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Exploration and Identification of the Malacca Plant in North Padang Lawas District, North Sumatra

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ABSTRACT

The Malacca plant is well-known for its therapeutic benefits and is commonly used to make jam. It is critical to understand the existence and diversity of Malacca plants to preserve germplasm and improve attributes through plant breeding. This study sought to investigate and identify malacca plants in North Padang Lawas Regency. The study was conducted in three subdistricts: Halongonan, Padang Bolak, and Padang Bolak Julu, from May to June 2023. This study employed a survey using purposive sampling. Malacca plant samples from the generative period (flowering and fruiting) were selected. The observation included vegetative characteristics (plant height, stem bark color, leaf size, shape, and color) as well as generative characteristics (flower and fruit shape and color). The findings revealed that there were eight accessions dispersed throughout four settlements. One accession, HT1, is designated as the *Phyllanthus emblica* species due to changes in leaf, flower, and fruit morphology. In contrast, the remaining seven accessions are categorized as *P. indofischeri*. The changes can be seen in the shape of the leaf tips, stigma branching, and fruit shape and size.

Keywords: indian gooseberry, *Phyllanthus emblica, Phyllanthus indofischeri*

INTRODUCTION

Malacca plants have two scientific names: *Phyllanthus emblica* and *P. indofischeri*. This plant belongs to the Phylanthaceae family, which was once part of the Euphorbiaceae family. The Malacca plant, also known as amla, aonla, or Indian gooseberry, is found in Southeast Asia and western India and has long been cultivated in India for a variety of purposes, including traditional medicinal and food consumption (Pathak 2003, Kishore 2017). The Indian gooseberry was previously recognized as the genus Emblica before being renamed Phyllanthus (Singh *et al.* 2019). The plant is widely cultivated in India, and its processed products are exported to over 42 countries. Malacca germplasm has been commercialized and released in India as numerous cultivars, including Banarasi, Francis, Krishna (NA-4), Kanchan (NA-5), Balwant (NA-10), Chakaiya, Narendra Aonla-7 (NA-7), and NA-9 (Pathak 2003, Kishore 2017, Charmkar & Singh 2022, Sawant *et al.* 2022).

Phyllanthus emblica and *P. indofischeri* differ in their morphological characteristics and adaptability to various environments. *P. emblica* is the more extensively known and cultivated species, whereas *P. indofischeri* is less widespread. Krishna (NA-4) is one of the most popular *P. indofischeri* cultivars in India. The usage of these two scientific names suggests that there is extensive genetic variety across malacca plant species, which is used in breeding to improve qualities like disease resistance or adaptation to certain climatic circumstances (Ganesan 2003).

In Indonesia, the malacca plant is known as *kimalaka* (Indonesia), *kemloko* (Java), *malaka* (Sunda), and *balakka* (North Sumatra). Its distribution region includes the islands of Java, Sumatra, Kalimantan, Maluku, and Nusa Tenggara, where it grows in the form of trees and is considered wild in the forest (Uji 2007). Southern part of North Sumatra is one of the places that have been reported to be the distribution site for the malacca, primarily located in the Padang Lawas and North Padang Lawas districts. Malacca can typically be found growing wild in uncultivated dry places, is only used in a traditional spice mixture known as *holat* (Khoiriyah *et al.* 2015). The plant's young stem bark is utilized in spice mixtures. Typically, the peasants would harvest the malacca plant by chopping it down, causing the existence of wild malacca in nature to progressively decline or become extinct if they were not conserved by collection or cultivation.

Several studies on malacca plants conducted in Indonesia and reported as *P. emblica* have only been limited to its distribution in Indonesia (Uji 2007, Khoiriyah *et al.* 2015), dormancy breaking test on malacca seeds (Adelina *et al.* 2020), ethnobiological study of malacca plants (Keim *et al.* 2020), and the use of malacca fruit extract as a mixture of drinking water for broiler chickens (Hutasuhut *et al.* 2023). Meanwhile, investigations on the distribution and identification of

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malacca plants in North Sumatra, particularly Padang Lawas Regency, have received little attention.

The purpose of this study is to examine and identify malacca plants scattered throughout North Padang Lawas Regency to learn about the diversity of individual plants. This study is expected to provide a significant source of information about other species of malacca, such as *P. indofischeri*, which can then be utilized to gather and cultivate the plants in Indonesia.

