



MORPHOLOGICAL CHARACTERISTICS OF KECOMBRANG (*Etilingera elatior* (Jack) R. M. Smith) IN SEVERAL REGIONS IN ACEH PROVINCE, SUMATRA

KARAKTER MORFOLOGI KECOMBRANG (*Etilingera elatior* (Jack) R. M. Smith) DI BEBERAPA DAERAH DI PROVINSI ACEH, SUMATRA

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Abstract

Kecombrang (*Etilingera elatior*) is one of the plant species of the *Zingiberaceae* family is widely used by the community as food and medicine. Not much research has been done on the morphological diversity of kecombrang plants in Aceh, so scientific information about these plants is still minimal. Therefore, this research needs to be carried out to enrich knowledge about these plants in the Aceh region. Sampling was conducted from January to April 2022 at three places in Central Aceh, Banda Aceh, Weh Island, and Simeulue Island. This research was carried out according to the survey method by roaming and direct collection. A total of 12 groves were collected from wild and cultivated area and observed for 43 characters consisting of quantitative and qualitative data. Based on these observations, two variations of the kecombrang plant have been found based on the color of the bracts, namely the red and pink variants. Based on morphological characters of vegetative organs, all samples of *Etilingera elatior* had a similarity distance coefficient from 67 to 86%. In addition, the kecombrang plants found in the highlands of Central Aceh have a larger size in leaf and inflorescent compared to samples from other locations.

Keywords: Central Aceh; Simeulue Island; Weh Island; *Zingiberaceae*

Abstrak

Kecombrang (*Etilingera elatior*) adalah salah satu jenis tumbuhan famili *Zingiberaceae* yang secara luas penggunaannya dikenal oleh masyarakat sebagai makanan dan obat. Belum banyak penelitian terkait keanekaragaman morfologi tumbuhan kecombrang di Aceh, sehingga informasi ilmiah tentang tumbuhan ini masih sedikit. Oleh karena itu penelitian ini perlu dilakukan untuk memperkaya pengetahuan tentang tumbuhan tersebut di daerah Aceh. Pengambilan sampel dilakukan pada bulan Januari hingga April 2022 di tiga tempat yaitu di Aceh Tengah, Banda Aceh, Pulau Weh, dan Pulau Simeulue. Penelitian ini dilakukan dengan metode survei dengan cara jelajah dan pengumpulan langsung. Sebanyak 12 rumpun dikumpulkan dari kawasan liar dan budi daya dan diamati sebanyak 43 karakter yang terdiri dari data kuantitatif dan kualitatif. Berdasarkan pengamatan tersebut, ditemukan dua variasi tanaman kecombrang berdasarkan warna braktea, yaitu varian merah dan merah jambu. Berdasarkan karakter morfologi organ vegetatif, seluruh sampel *Etilingera elatior* memiliki koefisien kemiripan dari 67 hingga 86%. Selain itu, kecombrang yang ditemukan di dataran tinggi Aceh Tengah mempunyai ukuran daun dan perbungaan yang lebih besar dibandingkan sampel dari lokasi lain.

Kata kunci: Aceh tengah; Pulau Simeulue; Pulau Weh; *Zingiberaceae*

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INTRODUCTION

Zingiberaceae is one of the *Liliopsida* plant groups which is widely cultivated by the public. *Zingiberaceae* has about 53 genera and 1200 species of plants. Almost all of these plant species can be found in the tropical forests of India to New Guinea (Kress et al., 2002). Plants of this group have long been used by the community as food and medicine. Some plant organs are used as a treatment for several types of diseases, including flu, fever, cough, diarrhea, earache, stomach ache, and wound cleansing (Ernilasari et al., 2018; Saudah et al., 2021a). Another benefit of this plant group is as a medicinal ingredient for postpartum care (Saudah et al., 2018).

