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OPTIMIZATION OF BREAKING DORMANCY OF SUGAR PALM SEEDS (*Arenga pinnata* Merr.) THROUGH PHYSICAL SCARIFICATION WITH POSITION VARIATIONS

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ABSTRACT

The germination process is the key to plant phenology, which significantly influences the success of early plant growth. Some seeds have a dormancy, so the germination process is hampered or does not occur. However, dormancy-breaking treatments in plants have been widely reported, such as breaking the dormancy of sugar palm seeds through physical scarification. This research aims to determine the best scarification position to break the dormancy of sugar palm seeds. This research was carried out at the Seed Technology Laboratory, Faculty of Agriculture, Universitas Andalas from July to October 2023. The design was completely randomized with scarification in two position variations, the operculum (A1) and dorsal (A2) points, repeated thrice. The results showed that the position of seed scarification affected the emergence time of cotyledon petioles and coleoptiles, germination capacity, and seed moisture content. Scarification at the operculum point requires a dormancy break of 16 DAP (Days After Planting) compared to 29 DAP for the dorsal. Seed viability was good in seeds sacrificed at the operculum point, with a germination percentage of 81.94%.

Keywords: dorsal, operculum, cotyledon petiole

INTRODUCTION

Sugar palm plants are found in many tropical areas with many benefits, especially for food, forest conservation, and biofuel. In Indonesia, especially in West Sumatra, sugar palm cultivation has not been done intensively, only using sugar palm that grows wild in forests or people's gardens. The selection of high-quality seeds is also based solely on seeds consumed by animals, such as civets, that grow in a specific location. This process breaks dormancy due to the enzymes and high temperatures in the civet's stomach, allowing the seeds to germinate.

As reported in numerous studies, sugar palm seed dormancy is attributed to various factors. Hartawan (2016) states that the cause of dormancy in palm seeds is the rigid and impermeable seed coat, hindering water imbibition. Rozen et al. (2016) highlight that dormancy in palm seeds is structural, arising from the harsh conditions of the seed coat and endosperm. Additionally, Tambunan (2023) asserts that dormancy in palm seeds can also be induced by inhibitory substances, such as ABA (abscisic acid), immature embryos, and genetic factors in the sugar palm plant.

Based on the causes of dormancy in sugar palm seeds, appropriate treatments are needed to break dormancy, and seed sources will respond differently. Matanari et al. (2023) reported that applying gibberellin at a concentration of 3.5 mg/l can enhance the maximum growth potential to reach 98.33%. Physical treatments (filing, perforation, pounding) germination rates are 54-64% higher than untreated seeds, which only exhibit a germination rate of 40% (Rahmaniah et al., 2018). Pangestu et al. (2021) indicate that a concentration of 20 ml/l of atonic can accelerate the emergence of apical buds, 13 DAP, compared to untreated seeds, which take

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19 DAP. However, dormancy breakage through scarification and using natural growth regulators in the study by Wulantika and Sentot (2023) did not result in germination or dormancy breakage up to 120 days after germination.

The breaking of dormancy through physical and mechanical scarification is most commonly reported. Scarification involving the abrasion of the seed coat should also consider the proper position to achieve the goal of accelerating seed germination. Therefore, this research aims to determine the optimal position for scarification to break dormancy in sugar palm seeds.

MATERIALS AND METHODS

This research was conducted at the Laboratory of Seed Technology, Faculty of Agriculture, Universitas Andalas, from July to October 2023. The seeds were sourced from Nagari Batu Bulek, Kecamatan Lintau Buo Utara, Kabupaten Tanah Datar, West Sumatra. The selected parent trees had already produced good sap yields and were free from pest and disease attacks. The sugar palm seeds were collected from fruits that had reached physiological maturity, with a yellow-brown and smooth exocarp, a yellow-brown and soft mesocarp, and a very hard, dark black endocarp (Figure 1).

Figure 1. Physiologically ripe sugar palm fruit (2,5 GY)

The seeds were not extracted or manually separated from the fruit peel. Seed retrieval was performed carefully using protective equipment such as gloves due to the itching sensation caused by the presence of oxalate compounds in the fruit's flesh. Subsequently, scarification was carried out at two different positions, the dorsal part, and the operculum point, using 100-grit sandpaper. The operculum of the palm seed also exhibited variation in its location, marked by a slight depression on the seed coat (Figure 2). The seeds were then soaked in water for 36 hours. Each treatment consisted of 25 seeds with three replications.