METHODS

This study was carried out from May to June 2023 in North Padang Lawas Regency, North Sumatra Province, located between 1°13'50"−2°2'32" N and 99°20'44"−100°19'10" E. Malacca plant samples were gathered from three subdistricts in North Padang Lawas Regency: Halongonan, Padang Bolak, and Padang Bolak Julu. This study used a survey approach with purposive sampling. The exploration began with a preliminary survey to obtain information about the existence of the plants in the local population. The plants used as samples were in the generative phase, which includes flowers and fruit.

Plant sampling locations were organized using a mobile-based web map program (Google Maps pins location). The morphological plant observations were carried out on vegetative characters (plant height; bark color; leaf size, shape, and color) and generative characters (shapes and colors of flowers and fruits), which refers to the description of vegetative and generative characters of two modified malacca species (*Phyllanthus emblica* and *P. indofischeri*) (Ganesan 2003). Quantitative data on vegetative and generative characteristics were obtained from three samples of plant parts or three replication observation sites and evaluated using Microsoft Excel. Qualitative data on vegetative and generative characteristics were captured in photographs and examined descriptively.

RESULTS AND DISCUSSION

General Condition of the Research Site

The topography of exploration sites is often flat and inclined. Halongonan and Padang Bolak subdistricts feature level topography, whilst Padang Bolak Julu has slope and steep topography. Malacca plants were discovered in eight locations: three in Hutanopan village (HN), one in Hutaimbaru village (HT) in Halongonan Subdistrict, three in Sipenggeng village in Padang Bolak Subdistrict (PB), and one in Sipupus village in Padang Bolak Julu Subdistrict (PBj) (Table 1).

The density of the plant population was quite variable, with the lowest population being one plant and the largest population exceeding 100 plants. Populations are typically concentrated in hillside locations with grassland environments. Malacca typically grows wild in hot, arid, and barren places. Agricultural operations are minimal in the hillside area, allowing this plant to thrive without interference. This area was preserved as grassland around the plant. The grassland soil is often sandy and low in nutrients. This is evident from the fact that the plants are only about 5 m tall. The height of plants identified ranged from 4.3 to 10.8 m, varies greatly because it grows wild rather than being cultivated. Meanwhile, the plants that grow naturally in flat regions tend to be taller (10.8 m). It is assumed that its environment, which consists of woods and rubber plantations, has relatively fertile soil due to the breakdown of fallen leaves from the trees.

The overall appearance of the plants was rated moderate and good for further identification and characterization. Moderate conditions apply when accessions arise during the generative phase (flowering). While a good criterion was whether the selected accession was flowering and fruiting.

Figure 1 depicts the appearance of many malacca accessions from various settings. The plants were not farmed by the community, thus they can be found distant from residential places, such as bush

Table 1 Malacca accessions found across North Padang Lawas

Accession	Sampling coordinates	Subdistrict/ Village	Topography	Habitat	Height (m)	Population
HN1 HN2 HN3	1° 33' 0.504" N 99° 45' 8.748" E	Halongonan/ Hutanopan	Flat	Forest	5.7 4.3 6.5	23
HT1	1° 32' 58.596" N 99° 45' 10.836" E	Halongonan/ Hutaimbaru	Flat	Forest	10.8	1
PB1	1° 32' 58.56" N 99° 43' 51.744" E	Padang Bolak/ Sipenggeng	Flat	Rubber plantations	8.9	5
PB2	1° 33' 0.252" N 99° 43' 50.988" E		Flat		6.7	
PB3	1° 25' 12.288" N 99° 32' 6.864" E		Flat		6.9	
PBj1	1° 25' 12.288" N 99° 32' 6.864" E	Padang Bolak Julu/ Sipupus	Hillside	Grassland	5	>100

woodlands (Figure 1a), agricultural land between rubber plants (Figure 1b), and grassland (Figure 1c). According to Khoiriyah *et al.* (2015), malacca can grow in open areas, secondary dryland forests, industrial plantations, dryland farms, shrubs, and paddy fields. Ahmad *et al.* (2021) described that malacca species, *P. emblica*, is usually found on slopes and beaches and thrives in tropical and subtropical climates like Malaysia, Pakistan, and Southeast Asia.

Morphological Vegetative Character

All malacca accessions have gray bark with irregular white dots. Old tree bark spontaneously peels off in square or irregularly shaped flakes with irregular red-brown patches (Figure 2). The stem bark characteristics of eight plant accessions are similar to those reported by Sangeetha *et al.* (2010), namely that the stem bark of both *P. emblica* and *P. indofischeri* species is grey in color, ranging from light to dark grey and accompanied by irregular white spots. The brown bark trait used to identify *P. emblica* species from *P. indofischeri* (Ganesan 2003) was not present in all accessions.

