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Sohag Journal of junior Scientific Researchers
Journal homepage: https://sjyr.journals.ekb.eg/
ISSN 2735-5543

Article

Effects of sulfuric acid and mechanical method by using sandpaper on the germination of Christ's thorn *Zizphus spina-christi* (L.) Desf. seeds

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Article info.

Citation: Hussien M., Abdelall E., Abdel Rehim S., Abdelhadi M., Mahmoud A., Mohamed A., Abd-Elgawad O., Amin A., Bhnsawy M., Ahmed A., Ahmed K., Mohamed M., Ibrahim I., Hamza A., Abdelghffar A., and Asran A. (2023). Effects of sulfuric acid and mechanical method by using sandpaper on the germination of Christ's thorn *Zizphus spina-christi* (L.) Desf. seeds. ***Sohag Journal of Junior Scientific Researchers***, Vol. **3** (*3*). 17-24.

https://doi.org/10.21608/sjyr.2023.302837

Received: 25/01/2023
Accepted: 24/03/2023
Published: 01/09/2023

Abstract

The present study was conducted during the 2022 season on seeds of Balady *Ziziphus* ***(****Zizphus spina-christi* (L.) Desf. in El-Kwamel at Sohag University, Sohag, Egypt. This study examined how (*Z. spina-christi)* responded physiologically, in terms of seed germination, to scarification by using sandpaper and cracking of the seedcoat, and sulfuric acid (98%), applied for (60 and 120 min) then, the seeds were washed and placed underwater for 30 minutes. As a result, the maximum value of germination percentage, shoot length, root length, number of root hairs, and number of leaves was recorded by soaking in sulfuric acid (98%) compared with the control. Therefore, it is concluded that using soaking (*Z. spina-christi)* seeds in sulfuric acid (98%) for (120 min) once led to clear enhancements in the majority of the tested parameters of (*Z. spina-christi*). This study explored treatments (Scarification by using sandpaper and cracking of the seedcoat, sulfuric acid (98%) for 60 minutes, and sulfuric acid (98%) for 120 minutes). After 60 days has been determined of germination percentage (G.P) and Mean germination time (MGT), root and shoot lengths were measured with the help of a ruler and expressed in centimeters (cm). After that calculated, the number of root hairs and leaves was. The emergence percentage was highest after immersing seeds in acid for 120 minutes, while untreated seeds (control) had the lowest germination percentage. All treatments except untreated seeds significantly increased the total number of seedlings.

Keywords: *Ziziphus spina-christi,* Stratification, Scarification, Seed Germination.

1. Introduction

Indigenous fruit trees play an essential role in the livelihood of rural people in Saharan Africa (Mithöfer & Waibel, 2003; Schreckenberg et al., 2006). This species grows widely in the north and center of the country (El Amin, 1990). It is a multi-purpose tree with edible fruits that are rich in carbohydrates (80.6% 100 g-1 dried fruit), notably starch (21.8%), sucrose (21.8%), glucose (9.6%), fructose (16%), and iron (3 mg 100 g-1 dried fruit) (Nour et al., 1987; Abdelmuti, 1991).

Germination is a critical stage in the life cycle of weeds and crop plants and often controls population dynamics with significant practical implications. In addition, seed germination is the critical stage for species survival (Huang et al., 2003; Yang et al., 2008). In the recent 20 years, desertification has been recognized as a significant environmental problem and is a primary focus of the United Nations Environment Programme (Zare et al., 2011). Although vegetation is a protector of the soil against water and wind erosion as well as a casualty of soil erosion (Yates et al., 2000; Manzano & Navar, 2000), each desert-inhabiting plant has its complex of strategies that enable it to persist in desert habitats (Gutterman, 1994).

Strategies for improving the growth and development of arid-region plant species have been investigated for many years. Treated seeds with chemical compounds usually exhibit rapid germination when absorbing water under field conditions (Ashraf & Foolad, 2005).