The scientific use of *Zingiberaceae* plants is based on the content of chemical compounds contained in their cells. Many studies have been carried out on chemical compounds in *Zingiberaceae* plants, one of which is in the *Etilingera* genus. Plants in this genus have several bioactive compounds found in all their organs (Ud-daula & Basher, 2019). One of plant from this genus that is widely used is *Etilingera elatior* (Jack) R. M. Smith.

Etilingera elatior or kecombrang is a perennial (annual) herbaceous plant that has a height of 3–4 m (Lim, 2014). *Etilingera elatior* grow close together to form a clump, having creeping rhizomes (modified stems) more than one meter apart. *Etilingera elatior* has very sturdy shoot bases that are almost woody. The inflorescence of this plant is unique and distinctive so it has high aesthetic value. The inflorescences are red with pink and red inner segments with yellow or white borders. The inflorescences grow directly from the rhizome to a height of one meter and are reddish-conical in shape with small flowers appearing between the inflorescences (Rodrigues et al., 2015). This plant has seeds, but generally reproduces asexually through rhizomes (Ismail et al., 2020).

Etilingera elatior has local names kecombrang/honje (Indonesia), kantan flower (Malaysia), kaa laa (Thailand), torch ginger (English), and Malayischer fackelingwer (German) (Lim, 2014). Kecombrang in Aceh is known as bak kala which has a strong aroma to add to the taste of dishes, such as “gulee pliek u, gulee eungkot, gulee sie itek, sambai bungoeng kala”, and so on (Saudah et al., 2021a).

This plant also has several pharmacological activities, including antioxidant, antihyperglycemic, antitumor, anti-inflammatory, antihyperuricemic, anti-larvae and anti-aging (Ernilasari et al., 2021; Syahrani et al., 2021; Juwita et al., 2018). The kecombrang flower extract studied can also be antimicrobial with the activity of degrading peptidoglycan compounds in the bacterial cell wall (Sahalan & Lian, 2021). The pharmacological activity is because *E. elatior* contains several phytochemical compounds, such as alkaloids, terpenoids, tannins, phenolics, flavonoids, fatty acids, and steroids (Maulidna et al., 2019; Resna et al., 2021; Syarif et al., 2010).

Kecombrang is a plant that is widely found in Indonesia, including in all districts of the Aceh region. Based on previous research in West Sumatra, color variations were obtained from flowers in several samples (Putri et al., 2017). Although this plant is commonly found in several locations, the morphologically observed variant is unknown based on differences in geographical location in Aceh. Geographical information is not yet available regarding differences in plants that grow in the highlands, lowlands, and differences in latitude in the form of different islands. Information on the morphology of *E. elatior* in several areas in Aceh has not been widely carried out. Therefore this research needs to be done to enrich knowledge about these plants. This research is also expected to contribute to the development of modern medicinal materials.

MATERIALS AND METHODS

The research sample was taken in Banda Aceh, Simeulue Island, Weh Island, and Central Aceh (Figure 1). Furthermore, further examination of morphological characters was carried out at the Laboratory of Plant Structure and Development, Faculty of Mathematics and Natural Sciences, University of Syiah Kuala.

