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Production of self-rooted peach seedlings

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ABSTRACT

The use of mini-cuttings in the production of peach seedlings may prevent the inconvenience of grafting and make possible the fast, simple and low-cost production of a great number of seedlings, in a shorter period of time. Seedlings collection from self-rooted scion cultivars may be an option for locations where the use of rootstock does not offer any specific advantage. The objective of the present experiment was to evaluate the growth and survival of self-rooted peach scion cultivars cloned through mini-cutting under the soilless cultivation system and in packages with commercial substrate, in a greenhouse. The experiment used rooted herbaceous mini-cuttings from the Maciel and Bonão scion cultivars transplanted to a package with commercial substrate and to a soilless cultivation system as vegetal material. The Maciel cultivar showed greater rooting and survival percentages after transplantation when compared to Bonão. At 120 days after transplantation to the cultivation systems, self-rooted seedlings from the Maciel and Bonão cultivars reached half the length of a commercially ready seedling. The soilless cultivation system improves self-rooted peach seedlings development in relation to production in packages.

Key words: *Prunus persica*, clonal mini-cuttings, self-rooted seedlings, soilless cultivation systems, nutritious solution.

INTRODUCTION

Fruit plants seedlings, in the main growing regions around the world, are collected through clones and/or selection of genetically stable materials that guarantee uniformity, longevity and productivity to orchards. In Southern Brazil, the peach seedlings collection process is done, basically, through scion cultivars seeds to form rootstocks with pits obtained from the preserve industry. This practice is not recommended since this material does not carry desirable traits to form rootstocks of quality and homogeneous orchards (Raseira et al., 2014).

Rootstocks affect several scion cultivar traits such as trunk section area, scion volume, plant length and growth, nutrients absorption, flowering period, fruit production, production efficiency, resistance to disease and plant survival (Hartmann and Kester 1978; Young and Olcott-Reid 1979; Guerriero et al., 1985; Layne 1987; Klenyán et al., 1998). Depending on the rootstock used, planting spacing can go through changes as well as other crop practices such as plant conduction system, weed control, orchard green coverage management and irrigation system (Layne 1987).

Another grafting process inconvenience is the possible lack of compatibility between the graft and the rootstock, which may bring problems to the propagation process (Hartmann and Kester 1978).

The main advantage of a self-rooted seedling is the absence of grafting incompatibility (Colombo and Néri 2003). Seedlings collection from self-rooted scion cultivars may be an option for locations where the use of rootstocks shows no specific advantage such as nematodes resistance, for instance (Oliveira et al., 2003).

The adoption of mini-cuttings in the production of peach seedlings may prevent the inconveniences of grafting and make fast, simple and low cost production of great number of seedlings possible, in a shorter period of time (Tofanelli et al., 2002). Propagation by cutting is justified by descendant uniformity and seedling production facility (Chalfun and Hoffmann 1997).

Although propagation by cutting is very interesting, the production sector has not adopted it yet, since results, although promising, have been highly variable. Studies that assess how these plants, originated from cuttings, will behave in the field and provide support to nursery workers, are still scarce (Souza 2014).

Several workers have verified the rooting capacity of peach cuttings; however, results have been contradictory. Normally, some techniques are used to try to maximize herbaceous cuttings rooting percentage. Among the most used techniques is the exogenous application of growth regulators (Tofanelli et al., 2005; Timm 2011).

Among the growth regulator groups used in plant propagation, the auxins play an important role. The indolbutiric acid is the most used and most efficient synthetic auxin in promoting cutting rooting, working well with a large number of plants. Oliveira et al. (2003) and Ribas et al. (2007) tested it with peach trees to implement cuttings in Brazil, but so far, with variable results.

Another important factor in the rooting process is the substrate used, which is the mean through which the root system will develop, determining aerial part growth until transplantation. This substrate must be free of pathogens, with a good balance between macro and micropores, good water drainage capacity, good consistency (aiming at obtaining intact clumps when removed from the recipient), cost-effective and easy to obtain (Jabur and Martins 2002).

