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CHEMICAL SCARIFICATION UNLOCKING CASHEW NUT GERMINATION POTENTIAL

M. S. Rahman[1a], P. C. Sarker[2], T. Jahan[3], S. E. Akter[4], S. A. Mahmud[5] and M. S. Reza[2a*]

[1a]Seed Technology Division, Bangladesh Agricultural Research Institute (BARI), Gazipur; [2]Tuber Crop Research Center, BARI, Gazipur; [3]Tuber Crop Research Center, BARI, Gazipur; [4]Crop Physiology Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh;[5]Plant Breeding Division, BINA, Mymensingh; [2a*]Soil Science Division, BINA, Mymensingh. Bangladesh.

Abstract

The Seed Technology Division of BARI, Gazipur carried out a lab test to identify the best chemical scarification agent for improving germination and seedling performance of cashew nut. Water and vinegar at 25% and 50% concentrations were used as chemical scarification means. The seeds were soaked into `water and vinegars for 0, 24, 48, 72, and 96 hours following completely randomized design (CRD) with three replications. The results of the study reveal that germination percentage of cashew nut went up due to priming over varying times. Among the treatments, soaking cashew nut seeds in water for 72 hours was found as the most effective method for enhancing seed germination.

Keywords: Chemical scarification, Cashew seed germination, Dormancy breaking, Hydropriming, Vinegar.

Introduction

Cashew nut (*Anacardium occidentale L.*) is a rapidly expanding evergreen tree that is indigenous to northeastern Brazil. Cashew can be cultivated in various soil types, except wetlands. Subasinghe (2004) views that it requires minimal maintenance and helps protect soil erosion. Major cashew-producing countries include Brazil, Nigeria, India, Vietnam, and Cambodia (Ferreira-Silva *et al.,* 2009). In India, it grows well in states along the Bay of Bengal, particularly in coastal areas like West Bengal, Tamil Nadu, and Orissa (Rejani *et al.,* 2013). Although Bangladesh has a similar climate, it has not fully capitalized on its cashew production potential; the tree was introduced in Chittagong Division about 50 years ago (DAE, 2020). The Ministry of Agriculture is now prioritizing cashew planting in mountainous districts. However, seed dormancy poses challenges for successful seedling establishment, necessitating strategies to overcome this issue. There are two types of dormancy: chemical dormancy, caused by inhibitory substances in the fruit and seed covering, and physical dormancy, resulting from hard

* Corresponding author: selim.bsmrau48@gmail.com

seed coats that block light, gases, and water (Fasidi *et al.,* 2000). Both types can occur simultaneously, and seeds with immature embryos may also not sprout (Nikolaeva, 2004). Bajehbaj (2010) states that chemical scarification improves seed vigor, accelerates germination, and enhances seedling growth in challenging conditions. Although there is limited research on osmotically treated seeds in field conditions, chemical scarification has shown promising results in okra seeds (Sanjay *et al.,* 2000). This method provides benefits for various crops, such as quicker emergence, uniform stands, reduced reseeding, stronger plants, drought resistance, earlier flowering, and increased seed yield (Chavan *et al.,* 2014; Harris et al., 2001; Assefa *et al.,* 2008). Vinegar, which contains acetic acid, the one chemical used for scarification and is considered eco-friendly and promising for seed treatment (Tóbiás *et al.,* 2007). Studies have presented effective seed treatment techniques for ecological vegetable production, including antagonistic microorganisms, aerated steam and hot water treatments (Roberts *et al.,* 2006), plant extracts (Hartman *et al.,* 1995), essential oils, and natural acids (Tinivella *et al.,* 2004). Vinegar can also alter pH, making the environment unsuitable for germs. Borgen (2001) notes that acetic acid is a naturally occurring substance that po ses minimal oral hazards to humans and animals. In order to promote cashew nut seed germination and advance the region's underdeveloped cashew plantation culture, this study was undertaken to determine the most effective chemical scarification therapy.