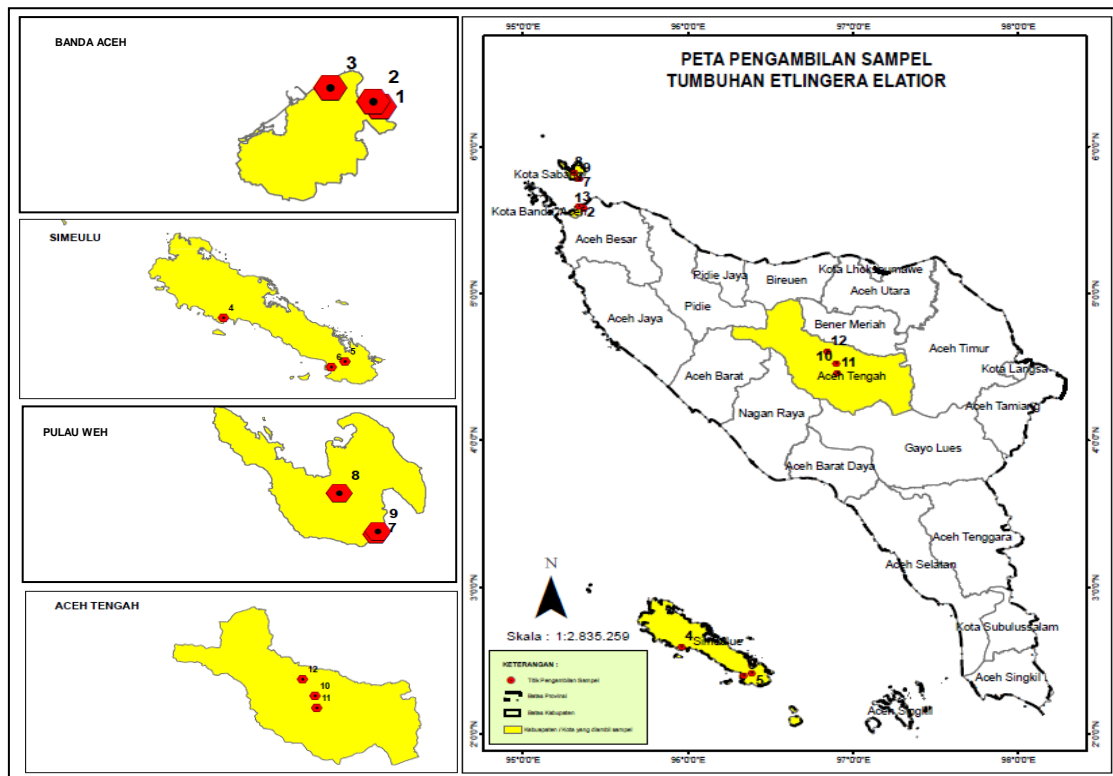


Figure 1. Research map

The materials used are the kecombrang plant (*Etilingera elatior*), old newspaper, masking tape, and 70% ethanol. The tools used are pH meter, thermometer, stationery, tape measure, and herbarium equipment. This research was carried out according to the survey method by roaming and direct collection. The plants used as samples are flowering plants. The number of plants observed in each determined area is three groves. Identification of plant characters includes stature, leaves, and inflorescences (Putri et al., 2017; Windarsih et al., 2021). Data analysis was carried out descriptively. The morphological characters of vegetative and generative organs converted to binary data, and analyzed Unweighted Pair Group Method with Arithmetic Mean (UPGMA) used NTSys version 2.02 software application, to determined the similarity among samples.

RESULTS

Based on the research that has been done, 12 groves of kecombrang have been collected from several locations in Aceh, namely Banda Aceh City (BNA), Simeulue Island (SML), Weh Island (SBG), and Central Aceh District (ATG) (Figure 1). The environment factors measured and showed in Table 1. The total morphological characters observed were 43 characters consisting of 19 quantitative characters and 24 qualitative characters (Table 2).

Table 1. The environment factors collected from several *Etilingera elatior* sample location

Sample code	Soil pH	Temperature (°C)	Humidity (%)
BNA1	6.3	30	70
BNA2	5.6	31	70
BNA3	7.1	30	60
SML1	6.2	28	80
SML2	6.1	28	80
SML3	6.1	28	75
SBG1	6	26	70
SBG2	7	26	70
SBG3	7	27	65
ATG1	6.8	18	60
ATG2	6.2	20	70
ATG3	6	19	80

Note: BNA= Banda Aceh; SML= Simeulue Island; SBG= Weh Island; ATG= Central Ac

Table 2. Comparison of several plant morphological characters of *Etilingera elatior*

