Effect of alternative rooting inducers on Umbu-cajazeira

Efeito de indutores alternativos de enraizamento em Umbu-cajazeira

DOI: 10.55905/revconv.16n.10-312

Recebimento dos originais: 29/09/2023
Aceitação para publicação: 30/10/2023

Flávia Soares Aguiar
PhD student in Plant Production in the Semi-Arid Region
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: fsa.agronomia@gmail.com

Fábio dos Santos Brito
Graduating in Agronomy
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: fabiodossantosbritolinha2jai@gmail.com

Laila Micaele Ferreira Gonçalves
Graduating in Agronomy
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: lailagoncalves2015@gmail.com

Juceliandy Mendes da Silva Pinheiro
PhD in Plant Production in the Semi-Arid Region
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: juceliandy.pinheiro@unimontes.br

Maria Luisa Mendes Rodrigues
PhD in Plant Production in the Semi-Arid Region
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: marialuisamendes@yahoo.com.br

Gisele Polete Mizobutsi
PhD in Plant Science
Institution: Universidade Estadual de Montes Claros
Address: Janaúba - MG, Brasil
E-mail: gisele.mizobutsi@unimontes.br
ABSTRACT
The propagation by the sexual method of some species of the genus Spondias, such as the umbu-cajazeira, is practically unfeasible, due to the fact that its pit rarely contains seeds, making it necessary to propagate vegetatively by the cutting method. To enhance the rhizogenesis process, plant hormones are used, such as auxins, which results in the development of adventitious roots. In view of the above, the objective was to evaluate the effect of an alternative source of natural plant hormone on the rooting of tree cuttings Umbu-cajazeira. The experiment was carried out in the fruit seedling nursery. The woody cuttings were removed from Umbu-cajazeira in vegetative rest. After collecting and preparing the cuttings, they were subjected to immersion in the solutions of AIB, ERT, ESL, AC and Water (evidence). After 90 days, the percentage of sprouted and rooted cuttings, number of leaves and shoots and roots, length and diameter of the largest shoot and largest root, dry mass of the root system and dry mass of shoots were evaluated. The data obtained were subjected to statistical analysis using the Tukey test at 5% probability. It was observed that the use of IBA provided 94% sprouting of the cuttings. The percentage of rooting of umbu-cajazeira cuttings was significant due to the use of alternative rooting inducers and indolebutyric acid, due to considerable amounts of auxins present in the extracts, inducing rhizogenesis in the cuttings. The AIB enhances the rooting and budding of umbu-cajazeira cuttings. The lentil extract is a natural plant hormone alternative for rooting umbu-cajazeira cuttings.

Keywords: Spondias sp., vegetative propagation, cuttings, auxins.

RESUMO
A propagação pelo método sexual de algumas espécies do gênero Spondias como a umbu-cajazeira, é praticamente inviável, em virtude do seu caroço raramente conter sementes, sendo necessária a propagação vegetativamente pelo método de estaquia. Para potencializar o processo de rizogênese, utilizam-se hormônios vegetais, como as auxinas, o que resulta no desenvolvimento de raízes adventícias. Diante do exposto, objetivou-se avaliar o efeito da fonte alternativa de hormônio vegetal natural, no enraizamento de estacas de Umbu-cajazeira. O experimento foi realizado no viveiro de mudas frutíferas. As estacadas lenhosas foram retiradas de Umbu-cajazeira em repouso vegetativo. Após a coleta e preparo das estacas, estas foram submetidas a imersão em soluções de AIB, ERT, ESL, AC e Água (testemunha). Após 90 dias foram avaliadas a porcentagem de estacas brotadas e enraizadas, número de folhas e brotos e raízes, comprimento e diâmetro da maior brotação e da maior raiz, massa seca do sistema radicular e massa seca das brotações. Os dados obtidos foram submetidos a análise estatística pelo teste de Tukey a 5% de probabilidade. Foi observado que a utilização de AIB proporcionou uma 94% de brotação das estacas. A porcentagem de enraizamento das estacas de umbu-cajazeira foi significativa pelo uso de induutores alternativos de enraizamento e ácido indolbutirico, devido a quantidades consideráveis de auxinas presentes nos extratos, induzindo a rizogênese em das estacas. O AIB potencializa o enraizamento e brotação de estacas de umbu-cajazeira. O extrato
INTRODUCTION

The umbu-cajazeira is an arboreal plant, probably resulting from the natural crossing between the umbuzeiro (Spondias tuberosa Arruda) and the cajazeira (Spondias mombim L.) (Giacometti 1993). The umbu-cajazeira (Spondias sp.) presents growing socioeconomic importance for the semi-arid region, as it becomes an alternative food and economic subsistence for thousands of families, generating employment and income (Fonseca & Oliveira 2012). However, this species with great economic potential is still restricted to the local and regional market, with cultivation and production technologies that are non-existent or still very incipient.

