

博士論文

Taxonomic study of the genus *Zingiber* Mill.
(Zingiberaceae) in Myanmar

(ミャンマーにおけるショウガ属 (ショウガ科)
の分類学的研究)

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**Taxonomic study of the genus *Zingiber* Mill.
(Zingiberaceae) in Myanmar**

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ABSTRACT

The genus *Zingiber* Mill. is the second largest genus in the Zingiberaceae with about 150 species, and occurs from S and SE Asia to China and eastward to Japan and to northern Australia, with its center of diversity in monsoonal Asia. Thus far 18 taxa of *Zingiber* have been recorded from Myanmar however this number reflects the lack of recent explorations, rather than the lack of biodiversity in Myanmar. Myanmar is a blank of plant diversity in Indo-Burmese Hotspot since British colonial time, and on the other hand, facing the destruction of natural environment without any scientific basic data. To clarify the species diversity of *Zingiber* in Myanmar, field explorations in various sites covering representative nine regions were carried out, and total 132 specimens of the genus were collected. The specimens housed in the herbaria of Makino Botanical Garden (MBK), Forest Research Institute, Myanmar (RAF) and University of Tokyo (TI) were examined. Furthermore the image data of authentic specimens kept in the herbaria of the Natural History Museum, London (BM), Central National Herbarium, Botanical Survey of India (CAL), Royal Botanic Gardens, Edinburgh (E), Xishuangbanna Tropical Botanical Garden (HITBC), Royal Botanic Gardens, Kew (K) and Museum National d'Histoire Naturelle, Paris (P) were also investigated. Additionally ethnobotanical investigation of *Zingiber* in Myanmar was also carried out. Voucher specimens were deposited in the herbaria of Forest Research Institute, Myanmar (RAF) and National Museum of Nature and Science, Japan (TNS). As the result of this extensive work on *Zingiber* have so far confirmed presence of 37 *Zingiber* species from all three sections to be present, of which 14 species, namely: *Z. bradleyanum*, *Z. bisectum*, *Z. capitatum*, *Z. chrysanthum*, *Z. corallinum*, *Z. densissimum*, *Z. flavomaculosum*, *Z. griffithii*, *Z. longiligulatum*, *Z. orbiculatum*, *Z. sadakornii*, *Z. tenuiscapus*, *Z. ottensii* and *Z. thorelli* were newly recorded from Myanmar, and of which four species belonging to sect. *Cryptanthium*

and sect. *Zingiber* were described here as new to science. A sterile plant considered as un-described was recognized and is assignable to sect. *Dymczewiczia*. Detailed description, key to the all species of Myanmar, distribution, habitat of each taxon and taxonomic treatment for all Myanmar *Zingiber* with their ethnobotanical uses are provided. This study critically revealed the species diversity of *Zingiber* in Myanmar for the first time after British Burma, and is the first comprehensive taxonomic revision of *Zingiber* in the country and should be formed a significant contribution to bridge the floristic blank in SE Asia.

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I INTRODUCTION

The Zingiberaceae are the largest family in the order Zingiberales with 53 genera and over 1200 species (Kress *et al.* 2002). The Zingiberaceae, diversified especially in SE Asia, is well-known for its economic values, which provide many useful products for food, spices, medicines, dyes, perfume etc. Therefore gingers are known as an important group with considerable economic potential.

Zingiberaceae is a pantropical family with one genus (*Renealmia*) in the tropics of America and Africa. Three genera (*Aframomum*, *Aulotandra* and *Siphonochilus*) are found in Africa and Madagascar, and the rest of the genera are distributed in East Asia and the Pacific Islands (Kress *et al.* 2002).

The family Zingiberaceae has been classified into different groups over the years. The most easily recognized by the characters which has been used to describe these groups are the size of the lateral staminodes and the number of locules in the ovary. Three tribes were first described by Petersen (1889) which were Zingibereae (trilocular ovary and small staminodes), Hedychieae (trilocular ovary and large staminodes), and Globbeae (unilocular ovary). Nearly a century has elapsed since Schumann revised the whole family classification (Schumann 1904), he followed the same classification. The currently accepted classification of the Zingiberaceae includes four tribes (Hedychiae; Alpineae; Zingibereae; Globbeae) and is based on morphological features, such as number of locules and placentation in the ovary, development of lateral staminodes or which united to the labellum, modifications of the fertile anther, and rhizome-shoot-leaf orientation (Kress *et al.* 2002).

Recently several molecular phylogenetic works have been made to clarify the generic relationship in the family (Kress *et al.* 2002; Ngamriabsakul *et al.* 2003), however the family is still poorly known taxonomically at the lower rank with many species (Theilade and Mood,

1997; Sakai and Nagamasu, 1998; Poulsen, Mood, and Ibrahim, 1999; Williams, Kress, and Thet Tun, 2002) and even genera (Newman, 1995; Mood and Larsen, 1997; Larsen and Mood, 1998; Sakai and Nagamasu, 2000; Kress and Larsen, 2001; Larsen and Jenjit-tikul, 2001) newly described in the last several decades.

The genus *Zingiber* Mill. is widely distributed throughout S and SE Asia to China and eastward to Japan and to northern Australia, with its center of diversity in monsoon continental Asia (Larsen, 2005). It is representing to approximately 100–150 species (Kishor and Leong-Škorničková, 2013). *Zingiber* is distinct from the other genera of the family by the presence of a single anther with a beak or horn-like shape appendage, which embraces the upper part of the style and in the vegetative stage by the presence of a pulvinus between the base of the petiole and ligule.

The extensive field work on Zingiberales in Vietnam were carried out by some botanists since 2008 (Leong-Škorničková *et al.* 2010, 2011, 2013, 2014; Leong-Škorničková and Ly 2010; Leong-Škorničková and Ly 2013; Leong-Škorničková and Trần 2013; Ly *et al.* 2010; Nguyễn and Leong-Škorničková 2012), the presence of thirty *Zingiber* species have been confirmed from Vietnam, of which nine species were described as new to science (Leong-Škorničková *et al.* 2014). Furthermore, Larsen is a pioneer of Thai ginger taxonomy, and his contribution to Thai species is great achievement. After Larsen, Triboun made extensive field works and discovered many new species from Thailand (Triboun *et al.* 2014).

On the other hand, Myanmar is well-known as a blank of plant diversity in Indo-Burma Hotspot nearly for a century since the British colonial time. However, no comprehensive floristic surveys have been conducted in Myanmar, and much remains to be learnt of its flora as well as of its floristic relations with neighboring regions in SE and E Asia (Tanaka 2005). Therefore Myanmar is so called “floristic black box”.

Thus far 18 taxa of *Zingiber* have been recorded from Myanmar (Kress *et al.* 2003; Tanaka 2012): however, this incredible small number reflects the lack of explorations in the whole of this country for the last half a century. Therefore it is considered that there might be many more taxa. However, Myanmar is situated in the mainland SE Asia, with a land area of 676,577 km², which has extremely rich in a high diversity of habitats (FRA 2015). The forest types in this country are classified by lowland evergreen forest, mixed deciduous forest, deciduous dipterocarp forest, semi-evergreen forest, hill evergreen forest, montane oak forest and coniferous forest (Tanaka 2005).

In this study, the genus *Zingiber* is taxonomically revised mainly based on the extensive field surveys and the morphological investigations and then the key to all taxa occurring in Myanmar is provided. Taxonomic discussion of each taxon of *Zingiber* is given in the taxonomic treatment. Additionally, the basic information about their utilization by local people in Myanmar was also provided for further applied scientific studies.

1.1. Historical Review of *Zingiber*

1.1.1. Previous Taxonomic Works on *Zingiber*

The name of *Zingiber* derived from Sanskrit “*sringavera/singabera*” (horn-root), referring to the shape of the rhizome (Leong-Škorničková and Newman, 2015). The vernacular names in SE Asia are; khnhei, khnehey, phlung (Khmer), Khing (Lao), gung (Vietnamese), ginger (English) and Gyin/Gyin-sein (Myanmar), (Nagathein, 1976; Ravindran *et al.* 2004).

The genus is easily recognized by its unique structure of the anther crest. *Amomum* L. is the heterotypic synonym of *Zingiber* Mill. Roscoe (1807) described many taxa of *Zingiber*, and also transferred some species described under *Amomum* to *Zingiber*; *Zingiber mioga* (Thunb.) Roscoe, *Zingiber roseum* (Roxb.) Roscoe etc.

Roxburgh and Wallich (1820) defined the genus *Zingiber* based on the morphological structure of the corolla with the interior border unilabiate; anther double, crowned with a single, horn-shaped, curved beak; capsule three-celled, three-valved; seeds many, arilled; embryo simple, and furnished with both perisperm and vitellus. Eleven *Zingiber* species were described based on their work, of which two species (*Z. panduratum*, *Z. squarrosum*) are from Rangoon (present Yangon), Burma.

Baker's treatment of the Scitamineae in the Flora of British India, Vol. 6 (1892) is still only one reference to India and Myanmar *Zingiber*. Baker (1892) recorded 24 species of *Zingiber* in the flora, of those 5 species were described from Myanmar.

Ridley (1899) first published taxonomic treatment of the Scitamineae of the Malay Peninsula. He described three species and five infraspecific taxa in his work. At a later date, the genus of the Malay Peninsula was revised by Theilade (1996) who enumerated 19 species and infraspecific taxa. Schuman (1904) published his monograph of the Zingiberaceae in "Das Pflanzenreich", he recorded 10 species of *Zingiber* from Java, Sumatra and New Guinea.

Gagnepain (1908), he published the Zingiberaceae of "Flore generate de l'Indochine" which he described 13 species of *Zingiber*. Recently Pham (2003) reported 11 species of *Zingiber* for Vietnam and to be added this list one new species, *Z. collinsii* Mood & Theilade (Theilade and Mood 1999). Furthermore Leong-Škorničková *et al.* (2015) improved the knowledge on the species diversity in Vietnam with description of nine new species, and of these one species belong to the sect. *Cryptanthium*, five species belonging to the sect. *Dymczewiczia*, and three species belong to the sect. *Zingiber*. Her work cleared that the terminal flowered species of *Zingiber* were diversified in Vietnam.

Valeton (1918) reported the 20 species of *Zingiber* in his article, “the New Notes on the Zingiberaceae of Java and Malaya” which was provided as well as information concerning distribution and habitats; however his key and descriptions are still very useful for identification. Holttum (1950) gave more details of *Zingiber*'s concept and taxonomic problem of especially the difficult group to discriminate, *Z. gracile*, *Z. griffithii*, and *Z. purberlum*. He explained similarities and differences with the important morphological characteristics between species. Furthermore, he also constructed a key for the Malayan species and profound descriptions which are necessary for reliable identification of species.

Smith (1988), she revised 18 *Zingiber* species and Theilade and Mood (1997, 1999) recognized eight new species from Borneo Island, Merrill (1917) recorded five taxa and Mood and Theilade (2001) described two new species in the Philippines belongs to the same floristic region as they done.

Hara *et al.* (1978) recorded two species from Nepal, and Smith (1994) recorded eight species from Bhutan. Kumar (2001) recorded eight taxa of *Zingiber* from Sikkim, India. Sabu (2003) described eight *Zingiber* species from Karnataka, south India. Tripathi (2006) listed seven species in his article titled “the taxonomic revision of the genus *Zingiber* in north-east India”. In Bangladesh, seven species have been recorded by Rahman and Yusuf (2013).

Theilade (1999), she revised the genus *Zingiber* in Thailand based on specimens in the herbarium during her Ph D study. 26 species were recognized including a key to the species of which six new species were described. A few years later, another three species were proposed as new species by Mood and Theilade (2002). However, Theilade handed over her material to Promote Triboun. Triboun started a thorough collection for three years. Larsen (2007), he mentioned that there are over 50 species of *Zingiber* in Thailand. Recently Triboun (2014) reported that novelties 10 new taxa found in Thailand.

Moo (1978) recorded four species, two of which are endemic to the Taiwan. Wu and Larsen (2000) treated Zingiberaceae for The Flora of China. They listed 42 species from China including 34 endemics and one introduced species and it shows China is one of the richest center of species diversity of *Zingiber*. Wu and Larsen (2000) recorded six species of *Zingiber* from Taiwan.

Kress *et al.* (2003) published first checklist covering all flowering plant in Myanmar titled as “A Checklist of the trees, Shrubs, Herbs, and Climbers of Myanmar”. They listed 17 species of *Zingiber*: *Zingiber barbatum* Wall., *Z. cassumunar* Roxb., *Z. gracile* Jack, *Z. gramineum* Noronha ex Blume, *Z. kerrii* Craib, *Z. ligulatum* Roxb., *Z. macrostachyum* Dalzell, *Z. montanum* (J. Koenig ex Retz.) Theilade, *Z. nimmonii* (J. Graham) Dalzell, *Z. officinale* Roscoe, *Z. panduratum* Roxb., *Z. pardocheilum* Wall. ex Baker, *Z. parishii* Hook. f., *Z. roseum* (Roxb.) Roscoe, *Z. rubens* Roxb., *Z. squarrosum* Roxb., *Z. zerumbet* (L.) Roscoe ex Sm. However *Z. cassumunar* Roxb. is widely accepted under the synonymy of *Z. montanum* (J. Koenig ex Retz.) Theilade, so 16 species actually listed in the checklist. Tanaka (2012a, 2012b) described *Zingiber popaense* Nob. Tanaka as a new species from Popa Mountain Park, Mandalay Region, Central Myanmar and also recorded *Zingiber idae* P. Triboun & K. Laesn for the first time from Myanmar. Totally 18 species of *Zingiber* have been recorded from Myanmar.

1.1.2. Section Delimitation in *Zingiber*

The genus *Zingiber* is conventionally classified into four sections based on their position of the inflorescence; sect. *Zingiber*, sect. *Dymczewiczia* (Horan.) Benth, sect. *Pleuranthesis* Benth. and sect. *Cryptanthium* Horan. Theerakulpisut *et al.* (2012) shows that *Zingiber* sect. *Dymczewiczia* and *Zingiber* sect. *Pleuranthesis* are not well segregated from

Zingiber sect. *Zingiber*, based on a recent molecular study using a single marker and limited materials.

Section *Zingiber* is distinct by its inflorescences arising from the rhizome and consisting of spikes on erect peduncles. Section *Cryptanthium* is characterized by inflorescences arising from the rhizome on procumbent peduncles. Sect. *Dymczewiczia* is distinctly characterized by its terminated inflorescence. Sect. *Pleuranthesis* is distinct by peduncles inflorescences arising from the side of the leafy stem.

II MATERIALS AND METHODS

2.1. Study Sites

Myanmar is geographically situated in the mainland South East Asia, with a land area of 676,577 km², and a coastline of 2,832 km. It lies between latitudes 9° 32' N to 28° 31'N and longitudes 92° 10' E to 101° 11'E, and is bonded by the China in the north-east, Laos and Thailand in the east, Bangladesh and India in the west. In Myanmar, it can be divided into seven administrative regions and 7 states which are: Ayeyarwady, Bago, Magway, Mandalay, Sagaing, Tanintharyi, Yangon, and seven states are: Chin, Kachin, Kayah, Kayin, Mon, Rakhine and Shan.

Field explorations were conducted in Chin, Kachin, Kayah, Shan States, and Bago, Mandalay, Sagaing, Tanintharyi and Yangon Regions between 2013 and 2015 (Table 1). The location of study sites covers almost of the States and Regions of Myanmar (Fig. 1). Kachin State is located in the Northern region, Shan and Kayah State belong to the East, North East and South East region, Chin State is situated in the Western region, Mandalay belongs to the Central Myanmar, Sagaing belongs to the North West region, Tanintharyi located in the Southern region, Yangon and Bago is the South West of Myanmar. The mean annual rainfall between mid-May and October varies from about 5,000 mm on the Tanintharyi Coast to about 760 mm at Mandalay and the dry season lasts for six months (November to April). The mean annual temperature is 27°C (81°F) and temperatures are generally lower in mountainous regions. Lower Myanmar, especially in the river delta and along the coastal regions, is the most humid part of the country (Hadden, 2008). Forest types range from lowland wet evergreen forest in the south of the country, to sub-alpine forest at high elevations in the far north. Observations were carried out in both of the flowering and fruiting seasons.

2.2. Plant Materials and Specimens Preparation

Totally 84 (132 including duplicates) specimens of *Zingiber* were collected during the field expeditions. The significant taxonomic characters of *Zingiber* plants; rhizomes, number of leaf pairs, ligules, inflorescence, flowers, and fruits, were photographed and taking these data in the field notes. The flowers and/or fruits were preserved in 70% ethyl alcohol. Detailed collection localities were taken by using GPS (Global Positioning System). The dried and pressed herbarium specimens were prepared in the field and shipped them to the Kochi University for taxonomic study. Voucher specimens in this study are deposited in the Herbarium of Forest Research Institute (RAF), Myanmar and Department of Botany, National Museum of Nature and Science, Japan (TNS). The duplicate specimens were also deposited in RAF according to CBD (Congress on the Biological Diversity) and ABS (Access to the Biological Resources and Benefit Sharing). On the other hand, the rhizomes of sterile plants were dug up and transplanted in the nursery of Forest Research Institute (FRI), Forest Department, Yezin, Myanmar. Morphological investigations of these materials were made based on the dried and pressed herbarium specimens, spirit collections and living materials. Detailed vegetative and reproductive parts were measured in the laboratory using light electron microscope (OLYMPUS – SZX7, DF PLAPO 1X- JAPAN).

2.3. Herbarium Studies

Herbarium works were carried out in RAF and MBK. All authentic specimens of the image data of *Zingiber* species collected from Myanmar and old Burma kept in BM, CAL, E, HITBC, K, P and TI were also investigated. Herbarium acronyms followed by Holmgren *et al.* (1998). The measurements were made based on dried, living, and also on spirit specimens. The identification was made based on these morphological characters by referring to their

original protologues. The details of morphological characters, ecology, distribution and other scientific data were described from field investigation, herbarium and spirit specimens. All characters were compared and key to all species for *Zingiber* occurring in Myanmar were also made, and provided in the taxonomic treatment.

2.1. Ethnobotanical Studies

Ethnobotanical investigations of *Zingiber* utilization were conducted in Chin, Kachin, Kayah, Shan States, and Bago, Mandalay, Sagaing, Tanintharyi and Yangon Regions from 2013 to 2015 beside the taxonomic studies (See Table 1). The randomly selected interviewees including 36 male persons with ages from 40 to 70 years old and 18 female persons with ages from 35 to 65 years old. The ethnobotanical data such as local name, part of the plants used and their purposes were collected through questionnaire, interviews and discussions with 54 resources persons who had traditional knowledge on the medicinal use of the ginger plants and had a tradition of healing in their families. The plant materials collected in the study were examined and identified in the laboratory of Kochi University. The voucher specimens are housed in MBK, RAF and TNS.

III RESULTS AND DISCUSSION

3.1. New or Noteworthy Taxa of *Zingiber* in Myanmar

As the result of this extensive field works and identifications of these materials collected, have so far confirmed presence of 37 *Zingiber* species from three sections to be presented (Table 2), of which 14 species, namely: *Z. bradleyanum* Craib, *Z. bisectum* D. Fang, *Z. capitatum* Roxb., *Z. chrysanthum* Roscoe, *Z. corallinum* Hance, *Z. densissimum* S.Q. Tong & Y.M. Xia, *Z. flavomaculosum* S.Q. Tong, *Z. griffithii* Baker, *Z. ottensii* Valetton, *Z. longiligulatum* S.Q. Tong, *Z. orbiculatum* S.Q. Tong, *Z. sadakornii* Triboun & K. Larsen, *Z. tenuiscapus* Triboun & K. Larsen, and *Z. thorelii* Gagnep., were newly recorded from Myanmar.

Zingiber orbiculatum S.Q. Tong and *Z. flavomaculosum* S.Q. Tong were described both from Yunnan, S. China. Both of the two species belong to sect. *Cryptanthium* Horan. having the radical inflorescence and their procumbent peduncles. *Z. capitatum* Roxb. only belongs to sect. *Dymczewiczia* with terminated inflorescence. In this study two species applicable to this section were recognized, and one is *Z. capitatum* Roxb., and another is unidentified because of the deficient sterile specimen. However the latter one is considered to be an undescribed species and detailed notes are given under the taxonomic treatment.

Zingiber sadakornii Triboun & K. Larsen and *Z. tenuiscapus* Triboun & K. Larsen were very recently described from Thailand (Triboun *et al.* 2014), and the expedition to Peninsular Myanmar, the Tanintharyi Region, revealed the existence of these two species as well in Myanmar.

Zingiber bradleyanum Craib has been known from Thailand, and this is the first record from Myanmar. *Zingiber densissimum* S.Q. Tong & Y.M. Xia, *Z. bisectum* D. Fang

and *Z. longiligulatum* S.Q. Tong were described from south China, and recently discovered also from Thailand. In this study, it became clear that a center of distribution of *Z. longiligulatum* is apparently Myanmar, because we could plot many locations of this species in western and eastern part of Myanmar. They are quite variable in their morphological characters.

Based on the materials collected in this study and by the study of related literatures (Horaninov 1862; Baker 1892; Schumann 1904; Gagnepain 1907; Valeton 1918; Hollutum 1950; Tong 1987; Tong and Xia 1987; Theilade 1998; Theilade 1999; Wu and Larsen 2000; Sabu 2003; Larsen and Larsen 2006; Chaveerach *et al.* 2007; Kishor and Leong-Škorničková 2013; Kumar *et al.* 2013; Rahman and Yusuf 2013; Rajkumar and Leong-Škorničková 2013; Leong-Škorničková *et al.* 2014; Thongam and Konsam 2014; Triboun *et al.* 2014; Newman 2015), four new species; *Zingiber tereris*, *Z. neomontanum*, *Z. pygmaea*, *Z. matupiense*, are described here as new to science.

Additionally a sterile plant considered as undescribed was also recognized and is assignable to sect. *Dymczewiczia*. However, the flower is still unknown, so here it is treated as an undescribed taxa, *Zingiber* sp. in the taxonomic treatment.

3.2. Taxonomic Characters of *Zingiber* in Myanmar

In the Myanmar species of *Zingiber* is classified into three sections based on the nature and position of the inflorescence: (1) sect. *Zingiber*; (2) sect. *Cryptanthium* Horan.; (3) sect. *Dymczewiczia* Benth (Fig. 2).

Section *Zingiber*: Sect. *Zingiber* is currently characterised by inflorescences arising from the rhizome and consisting of spikes on erect peduncles. Within the section *Zingiber*, some species have very characteristic inflorescences. In *Z. gramineum*, the inflorescences are

villous especially on upper half, giving a shaggy appearance, with acuminate apex, reduplicate or revolute. *Zingiber kerrii* is distinguished by the inflorescence with green bracts with red apex even in a dried state; it is easily recognised by the red-brown upper part of the bracts. *Zingiber neomontanum* is distinct by the very long spike with dark red closely imbricated bracts. *Zingiber zerumbet* is distinguished by its inflorescence covered with mucilage-like and uniquely aromatic.

Section *Cryptanthium* Horan.: Sect. *Cryptanthium* is characterised by inflorescence arising from the rhizome and consisting of spikes on procumbent peduncles. Most species of inflorescences are very short peduncle sitting on the ground and ovoid to globose spike such as *Z. chrysanthium*, *Z. matupiense*, *Z. squarrosum*, *Z. longiligulatum*, *Z. orbiculatum* and *Z. flovomaculosum*. The bracts have closely or loosely imbricate, lanceolate or ovate to broadly ovate, greenish or yellowish white, bright red with translucent margin and recurved or curved, acute or shortly acuminate at apex, more or less pubescent. *Zingiber thorelli* is distinctly recognized by the ellipsoid or oblong inflorescence tapering pointed at the apex, and the bright red bracts with mucronate apex. In *Z. squarrosum*, the bracts are more recurved, linear lanceolate and green with pinkish at the apex, apex distinctly hooked, densely pubescent towards the apex. In *Z. matupiense* bracts yellowish white with margin translucent and recurved.

Section *Dymczewiczia* Benth.: Sect. *Dymczewiczia* is characterised by the inflorescence terminally on the leafy stem, the only two of species found in Myanmar, *Z. capitatum* is distinguished by the spike born on terminal at the leafy stem, without stalk and bracts with red which reported here as newly recorded from the first time for Myanmar. A sterile plant of *Zingiber* species considered as undescribed taxon and is assignable to this section, it is easily

recognized by its inflorescence arising from terminal on the leafy stem and the spike is slender with bracts green with turning yellow with age.

In *Zingiber officinale* Roscoe, the variation of a position of the inflorescence is often observed even if in the same plant. Usually the inflorescence is arising from the rhizome and consisting of spikes on erect peduncles (Fig. 3A), however, sometimes the inflorescence is terminated on the leafy stem (Fig. 3B). For this reason, sect. *Zingier* and sect. *Dymczewiczia* are sometimes controversial. However, based on the observation in cultivation of the plants in this study, first the inflorescence is arising from the rhizome besides leafy stem, and gradually the inflorescence is elongated with foliation. Therefore I retained these two sections and the traditional sectional treatment of the section is upheld in this work.

When the comparison of all these species are considered, the shape, texture, color, pattern and relative position to the inflorescences of bracts and labellum are key diagnostic important characters.