No	Morphological characters	Accession of <i>Etilingera elatior</i>			
		Banda Aceh	Simeulue	Weh Island	Central Aceh
1.	Pseudostem color	Green	Green	Green	Green
2.	Plant height	3 m	4 m	3.5 m	5 m
3.	Leaf position	Opposite	Opposite	Opposite	Opposite
4.	Petiole length	2.7 cm	2.1 cm	2.5 cm	3.3 cm
5.	Margin leaf color	Green	Green	Green	Green
6.	Margin leaf shape	Entire and undulate	Entire and undulate	Entire and undulate	Entire and undulate
7.	Leaf venation	Parallel to the medio-lateral axis	Parallel to the medio-lateral axis	Parallel to the medio-lateral axis	Parallel to the medio-lateral axis
8.	Leaf shape	Lanceolate	Lanceolate	Lanceolate	Lanceolate
9.	Leaf tip	Acuminate	Acuminate	Acuminate	Acuminate
10.	Leaf base	Emarginate	Emarginate	Emarginate	Emarginate
11.	Leaf color	Green	Green	Green	Green
12.	Number of leaf	20	25	27	25
13.	Lamina length	33.6–43.6 cm	48.7–58.7 cm	42–52 cm	53.7–64.5 cm
14.	Lamina width	9–16 cm	10–17 cm	13.4–15 cm	12–19.7 cm
15.	Inflorescent color	Red, pink	Red, pink	Red	Red, pink
16.	Direction of inflorescent	Erect	Erect	Erect	Erect
17.	Inflorescent length	7–8 cm	10–11.5 cm	7.1–8.5 cm	14–15.3 cm
18.	Inflorescent stem length	33–34.1 cm	44–45.9 cm	40–41 cm	65–67.1 cm
19.	Sterile bract shape	Oblongus	Oblongus	Oblongus	Oblongus
20.	Sterile bract color	Red/pink, white margin	Red/pink, white margin	Red, white margin	Red/pink, white margin
21.	Sterile bract length	8–9 cm	7.7–7.9 cm	7.5–8.1 cm	16–18.3 cm
22.	Sterile bract width	1.2–1.9 cm	3.2–3.9 cm	5.5–6.7 cm	6–8 cm
23.	Sterile bract horn length	0.1–0.2 cm	0.2 cm	0.2–0.3 cm	0.4–0.6 cm
24.	Fertile bract shape	Spatulated	Spatulated	Spatulated	Spatulated
25.	Fertile bract color	Red/pink, white margin	Red/pink, white margin	Red, white margin	Red/pink, white margin
26.	Fertile bract length	5.2–5.9 cm	4.5–5.5 cm	6.1–7.8 cm	8.5–9 cm
27.	Fertile bract width	0.6–0.9 cm	2.3–2.9 cm	1.5–2.6 cm	1.8–2.5 cm
28.	Bracteole shape	Emarginate	Emarginate	Emarginate	Emarginate
29.	Bracteole color	White, pink tip	White, pink tip	White, pink tip	White, pink tip
30.	Bracteole length	1.8–2 cm	2–2.6 cm	1.3–1.8 cm	2–2.5 cm
31.	Calyx shape	Emarginate	Emarginate	Emarginate	Emarginate
32.	Warna calyx	Pink	Pink	Pink	Pink
33.	Calyx length	2.1–2.5 cm	2–2.5 cm	2–2.8 cm	1.9–2.1 cm
34.	Corolla lobe shape	Spatulated	Spatulated	Spatulated	Spatulated
35.	Corolla lobe color	White, pink tip	White, pink tip	White, pink tip	White, pink tip
36.	Corolla number	3	3	3	3
37.	Stigma shape and color	Club, red	Club, red	Club, red	Club, red
38.	Pistil length	2.3–2.5 cm	1.7–2 cm	1.7–2.3 cm	1.8–2.6 cm
39.	Labellum color	Red, yellow margin	Red, yellow margin	Red, yellow margin	Red, yellow margin
40.	Labellum length	3.6–3.9 cm	2.7–3 cm	4.8–5.6 cm	4.8–6 cm
41.	Labellum width	1.3–1.5 cm	1.3–1.8 cm	3.2–3.5 cm	3.5–4 cm
42.	Filament color	White	White	White	White
43.	Stamen length	1.7–2 cm	1.8–2.3 cm	1–2.6 cm	1.5–2.8 cm

