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Rooting of Herbaceous cuttings of Allamanda cathartica L. treated with gibberellic acid

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Abstract:

This study aimed to evaluate the effect of four concentrations (500; 1000; 2000 and 4000ppm) of gibberellic acid (GA3) to induce rooting in alamanda (Allamanda cathartica L.) stem cuttings (herbaceous). The cuttings were collected from existing plants in the landscaping area of the IFPA – Campus Castanhal, cut into a bevel, with approximately 10 cm from each cutting, which were treated with gibberellic acid in order to induce rooting. The experimental design used was in randomized blocks, with 4 treatments and three replications. The evaluations were carried out at the end of 40 days, after planting.Number of roots, root length, cutting survival and percentage of cuttings rooting were evaluated. For the parameters number of roots, root length and percentage of rooting, statistical differences were observed, highlighting the treatment with 2,000ppm of gibberellic acid with the best results. It is concluded that gibberellic acid influences the rooting of alamanda cuttings.

Keywords: Rooting; alamanda, gibberellic treatment

INTRODUCTION

Alamanda (*Allamanda cathartica* L.), belonging to the Apocynaceae family, was cataloged in 1771 by Carl Linnaeus (SILVA, 2007). It is native to the Brazilian Atlantic Forest (CRESPO, 2012), popularly known as 'yellow alamanda', 'carolina' and 'dedal-de-dama' (LORENZI; SOUSA, 1999). It is characterized as a climbing and semi-woody subshrub that blooms in spring and summer (LORENZI; MATOS, 2002).

Alamanda is a species widely used as ornamental plant, generally used to form hedges, as it is a vine and has bright gold yellowflowers. Another attractive aspect with desirable characteristics in landscaping is its simple, bright green leaves. It is a species that needs a lot of light, so it should be cultivated under full sun, in addition to needing fertile soil and frequent watering (LORENZI; SOUZA, 2001). Its propagation occurs mainly by cuttings (OLIVEIRA et al., 2007).

Cutting is a method of vegetative propagation widely used in the production of seedlings, as it allows uniformity, precocity, and health of the seedlings, guarantee of the genetics of the mother plant and production of many seedlings produced from a single plant (VILARINHO; CÂNDIDO, 2014, HARTMANN et al., 2002). However, the success of seedling production by cuttings depends on a series of factors, such as: physiological conditions and age of the mother plant, type of cutting (herbaceous, semi-woody and woody), environmental conditions, and substrate used (MONTEGUTI et al., 2008).

One way to increase the performance of cuttings in the emission of the root system is the use of synthetic plant hormones, known as plant growth regulators (BOLIANI; SAMPAIO, 1998). Growth regulators are synthetic products based on organic compounds that induce in plants the same or similar effects to the plant hormones produced naturally by plants.These organic compounds induce morphological and physiological changes in the plant (CAPUTO et al., 2008, AWAD; CASTRO, 1983).

According to Ribeiro et al. (2006) there are two main groups of growth regulators, they are: indolebutyric acid, one of the main rooting stimulators (FERRIANI et al., 2006) and gibberellic acid, which mainly influences shoot elongation (RIBEIRO et al., 2006). ., 2006).

Vilarinho and Cândido (2014), studying the effect of a bioregulator on the rooting of erythrin-green-yellow (*Erythrina indicapicta*) cuttings, did not observe a statistically significant difference in the number of rooted cuttings among the treatments. In contrast, Lucas et al. (2019) studying the growth of sugarcanemultibuds setts under doses of indolebutyric acid and gibberellic acid, found that there was no significant difference between the dry root masses in the treatments with gibberellic acid and indolebutyric acid. At the same time, Silva et al. (2019) found similar results in their study on sprouting and root system development of sugarcanemultibuds settsunder different doses of indolebutitic acid and gibberellic acid and immersion times. These studies demonstrate the potential of gibberellic acid for use as a rooting stimulator.

The literature reports the use of the growth regulator, indolebutyric acid (IBA), to favor hormonal balance and stimulate rooting (FERRIANI et al., 2006). However, there are few studies using gibberellic acid (GA3) for rooting induction purposes in the production of seedlings by cuttings.

In this context, the present study aimed to evaluate the effect of four concentrations of gibberellin (500, 1000, 2000 4000 ppm) of gibberellic acid

(Progibb 400) to verify the rooting capacity of herbaceous (Subapical) cuttings of *A. cathartica L.*

MATERIAL AND METHODS

The present study was carried out in a greenhouse and analyzed in the soil laboratory, located at the Federal Institute of Education, Science and Technology of Pará, Campus Castanhal,from January 29th to March 28th, 2018.

