

## **EFEITO DO HIDROGEL REUTILIZADO DE FRALDAS DESCARTÁVEIS NO DIÂMETRO E ALTURA DE MUDAS DE SABIÁ**

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### **1 RESUMO**

O presente estudo avaliou o uso de hidrogel reutilizado de fraldas descartáveis na produção de mudas de Sabiá (*Mimosa caesalpinifolia* Benth), espécie nativa da caatinga. O objetivo foi avaliar seu efeito sobre a altura e diâmetro das plantas durante quatro meses. O experimento foi realizado no Instituto Federal de Educação, Ciência e Tecnologia do Ceará, Campus Acopiara, utilizando diferentes dosagens de hidrogel (2 g, 4 g e 6 g) em comparação a um tratamento controle. Os resultados mostraram que doses elevadas de hidrogel prejudicaram o crescimento das mudas, enquanto o tratamento com 2 g não superou o controle indicando que, embora a retenção de água seja benéfica o excesso pode levar a problemas que afetam o desenvolvimento das plantas em ambientes como o semiárido. Os achados sugerem a necessidade de novas pesquisas para determinar a dosagem ideal de hidrogel que favoreça o desenvolvimento das plantas.

**Palavras-chave:** crescimento, polímeros, semiárido, escassez hídrica.

**PATRÍCIO, A. P. S.; MAGALHÃES JUNIOR, G. A.; SILVA, M. A. M.  
EFFECT OF REUSED DIAPER HYDROGEL ON THE DIAMETER AND HEIGHT  
OF SEEDLINGS OF SABIÁ**

### **2 ABSTRACT**

The present study evaluated the use of reused hydrogels from disposable diapers in the production of seedlings of thrush (*Mimosa caesalpinifolia* Benth.), a species native to the caatinga. The objective of this study was to evaluate its effect on the height and diameter of plants over four months. The experiment was carried out at the Federal Institute of Education, Science and Technology of Ceará, Campus Acopiara, using different dosages of hydrogel (2 g, 4 g and 6 g) compared with a control treatment. The results revealed that high doses of hydrogel inhibited seedling growth, whereas the 2 g treatment did not surpass the control, indicating that although water retention is beneficial, excess water can lead to problems that affect plant development in environments such as semiarid areas. These findings suggest the need for further research to determine the ideal dosage of hydrogel that favors plant development.

**Keywords:** growth, polymers, semi-arid, water scarcity.

### 3 INTRODUCTION

Disposable diapers have a high capacity for retaining and absorbing liquids because of the presence of superabsorbent materials that can retain large volumes. According to Colón *et al.* (2011), diapers are made up of a combination of organic matter, a superabsorbent polymer (SAP), and plastic and fibers. This polymer is known as a hydrogel, which, owing to its ability to retain water, can be an effective solution for vegetation in areas with water scarcity, where plants face limitations in the availability of water in the soil. This allows plants to use water for longer periods, reducing the need for frequent irrigation.

With the increasing demand for high-quality forest seedlings for ecological restoration or commercial planting, it is important to seek economically viable techniques to meet this demand (Souza *et al.*, 2023). In this context, the use of hydrogels in seedling production is a viable alternative since they act as water regulators in the soil, minimizing the amount of water needed for irrigation and reducing the cost of seedling production (Mendonça *et al.*, 2013).

To assess the quality of seedlings, morphological and physiological aspects are generally considered (Gomes; Paiva, 2008). Cargnelutti Filho *et al.* (2018) highlighted that, in experiments carried out in forest nurseries, it is important to evaluate characteristics such as the height and diameter of seedlings, in addition to the relationship between these two parameters throughout plant growth. Gomes and Paiva (2008) emphasized that height and diameter are important in determining the quality of seedlings. In addition, the diameter variable is considered the best indicator of performance after planting, although this variable may vary according to the species

and growing conditions (Ritchie *et al.*, 2010).

