



Moraceae diversity in the Universitas Sumatera Utara's arboretum

Arida Susilowati^{*1}, Deni Elfiati¹, Ida Mallia Ginting¹, Muhammad Irvan Rizmi¹

¹Faculty of Forestry, Universitas Sumatera Utara, Kampus 2 USU Bekala, Deli Serdang 20353, North Sumatra, Indonesia

*Corresponding Author: arida.susilowati@usu.ac.id

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ABSTRACT

The arboretum of the Universitas Sumatera Utara (USU) is an area for collecting and conserving tree species in North Sumatra. One of dominant family found in USU Arboretum is Moraceae. The objective of this reserach was to determine Moraceae diversity in the USU Arboretum. The census approach of vegetation analysis was used to determine the identity and abundance of Moracea. The research found 9 (nine) Moraceae species belongs to two genera in the USU arboretum, those were *Ficus microcarpa*, *Ficus elastic*, *Artocarpus heterophyllus*, *Ficus padana*, *Ficus fistulosa*, *Artocarpus altilis*, *Ficus benjamina*, *Ficus ampelas* and *Ficus hispida*. The species with the highest density value (57.92%) is *Ficus hispida*. The diversity index, richness index, and species dominance index were all quite low in the research location, with values of 1.455, 1.226, and 0.370, respectively. Meanwhile, the species evenness index at the research location is 0.662, which is classified into moderate. To improve the diversity of Moraceae in the USU arboretum, species enrichment activities are needed.

Keyword: Arboretum, Diversity, Indices, Moraceae



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1. Introduction

Arboretums at universities are typically designed to provide more than only as a venue for plant collections. The arboretum owned by was developed to function as a place for discussions, practicums, and research for various faculties [1]; a place for learning about the environment and biodiversity for various educational and general levels; field laboratories; germplasm resources (genetic banks) that store various collections of rare plant species, medicinal plants, production tree plants, and experimental location [2]. The USU Arboretum is an area assigned to environmental education, research, and future species conservation. Since 2006, the Universitas Sumatera Utara (USU) has been establishing an Arboretum by planting a variety of potential tree species due to ecological concern. The arboretum, which originated as unproductive terrain, has transformed into a habitat for a variety of plant species, including Moraceae.

Moraceae is a plant family with 37 genera that monoecious or dioecious trees, shrubs, lianas, or rarely herbs nearly all with milky sap [3]. The family identified by leaves are simple and alternating, rarely opposite. The stipules are tiny and lateral, or they might form a cap over the bud, leaving a cylindrical scar. The flowers are unisexual, small, and usually closely packed. The Moraceae is a family of flowering plants, known in the world as the mulberry family or the fig family [4]. In Indonesia it is known as the beringin-beringinan. Moraceae family grow mainly in tropical areas, then in subtropics and relatively small in temperate climates [5]. The Moraceae family contains numerous genera, including *Artocarpus*, *Ficus*, *Tregulus*, *Morus*, *Antiaris*, *Antiaropsis*, *Castilla*, *Helicostylis*, *Maquira*, *Mesogyne*, *Naucleopsis*, *Perebia*, *Poulsenia*, *Pseudolmedia*, and *Sparattosyce* [6].

The Moraceae family includes over 1,500 species that distributed in tropical mixed forests in Asia and Australasia. *Ficus* and *Artocarpus* are the most common genera. The African continent has approximately 185 species, while the American continent has approximately 270 species. In both area, the Moraceae species have a distinctive distribution but more endemic genera. Africa has seven endemic genera out of 17 that grow widely, but America has 14 endemic genera out of 19 genera [5]. Moraceae serves an important ecological role in rainforest ecosystems by providing food for frugivorous animals and is a major species in tropical rainforest ecosystems [3]. Among of Moraceae genus, *Ficus* is the largest with 600 species [2]. *Ficus* is a broad genus of flowering plants that grows throughout the tropical and semitropical temperate zones especially in Asia, America, Australia and Africa [4]. Plants in this genus have occupied a wide range of ecological niches, including deciduous or evergreen trees, shrubs, herbs, climbers, and vines, as well as free-standing trees, epiphytes or semi-epiphytes in cracks, rheophytes or lithophytes.