Many works tried to implement peach seedlings production in packages with substrate to provide good quality when compared to seedlings produced from a bare root (as in the case of seeds). They promote fast growth in the nursery, better fertilization and ants control, absence of nematodes (sterile substrates), faster initial development and greater and effective fruit production (Pereira and Mayer 2005; Picolotto et al., 2007).

The production of fruit plants clonal seedlings from mini-cuttings in soilless cultivation systems is a technique with great potential (Schuch and Peil 2012). As advantages, we can mention less time to produce seedlings, the supply of more adequate mineral nutrients, the best conditions for seedling development and the best pests and diseases control.

Thus, the mini-cutting technique differs from conventional cutting by the size of the propagating material, which are between three and five centimeters long, and presents one to three pair of leaves. It is considered highly promising in clonal seedlings production and has been used in Brazil with great success with forest species (Wendling et al., 2000; Alcântara et al., 2007) and tested in fruit trees (Pio et al., 2002a, 2002b; Marinho et al., 2009).

In order to develop technology for peach seedlings vegetative propagation, the objective of the present work was to evaluate the growth and survival of self-rooted peach scion cultivars, cloned through mini-cuttings in a soilless cultivation system and in packages with commercial substrate.

MATERIAL AND METHODS

This study included a factorial arrangement with three factors: peach scion cultivars (Maciel and Bonão), seedlings production systems (commercial substrate package and soilless cultivation system) and assays dates (30, 40, 60, 90 and 120 days after transplantation). Thus, the experiment included 20 treatments, resulting from the combination of the three factors different levels. The experimental design was completely randomized, with four replications per treatment, being each one composed of tem plants.

Assessed variables included percentage of rooted mini-cuttings, mini-cuttings survival after transplantation to the package system with commercial substrate and soilless growing system, length (cm) with the use of a measuring tape and number of lateral shoots. The mini-cuttings survival percentage variable for seedlings production systems was assessed only 45 days after transplantation. In this case, we considered the bi-factorial element (two scion cultivars x production system) and means comparison was realized through the Tukey test at 5% of probability. Data were submitted to an analysis of variance by the F test and means were submitted to a polygonal regression analysis through the WinStat de Machado and Conceição (2007) statistical program, , fixing the cultivar factor.

The experiment was conducted in a greenhouse located at the Plant Science Department Teaching and Experimental Field of Faculdade de Agronomia Eliseu Maciel da Universidade Federal de Pelotas (UFPel/RS), from December 2010 to June 2011.

During the seedlings production period, the greenhouse was exposed to natural ventilation and the lateral windows were opened from 8 am to 5 pm, daily. During low temperature days, strong and/or high environmental relative humidity external to the greenhouse, it was kept closed, depending on the weather conditions.

The vegetal material used in the peach clonal mini-cuttings experiment was obtained from Embrapa Temperate Climate mother plants, Pelotas/RS. Herbaceous mini-cuttings from the Maciel and Bonão peach scion cultivars with two to three buds and a leaf cut in half were prepared in a greenhouse. With the help of penknife, a superficial lesion was made on the base of the cutting, which was later immersed for 5 seconds in 2000 mg L^{-1} of indolebutyric acid solution. Next, they were placed in articulated and transparent Sampack® (10 x 13 x 20 cm) plastic packages with perforations on the bottom to prevent water accumulation.

The substrate used was a mix of expanded average vermiculite and autoclaved sand (1:1v/v), previously moistened with water. During rooting, whenever necessary, it was sprayed with water to prevent dehydration. Captan fungicide (3 g L^{-1} of the commercial product in water) was applied weekly. The packed mini-cuttings were kept in a greenhouse at 25°C for 45 days, according to the methodology described by Timm (2011). At the end of the period, the percentile of rooted mini-cuttings from the two scion cultivars was assessed. Next, the rooted mini-cuttings were transplanted to two seedlings production system (packing and in soil), in a Tudor-like greenhouse , levelled , with the soil covered with plastic coated with polyethylene (150 µm thick), 8 x 5 x 2.5 m of maximum height, placed in the North - South direction.