Zingiber matupiense has affinity with the Indian species, *Z. cernuum* Dalzell. known as curved-stem ginger. *Zingiber cernuum* Dalzell was described from India and considered to be endemic to south India, however, it is common (Kanivita *et al.*, 2007). Gross morphology of the plant is most similar to *Z. cernuum*, however, it is distinguished from *Z. cernuum* by erect leafy shoots (vs. always curved leafy shoots in *Z. cernuum*), larger and ovate ligules (vs. shortly auriform in *Z. cernuum*), prominently recurved bracts (vs. involute erect bracts in *Z. cernuum*), bright yellow lateral staminodes (vs. bright red one with greenish white blotched in *Z. cernuum*), and slightly notched or emarginated apex of labellum (vs. clearly bifid labellum in *Z. cernuum*). Additionally the inflorescence bracts in *Z. cernuum* are clawed at apex, on the other hand, that in the new species is not clawed and slightly mucronate at apex. Hence it is

described here as a new species with figures based on living and spirit materials. The morphological comparison between this species and *Z. cernuum* is also shown in Table 3.

3.3. The Entity of *Zingiber barbatum* Group

3.3.1. Variation

One of the most troublesome taxa is *Zingiber barbatum*. This species is very variable and is considered that Myanmar is one of the center of its diversification. One member in *Z. barbatum* Group was described by Tanaka (2012) from central Myanmar. *Zingiber popaense* is characterized by its almost linear leaves, conspicuously cuspidate inflorescence bracts, and the extensive field explorations in Myanmar in this study recognized three main types of variation in *Z. barbatum* as follows;

TYPE A: *Zingiber barbatum* Wall. sensu strict which is coincide with the plant described in the original protologue.

TYPE B: The plant with linear leaves and fusiform inflorescence with cuspidate bracts covered with long white hairs. It was described as a distinct species, *Z. popaense*, related with *Z. barbarum* (Tanaka 2012).

TYPE C: The very small plant up to only 30 cm tall, and characterized by densely arranged leaves with short internode, larger broad labellum (2.3 cm wide at the apex margin). This type is found in also central Myanmar. Based on the investigation and observation made in this study, *Zingiber barbatum* sensu lato includes these three taxa, and each type can be clearly distinguished and assignable to three independent species. Type C has not been described. The morphological comparison between these three types of *Z. barbatum* Group is shown in Table 4. Type C is described as *Zingiber pygmaea* in this study (See the taxonomic treatment).

3.3.2. Lectotypification of *Zingiber barbatum* Wall.

Zingiber barbatum is described by Wallich (1830) from Prome along the Irrawaddy (Ayeyawaddy) river near Rangoon (present Yangon), Myanmar. The original protologue in *Plantae Asiaticae Rariores* (Fig. 4) provided an illustration (t. 55), however, no type materials are designated. That illustration was apparently drawn by the plant collected from Prome, and only one material for application of this scientific name. Therefore the illustration as a lectotype according to the International Code of the Botanical Nomenclature 9.1 (2012) is designated here as a lectotype.

Type A is identical with Wallich's *Zingiber barbatum*, and its scientific name is applicable to this plant.

3.4. The Entity of *Zingiber montanum* Group

The *Zingiber montanum* complex comprising *Z. neesatum*, *Z. idae*, *Z. corallinum*, *Z. tenuiscapus*, *Z. montanum*, *Z. neomontanum* and *Z. griffithii* belong to the sect. *Zingiber*, they have long caused much confusion of their relationship within the group with closely the size and shape of the inflorescences, overlapping bracts, and inside of the colour of labellum with or without stripe and the hairiness are more variable characters and more difficult to outline.

Group I. *Z. montanum* resembles to *Z. neesatum*, *Z. idae*, *Z. corallinum* and *Z. tenuiscapus* in the linear leaves, flowers cream with crisped margins very short ligules with scarious margin as well as the greenish brown bracts but differs in having densely arranged with short internode upper part of the leafy stem, ascending, more or less pubescent. Within the first group *Z. neesatum* and *Z. idae* have species of the spikes slender tapering pointed towards the apex and bracts narrowly ovate with greenish red. The remaining species in the group have

labellum cream with purple striped in *Z. corallinum* and labellum cream with two pink bands near base in the central lobe and creamy white with one red band near the base in lateral staminodes are very distinct in *Z. tenuiscapus*. These two species of rhizomes are same aromatic with *Z. montanum*.

Group II. *Z. montanum* is similar to *Z. neomontanum* and *Z. griffithii* in closely overlapping bracts, spike fusiform and flowers are cream without striped with various in size. In *Z. neomontanum* is most similar to *Z. montanum* but differs in having rhizome slightly aromatic, leaves glabrescent, sparsely arranged with long internode, distinctly pulvinus with red dotted both side of leave base and spike very long (18–28 cm). Rhizome of *Z. neomontanum* and *Z. griffithii* are pale yellow inside and slightly aromatic rather than *Z. montanum*. The morphological comparison between these three species of *Z. montanum* Group is shown in Table 5.

3.5. Ecological Habitats and Their Distribution

In Myanmar, the ecology of the genus *Zingiber* is very diverse and different habitats which are distributed through the country. The typical habitats of *Zingiber* are perennial and grow mainly damp places, in moist humus rich soils in shady habitats, but they are also frequent in secondary forest, open habitats at the edges of the forests, disturbed sites, and bamboo thickets on rocky ground up to 1000 m.

In Myanmar, the genus is usually found in the low land evergreen, the deciduous, the hill evergreen and bamboo forests. Myanmar is situated at the convergence of four major floristic regions: the Indian, Malesia, Sino-Japanese and Indo-Chinese (Takhtajan, 1986). Most *Zingiber* species have distribution in floristic regions closed to Indian, Indo-Chinese, Sino-Japanese and Malaesian. From the sum of each region, the location of optimum

distribution and the location of maximum ecological productivity of the taxon should overlap each other (Triboun, 2006). Recently, Wu & Larsen (2000) reported that China had the highest number of species at 43; Triboun *et al.* (2014) recognized 56 species of the genus in Thailand. From the present study, the total number of 37 species distributed in various regions in Myanmar (Table 6 and Figs. 5, 6, 7). These are the first record from Myanmar. The results show Myanmar is one of the most diversified regions of *Zingiber* in the world next to Thailand and China.

3.6. Phylogeographic View of Myanmar *Zingiber*

The genus *Zingiber* has been variously classified by different others which is indigenous to tropical Asia since long time years ago and now throughout the tropics. Its country of origin is unknown. (Holtum, 1950) mentioned that the largest concentration of genera and species is in Southeast Asia, and decided by the existing distribution of the family the place of origin was within the Indo-Malayan region. As the result of this study, ten species of Myanmar *Zingiber*; *Z. barbatum*, *Z. popaense*, *Z. pygmaea*, *Z. pardocheilium*, *Z. panduratum*, *Z. squarrosus*, *Z. matupiense*, *Z. tereris*, *Z. parishii*, and *Z. neomontanum*, are described and having type localities in Myanmar. Of these seven species except for *Z. barbatum*, *Z. pardocheilium* and *Z. parishii* are endemic to Myanmar.

The number of the thirty-seven species is just double as that previously known from Myanmar. Twenty-three of thirty-seven Myanmar species of *Zingiber* are distributing in Thailand as well. Of the 4 species of *Zingiber* (*Z. desissimum*, *Z. flavomaculosum*, *Z. longiligulatum*, *Z. orbiculatum*) show the southern limit of the distribution of these species. Some 65 % of *Zingiber* is overlapping with Thai species. On the other hand, thirteen species are found in Indian Region as well, ten species in Sino-Japanese, six species in Malaysia.

From the phytogeographic point of view in *Zingiber*, Myanmar is categorized in Indo-Chinese elements (Table 7); however, other Asian main three floristic elements are partially intermingled on the periphery of the country. Therefore the species diversity of this region is considered to be higher than any other regions.

3.7. Taxonomic Treatment

ZINGIBER Miller, Gard. Dict. Abr., ed. 4, [1545]. 1754, nom. cons.

Perennial rhizomatous herb. Rhizomes horizontal tuberous, aromatic. Leafy stem terete, erect, somewhat curved, stout. Leaves distichous; leaf blade elliptic-oblong, linear-lanceolate, broadly ovate-lanceolate, margin more or less undulate with hyaline; petiole almost sessile or short, pulvinate; ligules bilobed, triangular or quadrangular, sheath elongate, clothing the stem. Inflorescences terminal or axillary, scape cone-like spike, radical procumbent or erect, rarely terminating the leafy stem; peduncle clothed with scale-like sheaths. Bracts closely or loosely imbricate, green or other color, variable in shape, persistent, usually single-flowered. Flowers sessile; calyx tubular, split on single side, apex 3-toothed; floral tube cylindrical; corolla lobes 3, dorsal lobe lanceolate to linear, oblong-ovate, unequal, wider than lateral lobes. Lateral staminodes adnate to labellum, forming a 3-lobed labellum; central lobe oblong, orbicular, ovate-oblong, ovate, apex truncate or emarginate, somewhat cleft at apex. Fertile stamen short or accurate; anther connective produced into a long with narrow crest or beak as long as anther lobes. Ovary trilocular, ovules numerous per locule; placentation axile. Style slender, continued beyond the anther; stigma capitate, ciliated margin. Capsule dehiscent, oblongoid. Seeds black, covered by aril; aril white, margin irregularly lacerate.

Type specimen: **Zingiber officinale** Roscoe

Key to the genus *Zingiber* in Myanmar

1. Inflorescence terminal on a leafy stem 2
1. Inflorescence radical on a leafless stem 3
2. Leaves linear, subcoriaceous, no prominently plicate, bracts dark red, margins scarious
..... 1. *Z. capitatum*
2. Leaves narrowly ovate to lanceolate, coriaceous, prominently plicate, bracts green when
turning yellow with age 2. *Zingiber* sp.
3. Inflorescence arising from rhizome on an erect peduncle..... 4
3. Inflorescence arising from rhizome on a procumbent peduncle..... 15
4. Leaves linear or narrowly lanceolate 5
4. Leaves lanceolate or oblong 9
5. Bracts obovate to suborbicular, 2.5 x 2 cm, green with yellowish white margin at apex,
labellum dark red purple with yellowish blotches, margin entire 3. *Z. officinale*
5. Bracts ovate-broadly lanceolate, green, inflorescence narrowly fusiform, apex acuminate,
whole plant villous..... 6
6. Labellum yellowish creamy, pinkish basally, 1.5 x 1.8 cm 4. *Z. idae*
6. Labellum white with purplish red striped at the center towards the base, 2.5 x 2.6 cm
..... 5. *Z. neesatum*
7. Spike 13-15 cm long, peduncle 15-20 cm long 8
7. Spike 18-28 cm long, peduncle 20 cm long 9
8. Bracts oblong, dark green, somewhat pubescent, corolla lobes with purple striped, 1.5
cm long 6. *Z. corallinum*
8. Bracts ovate, reddish brown, densely pubescent, corolla lobes with yellowish white
..... 7. *Z. montanum*

9. Labellum whitish yellow with crisped margin, obovate, 3.4 x 2.5 cm 10
9. Labellum pale yellow or tessellated with purple medially, 1.5-2 x 1 cm 11
10. Leave linear to lanceolate, glabrescent, sparsely arranged with long internode, distinctly spike very long, 18-28 cm 8. *Z. neomontanum*
10. Leave broadly lanceolate, lower sheaths purplish red, upper one green, pubescent, densely arranged with short internode, spike ca. 10 cm long..... 9. *Z. griffithii*
11. Bracts broadly ovate, reddish brown, pubescent 10. *Z. gracile*
11. Bracts obovate to suborbicular, greenish yellow, upper edge turning red when old 11. *Z. parishii*
12. Leaves 10-13 pairs, oblong to lanceolate, 20-25 cm long 13
12. Leaves 6-10 pairs, oblong to oblanceolate, 25-40 cm long 14
13. Labellum creamy white with 2 pink bands near base in the central lobe and creamy white with one red band near base in lateral staminodes 12. *Z. tenuiscapus*
13. Labellum pale yellow with purplish red blotches at near the base of labellum 13. *Z. sadakornii*
14. Labellum pale yellow without markings 14. *Z. zerumbet*
14. Labellum pale yellow with faint red or brownish spotted 15. *Z. ottensii*
15. Leaves linear to lanceolate, 20-30 cm long 16
15. Leaves lanceolate to ovate-oblong, 15-20 cm long 17
16. Bracts ovate, green with red apex, glabrous, apex acute 16. *Z. kerrii*
16. Bracts ovate-lanceolate, dull deep purple, villous especially on upper half giving the inflorescences a shaggy appearance, apex acuminate 17. *Z. gramineum*
17. Plant 1 m tall, villous, leaves sparsely arranged with long internode 18
17. Plant 30 cm tall, villous, leaves densely arranged with short internode 19
18. Inflorescence ovate-oblong, labellum 1.4 x 1.5 cm 18. *Z. barbatum*

18. Inflorescence ovoid first, gradually becoming fusiform with age; labellum 1 x 0.9 cm
..... 19. *Z. popaense*
19. Inflorescence ovoid, peduncle very short, labellum larger broad, 1.7 x 2.3 cm
..... 20. *Z. pygmaea*
19. Inflorescence ovate to oblong, peduncle sessile or very short, sitting on the near at
rhizome 20
20. Labellum bright yellow without mottled 21. *Z. chrysanthum*
20. Labellum creamish background with red dotted, red anther 22. *Z. rubens*
21. Inflorescences dense, spike ovate or subglobose, 5-8 cm long 22
21. Inflorescences ellipsoid or oblong, ca. 10 cm long 25
22. Bracts squarrose, green with pale pink towards the apex, labellum white blotches with
lilac towards the apex 23. *Z. squarrosum*
22. Bracts lanceolate, yellowish white with margin translucent and recurved, labellum
creamy yellow blotches with maroon 24. *Z. matupiense*
23. Bracts linear-oblong to lanceolate, reddish pink, labellum light yellow with red mottled
..... 25. *Z. nimmonii*
23. Labellum yellowish white, obovate-cuneate, 2.2 x 1.2 cm 26. *Z. ligulatum*
24. Labellum yellowish white, ovate to oblong-cuneate, 2.4 x 1 cm 27. *Z. roseum*
24. Labellum tessellated dark with lilac on a yellowish-white ground, obovate to cuneate,
1.8 cm long 28. *Z. pardocheilium*
25. Corolla lobe bright red, lanceolate, apex acuminate, labellum panduriform, ca. 2 cm
long 29. *Z. panduratum*
25. Corolla lobe pinkish red dotted with yellowish apex, lanceolate, strongly curved at the
apex, labellum ligule like, ca. 2.5 cm long 30. *Z. thorelli*

26. Ligule less than 1 cm – 2 cm long, white, glabrous, apex truncate 27
26. Ligule 1-3 cm long, green with white margin, curved, more or less pubescent, apex acuminate, labellum white, anthers bright yellow 28
27. Labellum white, oblong- elliptic, translucent, lateral staminodes very small, lanceolate, 8 mm long 31. ***Z. tereris***
27. Labellum white, orbicular, 2.5 cm long, lateral staminodes obovate, 1.7 cm long 32. ***Z. orbiculatum***
28. Spike ovate to sub-globose, covered with gelatinous substance, bracts ovate whitish green, apex mucronate 33. ***Z. desissimum***
28. Spike cylindrical or obconic, bracts linear to lanceolate, green turning pale cream and finally pink or red, apex acuminate 34. ***Z. bradleyanum***
29. Bracts oblong-lanceolate, loosely imbricate, 4-6 cm long, pubescent, apex acute-acuminate 30
29. Bracts broadly oblong, densely imbricate, 3-5 cm long, covered with brown hairs, apex convex 31
30. Ligule 4-5 cm long, red, scarios, labellum yellow or somewhat orange tinge, lateral staminodes absent 35. ***Z. longiligulatum***
30. Ligule 4-6 cm long, white, very thin, labellum black-purple with white spotted, lateral staminodes ca. 1 cm long 36. ***Z. bisectum***
31. Ligule 4 cm long, white, very thin, scarios, labellum dark red with yellow spotted, lateral staminodes 1.5 cm long 37. ***Z. flavomaculosum***

1. *Zingiber capitatum* Roxb., *Asiat. Res.* 11: 348 (1810); *Monandr. Pl. Scitam.* t. 86 (1824); Roxburgh in *Fl. Ind.* 1: 55 (1832); Baker in Hook. f. *Fl. Brit. India* 6: 248 (1892); Smith in *Fl. Bhu.* 17: 187 (1888b); Sabu in *Folia Malaysiana.* 4(1): 30 (2003). –Type: India, Hindostan (1810). Wallich *N. Cat.* 6560 (1820). (Fig. 8).

Zingiber capitatum Roxb. var. *elatum* (Roxb.) Baker, *Fl. Brit. India* 6: 249 (1892).

Perennial rhizomatous herb, ca. 1 m tall. *Rhizomes* thick, yellow internally, aromatic; *root tubers* oblong, many. *Leafy stems* hairy, green. *Leaves* 4–6 pairs, sessile; *leaf blade* linear-lanceolate, 20–30 cm long, 1.5–2 cm wide, usually shortly pubescent beneath, base cuneate, apex acuminate; *ligules* 1–2 mm, puberulent. *Inflorescences* arising from terminal on the leafy stem, erect, sessile; *spikes* oblong or oblong-cylindrical, 7–15 cm long, 3.5–5 cm wide, apex obtuse. *Bracts* ovate, 3–4 cm long, 1–1.5 cm wide, closely imbricate, dark red, margin scarious, apex acute or shortly acuminate, sparsely pubescent, subcoriaceous. *Bracteoles* linear lanceolate, light green, 2-keeled, ca. 2.5–3 cm long and 1.2–1.5 cm wide, sparsely pubescent. *Flowers* dense, yellow, 4.5–4.8 cm long, longer than the bracts; *calyx* tubular, 1–1.3 cm long, 1–1.2 cm wide, 3-toothed, white, membranous, apex truncate, unequally 3-toothed; short flower hair on the margin; *floral tube* cylindrical, ca. 1.5 cm long, glabrous; *corolla lobes* 3, yellow, unequal, glabrous; dorsal lobe 2–2.4 cm long, 1–1.3 cm wide, lateral lobes 2–2.2 cm long, 0.4–0.5 cm wide; *labellum* trilobed, pale yellow, orbicular; central lobe orbicular, margin entire, apex bilobed, emarginate, ca. 2.5 cm long, ca. 2.5 cm wide; lateral staminodes oblong, ca. 2 cm long, ca. 5 mm wide. *Stamen* ca. 2.2 cm long; filament sessile; *anther* yellow, thecae parallel, ca. 1.2 cm long, crest ca. 1 cm long, equal to the thecae. *Ovary* ca. 5 cm long, pubescent, trilocular with many ovules, placentation axile; *epigynous glands* linear, two, ca. 7 mm long, white; style shorter; stigma funnel-shaped with ciliated margin,

below the crest. *Capsule* elliptic, three sided, smooth, bright red, 3-celled; *seed* many, black, arillate, aril white, lacerate.

Distribution: Northern Myanmar, India, Central and Eastern Himalayas, and Bhutan.

Ecology: On hill slope in moist deciduous forest, ca. 200 m alt.

Phenology: Flowering from September to October.

Specimens examined. Kachin State: Myintkyina Township, Kachin Hill, 7 July 1890, *J.C. Prazer 177* (CAL); *Loc. cit.*, Sep 1897, *Shaik Mokim 36* (CAL); Sep 1899, *Shaik Mokim 50* (BM); 8 June 2014, *Mu Mu Aung 042* (RAF).

Vernacular name: Local gyin (Wild ginger)

Notes: *Zingiber capitatum* Roxb. is known as wild ginger in Myanmar and found in forest area in northern part of Myanmar. This species belongs to the sect. *Dymczewiczia*, it is found only one species within Myanmar since 1897. This species is distinguished by the inflorescence arising from terminal on the leafy stem, bracts dark red, margin scarious, flowers pale yellow.

2. Zingiber sp. – Type: MYANMAR. **Sagaing Region:** Homalin Township, Basin of Chindwin river, along the Nan-Ba-Gon stream, Nan-Ba-Gon area, Htamanthi Wildlife Sanctuary, 120 m alt., 25°121' N, 95°25' E, 24 October 2014, *Mu Mu Aung 073* (RAF, TNS). (Fig. 9).

Diagnosis: *Zingiber* sp. similar to *Z. capitatum* in inflorescence arising from the terminal at the leafy stem, erect, sessile but differs in its rhizome dirty white externally, leaves sheath green with dark red tinge towards the base, prominently plicate at the upper surface of leaf blade, bracts green when turning yellow with age.

Perennial rhizomatous herb, ca. 1.2 m tall. *Rhizomes* sparsely branched, internally cream, externally dirty white, slightly aromatic; *root hairs* many. *Leafy stems* finely appressed hairs; leaves sheath green with dark red tinge towards the base. *Leaves* 4–6 pairs, sessile; *leaf blade* narrowly ovate-lanceolate, 20–25 cm long, 5–5.5 cm wide, adaxially glabrous with dark green, abaxially sparsely pubescent towards the midrib with silverfish purple-red, prominently plicate, coriaceous, base cuneate, apex acuminate, margin entire, slightly undulating; *ligules* 6 mm long, bilobed, glabrescent, apex nearly rounded; *petiole* absent. *Inflorescences* arising from terminal on the leafy stem, erect, sessile; *spikes* cylindrical or narrowly oblong, 12–14 cm long, 3.5 cm wide, tapering pointed to the apex. *Bracts* ovate, ca. 3.7 cm long, 2.5 cm, green (turning yellow with age), apex acute or shortly acuminate, glabrous. Flower unknown.

Distribution: Thus far known only from Sagaing.

Ecology: Tropical evergreen forest, it can be found in undergrowth of giant dipterocarp species.

Phenology: Flowering probably from October to November.

Specimen examined. Sagaing Region: Homalin Township, along the Nankhawedaing stream, Nankhawedaing area, Htamanthi Wildlife Sanctuary, 180 m alt., 25°19' N, 95°28' E, 24 October 2014, *Mu Mu Aung 079* (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber* sp. was collected in Homalin, Sagain Region, western Myanmar, however, it was sterile. It is similar to only one species, *Z. capitatum* belonging to sect. *Dymczewiczia*, in Myanmar having erect, sessile, terminal inflorescence. However, *Zingiber* sp. differs from *Z. capitatum* in its brownish white rhizome, leaves sheath green with dark red tinge towards the base, prominently plicate leaf blade, and yellow bracts. Here this is remained as unidentified, *Zingiber* sp.

3. *Zingiber officinale* Roscoe in Trans. Linn. Soc. London 8: 348 (1807); Roxburgh in Fl. Ind. 1: 47 (1832); Baker in Hook. f., Fl. Brit. India. 6: 246 (1892); Holttum in Gard. Bull. Singapore 13: 54 (1950); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 124 (1975); Theilade in Nod. J. Bot. 19 (4): 393 (1999); Wu and Larsen in Fl. China 24: 325 (2000); Sabu in Folia Malaysiana. 4(1): 39 (2003). – Type: Herb. Hermann 4:7. No. 3 (BM) designated by Burt (1993). No specimen at LINN or I herb. Cliff. (BM) (Burt, 1972; Theilade, 1999). (Fig. 10).

Amomum zingiber L. Sp. Pl. 1: 1. (1753).

Curcuma longifolia Wall. Numer. List: 6612 nom. nud. (1828).

Perennial rhizomatous herb, 40–70 cm tall. *Rhizomes* branched, yellowish internally, whitish brown externally, thickened, fleshy, and strongly aromatic. *Leafy stems* glabrous except for short hairs near base of each leaf-blade. *Leaves* 7–9 pairs; *leaf blade* linear, 15–30 cm long, 2–2.5 cm wide, adaxially glabrous, abaxially pubescent, narrowed to a slender tip, base cuneate, margin slightly undulate; *petiole* sessile; *ligules* more or less quadrangular, slightly 2-lobed, 2–4 mm, membranous. *Inflorescences* radical somewhat the upper sheaths with or without short leafy tips; *spikes* ovoid or elliptic, 4–6 cm long, ca. 1.5 cm wide; *peduncle* 15–25 cm long. *Bracts* obovate to suborbicular, ca. 2.5 cm long, ca. 2 cm wide, light green with yellowish white margin at the tip, narrow translucent margin, margins incurved. *Bracteoles* equaling bracts. *Flower* creamy; *calyx* tubular, ca. 1 cm; corolla yellowish green; tube 2–2.5 cm long; lobes lanceolate, ca. 1.8 cm; *labellum* dark reddish purple with cream blotches, central lobe oblong-obovate, shorter than corolla lobes; lateral staminodes ovate, ca. 6 mm long, free nearly to base. *Stamen* ca. 2.2 cm; filament nearly sessile; *anther* ca. 1.2 mm long, cream; connective appendage curved; *anther crest* ca. 1 cm, dark reddish purple. *Ovary*

white, ca. 1 mm long, globoid, glabrous, placentation axile with two rows of ovules in each loculus; style 3.3–3.5 cm long, filiform; *stigma* white, margin ciliate; *epigynous glands* linear, two, 4–5 mm long, yellowish white.

Distribution: Cultivated in tropical and subtropical countries throughout the world.

Ecology: Growing in secondary forest and cultivated especially in mountainous regions.

Phenology: Flowering from September to November. Flowers open in the morning until evening.