The Moraceae family also produces edible fruit, including figs (*Ficus carica*), breadfruit (*Artocarpus altilis*), mulberry (*Morus alba*), and jackfruit (*Artocarpus heterophyllus*). The Moraceae family are known as plants in tropical forests that have the potential to produce bioactive compounds and are relatively abundant [7]. Apart from the functions or uses mentioned above, the types of Moraceae species also have uses as medicinal plants. The sap of many *Ficus* is used medicinally, especially to cover and heal cuts, boils and sores, but also as an antirheumatic, and is ingested to cure coughs, flu, and treat diarrhea [8]-[9]. Despite its numerous advantages, information about the Moraceae diversity at the USU Arboretum is still limited, therefore this research aim to was to determine Moraceae diversity in the USU Arboretum. In fact, information about the diversity of this family can aid improve maintenance efforts and serve as a reference for future conservation measures.

2. Method

2.1. Research location

This study was carried out at the USU Arboretum in Kwala Bekala, Pancur Batu District, Deli Serdang Regency, North Sumatra Province. The topography of the USU Arboretum varies, however the most of it is slope. Geographically, the USU arboretum is located at 98°39'12.90" to 99°10'2.83" East Longitude and 3°32'7.00" to 3°34'8.06" N Latitude [10]. A large number of tree species planted in the arboretum are Multi-Purpose Tree Species (MPTS), which are expected to deliver optimal benefits in people surrounding the arboretum.

2.2. Data Collection

This study using field inventory to collect primary data. The census technique was used across the arboretum. All morphological traits, including leaf, fruit, flower, and stem characters, were noted as supporting information for species identification in this study. Meanwhile, the number of species and individuals was determined for quantitative study. As qualitative data, the utilization and conservation status of all Moraceae species discovered were also examined.

Relative density (RD), species diversity (H'), species uniformity (E), species richness (R), and species dominance (D) were calculated from the data. The proportion of the number of individuals to the size of the entire observation area was used to calculate relative density (RD). The following formula can be used to compute relative density:

$$\text{Relative density (RD)} = \frac{\text{Number of individual species}}{\text{Total number of trees}} \times 100\% \quad (1)$$

Diversity indices were quantifying by using some of formula. Individual diversity analysis is performed by quantifying the comparison of all individual species detected using the formula referred to in [11] those were:

$$H' = -\sum_{i=1}^s P_i \ln p_i \quad (2)$$

where H' is the Shanon-Wiener diversity index and n_i is the individual size of the i -th species. $P_i = n_i/N$ Additionally, N is the total amount of individuals identified at the research site from all species. The evenness values also calculated in this study with the following Equation [12].

$$E = \frac{H'}{\log n_i - \log n_s} \quad (3)$$

where E is the species evenness index and H' is the species diversity index value. Meanwhile, S represents the total number of species discovered in the study area. The results of species evenness calculations can be classified into three categories: low if E is < 0.5, moderate if $0.5 < E < 0.6$, and high if $E > 0.6$. Margalef Index (D) were quantifying by using following Equation [13].

$$D = (S - 1) / \ln N \quad (4)$$

Where S is the total number of species and N is the total number of individuals. The species dominance index is calculated using the formula from [11]. Among the various ecological indices used, the Simpson index was calculated to determine the dominance of Moraceae species at the research location. The Simpson index is calculated using the following formula:

$$C = \sum (P_i)^2 \quad (5)$$

Where, C expresses Simpson's dominance index and P_i is the ratio between the number of individuals of a species (n_i) to the number of individuals of the entire species (N). According to [11], the dominance index will produce a value between 0 and 1, where the lower the value obtained (closer to 0), the number of individuals in each species tends to be evenly distributed and no species dominates. Conversely, the greater the value obtained (closer to 1), it can be concluded that there is a species with a dominant number of individuals.

3. Results and Discussion

3.1. Moraceae Diversity

According to the research findings, as many as 9 (nine) Moraceae species belongs to 2 genera were found in the USU arboretum (Figure 1). The Ficus is the larger genera, with seven species, followed by the Artocarpus, which includes two species. *Ficus hispida* has the highest relative density of 57.92%, followed by *Ficus ampelas*, which has a density of 14.96%. *Ficus microcarpa*, on the other hand, is the least species and has the lowest density value, approximately 0.88%.

