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Rooting of japanese apricot mini-cuttings with indolebutyric acid

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ABSTRACT

The use of rootstocks originated from sexual propagation results in serious problems for peach culture, being vegetative propagation an important alternative to minimize these problems partially. Among vegetative propagation methods, the use of mini-cuttings constitutes an innovation against the conventional mini-cutting method, which, in some species, have promoted an increase in productivity, uniformity and rooting percentage. Thus, the objective of the present work was to evaluate the viability of Japanese apricot propagation through herbaceous mini-cuttings, by testing different concentrations of IBA (0, 1.000, 2.000 e 3.000 mg.L^{-1}) and types of mini-cuttings (apical, median and basal), in a completely randomized design with four replications. Prepared with two buds and a leaf cut in half, with two lesions on the basis, they were immersed in IBA solution, for 10 seconds, and placed in transparent, articulated plastic packages with vermiculite growing medium. Next, they were placed in a greenhouse under controlled temperature. Sixty days after installation, the percentage of rooted mini-cuttings, number and length of the three largest roots were evaluated. During rooting, the apical, median and basal mini-cuttings showed higher percentage using 1.000 mg.L^{-1} of IBA.

Key words: *Prunus persica*, fruit growing, rooting.

INTRODUCTION

The Japanese apricot (*Prunus mume* Sieb. Et Zucc.), a deciduous fruit plant originated from China, is largely cultivated in the Asian countries, especially in Japan. This rosacea carries important agronomical characteristics such as rusticity, resistance to pests, adaptability to mild winters and high productivity, considering that some selections from the Agronomic Institute of Campinas (IAC) reach 100 kg/plant (Campo Dall'orto et al., 1995/1998).

The use of rootstocks originated from sexual propagation is one of the main problems faced by peach culture in Brazil, reflected by the lack of plant homogeneity, compromising orchard production and longevity. Despite important advances in scion genetic breeding, research in the area of rootstocks are scarce, which can be attested by the lack of recommended clonal cultivars (Mayer et al., 2007).

In this context, vegetative propagation would be an important alternative for genetic material uniformity maintenance, guaranteeing plants homogeneity, considering that, in forestry, this kind of propagation is already a reality, mainly for *Eucalyptus* sp., one of the most developed and established. Based on results in the field, this type of propagation was implemented intensively in different regions around the world (Xavier et al., 2009). The main advantages are the low cost, the need of a small area for the propagation, the absence of intermittent nebulization and, due to the small size of the mini-cuttings, high yield per parent plant. In fruit species, the reduction in mini-cutting size can also be used successfully associated with other techniques (Carvalho et al., 2007).

In this technique, several factors may affect the development of roots: parent plant vigor, age and position of the branches, presence of leaves and buds, period of the year, temperature, humidity, light, substrate, growth regulators application and type of mini-cutting, among others. As the tissue chemical composition varies along the branch, cuttings originated from different portions of the branch tend to differ in regards to rooting (Fachinello et al., 2005).

Besides choosing the type of mini-cutting, another way to try to maximize rooting percentage is through the exogenous application of growth regulators. However, it may bring positive or negative effects to the process of rooting in vegetative propagules, being the indolebutyric acid (IBA) the most used, varying in application forms, which can be done via talc and liquid and most recently, via gel (Brondani et al., 2008).

The IBA is probably the main synthetic auxin of general use, since it is not toxic for most plants, even in high concentrations (Lone et al., 2010). Therefore, it is one of the most used by seedlings producers due to the results obtained and easy manipulation.

Based on these aspects, the objective of this work was to evaluate the effects of different types of mini-cuttings and IBA concentrations in Japanese apricot rooting.

MATERIAL AND METHODS

The work was conducted at the FAEM/UFPel/RS Department of Phytotechnology greenhouse, under the constant temperature of 25°C±2°C, in the winter and summer of April 2015. The study adopted a completely randomized design in the following factorial arrangement: type of mini-cutting (apical, median and basal) and IBA concentrations (0, 1,000, 2,000 or 3,000 mg.L^{-1} with four replications of 20 mini-cuttings, a total of 12 treatments.