Under the packing system, plants were kept in 10 x 15 cm black polyethylene bags, with Carolina® substrate. During seedlings production and development, they were irrigated daily with water, according to crop demand, and weekly with a complete nutrition solution (macro and micronutrients) composed by Schuch and Peil (2012), whose electrical conductivity is 1.6 dSm^{-1} and the pH 6.0 ± 0.5.

The soilless farming system for the production of seedlings from peach mini-cuttings defined by Schuch and Peil (2012) (Figure 1), was constituted by plastic flower boxes (80 cm x 20 cm) containing medium sand. A 5 cm layer of crushed stone was placed inside the flower boxes for draining, with a shade cloth and a layer of medium sand of approximately 12 cm. The shade cloth is used to prevent crushed stones and sand to mix. During seedlings production and development, they were irrigated daily, according to crop demand, with the same nutritious solution used with the packing system. The nutritious solution was monitored through electrical conductivity (using digital electric conductivity meter) and pH (using a pH digital meter) measurements.

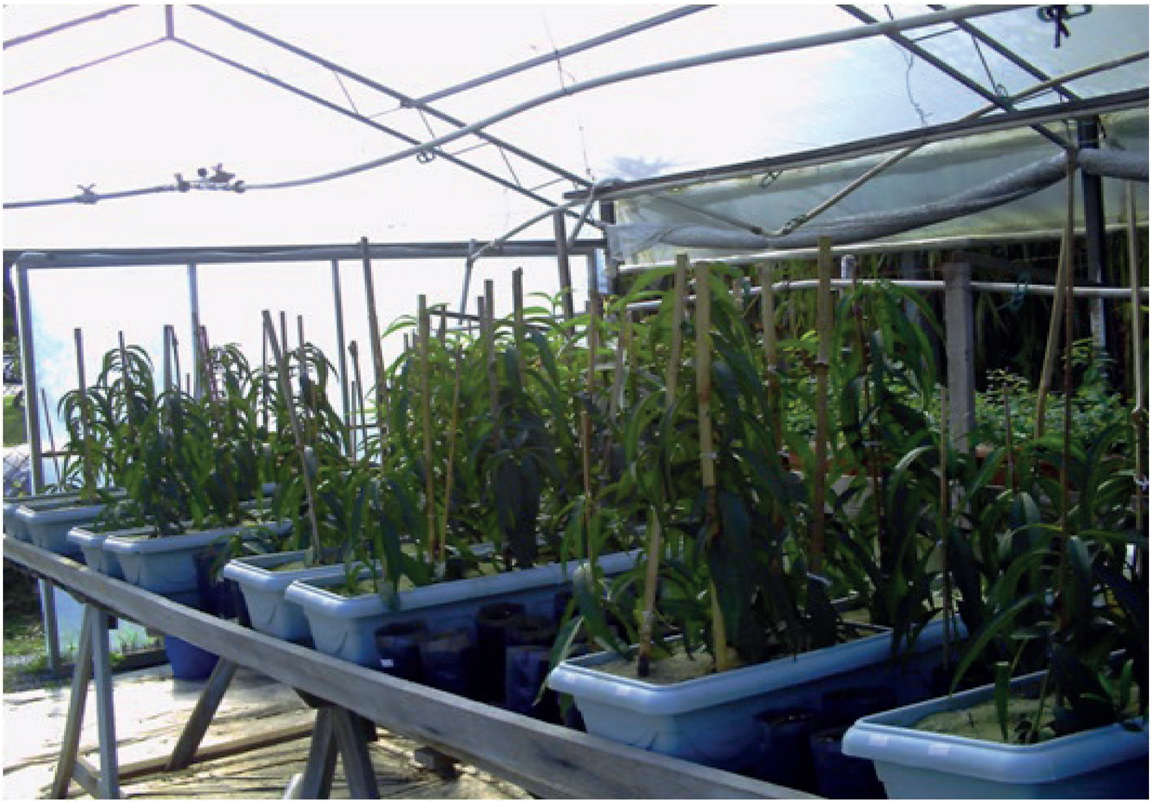

Figure 1. Self-rooted peach seedlings in soilless cultivation system (Tomaz, 2011). FAEM/UFPel, Pelotas, RS, Brazil. 2013.

