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BREAKING SEED DORMANCY USING CHEMICAL, PHYSICAL, AND ORGANIC SCARIFICATION METHODS ON THE GROWTH OF AREN SEEDS (Arenga pinnata Merr.)

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Abstract

Prolonged seed dormancy is an obstacle in the provision of quality seedlings. Therefore, this study was conducted to accelerate the germination process of Arenga pinnata Merr. seeds through various treatments. This study aims to evaluate the response of chemical, physical, and organic dormancy breaking on the growth and development of Arenga pinnata Merr. seeds. The method used was a Non-Factorial Complete Randomized Design with seven treatments: seed soaking in 3% H_2SO_4 solution (6 hours), 0.5% KNO_3 (24 hours), 3% HCl (6 hours), sanding (sandpaper), 100% red onion extract (24 hours), 100% palm sap (24 hours), and 100% coconut water (24 hours). The results showed that seed soaking in 3% HCl or sandpaper abrasion yielded the best results in terms of germination rate, although there was no statistically significant effect; these treatments also successfully reduced the dormancy period of palm seeds. Additionally, soaking with 100% palm sap produced the tallest plants at 8 MST and 12 MST. This study is expected to provide useful information for the development of more efficient and practical palm seedling propagation technology.

Keywords: ***Arenga pinnata Merr, Dormancy, Dormancy Break, Growth, HCl, Palm Sap.***

INTRODUCTION

The sugar palm (Arenga pinnata Merr.) is a plantation crop native to Southeast Asia that has the potential for future development and high economic value, making it commercially viable (Farida, 2017). The sugar palm is a type of palm tree that is widely distributed throughout Indonesia. In 2023, the total area of sago palm plantations in Indonesia was 37,434 hectares (34.78% of the total area), with a production of 106,486 tons and a productivity of 2.8446 tons/hectare (Suri et al., 2024). Aren seeds have a long dormancy period, which poses challenges in providing good-quality seeds for planting (Hartawan, 2016). Aren plant propagation can only be done through generative methods, i.e., from aren seeds; however, planting using seeds requires a relatively long time due to their thick and hard seed coat structure. According to Marsiwi (2012), palm seeds naturally have a long dormancy period, varying from 1 to 12 months, due to their hard and impermeable seed coat, which inhibits water imbibition into the seed. Therefore, efforts are needed to accelerate the planting process by breaking the dormancy of palm seeds using the scarification method. Wijayanti (2022) states that scarification is a method used to break dormancy. Scarification methods are divided into two types: mechanical scarification, which uses tools such as knives, files, sandpaper, and others, and chemical scarification, which uses chemicals such as sulfuric acid, HCl, KNO3, HNO3, and gibberellin hormones. Mechanical and chemical scarification are essential, especially for seeds with physical dormancy, such as thick and hard seed coats that prevent water and gas penetration. Scarification has positive effects on plant growth, including enhancing germination capacity, accelerating germination, influencing seed vigor, and breaking dormancy. According to Astari et al. (2014), the prolonged dormancy period of seeds can be shortened through various physical and chemical treatments. Planting acceleration is achieved by removing inhibitory factors such as thinning the seed coat or using growth regulators. This study aims to examine the effects of physical, chemical, and organic scarification on seed dormancy breaking and seedling growth of sugar palm (Arenga pinnata Merr.).