Japanese apricot herbaceous branches were collected from a one-year-old parent plant conducted in a semi-hydroponic system and maintained in an agricultural greenhouse at the Federal University of Pelotas Fruit Plants Propagation Laboratory. Herbaceous mini-cuttings of 3-5 cm were prepared with two buds and a leaf cut in half, in bevel at the top and transversal at the basis. With the help of a penknife, two superficial lesions were made at the basis (0,5 cm) and, and then immersed in indolebutyric acid (IBA) for ten minutes, dissolved in ethanol at 30%, and the remaining volume filled with distilled water.

Next, they were packed in articulated, transparent plastic bags with 22 x 14 x 10 cm of length, width and height, respectively, containing expanded fine vermiculite (volume of 1 dcm^3), previously moistened with 500 mL of distilled water. Whenever necessary, they were sprinkled with water, leaving them closed to prevent dehydration and removing the dead mini-cuttings constantly to avoid contamination. The fungicide Orthocide (3g L^{-1} of the commercial product in water) was applied weekly.

At 60 days after installation, the percentage of rooted mini-cuttings and the number and length of the three largest roots were evaluated (measured with a millimeter ruler).

Data were analyzed in regards to normality by the Shapiro-Wilk test, to homocedasticity by the Hartley test and residues independence was verified graphically. Next, data were submitted to an analysis of variance ($p \leq 0.05$). Mini-cutting type effect was evaluated by the Tukey test ($p \leq 0.05$), when statistical significance was detected. In regards to the IAB concentration factor, a regression analysis was conducted to choose the best data adjustment, based on the significance and regression coefficient.

RESULTS AND DISCUSSION

There was an interaction among the evaluated factors for rooted mini-cutting variables and average length of the three longest roots, indicating that they are dependent. A simple effect was verified for the IAB dosages for the number of roots variable. There was also an increase in rooting percentage with the use of IAB (Table 1).

Table 1. Percentage of rooted Japanese apricot minicutting in function of branch types and IAB concentrations, Pelotas/FAEM-UFPel, 2016.

Branch type	Percentage of Rooted Minicuttings			
	IAB (mg.L^{-1})			
	0	1000	2000	3000
Apical	10 Ba[1]	70 Aa	64 Aa	70 Aa
Median	11 Ba	69 Aa	61 Aa	62 Aa
Basal	12 Ba	41 Ab	24 ABb	22 ABb

[1]Lowercase letters in the column and uppercase letters in the line show the significant difference at 5% of probability by the Tukey test.

No statistical difference was detected for apical and median mini-cuttings in all tested concentrations, and they showed a quadratic behavior by the regression analysis. All mini-cutting types showed greater rooting percentage with 1.000 mg L^{-1} of IAB (Figures 1, 2, 3 and 4). According Fachinello et al. (2005), tissue chemical composition varies along the branch, and mini-cuttings originating from different portions of the branch tend to differ in regards to rooting. In general, cuttings collected in the branch apical position shows lower degree of lignification, meristematic cells with more active metabolism and absence or low amount of phenolic compounds, facilitating rooting and shoots emission (Hartman et al., 2011). Consequently, apical mini-cuttings, probably due to this finding, have resulted in greater rooting percentage (70%) with concentrations of 1.000 and 3.000 mg L^{-1} of IAB. Fachinello et al. (2005), working with peach trees, stated that, along the branch, carbohydrate and rooting inhibiting and promoting substances contents in the tissues show variation, being one of the reasons why mini-cuttings collected from different branch portions tend to differ in regards to rooting potential.

According to Hartmann et al. (2011), depending on the position of the branch from which mini-cuttings were removed, they present different physiological conditions and may show greater carbohydrates, nitrogen substances, amino acids, auxins and phenolic compounds contents. Such compounds, when in adequate proportions and concentration, they accumulate in the root regeneration zone, contributing to the emission of adventitious roots. According to Figure 1 to 4, with the results obtained from the absence of IAB for all mini-cutting types, it is possible to affirm that the level of endogenous auxins present in them was insufficient to promote rooting, showing the need to use exogenous auxins.