Specimens examined. Sagaing Region: Alungdaw Kathapa National Park, ca. 200 m alt. 22 Jan 2001, *N. Kuroiwa et al.* 20050518 (MBK, TNS). **Northern Shan State:** Kyaukme Township, 1,159 m alt., N 19°57' N, 96°99' E, *Mu Mu Aung 107* (RAF, TNS). **Kayah Stat:** Loikaw Township, Loilin Lay village, Nan Oo reserved forest, 810 m alt., 19°52'28" N, 97°14'17" E, 8 Nov 2014, *Mu Mu Aung et al.* 087, 090 (RAF, TNS).

Vernacular name: Gyin, Gyin-sein (commercial name in Myanmar)

Notes: Widely cultivated for medicine and spice throughout the country. This species is recognized by the linear leaves and light green obovate and curved bracts with yellowish white margin at the tip. Labellum is dark reddish purple with cream blotches.

4. Zingiber idae P. Triboun & K. Larsen in Thai Forest Bull., Bot. 30: 62 (2002); N. Tanaka *et al* in Makinoa N. S. 10: 153 (2012). – Type: Thailand – Western: Kanchanaburi (Sai Yok, Huay Bankan, 14°55' N 98°45' E, *Beusekom et al.* 3531 (L-holo, C, P!iso).

Z. villosum I. Theilade in Nord. J. Bot. 19: 396 (1999), non *Z. villosum* (Louriero) Stokes, (1812).

Perennial rhizomatous herb, 0.7–1.8 m tall. *Rhizomes* yellowish brown externally, white internally, strongly aromatic; *roots* bearing tubers; *tubers* spindle-shaped, 2–4 cm long, 1–2 cm wide, white. *Leafy stems* villous, green. *Leaves* 8–12 pairs; *leaf sheaths* villous, sometimes reddish at margin; *ligules* bilobed, 2–3 mm long, villous; *leaf blade* narrowly lanceolate, 15–30 cm long, 1–3 cm wide, pubescent on both surface, occasionally lower surface glabrous, midrib hairy, base cuneate, apex acuminate to caudate; *petiole* very short, villous, ca. 3 mm long. *Inflorescences* indeterminate; *spikes* narrowly fusiform, 15–17 cm long, 1.8–2.5 cm wide, entirely enclosed by 15–20 bracts; *peduncle* radical, erect, slender, 20–30 cm long with 5–7 sheaths, villous, rarely glabrous, sheaths margin membranous, whitish. *Bracts* 25–40, loosely imbricate, lanceolate, 3.5–4.5 cm long, 1.3–1.5 cm, dark green turning to reddish purple when fruiting, densely villous on both sides, apex acuminate. *Bracteoles* lanceolate, white, 3–3.3 cm long, 1–1.4 cm wide, villous adaxially, glabrous abaxially, margin membranous, transparent, apex bifid. *Flower* slightly yellowish creamy, 7 cm long; *calyx* tubular, glabrous or sparsely hairy, rolled, 1–1.2 cm long, 9 mm wide, apex shallowly tridentate; *floral tube* 4.2 cm long; *corolla lobes* 3, yellowish cream, dorsal lobe ovate, 2.2–2.5 cm long, 1.2–1.3 cm, lateral lobes lanceolate, 1.6–1.7 cm long, 5 mm wide; *labellum* trilobed, slightly yellowish creamy, pinkish basally, central lobed emarginated, 1.5 cm long, 1.7–1.8 cm wide; lateral staminodes sub-equal, 4–5 mm long, 7–8 mm wide, apex rounded. *Stamen* 2.7 cm long; *anther* 1.3–1.4 cm long, 4 mm wide, anther appendage white, ca. 1 cm long, shorter than stigma. *Ovary* 5–6 mm, villous, 3-locular, 11–13 ovules per locule. *Capsule* ellipsoid, hairy.

Distribution: Myanmar and Thailand.

Ecology: In dry mixed deciduous forest, 200–500 m alt. Flowering is day time.

Phenology: Flowering and fruiting from July to September

Specimens examined. Sagaing Region: Kani Township, in conserved forest of teak, near Alaungdaw Kathapha National Park, NW of Kabaing, 236 m alt. 22° 14' N 94° 37' E, 9 December 2004, *Shiro Kobayashi & Motohiro Hamaguchi 031721* (MBK); Alaungdaw Kathapha National Park, near Yagyi, alt. 560-620 m, 22° 32' N 94° 35' E, 10 December 2004, *Shiro Kobayashi & Motohiro Hamaguchi 20041038* (MBK) along the stream to the south of Alaungdaw Kathapha National Park from the base camp, 300-200 m alt. 22° 18' N 94° 20' E, 22 January 2005, *Jin Murata et al. 031850* (MBK, TI).

Vernacular name: Unknown

Notes: This species is characterized by the whole plant being villous and the long, slender inflorescence with red, acuminate bracts.

5. *Zingiber neesatum* (J.Graham) Ramam., Fl. Hassan Distr.: 769 (1976); Baker in Hook. f., Fl. Brit. India. 6: 246 (1892); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 140 (1975). Sabu in Folia Malaysiana. 4(1): 33 (2003). – Type: South W. India. (CJS 14599, HEP 1047, non. vide). (Fig. 11).

Alpinia neesana Graham, Cat. Pl. Bombay 207. (1839).

Zingiber macrostachyum Dalzell in Hooker's J. Bot. Kew Gard. Misc. 4: 342 (1852).

Perennial rhizomatous herb, 0.7–1.1 m tall. *Rhizomes* yellow internally, roots fleshy with many fusiform, white with root tubers, strongly aromatic. *Leafy stems* reddish green, pubescent. *Leaves* 7 pairs; *leaf blade* linear to oblong-lanceolate, 22–25 cm long, ca. 2 cm wide, dark green, adaxially glabrous, abaxially pubescent, apex acute, base obtuse, margin more or less undulate; *ligules* triangular, 2–3 cm long, 3–4 mm wide, whitish, membranous, pubescent; *petiole* 5–6 mm long, green. *Inflorescences* radical, 15–30 cm long, 4–6 cm wide;

spikes narrowly fusiform, greenish red; *peduncle* elongate, slender, clothed with greenish or reddish sheath. *Bracts* ovate, 2.5–2.6 cm long, 1.8–2 cm wide, purplish red, cymbiform. *Bracteoles* lanceolate, 2.5–3 cm long, 1.5 cm wide, split to the base, green with purple spots on the outer surface, minutely pubescent. *Flower* white; *calyx* tubular, 1.6–1.7 cm long, 1–1.3 cm wide, white, membranous, glabrous, apex slightly 3-toothed; *floral tube* 3–3.3 cm long; *corolla lobes* 3, greenish white, dorsal lobe lanceolate, 2.8–3 cm long, 1–1.1 mm wide, concave, lateral lobes 2–3 cm long, 8–9 mm wide; *labellum* trilobed, white with purplish red striped, glabrous; central lobe 2.2–2.5 cm long, 2.4–2.6 cm wide, orbicular to obovate-cuneate, apex emarginate; lateral staminodes 1 cm long, 0.6 cm wide, oblong-ovate, white. *Stamen* 2.2–2.5 cm long, yellowish white; filament 4–6 mm long; anther pale yellow, 1.8–1.9 cm; anther crest 8–9 mm, pale yellow, elongate, cylindrical, recurved. *Ovary* white, 7–8 mm long, oblongoid, pubescent, placentation axile with two rows of ovules in each loculus; *style* filiform, 5.8–6 cm long; *stigma* white, margin ciliate; *epigynous glands* linear, two, 4–5 mm long, yellowish white.

Distribution: Myanmar and India.

Ecology: Undergrowth of dry mixed deciduous forest, 200–600 m alt.

Phenology: Flowering and fruiting during August–November. Flowering is day time.

Specimens examined. Yangon Region: Insein Township, Tin Tin Win 25 (RANG). **Sagaing Region:** Kani Township, Alaungdaw Kathapha National Park between Kabaing and Thebeik Sae base camp, Magu range, approx. 10 miles from camp Butolong Reserve, 625 m alt., 22° 19' N 94° 28' E, 15 July 1997, W. J. Kress 97-5806 (US, RAF); in conserved forest of teak, near Alaungdaw Kathapha National Park, NW of Kabaing, 236 m alt. 22° 14' N 94° 37' E, 9 December 2004, Alaungdaw Kathapha National Park, near Yagyi, alt. 560–620 m, 22° 32' N

94°35'E, 10 December 2004, *Shiro Kobayashi & Motohiro Hamaguchi 20041038* (MBK, TNS-spirit).

Vernacular name: Unknown

Notes: *Zingiber neesatum* is closely related to *Z. montanum* but is differ by its tomentose leaves and leaf sheaths, bracts ovate, red and white labellum with purple striped at the center towards the base.

6. *Zingiber corallinum* Hance in J. Bot. 18: 301 (1880); Loesener in Nat. Pflanzenfam. ed. 2. 15a: 588 (1930); Wu and Larsen in Fl. of China 24: 326 (2000). – Type: China, Hainan, Dec. 1878, W. Hancock, Herb. Hance n. 20747 (BM).

Perennial rhizomatous herb, 1–2 m tall. *Leafy stems* glabrous, margin scarious. *Leaves* linear to narrowly lanceolate, 40–45 cm long, 5–6 cm wide, adaxially glabrous, abaxially pubescent; *ligules* broad, to 1–2 cm long, hairy, apex acute; *petiole* densely pubescent. *Inflorescences* radical, erect, 13–15 cm long; *spikes* fusiform, apex acute; *peduncle* 25–45 cm long, scale-like sheaths 4–5 cm long. *Bracts* ovate, 3.5–4 cm long, 3–3.5 cm wide, dark green when flowering, margin scarious, pubescent. *Bracteoles* elliptic, 1.5 cm long. *Flower* creamy white; *calyx* tubular, 1.5–1.8 cm long, split to middle; *floral tube* 2.5 cm long; *corolla lobes* with purple striped, oblong, ca. 1.5 cm long, apex acute, dorsal lobe larger than lateral ones; *labellum* trilobed, creamy white with purple striped; central lobe ovate, ca. 1.5 cm long, lateral staminodes ca. 8 mm long, apex emarginate or slightly bifid. *Stamen* cream, ca. 1.5 cm long; *filament* sessile, *anther lobe* ca. 1 cm long, connective appendage beaklike, curved, crest ca. 5 mm. *Ovary* 2–2.5 mm long, sericeous, *Capsule* broadly ellipsoid, glabrous.

Distribution: Myanmar, Thailand, India, Laos, Cambodia, Vietnam, China, Madagascar.

Ecology: Lowland evergreen forest.

Phenology: Flowering and fruiting during August – October.

Specimen examined. Yangon Region, Great Cocos Island, 1889, *David Prain 713* (CAL).

Vernacular name: Unknown.

Notes: In the original description, Hance (1880) noted that *Zingiber corallinum* is closely allied to *Z. cassumunar* Roxb. However, *Z. cassumunar* Roxb. is currently accepted as the synonymy of *Z. montanum*. It is morphologically very close to *Z. montanum*.

7. *Zingiber montanum* (Koenig) Link ex Dietr., Sp. Pl., ed. 6. 1: 52 (1831). Roxburgh in Fl. Ind. 1: 49 (1832); Baker in Hook. f., Fl. Brit. India. 6: 248 (1892); Theilade in Nod. J. Bot. 19 (4): 393 (1999); Sabu in Folia Malaysiana. 4(1): 31 (2003). – Type: Thailand, Phuket, Koenig s.n. (C holotype). (Fig. 12).

Amomum montanum Koenig in Retz. Observ. 3: 51 (1783).

Zingiber cassumunar Roxb., Asiat. Res. 11: 347 (1810).

Perennial rhizomatous her, 1.5–2 m tall. *Rhizomes* yellow internally, pale brown externally, strongly aromatic. *Leafy stems* terete, green above and reddish below, pubescent sometime glabrescent. *Leaves* 8–10 pairs, densely arranged with short internode upper part of the leafy stem; *leaf blade* linear to narrowly lanceolate, 15–17 cm long, 2–4 cm wide, green, adaxially glabrescent, abaxially densely pubescent, apex acute, base cuneate, margin more or less undulate; *ligules* triangular, 1.5–2.5 cm long, 5–10 mm wide, white, membranous; *petiole* nearly sessile, green. *Inflorescences* radical, erect; *peduncle* elongate, 15–20 cm long, clothed with pubescent sheaths; *spikes* 10–15 cm long, 3–5 cm wide, oblong-ovate, greenish dark red or brownish red. *Bracts* broadly ovate to obovate, 3.8–4 cm long, 2.5 cm wide, greenish or

reddish brown, densely appressed pubescent, apex and margin white, membranous. *Bracteoles* broadly lanceolate, 3–5 cm long, 1–1.2 cm wide, yellowish white, membranous, pubescent. *Flower* creamy white; *calyx* tubular, 1.8–2.1 cm long, 1–1.3 cm wide, white, membranous, glabrous, apex 3-toothed; *floral tube* 2.9–3.1 cm long, yellowish white; *corolla lobes* 3, yellowish white, membranous, dorsal lobe oblong-ovate to lanceolate, 2–2.1 cm long, 8–9 mm wide, cymbiform, lateral lobes 1.7–1.9 cm long, 4–5 mm wide; *labellum* trilobed, creamy white; central lobe 1.7–1.8 cm long, 2.4–2.6 cm wide, orbicular, apex retuse somewhat bifid, margin crisped; lateral staminodes large, 5–6 mm long, 4–5 mm wide, oblong-obovate. *Stamen* 1.6–1.8 cm long, yellowish white; filament 2–3 mm long; *anther* white, 8–10 mm; *anther crest* 5–6 mm, yellowish white, elongate, cylindrical, recurved. *Ovary* white, 3–4 mm long, oblongoid, pubescent, placentation axile with two rows of ovules in each loculus; *style* filiform; *stigma* white, margin ciliate; *epigynous glands* linear, two, 4–5 mm long, yellowish white.

Distribution: Myanmar, India, Thailand, and Malaysia.

Ecology: It can be grown in lowland to hill evergreen forest and it cultivated as a village plant through the country.

Phenology: Flowering from August to September, fruiting from September to November. Flowers open in the morning simultaneously 2–5 flowered per upper part of the inflorescence.

Specimens examined: Mandalay Region: Kyaukpadaung Township, Ye-su Camp to the Environmental Education Center along the car roadside, Popa Mountain Park, 27 Aug 2001, *N. Tanaka* 20010265 (TNS-spirit). **Sagaing Region:** Hpowindaung, ESE of Yinmabin. alt. 140–290 m. 7 Dec 2004, *N. Tanaka* 20041071 (TNS-spirit). **Chin State,** Kanpetlet Township, Natma Taung National Park, 1730 m alt., 21°19'774" N 94°03'033" E, 20 May 2014, *Mu Mu Aung et al.* 004 (RAF). Eastern part of **Shan State,** Kyaingtong Township, 880 m alt., 21°50'

455" N 99°7'049" E, 27 June 2014, *Mu Mu Aung 024* (RAF, TNS). **Nay Pyi Taw:** Zaeyathiri Township, Yezin, 25 November 2014, *Mu Mu Aung 109* (RAF, TNS). **Mandalay Region:** Pyin Oo Lwin Township, 1300 m alt., 21°57'54.426" N, 96°27'05.867" E, 11 August 2015, *Mu Mu Aung et al. 211, 214* (RAF, TNS).

Vernacular name: Meik-thalin

Notes: This species can be easily recognized by the linear leaves and very short ligules as well as the reddish brown bracts. The rhizome is strongly aromatic and for a variety of medicinal uses.

8. *Zingiber neomontanum*, M. M. Aung & Nob. Tanaka, sp. nov. – Type: MYANMAR. Tanintharyi Region, Tanintharyi Reserved Forest, Yephyu Township, 87 m alt., 14°37'22.63" N, 98°08'17.24" E, 31 July 2015, *Mu Mu Aung et al. 144* (holo-TNS, iso-RAF). (Fig. 13).

Diagnosis: This is similar to *Zingiber montanum* by the linear to lanceolate leaves, in closely imbricated bracts, creamy white labellum and lateral staminodes, but differs in having rhizome slightly aromatic, leaves glabrescent, sparsely arranged with long internode, distinctly pulvinus with red dotted both side of leave base and spike very long (18–28 cm).

Perennial rhizomatous herb, up to 2 m in height. *Rhizomes* whitish brown externally, creamy white internally, slightly aromatic. *Leafy stems* erect, green, glabrous somewhat pubescent near the apex of sheath. *Leaves* 10–12 pairs, sparsely arranged with long internode, green; *leaf blade* linear to lanceolate, 45–50 cm long, 4–4.5 cm wide, apex acuminate, base narrowly cuneate, margin slightly undulate, adaxially glabrous, abaxially sparsely pubescent; *ligules* bilobed, 2 mm long, hyaline membranous, densely pubescent, apex truncate; *petiole*

very short, pubescent, distinctly pulvinus. *Inflorescences* usually 1, arising from rhizomes; *peduncle* radical erect, ca. 20 cm long, sheathing bracts green, oblong to narrowly ovate, 5–6 cm long, 1 cm wide, apex rounded, densely pubescent; *spikes* fusiform, 18–28 cm long, ca. 5 cm wide, slightly tapered blunt apex. *Bracts* ovate, ca. 4.5 cm long, 2–2.5 cm wide, bright red, apex acute to acuminate, densely appressed pubescent, very fine silky hairs toward the base. *Bracteoles* oblong, 3 cm long, white, densely pubescent appressed externally, glabrous internally, apex emarginate. *Flowers* ca. 8.3 cm long, exerted from the bract; *calyx* tubular, ca. 2.2 cm long, white, membranous, glabrescent, apex tri-dentate; *floral tube* cylindrical to weakly funnel-shaped at apex, creamy white, 4.5 cm long, glabrous; *corolla lobes* 3, cream to pale yellow, glabrous, dorsal lobe ovate, cymbiform, involute, 3 cm long, 1.5 cm wide, lateral lobes linear-lanceolate, 2.6 cm long, 9 mm wide; *labellum* tri-lobed, white to cream or pale yellow; central lobe obovate, ca. 3.4 cm long, 1.5 cm wide, apex cleft, margin crisped; lateral staminodes ovate to obovate with rounded tip, ca. 1.5 cm long, 8 mm wide. *Stamen* ca. 2.4 cm long; *filament* sessile; *anther* white, densely black spotted both of crest and appendage (visible in spirit material only); *anther crest* ca. 1.1 cm long, strongly curved; *anther thecae* 1.3 cm long with connective appendage. *Ovary* white, sub-ellipsoid, densely pubescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 7 mm long, white. *Capsule* unknown.

Distribution: Thus far known only from the type locality.

Ecology: Lowland evergreen forest or secondary forest growing with bamboo species in damp, shady places in humus rich soil, ca. 100 m alt.

Phenology: Flowering and fruiting during July–October. Flowers open in the evening simultaneously 1-2 flowered per inflorescence.

Etymology: This species epithet came from the name of *Z. montanum* differences between their characters as a new.

Vernacular name: Unknown

Notes: As discussed before, *Z. montanum*-complex is one of the most problematic taxon of *Zingiber* in Myanmar. *Z. neomontanum* is no doubt a member of them. This plant has been often identified as *Z. corallinum*. However, *Zingiber corallinum* was described from Hainan Island, China, and this plant is different from it by the shape of inflorescence bracts and leaf blade. Therefore the new name is required for this species.

9. *Zingiber griffithii* Baker, Fl. Brit. India 6: 246 (1892); Holttum in Gard. Bull. Singapore 13: 60 (1950); Theilade in Gard. Bull. Singapore 48: 229 (1996). – Type: Malacca, Griffith 5731 (K) (1864).

Perennial rhizomatous herb, 1–1.5 m in height. *Rhizomes* whitish brown externally, creamy white internally, slightly aromatic. *Leafy stems* terete, spreading to weakly arching, lower sheaths purplish red, upper one green, pubescent, margin scarious. *Leaves* 4–8 pairs, densely arranged with very short internode; *leaf blade* elliptic to broadly elliptic, 20–35 cm long, ca. 4.5 cm wide, adaxially dark green, smooth, glabrous, abaxially reddish green, very finely appressed pubescent towards the midrib, margin entire, scarious purplish tinge, apex acuminate, base broadly to narrowly cuneate, red dotted both side; *ligules* bi-lobed, thin, densely pubescent, 2–4 mm long, apex; *petiole* very short, distinctly pulvinate. *Inflorescences* arising from rhizomes; *peduncle* radical erect, ca. 15 cm long, the sheaths to 3.5 cm long, green, densely pubescent; spike ca. 10 cm long, fusiform when young, when old nearly evenly cylindrical except for the slightly tapered blunt apex. *Bracts* ovate-obtuse, lower orbicular,

2.5–3 cm long, 2–4 cm wide, bright red, apex very broadly pointed with a very short hair tip, glabrous or with very fine silky hairs toward the base. *Bracteoles* 2.5 cm long, 8.5 mm wide, glabrescent. *Flowers* white to cream, 6 cm long; *calyx* tubular, ca. 1.7 cm long, white, membranous, glabrescent, apex nearly truncate; *floral tube* slender, ca. 3 cm long; corolla lobes 3, white to cream, white hairy abaxially, dorsal lobe narrowly ovate, cymbiform, ca. 3 cm long, ca. 1.2 cm wide, lateral joined together for nearly half their length below the lip; *labellum* trilobed, white to cream or yellow; central lobe obovate, ca. 3.4 cm long, 1.2 cm wide, apex cleft, margin crisped; lateral staminodes ovate to obovate with rounded tip, ca. 1.7 cm long, 8 mm wide. *Stamen* ca. 2.3 cm long; *filament* sessile; *anther* white, densely black spotted both of crest and appendage (visible in spirit material only); *anther crest* ca. 1.1 cm long, strongly curved; *anther thecae* 1.3 cm long with connective appendage. *Ovary* white, sub-ellipsoid, densely pubescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 7 mm long, white.

Distribution: Southern Myanmar, Malacca, and Malaya Peninsula.

Ecology: Lowland evergreen forest or secondary forest in damp, shady places in humus rich soil, ca. 400 m alt.

Phenology: Flowering and fruiting during July – October. Flowers open in the evening simultaneously 1–2 flowered per inflorescence.

Specimens examined. Tanintharyi Region: Dawei (old Tavoy), Heinze compt. No. 1, 15 April 1921, *P.T. Russell. 2021* (CAL). **Tanintharyi Region:** Yaephyu Township, Kanbauk, Tanintharyi Reserved Forest, 24 m alt., 14°18'50.70" N, 98°12'23.52" E, 30 July 2015, *Mu Mu Aung et al. 128* (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber griffithii* is well characterized by its broad leaves with pubescent on the lower surface and finely raised veins when dried. The leave and inflorescence are aromatic. *Z. griffithii* is closely related to *Z. neomontanum* and *Z. gracile* but the leaves are broader and the inflorescence is more elliptic than either of these. Furthermore, the bracts in *Z. griffithii* are much less tough than in *Z. montanum* and *Z. gracile*.

10. Zingiber gracile Jack in Malay. Misc. 1(1): 1 (1820). Baker in Hook. f., Fl. Brit. India. 6: 246 (1892); Holttum in Gard. Bull. Singapore 13: 63 (1950); Bull. Singapore 48: 231 (1996); Tin Tin Win, Zingiberaceae of Burma in Part, M.Sc Thesis: 133 (1975). – Type: Penang, Peninsular Malaysia, April 1890, *Curtis* s.n. (SING075425-neotype).

Z. gracile var. *petiolatum* Holttum, Gard. Bull. Singapore 13: 63 (1950).

Perennial rhizomatous herb, 0.9–1.3 m tall. *Rhizomes* tuberous, 3–5 cm long, 2.5–3.5 cm wide, pale yellow. *Leafy stems* terete, green above and reddish below, pubescent. *Leaves* 6–10 pairs; *leaf blade* linear to narrowly lanceolate, 15–17 cm long, 2–4 cm wide, adaxially glabrous, abaxially pubescent, apex acute, base cuneate, margin more or less undulate; *ligules* triangular, 1.5 cm long, 5–10 mm wide, whitish brown, membranous; *petiole* 4–6 mm long, pale green. *Inflorescences* radical, 7–10 cm long, 3–5 cm wide, oblong-ovate, greenish red; *peduncle* erect, slender. *Bracts* broadly ovate, 3.8–4 cm long, 3.6–3.8 cm wide, reddish brown, pubescent, apex and margin white, membranous. *Bracteoles* broadly lanceolate, 2.8–3.1 cm long, 1–1.2 cm wide, yellowish white, membranous. *Flower* yellowish white; *calyx* tubular, 1.8–2.1 cm long, 1–1.3 cm wide, white, membranous, glabrous, apex 3-toothed; *floral tube* yellowish white, 2.9–3.1 cm long, yellowish white; *corolla lobes* 3, yellowish white, concave, membranous, dorsal lobe oblong-ovate to lanceolate, 2–2.1 cm long, 8–9 mm wide, lateral

lobes 1.7–1.9 cm long, 4–5 mm wide; *labellum* trilobed, yellowish white; central lobe ca. 2 cm long, 2.5 cm wide, orbicular, apex retuse, margin undulate; lateral staminodes large, 1 cm long, 4–5 mm wide, oblong-obovate. *Stamen* 1.6–1.8 cm long, yellowish white; filament 2–3 mm long; anther white, 8–10 mm; anther crest 5–6 mm, yellowish white, elongate, cylindrical, recurved. *Ovary* white, 3–4 mm long, oblongoid, pubescent, placentation axile with two rows of ovules in each loculus; *style* long, filiform; *stigma* white, margin ciliate; *epigynous glands* linear, two, 4–5 mm long, yellowish white.

Distribution: Myanmar, Thailand and Peninsular Malaysia.

