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Morphological Characters of Plant Species of the Zingiberaceae Tribe in Joben Resort Gunung Rinjani National Park, East Lombok

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Abstrack: *Zingiberaceae is a family of aromatic herbaceous plants, pseudostem, and rhizomes. Members of this species are found in the low-high lands (2000 meters above sea level), in areas with very high rainfall, and in humid places. Resort Joben is located in the south of Mount Rinjani so the water source is quite abundant and the humid forest conditions are a place to grow various species of Zingiberaceae. This study aims to determine the species and distribution of Zingiberaceae in the Joben Resort, Rinjani Mount National Park, East Lombok. Sampling used the cruising method with five cruising lines, each line has a wide range of 20 meters. Morphological characters identify using the reference book Vascular Plant Systematics, and the kinship relationship dendrogram was created using past 4.09 software. Samples were collected and documented as herbarium, then identified their morphological characters and species. The results of the study found six species of Zingiberaceae which belong to three sub-family, namely Zingiberoideae: Curcuma zanthorrhiza and Hedychium coronarium; Alpinioideae: Amomum dealbatum, Etlingera spinulosa and Etlingera rubroloba, and Costoideae: Costus spiralis.*

Keywords: *morphology, Zingiberaceae, Resort Joben, Mount Rinjani National Park, Lombok.*

1. INTRODUCTION

Mount Rinjani National Park is generally an area with a tropical climate, which has various types of ecosystems and vegetation that are quite complete, ranging from lowland tropical forests (semi-evergreen) to high-top rain forests (2000 m above sea level) (BTNGR, 2015). According to As-syakur (2009) based on classification (Schmidt and Ferguson, 1951), the Mount Rinjani National Park area has an average annual rainfall of 1500-2500 mm, the higher the altitude, the higher the rainfall. The average temperature on Lombok Island is 22°C with variations of 30-32°C (maximum temperature) and 20-24°C (minimum temperature). If every 100 m rise is accompanied by a decrease in temperature of 0.5°C, then the temperature at the peak of Mount Rinjani can reach 11°C, especially during the dry season with strong winds.

Joben Resort is located to the south of Mount Rinjani with topographic heights varying between 200-2,932 meters above sea level, meanwhile the slopes range from moderate to moderate (0-25°), heavy (25-40°), and very heavy (>40°). (BTNGR, 2015). The Joben Resort area is a tropical rainforest area with dense primary forest and has abundant water sources which make the Joben Resort Forest humid so that the vegetation is still natural and provides a habitat for flora and fauna (BTNGR, 2020). The Zingiberaceae family or better known as the ginger family are flowering plants that have aromatic rhizomes with false stems that are formed from the midribs of the leaves. Zingiberaceae is a plant that is often found in tropical forest areas and can live in lowland

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forests up to an altitude of less than 2000 m above sea level (asl), especially in areas with high rainfall.

The various species of Zingiberaceae plants have many functions for society, especially for those who live in rural areas, because their rhizomes generally contain essential oils, so they are often used as ingredients in traditional medicines and even used as ingredients for cosmetics. Zingiberaceae plants in Mount Rinjani National Park, which have varied topography and slopes and have quite high rainfall, have never been studied. Based on this, it is necessary to research, especially to describe the morphological characters of the types and distribution of plants of the Zingiberaceae family spread across the Joben Resort Area, Mount Rinjani National Park, East Lombok.

2. RESEARCH METHOD

Location and Time

The research was conducted at the Joben Resort, Mount Rinjani National Park, East Lombok and the Advanced Biology Laboratory, Faculty of Mathematics and Natural Sciences, Mataram University from June to August 2022.

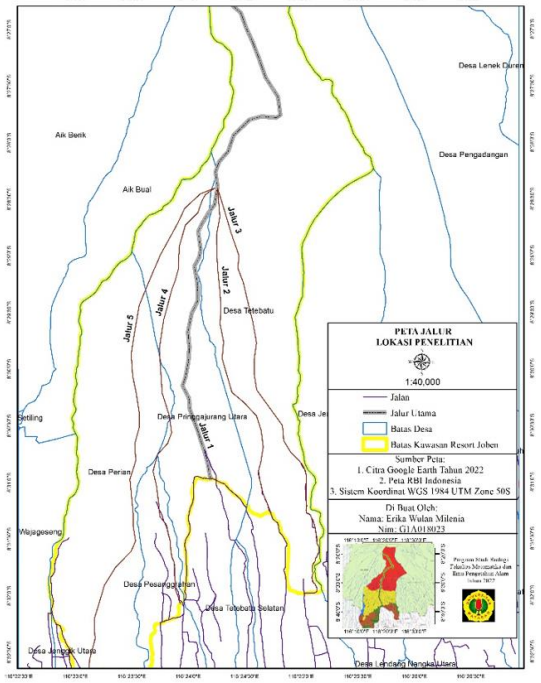

Figure 1. Map of research locations and sampling routes at Joben Resort, Rinjani Mount National Park (Source: Mount Rinjani National Park Office)

Tools and Materials

The tools used include stationery, plant systematics books (Radford et al., 1974; Simpson, 2006 & 2010), labels, GPS, scissors, calipers, cellphone cameras, drying cabinets, millimeter blocks, knives, measuring tape, saw, razor, and sprayer. Cell phone that has software: avenza maps, thermohygrometer, luxmeter, altimeter acurate, plantNet, Google image, Google earth, The Plantlist, Picture This-Plant Identifier, Past 4.09.

The materials used include water, 70% alcohol, labels, plastic bags, cardboard, A3 paper, label paper, tissue paper, herbarium labels, glue, tape, raffia, and all types of plants from the Zingiberaceae tribe found during the research.

Research Procedure

The sampling method used was the roaming method by creating five cruising lanes 16 km long with a roaming width of 20 meters (10 meters to the right and 10 meters to the left). Samples found in the field are taken for collection and recording. The data recorded is in the form of field data which is divided into physical data and specimen data. Physical data includes point coordinates, altitude, temperature, humidity, and light intensity, while specimen data includes plant height, plant color, habitus. After the field data was obtained, pictures were taken of the species' natural habitat as documentation. Herbarium data includes stems (rhizomes and pseudo stems), leaves, flowers, inflorescences, fruit, and seeds (if any).

Sample identification uses software in the form of PlantNet, Picture This-Plant Identifier, Google Image and related journals (Rizki & Des, 2019), verification of scientific names uses The Plant List website. Identification of morphological characters used the guidebook: Vascular Plant Systematic (Radford et al., 1974).

