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Effect of indolebutyric acid on rooting and budding of cuttings of *Glyicidium sepium*

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ABSTRACT

Studies carried out with the use of gliricidia biomass found that green manure contributes to increasing the productivity of forest crops when compared to the incorporation of other legumes. This study aimed to evaluate the viability of vegetative propagation by cuttings in the development of rooting and budding of *Glyicidium sepium* in different concentrations of indolebutyric acid (IBA). The experiment was carried out in a greenhouse with an entirely randomized block design and increasing concentrations of IBA 0, 625, 1250, and 3000 mg.L^{-1} with six replicates. The cuttings were standardized in length and diameter, then treated with sodium hypochlorite and immersed in different concentrations of IBA. The parameters plant evaluated were the sprouts number, sprouts length, sprouts diameter, sprouts dry weight, and roots dry weight. The concentration of IBA was shown to be effective in increasing all parameters studied at the IBA concentration of 2100 mg.L$^{-1,}$ and the higher concentrations did not offer any cost-benefit advantages for the production of gliricidia by cutting.

Keywords: Auxins, aerial biomass, root system, vegetative propagation.

Introduction

Gliricidia (*Gliricidia sepium* (Jacq.) Kunth ex Walp.) is a tree legume fast-growing, drought-tolerant used as green manuring and forage, reforestation, hedgerow, among others (Kaba et al., 2019). For these purposes, the species has been cultivated in the cacao region of Bahia for several years and was introduced in the 1990s in the states of Sergipe, Pernambuco, and Ceará. It is currently being cultivated throughout tropical Brazil (Primo et al., 2018). Studies in other regions of the world have found that the use of gliricidia biomass as green manure contributes to increasing the productivity of forest crops when compared to the incorporation of other legumes due to its high rate of nitrogen mineralization (Silva et al., 2013).

Vegetative propagation through cuttings is one of the most important methods of macropropagation (Giraldo et al., 2015). In this sense, the cutting has some advantages such as obtaining, in a short time, a large number of seedlings from a single matrix plant, an efficiently executed technique, does not present problems common to other vegetative propagation processes such as the incompatibility between grafting and rootstock (Araujo-Filho et al., 2013).

Some substances contribute to a higher rate of root growth on cuttings of species with a low level of rooting. The complementation of the endogenous auxin levels is often necessary with a phytoregulator, with IBA being the most used for this purpose (Veras et al., 2018). The application of auxin also contributes to a higher rate of formation, quality, and uniformity of the root system (Oliveira et al., 2018).

In order to overcome the difficulties in rooting of some plant species, it is necessary, in many cases, the application of phytorelevators for the acceleration of rooting. Among these, auxins, especially IBA, are indicated, and however, there are still difficulties for its recommendation, and several studies are necessary to indicate the need and concentrations of the hormone. This study aimed to evaluate the viability of vegetative propagation by cuttings in the development of rooting and budding of *Glyicidium sepium* in different concentrations of IBA.

Material and Methods

The experiment was conducted in a greenhouse for 150 days at the Departmento de Energia Nuclear of the Universidade Federal de Pernambuco, in Recife, Pernambuco state. Three concentrations of the IBA diluted in deionized water were used, constituting the following treatments: T1 - witness without indolebutyric concentration, T2 - 625 mg.L^{-1}, T3 - 1250 mg.L^{-1}, and T4 - 3000 mg.L^{-1} in a completely randomized design with six replicates in polyethylene plastic bags containing three kilograms of soil classified as Neossolo regolítico (Embrapa, 2018) and increasing concentration of IBA. The soil was collected at a depth of 20 cm, air-dried at room temperature, and then sieved in a 2 mm mesh. Chemical analyses were performed for the characterization (Table 1), according to the method described by Embrapa (2017).

Table 1. Chemical characterization of soil classified as Neossolo regolítico,

pH	**P**	**Na**	**K**	**Ca**	**Mg**	**Al**	**H+Al**	**OC[(1)]**
Water	**mg.dm^{-3}**	**------------------------cmol$_c$.dm^{-3}-----------------------**						**g.kg^{-1}**
2,5	20	0.05	0.25	1.5	1.4	0.1	3.5	11

[(1)] Organic carbon soil.

The gliricidia cuttings 40 cm used in the treatments were collected in the municipality of Itambé PB, at the IPA Experimental Station (Pernambuco Institute of Agronomic Research). In choosing the trees for the collection of the cuttings, we will try to identify those more vigorous, avoiding trees that are not well developed or that present occurrence of diseases.