Z. spina-christi is a plant species that has edible fruits and several other beneficial applications that include the use of leaves as fodder, branches for fencing, wood as fuel, for construction and furniture making, and the utilization of different parts, e.g., fruits, leaves, roots, and bark, in folk medicine. Moreover, the plant is adapted to dry and hot climates, which makes it suitable for cultivation in an environment characterized by increasing degradation of land and water resources. *Z. spina-christi* Wild is a spiny shrub or small tree in the Rhamnaceae family that grows in tropical and subtropical regions of the world (Johnston, 1963).

Propagation of desirable Ziziphus cultivars for harvesting leaves and fruit is via grafting. Grafted Ziziphus tree usually is produced via rootstock production from wild Ziziphus *(Z. spina-christi.)* and then budding of Indian cultivars *(Z. mauritiana)* on it. In nature, the seed coat makes soft by several factors, such as mechanical wear, repeated freezing**,** and melting, and microbial attack on the soil causes the seed coat to become soft.

In this relation, the hard endocarp is one of the barriers to seed germination and rootstock production. By employing the right treatments, Scarification can shorten the time it takes for rootstock to produce and enhance germination rates. Melting, a microbial attack on the soil, causes the seed coat to become soft. (Khoshkhoui, 1989; Blazich, 2002) Most of the planting material is produced from seeds, and some reports must present satisfactory germination (Osipi, 2000).

This study aims to shorten the time of germination of seeds and increase the total germination percentage by using sulfuric acid (98%) for 60 minutes, sulfuric acid (98%) for 120 minutes, and Scarification by using sandpaper and cracking of the seed coat.

2. Materials and Methods

This investigation was carried out during the 2022 season on seeds of Balady *Ziziphus* in the Horticulture research center located in El-Kwamel at Sohag University, Egypt.

Seeds were extracted from mature fruits and were removed from seeds after drying up for three days at room temperature (20°C) in the darkness following the method of (Cardenas et al., 2013).

To evaluate the effect of various treatments on Balady Ziziphus seed germination, an experiment was conducted in a completely randomized design with four treatments and three replications. All treatments were soaked in tap water for 24 hours and then extracted the seeds from fruits that left seeds to dry. Plastic cans were prepared and pierced with holes for draining excess water and filled with a 1:1 ratio of sand and silt.

2.1. Determination of germination percentage (G.P) and Mean germination time (MGT)

Observations were recorded daily after the start of germination up to 45 days after sowing for each treatment, and germination percentage was determined using the formula:

G.P = (total number of seeds germinated/total number of seeds sown in all replicates) x100. Mean germination time (MGT) was estimated by using the formula: MGT = ∑ (nt)/∑n [n= number of seeds newly germinating at time t, t= days from sowing] (Nichols & Heydecker, 1968).

In stratification treatments, the seeds were soaked in Sulfuric acid for 60 and 120 minutes, respectively, after which they were thoroughly washed and placed under water for 30 minutes— after washing the seeds, put them in plastic cans.

Sandpaper is used to crack the seedcoat during scarification treatment and is then placed in plastic cans. The traits of day-to-germination (the number of days from sowing until the first seed germinated) and the total germination percentage were calculated.

2.2. Post-germination study

After 60 days of seed sowing, three random seedlings from each replication were selected. Then the root portions were dipped in a bucket of water to clean the adhered soil particles. Later, the seedlings were kept on blotting paper to soak extra water, and their root and shoot lengths were measured with the help of a ruler and expressed in centimeters (cm). After that calculated, the number of root hairs and leaves was.

Figure 1. Geaves, spines, seeds, and fruits of *Z. spina-christ*.

Figure 2. Germination seed for sulfuric acid 120 minutes of *Z. spina-christ*.

Figure 3. Seedling of control.

Figure 4. Seedling of Sulfuric acid for 120 minutes.

The treatments composition was as follows.

T1: Control.
T2: Sulfuric acid (98%) for 120 minutes.
T3: Sulfuric acid (98%) for 60 minutes.
T4: Scarification by using sandpaper.

2.1. Statistical analysis

The data were subjected to the Analysis of Variance (ANOVA) using the Minitab 19.1 statistical program. Where significant differences were detected, the means were separated using Duncan's New Multiple Range Test (DNMRT) at $P < 0.05$.