All accessions have compound leaves composed of several leaflets. The average length of compound leaves varied from 13 to 21 cm, with 70 to 141 leaflets. The leaflets ranged in length from 1.6 to 2.2 cm and width from 0.3 to 0.5 cm (Table 2). Long thin leaves (linear) with pointy tips (apiculate) were observed in four accessions: HN2, HT1, PB2, and PBj1. The other four accessions have an elongated leaf shape with slightly parallel sides, like an oblong rectangle with a round tip, and the leaflets' bases are heart-shaped (cordate) or circular (Figure 3). The upper leaf surface is green, and the lower leaf surface is greyish green. Yellow colored dots appear on the upper leaf surface of accessions HN3 and PBj1. This implies that the leaves have matured since they are undergoing senescence and will eventually fall or fall off.

Based on the morphological description of vegetative characters used to distinguish *P. emblica* species from *P. indofischeri* (Ganesan 2003), it is

Figure 1 General appearance of malacca plants in three districts: (A) Halongonan (HN1 accession), (B) Padang Bolak (PB3 accession, white arrow) and (C) Padang Bolak Julu (PBj1 accession).

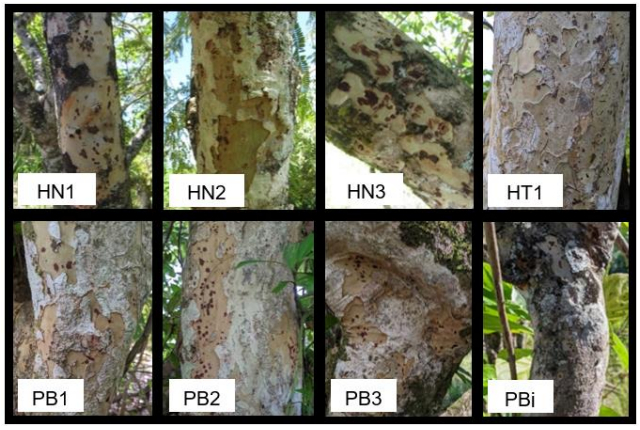

Figure 2 Stem bark color of malacca plants explored in North Padang Lawas Regency. HN (Hutanopan), HT (Hutaimbaru), PB (Sipenggeng), PBj (Sipupus)

Table 2 Average leaf length, number, and size of leaflets of malacca plants explored in North Padang Lawas Regency

Parameters	Accession							
	HN1	HN2	HN3	HT1	PB1	PB2	PB3	PBj1
Leaf length (cm)	13.1	20.8	18.3	18.7	17.7	15.2	15.4	20
Number of leaflets	87	128	141	99	70	81	64	102
Leaflet size (l×w cm)	1.6×0.4	1.8×0.4	1.3×0.4	1.8×0.4	1.9×0.3	1.8×0.4	2.2×0.5	1.8×0.3

Description: HN = Hutanopan, HT = Hutaimbaru, PB= Sipenggeng, and PBj = Sipupus

difficult to determine whether the explored accessions are *P. emblica* or *P. indofischeri* based on leaf length, number of leaflets, leaflet size, leaf shape, and color. There are some mismatches between each character, such as accession HN2, which has the number of leaflets and leaflet size according to the description of *P. emblica*, with more than 100 leaflets and leaf sizes ranging from 1.8 × 0.5 cm, but the leaf length is only half of the description (40 cm). This could be attributed to the effects of various agroclimatic situations. According to Sangeetha *et al.* (2010), *P. emblica* growing at medium altitude (400−800 masl) had leaflets that were 2−3 times longer and wider than those growing at low (200−400 masl) and high altitude (800−1500 masl).

Morphological Generative Characters

Only six accessions are currently blossoming. Except for HN2, which only has generative buds with male flowers, accession HN3 has reached the end of its flowering period because it only has generative buds with male flowers that are no longer present and female flowers that have been pollinated, as indicated by the tip of the pistil head drying up (Figure 4a). Five accessions feature compound blooms, which are made up of multiple female flowers surrounded by several male flowers with longer flower stalks than the females. The female flower is located at the top of the generative bud. The female flower's corolla consists of six sections that are greenish white or pale green in hue, and the pistil late stalk is three-branched. The male flower's corolla is greenish-white or pale green, with three yellow anthers. Avinash *et al.* (2024) stated that the *Phyllathaceae* has little blooms that are either male or female. Male blooms are attached to the leaves, followed by two female flowers in the lower axillary area.