The data (Table 1) showed that *Etilingera elatior* can live with any environmental conditions. It can live with the soil pH between 5.6–7.1, the temperature between 18–31 °C, and the humidity between 60–80%. The results showed that at the four observation sites, the morphological characters of *E. elatior* generally had similarities (Table 2). The difference appears in the color of the inflorescence and the size of the plant. The inflorescences on the Banda Aceh, Simeulue Island, and Central Aceh torch ginger plants have red and pink bract color variations. Whereas *E. elatior* from Weh Island only found red bracts.

The differences in plant variants of *E. elatior* are based on the color of the inflorescences. The inflorescence color of *E. elatior* found in the field is red and pink (Figure 2). Fruit characters were also not included in the data from this study because fruit is rarely found in the field. Color

differences are located in the color characters of the sterile bracts, fertile bracts, bracteole, calyx, and corolla lobe while the color of the pseudostem, lamina, stigma, labellum, and filaments is the same for the two variants of *E. elatior*.

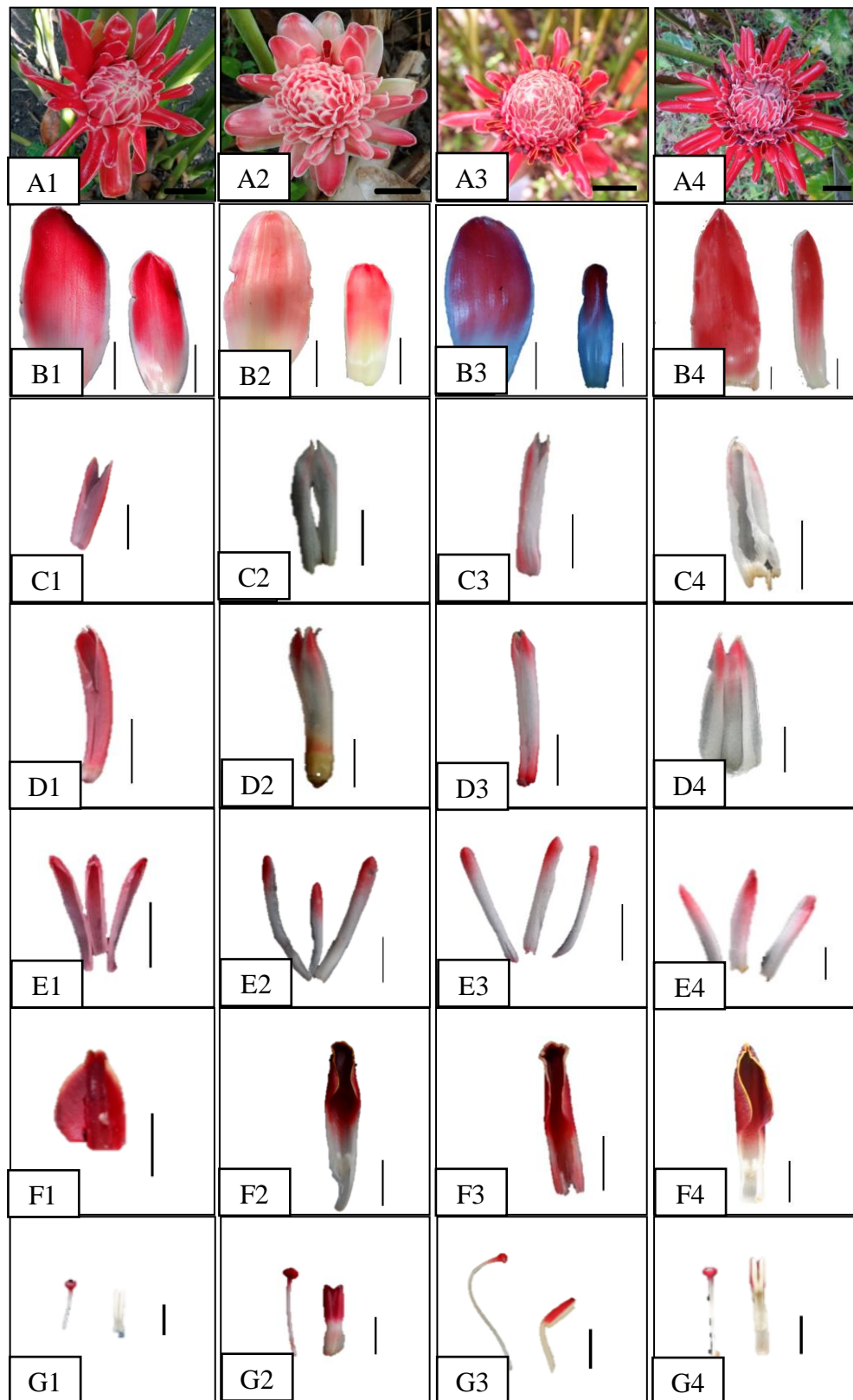


Figure 2. Flower characteristics. 1. Banda Aceh. 2. Simeulue Island. 3. Weh Island. 4. Central Aceh. Flower (a); bracts (b) (left= sterile right= fertile); bracteole (c); calyx (d); corolla (e); labellum (f); generative parts (g) (left= pistil, right= stamen)

The vegetative and generative parts of the plant was observed in this research. The size of the plants in the Central Aceh research location is generally larger than Banda Aceh, Weh Island, and Simeulue Island. Morphological characters such as plant height, leaf length and width, as well as the size of the inflorescence component at this location were larger than the other samples.

Etilingera elatior has compound flowers that grow from its rhizomes. The inflorescent have grow on erect direction from the ground. *E. elatior* has two types of bracts, namely fertile and sterile bracts (Figure 2). There are two variants found at the study site, there are red and pink. The color variants of the *E. elatior* bracts in several regions varied in number. In the Simeulue Island accession plant, flowers have leaves that grow from the bracts, specifically at the horn tip (Figure 3 & 4). This organ is not found in all plants and other accession plants.



Figure 3. Leaves appearing on the horn tip bracts are sterile (red arrow). Line scale= 5 cm