Data Analysis

Data analysis used descriptive analysis, making a dendrogram of kinship relationships was used Past 4.09 software application. The results of data analysis are presented in the form of identification keys, specimen images, kinship relationship dendograms and distribution maps of

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the Zingiberaceae tribe found at the Joben Resort, Mount Rinjani National Park.

3. RESULTS AND DISCUSSION

Results

Based on research that has been carried out, namely the morphological characteristics of plant species of the Zingiberaceae family in the Joben Resort area of Mount Rinjani National Park, East Lombok, six species of plants of the Zingiberaceae family were found, namely *Amomum dealbatum*, *Curcuma zantthorrizha*, *Costus spiralis*, *Hedychium coronarium*, *Etlingera rubroloba*, and *Etlingera spinulosa*. The plant species found belong to the three sub-families: Alpinioideae, Zingiberoideae, and Costoideae.

Alpinioideae sub-family consists of three species, such as: *A. dealbatum*, *E. rubroloba*, and *E.* spinulosa. Zingiberoideae sub-family has two species, e.g., *Curcuma zantthorrizha* and *H. coronarium*, and Costoideae sub-family only has one species, namely *Costus spiralis*.

Instructions for Morphological Characters and Character Scoring for Plants of the Zingiberaceae Family at the Joben Resort, Rinjani Mount National Park (RMNP)

Table 1. Characteristics of scoring indicators for plants of the Zingiberaceae family at the Joben Resort, RMNP.

No	Characters	Scoring		
		1	2	3
1	Habit	Herbaceous shrubs	Herbaceous shrub	
2	The direction of pseudo-stem growth	Vertical	Curved	Vertical, tip curved
3	Pseudo-stem shape	Elliptical	Cylinder	
4	Pseudo-stem height (cm)	50 - <100 cm	>100 cm	
5	Pseudo-stems surface	Glabrous	Puberulous	
6	Leaf position	Alternate	Equietant	Spiral
7	Leaf completeness	Vagina-lamina	Vagina-petiole-lamina	
8	Leaf texture	Chartaceous	Coriaceous	
9	Lamina shape	Oblong	Lanceolate-oblong	Lanceolate
10	Lamina adaxial surface	Glabrous	Puberulent	
11	Lamina abaxial surface	Puberulent	Pubescent	
12	Lamina based	Attenuate	Cuneate	Rounded
13	Lamina margin surface	Glabrous	Puberulous	
14	Venation type	Pinnate	Parallel	
15	Number of venation	1-<20	20-<40	≥40
16	Vagina leaf shape	Linear	Oblong	
17	Vagina leaf outside surface	Glabrous	Puberulent	Puberulous

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Dendogram of Relationships Between Plant Species of the Zingiberaceae Family at the Joben Resort, RMNP

The character scoring data that was created (Table 1) was analyzed using the Past 4.09 software application to create a phylogenetic relationship dendrogram, the results of which are displayed as follows:

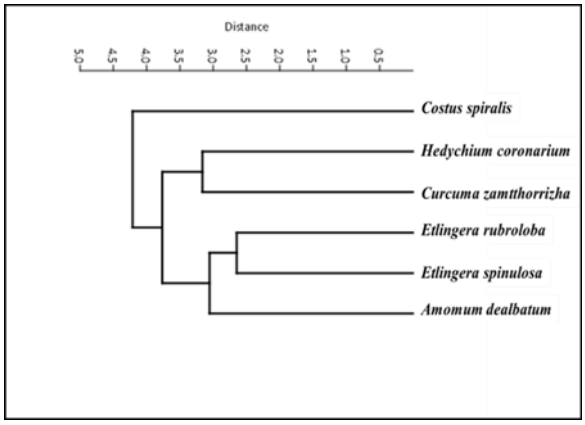

Figure 2. Dendrogram relationship between plant species of the Zingiberaceae family at the Joben Resort, RMNP**.**

Identification key to Zingiberaceae plant species based on morphology at the Joben Resort, RMNP.

1a. Parallel venation type, oblong sitting leaf (vagina) shape …...…….*Coctus spiralis*
1b. Pennate venation type, linear vagina leaf shape ……..……..……2
2a. Glabrous stem, leaf magin and outside sitting leaf surfaces, puberulent adaxial leaf surface …….…….…….3
2b. The surface of the pseudostem is densely pubescent, the upper surface of the leaves is glabrous, the surface of the leaf edges is densely pubescent, the outer surface of the sitting leaf is sparsely pubescent ……4
3a. The direction of growth of the pseudo- stem is vertical, the shape of the pseudo-stem is cylindrical, the height of the pseudo-stem is >100 cm, the leaves sit alternately (alternate), the leaves are not the direction of growth of the pseudo- stem is vertical, the shape of the pseudo-stem is cylindrical, the height of the pseudo-stem is >100 cm, the leaves sit alternately, the leaves are imperfect, the shape of the leaf blade is lanceolate-oblong … *Curcuma zantthorrizha*
3b. The direction of growth of the pseudo- stem is curved, the shape of the pseudo-stem is elliptical, the height of the pseudo-stem is 50 - <100 cm, the leaves are sitting equitant, the leaves are perfect, the shape of the leaf blade is lanceolate …… *Hedycium coronarium*
4a. The leaf texture is coriaceous, the base of the leaf is rounded, the number of venation is 20-<40 ……..5
4b. Leaf texture becomes coriaceous, leaf base attenuate, number of venations ≥40 …. …….. *Amomum dealbatum*
5a. Habitus is a herbaceous shrub, the leaf blades are slender, the lower surface of the leaves has thick puberulous ……*Etlingera rubloloba*
5b. Habitus of herbaceous shrub, leaf blades are oval, the lower surface of the leaves is sparsely puberulous
……*Etlingera spinulosa*

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Description of Zingiberaceae plant species at Joben Resort, Mount Rinjani National Park, East Lombok

1. ***Amomum dealbatum* Roxb.**, Hort. Bengal. 1 (1814), nomen; Fl. Ind., ed. Cerey & Wall., i. 42 (1820); Fl. Ind., ed. Cerey, i. 43 (1832) (Figure 3)

   Synonym: *Cardamomum dealbatum* (Roxb.) Kuntze

   Herbaceous shrub, biennial, height 63-182 cm, diameter 1.3-2.2 cm, growth curved, cylindrical, green, thick puberulous hairs. Stems modify to rhizomes, growth direction of the rhizomes is horizontal, rounded, 2.3-3 cm in diameter, yellowish white. Leaves, intact, single, alternate, coriaceous, oblong, length x width: 27-59.2 cm x 5-8 cm, green, upper surface glabrous, lower surface sparsely pubescent, base attenuate, tip acuminate, margin entire, edge surface with thick fine hairs, pinnate leaf veins, 55 pairs; petiole plano-convex, length x diameter: 3.7 cm x 1.1 cm, green, sparsely puberulous; linear, length x width: 55.5-182 cm x 2.5 cm, outer surface sparsely puberulous, inner surface glabrous, densely arranged alternately to form a stem-like structure called pseudostem; ligula triangular, height x base: 0.6 cm x 0.6 cm, greenish yellow, thin like a membrane. Lateral inflorescences.