In view of this, the present study aimed to evaluate the reuse of hydrogels from disposable diapers to produce forest seedlings, evaluating their effects on height and diameter over four months in Sabiá seedlings (*Mimosa caesalpiniiifolia* Benth.), a species native to the caatinga.

### 4 MATERIALS AND METHODS

The experiment was carried out at the Federal Institute of Education, Science and Technology of Ceará, Acopiara Campus, in 2024. Sowing took place on April 17, and data collection was completed on August 17, for a total of four months.

The species used in the experiment was *Mimosa caesalpiniiifolia* (Sabiá), which is native to the caatinga and is commonly used in the recovery of degraded areas, as it contributes to the regeneration of vegetation and soil recovery (Azevedo, 2011).

The seeds were physically broken by immersion in sulfuric acid for 10–13 minutes. This method is considered the most effective method for determining the pregermination process of a species, according to studies by Bruno *et al.* (2001) and Passos, Tavares and Alves (2007). After breaking dormancy, the seeds were sown in plastic seedling bags in a nursery located at the IFCE - Acopiara Campus. Each bag had a capacity of two kilograms, and the substrate used was composed of 70% soil (35% white clay and 35% sandy soil) and 30% cured cattle manure. To identify the ideal amount of water required for irrigation, the field capacity of the soil, which was determined to be 500 ml, was calculated. The amount of water used for irrigation was adjusted to 50% of the field capacity of the

soil, and the irrigation regime was maintained on alternate days.

The amounts of hydrogel used in the treatments were 2 g, 4 g, and 6 g, in addition to a control treatment, which did not receive hydrogel. Each treatment consisted of five plants, for a total of 20 plants in the experiment. After sowing, the hydrogel was weighed and diluted in 1 liter of water for each sample and then incorporated into the substrate with the seeds. The growth of the individuals was monitored monthly for four months, and the height of the plants (in centimeters) was measured with the aid of a tape measure, and the diameter of the stem (in millimeters) was measured via a digital caliper.

To evaluate the influence of different amounts of hydrogel on height and diameter, the mean and maximum height and diameter data collected were subjected to the Shapiro–Wilk normality test. Those that presented a normal distribution ( $p > 0.05$ ) were subjected to analysis of variance (ANOVA), followed by Tukey's test. To compare the means between treatments, a significance level of 0.05 was used. All the

statistical analyses were performed via PAST 4.03 software.

## 5 RESULTS AND DISCUSSION

There was a significant difference in the height and diameter variables between the treatments with different hydrogel dosages. Compared with the CH6 treatment, the CH2 treatment significantly differed in terms of average height (Table 1). These results indicate that the higher dosage negatively impacted the height growth of the plants, since the lowest average height was recorded in the CH6 treatment, and the highest average height was recorded in the CH2 treatment.

Furthermore, the CH6 treatment significantly differed from the SH control, since the latter presented a greater average height. However, there was no significant difference between the CH2, CH4 and SH treatments, whose values were similar. It was also observed that the CH6 treatment significantly differed from the CH4 treatment, presenting lower values.

**Table 1.** Data on the height (cm) and diameter (cm) of Sabiá (*Mimosa caesalpinifolia*) individuals under different dosages of reused hydrogel from diapers.

Treatment	Average Diameter	Maximum Diameter	Average Height	Maximum Height
CH2	2.40 <sup>a</sup>	2.70 <sup>a</sup>	42.91 <sup>a</sup>	50.13 <sup>a</sup>
CH4	2.28 <sup>ab</sup>	3.08 <sup>a</sup>	29.08 <sup>th</sup>	46.45 <sup>a</sup>
CH6	1.39 <sup>b</sup>	1.93 <sup>b</sup>	14.60 <sup>b</sup>	20.75 <sup>b</sup>
SH	2.79 <sup>a</sup>	3.45 <sup>a</sup>	37.32 <sup>a</sup>	53.55 <sup>a</sup>

