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Morphology and germination of the candlenut seed (*Aleurites moluccana*) from Samosir Island-North Sumatra

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Abstract. *Aleurites moluccana* or locally known as *kemiri* or candlenut is domesticated multipurpose tree species found in Indonesia, particularly in North Sumatra. As one of high economic value commodities, candlenut can be adopted as agroforestry species, windbreak, soil immobilization and land rehabilitation for critical land that can improve community livelihood with a variety of benefits. Information regarding seed characteristics of the candlenut in North Sumatra Province and its germination strategies is still limited, whereas this information are needed to support candlenut cultivation. Therefore, this research was conducted to obtain information on morphology and germination process of the seed of candlenut. Direct measurement and observation of seed were quantified to observe the seed morphology. The germination process is also quantified through direct observation. The results of seed morphology showed that the candlenut had rough elliptical shell shape with about 6.08 cm in diameter and the shell thickness was approximately 2.56 cm. Germination process took 4-5 months with hypogeal germination type.

1. Introduction

Candlenut is one of ornamental domesticated trees that have been widely cultivated in the world. This species is native to Indo-Malaysia and has been introduced into Pacific Islands by Aborigin people [1]. In Indonesia, candlenut has been planted for both subsistence and commercial purposes, particularly in regions with a tropical monsoon climate and has been important in sustaining the everyday life of people in Eastern Indonesia [2]. The species has been used for various purposes; for an instance, the seeds can be used as media for lighting, cooking and medicine and the stems can be used for wood [3]. Previous research on its pharmacological use found that candlenut is also prospective medicine for ulcers, headache, fever, diarrhea and hypocholesterolaemia and many more. The extracted oil from seeds has been used as a strong irritant and laxative similar to castor oil [4].

The production area of candlenut in Indonesia tends to increase every year. It has been supported by potential land area and candlenut plants production in Indonesia since 2004. In 2004, the area of candlenut land was 206,321 Ha with yields of 94,005 tons, until 2009 the estimated area of land was 210,198 ha which increased the production by 111,058 tons [5]. However, along with modern



agriculture development, the management and germination process of high quality seed is very important. The data of candlenut seed were required to analyse, evaluate, and maintain the quality of the products [6].

Seed is an essential planting material to obtain high yields. Seed is also genetically and physiologically able to determine the successfulness of cultivation process [7]. Quality seeds are those that have characteristics such as high levels of genetic and physical purity, health and safe water content during storage. Germination of plants by using seeds often encounters obstacles because the morphology of certain seeds causes seed dormancy which requires special treatment [8]. Therefore, our study was conducted to determine the morphology and germination of candlenut seed.

2. Material and methods

The seeds for the morphological observation originated from Parbaba Village, Pangururan Subdistrict, Samosir Regency, North Sumatera Province. The germination process was conducted in a greenhouse at Faculty of Agriculture, Universitas Sumatera Utara. The initial step of morphology and germination study was selecting the superior trees and identifying the fruit trees. The seeds were directly harvested from selected trees by threshing, picking, and collecting fruit on the forest floor [7].

The morphological observation of the seeds was carried out directly on fresh and mature candlenut seeds. Observation and measurement were conducted using calliper to all seed part, namely: seed diameter, shell thickness and endosperm condition. The morphological observation was conducted through primary observation on the whole outer and inner seed part such as fruit colour, shape, endosperm, cotyledon, epicarp and endocarp colour.

The germination process was conducted after submerging half of the seeds into the prepared planting media (sand). The germination process was observed and measured after the seed coat was opened and began to germinate. Seed development was identified based on its morphological differences before and after germination.

3. Result and discussion

3.1. Seed morphology

Morphologically, candlenut seeds were classified into of stone fruit type because of their physical characteristics of hard skin, shell shape, and roughly curved outer surface. The ripe candlenut seed could be identified from pale green pericarp and brown shell (Figure 1a), while the unripe fruit had light green pericarp and brown shells with different hardness. The average seed diameter of Ssamosir candlenut was 6.08 cm. The seeds had a hard, black, rough, elliptical shell and about 2.56 cm. Candlenut shells are similar in shape and texture to walnut shells, yet they were smaller and thicker and there were about 100–120 seeds covered with shells, but with husks removed [9].

There were two seeds of candlenut in one fruit. The two seeds were adjacent to a parallel position in the fruit. The candlenut seeds had three layers differing in colour appearance. The first layer was brown, the second layer was white and the inner part was bright green (Figure 1b). In the third layer there was a black coat covering the seed shell (Figure 1c).