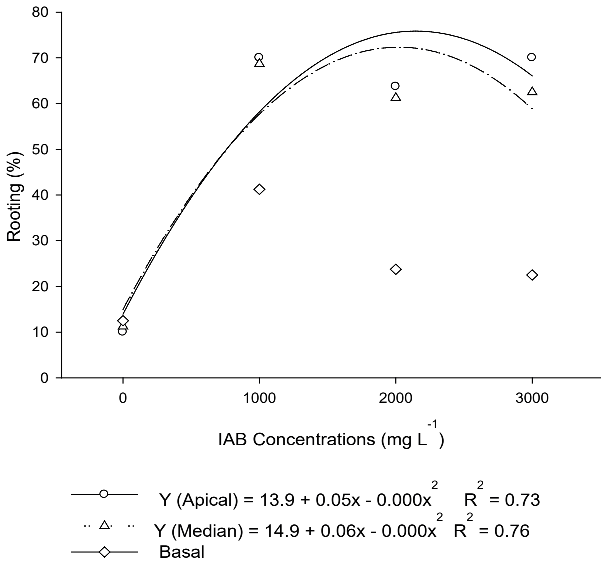

Figure 1. Rooting percentage of Japanese apricot rootstock with different IAB concentrations and minicuttings types. UFPEL, Pelotas, RS, Brazil. 2016.

Figure 2. Rooted apical minicuttings from Japanese apricot rootstock. UFPEL, Pelotas, RS, Brazil. 2016.

Figure 3. Rooted median minicuttings from Japanese apricot rootstock. UFPEL, Pelotas, RS, Brazil. 2016.

Figure 4. Rooted basal minicuttings from Japanese apricot rootstock. UFPEL, Pelotas, RS, Brazil. 2016.

The endogenous auxins contents produced by the buds and leaves were insufficient for the dedifferentiation and induction to cell division. Brondani et al. (2010) emphasize that the endogenous balance between vegetal regulators has a strong influence on the Emission of adventitious roots; however, the exogenous concentrations may vary in function of the work conditions and characteristics of each genetic material.

Several works have shown the need for an exogenous application of vegetal regulators on peach tree cuttings to increase rooting percentage (Timm et al., 2015).

In regards to number of roots, there was a significant difference only for IAB concentrations, being the highest means obtained by mini-cuttings submitted to IAB application, while, without the use of the vegetal regulator, the highest mean was 1.7 (Table 2 and Figure 5).

Table 2. Number of Japanese apricot minicuttings roots in function of types of branches and IAB concentrations, Pelotas/FAEM-UFPel, 2016.

Branch type	Number of roots per minicutting			
	IAB (mg.L^{-1})			
	0	1000	2000	3000
Apical	1.0 Ba[1]	2.7 ABa	3.9 Aa	4.0 Aa
Median	1.3 Ba	3.3 Aa	4.9 Aa	3.9 Aa
Basal	1.7 Aa	3.2 Aa	3.1 Aa	3.0 Aa

[1]Lowercase letters in the column and uppercase letters in the line show significant difference at 5% of probability by the Tukey test.

Similar result was found by Chagas et al. (2008) working with Japanese apricot clones, obtaining greater average number of roots by mini-cuttings, with concentration of 2.000 mg L^{-1} of IAB. Timm et al. (2015), assessed the rooting of Okinawa herbaceous mini-cuttings and found 9.04 roots per mini-cutting with 2.000 mg L^{-1} of IAB. They consider this a good result to guarantee the development of an adequate root system.

Results from the present study showed that, in the case of the Japanese apricot, the use of vegetal regulator stimulates roots emission and rooting potential is variable among the mini-cutting types evaluated. Not all mini-cuttings rooted at the same proportion and amount, and, probably, these characteristics are also influenced by the rootstock genetics and mini-cutting type testes in this experiment.

IAB and mini-cutting type interacted significantly for the three largest roots average length (Table 3). With 2.000 mg L^{-1} of AIB, apical and median mini-cuttings showed the longest root (3.9 and 3.8cm, respectively), while basal mini-cuttings resulted in longer roots without the use of IAB (3.5cm) (Figure 6). It is known that tissue chemical composition varies along the branch, causing differences originating from different parts; probably, in this case, this variable was not influenced by the IAB. Although root number and length are related to survival capacity and plant development, there is no adequate amount to be compared.

