data also showed that all scion/rootstock combinations had potential to support a greater amount of fruit per tree. Thus, by this criterion and dividing the values showed in Table 4 by values in Table 3, this index varied from 1.21 fruits/cm<sup>2</sup> (on own-rooted trees in 2019) up to 3.21 fruits/cm<sup>2</sup> (on 'Barrier' in 2016). The annual averages, with all rootstocks combined (data not shown), were close to 2 fruits/cm<sup>2</sup> of TCSA, indicating that all scion/rootstock combinations could withstand double fruit number per tree, in the four evaluated crops, without impairing fruit quality. Smaller amounts of fruit in the lower tree part may explain the lower yield per tree in relation to their potential (based on TCSA), although this was observed in all treatments.

The fruit weight (FW) is a function of fruit load, tree vigor and edaphoclimatic conditions (mainly soil temperature and soil humidity) before harvest (LAYNE, 1994). Fruit weight (Table 5) was not influenced by rootstocks when trees were still young, with two years old in 2016. However, with increasing age, significant differences occurred, with the highest values seen on six treatments in 2017, four in 2018 and only one treatment in 2019. Clone 15 being the only one to confer the highest fruit weight in all four crops, proving an important characteristic that species (*P.mume*) can confer to the scion when used as a rootstock for peach, since selected clones and vegetative propagation be used (MAYER et al., 2006; MATHIAS et al., 2008; MAYER et al., 2015). The common fruit weight of 'BRS Kampai', when budded on 'Capdeboscq' and cultivated in Pelotas-RS, is between 112 and 127g (RASEIRA et al., 2010). In the present study, fruit weight was increased by up to 37% in trees budded on Clone 15, compared to fruits produced on 'Capdeboscq' (in 2019), with the same amount of fruits per tree (Table 4). The greater fruit weight conferred by Clone 15 and 'Rigitano' compared to those produced on 'Okinawa', has already been reported for 'BRS Libra', in Chapecó, Santa Catarina State, with fruit weight increments of 25% to 38% (SANTANA et al., 2020) and also for 'Aurora-1', in Vista Alegre do Alto, São Paulo State, with increases of 18% to 30% in fruit weight, beyond anticipation of five

to seven days for fruit ripeness (MATHIAS et al., 2008). The greater efficiency on uptake and translocation of nutrient and water by the rootstock to the scion is usually the reason for fruit weight increasing (REIGHARD and LORETI, 2008), aspects that also are being investigated in these *P.mume* clones.

Fruit yield per tree (FYT) is a function of fruit set, thinning intensity, fruit size, fruit number per tree, tree size and environmental conditions (mainly air temperature and rainfall) that precede harvest (LAYNE, 1994). When observing yields per tree and per hectare (Tables 6 and 8), it turns out that 'Rigitano', Clone 15, I-67-52-4, 'Tsukuba-1', 'Tsukuba-2', 'Flordaguard' and 'Nemared' rootstocks, as well as own-rooted trees, presented significantly higher FYT averages than the traditional 'Capdeboscq', in most evaluated years. At four-years old (2018 season), yield per hectare conferred by several of the rootstocks tested was higher than the yield average obtained in commercial orchards in Pelotas-RS, which is 11.1 t ha<sup>-1</sup> (IBGE, 2020). Yields per hectare greater than produced on 'Capdeboscq' were obtained from seven rootstocks in 2018 ('Rigitano', Clone 15, I-67-52-4, 'Tsukuba-2', 'Tsukuba-3', 'Flordaguard' or 'Nemared'), beyond own-rooted trees. With five-years old (2019 season), yields per hectare increased and, on Clone 15, I-67-52-4, 'Tsukuba-1', 'Flordaguard' and 'Nemared' rootstocks, were significantly higher in relation to 'Capdeboscq'. These data prove that cultivars or selections developed for rootstock purpose can increase yields per tree and per hectare, as compared in relation to the regional reference 'Capdeboscq' used as a rootstock for many years. Rootstocks with desirable characteristics such as better adaptation and induction of greater yield, can offer an important contribution to regional peach production, as this objective can be achieved without increasing nursery trees prices, due to rootstock change.