LITERATURE REVIEW

The dormancy of sugar palm seeds is physical in nature due to their hard, impermeable seed coat and dense endosperm. This dormancy inhibits water imbibition and slows down the germination process, requiring special treatment to break it. Seed dormancy is a condition where viable seeds fail to germinate by the end of the observation period despite optimal environmental conditions for germination (Ilyas, 2012). Seed dormancy is also caused by the impermeability of the seed coat to water and gas, as well as an embryo that has not fully developed (Ariyanti et al., 2017). One treatment that can be applied to overcome the dormancy period of sugar palm seeds is seed scarification (Purba et al., 2014). The prolonged dormancy period of seeds can be shortened through various physical, chemical, and biological treatments (Natawijaya and Sunarya, 2018). Seed dormancy is a mechanism for plants to survive and adapt to their environment. Seed dormancy can prevent germination in the field, serve as a mechanism to preserve seed viability, and in some species, enhance storage tolerance. However, seed dormancy can disrupt planting schedules, prolong germination time, and cause issues in interpreting seed testing results (Widajati et al. 2013). Dormant breaking is a term used to describe the process or conditions used to accelerate seed germination so that the germination rate remains high. Dormant breaking treatment is applied to seeds that are difficult to germinate (Widhityarini et al. 2013). Several methods or techniques target the seed coat, embryo, or endosperm of the seed with the aim of removing germination inhibitors and reactivating dormant seed cells (Yuniarti, 2013). Dormant seed breaking is performed according to the cause of dormancy. According to Copeland and McDonald (2001), dormancy caused by physical conditions of the seed coat is typically broken through mechanical scarification or chemical scarification. Mechanical scarification involves scraping the seed coat with a grinder or sandpaper, or piercing it with a needle. Chemical scarification is performed by soaking the seeds in sulfuric acid, sodium hypochlorite, or hydrogen peroxide.

METHOD

The study was conducted in the greenhouse of the Faculty of Agriculture, University of Islam Sumatera Utara, Medan City, at an elevation of approximately 25 meters above sea level, from November 24, 2024, to April 26, 2025. The materials used included Aren seeds, rice husk biochar, topsoil, 100% red onion solution, 100% Aren sap, 100% coconut water, 3% H_2SO_4, 3% HCl, and 3% KNO_3. This study employed a non-factorial completely randomized design (CRD) with one treatment factor (soaking) repeated three times. The soaking factor (B) consisted of: B1 (3% H_2SO_4 - soaked for 6 hours); B2 (KNO_3 0.5% - soaked for 24 hours); B3 (HCl 3% - soaked for 6 hours); B4 (Sanding); B5 (Onion extract 100% - soaked for 24 hours); B6 (Palm sugar 100% - soaked for 24 hours); B7 (100% coconut water - soaked for 24 hours). The data obtained were analyzed using analysis of variance (ANOVA) at the 5% level, and if there was a significant effect, it was followed by Duncan's Multiple Range Test (DMRT). The observations conducted were: 1. Germination Rate - Calculated by observing the treatment that germinated first, observations were conducted daily to determine which treatment germinated faster with the highest percentage; 2. Plant Height - Measured using a ruler from the soil surface to the tip of the tallest leaf, conducted at 8 MST and 13 MST or at the end of the study.

RESULTS AND DISCUSSION

1. Germination Rate

Based on the results of the analysis of variance (ANOVA), it was found that scarification did not have a significant effect on the germination rate in all treatments, but there were differences in the results for each treatment. Scarification treatments B3 (3% HCl) and B4 (sanding) resulted in a faster average germination rate of 29 days (Table 1).

Table 1. Average Germination Rate of Aren Plants Due to Scarification Treatment (days)

Treatment	Germination Rate
$B_1 = H_2SO_4$ 3 %	36.00
$B_2 = KNO_3$ 0,5 %	39.00
B_3 = HCL 3 %	29.00
B_4 = Pengamplasan	29.00
B_5 = E. B. Merah 100 %	43.00
B_6 = Nira aren 100 %	37.00
B_7 = Air kelapa 100 %	38.00

Note: Numbers in the same column without notation indicate no significant difference at the 5% level based on the BNT test.

Based on these results, it can be seen that although the treatment did not have a significant effect, it can be concluded that soaking aren seeds in 3% HCL can produce the best results in terms of germination speed, maximum growth potential, and germination capacity. These results have not yet achieved the expected outcomes, but the varying differences in germination rate, Maximum Growth Potential, and Germination Capacity indicate that these results are supported by what was stated by Anggriyani et al. (2022) mentioned that differences in the percentage of palm seed germination are caused by the volume of water entering the seed, which can shorten the seed dormancy period and encourage germination. Thus, it can be concluded that soaking aren seeds in 3% HCl can open pores on the surface of the thick and hard aren seed coat, allowing water to enter the seed, resulting in faster germination of aren seeds soaked in 3% HCl. According to Rahmaniah et al. (2019), seed availability in a short time can be achieved by eliminating the dormancy period.