The cuttings were collected in the region of the base, which is baseless cuttings without leaves of individuals with lengths of 15 and 20 cm, and a diameter between 0.5 and 1.5 cm. After collection, they were placed in containers with water so that no loss of moisture occurred, being carried out in all cuttings cutting straight at the apex and beveled at the base and at the time of planting treated with 1.0% sodium hypochlorite for one minute and then immersed in the concentrations with different concentrations of IBA for 15 seconds.

The treatments were irrigated with 50 ml of water every two days based on soil field capacity, and the evaluations of the effect of the different concentrations were performed at one hundred and twenty days after the experiment was set up. The parameters plant evaluated were the sprouts number, sprouts length, sprouts diameter, sprouts dry weight, and roots dry weight. The dry matter of sprout and sprout roots was obtained after drying in a forced circulation oven at 65ºC for 72 hours and weighing on an electronic scale with an accuracy of 0.0001 g.

The experimental design was a completely randomized design with six replicates and four IBA concentrations totaling twenty-four plots. The results were submitted to analysis of variance (ANOVA) and, depending on the level of significance of the test F. A polynomial regression study was performed, choosing the model that best suits the concentrations used. The data were statistically analyzed using the statistical program Sisvar (Ferreira, 2019).

Results

The parameter analyzed for sprouts number presented the best fit for the quadratic regression model. The sprout number at the maximum concentration obtained in the equation of 1875 mg.L^{-1} showed an increase in the sprout number corresponding to 5.44 units in the gliricidia cuttings (Figure 1).

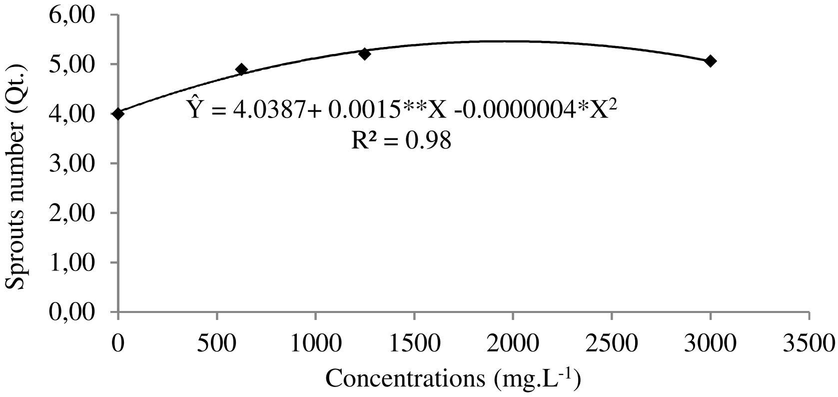

Figure 1. Number of sprouts of gliricidia cuttings in the function of hormone concentrations. Significant at *P < 0.05, **P < 0.01.

The values of the variables sprouts length and diameter were adjusted to the quadratic model. These variables had a maximum concentration of 1662.5 and 1571.4 $mg.L^{-1,}$ respectively, yielding a sprout length of 21.01 cm and sprout diameter 4.5 cm (Figures 2 and 3).

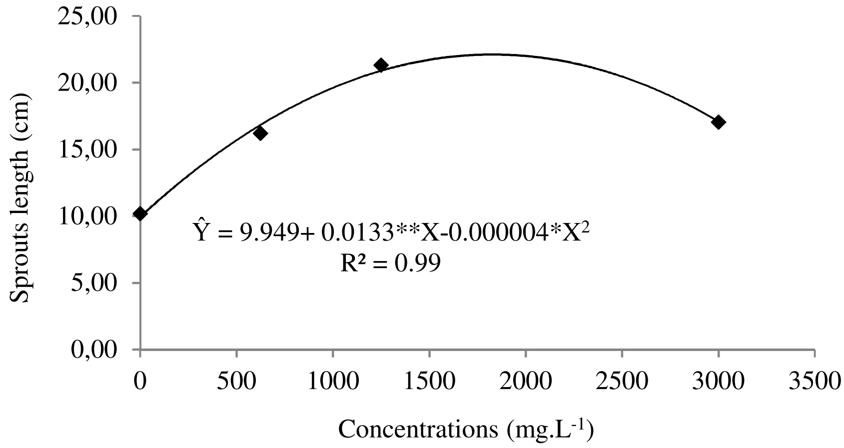

Figure 2. Sprouts length of gliricidia cuttings in the function of hormone concentrations. Significant at *P <0.05, **P <0.01.