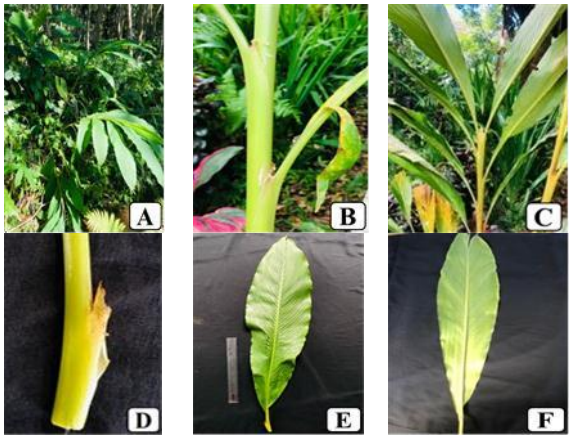

Figure 3. Morphology of *Amomum dealbatum*. Notes: A. habitus, B. Pseudo stem, C. Sitting leaves, D. Ligula, E. Leaves from the upper side, F. Leaves from the lower side, G-H. Rhizomes (Source: Personal documents).

Local names: Renggak (Sasak Joben), Wresah (Indonesian).

Distribution: lives at an altitude of 694 – 711 m asl, in Tetebatu Village, Orong Gerisak Hamlet, Joben TNGR Resort utilization zone, at coordinate: 8°31′56″S-8°31′52″S and 116 °25′08″E-116°25′06″E.

Habitat and ecology: Secondary forests, near rivers, shaded to open areas on clay and slightly rocky soil, humidity 66-70%, temperature 26.3-27°C, and light intensity 3118-32767 lux.

2. ***Curcuma zanthorrhiza* Roxb.**, Hort. Bengal. 1 (1814), nomun; Fl. Ind., ed. Cerey & Wall.,i. 25 (1820); Fl. Ind., ed. Cerey, i. 25 (1832) (Figure 4)

   Herbaceous shrub, biennial, height 64-82 cm, diameter 2.2-2.4 cm, growth direction curved, elliptical, green, glabrous. Modified stems form rhizomes, rhizome growth direction is horizontal, rounded, diameter: 2.1-3.2cm, yellow. Leaves, intact, single, equitant; leaf blades are coriaceous, lanceolate, length x diameter: 42-53 cm x 10-12.5 cm, green, upper and lower surfaces with sparse pubescent hairs, base wedge, pointed tip, flat edges, leaf margins glabrous, venation pinnate, 13 pairs; petiole plano-convex, length x diameter: 5.8 x 0.7cm, green, glabrous; Vagina linear, length x width: 64-82 cm x 2.4-4.1 cm, outer and inner surfaces are glabrous, arranged equitably to form a stem-like structure called pseudo-stem. Inflorescences, axillary, spike.

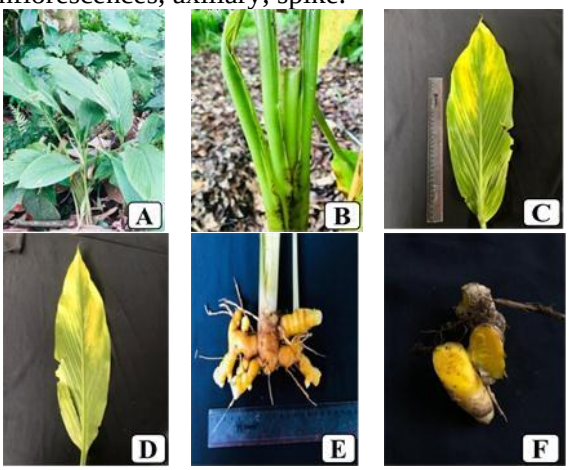

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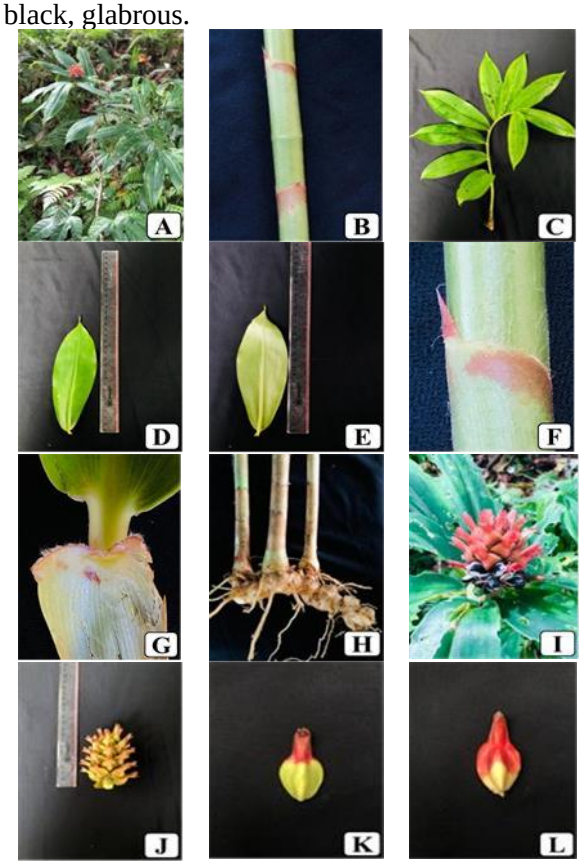
Figure 4. Morphology of *Curcuma zanthorrhiza*. Notes: A. Habitus, B. Pseudo-stem and sitting leaves, C. Leaves from the top side, D. Leaves from the bottom side, E-F. Rhizomes (Source: Personal documents).

Local names: Temu lawak (Sasak Joben), Temu lawak (Indonesia)
Distribution: At an altitude of 775-785 m asl, in Tetebatu Village, Lingkung Hamlet, Joben TNGR Resort traditional zone, at coordinate: 8°13′31″S, 366°34′48″E, and in the Village Pesanggrahan, Joben Hamlet, Joben Resort TNGR utilization zone, at coordinate: 8°13′13″S, 366°33′50″E.
Habitat and ecology: Secondary forests, shaded, grows on rocky soil, humidity 57-80%, temperature 27-28°C, and light intensity 418-1891 lux.