Materials and Methods

A two-factor Complete Randomized Design (CRD) with three replications of each treatment was followed. The experimwnt was set up in the Seed Technology Division research laboratory of BARI, Joydebpur, Gazipur. Cashew nuts (M-23 variety) were sourced from LA Agro Limited, Bandarban.Water, 25% vinegar, and 50% vinegar were used as chemical scarification (Factor A) and Soaking durations were 0, 24, 48, 72, and 96 hours (Factor B). All cashew nut seeds were cleaned three times using distilled water before vinegar treatments and were then disinfected for three minutes with 70% ethanol. Six beakers were labeled according to the vinegar concentrations after being cleaned with distilled water and a 10% bleach solution. The first beaker was filled with 100 milliliters of pure vinegar. The second beaker, labeled as 50%, received 50 milliliters of the 100% vinegar solution, followed by the addition of 50 milliliters of distilled water, which was then gently swirled. Similarly, the third beaker, designated as 25%, was filled with 25 milliliters of the 100% solution and then diluted with 75 milliliters of pure water, after which it was also swirled gently. Using soil media, seed germination was carried out at room temperature (25^0C). Water and 25% and 50% vinegar solutions were used to soak the seeds for 24, 48, 72, and 96 hours. After soaking the seeds for each time duration their weights were taken and the initial weight of the seeds was recorded. The original weight was compared with the weight after soaking to calculate the amount of water absorbed. Total ten seeds were used for each solution, with three replications, in order to calculate an average percentage. The number of seeds that germinated was counted daily over a period of 30 days. The following formula was used to assess the seedlings' survival rate after 60 days.

$$\text{Survival rate (\%)} = \frac{\text{Total number of emerged seedlings} - \text{Total number dead seedlings}}{Total\ number\ of\ emerged\ seedlings} \ x\ 100$$

Data analysis

Open-source R software was used to perform two-way analysis of variance (ANOVA) on the data collected to evaluate the impact of priming types and soaking duration on germination and associated parameters. The significant means were separated using the Least Significant Difference (LSD) test.

Results and Discussion

Effects of chemical scarification and soaking duration on the germination characteristics of cashew nut seeds

The germination capability of a single seed, which is based on a binary respond (germinated/non-germinated), is one qualitative aspect of the germination process that is commonly converted into a quantitative feature, typically given as a percentage. Figure 1 showed that there were variations (at the 5% level) between the treatments on germination characteristics andit resulted in significant changes in germination quality. The results of the study showed that the percentage of cashew nuts that germinated increased when chemical scarification was imosed for different duration of time. The results showed that the most effective treatment for improving seed germination was water with a 72-hour soaking time (73%), which was statistically different from all other treatments. Until the 72-hour soaking period, the germination percentage increased; after that, it began to decline for water. Germination went up quickly for 48 hours in a 25% vinegar solution before declining. Germination for a 50% vinegar solution only happens after a 24-hour soaking period. The findings showed that vinegar inhibited cashew nut germination. Mere *et al.* (2021) reported d similar results.

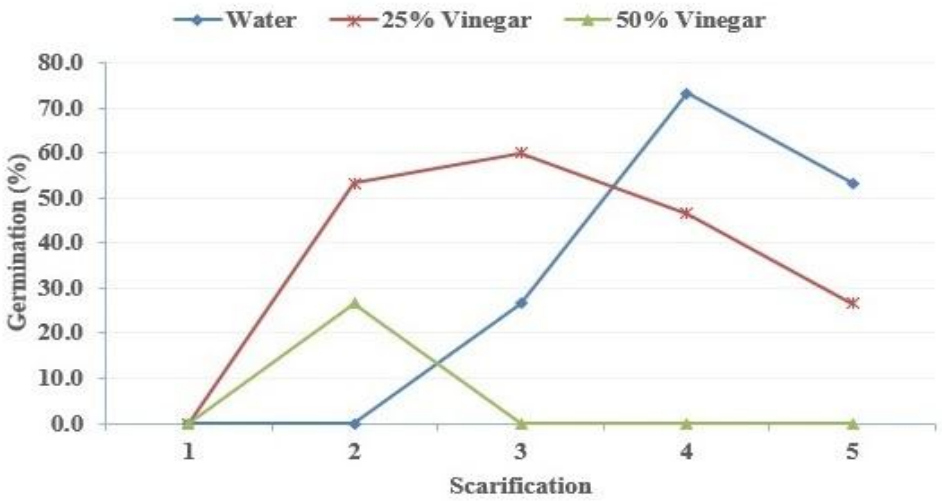


Fig. 1. Interaction effect of scarification types over time (1=0 h, 2=24 h, 3=48h, 4=72h and 5= 96 h) on germination