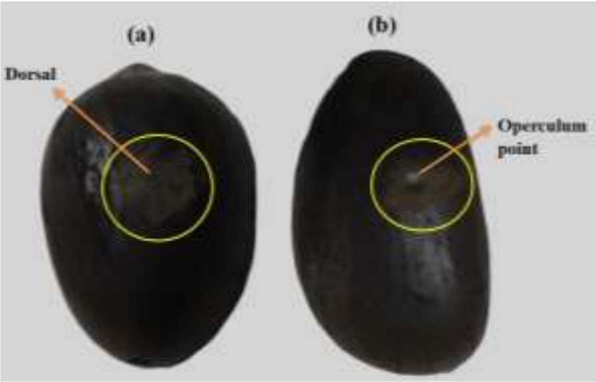

Figure 2. Variations in scarification positions (a) dorsal (b) operculum point

The seeds were germinated using sand as a medium previously sterilized using an autoclave for 30 minutes at a temperature of 101°C. Subsequently, the seeds were placed in a germination chamber at 28°C without light. The observed parameters included the time of appearance of the cotyledon petiole and coleoptile, germination power, and seed water content. The Cotyledon petiole refers to the part that connects the cotyledon (the first embryonic leaf in plants that emerges from the seed).

RESULTS AND DISSCUSSION

The Time of Appearance of Cotyledon Petioles and Coleoptiles

The germination of sugar palm seeds, which have broken dormancy or sprouted, is marked by the emergence of the cotyledon petiole. The position of the cotyledon petiole's emergence is often associated with the embryo's position within the seed. The calculation of days is based on the attainment of T50, where 50% of the seeds have germinated. The counting of days begins from the time the seeds are germinated in the germination chamber. The time required for sugar palm seeds to germinate can be observed in Table 1.

Table 1. Time of emergence of cotyledon petioles and coleoptiles of sugar palm sprouts with different scarification positions

Scarification positions	Cotyledon petiole (DAP)	Coleoptile (DAP)
Operculum point	16a	41a
Dorsal	29b	59b

Numbers followed by different lowercase letters within columns indicate significant differences according to the DMNRT post hoc test at a significance level of 5%

Based on Table 1, scarification at the operculum point results in a faster dormancy break than scarification at the dorsal. Hartawan (2016) reported that sugar palm seeds whose seed coat was scarified on average germinated on the 130 DAP, in contrast to not scarified seeds that took longer, reaching 191 DAP. Based on research by Chaerani (2023), sanding sugar palm seeds in the embryo position resulted in the highest germination percentage of 70.66% compared to 57.33% without sanding. Scarification treatment applied directly to the embryo's position tends to be more effective in breaking the dormancy of sugar palm seeds (Farida, 2016). Scarification at the operculum point also makes it easier for the cells and tissue of the prospective cotyledon petiole to penetrate the thin seed coat.

The morphology of sugar palm sprouts when the cotyledon petiole has appeared 2 mm and the coleoptile at 60 DAS can be seen in Figure 3.

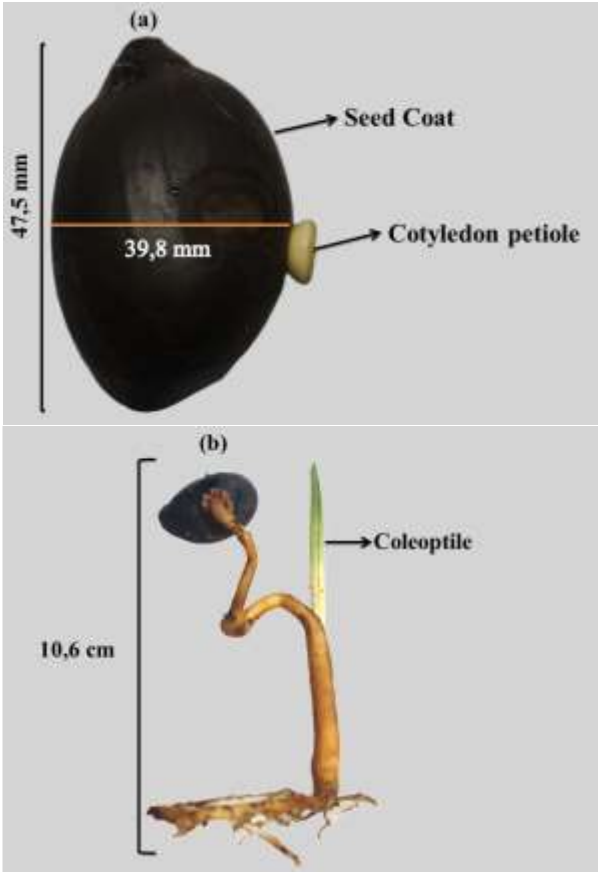

Figure 3. Morphology of Sugar Palm Sprouts (a) When the cotyledon petiole appears (b) Coleoptile