3. ***Costus spiralis* Roscoe**, Trans. Linn. Soc. London 8: 350 (1807) (Figure 5)
   Synonym: *Alpinia spiralis* Jacq.,*Amomum spirale* (Jacq.) Steud., *Coctus pisonis* Lindl., *Coctus spiralis* var. *Jacquin*ii Griseb., *Costus spiralis* var. *pisonis* Griseb., *Costus spiralis* var. *roscoei* Griseb., *Costus spiralis* var. *spiralis*, *Gissanthe spiralis* (Jacq.) Salisb.

Herbaceous shrub, biennial, height 147-156 cm, diameter 2-3.3 cm, vertical growth direction with spiral tip, cylindrical, green, with thick puberulous. Stem modify to rhizome, growth direction horizontal, rounded, diameter 2.4–3.8 cm. Leaves, intact, single, spiral, coriaceous, lanceolate, length x width: 25.5-28.3 x 7.4-7.6 cm, light green, upper surface with sparse pubescent, lower surface with thick puberulous, base rounded, tip acuminate, margin entire, edge surface thick puberulous, venation parallel, 16 pairs; petiole plano convex, length x diameter: 0.4 - 0.7x0.3 cm, green, thick puberulous; Sitting leaves (vagina) oval, length x width: 6-7.3x1.5-1.8cm, outer surface with sparse puberulous, inner surface glabrous, arranged in dense spirals to form a stem-like structure called pseudo-stem; ligula coriaceous, triangular, length x width: 0.3x0.4 cm, red; leaf ears papery, triangular, length x width: 0.3x1.8cm, yellowish red. Inflorescence, terminal, gyno-androphore, length x diameter: 6.5 x 4.6 cm; Peduncle cylindrical, length x diameter: 6.3cm x 1.3 cm, sparsely pubescent; brachtea attached to flower petals, delta, length x width: 2x1.3 cm, yellowish red, outer and inner surface with sparse pubescent; Prophylls (bracteoles) are arranged spirally on the rachis, lanceolate, length x width: 1.4 cm x 0.6 cm, yellowish red, outer and inner surface hairy, 1 pedicle supports 1 flower.

Flower, bisexual, zygomorph; flower petals are tubular, length x diameter: 1.3 cm x 0.1 cm, base-middle part green, tip red, 1 lobe, closed (valvate), inner surface glabrous, outer surface sparsely puberulous; carpels 3. Fruit capsule, oval, length x diameter: 3.5x 0.6 cm, red, thick pubescent, 3 chambers, 13-21 seeds/chamber. Square seeds, length x diameter: 3-3.5x0.2mm, black, glabrous.



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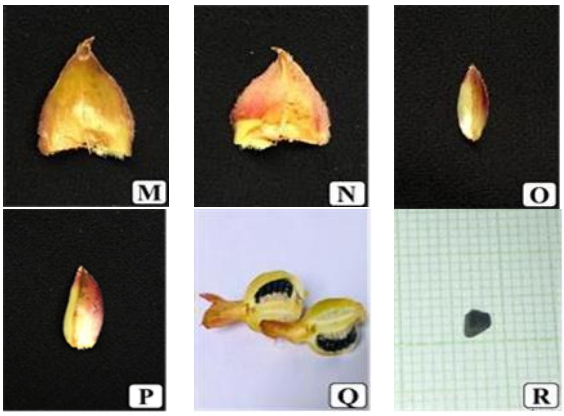

Figure 5. Morphology of *Costus spiralis*. Notes: A. Habitus, B. Pseudo stem, C. Sitting leaves, D. Adaxial leaves, E. Abaxial Leaves, F. Ligula, G. Auricula, H. Rhizome, I-J. Inflorescence, K. Calyx, L. Fruit, M. Brachtea from the inside, N. Brachtea from the outside, O. Brachteole from the inside, P. Brachteole from the outside, Q. Fruit looking inside, R. Seeds. (Source: Personal documents).

Local name: Pacing (Sasak Joben)
Distribution: At an altitude of 651-902 m asl, in Pesanggrahan Village, Joben Hamlet, Joben TNGR Resort utilization zone, at coordinate: 8°13′03″S, 366°31′51″E, in Perian Village , Gunung Paok Hamlet, Jobrn TNGR Resort traditional zone, at coordinate: 8°11′54″S, 366°33′15″E, in Tetebatu Village, Lingkung Hamlet, Joben TNGR Resort traditional zone, at coordinate: 8°13′15″S-8°13′45″S, 366 °34′41″E-366°34′19″E, and in Tetebatu Village, Orong Gerisak Hamlet, Resort Joben TNGR utilization zone, at coordinate: 8°13′56″S-8°13′34″S, 366°35′38″E.
Habitat and ecology: Secondary forest, in shaded and open places, near rivers, clay and rocky soil, humidity 68-74%, temperature 26-27°C, and light intensity 594-2306 lux.

4. ***Hedychium coronarium* J. Koenig**, Observ. Bot. (Retzius) 3: 73. (1783) (Figure 6)
Synonym: *Amomum filiforme* Hunter ex Ridl.,*Gandasulium coronarium* (J. Koenig) Kuntze, *Gandasulium lingulatum* (Hassk). Kuntze, *Hedychium chrysoleucum* Hook., *Hedychium coronarium* var. baimao Z. Y.Zhu, *Hedychium coronarium* var.*chrysoleocum (*Hook.) Baker, *Hedychium coronarium* var. *maximum* (Roscoe) Eichler, *Hedychium gandasulium* Buch.-Ham.exWall., *Hedychium Lingulatum* Hassk., *Hedychium maximum* Roscoe, *Hedychium prophetae* Buch.-Ham. ex Wall., *Hedychium spicatum* Lodd.,*Hedychium sulphureum* Wall., *Kaempferia hedychium* Lam.