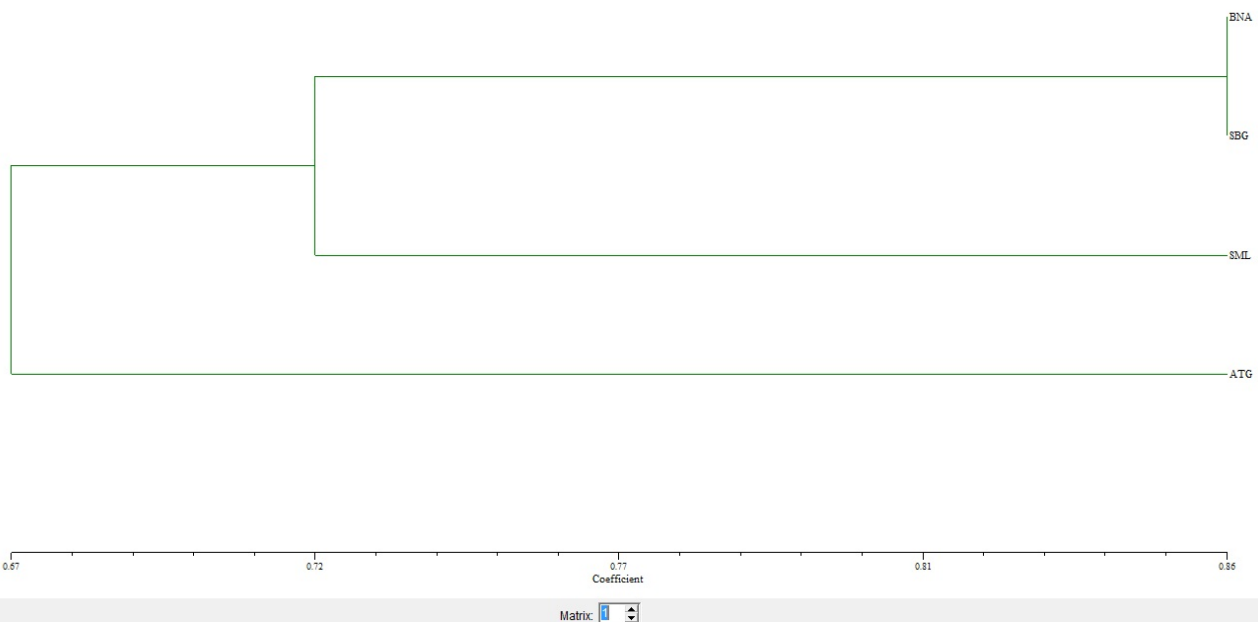


Figure 4. Dendrogram of *Etilingera elatior* collected from Banda Aceh (BNA), Simeulue Island (SML), Weh Island (SBG), and Central Aceh (ATG), based on morphological characteristics of vegetative and generative organs

Fertile bracts are named for those that have a generative component of the flower (stamens and pistils), while sterile bracts do not. Oblong sterile bracts form and spatulated fertile bracts form. Fertile bracts of the red variant are 5.2–8.6 cm long, and 0.6–2.9 cm wide. The pink variant is 5.4–6.5 cm long, 1.6–2 cm wide. Fertile bracts of *E. elatior* pink and soft pink. Red variant bracteole common form is retusus, tip emarginatus. The red variant is 1.4–3.6 cm long and 0.3–0.8 cm wide. The 'pink' variant is 1.8–3.3 cm long and 0.3–1.8 cm wide.

Calyx is red for red variant, smooth surface, emarginatus tip, and length 1.2–4 cm. Retusus 'pink' variant, smooth surface, emarginatus tip, calyx have 2.8 cm long. The shape of the corolla lobe of *E. elatior* red variant is spatulated, white and red at the tip. The pink variant is spatulated, white in color and has a pink tip. The labellum of the 'red' variant is ovate in shape, brownish red in color, yellow edges.

DISCUSSION

Based on the research results, environmental factors appear to be different at all sampling locations. The soil where the *Etingera elatior* samples were taken had a pH between 5.6 and 7.1. Soil pH conditions tend to be good because, at a pH between 6–7, some nutrients will easily dissolve in water and can be absorbed by plants. Apart from that, fungi and bacteria that decompose organic matter will grow well (Basuki & Winarso, 2021; Rukmana et al., 2019). Soil hydrogen potential (pH) will be influenced by the presence of organic material in the soil. If the soil contains urea, the acidity level of the soil will increase (Mautuka et al., 2022). Other research, even shows that the thickness of the epidermis and palisade as well as oxalic acid levels are positively correlated with soil pH (Apriliani & Yuliani, 2020).

The research showed several differences from the plant of many location. One of the different is bract color. The bract is the most outer part of the flower which is often called the protective leaf of the flower (Lestari et al., 2015). The color of the inflorescences varies between red and pink, except for the *Etingera elatior* Weh Island inflorescences which are only found in red. The degree of reddish color in a plant is directly correlated with the anthocyanin content. The fainter the red color, the lower the anthocyanin content in the plant. (Huang et al., 2020). Flower color is a display of the presence of pigments in these organs. Pigments (dyes) can generally be grouped into carotenoids, flavonoids, and alkaloids (Pina, 2014). The pigment content in plants can be influenced by several factors such as light, water content, soil pH, nutrients, and hormones in plants (Zhao & Tao, 2015).