Sanding palm seeds makes the seed coat thinner, so the imbibition occurs more quickly. Rofik and Endang (2008) stated that the most effective scarification method in breaking the dormancy of sugar palm seeds is by deoperculating the position of the embryo, where the palm seeds have different embryo locations, such as the right or left side of the back and some are located in the middle. Sari et al. (2021) also reported four variations in the appearance of the cotyledon petiole: the top and bottom right and the top and bottom left positions. The difference in position where the cotyledon petiole emerges in this study can be seen in Figure 4.

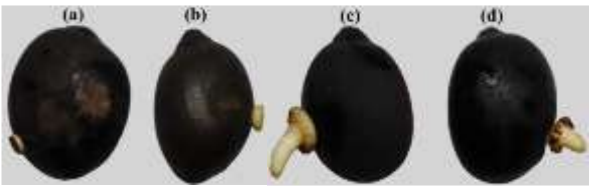

Figure 4. Position of appearance of cotyledon petiole on sugar palm sprouts

Mechanical scarification at the operculum point using a sitting grinder and 100 ppm GA3 can speed up the dormancy breaking time, namely 18.67 days (Noprizal et al., 2023). Based on Table 1 above, an essential thing to study further is the length of time required for coleoptile formation. The average time needed is more than one month, longer than the time for dormancy to break or the cotyledon petiole to emerge.

Germination Test (%)

Seed germination can reflect the level of seed viability. Germination capacity is calculated based on the number of seeds germinating, typically at a specific count divided by the total number of seeds germinating. The germination capacity of palm seeds in two different scarification positions can be seen in Table 2 .

Table 2. Germination rate of sugar palm seeds at 90 DAP

Scarification positions	Germination (%)
Operculum point	81,94a
Dorsal	64,61b

Numbers followed by different lowercase letters within columns indicate significant differences according to the DMNRT post hoc test at a significance level of 5%.

Scarification at the operculum point produces regular sprouts reaching 81.94% up to 90 DAP, meaning that the sugar palm seeds used have good viability. Hartawan (2016) shows that breaking dormancy with scarification treatment on the seed plumule and 1% KNO3 produces germination to 86.67%. Sanding on the right side of the seed (embryo position) resulted in the fastest germination, with an average time for sprout emergence on 7 DAP, the percentage of sprouts reaching 45.6%, and radicle length reaching 6.3 cm on 11 DAP (Yamesa dan Yuliana 2021).

The germination process in sugar palm plants is included in the epigeal category because the palm seeds rise to the soil's surface (Matana, 2013). Rofik and Endang (2008), apart from the source of sugar palm seeds, germination media also influence factors such as sand and charcoal husk media, which have a high maximum growth potential value reaching 96.67%.

Seed Water Content (%)

Water content was essential in seed germination because the imbibition process was the initial stage of successful germination. The success of this imbibition process can be seen by increasing the water content of the seeds before and after being soaked in water. The water content of palm seeds before and after the imbibition process (soaked in water for 36 hours) can be seen in Table 3.

Table 3. Seed moisture content after harvest and after imbibition.

Scarification positions	Harvest	After imbibition
	Seed water content (%)	
Operculum point	21,83	26,24
Dorsal	22,04	29,50

Numbers followed by different lowercase letters within columns indicate significant differences according to the DMNRT post hoc test at a significance level of 5%

Sugar palm seeds are intermediate with a relatively high moisture content (20-30%). An increase in the water content of the seeds before and after soaking can be seen when sanding the dorsal; this is due to the thin seed coat's wider area than when sanding the operculum point. Hartawan (2016) found that there was an increase in the water content parameters of scarified seeds in the plumule (33,57%) on the dorsal (33,50%), with 21,05% without scarification. Imbibition still occurs even though the seeds do not undergo a scarification process. Even though it is at a low level, the continuity of this imbibition process shows that the sugar palm seed coat is not entirely resistant to water; it is just that this process takes place slowly.

CONCLUSIONS

Breaking dormancy through physical scarification with sanding at the operculum point yielded higher germination rates (81.94%) than the dorsal part. Scarification at the operculum point also accelerated the emergence time of the cotyledon petiole, occurring 16 Days After Plantings.

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