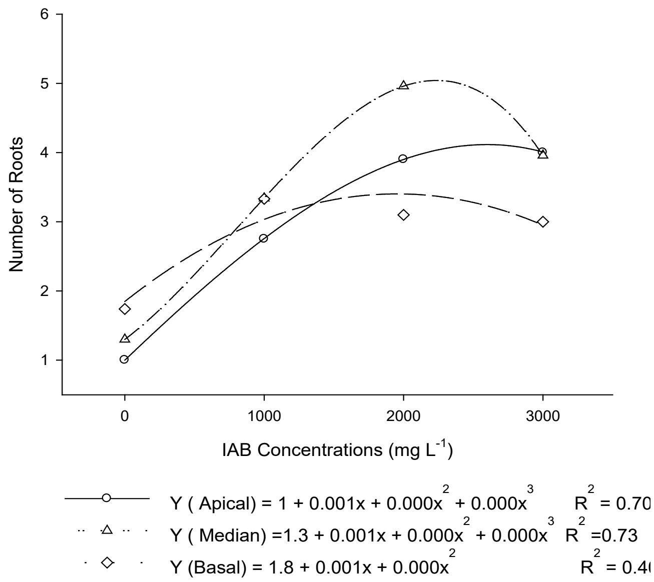

Figure 5. Number of Japanese apricot minicutting roots in function of IAB concentrations and minicutting types. UFPEL, Pelotas, RS, Brazil. 2016.

Table 3. Average length of Japanese apricot minicuttings roots in function of branch types and IAB concentrations, Pelotas/FAEM-UFPel, 2016.

Branch type	Average roots length by minicutting			
	IAB(mg.L^{-1})			
	0	1000	2000	3000
Apical	1.34 Ba[1]	3.82 Aa	3.90 Aa	3.13 ABa
Median	1.78 Ba	3.55 Aa	3.87 Aa	3.51 Aa
Basal	3.47 Aa	3.42 Aa	3.10 Aa	2.71 Aa

[1]Lowercase letters in the column and uppercase letters in the line show significant difference at 5% of probability by the Tukey test.

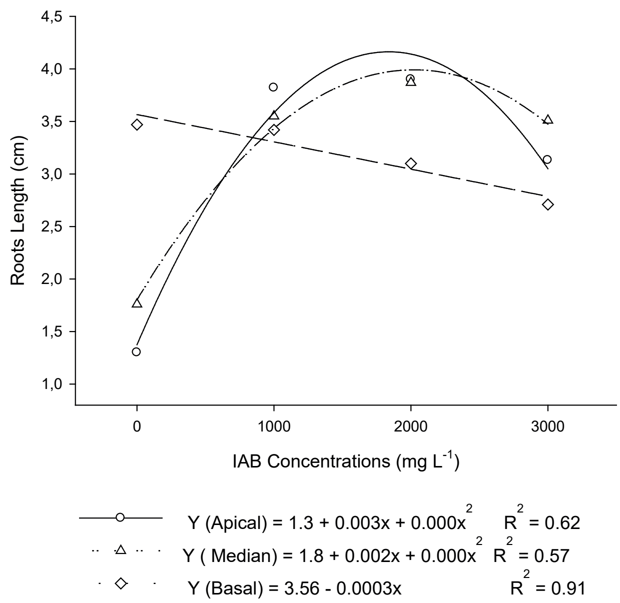

Figure 6. Average length of the three largest Japanese apricot minicutting roots in function of different IAB concentrations and minicutting types. UFPEL, Pelotas, RS, Brazil. 2016.

An important aspect of rooting studies refers to the joint analysis of root number and length variables. Since it is not practical for a mini-cutting to produce a single long root or several short roots. Therefore, a determined condition or treatment should be found that would result in a balance between these variables, i.e., a mini-cutting that produces several roots with good growth in a short period of time, which increases survival chances.

CONCLUSIONS

Different concentrations of indolebutyric acid promote favorable results in all types of Japanese apricot mini-cuttings, for all analyzed variables.
The use of 1,000 mg $L^{-1}$of IAB is the most recommended for apical, medial and basal mini-cuttings.
Apical and median mini-cuttings showed higher rooting percentages.

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