Ecology: Moist deciduous forest, wet place, ca. 100–150 m alt.

Phenology: Flowering and fruiting during August–October

Specimens examined. Yangon Region: Myaukhlaing Reserve, Insein Township, *Po Khant D. R. 604* (RAF). **Mandalay Region:** Pyin Oo Lwin Township, 1300 m alt., 21°57'54.426" N, 96°27'05.867" E, 11 August 2015, *Mu Mu Aung et al. 212* (RAF, TNS).

Vernacular name: Myauk-gyin-sein (Local name)

Notes: This is the species corresponding to Jack's original description. Holttum (1950) recognized three varieties of *Z. gracile*. In this treatment they have been treated as independent species rank. *Zingiber gracile* was described from Malay Peninsula, but it is distributed in center and southern regions of Myanmar as well. It is closely related to *Z. griffithii* but differs in the long thin ligules covered with hairs and the narrowly lanceolate leaves.

11. *Zingiber parishii* Hook. f. in Bot. Mag. 99: t. 6019 (1873). Baker in Hook. f., Fl. Brit. India. 6: 248 (1892); Ida Theilade in Nod. J. Bot. 19 (4): 401 (1999). – Type: An illustration of Curtis's Botanical Magazine 99, t. 6019, lectotype designated here. (Fig. 14).

Perennial rhizomatous herb, up to 1 m tall. *Rhizomes* cream internally, pale brown externally, fleshy, aromatic; *roots* tuberous *Leafy stem* terete, erect, green, glabrous. *Leaves* 7–14 pairs; *leaf blade* elliptic-oblong to lanceolate, 25–35 cm long, ca. 2 cm wide, glabrous below, base rounded, apex acute-acuminate, margin slightly undulate; *petiole* glabrous or sparsely hairy; *ligules* ca. 5 mm long, bilobed, triangular, green with scarious margin, glabrous. *Inflorescences* radical; *peduncle* 10–20 cm long, green, clothe with obtuse sheaths; *spikes* fusiform 10–15 cm long, apex obtuse. *Bracts* obovate to suborbicular, 3–3.5 cm long, 2–2.5 cm wide, greenish yellow, upper edge turning red when old, apex truncate or obtuse, incurved, hairy, margin scarious. *Bracteoles* elliptic, 2.5–3 cm long. *Flower* cream, 2.5 cm long; *calyx* tubular, 1.5 cm long, slit half way down; *floral tube* ca. 2.5 cm long; dorsal lobe ca. 2 cm long, 1 cm wide, linear oblong, apex acute, recurved; lateral lobes shorter than dorsal lobe; *labellum* pale yellow, tessellated with purple medially; central lobe obovate, 1.5 cm long, 1.1 cm wide, margin entire; lateral staminodes oblong, 0.8 cm long, 0.4 cm wide, whitish-cream.

Distribution: India, Myanmar and Thailand.

Ecology: Moist deciduous forest found in wet place.

Phenology: Flowering and fruiting during August – November, flowers open in day time simultaneously 2-3 flowered per inflorescence.

Specimens examined. Yangon Region: Hlaegue Township, Phaung-gyi area, 13 Jul 2014, *Mu Mu Aung 034*, 6 August 2015, *Mu Mu Aung 204* (RAF, TNS).

Vernacular name: Myauk-gyin-sein

Notes: This species was described from Moulmein, Myanmar by Parish (1872). Recently Triboun (2006) recorded this species from Thailand, and Sabu et al. (2009) recorded from India. Hooker (1873) provided a characteristic illustration of this species with his original

potologue in Curtis's Botanical Magazine t. 6019 based on Parish's collection, which is selected as a lectotype here.

12. *Zingiber tenuiscapus* Triboun & K. Larsen, in Thai J. Bot. 6(1): 65 (2014). – Type: Thailand: Tak, Mae Sot, in mixed deciduous forest, alt. 800-1,000 m, 15 Jul. 2002; P. Triboun 3343 (holotype BK; isotypes AAU, KKU). (Fig. 15).

Perennial rhizomatous herb, 1–1.5 m tall. *Rhizomes* yellow internally, pale brown externally, strongly aromatic. *Leafy stems* erect or decurved, dark green, glabrous; leaf sheaths glabrous. *Leaves* 10–12 pairs; *leaf blade* linear with fine, parallel nerves, 25–30 cm long, 2.5–3 cm wide, both side glabrous; *ligules* papery, bilobed with truncate sheaths, to 0.8-1 cm long, slightly pubescent near the base, apex acute or obtuse, glabrous; *petiole* nearly sessile, pubescent. *Inflorescences* radical, 1–2 from rhizome near leafy stem; *spikes* fusiform, 15–25 cm long, apex acute; peduncle erect, slender, 30-35 cm long, 6–10 sheaths, green. *Bracts* broadly ovate, 2.8–3.5 cm long, 2.5–3.0 cm wide, brownish green or brownish red, glabrous both surfaces. *Bracteoles* elliptic, 2 cm long, pilose on outside surface near base, slightly tri-toothed at the apex. *Flower* creamy white; *calyx* tubular, ca. 2 cm long, apex emarginate, as long as the bracteoles; *floral tube* 2.2 cm long; corolla lobes creamy white, oblong-ovate, boat-shaped, dorsal lobe ca. 2.5 cm long, 1 cm wide, apex acuminate, curved, dorsal lobe larger than lateral ones; *labellum* trilobed; central lobe orbicular or obovate, ca. 2.5 cm long, 1.5 cm wide, creamy white with 2 pink bands near base, emarginate apex; lateral staminodes ca. 1.5 cm long, 7 mm wide, creamy white with one red band near base, apex nearly rounded. *Stamen* pale yellow, 2.3 cm long; *filament* sessile or very short; *anther lobe* ca. 1 cm long, pale yellow with a pale pink band on lower half of back side, connective

appendage curved, ca. 1.2 cm, apex bifid, shorter than stigma. *Ovary* globose, ca. 3.0 mm in diam., villous. *Capsule* unknown.

Distribution: Myanmar and Thailand.

Ecology: Lowland evergreen forest, ca. 50 m alt.

Phenology: Flowering and fruiting during July – October.

Specimen examined. Tanintharyi Region: Michaung hlaung, Tanintharyi Reserved Forest, Yephyu Township, 38 m alt., 14°38'19.18" N, 98°11'44.27" E, 1 August 2015, *Mu Mu Aung et. al* 150 (RAF, TNS).

Vernacular name: Padecaw (local name)

Notes: *Zingiber tenuiscapus* was described by Triboun (2014), which was considered to be endemic to Thailand. It is characterized by its labellum creamy white with 2 pink bands near base in the central lobe and creamy white with one red band near base in lateral staminodes. The field expedition in this study to the Peninsular Myanmar revealed it is distributed in Myanmar as well, and it is the first record for this species from Myanmar. The local residents utilize this plant as medicinal and smell of rhizome is the same as *Z. montanum*.

13. *Zingiber sadakornii* Triboun & K. Larsen, Thai J. Bot. 6(1): 65 (2014). – Type: Thailand: Loei, Nong Hin, in mixed deciduous forest, 25 Jul. 2003; *P. Triboun* 3341 (holotype BK; isotypes AAU, KKU). (Fig. 16).

Perennial rhizomatous herb, 1–1.4 m tall. *Rhizomes* pale yellow internally, brown externally, slightly aromatic. *Leafy stems* erect or decurved, green, glabrous; *leaf sheaths* pubescent, *Leaves* 13 pairs; *leaf blade* linear to oblong, 21–25 cm long, 4–6 cm wide, apex acuminate, base cuneate, both surfaces light green, sparsely hairy above, glabrescent or long

hairy below; *ligules* bilobed; lobes rounded, 4–5 mm long, white, membranous, apex rounded, glabrescent to pubescent; *petiole* nearly sessile, 3–4 mm long, pubescent. *Inflorescences* 1–2, arising from rhizome; *peduncle* radical, erect, slender, 20–30 cm long, 10–14 sheaths, brownish green, elliptic, 4–5 cm long, outside pubescent; *spikes* ellipsoid, 9–10 cm long, 3–4 cm wide. *Bracts* obovate to suborbicular, 3–3.5 cm long, 2.5–3 cm wide, green turning to red at maturity, glabrous both surfaces, apex rounded or slightly mucronate, convex, the upper ones small, glabrous, pubescent near base. *Bracteoles* oblong, ca. 3 cm long, apex mucronate, glabrescent. *Flower* yellowish white, 7.5 cm long; *calyx* tubular, ca. 1.2 cm long, apex tridentate; *floral tube* ca. 3.5 cm long; *corolla lobes* yellowish white, dorsal lobes lanceolate, ca. 3 cm long, apex acute; *labellum* pale yellow to white with purple blotches near the base, trilobed; central lobe ovate, ca. 3 cm long, 2 cm wide, apex rounded; lateral staminodes ca. 8 mm long, 5 mm wide, creamy white with one red band near base, apex acute. *Stamen* pale yellow; filament sessile or very short; *anther* ca. 1 cm long, pale yellow with a pale pink band on lower half of back side; anther crest ca. 8 mm, apex bifid, shorter than stigma. *Ovary* globose, ca. 3 mm in diam., villous. *Capsule* ovoid, ca. 3 cm long, 2 cm wide, 3-angled. *Seeds* pale, obovoid, ca. 3 mm.

Distribution: Myanmar and Thailand.

Ecology: Hill evergreen forest in wet place, growing with bamboo species, ca. 820 m alt.

Phenology: Flowering from August to September and fruiting from October to November.

Specimen examined. Kayah State: Loikaw Township, Nan Oo reserved forest, Loilin Lay village, 821 m alt., 19°51'43" N, 97°14'16" E, 8 Nov 2014, *Mu Mu Aung et al.* 88 (RAF, TNS).

Vernacular name: Bokhout (loca name)

Notes: *Zingiber sadakornii* resembles *Z. zerumbet* but is easily recognized by its bilobed ligule, bright green and coriaceous leaves, the inflorescence with long peduncle and ellipsoid spike, larger creamy flowers with purplish red blotches at the base of labellum.

14. Zingiber zerumbet (L.) Roscoe ex Sm. in Exot. Bot. 2: 105 (1806); Roxburgh in Fl. Ind. 1: 48 (1832); Baker in Hook. f., Fl. Brit. India. 6: 247 (1892); Valeton in Bull. Jard. Bot. Buitenz. 27: 129 (1918). Holttum in Gard. Bull. Singapore 13: 59 (1950); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 135 (1975); Theilade in Nod. J. Bot. 19 (4): 404 (1999); Wu and Larsen in Fl. China 24: 326 (2000); Sabu in Folia Malaysiana. 4(1): 47 (2003). – Type: This species remains to be typified based on further nomenclatural study. (Fig. 17).

Amomum zerumbet L., Sp. Pl. 1:1 (1753).

Perennial rhizomatous herb, 1.2 m tall. *Rhizomes* yellow internally, pale brown externally, fleshy roots tuberous, aromatic. *Leafy stems* terete, erect, green, glabrescent. *Leaves* 8–10 pairs; *leaf blade* oblong or oblanceolate, 25–40 cm long, 5–8 cm wide, adaxially glabrescent, abaxially pubescent, base attenuate, apex acuminate; *petiole* sessile or very short; *ligules* very thin, translucent, entire, 1.5–2 cm long. *Inflorescences* arising from rhizomes, radical; *spikes* conical or ovoid to ellipsoid, 6–15 cm long, 3.5–5 cm wide, apex obtuse; *peduncle* 10–30 cm erect, sheaths green. *Bracts* 3.8–4.1 cm long, 4.8–5 cm wide, green when flowering, apex red with creamy white toward the base when old, convex near upper edge, apex broadly rounded with a thin margin. *Bracteoles* ca. 2.5 cm long, linear to lanceolate, thin but persistence to fruiting. *Flower* white; *calyx* tubular, 1.8–2 cm long, membranous, split on 1 side, apex 3-toothed; *floral tube* 2.8–3 cm long, slender; corolla lobes pale yellow,

oblong-ovate to lanceolate, glabrous, concave, unequal; dorsal lobe 2–2.5 cm long, yellowish white, lateral lobes 1.8–2 cm long; *labellum* cream, central lobe suborbicular or almost rounded, ca. 2 cm long, ca. 2.5 cm wide with deep yellow towards the base, apex emarginate or deeply bifid; lateral staminodes obovate, ca. 1 cm long, free nearly to base. *Stamen* erect, yellowish white, 1–2 cm; connective appendage beak like, ca. 8 mm. *Ovary* ca. 4 mm, globoid, white glabrous, placentation axile with two rows of ovules in each locule; style long, filiform; stigma white, margin ciliate; *epigynous glands* linear, two, 3.5–4 mm long, creamy white. *Capsule* ellipsoid, 0.8–1.2 cm. Seeds black.

Distribution: Myanmar, Thailand, India, Laos, Cambodia, Vietnam, China and Madagascar.

Ecology: It can be found in evergreen forest on hillsides and rocky ground, moist deciduous forest with teak. It is cultivated species as home garden in local area.

Phenology: Flowering and fruiting during July–November, flowers open in the morning.

Specimens examined. Sagaing Region: Homalin Township, Basin of Chindwin river, Nankhawedaing area, Mawyon Myaing village, 120 m alt., 25°20' N, 95°16' E, 29 October 2014, *Mu Mu Aung et al. 081* (RAF, TNS). **Kayah State:** Demawso Township, Nan San Phu reserved forest, 928 m alt., 19°33'07" N, 97°05'49" E, 10 November 2014 *Mu Mu Aung et al. 096* (RAF, TNS); Fruso Township, Kholeso reserved forest, 1167 m alt., 19°22'10" N, 97°13'42" E, 11 November 2014, *Mu Mu Aung et al. 097* (RAF, TNS). **Yangon Region:** Laegue Township, Phaung-gyi area, east Bago Yoma, ca 25 m alt., 17°33' N, 96°16'E, 30 November 2014, *Mu Mu Aung 111* (RAF, TNS). **Kayah State:** Fruso Township, Kholeso reserved forest, 1167 m alt., 19°22'10" N, 97°13'42" E, 25 July 2015, *Mu Mu Aung et al. 119* (RAF, TNS). **Tanintharyi Region:** Kalein Aung, Tanintharyi Reserved Forest, Yephyu Township, ca. 50 m alt., 14°38' N, 98°10' E, 3 August 2015, *Mu Mu Aung et al. 188* (RAF, TNS).

Vernacular name: Gateik, Linnay-gyi

Notes: *Zingiber zerumbet* resembles to *Z. ottensii* but differs having in rhizome yellow internally, inflorescences fragrant and the labellum is pale yellow without markings.

15. Zingiber ottensii Valetton, Bull. Jard. Bot. Buitenz. 27: 136, t. 19 (1918); Ridley. Fl. Mal. Pen. 4: 259 (1924). Holttum (1950) in Gardens Bull. Singapore 13: 56; Theilade in Nod. J. Bot. 19 (4): 404 (1999). – Type: Java, Bogor, Ottens 676 (K isotype). (Fig. 18).

Perennial rhizomatous herb, up to 1 m tall. *Rhizomes* dark purplish internally, strongly aromatic. *Leafy stems* spreading to weakly arching, with 6–10 pairs well developed leaves when flowering, densely arranged with short internode, basal $\frac{1}{4}$ leafless; *leaf sheaths* broad slightly pubescent near base and apex; *leaf blade* elliptic to oblanceolate-oblong, 35–40 cm long, 6–8 cm wide, adaxially glabrous, abaxially slightly pubescent towards the base, apex acuminate-attenuate; *ligules* broad, thin, ca 1.2 cm long, pubescent towards the base; *Petiole* 5 mm, finely pubescent, consisting of pulvinus only. *Inflorescences* 2-3, arising from rhizome; *peduncle* radical, erect. 25–40 cm long. *Spike* evenly ellipsoid to cylindrical with a broad apex, obtuse, 10–12 cm long, 4 cm wide. *Bracts* ovate, 4 cm long and almost as wide, convex with incurved tips, dull red to bright red when old. *Bracteoles* linear to lanceolate, 3.2 cm long. *Flowers calyx* tubular, 2.3 cm long, white; *floral tube corolla lobes* 5.7 cm long, cream to yellow: dorsal lobe 2.2 cm long, 1 cm wide: lateral lobes 2 cm long, 6 mm wide; *labellum* 5.5 cm long, pale yellow with faint red-brownish markings: central lobe ovate almost round, 2 cm long, 1.5 cm wide, apex rounded and slightly cleft: lateral staminodes ovate, 1.5 cm long, 0.9 cm wide. *Anther* 1.2 cm long, pale yellow, curved. *Capsule* oblong, red.

Distribution: Myanmar, Thailand, Peninsular Malaysia, and Indonesia (Java, Sumatra and Borneo).

Ecology: Lowland evergreen forest.

Phenology: Flowering and fruiting during July to November, flowers open in the evening.

Specimens examined. Tanintharyi Region: Yephyu Township, Michaung Hlaung (Old village), Tanintharyi Reserved Forest, 70 m alt., 27 October 2015, *Myo Min Latt, TNR 00198, 00199* (RAF).

Vernacular name: Gyin-net (Black-gyin)

Notes: *Zingiber ottensii* is closely allied to *Z. zerumbet* but differs in the convex bracts with incurved tips and the pale yellow flowers with faint red or brownish markings. Furthermore, *Z. ottensii* can be distinguished by the rhizome, which is dark purple inside in contrast to the yellow rhizome of *Z. zerumbet* and *Z. montanum*.

16. Zingiber kerrii Craib in Bull. Misc. Inform. Kew 1912: 403 (1912); Theilade in Nord. J. Bot. 19 (4): 397 (1999); Thongam in Taiwania 58(4): 291 (2013). – Type: Thailand, Kerr. A.F.G 1290 (BK). (Fig. 19).

Perennial rhizomatous herb, up to 2 m tall. *Rhizomes* subterranean. *Leafy stems* glaucous. *Leaves* 12–15 pairs, erect, patent; *leaf blade* linear-lanceolate, 22–30 cm long, 3–3.5 cm wide, tip acuminate, glabrous on both surfaces; *petiole* 0.4–0.6 cm long, green, pubescent; *ligules* short, 2–3 mm long, bilobed, membranous, sparsely pubescent. *Inflorescences* radical, erect, separate from leafy shoot; *spikes* elliptic or ovate, fusiform, 12–15 cm long, 4–5 cm wide, cone-shaped, tapering to a narrow apex; *peduncle* 15–20 cm long, clothed with green sheaths, oblong-ovate, tipped with red. *Bracts* ovate, 3–3.5 cm long, 2–2.5 cm wide, glabrous, tip rounded, green with reddish pink at the apex, closely imbricate. *Bracteoles* 2.7–3 cm long, 1 cm wide, lanceolate. *Flower* longer than the bract, 5–5.3 cm

long; *calyx* tubular, 0.7–1 cm long, creamy white, membranous, glabrous; *floral tube* slender, creamy white, glabrous, 3 cm long; *corolla lobes* unequal, dorsal lobe 2.5–2.8 cm long, 0.5–0.6 cm wide, ovate, yellowish, apex acute, curved; lateral lobes 2.5–2.8 cm long, 0.3–0.5 cm wide, narrowly ovate, yellowish, tip acute; *labellum* creamy white, trilobed; central lobe 2.5–2.8 cm long, 0.5–0.6 cm wide, sub-orbicular, base attenuate, emarginate - obcordate, margin crumpled; lateral staminodes 0.7–0.9 cm long, 0.3 cm wide, lanceolate, apex acuminate, recurved, and margin entire, white. *Stamen* 1.7 cm long; anther thecae, 0.7 cm long, anther crest long 0.5–1 cm long, 0.3 cm wide, filament white, curved. *Ovary* 2.5 cm long, trilocular with numerous ovules on axile placenta; *stigma* curved, white; *epigynous glands* cylindrical, tip blunt, creamy white.

Distribution: Myanmar, India and Thailand.

Ecology: Secondary forest, margin of the forest, forest edge, hillside.

Phenology: Flowering and fruiting during July–October, flowers open in the day time, two flowered per inflorescence.

Specimen examined. Mandalay Region: Pyin Oo Lwin Township, ca. 1300 m alt., 21°57'54.426" N, 96°27'05.867" E, 11 August 2015, *Mu Mu Aung et al.* 213 (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber kerrii* is distinguished by the glaucous leafy stem, linear or narrowly lanceolate leaves and green bracts with red apex. In a dried specimen, it is easily recognized by the red-brown upper part of the bracts.

17. *Zingiber gramineum* Noronha ex Blume, Enum. Pl. Javae 45 (1827); Valetton in Bull. Jard. Bot. Buitenz. 27: 139 (1918). Backer and Back. f. in Fl. Java 3: 43 (1968); Theilade in Nod. J. Bot. 19 (4): 393 (1999). – Type: Indonesia, Java.

Perennial rhizomatous herb, 1.5 m tall. *Rhizomes* slender. *Leafy stems* green with deep purple sheaths, villous. *Leaves* linear-lanceolate, ca. 23 cm long, ca. 2 cm wide, green with deep purple sheaths, villous below, base rounded, apex rostrate; *petiole* yellowish velutinous; *ligules* bilobed, 5 mm, velutinous. *Inflorescences* on basal stalks; *spikes* very variable in shape with age, first ovoid, later almost globose, 6–10 cm long, 3–5 cm wide, apex obtuse; *peduncle* erect, 20–30 cm long; red sheaths pubescent. *Bracts* at first loosely appressed, soon obliquely spreading, finally irregularly spreading, ovate-lanceolate, 3.5–4 cm long, 1–2 cm wide, dull deep purple, villous especially on upper half giving the inflorescences a shaggy appearance, apex acuminate, reduplicate or revolute. *Bracteoles* resembling bracts and about as long or sometime a little longer, narrower, pubescent. *Flower* small, white; *calyx* tubular, ca. 2.7 cm long, hairy, slit to the base; *floral tube* whitish, 5.4 cm long; dorsal corolla lobe 1.8 cm long; lateral lobes a little shorter than the dorsal corolla lobe; *labellum* yellow-whitish, regularly veined, about as long as corolla lobes, central lobe orbicular, entire; lateral staminodes rounded, 6 mm long.

Distribution: Myanmar, Thailand, Cambodia, Vietnam, and Indonesia (Java and Sumatra).

Ecology: Understory in low indaing forest.

Phenology: Flowering from July–August.

Specimen examined: Bago Region: Htantapin Township, near Kyaukpan village, 15 km from Taungoo, ca. 50 m alt., 18°51' N, 96°31' E, 11 Jul 1998 *W.J. Kress 98-6169* (RAF, US).

Vernacular name: Unknown

Notes: *Zingiber gramineum* is characterized by the bracts ovate-lanceolate, dull deep purple, villous especially on upper half giving the inflorescences a shaggy appearance, apex acuminate, reduplicate or revolute.

18. *Zingiber barbatum* Wall, [Cat. 6567 nom. nud. (1826)] Pl. Asiat. Rar. (Wallich) 1: 46, t. 55 (1830); Baker in Hook. f., Fl. Brit. India. 6: 244 (1892); Nord. J. Bot. 19 (4): 405. (1999).
–Type: An illustration of Wallich, Pl. Asiat. Rar., t. 55 (lectotype, designated here). (Fig. 20).

Perennial rhizomatous herb, ca. 1 m in height. *Rhizomes* brown externally, whitish brown internally, roots with tubers. *Leafy stems* erect, green, villous. *Leaves* 7 pairs; *leaf blade* lanceolate, dark green, 20–25 cm long, 3–4 cm wide, margin undulate with densely pubescent on both surfaces, apex acuminate, base cuneate; *ligules* 2 mm long, bilobed, truncate, velutinous; *petiole* very short or nearly sessile, velutinous. *Inflorescences* radical, oblong-ovate, ca. 7 cm long, apex acute, peduncle up to 3 cm long, villous. *Bracts* ovate to cuspidate, dark green, 2.8–3.5 cm long, 2.3–2.8 cm wide, densely villous externally, glabrous internally, apex shortly pointed. *Bracteoles* 2.2 cm long, 6 mm wide, sparsely pubescent along the margin towards the apex. *Flower* white; *calyx* tubular, 1.2 cm long, 3.5 mm wide, white, membranous, glabrous, slightly dentate at the apex; *corolla tube* white, ca. 2.5 cm long; *corolla lobes* 3, lanceolate, white, dorsal lobe, ca. 2 cm long, 7 mm wide, glabrous, lateral lobes 1.5–2 cm long, 5 mm wide; *labellum* trilobed, white with a pink tinge at the base; central lobe ca. 1.4 cm long, 1.5 cm wide, obovate, apex emarginate, slightly notched, margin crisped; lateral staminodes small, oblong, apex rounded, ca. 8 mm long, ca. 2.5 mm wide. *Anther* sessile, white, 1.5 cm long, anther thecae ca. 7 mm, cylindrical, recurved. *Ovary* white, sub-ellipsoid, glabrescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 3 mm long, whitish.

Distribution: Myanmar and Thailand.

Ecology: moist deciduous forest, wet place, ca. 100-150 m alt., flowering in the evening, and three flowers open simultaneously per inflorescence.

Phenology: Flowering and fruiting: July–September

Specimens examined. Yangon Region: Myaukhlaing Reserved forest, Insein Township, 23 July 1948, *Po Khant D. R. 572* (RAF). **Kayah State:** Kyat Gu Reserved Forest, Loikaw Township, 925 m alt., 19°40'05" N, 97°20'05" E, 20 July 2015, *Mu Mu Aung et al. 114* (RAF, TNS).