Candlenut seeds had different thicknesses on the top and bottom of the shell. At the top of shell was a hilum and at the bottom was a micropyle. The shape of bottom of shell was slightly tapered compared to the top of the shell (Figure 1b). The top of shell also showed differences in colour, which were getting closer to the colour of the shell that tended to be lighter. In ripe fruit, there was a small pore on the micropyle. During the germination process, the micropyle became a place where the roots emerged. Whereas, the hilum became a place where seeds were attached to the stems of plants when germinated.

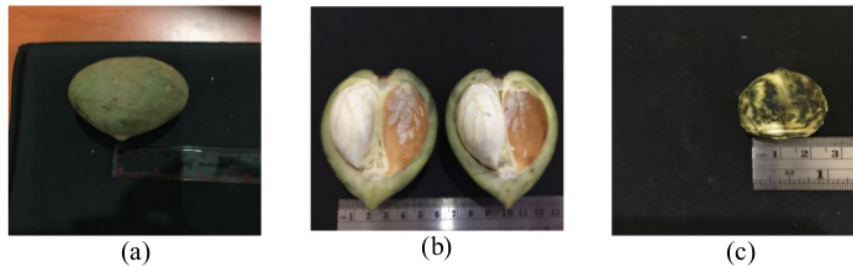


Figure 1. Seed morphology of candlenut (*Aleurites moluccana*)

Based on the observation and measurement results, the mean of candlenut diameter was 6.08 cm, seed apex hole was 1.05 cm, shell thickness was 2.58 cm, and cotyledon thickness was 3.99 cm (Table 1). The shell was hard and might be the cause for long germination of candlenut seed. This statement is in accordance with [10] stating that dormancy can be caused by external factors, one of which is seed coat thickness.

Table 1. Candlenut (*Aleurites moluccana*) fruit diameters, micropyle, shell thickness, cotyledone and germination time

Seed	Diameters (cm)	Seed apex hole (mm)	Shell thickness (mm)	Cotyledon (cm)	Germination time (day)
1	6.15	1.05	2.88	4.25	not germinate
2	5.93	0.98	2.36	3.62	107
3	6.26	1.16	2.79	4.51	85
4	6.02	0.97	2.38	3.55	103
5	6.31	1.27	2.91	4.54	101
6	5.87	0.95	2.31	3.53	not germinate
7	5.93	0.97	2.33	3.66	101
8	5.85	0.94	2.29	3.52	not germinate
9	6.18	1.06	2.72	4.29	103
10	6.28	1.16	2.78	4.42	not germinate
Mean	6.08	1.05	2.56	3.99	

3.2 Seed germination

The research showed that untreated candlenut seeds took a long time to germinate (Table 1). The length of candlenut germination time was caused by physical barrier due to its hard shells and it causes the germination time takes 3-5 months [1]. Hard shells could inhibit water absorption and caused seed dormancy. The candlenut had hard and impermeable seed shell [11-12] and the shell was resistant to O₂ and water. Both factors caused the candlenut seed dormancy (resting) and need 4-5 month for germinate.

The candlenut germination process began with the breaking of shell and the appearance of light green hypocotyl (Figure 2). After that, the hypocotyl grew larger, formed roots in the soil. Based on this germination process, it could be seen that the candlenut seed had a hypogeal germination type. It is indicated by the growth of seeds that turned into pieces of cotyledons and remained below the surface of the soil while hypocotyl grew upward and grew leaves. Hypogeal type is when the cotyledons is not enlarged, so that they remain underground during germination [13].

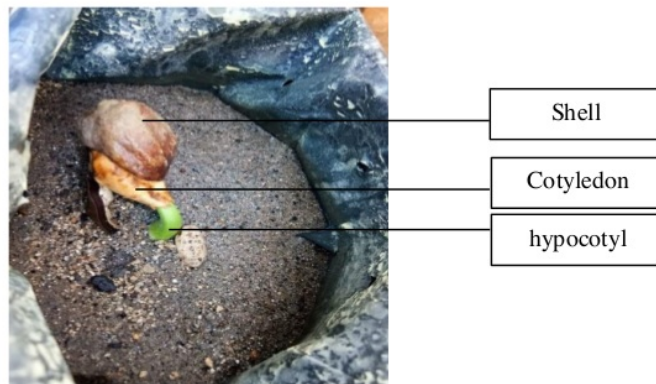


Figure 2. Candlenut germination

Several seeds experienced abnormal growth and died. Abnormal germination was indicated by the growth of curved hypocotyl stems, undeveloped leaves and very long stem length/above average (Figure 3a). Dead seeds were indicated by the absence of hypocotyl from the beginning of the germination process until its enlarge and development (Figure 3b). Unlike seeds that grew abnormally and died, normal germination would look fresh, healthy and would have green leaves at the end of the germination period (Figure 3c).