Ficus were dominant species in research location with 647 individuals. Whereas, *Ficus hispida* has 395 individual number, higher than other species (Table 1). *Ficus hispida* characterized by tree habitus up to 15 meters high, branched brown trunk, white gummy, leaf shape resembling a heart, tapered tip, and hairy. The high number of this species is caused by the condition of the arboretum which suits its living needs. Ficus may survive and adapt well to environmental conditions. The presence of ficus in the USU arboretum can serve as an indicator of the succession process. The abundance of these species is naturally influenced by various environmental conditions, including humidity, temperature, height, and the fertility of the land on which it grows. The ficus genus is well-known for its adaptability and wide range of habitat suitability. This is what leads to the large quantity of ficus in the research area. Furthermore, [14] stated that Ficus is a plant that adapts well to a variety of environmental circumstances. Aside from humidity and temperature, wind plays a significant role in the pollination process of Moraceae species, particularly ficus. Areas with normal rainfall are ideal for Moraceae plants, particularly ficus. According to [15], a good climate for Moraceae plants is an environment with air humidity of 50% - 90%, which is directly influenced.

Table 1. Density, utilization and conservation status of Moraceae species in USU Arboretum, Kwala Bekala

No	Species	Number of individual	RD (%)	Utilization	Conservation status
1	<i>Ficus microcarpa</i>	6	0.88	Ornamental, medicinal tree [16]	LC
2	<i>Ficus elastica</i>	15	2.20	Ornamental, medicinal tree [17]	LC
3	<i>Artocarpus heterophyllus</i>	27	3.96	Medicinal tree [18], natural dye [19], handicraft [20], food	-
4	<i>Ficus padana</i>	33	4.84	Medicinal tree [21], food, Ornamental [22]	LC
5	<i>Ficus fistulosa</i>	34	4.99	Medicinal tree [23]	LC
6	<i>Artocarpus altilis</i>	35	5.13	Food, medicinal tree [24]	-
7	<i>Ficus benjamina</i>	35	5.13	Ornamental, medicinal tree [25]	LC
8	<i>Ficus ampelas</i>	102	14.96	Medicinal tree [26]	LC
9	<i>Ficus hispida</i>	395	57.92	Medicinal tree [27]	LC

The moraceae species observed at the research site have a variety of benefits (Table 1), including primary resources in tropical forests [28], environmental indicators [29], restoration plants [30], and medicinal plants [16]-[27]. Aside from that, some of them, such as *Artocarpus altilis* and *Artocarpus heterophyllus*, produce fruit, hence these two species have economic significance in the surrounding community.

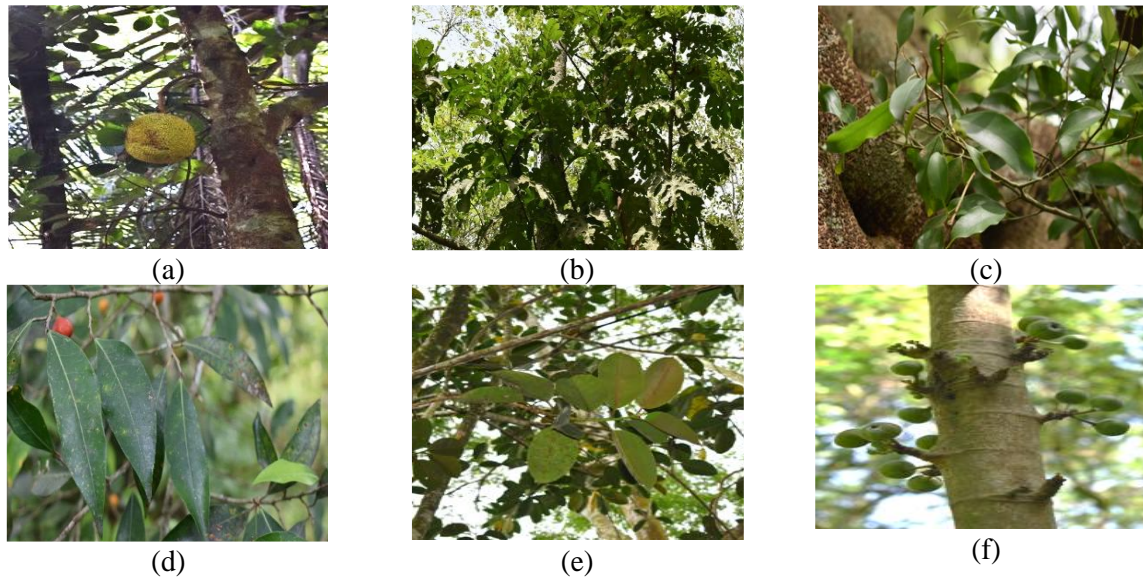


Figure 1. Some species from the Moraceae family in the USU arboretum: (a) *Artocarpus heterophyllus*, (b) *Artocarpus altilis*, (c) *Ficus benjamina*, (d) *Ficus ampelas*, (e) *Ficus elastica*, (f) *Ficus fistulosa*