Vernacular name: Pwe-au, Meik-tha-lin

Notes: This is *Zingiber barbatum* sensu strict among the three types which was here recognized in the *Z. barbatum* Group. Wallich (1810) noted that this species was common in Prome along the Irrawaddy (Ayeyawaddy) river near Rangoon (present Yangon). Wallich's illustration is identical with this plant. The inflorescence is strongly fragrant.

19. Zingiber popaense Nob. Tanaka in Makinoa N. S. 10: 160 (2012). – Type: MYAMAR. Mandalay Division: along Ye Nge Road from the Environmental Education Center to Ye Nge Guest House, Popa Mountain Park, Kyaukpadaung Township, 20°45' N 95°15' E. 25 October 2000, *J. Murata, N. Tanaka, M. Miyake, T. Ooi, Than Than Aye and Khin Myo Htwe 020789* (holo-MBK, iso-TI). (Fig. 21).

Perennial rhizomatous herb, 0.8–1.5 m tall. *Rhizomes* yellowish brown externally, whitish internally, aromatic; *roots* bearing tubers, tubers globose, whitish both internally and abaxially, 2–3 cm long, 1–3 cm wide. *Leafy stems* villous, reddish. *Leaves* 9–15 pairs; *leaf blade* linear to lanceolate, green, densely pubescent on both surfaces, apex acute, 15–25 cm long, 1.2–2.5 cm wide; *petiole* villous, 3–5 mm long; *ligules* bifid, 2–5 mm long, pubescent at

margin; sheaths green, with long white hairs at margin. *Inflorescences* arising from rhizome; *spikes* ovoid when young, gradually becoming fusiform with age, 6–9 cm long, 2.5–3.5 cm wide, entirely enclosed by 40–50 bracts; *peduncle* radical, procumbent, up to 2.5 cm long. *Bracts* ovate to cuspidate, deep green, densely villous externally, almost glabrous internally, 2.5 cm long, 1.5 cm wide, apex sharply pointed, greenish with long white hairs, each subtending a single flower. *Bracteoles* ovate, pubescent abaxially, glabrous adaxially, 2 cm long, 1 cm wide. *Flower* white, blooming in the evening, slightly scented; *calyx* tubular, oblanceolate, rolled, 1.5 cm long, 3–3.5 mm wide, glabrous; *flora tube* 1.5–1.7 cm long, corolla lobes 3, white; dorsal lobe 1.8 cm long, 8 mm wide, lateral lobes 1.1–2 cm long, 5 mm wide; *labellum* trilobed, white to slightly creamy, recurved; central lobe obovate, 1 cm long, 0.9–1 cm wide, apex emarginate, margin crumpled, lateral staminodes ovate-oblong, 3–4 mm long, 2.7–3 mm wide, apex rounded or somewhat obliquely truncate. *Anther* subsessile, thecae 7 mm long, appendage white, 7–10 mm long, recurved. *Ovary* ovoid, 3.5–4 mm long, 2.5 mm wide.

Distribution: Central Myanmar. Thus far known only from Mt. Popa.

Ecology: Shaded forest floor in semi-evergreen forest, 800–1000 m alt., flowering in the evening, and one-three flowers open simultaneously per inflorescence. Flower is slightly fragrant.

Phenology: Flowering and fruiting during September–November

Specimens examined. Mandalay Region: Popa Mountain Park, Kyaukpadaung Township, 20° 45' N 95° 15' E. 1 September 2005, *Khin Myo Htwe 032823* (MBK, TI); 12 Nov 1997, *W. J. Kress 97-5933* (US, RAF).

Vernacular name (Myanmar): Meik-tha-lin.

Notes: Endemic to Myanmar.

20. *Zingiber pygmaea* M. M. Aung & Nob. Tanaka, **sp. nov.** – Type: MYAMAR. **Mandalay**

Region: Popa Mountain Park, Kyaukpadaung Township, 20°45' N 95° 15' E. 1 June 2001, *N. Tanaka et al. 0267* (holo-MBK, iso-TNS). (Fig. 22).

Diagnosis: This species is similar to *Zingiber barbatum* and *Z. popaense* but differs in having small plant up to 30 cm tall, densely arranged hirsute leaves with very short internode, and creamy white wide labellum with pink tinged base.

Perennial rhizomatous herb, up to 30 cm tall. *Rhizomes* very short, brownish white externally, whitish internally, aromatic; *roots* bearing tubers, tubers subgloboes, 2 cm long, 1.5 cm wide, brownish externally, whitish internally. *Leafy stems* villous, reddish green. *Leaves* 7 pairs; *leaf blade* densely arranged with very short internode, ovate to oblong, green, densely hirsute on both surfaces, apex acute, base rounded, 15–18 cm long, 9–10 cm wide; *petiole* villous, 3–5 mm long; *ligules* bifid, inconspicuous, ca. 2 mm long, pubescent at margin; sheaths green, with long white hairs at margin. *Inflorescences* ovoid, 3.5–4 cm long, 2.5–3 cm wide; peduncle radical, very short. *Bracts* ovate to cuspidate, 2.3 cm long, 1.7 cm wide, reddish brown at the apex, whitish towards the base, densely villous at apex, glabrescent at the base externally, almost glabrous internally, apex shortly pointed, each subtending a single flower. *Bracteoles* oblong, rolled, 1.8 cm long, 0.6 cm wide, sparsely pubescent abaxially, glabrous adaxially. *Flower* cream to pale yellow, blooming in the evening, slightly scented; *calyx* tubular, slightly dentate, ca. 1 cm long, 3.5 mm wide, glabrous; *floral tube* ca. 2.5 cm long, *corolla lobes* 3, white, lanceolate; dorsal lobe ca. 1.8 cm long, ca. 1 cm wide, lateral lobes ca. 1.8 cm long, ca. 7 mm wide; *labellum* trilobed, white to slightly creamy, recurved; central lobe obovate, ca. 1.7 cm long, ca. 2.3 cm wide, apex emarginated, margin crispate, lateral atminodes ovate-oblong, ca. 8 mm long, ca. 3 mm wide, apex rounded or sometimes

dentate. *Anther* subsessile, cream, 1.5 cm long, thecae ca. 8 mm long, recurved. *Ovary* ovoid, 3.5–4 mm long, 2.5 mm wide, glabrescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 3 mm long, creamy.

Distribution: Currently known only from the type locality.

Ecology: Shaded forest floor in semi-evergreen forest, 800–1000 m alt., flowers open in the evening, and simultaneously one – three flowered per inflorescence

Phenology: Flowering and fruiting during June–September.

Etymology: The specific epithet of this new species is named showing the distinct character of small plant.

Notes: *Zingiber pygmaea* is considered to be endemic to Myanmar.

21. *Zingiber chrysanthum* Roscoe, Monandr. Pl. Scitam.: t. 86 (1824); Baker in Hook. f. Fl. Brit. India 6: 243 (1892); Smith, Fl. Bhu. 17: 187 (1987). – Type: Nepal, s.coll. Cat. 6566 (1826), Wallich Cat. 6566B (1867); Williams & Stainton 8233. 4600 m; Himalaya (Kumaun to Sikkim), Assam.

Z. flavescens Link ex A.Dietr. Sp. Pl. 1: 54 (1831).

Perennial rhizomatous herb, 2–3 m tall. *Rhizomes* fleshy, running horizontally, very large, root tuberous. *Leafy stems* erect, numerous. *Leaves* subsessile, on a short twisted petiole; *leaf blade* oblong-lanceolate, 20–30 cm long, 5–8 cm wide, adaxially glabrous, abaxially pubescent beneath, ciliate, base attenuate, apex acute thinly acuminate; *ligules* bifid, 2 cm long, apex with blunt stipulated ocrea. *Inflorescences* radical sitting closely on the root; *spikes* 8–9 cm long, to 5 cm diameter, globose-oblong; *peduncle* sessile or very short. *Bracts*

densely imbricate, broadly ovate, narrowing to the point, 6–7 cm long, 3–5 cm wide, pale green, apex villous, acuminate, twisted, reflexed. *Bracteoles* pale green, ca. 3 cm. *Flower* red; *calyx* tubular, ca. 2 cm long, white, membranous, pellucid, ciliated, tube incurved, downy; *floral tube* just exerted from bracts; *corolla lobes* 3, bright red, dorsal lobe lanceolate, ca. 3 cm long, 1.5 cm wide, concave, incurved, slightly hairy, lateral lobes ca. 2.5 cm long, 1 cm wide; *labellum* trilobed, bright yellow; central lobe orbicular, 2.5 cm long, 2.5 cm wide, crenate, apex emarginate, slightly bifid, margin entire; lateral staminodes ovate, ca. 1.5 cm long, 8 mm wide. *Stamen* ca. 3 cm, yellow; *filament* nearly sessile; *anther* yellow, very long, ca. 1.5 cm; anther crest ca. 1.5 cm, cylindrical, recurved. *Ovary* white, sub-ellipsoid, densely pubescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 7 mm long, light yellow. *Capsule* oblong, bright red.

Distribution: Myanmar (northern), eastern Himalaya and north east India

Ecology: moist deciduous forest, wet place, ca. 100–150 m alt.

Phenology: Flowering and fruiting during July–September.

Specimen examined. Kachin State: Kachin Hill, 1897, *Shaik Mokim s. n.* (CAL).

Vernacular name: Unknown

Notes: *Zingiber chrysanthum* is characterized by its bright golden flowers closely sitting on the ground, make a singular appearance. The fresh roots are slightly aromatic to the taste. This species is native of Nepal. This is newly recorded from and it shows that eastern limit of distributional range for this species.

22. Zingiber rubens Roxb. in As. Res. 11: 348 (1810). Monandr. Pl. Scitam. t. 86 (1824); Fl. Ind. 1: 53 (1832); Baker in Hook. f., Fl. Brit. India. 6: 244 (1892); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 122 (1975); Smith in Fl. Bhu. 17: 187 (1987);

Theilade in Nord. J. Bot.19 (4): 406 (1999). – Type: India, Khasia Hills, Clarke, Hook.f. & Thomson, Ind. Orient. 10 (lectotype- K). (Fig. 23).

Perennial rhizomatous herb, 1.8–2.5 m tall. *Rhizomes* creamy white internally, light brown externally, slightly aromatic. *Leafy stems* terete, glabrous, green above, reddish pink below. *Leaves* 7 pairs; *leaf blade* elliptical to oblong-broadly lanceolate, 30–40 cm long, 10–12 cm wide, adaxially glabrous, abaxially pubescent, apex acute, base obtuse, margins more or less undulate; *ligules* triangular, 1 cm long, glabrous, white, membranous; *petiole* 3–5 mm long, slightly pubescent. *Inflorescences* radical, procumbent, dense; *spikes* ovate, ca. 6 cm long, 5.5–6.5 cm wide, apex truncate; *peduncle* 6–7 cm long. *Bracts* lanceolate, ca. 6 cm long, bright red, slightly pubescent. *Bracteoles* usually linear, 5.5 cm long, sparsely pubescent, pale red, membranous. *Flower* whitish to pale red; *calyx* tubular, 2.5 cm long, white, membranous; *floral tube* ca. 4 cm long, whitish to pale red; *corolla lobes* turning bright red, pubescent; dorsal lobe 3.5 cm long, 0.5 cm wide; lateral lobes ca. 3 cm long, 0.6 cm wide; *labellum* creamish background dotted with red spots; central lobe oblong, 3 cm long, 1 cm wide, apex rounded rarely bifid; lateral staminodes very small, rounded. *Stamen* 3.5 cm long, arcuate, dark red; *filament* 2 mm long, white; *anther lobes* oblongoid, parallel, 2 cm long, 4 mm in diameter, yellowish maroon, crest long and curved, 1.5 m long, pinkish maroon. *Ovary* oblongoid, 5 mm long and 3–4 mm in diameter, brownish, pubescent, trilocular, the placentation axile with 3 rows of ovules in each loculus, style 5.8–6 cm long, stigma infundibuliform, ca. 1 mm long, white, margins ciliate; *epigenous glands* linear, 4–5 mm long, pale yellow. *Capsule* obovoid, ca. 2.6 cm long and ca. 1 cm in diameter, pinkish white.

Distribution: Myanmar, India, Bhutan and Thailand.

Ecology: Moist deciduous forest, undergrowth of the teak bearing forest, shady place.

Phenology: Flowering and fruiting: August–October

Specimen examined. Bago Region: Yetashae Township, Phokya forest camp, East Bago Yoma, ca. 200 m alt., 13 July 2014, *Mu Mu Aung* 022 (RAF, TNS).

Vernacular name: Toukta

Notes: This species is considered to be a native of Bengal, India. *Zingiber rubens* is easily recognized by the larger leaves, reddish ovate inflorescence with red bracts, flowers with red labellum with yellow mottled. Flowers are similar to those of *Zingiber longiligulatum* S.Q. Tong, however, ligules in *Z. rubens* are much shorter and inconspicuous.

23. Zingiber squarrosus Roxb., *Asiat. Res.* 11: 348 (1810); Roxb. *Hort. Beng.* 1; Roscoe, *Monandr. Pl. Scitam* t. 86 (1824); *Fl. Ind.* i: 54 (1832); Baker in Hook. f., *Fl. Brit. India.* 6: 245 (1892). – Type: A lectotype is remained to be designated among the Roxburgh’s specimens in CAL, based on further nomenclatural study. (Fig. 24).

Zinginer squarrosus Wight, *Icon. Pl. Ind. Orient.* t. 2004 (1853).

Perennial rhizomatous herb, 1–2 m tall. *Rhizomes* yellowish brown externally, creamy yellow internally, aromatic; *roots* tuberous, fleshy, without tubers. *Leafy stems* erect, terete, thick, green above, dark red below. *Leaves* 7–10 pairs, almost sessile; *leaf blade* oblong-lanceolate, 40–50 cm long, 10–15 cm wide, glabrous, midvein basally enlarged, base cuneate or attenuate, apex acute-acuminate; adaxially dark green, abaxially off-green; *ligules* greenish white, 1 cm long, bilobed, membranous. *Inflorescences* radical, procumbent; *spikes* dense, ovate or subglobose, 5–8 cm long; *peduncle* short or absent, sheath ovate to broadly ovate. *Bracts* numerous, linear lanceolate, 4–6 cm long, 1–2 cm wide, squarrose, green with pale pink towards the apex, closely imbricate, apex distinctly hooked, pubescent towards the

apex. *Bracteoles* lanceolate, trilobed, whitish towards the base, ca. 3 cm long, 0.6 cm wide, pubescent. *Flower* white, 4.5 cm long; *calyx* tubular, ca. 2.4 cm long, shortly dentate, unilaterally split; *floral tube* slender, ca. 2.4 cm long, pale pink to white towards the base; corolla lobes 3; dorsal lobes ovate-lanceolate, ca. 3 cm long, 1.2 cm wide, translucent white at the base, pink at apex, boat-shaped; lateral lobes ca. 2.7 cm long, 0.7 cm wide, colored as the dorsal lobe, recurved, adhering basally to the ventral surface of the labellum at 1.2 from the apex; *labellum* trilobed, white blotches with lilac towards the apex; central lobe ca. 2 cm long, 1.5 cm wide, glabrous, ovate, margin slightly wavy, deflexed, apex slightly bifid, and emarginate or crenate at the apex; lateral staminodes short, ca. 2 cm long, 6 mm wide, adnate, spreading rounded, red with white spots. *Stamen* pale yellow at the base pinkish red towards the tip; *anther* almost sessile, pale yellow, ca. 2.2 cm long with a long crest, ca. 7 mm long; connective appendage ca. 1.5 cm, thecae parallel. *Ovary* ca. 3–2 mm, trilocular with many ovules on axile placenta; style filiform; stigma white with a circular apical aperture surrounded by stiff hairs; *epigynous glands* ca. 4 mm long, linear. *Capsule* green to red, ovoid, 6 cm long, 2–2.5 cm wide, triangular. *Seeds* many, dark red, oblong, arillate, aril white, lacerate.

Distribution: Myanmar and India (Arunachal Pradesh, Andaman Is).

Ecology: Moist deciduous forest, wet place, forest edge, flowering in the afternoon, two-three flowers open per inflorescence.

Phenology: Flowering and fruiting: July–November

Specimens examined. Yangon Region: Hlaegu Township, East Bago Yoma, ca. 200 m alt., 13 July 2014, *Mu Mu Aung* 035 (RAF, TNS). **Tanintharyi Region:** Yephyu Township, Mainmapan Chaung, Zinbar, Tanintharyi Reserved Forest, 160 m alt., 14°38'15.29" N, 98°08'17.24" E, 31 July 2015, *Mu Mu Aung* 134 (RAF, TNS).

Vernacular name: Toukta, Kyat-cahnthee

Notes: *Zingiber squarrosus* was described by Roxburgh (1810), and he mentioned that the species was a native of Pegu (Bago Region), lower part of Myanmar. *Zingiber squarrosus* is distinguished by the bracts are more recurved, squarrose, linear lanceolate and green with pinkish at the apex, distinctly hooked, densely pubescent towards the apex.

4. *Zingiber matupiense* M. M. Aung & Nob. Tanaka, **sp. nov.** – Type: MYANMAR. **Chin State:** along the roadside between Taingsi village and Hakha road, near the foothill of Mt. Victoria, Matupi Township, Natma Taung National Park, 1660 m alt., 21°50.349' N 93°28.343' E, 12 July 2013, *Mu Mu Aung et al. 94216* (holotype-TNS; isotypes-MBK, RAF). (Fig. 25).

Diagnosis: This species is most similar to *Zingiber cernuum* Dalz. but differs by its erect leafy stem, bracts yellowish white with margin translucent and recurved, longer floral tubes, lateral staminodes and anther crest with bright yellow.

Perennial rhizomatous herb, up to 1.2 m in height. *Rhizomes* thick, 5 cm in diam., externally pale brown, internally creamy white, slightly aromatic, roots many, strong and fleshy. *Leafy stems* erect, with up to 20 leaves, basal 1/3 of pseudostem leafless, fleshy, the lower part reddish green, upper part green; bladeless sheaths 3–4, dark red. *Leaves* 4–10 pairs, *petiole* almost sessile, pale green, pulvinate at base; *ligules* white, membranous, sometimes reddish on the lower leaves, ca. 1 cm long, glabrous, apex round, scarious when matured; *leaf blade* broadly ovate to oblong-lanceolate, 20–40 cm long, 10–15 cm wide, almost smooth, glabrous, mid-vein basally enlarged, base cordate to cuneate, apex acute to acuminate; adaxially dark green, abaxially pale green, margin more or less undulate. *Inflorescences* radical; *peduncle*

procumbent, very short, up to 8 cm long, covered by sheaths, lower ones smaller than upper, glabrous; *spikes* obovate to sub-globose, 8 cm long, 5 cm wide, consisting of 20–25 bracts, coriaceous. *Bracts* ovate-lanceolate, 4.5–5 cm long, 2–2.8 cm wide, outer bracts greenish white, inner bracts yellowish white, loosely imbricate, slightly recurved, apex acute or shortly acuminate, glabrous, margin hyaline, semi-translucent white, enclosing single flower. *Bracteoles* lanceolate, white, 3.5 cm long, 1 cm wide, glabrous, apex shortly trilobed. *Flower* 7–8 cm long, yellowish white; *calyx* tubular, 1.5–2 cm long, apex shortly tridentate, membranous, unilaterally split, glabrous; *floral tube* slender, 4.5–5 cm long, 0.6 cm in diam. at mouth, pale yellow to white towards the base, glabrous, *corolla lobes* subequal; dorsal corolla lobe ca. 3 cm long, 1.2 cm wide, translucent cream at base, yellowish white at apex, ovate-lanceolate, curved; lateral corolla lobes ca. 2.7 cm long, 0.7 cm wide, colored as the dorsal lobe; *labellum* broadly ovate, maroon with creamy yellow blotches, glabrous, central lobe oblong, ca. 2.2 cm long, 1.3 cm wide, margin slightly undulate, apex slightly notched or emarginate; lateral staminodes 1.4 cm long, 0.5 cm wide, bright yellow, connate to labellum by basal 1/2–1/3. *Anther* yellow, ca. 2.7 cm long with a crest, anther crest ca. 1.4 cm long, wrapped around stigma; connective appendage ca. 1.3 cm, yellow; thecae 1.3 cm long, parallel, dehiscing along the entire length. *Style* white, filiform, glabrous, stigma white with a circular apical aperture surrounded by stiff hairs. *Ovary* ca. 4 mm long, 2 mm wide, white, trilocular with many ovules on axile placenta, densely pubescent; *epigynous glands* two, ca. 6 mm long, linear, pale yellow. *Capsule* unknown.

Distribution: Thus far known only from the type locality.

Ecology: Evergreen forest margins in shade, ca. 1660 m alt.

Phenology: Flowering from June to August. Fruiting period unknown. Flowers open in the morning, simultaneously 2-3 flowered per inflorescence

Etymology: The specific epithet is derived from the name of type locality.

Notes: Although its vegetative morphology has some similarity to *Z. cernuum* Dalz. *Z. squarrosum* Roxb. and others, radical inflorescences on short peduncles, which emerge from the base of the rhizome belong to the Sect. *Cryptanthium*. In *Z. matupiense* the bracts have lanceolate, yellowish white with margin translucent and recurved, acute or shortly acuminate at apex, glabrous and the flower is overall creamy yellow blotches with maroon, prominent lateral staminodes with bright yellow larger than *Z. cernuum* and *Z. squarrosum*.

25. *Zingiber nimmonii* (J. Graham) Dalzell in Hooker's J. Bot. Kew Gard. Misc. 4: 341 (1852). Baker in Hook. f., Fl. Brit. India. 6: 244 (1892); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 119 (1975); Sabu in Folia Malaysiana. 4(1): 36 (2003). – Type: A lectotype for this species remains to be selected based on further nomenclatural study.

Alpinia nimmonii J. Graham Cat. Pl. Bombay 206 (1839).

Perennial rhizomatous herb, 1.2–1.5 m tall. *Rhizomes* pale brown externally, fleshy; *roots* tuberous, 5–6 cm long white. *Leafy stems* terete, stout, 0.9–1.2 m in length and 1.5–2.0 cm in diameter, glabrate, flattened, green above reddish pink below. *Leaves* alternate and distichous; *leaf blade* lanceolate, 30–38 cm long and 7–8 cm wide, apex acuminate, base cuneate, the lateral veins numerous, pubescent on the both surfaces; *petiole* 9–10 mm long and 4–5 mm wide, pubescent, reddish brown; *ligules* more or less orbicular, 2–3 cm long and 5–6 mm wide, pale red, membranous, the sheaths 10–11 cm long and 22–25 cm wide, reddish green, pubescent. *Inflorescences* cauline axillary spikes; *peduncles* 3–4 cm long and 1.2–1.5 cm in diameter, pale pink, glabrate; *spikes* ovate or sub-globose, 8–8.5 cm long and 3.8–4 cm in diameter, reddish pink. *Bracts* variable, the lower broadly ovate, 4–4.2 cm long and 3.8–4

cm wide, glabrous, reddish pink, the upper linear-oblong to lanceolate, 4–4.4 cm long and 1.7–2 cm wide, reddish pink. *Bracteoles* oblong-linear, 3–3.2 cm long and 7–8 mm wide, pale pink, membranous. *Flower* 5.3–5.5 cm long and 1.3–1.5 cm in diameter, inserted, reddish yellow, sessile usually opening singly; *calyx* tubular, 1.8–2 cm long and 1–1.2 cm wide, white, membranous, the tube 1.7–1.9 cm long and 1–1.2 cm wide, the lobes triangular, about 1 mm long and 2 mm wide; *floral tube* 2.5–2.6 cm long and 2–4 mm wide, white; *corolla lobes* unequal, lanceolate, concave, dorsal lobe 3.5–3.7 cm long and 5–6 mm wide, reddish yellow; lateral lobes 2–2.2 cm long and 4–5 mm wide, pinkish white; *labellum* oblong, 2.5–2.7 cm long and 1.5–1.7 cm wide, light yellow with red mottled, the tips retuse, lateral staminodes very small, orbicular. *Stamen* arcuate, 1.5–1.7 cm long and 2–3 mm in diameter, yellow, filament 1–2 mm long and about 1 mm wide, white, anther lobes ellipsoidal, 1.1–1.3 cm long and 2–3 mm in diameter, white, spur absent, crest narrow, long and curved, 3–4 mm long and about 1 mm wide, yellow. *Ovary* oblongoid, 6 mm long and 3–4 mm in diameter, pinkish white, pubescent, trilocular, the placentation axile with 3 rows of ovules in each loculus, the style 4–8 cm long and about 0.1 mm wide, the stigma infundibuliform, about 2 mm long and 0.5 mm in diameter, white the margin ciliate, 4–5 mm long and about 1 mm in diameter, white. *Capsule* oblongoid, 2.8–3 cm long and 1.5–1.7 cm in diameter, reddish pink, pubescent.

Distribution: Myanmar and India.

Ecology: Undergrowth of trees both low and high altitudes, from 200 to 1000 m alt.

Phenology: Flowering and fruiting during June–October.

Specimens examined. Mandalay Region: Maymyo (Pyin Oo Lwin), near Bot. Gard., *Tin Tin Win & Hlaing Win* 89 (RANG- non vide); Thonedaung, *Tin Tin Win* 113; *Tin Tin Win & Hlaing Win* 142 (RANG).