Bract color as an ornament of the *Etingera elatior* flower was the main character for identification. While fruit color is not used as a character to distinguish *E. elatior* variants because the characters do not have high variation when compared to bract color in compound flowers *E. elatior*. There are four variants of kecombrang in West Sumatra, namely red, pink, pale pink, and white (Putri et al., 2017). There are two color variants of the kecombrang bracts in Pancur Batu District, North Sumatra, namely bright pink (punch) and pale pink (Fadhilah et al., 2018). Biotic and abiotic factors can influence plant color variations on a wide scale. Lighter flower colors can occur if pollinators are few, solar radiation is high, rainfall is low, and the growing season is short. In other words, flower colors can be brighter if the plant is under environmental stress (Dalrymple et al., 2020).

The bract in this plant divided into two parts, there are sterile and fertile bracts. Fertile bracts are lighter in color than sterile bracts and are smaller in size (Lim, 2014). The flower character of all location have the same labellum. Labellum is the part of flower and the position is next to calyx. Labellum of the *E. elatior* is usually dark red with a yellow margin (Windarsih et al., 2021).

The plant also varies in size, for example, plant height, number of leaves, and leaf area. The torch ginger in Central Aceh is the highest than others. The number of leaves for accession Simeulue and Central Aceh is the same for accession Banda Aceh is less than others. Banda Aceh has a higher temperature than other places but has humidity on average. This condition assumes that *Etingera elatior* from the lowland area may be smaller than the highland area. Previous research explained a correlation between the increase in leaf area and the increase in land altitude (Guo et al.,

2018). At high altitudes, plants can absorb more water from the environment so that each cell can be in a turgor state. The highlands have a different microclimate from the lowlands. This microclimate is influenced by low temperatures and high humidity (Azkiyah & Tohari, 2019).

The pseudostem color is the same all accessories were green. This is following previous research which stated that *Etilingera elatior* has green pseudostems. The closest species, *Etilingera haemispherica*, has a greenish-red pseudostem. Pharmacologically, the pseudostem of this plant can be used as a cough medicine (Saudah et al., 2021b).

In one of the sample plants on Simeulue Island, there are parts of the leaves that appear on the inflorescence. This is not often found in plants in other areas. This form assumes that the bracts are also part of the leaf and can appear if there is expression of certain genes, such as the FLO/LFY gene (Hofer et al., 1997). Leaf organs have the same regulations as flowers in their morphogenesis. This similarity can also sometimes be observed in the structure of leaves and flowers (Satina & Blakeslee, 1941).

Based on the dendrogram, it can be seen that the *Etilingera elatior* from Simeulue Island is separate from the Banda Aceh and Pulau Weh. Meanwhile, Aceh Tengah's *Etilingera elatior* is at the farthest point of similarity with other region. The kinship relationship between the Banda Aceh and Pulau Weh kecombrang based on morphological characters has a similarity coefficient of 86%, while for Simeulue it is 72% and for Central Aceh it is 67%. This could be because Banda Aceh and Pulau Weh are geographically close, so the morphological conditions of the plants are not much different. Meanwhile, Central Aceh has a lower environmental temperature than other areas, so it can influence plant morphology in the form of the size of plant leaves and inflorescences. In previous research, it was explained that leaf thickness increases with increasing height. The thickness of the upper leaf epidermis, lower epidermis, palisade and mesophyll of sponges, and main veins increases with increasing height. Stomata density in each sample increases simultaneously with increasing height. These results explain that plants can adapt to environmental changes in the form of highlands by increasing leaf thickness, mesophyll tissue thickness and stomata density (Zhang et al., 2020).

CONCLUSION

Based on observations made on *E. elatior* plants found in several locations in Aceh, two different characters were found. The color of the inflorescences on the Weh Island kecombrang was only found in red, while in three other locations, there were 2 color variants, namely red and pink. In addition, the kecombrang plants found in the highlands of Central Aceh have a larger size compared to samples from other locations. Based on morphological characters of vegetative organs, all groves of *Etilingera elatior* had a similarity distance coefficient from 67% to 86%.

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