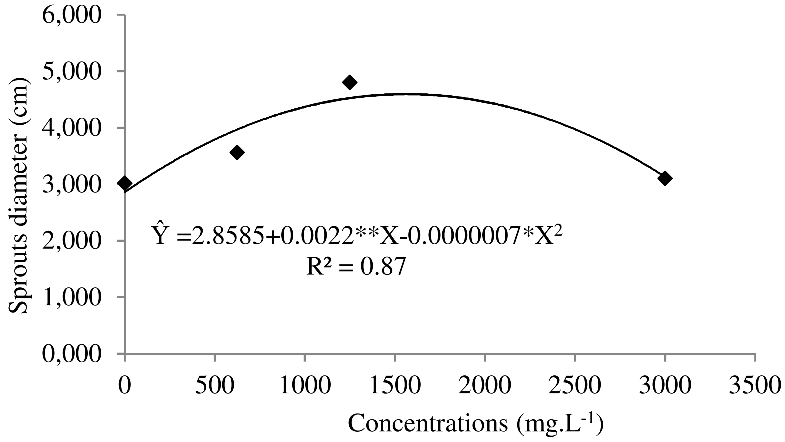

Figure 3. Sprouts diameter of gliricidia cuttings related to hormone concentrations. Significant at *P < 0.05, **P < 0.01.

It was observed a small tendency to occur a higher sprouting percentage in cuttings 20 cm long and 4 cm in diameter. The increase in concentrations showed a significant increase in the length and diameter of sprouts and concentrations from 3000 $mg.L^{-1}$ showed phytotoxicity characteristics.

The most expressive result was found in the quadratic model of this parameter and was identified in the 1725 mg.L^{-1} concentration in the gliricidia cuttings, showing that the application of IBA provided a positive effect on sprout dry matter production in 11.68 g (Figure 4).

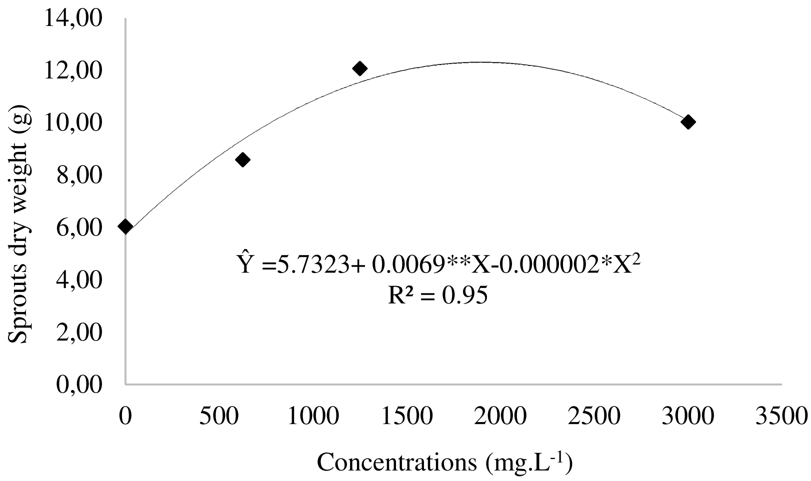

Figure 4. Sprout dry matter of gliricidia cuttings in the function of hormone concentrations. Significant at *P < 0.05, **P < 0.01.

Therefore, the results showed that the dry matter production of the roots of gliricidia had a significant effect over hormone concentrations. As shown in Figure 5, the regression equation of the dry matter production with the concentrations presented adjustments to the quadratic model. Considering the regression equations, it was verified that with an increase of the concentrations decreased the dry matter production of the root. The maximum concentration of 2100 mg.L^{-1} of IBA was obtained, in this way it is denoted that the production of 10.92 g of the root mass. As the concentrations of the hormone increase, the dry mass of the roots of the cuttings decreases.