The form of the stigma differs between the five accessions. The stigma form of an HT1 accession is either divided in two (dichotomously bifid) or branched with flat and curved shapes. PB2 accession has a two-branched stigma, but the apex is somewhat divided

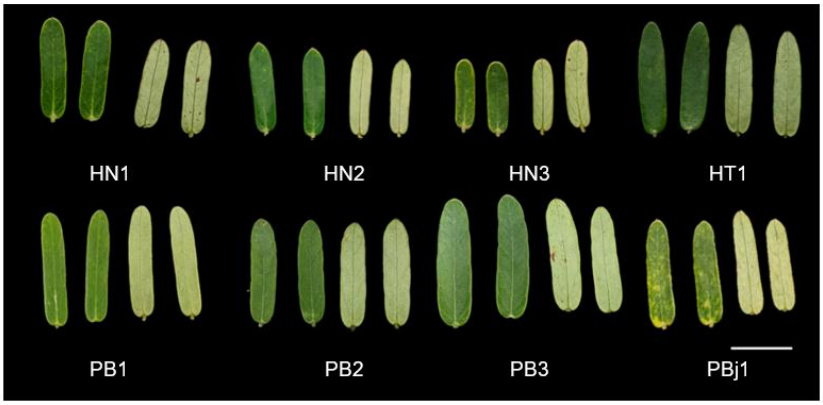

Figure 3 The leaf shape and color of malacca explored in North Padang Lawas Regency. HN = Hutanopan), HT = Hutaimbaru, PB = Sipenggeng, and PBj = Sipupus. White line length = 1 cm.

Figure 4 Morphology of (a) flower and (b) pistil of malacca explored in North Padang Lawas Regency. HN = Hutanopan, HT = Hutaimbaru, PB = Sipenggeng, and PBj = Sipupus, White arrow = branching shape of stigma, and White circle = the node color where the flower appears.

and thicker. HN1, HN3, and PBj1 accessions contain more than two branching stigma types (dichotomously branched). Based on Ganesan's morphological description of vegetative features, the difference in stigma branching form may easily determine which accessions belong to *P. emblica* or *P. indofischeri*. The HT1 accession is classed as *P. emblica*, while the remaining accessions are classified as *P. indofischeri*. Another noticeable difference is that the brown hue on the node where the blooms develop in the HT1 accession is less intense than in other accessions (Figure 4b).

All eight accessions produce round fruit (globose). HT1 accessions feature smaller and flatter fruit shapes than other accessions because the vertical diameter of the fruit measured from the base to the tip is shorter than the horizontal diameter. This fruit shape corresponds to the description of *P. emblica* fruit. The other fruits matched the description of *P. indofischeri*'s fruit (Ganesan 2003). Another noticeable difference is that Accession HT1 has a blunter endocarp tip. The rind colors of all accessions ranged from yellowish green to pale yellow. The rind surface is lustrous, with some brown spots produced by insect infestation or signaling that the fruit has completed the physiological ripening period, as seen in the HN1, HN2, PB1, and PBj1 accessions (Figure 5).

According to Khan (2009), Patel, and Goyal (2012), the mesocarp or pulp of the malacca fruit is yellowish green to pale yellow. The endocarp, which hardens like a rock to preserve the seed, turns yellow-brown as it ripens. The fruits of the HN1, HT1, and PB3 accessions are smaller in size and thinner in flesh thickness than the other accessions because they are still immature and not fully ripe. The color of the mesocarp is still yellowish green, but the endocarp remains green. The PB2 accession fruit is still ripening, with the mesocarp changing from yellowish green to pale yellow and the endocarp from green to yellow-brown. The fruits of the other accessions were in the physiological ripening phase, with pale yellow mesocarps and yellow-brown endocarps (Figure 5).

CONCLUSION

The findings of the identification of malacca plants based on differences in leaf, flower, and fruit features revealed that one accession, HT1, belongs to the *P. emblica* species, while the other seven belong to the *P. indofischeri* species. The differences are evident in the shape of the leaf tips, the branching of the stigma, and the shape and size of the fruit.

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Figure 5 Morphological fruit of malacca explored in North Padang Lawas Regency. HN = Hutanopan, HT = Hutaimbaru, PB= Sipenggeng, and PBj = Sipupus. White line length = 1 cm.

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