The propagation of species of the genus Spondias is carried out commercially by the sexual method, however for some species such as the umbu-cajazeira, this method is practically unfeasible, due to the fact that its pit rarely contains seeds. The umbu-cajazeira is propagated vegetatively by the cutting method, using large cuttings, planted directly in the field, which take time to root and form the crown of the new plant. Cuttings, most of the time, produce shoots, but do not root (Souza & Araújo 1999). For the economic exploitation of umbu-cajazeira, challenges need to be faced, such as the generation of knowledge and technologies about the vegetative propagation process, aiming to identify the variables that interfere in the process and the necessary conditions for using small cuttings (Santos 2009).

The work carried out with umbu-cajazeira shows that very low rooting is achieved (Souza, 2005). Being that, Paula et al. (2007) obtained 33.30% rooting, and Santos (2009) observed a rooting percentage not exceeding 13.21%. Several factors can influence the rooting of cuttings, both intrinsic, related to the plant itself, and extrinsic, related to environmental conditions. Internal conditions of the plant can be translated by the hormonal balance between rooting inhibitors, promoters and cofactors that interfere with root growth (Fachinello et al. 2005).

To maximize the rhizogenesis process, plant hormones are used, such as auxins, which results in the development of adventitious roots and, above all, an increase in the percentage of
rooting, thanks to the acceleration of the emission of uniform, quality roots (Baldotto & Baldotto 2014, Stuepp et al. 2015).

Of the synthetic auxins most used to promote rooting, indolebutyric acid (IBA) stands out, as it is a photostable substance, with localized action and less sensitive to biological degradation, compared to other synthetic auxins (Fachinello et al. 2005).

However, the use of plant hormones during the rooting process of cuttings poses risks to the environment and human health. Therefore, alternative sources of rooting inducers have been sought, such as natural extracts, which can be viable options due to the presence of substances that stimulate rhizogenesis in cuttings (Câmara et al. 2016). This causes several natural alternative substances produced by some plant species to act as rooting promoters. Among these substances, sedge extract stands out (Cyperus rotundus Lineu), one of the most prominent weeds in the world, due to its high competition capacity, aggressiveness and difficulty of control (Durigan et al. 2005). The tubers of this species, popularly called “potatoes”, appear as alternative rooting inducers, as they act as plant hormones, being able to induce rhizogenesis in several plant species, due to considerable amounts of auxins (Fanti 2008, Souza et al. 2012).

The lentil (Lens culinaris) is one of the most produced and consumed legumes worldwide, being a source of various nutrients and minerals, as well as natural antioxidants (Bragança, 2016). The lentil seed germination is an inexpensive process that can result in considerable changes in the content of bioactive substances, such as phenolic compounds and biopeptides (Ghumman; Kaur; Singh, 2016). When lentils germinate, they release auxins, making this plant a provider of growth hormones.

The coconut tree (Cocus nucifera L.) offers the most diverse possibilities of use. One of the main properties of coconut water is attributed to its antioxidant activity, due to its ascorbic acid and glutathione content (Silva et al, 2010). According to César et al. (2015), 3-indole acetic acid (IAA), the main plant hormone, is present in coconut water.

In this sense, due to the scarcity of information on the commercial production of Umbu-cajazeira seedlings, it is necessary to develop research work with alternative sources to promote the rooting of cuttings, generating information for the commercial production of Umbu-cajazeira fruit seedlings for small producers. In view of the above, the objective was to evaluate the effect of an alternative source of natural plant hormone on the rooting of Umbu-cajazeira cuttings.
2 METHOD

The experiment was carried out in the fruit seedling nursery in the experimental area of the Department of Agricultural Sciences at the State University of Montes Claros (UNIMONTES), campus Janaúba-MG. A completely randomized design was used, containing five treatments (sedge rhizome extract, lentil germinated seed extract, pure coconut water, indolebutyric acid (IBA) and water [control]) with 5 replications and 4 cuttings per replication.