RESULTS AND DISCUSSION

The percentage of herbaceous mini-cuttings rooted in average vermiculite and sand was highly significant for the scion cultivars Maciel and Bonão, with 93.33 and 77.5% respectively. In a study conducted on the rooting of 'Okinawa' peach tree herbaceous mini-cuttings collected from young plants, the best results were obtained with the use of fine or average granulometry vermiculite (87,6% e 80,6%, respectively), attributed to the best water/air balance presented by the vermiculite (Nachtigal and Pereira 2000). These rooting percentages agree with those reported by Mayer et al. (2009), who obtained from some peach tree genotypes up to 87% of rooted cuttings ready to be transplanted.

As for the mini-cuttings survival 45 days after transplantation, there was a statistical difference among treatments (Table 1). The soilless cultivation system was superior in both cultivars. Systems showed no difference when comparing 'Bonão' under soilless farming and 'Maciel' under packing. The highest mini-cuttings survival rate under the soilless farming system was, probably, due to better availability of nutrients for the seedlings that received the nutritious solution daily. The unsatisfactory performance of the seedlings in package is due to the low amount of nutrients associated to interactions that the substrate exerted on the root medium, damaging seedlings survival. According to Oliveira et al. (2001), each substrate demand a different management due to specific properties. Nutritious solution supply in substrates with high chemical activity such as that used by the packing system cannot follow the same daily frequency maintained for sand cultivation, running the risk of causing environmental salinization.

Table 1. Percentile of herbaceous mini-cuttings from self-rooted peach scion cultivars under the soilless cultivation system and in a package with commercial substrate at 45 days after transplantation. FAEM/UFPel, Pelotas, RS, Brazil. 2013.

Cultivation systems		Survival (%)
Soilless	Maciel	60.0a[1]
	Bonão	47.5ab
In a package	Maciel	37.5 b
	Bonão	20.0 c

[1]Lower case letters in the column show significant differences at 5% of probability by the TukeyTest.

By considering the days after rooted mini-cuttings transplantation to cultivation systems, it was possible to see the seedlings length quadratic behavior for both scion cultivars. Between 45 to 120 days after transference to the systems, the 'Maciel' seedlings reached, on average, 26.10 and 20.70 cm of length for both soilless and packing cultivation systems, respectively (Figure 2a). The 'Bonão' seedlings reached, on average, 19.74 cm of length under the soilless cultivation system 60 days after transplantation (Figure 2b). There was no evaluation date on seedlings length under the packing system.