2. Plant Height (cm)

Based on the results of the analysis of variance, it was found that the height of the aren palm plants did not have a significant effect on the application of all treatments, both at 8 MST and 12 MST. However, there were differences in the growth data of the aren palm plants for each treatment applied (Table 2).

Table 2. Average Plant Height of Aren Palm Due to Scarification Treatment (cm)

Perlakuan	Minggu Setelah Tanam (MST)	
	8 MST	12 MST
$B_1 = H_2SO_4$ 3 %)	6.56	23.01
$B_2 = KNO_3$ 0,5 %)	4.80	16.34
B_3 = HCL 3 %)	6.26	22.33
B_4 = Pengaplasan)	6.99	22.67
B_5 = E. B. Merah 100 %	4.35	21.16
B_6 = Nira aren 100 %	8.95	25.48
B_7 = Air kelapa 100 %	4.88	19.81

Note: Numbers in the same column without notation indicate no significant difference at the 5% level based on the BNT test.

Based on Table 2 above, it can be seen that although the treatment had no significant effect, it can be noted that the average plant height at 8 MST and 12 MST was highest in the treatment of soaking palm seeds with 100% palm sap, which was 8.95 cm (8 MST) and 25.48 cm (12 MST). Meanwhile, the lowest average plant height was observed in the treatment involving seed soaking with 100% red onion extract, at 4.35 cm (8 MST), and at 12 MST, the lowest average plant height was observed in the treatment involving seed soaking with 0.5% KNO_3, at 16.34 cm. Palm sap can enhance plant growth because it contains essential nutrients and organic compounds that aid in plant physiological processes such as photosynthesis, cell division, and stem elongation. All of this is supported by the findings of Norjanah (2023) and Ginting et al. (2019), which confirm that palm sap contains 15–20% carbohydrates, N, P, K, Ca, and micro minerals, and that palm sap helps plants grow taller. During the growth phase, nutrients are required, and the introduction of Nira Aren into the aren seeds indirectly provides the nutrients needed for the plant to grow and develop. In aren seeds where the seeds are still attached, nutrients are still supplied to the cotyledons in the aren seeds. Similarly, the role of the growing medium used—topsoil and biocar charcoal husk—is important in enhancing plant growth, particularly because both improve the physical, chemical, and biological properties of the soil. The germination of palm seeds is classified as epigeal, meaning that the seeds will rise to the surface of the soil. This process requires energy not only from the embryo, so the application of ZPT is necessary to help accelerate the growth process. Palm sap is one of the natural ZPTs, which may explain why seeds at 3 BST achieved the highest plant height in the 100% palm sap soaking treatment, reaching 25.48 cm. According to the certification standards based on Ministerial Decree No. 79 of 2019, the standard height for 6-month-old palm seeds is ≥ 40 cm. Therefore, it can be concluded that the 100% Nira water soaking treatment has not yet met the standards of Ministerial Decree No. 79 of 2019 for the height of Aren plant seeds, and the 100% Nira water soaking treatment has also not significantly influenced the height of Aren plant seeds. According to Gao et al. (2022), the purpose of measuring plant height is to determine the influence of treatments and the environment on plant growth.

CONCLUSION

Soaking palm seeds in 3% HCL and sanding them produces the best results in terms of germination speed, which is 29 days, while soaking them in 100% palm sap produces the highest plant height at 8 MST (8.95 cm) and 12 MST (25.48 cm). The use of 3% HCl or sanding is recommended for breaking the dormancy of sugar palm seeds, especially since the difference in plant height produced by the 100% sugar palm sap treatment is not significant, only 3.15 cm, while the difference in germination speed is up to 8 days faster when using 3% HCl or sanding.

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