Herbaceous shrub, biennial, height 53-133 cm, diameter 2.3 cm, growth direction vertical, cylindrical, green, glabrous. Stems modify to rhizomes, growth direction horizontal, rounded, diameter 2-3.1 cm. Leaves, sitting leave-lamina, single, alternate, coriaceous, lanceolate-oblong, length x width: 26-44.3x4.6-8.2cm, shiny light green, upper and lower surface with sparse pubescent, base wedge, tip acuminate, margin entire, leaf surface glabrous, venation pinnate, 15 pairs; Sitting leaves linear, length x width: 53-133x3.4-4cm, outer and inner surfaces glabrous, densely arranged alternately to form a stem called pseudo-stem; ligula, thin membranaceous, triangular, length x width: 2x1.8cm, greenish yellow. Inflorescence, terminal, gyno-androphore, length x diameter: 13x3.2cm; cylindrical handle, length x diameter: 6.2 cm x 3 cm, surface with sparse pubescent; peduncle leaves at the end of the peduncle, lanceolate, length x width: 6.2x3cm, green, outer and inner surfaces glabrous; The prophylls are arranged spirally on the rakis, lanceolate, length x width: 3.4x1.2 cm, green, the outer and inner surfaces are glabrous, each pedicle supports 1 flower. Flower, bisexual, zygomorphy; flower tube, length x diameter: 4x2.5mm, green, 1 lobe, closed, outer and inner surfaces glabrous; flower corolla thread-like and lip-shaped (labelum), length x width: 4.2 cm x 0.6 cm, white, number of flower corolla 5 (3 separate and 2 fused to form labellum), closed, choriopetalus, outer-inner surface thorough bald, gentle floral aroma; stamens 2, antisephalus, not filamentous, anther size: length x width: 1.4x0.8 cm; ovary triangular, epigynous, pistil: style 1, 4.7 cm long, stigma 1, lobed. Petals 5 (3 separate and 2 fused to form labellum), closed, choriopetalus, outer-inner surface completely glabrous, soft floral, aroma; stamens 2, antisephalus, anther sessle, length x width: 1.4x4.8cm; ovary triangular, epyginous, style 1,4.7cm long, stigma 1, lobed.

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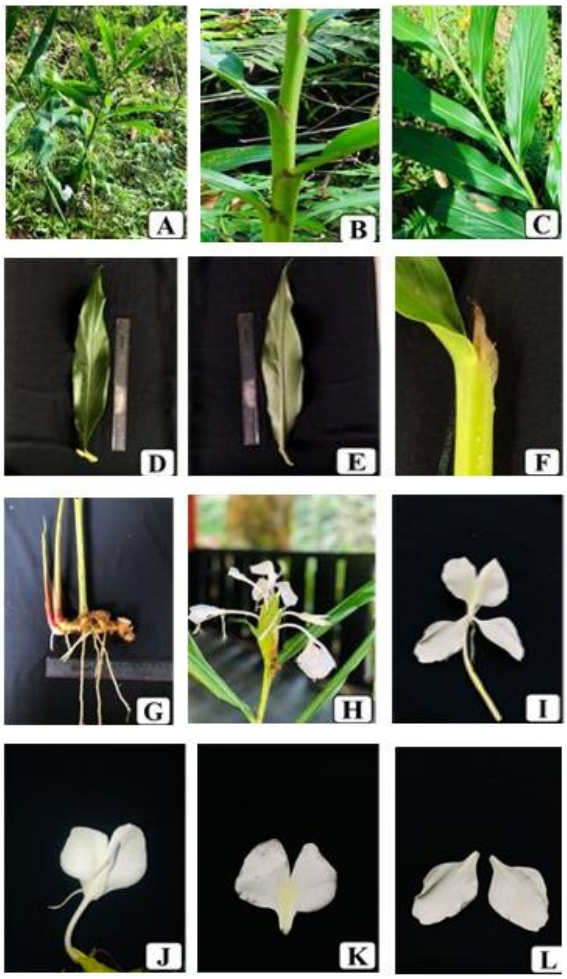
Local names: Bujak (Sasak Joben), Gondosuli (Indonesian).
Distribution: At an altitude of 641- 815 meters above sea level, in Pesanggrahan Village, Joben Hamlet, Joben Resort TNGR utilization zone, at coordinate: 8°12′03″S-8°12′02″S, 166°33 ′51″E-366°33′54″E, in Perian Village, Gunung Paok Hamlet, Joben Resort TNGR traditional zone, at coordinate: 8°12′11″S-8°12′00″S, 166°33′10″E-366 °33′05″E, in Tetebatu Village, Dusun Lingkung, Resort Joben TNGR utilization zone, at south latitude: 8°12′09″S, 166° 34′41″E, in Tetebatu Village, Orong Gerisak Hamlet, Joben Resort TNGR utilization zone, at coordinate: 8°11′58″S-8°11′55″S and at coordinate: 166°35′08″ E.
Habitat and ecology: Secondary forests, shaded, near rivers, on clay and slightly rocky soil, humidity 57-68%, temperature 26-28.4°C, light intensity 4431-6080 lux.



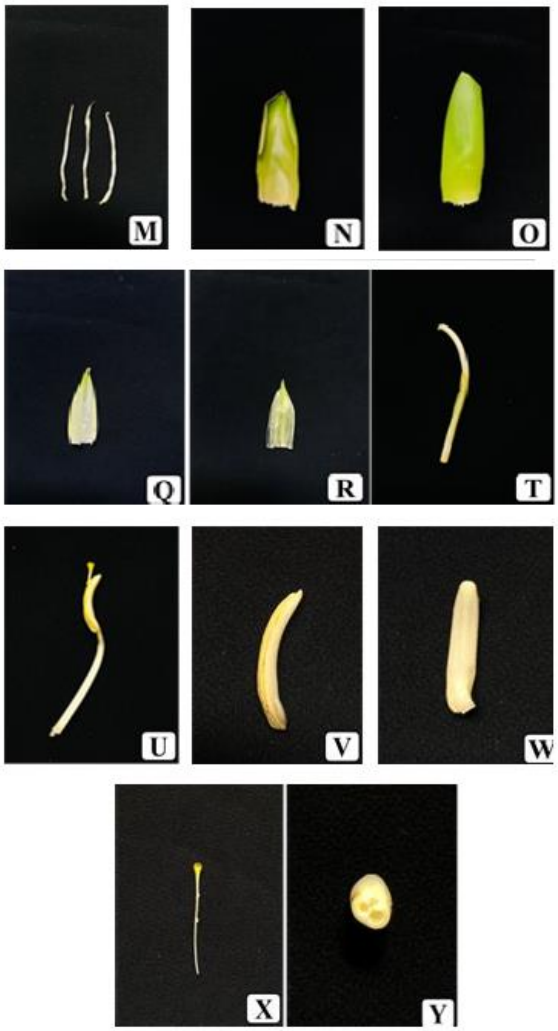


Figure 6. Morphology of *Hedychium coronarium*, Notes: A. Habitus, B. Pseudo stem, C. Sitting leaves (vagina), D. Leaves from the upper side, E. Leaves from the lower side, F. Ligula, G. Rhizome, H. Inflorescence, I. Whole flower front view, J. Whole flower rear view, K. Labelum, L. Stamenioda lateral, M. Corolla, N. Brachtea from the inner side, O. Bractea from the side, P. Primary brachteola, Q. Brachteole, R. Tertiary brachteole, S. Calyx, T. Filamen, U. Stamen, V. Anther from the side, W. Anther from the back, X. Stigma, Y. Ovaries (Source: Personal documents).