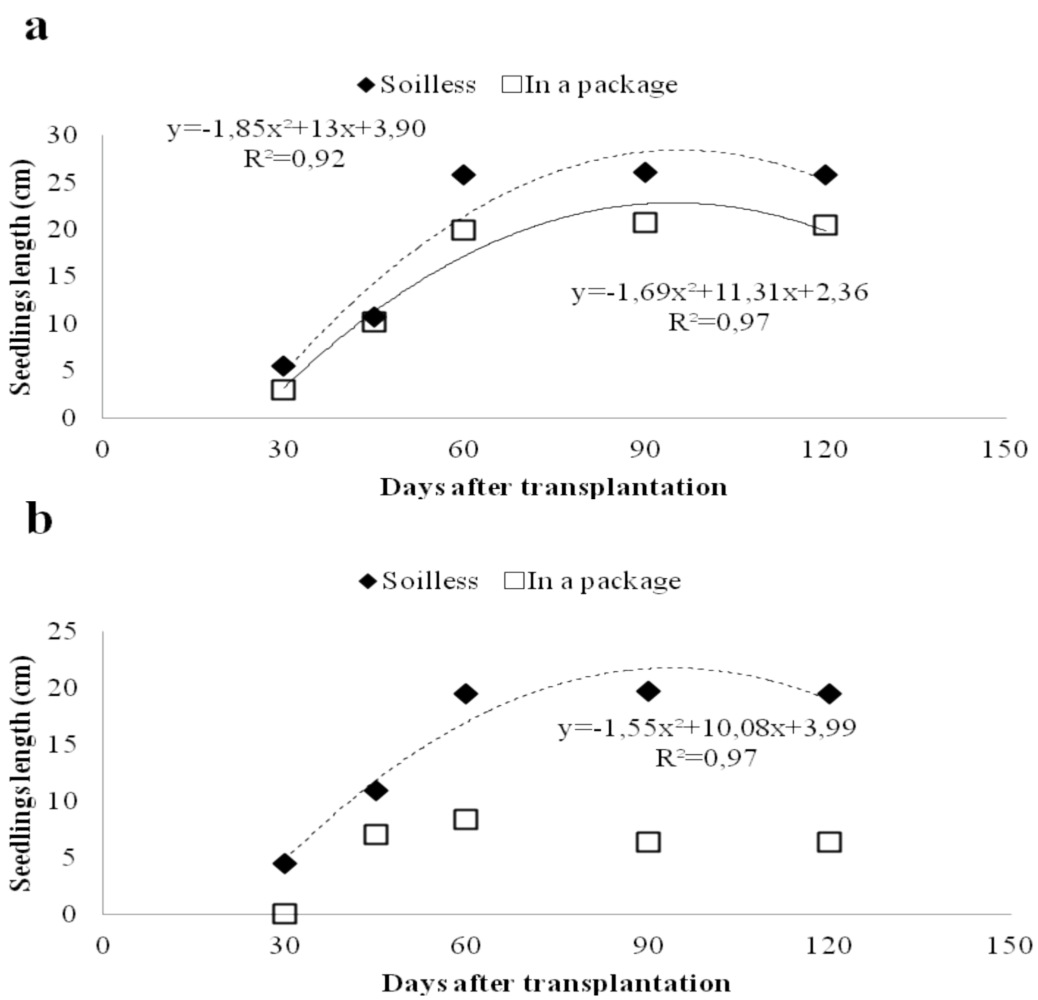

Figure 2. Peach seedlings length from scion cultivars Maciel (**a**) and Bonão (**b**) self-rooted under the soilless cultivation system and in package with commercial substrate, 2011. FAEM/UFPel, Pelotas, RS, Brazil. 2013.

According to Taiz and Zeiger (2004), plants ability to get water and mineral nutrients is related to their capacity to develop an extensive root system. It must also be consider that isolated use of a commercial substrate may increase peach seedlings production costs. It is important to emphasize that in commercial productions, the nurseryman must assess the cost of materials used, such as the substrate and time to develop a seedling of quality (Wagner Junior et al., 2007).

The number of lateral shoots variable showed a linear tendency for the Maciel seedlings, with 2.25 on average 60 days after transplantation to soilless cultivation. Under the packing system, however, it showed an average of 2.5, 60 days after transplantation (Figure 3a). Bonão seedlings sowed a linear tendency with an average of 2.5lateral shoots under the soilless cultivation 120 days after transplantation (Figure 3b). The work developed by Wagner Junior et al. (2008) on the peach tree initial growth with gibberellic acid spraying (GA3) (0; 50; 100; 150 e 200 mg L-1) promoted on average 3.35 shoots at 130 days of cultivation. In the present work, there was no application of GA3 on the seedlings, but the result were significant at 120 days, indicating a reduction in seedling production period.