Similar to the aforementioned, Yao *et al.* (2022) observed that neem seed aqueous extract was efficient against the majority of pests. These aqueous extracts can be utilized in an integrated control program to combat key crop pests like cabbage. In align with this, Ndour *et al*. (2021) suggest that seed treatment is crucial to the survival of the species. Using 25% vinegar for 24 and 48 hours of priming yielded the highest survivorship value (Table 1a), which was statistically equal to all other treatments.

Every treatment had a survivorship rate of 80% or higher, indicating that treatments had no effect on survivability. According to Table 1b, hydration and priming for 72 hours with 25% vinegar hours resulted in the greatest number of leaves (11.0), whereas hydration for 96 hours and 25% vinegar for 48 hours produced the lowest number (7.0). According to Table 1c, the 72-hour soaking period produced the most leaf length (6.93 cm), which was statistically equivalent to the 96-hour soaking period. The 25% vinegar treatment produced the smallest leaf length (4.23 cm) after 96 hours of soaking.

The leaves with the largest diameter, measuring 3.43 cm, were soaked in a 25% vinegar solution for 24 hours. This treatment yielded results that were statistically similar to those of leaves soaked for 48 hours, as indicated in Table 1d. For the leaves with the smallest diameter, measuring 2.67 cm, a 25% vinegar solution was applied for 96 hours; this treatment was statistically equivalent to hydration over the same duration.The highest seedling length recorded was 17.00 cm after a 72-hour hydration period. This length was statistically comparable to the lengths observed after 24 and 96 hours of soaking in 25% vinegar, as well as 24 hours in a 50% vinegar solution, as shown in Table 1e. These results indicate that seedling length was not significantly affected by priming. The seeds that were soaked for 96 hours in all three combinations—hydration, 25%, and 50% vinegar solution-absorbed the most water, as shown by the results in Table 1f (6.17g, 5.79g, and 6.11g, respectively). The rate of water absorption increased with time.

Table 1a. Survivability (%)

Chemical Scarification/ Soaking duration	0h	24h	48h	72h	96h
Water	0	0	0	80.7	78.0
25% Vinegar	0	89.0	89.0	83.3	83.3
50% Vinegar	0	83.0	0	0	0
CV (%)			41.1		
LSD (0.05)			26.8		

Table 1b. Number of leaves

Water	0	0	0	11.0	7.0
25% Vinegar	0	7.0	8.0	11.0	8.0
50% Vinegar	0	9.0	0	0	0
CV (%)			11.4		
LSD (0.05)			1.1		

Table 1c. Leaf length (cm)					
Water	0	0	0	6.93	6.27
25% Vinegar	0	5.70	6.00	5.63	4.23
50% Vinegar	0	5.10	0	0	0
CV (%)			11.9		
LSD (0.05)			0.75		