3. Results and Discussion

3.1. Germination and total germination percentage seeds

There was a significant difference between the control and other treatments. The seed germination was significantly faster in Sulfuric acid for 120 minutes than in the different treatments, and the lowest seed germination was obtained in control after 20 days. Anyhow, germination velocity was in the third week that was observed in all treatments. The highest germination percentage in seeds was observed in Sulfuric treatment for 120 minutes, while the lowest germination percentage was in non-seeds treated (control).

On the other hand, the findings of Saied et al. (2008) and Hartley et al. (2000) on *Ziziphus.* On *Tamarind*, Nasiri and Eisavand (2001). On *Cycas, revolute* introduced Sulfuric acid as the best treatment.by Hojati et al. (2007). In this study, sulfuric acid for 120 minutes in wild Ziziphus seed is the best method to fast germination and a high percentage of germination.

Table 1. Effects of some treatments on Mean Germination Time (Days after sowing) and total germination percentage seeds (%) of Christ's thorn (Z. spina-christi) seeds.

Treatments	Mean Germination Time (Days after sowing)	Total germination percentage seeds (%)
Control	20^{a}	23.33^{d}
Sulfuric acid for 120 minutes	10^{d}	97.42^{a}
Sulfuric acid for 60 minutes	11^{c}	94.56^{b}
Scarification by using sandpaper	17^{b}	82.24^{c}

Figure 5. Comparison of the effect of treatments on the Mean Germination Time (Days after sowing) of Balady Ziziphus.

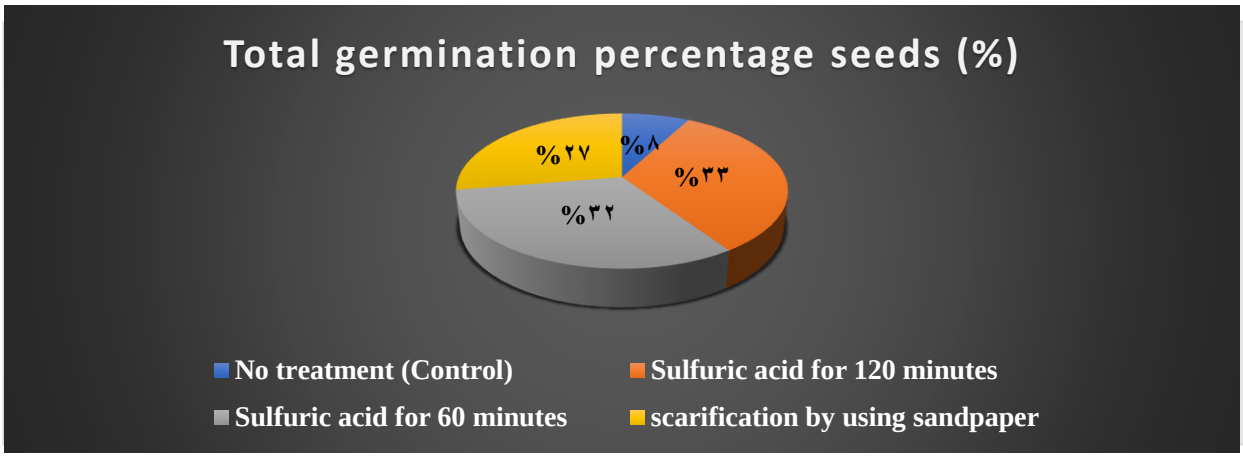

Figure 6. Comparison of the effect of treatments on germination percentage of Balady Ziziphus.

3.2. Shoot length (cm)

No significant differences were observed between various soaked in sulfuric acid and Scarification using sandpaper on plant height (Table 2 and Figure 7).

3.3. Root Length (cm)

Root length differed significantly between various treatments of sulfuric acid and Scarification by using sandpaper. However, data in Table 2 and Fig. 7 revealed that the longest roots (8.5 and 5.5 cm) were recorded with seeds treated with Sulfuric acid (98%) for 60 minutes and Sulfuric acid (98%) for 120 minutes. At the same time, the shortest roots (3.3 and 4.07 cm) were observed with Scarification using sandpaper and Control treatments. These results agree with those obtained by Anim-Kuapong and Teklehaimanot (2001), who found that treatments significantly affected root length. The longest root was recorded in seeds of Albizia Syria scarified by Sulfuric acid for 5 minutes.