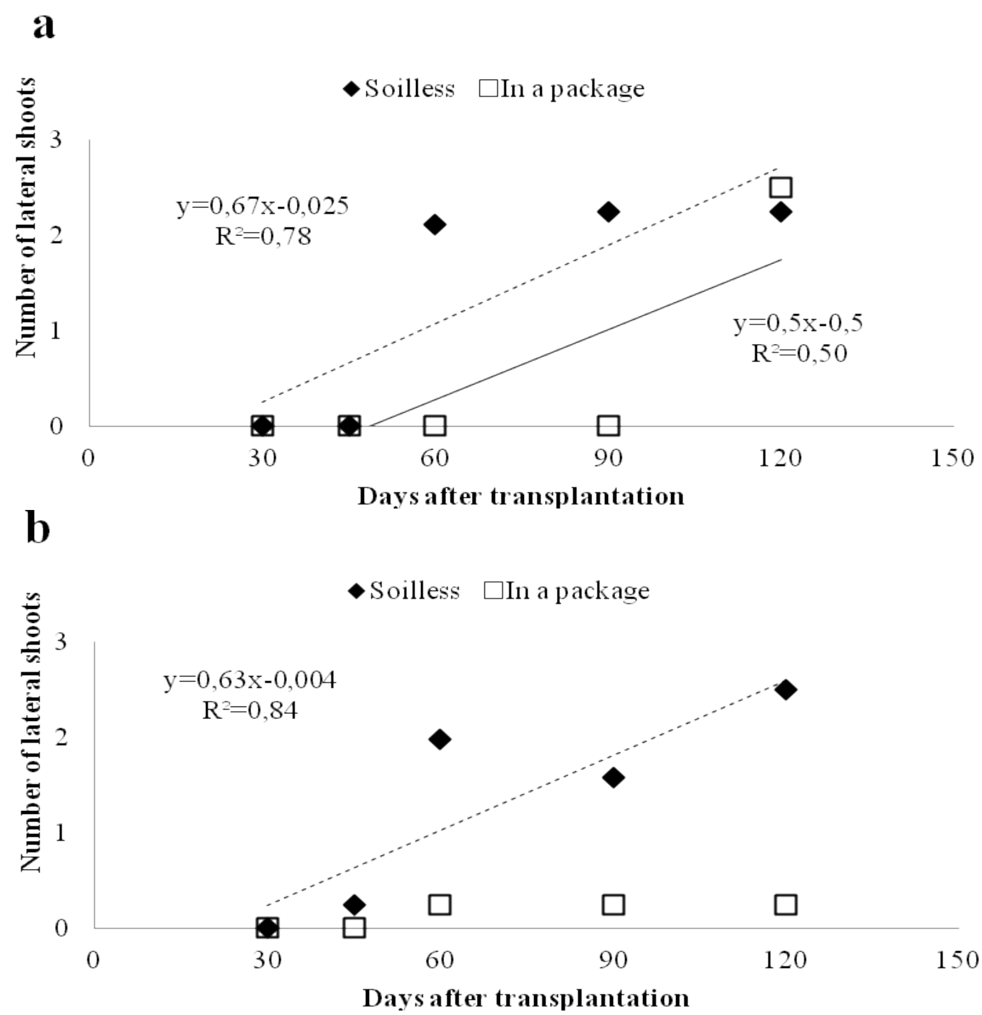

Figure 3. Number of peach seedlings lateral shoots from scion cultivar Maciel (**a**) and Bonão (**b**) self-rooted under the soilless system and in package with commercial substrate, 2011. FAEM/UFPel, Pelotas, RS, Brazil. 2013.

According to Monte Serrat et al. (2000), an important way to produce branches is through an adequate supply of nitrogen during the plant development period. Branches development is a phenomenon verified only under determined physiological conditions, showing a dynamics of highly diverse response.

By using 40cm of lengths as a criterion for the commercially ready plant, self-rooted seedlings from cultivars Maciel and Bonão reached half this length in only 165 days from the beginning of the rooting process in a greenhouse, without the use of grafting. Tis seedlings production period is rather inferior to that observed for the production in seedbeds and greenhouses, under the country's Southern conditions, using grafting on rootstocks produced from the seeds. According to Fachinello et al. (2005) and Chalfun and Hoffmann (1997), the grafting method most used for propagation in peach culture is the yolk through active bud carried out during the Spring-Summer period, which allows for seedling development with approximately 14 months.

CONCLUSIONS

Cultivar Maciel shows greater percentage of rooting and survival after transplantation than te Bonão cultivar.

At 120 days after transplantation to the farming system, the self-rooted seedlings from cultivars Maciel and Bonão reached half of the length of a commercially ready seedling.

The soilless cultivation system promotes better peach self-rooted seedlings development in relation to the production in packages.

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