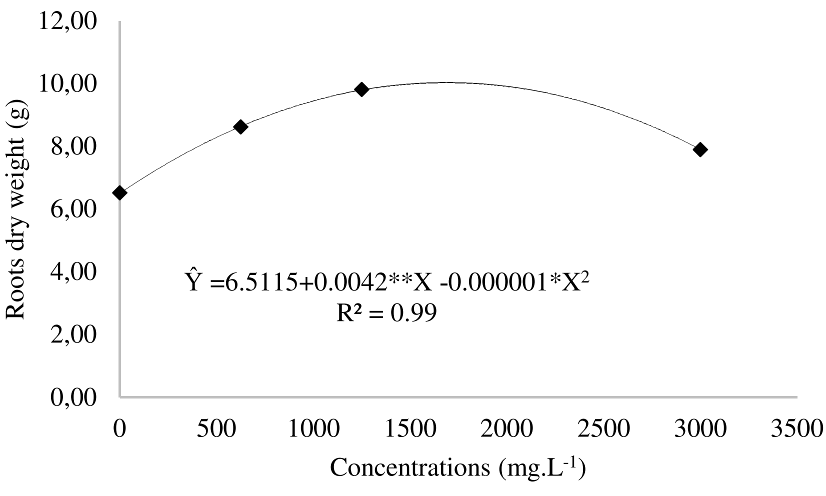

Figure 5. Root dry matter of gliricidia cuttings in the function of hormone concentrations. Significant at *P < 0.05, **P < 0.01.

Discussion

In a high concentration of IBA, the cuttings of gliricidia presented a reduced percentage of sprouts, evidencing a probable phytotoxicity, which can also be observed in the work of Yamamoto et al. (2010), where very high concentrations of IBA were used, causing phytotoxic effects, such as inhibition of bud growth, and even death of cuttings. According to Fachinello et al. (2005) reported that the increase of the auxin concentration, applied on cuttings, stimulates sprouts up to a particular maximum value and an increase in the concentration of the phytorregulator has an inhibitory effect.

Different results of Pereira-Junior et al. (2008) observed average values around 0.20 units using cuttings of 20 cm in length without application of IBA concentrations. Martins et al. (2012) obtained mean values of 0.17 units with cuttings of 25 cm in length. It is probably related by the amount of nutritional reserves of the cuttings and by the weak development of the root system of these seedlings. According to Rickli et al. (2017), the use of adequate concentrations of IBA can help in physiological reactions of the species, favoring better conditions for rooting and development of the plants, providing greater organ lengthening.

The IBA favors the growth of seedlings, due to the fact that the auxins promote better development, provide higher percentage, speed, and quality of the root system, varying according to the species (Botin & Carvalho, 2015). It occurs since the exogenous supply of auxin, in certain amounts, promote a hormonal alteration which favors the rooting of cuttings.

According to Sutili et al. (2018), auxins are the most used growth regulator, being essential in the rooting process, promoting the formation of roots. The rooting of *Eucalyptus* sp., Performed by Girijashankar (2012), determined that the application of IBA was the most indicated for vegetative propagation, being the dosage according to the species used. According to Amaro et al. (2013) part of the dry matter accumulated by the plants is the result of the absorption of nutrients, in this way, the increase of the dry matter is directly related to the rooting and the utilization of the reserves of the storage tissues.

Pizzatto et al. (2016), using three forest species, observed that cuttings of *Hibiscus rosa-sinensis* L. cv. Snow Queen, with IBA applications showed a higher number of dry mass in the root portion, and no significant effect of hormone application was observed. Oliveira et al. (2018) obtained results of the non-influence of the plant regulator to the detriment of the dry mass and may be due to the genetic material and all the management adopted in the production system.

The effect of IBA application on root dry matter production has been reported in numerous studies in different crops, providing beneficial effects on the weight and quality of the root system formed (Suzuki et al., 2015). According to Neumann et al. (2018), the relation between the increase of the dry mass and the live mass is due to the stimulation of the cellular division promoted by the hormonal balance, providing the increase in the number of cells, promoting the expansion of the organ.

The development of the root system of the cuttings is important for the establishment and survival of the species in the field since the unsatisfactory development presents characteristics of nutritional deficiencies and problems in periods of water deficits (Kettenhuber et al., 2019). It is also important to note that, when no exogenous concentrations of IBA were applied, percentages above 50% of budding and rooting could be obtained, and sprouting before rooting is detrimental to the formation of roots in the cuttings.

It is assumed, therefore, that the cuttings of gliricidia produce sufficient quantities of endogenous auxins, which allow these high percentages of budding and rooting, and the species can be classified as easy vegetative propagation. The increase in sprout length was probably influenced by the nutrient reserve, and the greater number of axillary buds favoring budding (Lima et al., 2015). According to Taiz & Zeiger (2013), it is important to emphasize the root growth in formation, which are sites of synthesis of cytokinins, which are translocated to the growth points in the area, thus stimulating cell multiplication, making it possible to explain the relationship between sprouts and development of the root system on cuttings.

Conclusion

The concentration of IBA showed to be effective in increasing all variables: sprout length, number of sprouts, stem diameter of sprouts, dry matter of sprouts, and roots.

Higher concentrations of IBA 2100 mg.L^{-1} did not offer cost-effective advantages for the production of gliricidia by cutting.

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