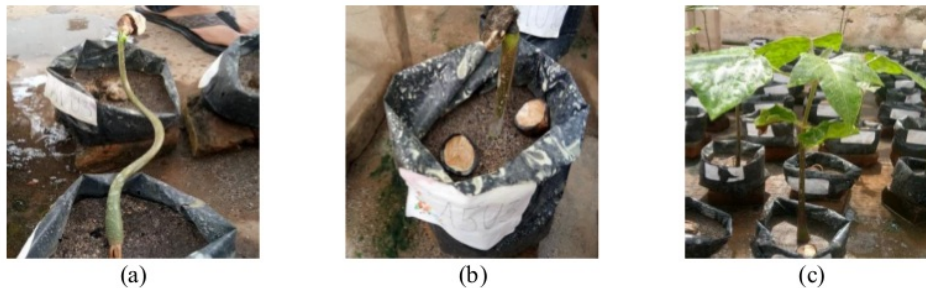


Figure 3. Candlenut sprout growth

Abnormal seed growth can occur when the seed has a low vigour that affects the hypocotyl growth during the germination process. Seed vigour is one of the characteristics of seeds that determines the potential for rapid and normal growth of sprouts [14]. The low vigour of a seed is caused by several factors such as physiological, cytological and microbial. Unsuitable storage condition may cause abnormal growth and affect the seed vigour. The low seed vigour can be caused by deterioration of seed quality during storage.

4. Conclusions

It is concluded that ripe candlenuts would be round with pale green pericarp and brown shell, an average diameter of 6.08 cm, shell thickness of 2.58 cm, and cotyledon thickness of 3.99 cm. Based on the germination process, the candlenuts were classified into hypogeal germination type that took more than 3 months to germinate.

References

- [1] Siemonsma J S 1999 *Plant Resources of South-East Asia* vol 13, ed De Guzman C C and Siemonsma J S (Netherland: Backhuys Publishers)

- [2] Koji T 2000 *Proc. International Symposium and Workshop the Beginning of the 21st Century: Endorsing Regional Autonomy, Understanding Local Cultures, Strengthening National Integration* (Makassar: Hasanuddin University) pp 1-23
- [3] Krisnawati H, Kalilo M and Kanninen M 2011 *Aleurites moluccana* (L.) Willd. *Ecology, Silviculture and Productivity* (Bogor: CIFOR)
- [4] Shamsuddin T, Rahman W, Khan S A, Shamsuddin K M and Kintzinger J B 1988 Moluccanin, a coumarinolignoid *Aleurites moluccana* *Phytochemistry* **27** 1908-09
- [5] Sihombing T P H 2011 *Analysis of the People's Crop Management at Pinem Field District Dairi, North Sumatera Province* (Bogor: Bogor Agricultural University)
- [6] Mohsenin N N 1986 *Physical Properties of Plant and Animal Materials. Structure, Physical Characteristics and Mechanical Properties* (New York: Gordon and Breach Science Publishers)
- [7] Susilowati A, Kusuma Y S and Kholibrina C R 2019 Seed Morphology and Germination of Macadamia (*Macadamia integrifolia*) North Sumatra *IOP Conf. Series: Earth and Environmental Science* **260** 2019 012164
- [8] Lita S 2010 *Seed Technology* (Jakarta: Rajawali Pers)
- [9] Elevitch C R and Wilkinson K M 2003 *Propagation Protocol for Production of Container Aleurites moluccana* (L.) Willd *Native Plant Network* (Moscow: College of Natural Resources, Forest Research Nursery)
- [10] Abidin Z 1993 *Dasar-Dasar Tentang Zat Pengatur Tumbuh [The Principles of Plant Growth Regulator]* (Bandung: Penerbit Angkasa)
- [11] Husain I and Rully T 2012 Breaking Dormancy of Candlenut (*Aleurites moluccana* L. Willd) Using Organic Plant Growth Regulator Basmingro and Its Effect to Seed Viability *JATT* **1** 2 2252-64
- [12] Kholibrina C R, Susilowati A, Kusuma Y S and Aswandi 2019 The Effect of Various Storage Condition to Maintain Macadamia (*Macadamia integrifolia*) Seeds Viability *IOP Conf. Ser.: Earth Environ. Sci.* **305** 012006
- [13] Irawanto R, Ariyanti E E and Hendrian R 2015 *Pros Sem Nas Masy Biodiv Indon* **1** 5 pp 1011-1018
- [14] Utami E P 2013 *Perlakuan Priming Benih untuk Mempertahankan Vigour Benih Kacang Panjang (Vigna unguiculata) Selama Penyimpanan [The Seed Priming Treatment for Enhance Vigna Unguiculata Seed Vigour]* (Bogor: Departemen Agronomi dan Hortikultura [Department of Agronomy and Horticultural] Institut Pertanian Bogor)

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