Vernacular name: Unknown

Notes: Tin Tin Win (1975) recognized this poorly known species from Myanmar as well, but its existence has been still not confirmed, because of the bad condition of specimens in RANG. Tin Tin Win (1975) provided a drawing, and it looks identical with *Z. nimmonii*. In this study I failed to recollect this species, and further field studies are required to make it clear. This species is characterized by its short radical, dense flowered inflorescence, labellum light yellow with red mottled and lateral staminodes very small.

26. *Zingiber ligulatum* Roxb. in As. Res. 11: 348 (1810). Fl. Ind. 1: 51 (1832); Baker Hook.f, Fl. Brit. India 6: 245 (1892); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 138 (1975). – Type: An illustration of t. 253 in Roxburgh’s “Plants of the coast of Coromandel, vol. 3” (lectotype designated here). (Fig. 26 A).

Perennial rhizomatous herb, 0.6–0.7 m tall. *Rhizomes* tuberous, 3–4.5 cm long, 4–8 mm in diam., pale pink without, the flesh white. *Leafy stems* terete, green above, pinkish below, glabrous. *Leaves* broadly ovate to ovate-lanceolate, 25–30 cm long, 5–8 cm wide, apex acute to acuminate, margin more or less undulate, base obtuse, glabrous on both surfaces; *petiole* 5–20 mm long, green, pubescent; *ligules* triangular, 3.3–3.5 cm long, 5–8 mm wide, pale green, sheaths 15–18 cm long, 1.2–1.5 cm wide. *Inflorescences* radical, procumbent; *spikes* obovoid to sub-globoid, 5–7 cm long, pink; *peduncle* 3–3.2 cm long, white. *Bracts* variable in shape, outer oblong-ovate, inner oblong-lanceolate, 3.5–3.7 cm long, 1.2–1.7 cm wide, pink. *Bracteoles* broadly lanceolate, 2.5–2.8 cm long, 8–9 mm wide, white membranous, pubescent. *Flower* infundibuliform, pale pink; *calyx* tubular, 1.3–1.5 cm long, 9–10 mm wide, white with red dots; *floral tube* 2–2.5 cm long, white, *corolla lobes* unequal, lanceolate,

dorsal lobe 2-2.2 cm long, 4-5 mm wide, pinkish white with red dots; *labellum* yellowish white, central lobe obovate-cuneate, 2-2.2 cm long, 1-1.2 cm wide, apex obtuse, margin undulate; lateral staminodes small, more or less acute. *Stamen* yellow; *filament* 2 mm long, white; *anther* ellipsoid, white, 9-10 mm long, the crest narrow, long, curved, 6-7 mm long, bright yellow. *Ovary* oblongoid, 3-4 mm long, yellowish white, pubescent, trilocular with many ovules, placentation axile; style long, filiform, white; stigma infundibuliform. *Capsule* oblong, 30 cm long and more, bright red inside. *Seeds* blackish-brown, with a nearly complete white aril.

Distribution: Myanmar, south and east India, to Thailand and China (SW Yunnan).

Ecology: Moist deciduous forest and hill forest

Phenology: Flowering and fruiting during June – December.

Specimens examined. Mandalay Region, Pyin Oo Lwin (Maymyo) Township, *Tin Tin Win & Hlaing Win 87* (RANG- non vide). **Mandalay Region:** Paungpyin Township, **Sagaing Region,** alt. 255 m, 17 June 2001, *W.J. Kress et al. 01-6913* (US).

Vernacular name: Unknown

Notes: This species was described by in Roxburgh (1810) the the exact locality of this type collection are unknown. It was reported to have been collected along the Coromandel Coast, which is the name given to the southeastern coast of the Indian Peninsula. Roxburgh (1810) noted that *Zingiber ligulatum* flowers during the rainy season and the seeds are ripe in December. *Z. ligulatum* is described as a medium sized (to two foot), rhizomatous herb with glabrous leaves beneath, bracts pink, outer ovate, inner lanceolate, corolla segment pink, lip obovate, cuneate, yellowish-white, unspotted, basal auricles small ovate. *Z. ligulatum* is very near *Z. roseum* and *Z. longiligulatum* (Hooker 1894). It is quite difficult to understand its entity from the Roxburgh's original protologue in his "Asiatick Researches" (1810) with very

poor description, and without any citation of specimens. However, later, Roxburgh (1819) provided the illustration of this species in his “Plants of the coast of Coromandel, vol. 3: t. 253. This is only one good material to understand its identity. For this reason this illustration should be selected as a lectotype for *Z. ligulatum* Roxb. in this study. *Zingiber ligulatum* is very similar to a variation of *Z. longiligulatum* often observed in this study in Myanmar. Further careful comparison of these two species in China and Myanmar would solve the taxonomic entity of this poorly known species.

27. *Zingiber roseum* (Roxb.) Roscoe in Trans. Linn. Soc. London 8: 348 (1807); Roscoe, Monandr. Pl. Scitam. t. 86 (1824); Fl. Ind. 1: 50 (1832); Baker in Hook. f., Fl. Brit. India. 6: 244 (1892); Tin Tin Win, Zingiberaceae of Burma in Part (M.Sc. Thesis): 119 (1975); Wu and Larsen in Fl. China 24: 328 (2000); Sabu in Folia Malaysiana. 4(1): 45 (2003). (Fig. 26 B)

Amomum roseum Roxb., Pl. Coromandel 2: 15. (1800).

Perennial rhizomatous herb, 1.2–1.5 m tall. *Rhizomes* pale yellow externally, roots tuberous. *Leafy stems* terete, slender, glabrous, green above and reddish brown beneath, pubescent. *Leaves* oblong or oblong-lanceolate, 30–40 cm long, 3–5 cm wide, apex acuminate, base cuneate, margin more or less undulate, adaxially glabrous, abaxially pubescent; *petiole* sessile, pubescent, covered with red dotted, pulvinus; *ligules* 2-lobed, apex nearly rounded, ca. 2 cm long, membranous. *Inflorescences* radical, procumbent; *spikes* ellipsoid, 3–5 cm long, very dense, pinkish red; *peduncle* very short. *Bracts* pale red, 3.5–4.5 cm long, outer ones broadly ovate, inner ones obovate-oblong. *Bracteoles* lanceolate, 3–3.2 cm long, 0.9–1 cm wide, white membranous. *Flower* white; *calyx* tubular, ca. 1.5 cm

long, white membranous; *floral tube* white, ca. 2 cm long; *corolla lobes* pale red, lanceolate; *labellum* yellowish white, ovate to oblong-cuneate, central lobe 2.4–2.6 cm long, 1–1.2 cm wide, shorter than corolla lobes, margin recurved, crisped, apex emarginate, lateral staminodes yellow, orbicular, very small. *Stamen* arcuate, 2–2.5 cm long and 2–3 mm in diameter, yellow, the filament 2 mm long, white, *anther* lobes ellipsoidal, parallel, 1–1.1 cm long and 2–3 mm in diameter, yellowish white, the spur absent, the crest narrow, long and curved, 9–10 mm long, dark yellow. *Ovary* oblongoid, 6–7 mm long and 3–4 mm in diameter, white, pubescent, trilocular, the placentation axile with 3 rows of ovules in each loculus; *style* 3.3–3.5 cm long, *stigma* infundibuliform, about 2 mm long, shallowly cupular, white. *Capsule* oblongoid, 3.4–3.6 cm long, 2.4–2.6 cm in diameter, red.

Distribution: Myanmar, China, India and Thailand.

Ecology: Secondary forest, growing at the margin of the forest.

Phenology: Flowering and fruiting during July–November, flowers open in the morning.

Specimens examined. Southern Shan State: Aung Ban Township, Myin-ma-hti area, 20°36'09.379" N, 96°36'53.498" E, 20 July 2008, *Lwe Lwe Oo*, No. 114. **Mandalay Region:** Pyin Oo Lwin Township, 1300 m alt., 21°57'54.426" N, 96°27'05.867" E, 11 August 2015, *Mu Mu Aung et al.* 216 (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber roseum* is widely distributed from India to China, and it can be easily recognized by its bracts pale red, ovate-lanceolate, labellum oblong cuneate, yellowish white, lateral staminodes very small, yellow.

28. *Zingiber pardocheilum* Wall. ex Voigt, Baker in Hook. f., Fl. Brit. India. 6: 245 (1892); Kress et al., Contr. U.S. Natl. Herb. 45: 124 (2003).

Perennial rhizomatous herb, ca. 1 m tall. *Leafy stems* stout. *Leaves* oblong-lanceolate, 30 cm long, 7–10 cm wide, glabrous on both surfaces, apex acute. *Inflorescences* very dense, radical; *spikes* long and broad, globose, 5–7.5 cm long; *peduncle* subsessile. *Bracts* red brown, obovate-cuneate, ca. 2.5 cm long. *Flower* reddish white; *calyx* tubular, ca. 2 cm long, white, membranous, apex 3-toothed; *floral tube* reddish white, ca. 2.5 cm long; *corolla lobes* 3, reddish, ovate lanceolate, dorsal lobe ca. 2 cm long, lateral lobes subequal, a little shorter than the tube; *labellum* deeply trilobed, tessellated dark with lilac on a yellowish-white ground; central lobe ca. 1.8 cm long, obovate-cuneate; lateral staminodes orbicular. *Stamen* ca. 3 cm; filament very short; *anther* pale yellow, ca. 1.5 cm; anther crest ca. 1.5 cm, cylindrical, recurved. *Ovary* trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* infundibuliform.

Distribution: Myanmar and Thailand

Ecology: moist deciduous forest, wet place, ca. 60 m alt.

Phenology: Flowering and fruiting during July–September.

Vernacular name: Unknown

Notes: This species was described from Burma (Myanmar) by Wallich, probably from Tenasserim. *Zingiber pardocheilum* is very little known species, and later Triboun (2006) recorded it from SW Thailand which is very close to Mawlamyaing (often spelled as Moulamine in British colonial time). This study failed to recollect this species however, further field trip to Tanintharyi Region would reveal its existence in Myanmar. It is distinct by the leaves glabrous beneath, bracts obovate-cuneate red brown truncate, corolla-segments reddish, lip deeply 3 lobed tessellated with dark lilac on a yellowish-white ground.

29. Zingiber panduratum Roxb. in [Hort. Bengal. 1 (1814), nomen nud.] Fl. Ind., ed. Carey & Wall., 1: 53 (1820); Roxb., Fl. Ind. i: 55 (1832); Baker in Hook. f., Fl. Brit. India. 6: 245 (1892).

Perennial rhizomatous herb, 0.6–1.0 m tall. *Rhizomes* a little taste and no fragrance; root numerous, long, fleshy, fibrous fibers, some of which swell into lanceolar tubers. *Leafy stems* erect, glabrous. *Leaves* broadly lanceolate, 15–30 cm long, 7–10 cm wide, glabrous on both surfaces, apex acute; *ligules* very large; glabrous, scarious; *petiole* very short. *Inflorescences* very dense, radical, the lower half immersed in the soil; *spikes* oblong, ca. 10 cm long, apex acute; peduncle very short. *Bracts* red, ovate, ca. 3.5 cm long. *Bracteoles* pinkish white, 2 cm long. *Flower* whitish red; *calyx tubular* ca. 2 cm long, white, membranous, apex 3-toothed; *floral tube* reddish white, ca. 3.5 cm long; *corolla lobes* 3, bright red, lanceolate, apex acuminate, dorsal lobe ca. 2.5 cm long, lateral lobes suequal; *labellum* trilobed, pale yellow, panduriform; central lobe ca. ca. 2 cm long, obovate, retuse, apex truncate or emarginate; lateral staminodes small, rounded. *Stamen* ca. 3 cm; filament very short; *anther* pale yellow, ca. 1.5 cm; anther crest ca. 1.5 cm, cylindrical, recurved. *Ovary* trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* infundibuliform.

Distribution: Myanmar

Ecology: Moist deciduous forest, wet place, ca. 65 m alt.

Phenology: Flowering start from July, fruits ripened from November to December.

Specimen examined: Yangon Region: Phaung-gyi area, Hlaegu Township, 25 m alt., 17°33' N, 96°16'E, 30 November 2014, *Mu Mu Aung et al.* 110 (RAF, TNS).

Vernacular name: Taw-thalin-phu, Hpala, Pha-lar

Notes: Roxburgh (1820) mentioned that *Z. panduratum* was a native to Myanmar, near ‘Rangoon’ (present Yangon) based upon the material which F. Carey sent to the Calcutta Botanic Garden in 1808. Baker (1892) cited some specimens; from Pegu collected by F. Carey, from Tavoy collected by Gomez. Lectotypification for this species is required however; further studies on the entity of *Z. panduratum* are needed.

30. *Zingiber thorelli* Gagnep. Bull. Soc. Bot. France 54: 169. (1907). Wu and Larsen in Fl. of China 24: 329 (2000); Triboun and Larsen in Thai J. Bot. 6(1): 65 (2014). – Type: Vietnam, Mekong, *Thorel 2363* (holo-P).

Zingiber xishuangbannaense S. Q. Tong in S. Q. Tong & Y. M. Xia, Acta Phytotax. Sin. 25: 461. (1987). – Type: China, Yunnan, Mengla, alt. 800 m, in sylvis, 12 VII (1981), *S. Q. Tong 24808* (holotype-HITBC-wide image). (Fig. 27).

Perennial rhizomatous herb, ca. 1 m tall. *Rhizomes* pale brown externally, cream internally, fleshy; *roots* tuberous. *Leafy stems* erect, green; *leaf sheaths* base with red sheaths. *Leaves* 4 pairs, sessile, aggregated at the apex of leafy stem, leafless 2/4 at base; *ligules* 2-lobed, 2–4 mm; *leaf blade* purplish red abaxially on basal leaves, elliptic or narrowly lanceolate, 20–35 cm long, 10–15 cm wide, adaxially sparsely hairy along sides of midvein, abaxially densely pubescent, base cuneate, apex acuminate, distinctly pulvinus with red dotted. *Inflorescences* arising from rhizomes; *peduncle* radical procumbent, 6–8 cm long, red; *spikes* ellipsoid or oblong, 5–10 cm long, tapering pointed at the apex. *Bracts* ovate or elliptic, 4–4.5 cm long, 3–3.2 cm wide, bright red, apex mucronate; *bracteoles* pale with red apex, 2.4–2.6 cm long, 5–6 mm wide. *Flower* pale red; *calyx* tubular, ca. 1 cm long, apex 2-toothed; *floral tube* 4–6 cm long; *corolla lobes* pinkish red with yellowish apex, lanceolate, strongly curved

at the apex; dorsal lobe 2.5–3 cm long, ca. 1 cm wide; lateral lobes narrower; *labellum* pale yellow; central lobe ligule-like, 2.1–2.5 cm long, 6–7 mm wide, margin curved; lateral staminodes auriculate, 1.3–1.5 cm long, 7–8 mm wide. *Stamen* yellow, *anther* ca. 1.4 cm; connective appendage yellow, ca. 1.4 cm. Ovary glabrous. *Capsule* obpyriform, 3.5–4.5 cm long, 2–2.5 cm wide, 3-angled. Seeds oblong, ca. 5 mm.

Distribution: South China, Myanmar and Thailand.

Ecology: Hill evergreen forest, forest edge, growing with undergrowth of bamboo species in shady place, ca. 900 m alt., and lowland evergreen forest, along the stream in damp place, ca. 80 m alt.

Phenology: Flowering from August to September and fruiting from October to November, flowers open at the day time.

Specimens examined. Kayah State: Loikaw Township, Kyat Gu Reserved Forest, Chikae. 925 m alt., 19°40'05" N, 97°20'05" E, 7 Nov 2014, *Mu Mu Aung et al. 084* (RAF, TNS).

Tanintharyi Region: Yephyu Township, along the stream, Tanintharyi Reserved Forest, 74 m alt., 14°44'23.50" N, 98°12'48.80" E, 2 August 2015, *Mu Mu Aung et al. 162* (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber thorelli* was described by Gagnepain with a single citation of the specimen, *Thorel 2363* and therefore the specimen should treat as holotype. The field investigation to Tanintharyi Region, southern Myanmar, in this study revealed *Z. thorelli* is distributed. This is the first record for this species for the flora of Myanmar, and also this is the western limit of the distribution of this species. It can be easily recognized by its ellipsoid inflorescence with oblong tapering pointed apex, and ovate bracts with mucronate apex. It is growing in lowland evergreen forest to hill evergreen forest.

31. *Zingiber tereris* M. M. Aung & Nob. Tanaka, **sp. nov.** – Type: MYANMAR. **Kachin State:** Shinbuiyang, Hukaung Valley Wildlife Sanctuary, 26°17' N 97°41' E 12 February 2007 *N.Tanaka et al. 20070029* (holotypes-MBK, TNS-spirit). (Fig. 28).

Diagnosis: *Zingiber tereris* is similar to *Z. longiligulatum* in ovate to broadly lanceolate, spike sitting on the ground beside of the leafy stem, bracts lanceolate and lateral staminodes absent but differs in it by ligules very short and membranous with truncate or nearly rounded apex, flowers white, translucent, labellum entire margin with rounded or slightly emarginate apex.

Perennial rhizomatous herb, up to 70 cm tall. *Leafy stems* erect, thick, fleshy; leaf sheaths the lower ones reddish green, upper ones green. *Leaves* 4 pairs; *leaf blade* broadly ovate to broadly lanceolate, 20–40 cm long, ca. 10 cm wide, green, smooth, glabrous, mid-vein basally enlarged, base cuneate, apex acute-acuminate, margin entire; *ligules* white, membranous, ca. 6 mm long, glabrous, apex truncate or rounded; *petiole* almost sessile, pale green, pulvinate. *Inflorescences* arising from rhizomes, radical; *spikes* oblong, ca. 8 cm long, sitting on the ground beside of the leafy stem; *peduncle* short, ca. 5 mm long. *Bracts* lanceolate, ca. 4 cm long, 9 mm wide, reddish pale green, imbricate, the upper one lanceolate, apex acute or shortly acuminate, pubescent, the lower one broadly ovate. *Bracteoles* lanceolate, white, tubular, 3.6 cm long, 6 mm wide, pubescent. *Flower* white, very small; *calyx* tubular, 1.5 cm long, shortly bidentate, unilaterally split; *floral tube* slender, ca. 3.5 cm long, lanceolate, white, dorsal lobes ca. 2.8 cm long, 9 mm, translucent, pubescent; lateral lobes ca. 2.3 cm long, colored as the dorsal lobe, longer than the labellum, adhering basally to the ventral surface of the labellum at 1.2 from the apex; *labellum* ca. 1.8 cm long, 9 mm wide, trilobed, white, glabrous, translucent; central lobe oblong-elliptic, margin entire, apex

emarginate, slightly bifid; lateral staminodes very small, ca. 8 mm long, lanceolate, apex acuminate. *Stamen* ca. 2.2 cm long, white, *filament* ca. 2 mm long, *anther* creamy, thecae ca. 1 cm long with a long crest, ca. 1 cm long; *style* filiform, *stigma* white with a circular apical aperture surrounded by stiff hairs. *Ovary* ca. 2 mm long, pubescent, trilocular with many ovules on axile placenta; *epigynous glands* ca. 6 mm long, linear, creamy.

Distribution: Thus far known only from the type locality.

Ecology: Tropical evergreen green and deciduous *Dipterocarpus* forest, wet place, ca. 200 m alt.

Phenology: Flowering in June–July and flowering time in the morning.

Etymology: The species epithet named from the very small and delicate flowers.

Vernacular name: Unknown

Notes: Study of the related taxa in the neighboring regions, such as India, China and monsoonal SE Asia (Dalzell, 1852; Baker, 1892; Gagnepain, 1908; Win, 1975; Tong, 1987a, b; Wu and Larsen, 2000; Sabu, 2003; Theilade, 1999; Larsen and Larsen 2006; Tripathi and Singh, 2006; Chaveerach *et al.*, 2007; Kishor and Leong-Škorničková, 2013; Thongam and Konsam, 2014; Triboun *et al.*, 2014; Leong-Škorničková *et al.*, 2015), *Zingiber tereris* did not match any *Zingiber* species belong to the sect. *Cryptanthium* Horan. This species is having delicate, somewhat translucent, whitish small flowers with very small lateral staminodes. Bracts are lanceolate with acute apex, and labellum is prominently curved in front. This species is considered to be endemic to northern Myanmar.

32. *Zingiber orbiculatum* S.Q.Tong in S. Q. Tong & Y. M. Xia, *Acta Phytotax. Sin.* 25: 463. 1987; Wu and Larsen in *Fl. of China* 24: 329. (2000). Type: China, South Yunnan, in forest;

Mengla Xian, alt. 620 m. in forest, 20 July 1981, S. Q. Tong 24804 (holo- HITBC-vid image). (Fig. 29).

Perennial rhizomatous herb, 1.5–2 m tall. *Rhizomes* whitish brown externally, creamy white internally, aromatic. *Leafy stems* glabrous, reddish green covered with white. *Leaves* 7–10 pairs, sessile; *leaf blade* lanceolate, 45–60 cm long, 7–9 cm wide, glabrous, mid-vein basally enlarged and densely red dotted on both sides, base cuneate, pulvinus, thick, red, apex acuminate; *ligules* green-white, 1.3–1.5 cm long, glabrous, apex subtruncate. *Inflorescences* arising from rhizomes, radical, procumbent; *spikes* ovoid or capitate, 8–10 cm long, 3.5–5 cm wide; *peduncle* 2.2–3 cm long. *Bracts* ovate or broadly ovate, 3–5 cm long, 2–2.5 cm wide, dark red, apex acute or shortly acuminate. *Bracteoles* linear lanceolate, pale proximally, red distally, tubular, ca. 4 cm long and ca. 8 cm wide, white pubescent. *Flower* white, blooming in the morning; *calyx* tubular, ca. 3 cm long, white, membranous, puberulent except densely pubescent at base, apex 3-toothed; *floral tube* 3.4–3.6 cm long; *corolla lobes* 3, creamy white; dorsal lobe creamy white with red apex, oblanceolate, 3–3.3 cm long, ca. 1 cm wide, lateral lobes ca. 2.2 cm long, ca. 7 mm wide; *labellum* trilobed, white, orbicular; central lobe semiorbicular-obovate, margin entire, apex slightly trilobed, emarginate, ca. 2.5 cm long, ca. 1.2 cm wide; lateral staminodes auriculate, obovate, ca. 1.7 cm long, ca. 7 mm wide. *Stamen* ca. 2.2 cm long; *filament* sessile; *anther* yellow, thecae parallel, ca. 1.3 cm long, connective appendage ca. 1 cm long, recurved. *Ovary* pale yellow, sub-ellipsoid, densely pubescent, trilocular with many ovules, placentation axile; *epigynous glands* linear, two, ca. 7 mm long, white. *Capsule* dark red with brown basally, oblong, 4–5 cm long, 2–2.5 cm wide, triangular. *Seeds* black, obovoid.

Distribution: Myanmar (east), China (south) and Thailand.

Ecology: Growing at the forest edge under the shade in semi-evergreen forest, ca. 865 m alt.

Phenology: Growing at the forest edge under the shade in semi-evergreen forest, ca. 865 m alt., flowering in June–July, one to three flowers open in the morning simultaneously per inflorescence.

Specimens examined. Shan State: Kyaingtong Township, 21°27'40.5'' N 99°55'6.5'' E, 868 m alt., 28 June 2014, *Mu Mu Aung 027* (RAF, TNS). **Kayah State:** Loikaw Township, Kyat Gu Reserved Forest, Chikae, 925 m alt., 19°40'05" N, 97°20'05" E, 20 July 2015, *Mu Mu Aung et al. 113* (RAF, TNS). **Mandalay Region:** Pyin Oo Lwin Township, Singyaung-lay, 1150 m alt., 21°58'18.411" N, 96°29'40.170" E, 12 August 2015, *Mu Mu Aung et al. 224* (RAF, TNS).

Vernacular name: Gon-min

Notes: *Zingiber orbiculatum* is characterized by reddish green and waxy white leafy stem glabrous leaves, basally enlarged mid-vein with densely red dots, white orbicular labellum. It has been reported only from the altitude 600 m above sea level, Yunnan, southern China (Tong, 1987b, Wu and Larsen, 2000), however, it was recently recorded from Thailand (Triboun *et al.*, 2014). This is the first record of this species from Myanmar (Mu Mu Aung *et al.*, 2015).

33. Zingiber densissimum S. Q. Tong & Y. M. Xia, Acta Phytotax. Sin. 25 (6): 467 pl. 6 (1987). Wu, T. L. and K. Larsen in Fl. of China 24: 330 (2000). – Type: China, Yunnan, Menghai, 1400 m alt., in pinetis vel in sylvis mixtis, 7 X 1986, S. Q. Tong et Y.M. Xia 24998 (holo-HITBC, vide image). (Fig. 30)

Perennial rhizomatous herb, ca. 75 cm tall. *Rhizomes* whitish brown externally, fleshy, tuberous; *root tubers* globose, brownish externally. *Leafy stems* erect, green, ascending; *leaf sheaths* densely silvery pubescent with scarious margin, lower sheaths reddish green, upper one green. *Leaves* 5 pairs, aggregated at leafy stem apex; *leaf blade* ovate to broadly lanceolate, 20–45 cm long, 4–9 cm wide, adaxially glabrous, abaxially densely silvery villous, base cuneate or attenuate, apex shortly acuminate; *ligules* bilobed, 1–2 cm long, densely silvery villous, apex rounded; *petiole* 2–5 cm, densely silvery villous, distinctly pulvinate. Inflorescences always 2, arising from rhizomes; *peduncle* radical, procumbent embedded in ground, ca. 3 cm long, slender; *spikes* covered with a gelatinous substance, ovoid or globose, ca. 4 cm long, 3.4–4.5 cm wide. *Bracts* whitish green, red at apex, elliptic, 3.5–4 cm, apex mucronate. *Bracteoles* 2.4–2.6 cm long, 4–6 mm wide, silvery villous. *Flowers* white; *calyx* tubular, 1.8 cm, silvery villous, apex unequally 3-toothed; *floral tube* 4.5–5 cm long; corolla lobes lanceolate, dorsal lobe 2.8–3.1 cm long, 8–10 mm wide, lateral lobes 2.2–2.5 cm long, 5–6 mm wide; *labellum* fan-shaped, white; central lobe obovate, 2.5–3 cm long, 2–2.5 cm wide, apex emarginate; lateral staminodes narrower than central one, 2–2.4 cm long, 1–1.2 cm wide. *Stamen* yellow, filament ca. 2 mm; *anther* yellow, ca. 1.5 cm; thecae ca. 9 mm with connective appendage. *Ovary* white, silvery villous.