The 'Barrier' rootstock, although had one of the highest accumulated yields per tree and per hectare in four years (Tables 6 and 8), it producing fruits with low weight (Table 5) and early bud breaking of the scion at end Summer, undesirable aspects that were also observed in trees on 'Cadaman'. Trees budded on G x N.9 showed typical symptoms of "translocated" graft incompatibility at the second year, bud drop and early defoliation, with soft dormant shoots in Winter and few standard fruit at harvest, as well as the symptoms described by Davies Jr. (2017). 'Ishtara' and 'Santa Rosa' also induce to the scion little yield and low fruit quality, in addition to symptoms of "translocated" graft incompatibility, but these symptoms were not as pronounced, as observed in G x N.9, and were visible only after three-years old. Translocated graft incompatibility of 'Myrobalan 29C' (*P.cerasifera*) and 'Marianna 2624' (*P.cerasifera* x *P.munsoniana*) with 'BRS Libra', 'BRS Kampai', 'Maciel' and 'Jade' scion peaches had already been detected before one-year old

trees in the field (NEVES et al., 2017; GONÇALVES et al., 2019; SANTANA et al., 2020).

An alternative that eliminates the need of grafting is the use of own-rooted nursery trees. This type of tree has interesting advantages in the nursery phase, such as the shorter time to produce nursery trees and it eliminates all operations inherent to the grafting process (COUVILLON, 1985; DAVIES Jr., 2017; MAYER et al., 2018). In the field, own-rooted trees can delay bloom, increase fruit size, fruit weight, yield per tree and per hectare of some peach and nectarine cultivars in soil without physical, chemical or biological restrictions (COUVILLON, 1985; GONÇALVES et al., 2019; JIMENEZ et al., 2020; SANTANA et al., 2020). The 'BRS Kampai' own-rooted trees showed high vigor, with high TCSA (Table 3), fruit number per tree and fruit weight equivalent to the best rootstocks (Tables 4 and 5). However, this kind of tree has a more vertical growth habit and greater production of sucker shoots, which makes it more difficult to manage trees on the "open-vase" training system during summer and winter pruning. The accumulated yield per tree of own-rooted trees in all four seasons was one of the greatest (84.93 kg tree<sup>-1</sup>), similar to those obtained in the best rootstocks (Table 6), which resulted in 47.14 t ha<sup>-1</sup> average of accumulated yield (Table 8). Thus, in the four harvests, the accumulated yield per hectare in own-rooted trees was 31.5% higher, compared to the trees budded on 'Capdeboscq'. Own-rooted peach trees can be a desirable alternative, as long as they are grown in soils that do not present problems with nematodes and without physical-chemical limitations (COUVILLON, 1985). Root quality of own-rooted trees is essential for initial setting and survival at the field, since trees with poor root system can result in 30% mortality in the first year. In addition, it becomes more susceptible to soil moisture at Fall, which is unfavorable for acclimatization to cold, as described by Layne (1994).

In the present study, the preservation of intact root system of the nursery trees at planting contributed for an excellent initial setting and growth at the field, with 100% tree survival of all 16 treatments. Trees had excellent anchorage and there were no falling problems. Nursery trees with satisfactory morphological pattern, provided by efficient rootstock and scion propagation methods and by a good nursery tree production system (bagged or potted trees), is an essential condition for successful orchard establishment and satisfactory yields (MAYER et al., 2019). Approximately 70% of total non-structural carbohydrate content in dormant young peach trees is found in roots and, of this total, more than 80% of which is in thin roots (WEIBEL et al., 2011), which proves the importance of a good root system for initial establishment at the field. According to Layne (1994), the main cause of tree mortality in the first year is the low quality of nursery trees, especially on those with poor root development.

Vegetative propagation of rootstocks is an efficient and quick way to perpetuate all selected characteristics in the cultivar's development (DAVIES Jr. et al., 2017), besides not presenting disadvantages of seed propagation (MILLER et al., 1989; BECKMAN, 1998). For these reasons, vegetative propagation of *Prunus* rootstocks by the softwood cuttings, as adopted for production of nursery trees in this research, represents a good prospect for use in commercial orchards.

## Conclusions

In the adopted experimental conditions, we conclude that 'Barrier' (*P. persica* x *P. davidiana*), 'Cadaman' (*P. persica* x *P. davidiana*), G x N.9 (*P. persica* x *P. dulcis*), 'Ishtara' [(*P. cerasifera* x *P. salicina*) x (*P. cerasifera* x *P. persica*)] and 'Santa Rosa' (*P. salicina*) do not have potential as a rootstock of 'BRS Kampai' peach due to irregular bud breaking of scion, small fruits and/or low fruit yield. Clone 15 (*P. mume*) stands out for increasing fruit weight and maintaining satisfactory fruit yield per tree. 'Flordaguard' (*P. persica*) is the best rootstock tested, which is vigorous, does not present any undesirable agronomic characteristics and induces the highest yields per tree and per hectare, exceeding 50 t ha<sup>-1</sup> in accumulated yield. Own-rooted trees of 'BRS-Kampai' peach have technical feasibility, as long as pruning is properly carried out.

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