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5. ***Etlingera rubloloba*** A. D. Poulsen, *Etlingera*of Sulawesi 214. 2012 (Figure 7)
Synonym: -

Herbaceous shrubs, biennial, height 166-182.3 cm, diameter 2.4-3 cm, curved growth direction, cylindrical, green, dense pubescent. Stem modify to rhizomes, horizontal growth direction, rounded, diameter: 2-3.2 cm. Leaves, intact, single, alternate, coriaceous, lanceolate, length x width: 33.6- 44.4 x 7-11.7 cm, shiny dark green, glabrous upper surface, sparse pubescent lower surface, rounded base, acuminate tip, entire and dense pubescent margin, venation pinnate, 27 pairs; petiole plano convex, length x diameter: 1.2x1cm, green, sparsely hairy; memita frond, length x width: 43-181 cm x 2-3.2 cm, outer surface sparse pubescent, inner surface glabrous, arranged in dense spirals to form a stem-like structure called pseudostem; ligula triangular, length x width: 0.6x0.4cm, yellowish green, skinned. Inflorescences, lateral.

Local name: Lempuik (Sasak Joben).
Distribution: At an altitude of 771- 2374 meters above sea level, in Pesanggrahan Village, Joben Hamlet, Joben Resort utilization zone, at coordinate: 8°11′18″S- 8°11′01″S, 366°33′ 45″E-366°33′43″E, Perian Village, Gunung Paok Hamlet, Joben Resort TNGR traditional zone, at coordinate: 8°12′19″S-8°11′51″S, 166°33′19″E-366°33′17″E, in Tetebatu Village, Lingkung Hemlet, Resort Joben TNGR traditional zone, at coordinat: 8°11′15″S-8°10′43″S, 366°34′43″E-366°34′40″E, in Tetebatu Village, Orong Gerisak Hamlet, Joben Resort TNGR utilization zone, at coordinate: 8°11′38″S- 8°11 ′34″S, 366°35′08″E - 366°35′09″E, in Tetebatu Village, Kembang Sri Hamlet, Joben TNGR Resort, utilization zone and jungle zone (Mount Sangkareang climbing route) on the line coordinate: 8°38′52″S- 8°37′23″S, 366°34′06″E-366°34′39″E.
Habitat and ecology: Secondary forest and primary forest, shaded, grows around cliffs and river streams, on clay soil, at humidity 68-79%, temperature 23-30.5°C, and light intensity 2306-4115 lux.

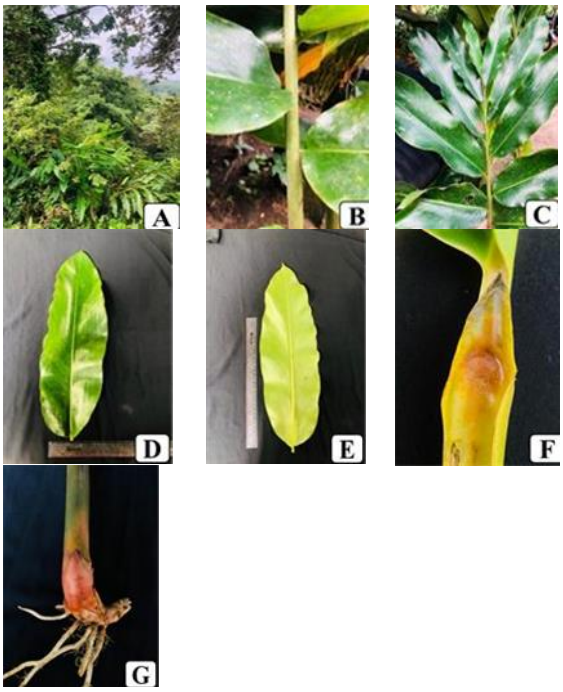

Figure 7. Etlingera rubloloba, Description: A. Habitus, B. Pseudo-stem, C. Sitting leaves, D. Leaves from the upper side, E. Leaves from the lower side, F. Ligula, G. Rhizome (Source: Personal documents)

6. ***Etlingera spinulosa*** A.D.Pouslen, *Etlingera* of Sulawesi 227 (2012) (Figure 8)
Synonym: -

Herbaceous shrub, biennial, height 148 cm, diameter 1.6 cm, curved growth direction, cylindrical, green, with dense pubescent. Stems modify into rhizomes, horizontal growth direction, rounded, diameter: 2-3.3 cm. Leaves, intact, alternate, threaded, oval, length x width: 30-46x6.2-9.3cm, dark green, upper surface glabrous, lower surface sparse pubescent, base rounded, tip acuminate, margin intere and thick pubescent, venation pinnate, 27 pairs; petioles plano convex, length x diameter: ,0.1 - 0.2 x 0.1 cm, dense pubescent; sitting leaves linear, length x width: 26.2-148x3.1-3.3cm, outer surface sparse pubescent, inner surface glabrous, densely arranged alternately to form a stem called pseudo-stem; ligula coriaceous, rounded, length x width: 0.6x0.5cm, green. Inflorescence, lateral, gyno androphore, length x diameter: 5.7x6.3cm; cylindrical handle, length x diameter: 9.2x0.6 cm, dense puberulous; brachtea at the end of the

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peduncle, delta, length x width: 2.9x2.7cm, red, outer and inner surfaces with sparse pubescent; Prophylls are spirally arranged on rachis, lanceolate, length x width: 2.2x1cm, red, outer and inner surfaces glabrous, 1 pedicle supports 1 flower. Flower, bisexual, zygomorphy. Fruit capsule, oval, length x diameter: 1.4x0.4mm, dull yellow, glabrous, 3 chambers, 15-24 seeds/chamber. Seeds are egg-shaped, length x diameter: 1.2x0.4mm, yellowish white, glabrous.