Distribution: China, Thailand and Myanmar.

Ecology: Hill evergreen forest growing with undergrowth of pine trees in shady place, ca. 1150 m alt.

Phenology: Flowering from July to August, flowers open in the morning, 2-3 flowers per inflorescence.

Specimen examined. Mandalay Region: Pyin Oo Lwin Township, Singyaung-lay, 1150 m alt., 21°58'18.411" N, 96°29'40.170" E, 8 Nov 2014, *Mu Mu Aung et al.* 223 (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber densissimum* resembles to *Z. bradleyanum* but differs in having short ligules, globose spikes covered with gelatinous substances, and the only two inflorescences arising each side of leafy stem.

34. *Zingiber bradleyanum* Craib, Kew Bull. 403 (1912); Theilade in Nod. J. Bot. 19 (4): 405 (1999). – Type: Thailand, Chiang Mai, Doi Sutep, 300 m alt., *Kerr 763* (holo-K, iso-BM, E, vide image). (Fig. 31).

Perennial rhizomatous herb, 0.75 m tall. *Rhizomes* pale brown externally, whitish internally. *Leafy stems* erect, light green; leaf sheaths pilose, margin scarious. *Leaves* 6 pairs, aggregated leave at the upper part of the leafy stem, closely arranged with short internode; *leaf blade* ovate to broadly lanceolate, 30–40 cm long, 5–8 cm wide, villous below especially on the midrib, apex acuminate; *ligules* bilobed, each lobe acuminate, 2–3 cm long, green with a white margin, curved, more or less pilose; *petiole* pubescent. *Inflorescences* radical, procumbent, densely; *spikes* cylindrical to obconical, ca. 5 cm, apex truncate; *peduncle* 2–4 cm long, pinkish red to white. *Bracts* more or less loosely imbricate, linear to lanceolate, ca. 2 cm long, green turning pale cream and finally pink or red, white towards the base, more or less pilose, margin scarious, apex acuminate. *Bracteoles* linear, ca. 1.5 cm long, apex acuminate. *Flower* white, ca. 5 cm long; *calyx* tubular, 1 cm long, white with a pinkish tinge; *floral tube* 3 cm long, longer than bract, white; dorsal lobe 2 cm long, 0.6 cm wide; lateral lobes 1.7 cm long, 0.5 cm wide; *labellum* ca. 2 cm long; central lobe oblong, 1.5 cm long, 1.3 cm wide, about the length of the lateral corolla lobes, white with a yellow marking, apex bilobed; lateral

staminodes oblong, 0.5 cm long, 0.7 cm wide. *Stamen* yellow; anther pale yellow, ca. 1 cm long, anther appendage yellow, 0.8 cm long, recurved. *Capsule* unknown.

Distribution: Myanmar and Thailand.

Ecology: Hill evergreen forest growing with undergrowth of Pine plantation, two to three flowers open in the morning simultaneously per inflorescence.

Phenology: Flowering and fruiting during August – October.

Specimens examined. Mandalay Region: Singaung-lay, Pyin Oo Lwin Township, 12 July 2015, 1160 m alt., 21°58'18.411" N, 96°29'40.170" E, 12 August 2015, *Mu Mu Aung et al.* 215, 221 (RAF & TNS).

Vernacular name: Unknown

Notes: *Zingiber bradleyanum* can be easily recognized by the long bilobed, green ligules and aggregated large leaves upper part of the leafy stem. The leafy stems are unique fragrant.

35. *Zingiber longiligulatum* S. Q. Tong, *Acta Phytotax. Sin.* 25 (2): 140, pl. 1 (1987); Wu and Larsen in *Fl. of China* 24: 327 (2000). – Type: China, Yunnan: Yingjiang, alt. 850 m, in sylvis tron dosis humidis, 10 Aug 1983, *S. Q. Tong et C.J. Liao* 24873 (holo-HITBC, vide image). (Fig. 32).

Perennial rhizomatous herb, 1–1.5 m tall. *Rhizomes* creamy white internally, pale brown externally, many fleshy roots. *Leafy stems* erect, green; *leaf sheathes* margin scarious with reddish purple, upper parts of leaf sheaths loosely imbricated from the leafy stem. *Leaves* 7 pairs; *leaf blade* ovate-elliptic or broadly lanceolate, 35–45 cm long, ca. 10 cm wide, adaxially glabrous, abaxially white pubescent, base cuneate, apex acuminate; *ligules* bifid,

triangular, 4–5 cm long, reddish white membranous, pubescent; *petiole* 5–10 mm. *Inflorescences* arising from rhizomes; *spikes* narrowly ovate-oblong, ca. 6 cm long, 2–2.4 cm wide, sitting on the ground beside of leafy stem; *peduncle* very short or ca. 2 cm long. *Bracts* loosely imbricate, narrowly lanceolate, dark red, 6 cm long, 1 cm wide, white pubescent, apex acuminate. *Bracteoles* 3 cm long, pubescent, tapering towards the apex. *Flower* whitish yellow, 6 cm long; *calyx* tubular, 2–2.3 cm, reddish white, membranous, puberulent, apex 3-toothed; *floral tube* 3 cm long, yellowish at apex, densely pubescent; *corolla lobes* white with red spotted, dorsal lobe linear-lanceolate 3 cm long, ca. 4 mm wide, lateral ones ca. 2.8 cm long adnate to the labellum; *labellum* yellow somewhat orange tinge, ligule-like, ca. 2.5 cm long, 6 mm wide, apex entire; lateral staminodes absent. *Stamen* yellow; *anther* sessile, yellow, ca. 1.5 cm; connective appendage orange or bright yellow, ca. 8 mm. *Ovary* oblongoid, 6–7 mm long and 3–4 mm in diameter, densely brown pubescent, trilocular, the placentation axile with 3 rows of ovules in each loculus; *style* 5.8–6.0 cm long; *stigma* infundibuliform, ca. 1 mm long, white, margins ciliate; *epigenous glands* linear, 4–5 mm long, pale yellow. *Capsule* obovoid, ca. 2.6 cm long and ca. 1 cm in diameter, pinkish white.

Distribution: Myanmar, China and Thailand.

Ecology: Evergreen forest growing in moist place undergrowth of bamboo species, hill slope.

Phenology: Flowering and fruiting during July-September, flowers open in the day time.

Specimens examined. Sagaing Region: Yagyi Camp, Alaungdaw Kathapa National Park, alt. 520-560 m, 10 December 2004 *M. Hamaguchi & S. Kobayashi* 20040268, 20041189 (MBK, TNS). **Kayah State:** Loikaw Township, Kyat Gu Reserved Forest, Chikae, 925 m alt., 19°40'05" N, 97°20'05" E, 20 Jul 2015, *Mu Mu Aung et. al* 115 (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber longiligulatum* is distinguished by the long ligule with red scarious, bracts loosely imbricate, dark red, very short peduncle and yellow labellum without lateral staminodes. This species was described from Yunnan, China and was considered to be endemic to China at that time. However at a later date, Triboun (2006) recorded it from Thailand. As the result of this study, it is apparently clear that center of the distribution of *Z. longiligulatum* is Myanmar, because this species was often collected in various places in this country from the east to the west.

36. *Zingiber bisectum* D. Fang, Guihaia 16 (1): 5-6 (1996); Wu, T. L. and K. Larsen in Fl. of China 24: 330 (2000). – Type: China: Guangxi; Kunlunguan, on hillslopes, 260 m, 8 Aug 1975 D. Fang 17878 (HT: GXMI, non vide). (Fig. 33).

Perennial rhizomatous herb, up to 1 m tall. *Rhizomes* yellowish internally, pale brown externally, fleshy, aromatic; *roots* tuberous at tip; *root tubers* globose, pale brown. *Leafy stems* terete, erect, green; *leaf sheaths* pubescent somewhat pubescent at the base of the leafy stem; *leaves* 5–10 pairs; *leaf blade* narrowly ovate or oblong-lanceolate, 25–45 cm long, 7.5–8.5 cm wide, adaxially densely brown dotted along midvein, sparsely pubescent, abaxially densely pubescent, base cuneate or attenuate, apex acuminate, margin undulating, involute; *ligules* 2-cleft, 4–6 cm, thin, scarious; *petiole* absent to 5 mm, villous abaxially. *Inflorescences* arising from rhizomes; *peduncle* radical, procumbent, 2–10 cm long, white, pubescent; *spikes* ovoid or oblong, 6–10 long, 2.5–7 cm in dia., 2-3 flowered. *Bracts* oblong-lanceolate, white tinged red apex, 4–4.5 cm long, ca. 1.1 cm wide, pubescent, apex acute-acuminate; *bracteoles* oblong, 3.5–4 cm long, ca. 7 mm wide, pubescent. *Flower* 5 cm long, whitish red, pubescent; *calyx* tubular, ca. 2 cm long, split on 1 side, villous, apex

3-toothed, red dotted; *floral tube* white, 4–4.7 cm long; *corolla lobes* red dotted, dorsal lobe ca. 2.5 cm long, 8–9 mm wide, lateral lobes lanceolate, ca. 2.3 cm long, 5 mm wide; *labellum* black-purple with white spotted; central lobe obovate, ca. 2 cm long, 1.3 cm long, apex 3-toothed; lateral staminodes ca. 1 cm long, 7 mm wide. *Stamen* ca. 3 cm long; *filament* sessile; *anther* pale yellow tinged red at base, ca. 1.5 cm long; anther crest ca. 1.5 cm, cylindrical, recurved, purplish towards the tip. *Ovary* white, sub-ellipsoid, densely pubescent, trilocular with many ovules, placentation axile; *style* long, filiform; *stigma* white, ciliate; *epigynous glands* linear, two, ca. 7 mm long, light yellow.

Distribution: China, Thailand and Myanmar.

Ecology: Hill evergreen forest, forest edge, growing with undergrowth of bamboo species in shady place, ca. 1100 m alt.

Phenology: Flowering from Jul to August, fruiting from September to November. Flowers open in the afternoon, 2-3 flowers per inflorescence.

Specimens examined. Kayah State: Loikaw Township, Kyat Gu Reserved Forest, Chikae. 925 m alt., 19°40'05" N, 97°20'05" E, 7 Nov 2014, *Mu Mu Aung et al. 085* (RAF, TNS); Demawso Township, Lweekahti. 1,166 m alt., 19°34'30" N, 96°59'54" E, 8 Nov 2014, *Mu Mu Aung et al. 095*, 21 Jul 2015, *Mu Mu Aung et al. 122* (RAF, TNS).

Vernacular name: Bwa

Notes: This species was described from Guangxi, China and was considered to be endemic to China at that time. However at a later date, Triboun (2006) recorded it from Thailand based on his extensive work on *Zingiber* in Thailand. The expeditions to Kayah State, eastern Myanmar revealed that *Z. bisectum* is distributed there, and this is the first record for this species for the flora of Myanmar. *Zingiber bisectum* resembles to *Z. flavomaculosum* in the

long ligules and shape of flowers but differs in by its ovoid or oblong inflorescence, lanceolate bracts, and acuminate apex.

37. *Zingiber flavomaculosum* S.Q.Tong, Acta Phytotax. Sin. 25(2): 144, pl. 1, f. 1. (1987).
Wu, T. L. and K. Larsen in Fl. of China 24: 329 (2000). – Type: China, Yunnan, Mengla, 580 m alt., in the forest, 6 Aug 1981, *S. Q. Tong 24806* (holo-HITBC, vide image). (Fig. 34).

Perennial rhizomatous herb, 1–1.5 m in height. *Rhizomes* whitish brown externally, creamy white internally, aromatic. *Leafy stems* slightly hairy, reddish brown basally. *Leaves* 3–17 pairs, subsessile; *petiole* 1.5–2 cm long, *leaf blade* broadly lanceolate, 20–35 cm long, 4–7 cm wide, adaxially glabrous, abaxially appressed pilosulose, ciliate, base attenuate, apex acute thinly acuminate; *ligules* membranous, 4 cm long, 2 cm wide, apex subtruncate; sheath abaxially pubescent. *Inflorescences* arising from rhizomes, 8–9 cm long, 4 cm wide, ovate - oblong, apex obtuse. *Bracts* densely imbricate, widely oblong, 3–5 cm long, 1.5–2 cm wide, red, coriaceous, apex convex, acute with brown hairs. *Bracteoles* pale red, ca. 3 cm, white puberulent. *Flower* red; *calyx* tubular, ca. 2 cm long, white, membranous, puberulent except densely pubescent at base, apex 3-toothed; corolla tube red, ca. 3 cm long, yellowish white; corolla lobes 3, red, white hairy abaxially, dorsal lobe lanceolate, ca. 3 cm long, 1.5 cm wide, white hairy abaxially, lateral lobes ca. 2.5 cm long, 1 cm wide; *labellum* trilobed, dark red with yellow spotted; central lobe ligule-like, ca. 2 cm long, 1 cm wide, apex almost emarginate, slightly notched, margin entire; lateral staminodes auriculate, ca. 1.5 cm long, 8 mm wide. *Stamen* ca. 3 cm; *filament* sessile; *anther* pale yellow, ca. 1.5 cm; anther crest ca. 1.5 cm, cylindrical, recurved. *Ovary* white, sub-ellipsoid, densely pubescent, trilocular with

many ovules, placentation axile; style long, filiform; stigma white, ciliate; *epigynous glands* linear, two, ca. 7 mm long, light yellow.

Distribution: Myanmar (Central), China (S. Yunnan) and Thailand.

Ecology: Evergreen forest, wet place, ca. 800 m alt.

Phenology: Flowering and fruiting during July – November

Specimens examined. Mandalay Region: Kyaukpadaung Township, along the trail to Mt. Popa peak, Popa Mountain Park, June 2000, *N. Tanaka et al. 093* (TNS-spirit). **Mandalay Region:** Pyin Oo Lwin Township, Pawekauk Waterfall, 530 m alt., 22°03'27.889" N, 96°31'25.391" E, 11 August 2015, *Mu Mu Aung et al. 217, 218, 219*; Paikchin-myaung Cave, Pyin Oo Lwin Township, 530 m alt., 22°05'48.562" N, 96°37'15.690" E, 11 August 2015, *Mu Mu Aung et al. 220* (RAF, TNS).

Vernacular name: Unknown

Notes: *Zingiber flavomaculosum* S.Q. Tong was described from Xishuangbanna, South Yunnan, China, and has been considered to be endemic to Xishuangbanna, China. Recently Triboun *et al.* (2014) recognized 56 species of the genus *Zingiber* in Thailand and *Z. flavomaculosum* was included therein. This is the first record from Myanmar. In the figure of the original protologue by Tong (1987a), labellum is somewhat truncate at apex, however, in the plant from Mt. Popa it is slightly notched at apex. This species could be also morphologically related to *Z. fragile* S.Q. Tong known from Yunnan. Further detail comparison between the Yunnan related taxa and Myanmar ones are required to clarify its rigorous entity and the range of its morphological variations. The gap of the distribution might be bridged by further field studies in Myanmar (Fig. 35).

3.8. Ethnobotanical Uses of *Zingiber* in Myanmar

Zingiber is one of the most important plant groups having economic value among the non-timber forest products in Myanmar, since it has been cultivated for various uses (e.g., traditional medicines, religious matters, and spices) by local people for a long time. In Myanmar, *Zingiber officinale*, true ginger is the most extensively used as floavoring for food and traditional herbal medicine (Ravindran *et al.* 2004; Htun and Satake 2009). It was very useful for rural households to get cash income for their daily life (Fig. 36). However, some species including *Z. montanum* and *Z. zerumbet*, which are well known village plants, are used as culturally important traditional herbal medicines (carminative and stimulant for the stomach) in Myanmar, mainly for the treatment of diarrhea and colic. Local people also use their fresh rhizomes for improving the symptom of numbness, swell & pain in a body felt, and women disease (Nagathein, 1976; Htun and Satake 2009).

In this study, the ethnobotanical data of their utilization were obtained totally from 13 species of *Zingiber* (Table 8). Of which six species; *Z. capitatum*, *Z. ottensii*, *Z. flavomaculosum*, *Z. orbiculatum*, *Z. tenuiscapus* and *Z. pygmaea* were newly recorded as ingredients for cooking and herbal medicine (Fig 37).

Zingiber capitatum, called wild ginger (Local-Gyin), is distributed in the Kachin State, northern part of Myanmar and grows in the forest areas which are of economically importance for local people's cash income. It is used as a spice and vegetable. They sell fresh rhizomes for Kyats 1000 per 1 kg in the local market (Fig. 38). Its fresh rhizomes are used as spice. According to the local people in Myitkyina, the taste is better than real Myanmar ginger (Gyin/Gyin-sein: *Z. officinale*). Kachin tribe is well versed with traditional knowledge of medicinal uses and others purposes.

The young leafy stems and fresh rhizomes of *Zingiber orbiculatum* are used for flavour in soup, and its young inflorescences are sometimes used for vegetable. *Zingiber flavomaculosum* is used as an herbal medicine. The rhizomes are soaked with rice wine or alcohol and are used as tonic for men only in the locality. *Zingiber ottensii* is cultivated and is used for traditional medicine. The rhizomes are pounded and then are used as for a poultice used after childbirth. *Zingiber tenuiscapus* has been recently described as a new species in Thailand (Triboun, 2014) and he noted that this species, similar to *Zingiber montanum*, was used as herbal medicine in Thailand. I found that this species in the Tanintharyi reserved forest, southern part of Myanmar, and that local people used this species as spice and herbal medicine for the treatment of child disease and fever. The rhizomes of *Z. tenuiscapus* and *Z. montanum* are capable of producing almost the same essence and colour. They are unusually used for food and medicine in the local areas. This study recorded the utilization of *Z. tenuiscapus* in Myanmar for the first time.

Zingiber zerumbet is distributed commonly in wet habitats place from lowland evergreen forest to hill evergreen forest. It is used especially for women's healthcare such as pregnancy, childbirth, breastfeeding and postpartum recovery. Local people call this species "Lin-nay-gyi". *Z. rubens* and *Z. squarrosum*, called "Toukta" in local name which means "prevention for poison", are well known village plants and are used as herbal medicine mainly for the treatment of food poisoning. *Z. cf. panduratum* is growing moist deciduous forest. According to the local people in Bago Yoma region and its surrounding area, dried rhizome is used as herbal medicine, and it is good for stomach digestion & flatulent. The fresh rhizome and inflorescences are eaten as vegetable, and they are good for intestinal disorder and abdominal illness.

Khin Myo Htwe *et al.* (2006) noted in her ethnomedicinal flora of Mt. Popa that tubers of *Zingiber barbatum*; tubers ground with water: applied to scalds and burns; taken orally to treat dysentery and vaginal discharge. In this study, it becomes a conclusion that specimen of *Z. barbatum* in Mt. Popa, considered to be *Z. pygmaea* only known from Mt. Popa, central part of Myanmar which is proposed here as new species.

This study may give the unique and important record for the utilizations of the genus *Zingiber* by Myanmar people. Many cases of them are first record of their uses in Myanmar. On the other hand, in this study the ornamental uses of *Zingiber* were not recorded in the study area. Comparing to other genera of Zingiberaceae, such as *Curcuma*, *Hedychium*, *Globba* and *Alpinia*, inflorescence and flowers of *Zingiber* might be less value of ornamental, because flowers opens in most cases in the evening, and spoil quickly.

The results of this research would make benefit to the local communities by enhancing their knowledge of indigenous plant resources, and preserving the knowledge of medicinal plant. There is much room for development of ginger industry, such as health food, medicine, cosmetics, biochemical and so on. Therefore this study giving a basic economic botanical data for little known Myanmar species of *Zingiber* would provide the information for applied scientific aspects; for example, natural products chemistry, applied biological sciences etc.

IV FURTHER PERSPECTIVES

I have so far confirmed the presence of at least 37 *Zingiber* species from all three sections in Myanmar, of which five were described here as new to science. This study critically revealed the species diversity of *Zingiber* in Myanmar for the first time after British Burma, and is the first comprehensive taxonomic revision of *Zingiber* in the country and should be formed a significant contribution to bridge the floristic blank in SE Asia.

It should provide very significant taxonomic and phytogeographic data to bridge the knowledge of Indian floristic region in the east and Indo-Chinese floristic region in the west, which has ever been obtained by former studies.

Although the number of the species in this study, compared to the number of species in the previous studies, the number almost double to 37 species, further surveys should be conducted in varied types of vegetation focus on montane regions and coastal and other lowland regions where any surveys have never been carried out. Additionally, through this study several materials could not have been identified, because of their sterility. I am continuously cultivating their living materials in the nursery of the Forest Research Institute (FRI) for further rigorous identification.

The question arises: "What should be given priority to taxonomic researches of *Zingiber* in Myanmar in the future?"

The answers are as followings:

- Further intensive field surveys are required to clarify species diversity of this country and their economical uses.
- Morphological investigations to comprehend total range of variations for each taxon and their records are required.

- Back to types for all taxon that have been already described in Myanmar and its surrounding regions, and revise their nomenclature as well as the lectotypification for all taxa.
- Molecular study is important for a better understanding of the generic boundaries and relationships between species and sections of *Zingiber* as a whole. It has brought this study a big step forward.
- Finally, in this study, I could not elucidate their ecological traits, pollination and phonology these should also help a better understanding of taxonomic treatment of each species.

The taxa that are distributed in Myanmar should be minutely compared with the related ones in the adjacent regions to clarify its rigorous entity and the range of their morphological variations.

Additionally, there is necessary to acquire and preserve this traditional system of herbal medicine by proper documentation and identification of specimens. Ethnobotanical data should be provided for pharmacological screening towards the development of potential phytotherapy and scientifically validate the traditional knowledge for the benefit of the Myanmar people. Further studies will definitely contribute towards a more constructive conservation program whether it is in-situ or ex-situ. The recommended conservation program should be community-based and economically attractive for the local villagers such a source of income for their daily life.

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Table 1. Study sites and field trips.

State/Region	Study area	Duration of field trip
Chin State (W)	Natma Taung (Mt. Victoria) National Park, and its neighbouring regions	15 June 2013-16 July 2013
Chin State (W)	Natma Taung (Mt. Victoria) National Park, and its neighbouring regions	17-21 May 2014
Kachin State (N)	Hukaung valley Wildlife Sanctuary, and its surrounding areas and Myintkyina Township	2-8 June 2014
Shan State (E)	Kyaingtong Township, Eastern part of Shan State	22-30 June 2014
Yangon Region (L)	Phaung-gyi area, East Bago Yoma, Hlaegue Township	13 July 2014
Sagaing Region (NW)	Basin of Chindwin river, Htamanthi Wildlife Sanctuary, Hkamti Township	20-30 October 2014
Kayah State (SE)	Reserved Forests and its surrounding regions	8-14 November 2014
Shan State (NE)	Yehtwet-Oo, Kyaukme Township, Northern Shan State.	10-14 November 2014
Nay Pyi Taw (C)	Yezin, Zaeyathiri Township	24 November 2014
Yangon Region (L)	Phaung-gyi area, east Bago Yoma, Hlaegue Township	30 November 2014
Kayah State (SE)	Reserved Forest and its surrounding regions	20-22 July 2015
Tanintharyi Region (S)	Tanintharyi Nature Reserved Forest, Yaephyu Township	30 July -5 August 2015
Bago Region (L)	Pho-kya forest camp, Yetashae Township	7-Jul-15
Mandalay Region (C)	Pyin Oo Lwin Township and its surrounding areas	10-12 August 2015

Note: N: Northern, NE: North-Eastern, NW: North-Western, E: Eastern, W: Western, S: Southern, L: Lower, C: Central

Table 2. Representative of *Zingiber* species in Myanmar by each section.