CH2: 2 g hydrogel; CH4: 4 g hydrogel; CH6: 6 g hydrogel; SH: no hydrogel (control). The same letters indicate statistical similarity. Different letters indicate significant differences. **Source:** The authors. (2024)

The results indicate that, compared with those in the other treatments, the maximum height in the CH6 treatment differed significantly from those in the CH2 and SH treatments, with lower values. This result is related to the addition of high doses of hydrogel, which increases water retention, which in excess can impair root aeration, resulting in a reduction in plant growth

(Navroski *et al.*, 2015). These findings indicate that, as a species native to the Caatinga and adapted to semiarid climates, *M. caesalpinifolia* is adapted to drought cycles and may not react well to excessive water availability. No statistically significant differences in maximum height were observed between the treatments with CH2, CH4 and SH.

There were also significant differences in the average diameter between the CH2 and CH6, CH6 and SH treatments. However, CH6 and CH4 did not significantly differ (Table 1). The CH2 treatment resulted in the largest average stem diameter, whereas the CH6 treatment resulted in the lowest value, which suggests that the application of a higher dosage of hydrogel negatively impacted the increase in biomass. This result corroborates the study by Cardoso (2017), who also reported negative impacts of the use of commercial hydrogels at high dosages on the diameter of *Hymenaea seedlings. stigonocarpa*.

Compared with the other treatments, the CH6 treatment presented the lowest mean diameter value, whereas the SH treatment presented the largest mean diameter. As the hydrogel dosage increased, plant growth in terms of height and diameter decreased. This finding is in agreement with Dranski *et al.* (2013) and Navroski *et al.* (2015), who also reported a reduction in height growth and stem diameter in seedlings subjected to higher doses of hydrogel.

The maximum diameter values obtained at the end of the experiment significantly differed among the treatments. There was a significant difference between the CH6 treatment and the CH2 and CH4 treatments. Furthermore, the CH6 treatment also differed significantly from the SH control. No statistically significant differences were detected between the CH2 or CH4 treatments and the SH control. These results cannot be directly compared to those of Souza *et al.* (2023), since that study evaluated the mean diameter, whereas the present work analyzed the maximum diameter. However, Souza *et al.* (2023) reported that the use of a 4 g/L natural tingui hydrogel in combination with the commercial substrate Tropstrato Florestal® led to an increase in the mean diameter and height of the plants, indicating a possible positive effect of the hydrogel on growth.

For a more accurate comparison, studies that use the same variable analyzed in this experiment are necessary.

Compared with the other treatments, the CH6 treatment resulted in a smaller maximum diameter and differed from all the other treatments, again indicating a negative effect of the higher hydrogel dosage. Similar results were obtained in the study by Navroski *et al.* (2015), who demonstrated that the 6 g/L commercial hydrogel had a negative effect on plant growth, as evidenced by the reduction in height and diameter compared with the 4.5 g/L dose. The authors argued that this decrease can be attributed to excess water and nutrients in the substrate, which, although initially seemingly beneficial, can result in adverse conditions for root development, compromising plant growth.

The control treatment (SH) presented the highest values of maximum diameter, maximum height and average diameter, which means that the absence of a hydrogel favored greater development under low-humidity conditions.

## 6 CONCLUSIONS

The application of the reused hydrogel at high doses (CH6) impaired the height and diameter of Sabiá (*Mimosa caesalpinifolia*) seedlings. Compared with the control, the CH2 treatment did not result in superior performance, which suggests that in environments where water availability is limited, such as in semiarid climates, the excessive addition of water provided by the hydrogel may not be beneficial to the plants. The CH4 treatment, on the other hand, presented a statistically similar diameter and height to those of SH, indicating that this dosage did not provide significant advantages in terms of the growth of the species. The results of height and diameter showed no differences between CH2, CH4 and SH, indicating that any of them can be

used in the region when these variables are considered. However, the results underscore the need for further research on the best dosage of reused hydrogel, as well as the amount of water and frequency of irrigation, to avoid excess water that may compromise the development of the plant.

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