Table 2. Effects of some treatments on Shoot length, Root length, No of root hairs and No. Leaves of Christ's thorn Z. spina-christi seeds.

Treatments	Characters			
	Shoot length	Root length	No root hairs	No.leaves
Control (No treatment)	3.06^{a}	4.07^{ab}	2.5^{b}	2^{a}
Sulfuric acid (98%) for 120 minutes	2.96^{a}	5.5^{ab}	0.5^{b}	2^{a}
Sulfuric acid (98%) for 60 minutes	2.63^{a}	8.5^{a}	9^{a}	2^{a}
Scarification by using sandpaper	2.45^{a}	3.3^{b}	3^{b}	2^{a}

3.4. Number of root hairs

Overall results showed significant differences among different treatments applied. Data in Table 2 revealed that the maximum number of root hairs (9) was recorded with treatments of Sulfuric acid (98%) for 60 minutes. Without significant differences between Sulfuric acid (98%) for 120 minutes, Scarification was done by using sandpaper and Control treatments. At the same time, the minimum number of leaves was obtained with Sulfuric acid (98%) for 120 minutes of treatment (0.5) followed by control (2.5) without significant differences between them. Supporting results obtained by (Mabundza et al., 37) indicated that the Scarification of seeds of Tamarindus indica L. with 95% Sulfuric acid for 5 minutes enhanced germination of the seeds' number of root hairs.

3.5. Number of Leaves

Overall results showed no significant differences among different treatments applied in Data in Table 2.

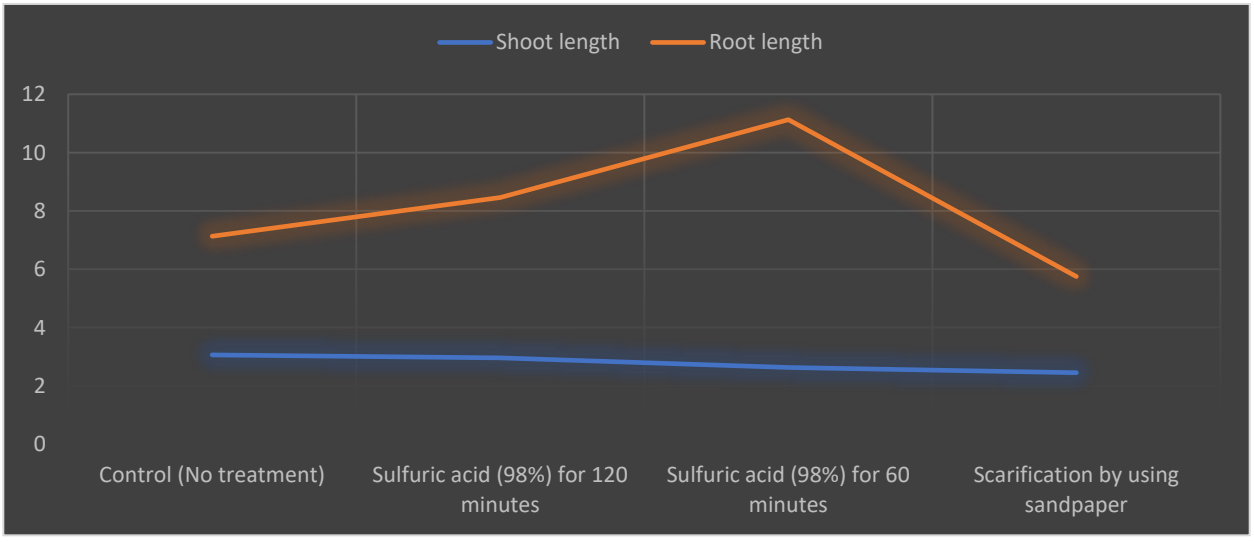

Figure 7**.** Comparison of the effect of treatments on shoot length and root length.