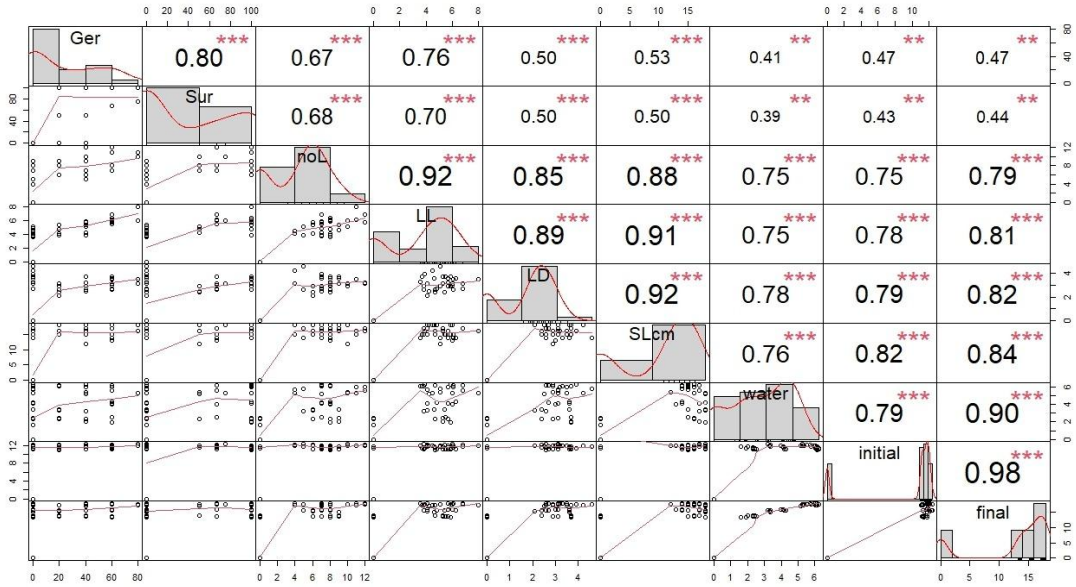
Table 1d. Leaf diameter (cm)					
Water	0	0	0	3.23	2.73
25% Vinegar	0	3.43	3.40	3.20	2.67
50% Vinegar	0	3.07	0	0	0
CV (%)			15.4		
LSD (0.05)			0.59		

Table 1e. Seedling length (cm)					
Water	0	0	0	17.0	15.3
25% Vinegar	0	16.3	13.7	14.3	16.0
50% Vinegar	0	16.3	0	0	0
CV (%)			10.4		
LSD (0.05)			2.00		

Table 1f. Amount of water absorbed after soaking (g)					
Water	0	2.12	3.28	5.34	6.17
25% Vinegar	0	2.25	4.12	5.73	5.79
50% Vinegar	0	2.26	3.90	5.60	6.11
CV (%)			7.71		
LSD (0.05)			0.45		

Correlation matrix

A linear link between different features was investigated using phenotypic correlation analysis, and the correlation matrix (Figure 1) illustrates this relationship. All of the parameters in this analysis showed a substantial positive connection with Germination (Ger). The majority of the metrics showed a high degree of positive association with one another. The amount of water absorbed during the soaking phase, leaf diameter (LD), and seedling length (SL) all showed somewhat positive significant connection with germination and survival. The strongest positive association was found between seedling length (SL) and leaf length (LL) and leaf diameter (LD).



*****Ger-Germination, Sur-Survivability, noL-Number of leaves, LL-Leaf length, LD-Leaf diameter, SL-Seedling length, Water-Amount of water absorbed during soaking, Initial-Initial seed weight, Final-Final seed weight

There was positive significant correlation between seed germination and its survival and the amount of water absorbed during soaking period, leaf diameter (LD), and seedling length (SL). Seedling length (SL), leaf length (LL), and leaf diameter (LD) showed the strongest positive correlation.

Conclusion

The study suggests that vinegar can inhibit the germination of cashew nuts. It was noted that maintaining 72 hours' hydration period yielded the best results, exhibiting a seed germination rate of 73% which was significantly higher than vinegar treatments.The results suggest that vinegar had no influence on seed germination and simply adequate hydration is important for improving seed germination of cashew nut.

Conflicts of interest

The authors declare no conflicts of interest regarding publication of this manuscript.

Authors' contribution

The experiment's conception and design, field testing, data collection, and report writing were all done by M. S. Rahman. P. C. Sarkar helped the fieldwork, evaluated the text, and helped analyze the results. S. E. Akter and S. A. Mahmud revised the work and assisted in the literature review. T. Jahan and M. S. Reza helped performing the statistical analysis, and offering technical advice throughout the study.

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