The greenhouse was of the chapel model, 12.0 m long, 4.5 m wide and 3.5 m high, arranged east-west, with a wooden structure and 70% shade cover.

The branches of *A. cathartica L.* were obtained from 2-year-old matrices, located at theCampus and were collected in January 2018. From the median portion of these, herbaceous cuttings (subapical with one leaf) were made, with 15 cm in length and 3.2 mm in diameter. To prepare the cuttings, a straight cut was made at the apex and in a bevel at the base, leaving a leaf in the apical portion with its area reduced to half. During this process, the cuttings were kept in a container containing water to avoid dehydration. Subsequently, the phytosanitary treatment was carried out by immersion for 10 minutes in 0.5% sodium hypochlorite, and the cuttings were subsequently washed in running water for another 10 minutes.

The cuttings were then subjected to treatments with gibberellic acid (GA3) at concentrations of 500mg L^{-1}, 1,000 mg L^{-1}, 2,000 mg L^{-1}, 4,000 mg L^{-1}or mg Kg^{-1}, in a 50% hydroalcoholic solution, v/v, for 10 seconds of immersion and in talc. Subsequently, the cuttings were planted in polypropylene pots with a capacity of 40 cm^3, containing fine-grained washed sand as substrate, being kept in a humid chamber with low density polyethylene plastic (LDPE) to maintain the relative humidity (approximately 80%) and controlled temperature, inside the greenhouse, with daily irrigations, once a day by sprinkling. Thecompletely randomized experimental design was used, with three replications of 10 cuttings per experimental unit, totaling 30 cuttings per treatment.

The experiment was evaluated after 45 days, and the following characteristics were analyzed: rooted cuttings (cuttings with roots of at least 1 mm in length); number of roots per cutting (total roots emitted); length of roots per cutting (length of the three longest roots formed by cutting, in cm) and live cuttings (live cuttings that did not present root induction or callus formation).

Data were evaluated for homogeneity of treatment variances using the Bartlett test. Then, the analysis of variance (ANOVA) and aF test was applied and, when significant, the data were submitted to Tukey's mean separation test ($p<0.05$).

RESULTS AND DISCUSSION

Regarding the different concentrations of gibberellic acid, significant differences were observed for the number of roots, root length and survival of cuttings, however for the percentage of survival parameter, no effect of treatments was observed in the linear and quadratic equations (Table 1). In the four treatments applied, the concentration of IBA 2,000 ppm showed the highest percentages for number of roots, root length and survival of cuttings; this behavior demonstrates that AIB is efficient to induce rooting in cuttings of*A. cathartica L.*, under the conditions of the experiment.

Loss et al. (2008), studying the rooting of cuttings of *A. cathartica L.* with herbaceous, semi-woody and woody cuttings, collected in the summer and with different concentrations of IBA (0, 4,000 and 8,000 ppm), observed the best results for semi-woody and woody cuttings with 8,000 ppm of IBA, and the herbaceous cuttings showed lower averages for the analyzed parameters, confirming that regardless of the plant regulator used (AIB or GA3) herbaceous cuttings of *A. cathartica L.* concentrations below 4,000 ppm are more suitable. Vilarinho et al. (2014), working with the effect of bioregulator on the rooting of *Erythrina indicapicta* cuttings (tip, median, and basal) reported that the use of indole butyl acid and gibberellic acid did not influence rooting.

Muniz et al. (2015), evaluating rooting and fresh mass production in tango apical cuttings using AIA and AIB, did not observe any influence on the survival of cuttings and the percentage of rooted cuttings, but the dose of 2,000 ppm of AIA caused an increase in the rooting speed in tango cuttings.This result demonstrates that the use of auxins or gibberellin promotes the rooting of herbaceous cuttings of some plants, and the main limiting factor will be other factors, with plant part, concentration of the regulator, and endogenous characteristics of the plant.

Table 1. Summary of analysis of variance for percentages of rooting (ROOT), number of roots (NUM), length (LEN), survival (SUR) in herbaceous cuttings from *Allamandacathartica*L. under different concentrations of the plant regulator gibberellic acid (GA3).

TRATAMENTOS	NUM	LEN (cm)	SUR (%)	ROOT (%)
500 (mg L^{-1})	7.20 ab	5.05 b	76.66 a	70.00 ab
1000 (mg L^{-1})	6.50 ab	5.63 b	86.66 a	73.33 ab
2000 (mg L^{-1})	13.93 a	9.50 a	96.66 a	96.66 a
4000 (mg L^{-1})	3.80 b	4.55 b	70.00 a	50.00 b
C.V[1] (%)	9.66	15.66	35.14	14.24
O.A[2]	7.86	6.18	82.50	72.50

*Means followed by the same letter do not differ from each other by the Tukey test ($p<0.05$). [1]C.V= Coefficient of variation. [2]O.A= Overall average.