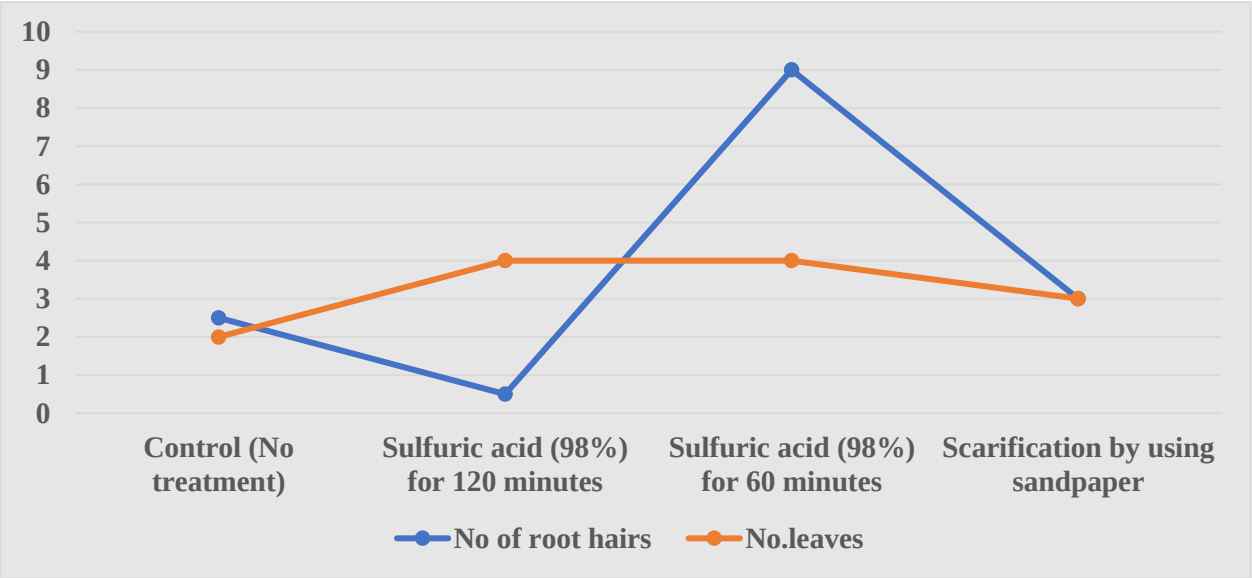

Figure 8. Comparison of the effect of treatments on the number of root hairs and the number of leaves.

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الملخص العربي

مقال

تأثير حمض الكبريتيك واستخدم ورق الصنفرة كطريقة ميكانيكية على الإنبات لبذور النبق

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النبق هو نوع من أشجار الفاكهة تنمو في البرية في المناطق القاحلة وشبه القاحلة في آسيا وإفريقيا حيث يتم استخدام الأوراق واللحاء والخشب بشكل مكثف في الريف. يعتمد في إكثاره على البذور، ولكن نسبة الإنبات في بذوره تكون منخفضة بالإضافة إلى أنها بطيئة الإنبات ويرجع ذلك لأن الغلاف الداخلي للبذور يكون شديد الصلابة. تم استخدام أساليب خدش ميكانيكي وخدش بواسطة الأحماض وأدى ذلك إلي تحسين نسبة الإنبات في بذور بعض الأنواع ومع ذلك لاتزال هذه الأساليب غير معروف مدى فعاليتها على أنبات بذور النبق على نطاق واسع. في هذه الدراسة أدت معاملات الخدش الميكانيكي باستخدام ورق الصنفرة، ونقع البذور في حمض الكبريتيك بتركيز (98٪) لمدة 60 دقيقة، وحمض الكبريتيك (98٪) لمدة 120 دقيقة إلي تحسين نسبة الإنبات بشكل فعال، فكانت أعلى نسبة أنبات للبذور في معاملة النقع للبذور في حمض الكبريتيك لمدة 120 دقيقة، بينما سجلت البذور غير المعاملة أقل نسبة أنبات. أدت جميع المعاملات باستثناء البذور غير المعاملة إلى زيادة معنوية في نسبة الإنبات.

الكلمات المفتاحية: النبق، الخدش الميكانيكي، الخدش الكيميائي، نسبة الأنبات