Ficus provide a year-round food source for frugivores; hence, they play a vital role in the ecology and are regarded as keystone species in tropical rainforests [31]. This genus is easily identifiable by the distinctive syconium and creamy latex. They are collectively referred to as “figs”. Plants in the genus *Ficus* are used by people in various ways throughout tropical and subtropical regions of the world. They have traditionally been employed as a source of medicine and food, as an attractive tree, religious plant, lac host, animal fodder, firewood, hedge, or enclosure [32]. Over the past few years, the medicinal properties of the *Ficus* genus have been extensively investigated through ethnobotanical field surveys and pharmacological studies, including studies into the antioxidant [33], antimicrobial [34], anticancer, anti-inflammatory [35], and antidiabetic [36]-[37] properties of these plants. The chemical base and mechanisms of action of *Ficus* substances for diabetic mellitus control have lately been extensively explored [38].

The wood of Moraceae is commonly used in the manufacture of musical instruments [20]. Several *Ficus* species found at the research site, such as *Ficus benjamina* and *Ficus elastic*, have great aesthetic value and are commonly utilized as ornamental plants. According to the IUCN Redlist, 7 of the 9 Moraceae species observed at the research location have been classified as Least Concern. Despite the fact that it is not yet designated as a species threaten species, this conservation status indicates that effective management is highly recommended to keep this species from extinction.

3.2. Ecological Index

According to the research findings, the Moraceae species diversity index in the USU arboretum is classified as low, with a value of 1.455 (Figure 2). A large number of Moraceae species discovered in the research area are expected to have an impact on the overall value of species diversity. The species evenness index, in contrast to the diversity index, revealed that the evenness of Moraceae species at the research location was moderate ($E = 0.667$). Obtaining a moderate evenness index implies that control of particular species does not occur completely at the study site. The dominance index score of 0.370 (Figure 2) is considered low, indicating that no specific domination or dominance exists.

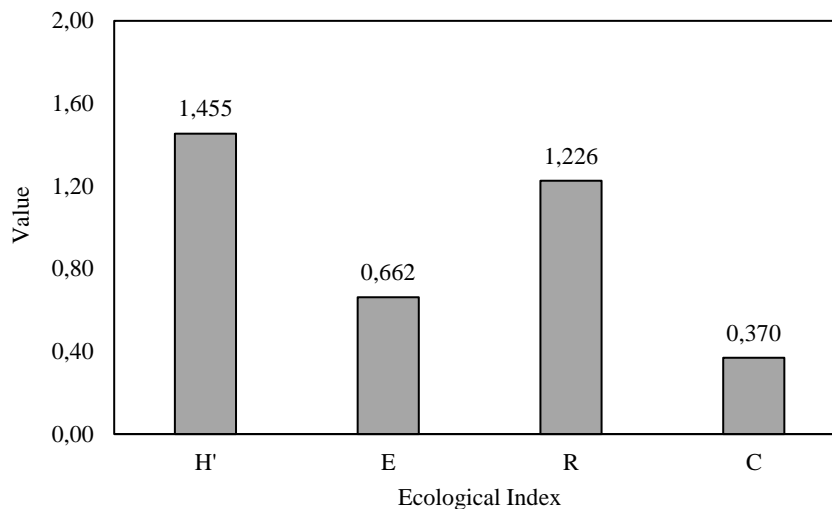


Figure 2. Moraceae ecological index in USU arboretum

The low number of Moraceae species discovered within the research area is regarded to have had a substantial impact on the species richness index's acquisition. The environmental conditions generated in the USU arboretum area are once again the most powerful indicator of the low value of species richness acquired. The habitat generated is anticipated to be less conducive to Moraceae species growth and development in various Arboretum areas, reducing the number of Moraceae species flourishing in several adverse places.

4. Conclusion

The USU arboretum were having nine Moraceae species: *Ficus microcarpa*, *Ficus elastic*, *Artocarpus heterophyllus*, *Ficus padana*, *Ficus fistulosa*, *Artocarpus altilis*, *Ficus benjamina*, *Ficus ampelas*, and *Ficus hispida*. The species with the highest density (57.92%) is *Ficus hypsida*. The diversity index, richness index, and species dominance index were all quite low in the research site, with values of 1.455, 1.226, and 0.370, respectively. Meanwhile, the species evenness index at the research site is 0.662, which is considered moderate. As key species, the maintaining effort still needed for these genus due to low of diversity.

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