2.1 PREPARATION OF THE SUBSTRATE AND ROOTING-INDUCING SOLUTIONS

The substrate was prepared from a mixture of sand, soil and manure in a ratio of 1:1:1 v/v. The nutsedge extract was prepared using 25g of sedge tubers *Cyperus rotundus* L, crushed and homogenized in a blender with 250 ml of distilled water, sieved and subsequently diluted in distilled water at a concentration of 10%. The lentil seeds were placed in trays lined with previously moistened cotton and covered with damp filter paper and incubated at 25±2°C in the absence of light. The samples were constantly moistened to maintain the humidity necessary for the germination process for 48 hours; then 25g of germinated seeds were crushed with 250 ml of distilled water, strained through a semipermeable sieve and diluted in distilled water at a concentration of 10%. Coconut water was used pure. The AIB solution was prepared by weighing 0.1g of AIB on a semi-analytical balance and dissolved in 50mL of alcohol, in a Becker, with the aid of an electromagnetic stirrer. After completely dissolved, the volume was completed to 100mL with distilled water, obtaining the concentration of 1.000mg L⁻¹ of AIB.

2.2 APPLICATION OF TREATMENTS

A 5cm portion of the cuttings were immersed for 30 minutes in the extracts, coconut water and water. While in the AIB acid solution, the cuttings were immersed for 5 minutes, and then all the cuttings were placed on the substrate in polyethylene bags. Two periodic irrigations are carried out, one in the morning and the other in the afternoon.

2.3 VARIABLES ANALYZED

After 90 days, the percentage of rooted cuttings was evaluated, using the ratio between rooted cuttings and the total number of planted cuttings; the percentage of cuttings with sprouts was determined by the ratio between sprouted cuttings and the total number of planted cuttings;
the number of leaves and buds measured by counting the leaves and buds emitted by the cuttings. The length and diameter of the largest shoot was measured using a caliper. The number of roots by counting the number of roots that are at least 1 cm long in each cutting; length of the longest root; dry mass of the root system and dry mass of shoots. The rooted cuttings were collected and the shoots and leaves (aerial part) and roots were separated. These parts were placed in separate paper bags as aerial parts and root parts, taken to an oven with forced air circulation at 70°C until constant weight and weighed on a semi-analytical balance.

2.4 STATISTICAL ANALYSIS

The results obtained were subjected to analysis of variance and the differences between the means were compared using the Tukey test, at 5% significance.

3 RESULTS

The average results of the analyzed sprouting variables are found in Table-1. It was verified that the highest percentage of sprouted cuttings was obtained with the application of indolebutyric acid (IBA), however, in relation to the dry mass of the shoot, indolebutyric acid and nutsedge rhizome extract (ERT) differed significantly from the induction inducers rooting and control (water). And these same treatments differed from the control in the number of shoots, but only indolebutyric acid showed a difference from the control in the number of leaves. However, there was no significant difference from the other treatments. When it comes to sprout length, lentil seed extract presented a similar average to AIB, which stood out with the highest value. For shoot diameter, the coconut water and ERT treatments presented higher averages and differed from the control.
Table 1. Values of percentage of sprouted cuttings (EB), shoot dry mass (MSB), number of shoots (NB), number of leaves (NF), shoot length (CB), shoot diameter (DB), of umbu-cajazeira cuttings subjected to different alternative rooting inducers.

<table>
<thead>
<tr>
<th>Variables Analyzed</th>
<th>A</th>
<th>AC</th>
<th>ESL</th>
<th>ERT</th>
<th>AIB</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB (%)</td>
<td>45.00 c</td>
<td>77.00 b</td>
<td>91.00 ab</td>
<td>86.00 ab</td>
<td>94.00 a</td>
<td>10.80</td>
</tr>
<tr>
<td>MSB (mg)</td>
<td>10.95 d</td>
<td>76.81 c</td>
<td>207.48 b</td>
<td>297.35 a</td>
<td>276.81 a</td>
<td>18.81</td>
</tr>
<tr>
<td>NB</td>
<td>1.00 b</td>
<td>2.50 ab</td>
<td>2.80 ab</td>
<td>4.10 a</td>
<td>3.70 a</td>
<td>27.77</td>
</tr>
<tr>
<td>NF</td>
<td>1.80 b</td>
<td>7.30 ab</td>
<td>10.10 ab</td>
<td>11.40 ab</td>
<td>15.50 a</td>
<td>28.80</td>
</tr>
<tr>
<td>CB (mm)</td>
<td>16.37 d</td>
<td>55.02 bc</td>
<td>65.74 ab</td>
<td>44.70 c</td>
<td>75.88 a</td>
<td>15.51</td>
</tr>
<tr>
<td>DB (mm)</td>
<td>1.16 b</td>
<td>2.94 a</td>
<td>2.46 ab</td>
<td>2.87 a</td>
<td>2.44 ab</td>
<td>32.04</td>
</tr>
</tbody>
</table>

Note. Means followed by the same letter on the line do not differ from each other using the Tukey test at 5% Probability.
Source: Author.