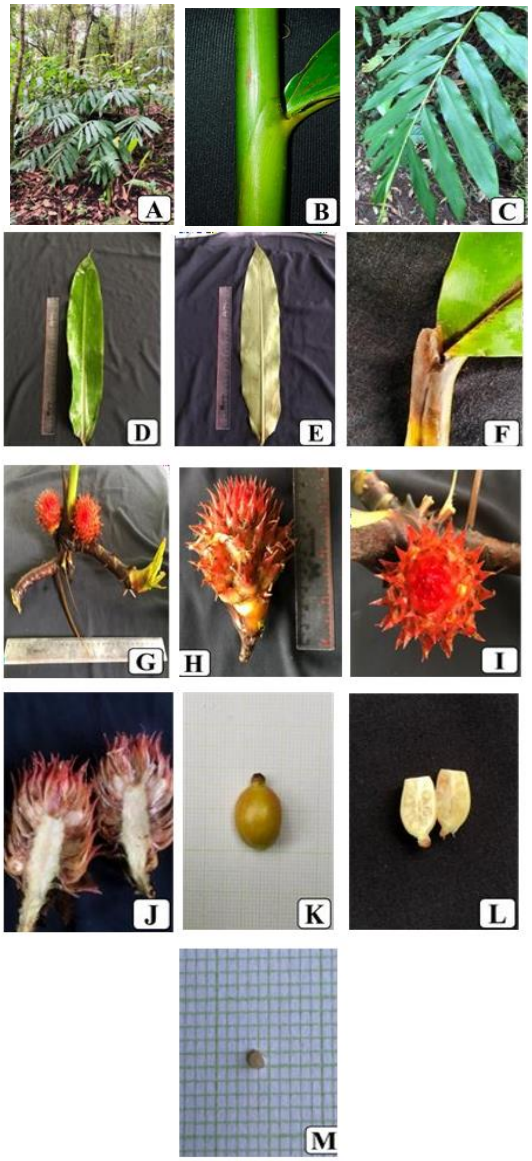

Figure 8. Morphology of *Etlingera spinulosa*. Notes: A. habitus, B. Pseudo-stem, C. Sitting leaves, D. Leaves from the upper side, E. Leaves from the lower side, F. Ligula, G. Inflorescence and rhizome, H. Inflorescence from the side, I. Inflorescence from the front side, J. Inside of the inflorescence, K. Fruit, L. Inside view of the fruit, M. Seeds (Source: Personal document).

Local name: Lempanas (Sasak Joben).
Distribution: At an altitude of 1421- 1715 meters above sea level, in Tetebatu Village, Dusun Kembang Sri, Resort Joben TNGR utilization zone and jungle zone (mount Sangkareang climbing route), at coordinate: 8°10′04″S-8°28′24″S, 166°33′60″E- 366°34′16″E.
Habitat and ecology: Primary forests, on hiking trails, shaded, clay soil, humidity 74-77%, temperature 24-26°C, and light intensity 3415-3551 lux.

Map of the distribution of Zingiberaceae plants species at Joben Resort, Mount Rinjani National Park, East Lombok

The distribution of Zingiberaceae plants at Joben Resort varies from medium to high altitudes (Figure 9). *E. rubloloba* is a plant that can be found at medium altitudes to the highest altitudes observed at Joben Resort, namely at an altitude of 771-2009 m asl. *E. spinulosa* is a species that is only found at high altitudes in primary forests, namely 1421-1715 m asl. Plants of the Zingiberaceae family at Joben Resort are generally found in shaded conditions and tend to be damp, which indicates that the plants like this type of habitat. Apart from that, they are also commonly found near rivers with watery soil conditions. Zingiberaceae plants are also found in open conditions, but their growth is not as good as in shaded conditions. In the picture above, the five paths traced show that this plant is present on every path created. Zingiberaceae plants are more widely distributed in the utilization and traditional zones. Even though the traditional and utilization zones are known as secondary forests which are more open with a lower tree density, zingiberaceae plants always grow under large trees that shade them or on cliffs that receive lower light intensity.

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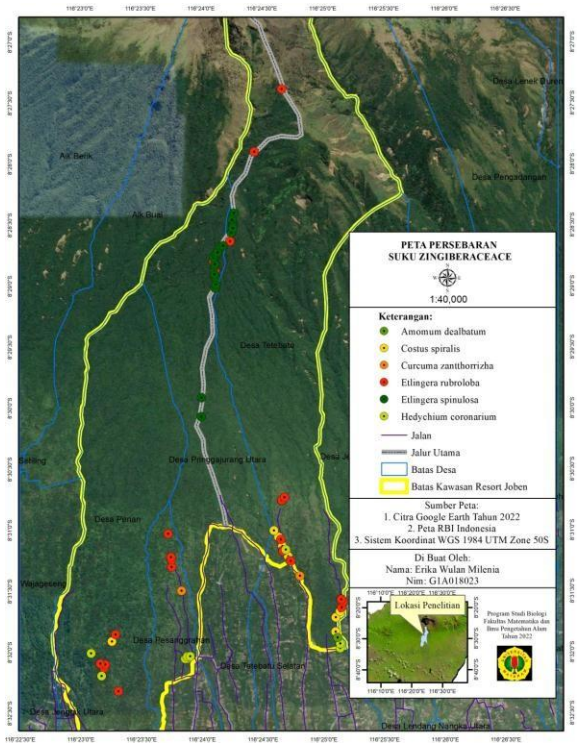

Figure 9. Map of the distribution of Zingiberaceae plants species at Joben Resort, Mount Rinjani National Park, East Lombok.

Discussion

Based on this research, the diversity of plant types of the Zingiberaceae family at the Joben Resort was found to be 6 species, namely *A. dealbatum*, *Curcuma zanthorrhiza*, *Costus spiralis*, *H. coronarium*, *E. rubloloba*, *E. spinulosa*.

The Mount Rinjani National Park Joben Resort, which is a conservation forest area, is located on a plateau from the foot to the peak of Mount Sangkreang which is included in the Mount Rinjani National Park area. This location allows the plant species that live here to have different morphological characteristics from similar species in other places, which can be attributed to their adaptation to their environment. *E. spinulosa* is one of the two species that is located highest compared to other species of the Zingiberaceae family at Joben Resort where it is found at an altitude of 1421-1715 m asl. This species is very similar to *E. spinulosa* which was reported on Mount Gandang dewata, Mamasa, West Sulawesi when viewed from its habitat and morphology. Based on its habitat and distribution, *E. spinulosa* on Mount Gandang dewata grows at an altitude of more than 1000 m asl., namely at an altitude of 1,681 m asl in primary forest under humid conditions (Ardiyani and Poulsen, 2019), this is in accordance with the conditions of *Etlingera spinulosa* at Joben Resort. Based on morphology, *E. spinulosa* at Joben Resort and at Mount Gandang dewata are almost the same, except for the leaf width where *E. spinulosa* at Mount Gandang dewata has a smaller width than *E. spinulosa* at Joben Resort, namely 2 cm. This difference could be caused by *E. spinulosa* at the Joben Resort occupying very shaded conditions, dark forests and receiving little light intensity so that the adaptation to wider leaves is intended to maximize light capture.