In this way, gibberellic acid can be used as a rooting inducer in herbaceous alamanda cuttings, with a concentration of 2,000ppm being the most suitable for rooting.

Winhelmann et al. (2015), investigating the rooting of *Angeloniaintegerrina*Sprengel apical cuttings (Herbaceas) with different concentrations of IAB (0, 500, 1,000, 2,000 and 4,000 ppm) did not observe significant differences for the parameters number of rooted cuttings, shoot and root systemlength, number of new leaves, root system volume, callus formation and root and aerial dry mass. Demonstrating that the use of plant regulators will depend on co-factors, existing in the plant and buds (adaxial and apical), favorable to vegetative propagation by cuttings, Taiz and Zeiger (2013), with a low amount of rooting inhibitor substances and that its rooting becomes more efficient when promoting substances such as gibberellin and auxin are used.

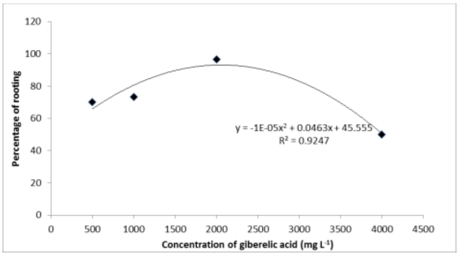

Figure 1. Percentage of rooting in cuttings of *A. cathartica L.* subjected to different concentrations of indolebutyric acid (IAB).

Regarding the rooting percentage variable, a quadratic behavior of the regression curve was observed (Figure 1), with the highest rooting percentage (96.66 %) in the treatment with 2,000 ppm of gibberellic acid, and from the dose of 2,000 ppm it started decreasing trend in the rooting capacity of herbaceous cuttings of alamanda. Meneguzzi (2015), studying the IAI effect with different concentrations (0, 1,000, 2,000, 3,000 and 4,000 mgL^{-1}) observed results similar to the present study, where a similar quadratic behavior was observed, where the treatment with 2,000 ppm presented the highest percentage of rooting (60%). The downward trend in rooting percentage with increasing concentration of AIA, IBA or gibberillin may be related to the phytotoxic effect of synthetic plant phytohormones. Cunha et al. (2004) studying *Sapiumglandulatum*Vell. Pax cuttings with the use of synthetic auxins found that there was a reduction in the rooting capacity of the cuttings with the increase in IBA and naphthalene-acetic acid (ANA) concentrations. Such an effect is possibly due to the toxic effect that the phytoregulator can cause.

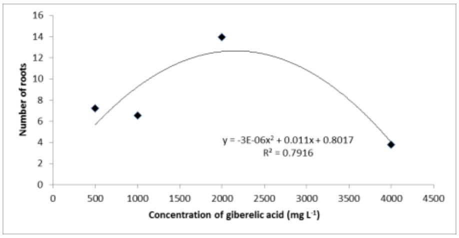

Figure 2. Number of cuttings roots of *Allamandacathartica*L. subjected to different concentrations of gibberellic acid.

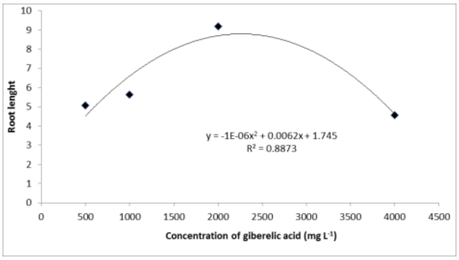

Figure 3. Length of roots in cuttings from *Allamandacathartica*L. subjected to different concentrations of gibberellic acid.

For the number of roots (Figure 2) and root length (Figure 3) present in *A. cathartica L.* 93) respectively, and, like the rooting percentage, there was a tendency to reduce the length and number of roots with increasing concentration of gibberellin. In addition, the wet chamber system provided constant humidity conditions, considerably reducing water loss through transpiration.

CONCLUSIONS

The herbaceous cuttings of alamanda in the treatment with 2,000 ppm of gibberellic acid, presented the best results for number of roots, length of roots and percentage of rooting, demonstrating that GA3 can be used as a rooting inducer in herbaceous cuttings of *Allamanda cathartica*L.

The concentration of 4,000 ppm, proved to be toxic for the rooting of *Allamanda cathartica*L. with gibberellic acid.

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