4 DISCUSSION

Studies carried out by Gomes et al. (2005) show a significant increase in the number of shoots with the application of IBA to umbu-cajazeira cuttings. Tosta et al. (2012), in umbu-cajazeira cuttings, found an increase in the number and length of shoots as the IBA concentration
increased, corroborating the results obtained in this study. In relation to the greater accumulation of dry mass in the cuttings, it may have occurred due to the rapid formation and development of roots, consequently increasing the absorption and translocation of photoassimilates to the aerial part (Souza et al. 2015).

However, these results differ from those obtained by Véras et al. (2018), in which they show that IBA did not influence the percentage of sprouted cuttings, the number, length and diameter of shoots from umbu-cajazeira cuttings, with the highest values occurring at doses of 0 mg L\(^{-1}\) of IBA, presenting values of 72.91\%, 1.5 shoots, 4.09 cm and 2.48 mm, respectively.

One of the negative aspects of shoot formation is the reduction it can cause in rooting, when the cutting’s reserves are used for this purpose, to the detriment of rooting. However, when there is enough time for these to produce auxins and send them to the base of the cutting, in a basipetal movement, they can favor rooting (Véras et al. 2018).

According to Taiz & Zeiger (2013), the induction of adventitious roots at the cut end of the cutting increases with the use and immersion in auxin solution. Mendes et al. (2021), working with rooting inducers Sela Gel, Radimax and without inducer, obtained significant results for the cuttings treated with Sela Gel, differing from the others, showing 51.25\% rooting, 30\% of seedlings suitable for planting and an average of 29 .50\%. According to Bastos et al. (2014), evaluating the vegetative propagation of umbu-cajazeira, found 35\% rooting using a dose of 3,000 mg.L\(^{-1}\) of IBA, results lower than those found in this study. In umbu-cajazeira cuttings, Tosta et al. (2012) found that the use of IBA at a concentration of 7775.9 mg L\(^{-1}\) provided the greatest accumulation of dry mass in the root system of umbu-cajazeira cuttings (45.9 mg plant\(^{-1}\)), an average higher than that found in this study. In this sense, treatment with IBA provides the cuttings with conditions to root and form high quality cuttings, since, for the establishment of seedlings in the field as well as the adequate development of the plants, the root system must be of good quality (Silva et al. 2012).

One of the advantages of the auxin effect is the promotion of rooting, consequently, a good root system provides greater capacity for absorption of water and nutrients by the plant, contributing to the rapid allocation of substances to the plant (Dourado Neto et al., 2014). Vieira et al. (2020), evaluating the influence of cutting diameter and indolebutyric acid -AIB on the rooting and emission of umbu-cajazeira leaves, concluded that thick umbu-cajazeira cuttings (20-22 mm) treated with IBA (1000 mg. L\(^{-1}\)) showed greater rooting capacity. Veras et al. (2018)
highlighted that indolebutyric acid promotes the rooting of umbu-ajazeira cuttings, and the maximum concentration of 6000 mg L\(^{-1}\) of IBA provides the highest percentages of adventitious rooting, with 43.75% of rooted cuttings.

5 CONCLUSION

The indolebutyric acid positively influenced the sprouting and rooting of umbu-ajazeira cuttings. Alternative rooting inducers Seedseed rhizome extract and lentil seed extract influenced the rooting of umbu-ajazeira cuttings. Lentil seed extract provided a better percentage of rooting and root development of umbu-ajazeira cuttings.

ACKNOWLEDGMENTS

To the Minas Gerais State Research Support Foundation – FAPEMIG, the Coordination for the Improvement of Higher Education Personnel – CAPES, the National Council for Scientific and Technological Development – CNPq and the State University of Montes Claros – UNIMONTES.
REFERENCES


Fonseca, N., & De Oliveira, R. G. (2012). *Implantação de unidades de observação de fruteiras no Semiárido da Bahia*. Comunicado Técnico 151, EMBRAPA, Cruz das Almas, BA.