A. dealbatum is known as a typical plant of Lombok Island which is widely distributed in the region and is widely consumed. This plant can be found in *Indonesia*, China, India and Thailand (Muliasari et al., 2019). This plant at the Resort can grow to a height of 711 m asl. In terms of habitat and ecology, *A. dealbatum* at the Joben Resort is similar to the one in the lowlands of the South Katangana Tiworo River where this species is located near the river flow and the light intensity is quite high. *A. dealbatum* in the South Katangana Tiworo River occurs at an altitude of 25-500 m asl (Sarangnga et al., 2013). Based on morphological characters, *A. dealbatum* is generally similar to similar species reported elsewhere. The surface of this plant organ is always protected by trichomes which have sparse to thick pubescent hairs. The presence of trichomes is important because plants are generally often found in a damaged condition due to being eaten by other organisms (Sarangnga et al., 2013) so the presence of trichomes provides protection for their survival. *H. coronarium* at Joben Resort has slight morphological differences from *H. coronarium* reported elsewhere. *H. coronarium* at Joben Resort has trichomes on the upper and lower surfaces of the leaves which are sparsely hairy, while *H. coronarium* identified in the Telagah Forest of Gunung Leuser National Park, Langkat Regency, North Sumatra has a glabrous leaf surface (Hutasuhut and Tambunan, 2018). The presence of sparsely pubescent on the leaves of *H. coronarium* at Joben Resort can be analyzed as part of this plant's adaptation to higher light intensity. As we know, Zingiberaceae plants

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are common in shaded places, but at the Joben Resort, *H. coronarium* is more common in open places near rivers with fairly low humidity, namely 57-68% humidity. Meanwhile, in the Telagah Gunung Leuser Forest, the humidity is higher, reaching 73%. Humidity is inversely proportional to light intensity or environmental temperature. *H. coronarium* in Joben Resort which has lower humidity than *H. coronarium* in Telagah Forest indicates that *H. coronarium* lives at higher temperatures and light intensity than in Telagah Forest. One of the functions of trichomes is to reduce evaporation, so *H. coronarium* at Joben Resort adapts to these trichomes to reduce the rate of transpiration at higher temperatures and light intensity.

E. rubloloba is a species of Zingiberaceae that grows highest at Joben Resort, reaching 2374 m asl. This plant is also reported to be at another resort in Mount Rinjani National Park, namely Senaru Resort (Ardiyani et al., 2012). Based on morphology and habitat, *E. rubloloba* at Joben Resort is very similar to *E. rubloloba* reported at Senaru Resort, this is of course because these two areas have the same physical conditions and are included in a series of Rinjani mountain forests. *E. rubloloba* is a plant that was first identified by Poulsen in 2012 (Ardiyani and Poulsen, 2019), and was determined to be endemic to Southeast Sulawesi (Jabbar, 2021), but in fact this plant can be found on Lombok Island, especially in TNGR area.

C. zhanthorrhiza is a plant that is widely known and used in Indonesia (Mukti and Hermady, 2020). *C. zhanthorrhiza* is a plant native to Indonesia which is commonly known as ginger (Rahmat et al., 2021). *C. zhanthorrhiza* at Joben Resort was found at an altitude of 775-785 m asl. Afifah (2005) stated that apart from growing well in the lowlands, this plant is also able to live up to an altitude of 1,500 m asl. (Afifah, 2005). The morphology of *C. zhanthorrhiza* in other places has not been described thoroughly and specifically regarding its organs, but the general characteristics of this plant in other places are generally the same as *C. zhanthorrhiza* at the Joben Resort where this plant is a pseudo-stems plant, has lanceolate leaves, has relatively large rhizomes with bright yellow rhizome slices (Syamsudin et al., 2019). *C. spiralis* at the Joben Resort has many morphological similarities to those that have been identified elsewhere, for example in the Clube de Caca e Pesca Itomoro de Uberlandia ecological reserve, Brazil, where this plant is a herbaceous plant that reaches a height of 50 cm to 2 m, the inflorescences *have* bracts. or prominent red stem leaves that overlap each other where flower buds and fruit develop (Araujo and Oliveira, 2007). This plant also has specific characteristics that are similar to similar types identified on the British West Indian Islands where this plant has a stem surface and leaves that are sparsely thick pubescent, leaves that are lanceolate, red bracts (Grisebach, 1864).

Based on the Flora of Lombok check list book and several *libraries*, including (Ardiyani et al, 2012) regarding Zingiberaceae in Lombok, namely: *Curcuma zanthorrhiza, Costus spiralis, H. coronarium, E. spinulosa,* are not mentioned as Zingiberaceae species that are distributed in Lombok. Thus, the species *Curcuma zanthorrhiza, Costus spiralis, H. coronarium,* and *E. spinulosa*, are new records on Lombok Island.

4. CONCLUSION

Based on research that has been carried out, it was found that six types of plants from the Zingiberaceae tribe at the Joben Resort TNGR East Lombok, namely *Amomum dealbatum*, *Etlingera rubroloba*, and *E. spinulosa* are included in the Alpinioideae sub-family, *Curcuma zantthorrizha* and *Hedychium coronarium* are included in the Zingiberoideae sub-family, and the last one is *Costus spiralis* which is included in the Costoideae sub-family. Plants from the Zingiberaceae family at Joben Resort are known for their pseudo-stem characteristics and aromatic rhizomes. Its distribution is in utilization zones, traditional zones, and jungle zones, generally in shaded places, near rivers and cliffs, in secondary forests except for *E. rubroloba* which grows in secondary-primary forests and *E. spinulosa* which is only found in forests primary. These types grow at different heights, where *A. dealbatum* grows at an altitude of 694-711 meters above sea level, *C. zantthorrizha* at an altitude of 775-785 m asl. *C. spiralis* at an altitude of 651-902 m asl., *H. coronarium* at an altitude of 641- 815 m asl., *E.*

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rubroloba at altitudes 771-2374 m asl. and *E. spinulosa* at altitudes 1421-1715 m asl.

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