Sect. <i>Cryptanthium</i>	Sect. <i>Zingiber</i>	Sect. <i>Dymczewiczia</i>
1. <i>Zingiber barbatum</i> *	1. <i>Zingiber officinale</i> *	1. <i>Zingiber capitatum</i> **
2. <i>Zingiber popaense</i> *	2. <i>Zingiber idae</i> *	2. <i>Zingiber</i> sp. ***
3. <i>Zingiber pygmaea</i> ***	3. <i>Zingiber neesanum</i> *	
4. <i>Zingiber chrysanthum</i> **	4. <i>Zingiber corallinum</i> **	
5. <i>Zingiber rubens</i> *	5. <i>Zingiber montanum</i> *	
6. <i>Zingiber squarrosum</i> *	6. <i>Zingiber neomontanum</i> ***	
7. <i>Zingiber matupiense</i> ***	7. <i>Zingiber griffithii</i> **	
8. <i>Zingiber nimmonii</i> *	8. <i>Zingiber gracile</i> *	
9. <i>Zingiber ligulatum</i> *	9. <i>Zingiber tenuiscapus</i> **	
10. <i>Zingiber roseum</i> *	10. <i>Zingiber sadakornii</i> **	
11. <i>Zingiber pardocheilum</i> *	11. <i>Zingiber parishii</i> *	
12. <i>Zingiber panduratum</i> *	12. <i>Zingiber kerrii</i> *	
13. <i>Zingiber thorelli</i> **	13. <i>Zingiber gramineum</i> *	
14. <i>Zingiber tereris</i> ***	14. <i>Zingiber zerumbet</i> *	
15. <i>Zingiber orbiculatum</i> **	15. <i>Zingiber ottensii</i> **	
16. <i>Zingiber densissimum</i> **		
17. <i>Zingiber bradleyanum</i> **		
18. <i>Zingiber longiligulatum</i> **		
19. <i>Zingiber bisectum</i> **		
20. <i>Zingiber flavomaculosum</i> **		

Note: * Recorded species, ** Newly recorded species, *** New species

Table 3. Morphological comparison between *Zingiber matupiense* sp. nov. with allied species *Z. squarrosum* and *Z. cernuum*. *Z. squarrosum* observed from the type locality of Yangon Region in July 2014.

Characters	<i>Z. matupiense</i>	<i>Z. squarrosum</i>	<i>Z. cernuum</i>
Leafy stem	erect, green above, reddish green below	erect, green above, reddish green below	curved, bright green
Leaf blade	20-40 cm long, ovate to oblong-lanceolate, apex acute-acuminate, margin undulating	40–50 cm long, oblong to oblanceolate, apex acute-acuminate, margin slightly undulating	36 cm long, lanceolate, apex acuminate
Ligule	ca. 1 cm long, white, membranous, round at apex, when matured scarious	1 cm long, greenish white, membranous, apex acute	ca. 0.5 cm long, auriform, green
Inflorescence	spike obovate to suglobose, up to 8 cm long, peduncle very short	spike globose, squarrose, 5-10 cm long, peduncle nearly sessile	spike ovoid, peduncle very short
Bracts	4.5-5 x 2-2.5 cm, ovate-lanceolate, yellowish white, recurved, acute or shortly acuminate at apex, glabrous, margin hyaline	4-6 x 1.2 cm, linear, green with pinkish at the apex, strongly recurved, apex distinctly hooked, densely pubescent towards the apex	2–3 cm long, ovate or oblong, involute, clawed at apex, greenish yellow, glabrous
Corolla lobes	dorsal lobe ca. 3 x 1.2 cm, translucent, cream at base, yellowish white at apex, ovate-lanceolate, curved	dorsal lobe ca. 3 x 1.2 cm, translucent white at the base, pink at apex, ovate-lanceolate, boat-shaped	dorsal lobe creamish, translucent, lanceolate, boat shaped
Floral tube	4.5-5 cm long, pale yellow to white towards the base, glabrous, longer than calyx	2-3 cm long, pale pink to white towards the base, glabrous, as long as calyx	3–3.5 cm long, white, pubescent

Table 3. Continued.

Characters	<i>Z. matupiense</i>	<i>Z. squarrosum</i>	<i>Z. cernuum</i>
Labellum	maroon with creamy yellow blotches, apex slightly notched or emarginate, central lobe oblong, c. 2.2 x 1.3 cm	white blotches with lilac towards the apex, apex distinctly bifid, central lobe ovate, c. 2 cm long, 1.5 cm wide, glabrous	white with blotches red, apex deeply bifid, central lobe ovate
Lateral staminodes	bright yellow, 1.4 x 0.5 cm, oblong	pinkish red with white spotted, 0.8 x 0.7 cm, rounded	bright red with yellow spotted, auricles
Anther crest	bright yellow	pale yellow at the base pinkish red towards the tip	pale yellow at the base pinkish red towards the tip

Table 4. Morphological comparison between *Zingiber barbatum* Group.

Characters	<i>Z. barbatum</i>	<i>Z. popaense</i>	<i>Z. pygmaea</i>
Rhizome	roots with tubers, globose, brownish externally	roots with tubers, globose, whitish externally	roots with tubers, globose, brownish externally
Leafy stem	1 m tall, villous, green	1 m tall, villous, reddish	up to 30 cm tall, villous, reddish green
Leave	7 pairs, sparsely arranged with long internode	9-15 pairs, sparsely arranged with long internode	7 pairs, densely arranged with very short internode
Leafy blade	lanceolate, dark green, 20-25 cm long, 3-4 cm wide, margin undulate with densely pubescent on both surfaces, apex acuminate, base cuneate	linear to lanceolate, 15-25 cm long, 1.2-2.5 cm wide, green, densely pubescent on both surfaces, apex acute,	ovate to oblong, green, densely hirsute on both surfaces, apex acute, base rounded, 15-18 cm long, 9-10 cm wide
Ligule	bilobed, 2 mm long, truncate, velutinous	bilobed, 2-5 mm long, pubescent at margin	bilobed, inconspicuous, ca. 2 mm long, pubescent at margin
Inflorescence	ovate - oblong, peduncle ca. 3 cm long	ovoid first, gradually becoming fusiform with age; peduncle very short	ovoid; peduncle very short
Bracts	ovate to cuspidate, dark green, 2.8-3.5 cm long, 2.3-2.8 cm wide, densely villous externally, glabrous internally, apex shortly pointed	ovate to cuspidate, deep green, 2.5 cm long, 1.5 cm wide, densely villous externally, almost glabrous internally, apex sharply pointed, greenish with long white hairs	ovate to cuspidate, 2.3 cm long, 1.7 cm wide, reddish brown at the apex, whitish towards the base, densely villous at apex, glabrescent at the base externally, almost glabrous internally, apex shortly pointed
Floral tube	ca. 2.5 cm long,	1.5-1.7 cm long	ca. 2.5 cm long

Table 4. Continued.

Characters	<i>Z. barbatum</i>	<i>Z. popaense</i>	<i>Z. pygmaea</i>
Corolla lobes	dorsal lobe, ca. 2 cm long, 7 mm wide, glabrous; lateral lobes 1.5-2 cm long, 5 mm wide;	dorsal lobe 1.8 cm long, 8 mm wide; lateral lobes 1.1-2 cm long, 5 mm wide.	dorsal lobe ca. 1.8 cm long, ca. 1 cm wide; lateral lobes ca. 1.8 cm long, ca. 7 mm wide;
Labellum	white with a pink tinge at the base; central lobe ca. 1.4 cm long, 1.5 cm wide, obovate, apex emarginate, slightly notched, margin crisped	white to slightly creamy, recurved; central lobe obovate, 1 cm long, 0.9-1 cm wide, apex bitten, margin crumpled, distantly crenulate	white to slightly creamy, recurved; central lobe obovate, ca. 1.7 cm long, ca. 2.3 cm wide, apex slightly or emarginate margin crisped
Lateral staminodes	oblong, apex rounded, ca. 8 mm long, ca. 2,5 mm wide	ovate-oblong, 3-4 mm long, 2.7-3 mm wide, apex rounded or somewhat obliquely truncate	ovate-oblong, ca. 8 mm long, ca. 3 mm wide, apex rounded

Table 5. Morphological comparison between *Zingiber montanum* Group.

Characters	<i>Z. montanum</i>	<i>Z. neomontanum</i>	<i>Z. griffithii</i>
Rhizome	yellow internally, strongly aromatic	pale yellow to white internally, slightly aromatic	creamy white internally, slightly aromatic
Leafy stem	erect, green above and reddish below, pubescent somewhat glabrous	erect, green, glabrous somewhat pubescent near the apex of sheath green, glabrous somewhat pubescent near the apex of sheath	spreading to weakly arching, lower sheaths purplish red, upper one green, pubescent
Leave	8-10 pairs, densely arranged with short internode upper part of the leafy stem	10-12 pairs, sparsely arranged with long internode, distinctly pulvinus with red dotted on both side	4-8 pairs, densely arranged with very short internode
Leafy blade	linear to narrowly lanceolate, 15-17 cm long, 2-4 cm wide, green, the upper glabrous, the lower pubescent, apex acute, base cuneate, margin more or less undulate	linear to lanceolate, 45–50 cm long, 4–4.5 cm wide, apex acuminate, base narrowly cuneate, margin slightly undulate, glabrescent	elliptic to broadly elliptic, 15–30 cm long, 5–10 cm wide, apex rather shortly pointed, base broadly to narrowly cuneate
Ligule	triangular, 1.5-2.5 cm long, 5-10 mm wide, white, membranous	bilobed, 2 mm long, hyaline membranous, densely pubescent, apex truncate	thin, glabrous or hairy, broad, 2-lobed, 4 cm long, 2 cm wide
Inflorescence	spike 7-15 cm long, 3-5 cm wide, oblong-ovate; peduncle 15-20 cm long, clothing sheaths pubescent, green	spike 18-28 cm long, ca. 5 cm wide, fusiform, slightly tapered blunt apex; peduncle 15-20 cm long, clothing sheaths pubescent, green	spike 10-15 cm long, 2.5-4 cm wide, fusiform when young, when old cylindrical except for the slightly tapered blunt apex; peduncle 5-15 cm long, the sheaths to 3.5 cm long, green, finely hairy

Table 5. Continued.

Characters	<i>Z. montanum</i>	<i>Z. neomontanum</i>	<i>Z. griffithii</i>
Bracts	broadly ovate, 3.8-4 cm long, 3.6-3.8 cm wide, greenish or reddish brown, pubescent, apex and margin white, membranous	ovate, ca. 4.5 cm long, 2-2.5 cm wide, bright red, apex acute to acuminate, densely appressed pubescent	ovate-obtuse, lower orbicular, 2.5-3 cm long, 2-4 cm wide, bright red or pink, apex very broadly pointed with a very short hair tip
Floral tube	2.9-3.1 cm long,	4.5 cm long	3 cm long
Labellum	creamy white; central lobe 1.7-1.8 cm long, 2.4-2.6 cm wide, orbicular, apex retuse, margin crisped	white to cream or pale yellow; central lobe obovate, ca. 3.4 cm long, 1.5 cm wide, apex cleft, margin crisped	white to cream or yellow; central lobe obovate, ca. 3.4 cm long, 1.2 cm wide, apex cleft, margin crisped
Lateral staminodes	large, 5-6 mm long, 4-5 mm wide	ovate to obovate with rounded tip, ca. 1.5 cm long, 8 mm wide	ovate to obovate with rounded tip, ca. 1.7 cm long, 8 mm wide

Table 6. The total number of 37 *Zingiber* species distributed in various sites covering representative regions in Myanmar.

Scientific Name	Distribution
Sect. <i>Cryptanthium</i>	
1. <i>Zingiber barbatum</i> Wall.	C, L, SE
2. <i>Zingiber popaense</i> Nob. Tanaka	C
3. <i>Zingiber pygmaea</i> M. M. Aung & Nob. Tanaka, sp. nov.	C
4. <i>Zingiber chrysanthum</i> Roscoe	N
5. <i>Zingiber rubens</i> Roxb.	C, L
6. <i>Zingiber squarrosus</i> Roxb.	L, S
7. <i>Zingiber nimmonii</i> (J. Graham) Dalzell	C
8. <i>Zingiber matupiense</i> M. M. Aung & Nob. Tanaka, sp. nov.	W
9. <i>Zingiber roseum</i> (Roxb.) Roscoe	C, SE, L
10. <i>Zingiber ligulatum</i> Roxb.	C
11. <i>Zingiber pardocheilum</i> Wall. ex Baker	**
12. <i>Zingiber panduratum</i> Roxb.	L, S
13. <i>Zingiber thorelli</i> Gagnep.	S, SE
14. <i>Zingiber orbiculatum</i> S.Q. Tong	C, E, SE
15. <i>Zingiber flavomaculosum</i> S.Q. Tong	C
16. <i>Zingiber bisectum</i> D. Fang	SE
17. <i>Zingiber longiligulatum</i> S.Q. Tong	NW, SE
18. <i>Zingiber bradleyanum</i> Craib	C
19. <i>Zingiber densissimum</i> S. Q. Tong & Y.M. Xia	C
20. <i>Zingiber tereris</i> M. M. Aung & Nob. Tanaka, sp. nov.	NW
Sect. <i>Zingiber</i>	
21. <i>Zingiber officinale</i> Roscoe	*
22. <i>Zingiber idae</i> (Theilade) Triboun & K. Larsen	NW
23. <i>Zingiber neesanum</i> (J. Graham) Ramamoorthy	L, NW

Table 6. Continued.

Scientific Name	Distribution
24. <i>Zingiber montanum</i> (J. Koenig ex Retz.) Theilade	C, *
25. <i>Zingiber corallinum</i> Hance	L
26. <i>Zingiber neomontanum</i> M. M. Aung & Nob. Tanaka, sp. nov.	S
27. <i>Zingiber griffithii</i> Baker	S
28. <i>Zingiber gracile</i> Jack	C, NE
29. <i>Zingiber tenuiscapus</i> Triboun & K. Larsen	S
30. <i>Zingiber sadakornii</i> Triboun & K. Larsen	SE
31. <i>Zingiber parishii</i> Hook. f.	L, S
32. <i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	L, NW, SE, S
33. <i>Zingiber ottensii</i> Valeton	S
34. <i>Zingiber kerrii</i> Craib	C, NE
35. <i>Zingiber gramineum</i> Noronha ex Blume	L, **
Sect. <i>Dymczewiczia</i>	
36. <i>Zingiber capitatum</i> Roxb.	N
37. <i>Zingiber</i> sp.	NW

Note: N: Northern, NE: North-Eastern, NW: North-Western, E: Eastern, W: Western, S: Southern, L: Lower, C: Central, *: Cultivated, **: Reported from Myanmar

Table 7. Distribution of *Zingiber* species in Myanmar compared with neighboring floristic regions.

Taxon	Indian	Indo-Chinese	Sino-Japanese	Malaesian	Endemic to Myanmar
Sect. <i>Cryptanthium</i>					
<i>Zingiber barbatum</i>	○	○			
<i>Zingiber popaense</i>					○
<i>Zingiber pygmaea</i>					○
<i>Zingiber chrysanthum</i>	○				
<i>Zingiber rubens</i>	○	○			
<i>Zingiber squarrosium</i>					○
<i>Zingiber matupiense</i>					○
<i>Zingiber nimmonii</i>	○				
<i>Zingiber ligulatum</i>	○	○			
<i>Zingiber roseum</i>	○	○	○		
<i>Zingiber pardocheilum</i>		○			
<i>Zingiber panduratum</i>					○
<i>Zingiber thorelli</i>		○	○		
<i>Zingiber tereris</i>					○
<i>Zingiber orbiculatum</i>		○	○		
<i>Zingiber densissimum</i>		○	○		
<i>Zingiber bradleyanum</i>		○			
<i>Zingiber longiligulatum</i>		○	○		
<i>Zingiber bisectum</i>		○	○		
<i>Zingiber flavomaculosum</i>		○	○		
Sect. <i>Zingiber</i>					
<i>Zingiber officinale</i>	○	○	○	○	
<i>Zingiber idae</i>		○			
<i>Zingiber neesatum</i>	○				
<i>Zingiber corallinum</i>		○	○		
<i>Zingiber montanum</i>	○	○		○	
<i>Zingiber neomontanum</i>					○
<i>Zingiber griffithii</i>	○			○	
<i>Zingiber gracile</i>				○	

Table 7. Continued.

Taxon	Indian	Indo-Chinese	Sino-Japanese	Malaesian	Endemic to Myanmar
Sect. <i>Zingiber</i>					
<i>Zingiber tenuiscapus</i>		○			
<i>Zingiber sadakornii</i>		○			
<i>Zingiber parishii</i>		○			
<i>Zingiber kerrii</i>	○	○			
<i>Zingiber gramineum</i>		○			
<i>Zingiber zerumbet</i>	○	○	○	○	
<i>Zingiber ottensii</i>		○		○	
Sect. <i>Dymczewiczia</i>					
<i>Zingiber capitatum</i>	○				
<i>Zingiber</i> sp. *					

Note: * A sterile plant considered as un-described taxon in Myanmar.

Table 8. *Zingiber* species used by local people in Myanmar.

No.	Scientific Name	Local Name	Parts Used	Traditional Uses
1	<i>Zingiber capitatum</i> Roxb.	Local-gyin	Rhizome	Vegetable, cooking, spice, herbal medicine for cough, catch cold, good for blood circulation, aromatic, strongly aromatic
2	<i>Zingiber officinale</i> Roscoe	Gyin, Gyin-gyi, Gyin-lay, Gyin-sein	Rhizome	Vegetable, spice and cooking, herbal medicine for many kinds of diseases as a main ingredient, aromatic
3	<i>Zingiber montanum</i> (J. Koenig ex Retz.) Theilade	Meik-tha-lin	Leave & Rhizome	Spice, herbal medicine for stimulant & carminative, numb feet & hands, swelling & pain of the body & joints, breastfeeding after childbirth, strongly aromatic
4	<i>Zingiber parishii</i> Hook. f.	Myauk-gyinsein	Leave, Inflorescence & Rhizome	Vegetable, spice and cooking, herbal medicine for flatulence, stomach digestion, slightly aromatic
5	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	Gat-eaik, Meik-tha-lin	Inflorescence & Rhizome	Vegetable soup, spice, herbal medicine for pregnancy, postpartum recovery and breastfeeding after childbirth, strongly aromatic

Table 8. Continued.

No.	Scientific Name	Local Name	Parts Used	Traditional Uses
6	<i>Zingiber tenuiscapus</i> Triboun & K. Larsen	Pade-kaw	Inflorescence & Rhizome	Vegetable and spice, herbal medicine for child disease, fever, cough, strongly aromatic
7	<i>Zingiber ottensii</i> Valetton	Gyin-net (Black-ginger)	Rhizome	Spiritual by local people, herbal medicine for a poultice after childbirth, aromatic
8	<i>Zingiber flavomaculosum</i> S.Q. Tong	Unknown	Rhizome	Herbal medicine for tonic, slightly aromatic
9	<i>Zingiber orbiculatum</i> S.Q. Tong	Gon-min	Young leafy stem & Rhizome	Young leafy stem for vegetable soup, herbal medicine for blood circulation, slightly aromatic
10	<i>Zingiber cf. panduratum</i> Roxb.	Pha-lar, Tawthalin-phu	Inflorescence & Rhizome	Vegetable, herbal medicine for intestinal disorder, abdominal illness, strongly aromatic
11	<i>Zingiber pygmaea</i> M. M. Aung & Nob. Tanaka	Meik-tha-lin	Tuber	Herbal medicine for dysentery and vaginal discharge, slightly aromatic
12	<i>Zingiber rubens</i> Roxb.	Toukta	Rhizome	Vegetable, cooking, spice, herbal medicine for food poinon, stromach digestion, slightly aromatic
13	<i>Zingiber squarrosom</i> Roxb.	Toukta, Kyat-cahnthee	Inflorescence, Fruit & Rhizome	Vegetable, cooking, spice, herbal medicine for the treatment of food poisoning, stromach digestion, slightly aromatic

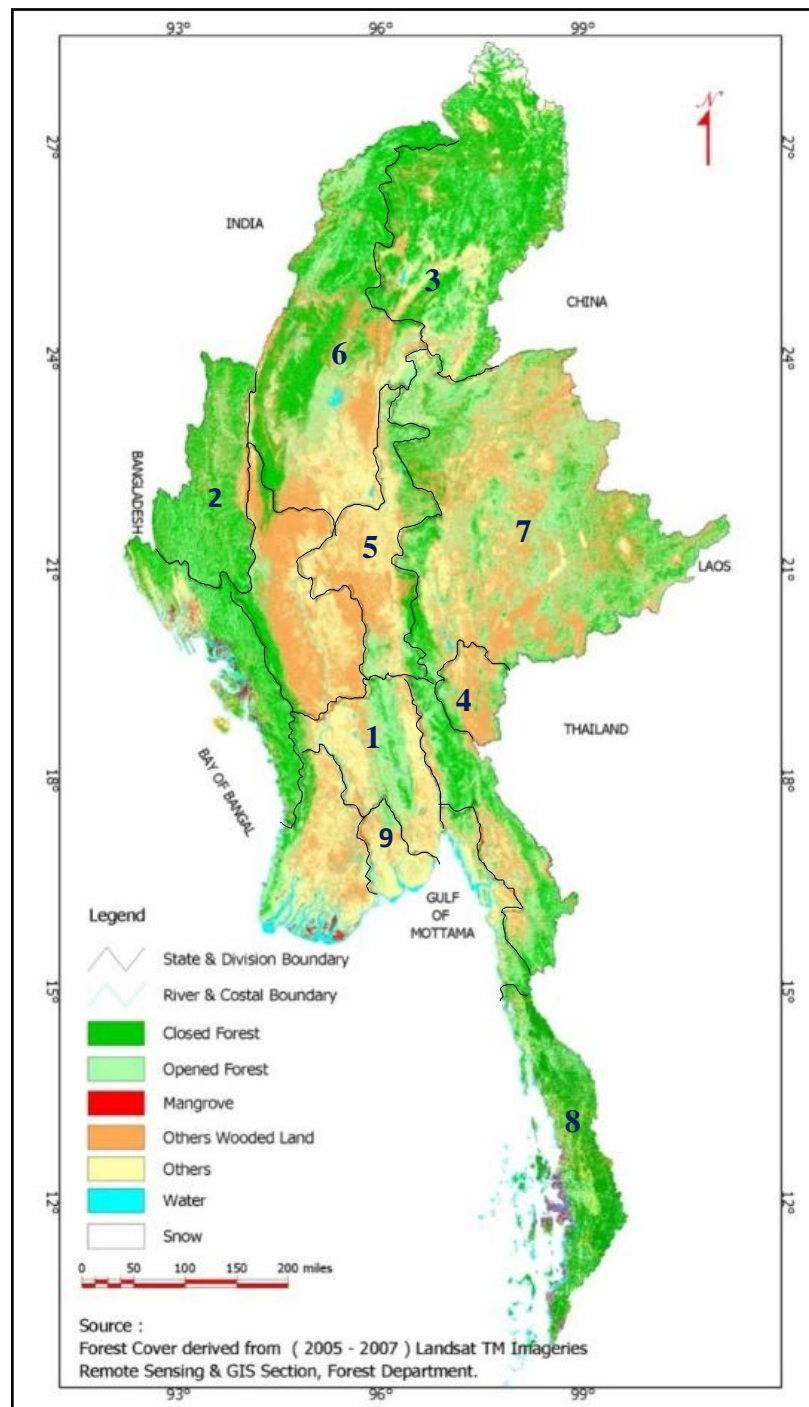


Fig. 1. Map of the Study Sites in Myanmar, showing located in the nine States and Regions based on the map of forest cover derived from Landsat TM Imageries (2005-2007) by Forest Department, Myanmar. 1. Bago; 2. Chin; 3. Kachin; 4. Kayah; 5. Mandalay; 6. Sagaing; 7. Shan; 8. Tanintharyi; 9. Yangon.

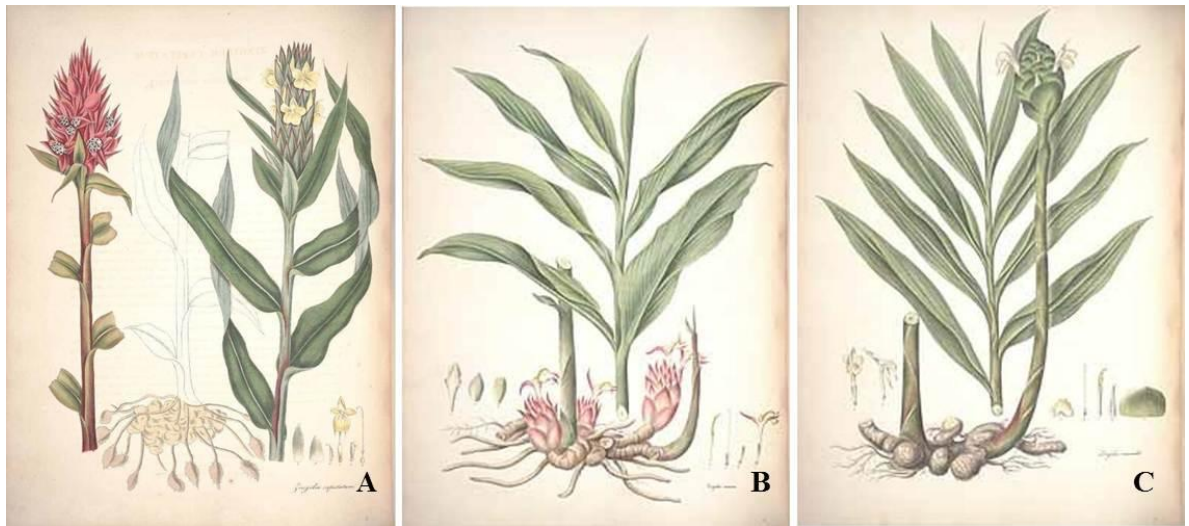


Fig. 2. Myanmar species of *Zingiber* is classified into three sections based on the nature and position of the inflorescences. A: Section *Dymczewiczia* (*Z. capitatum*), B: Section *Cryptanthium* (*Z. roseum*), C: Section *Zingiber* (*Z. zerumbet*) illustrated by Roscoe (1828) in *Monandrian Plants of the order Scitamineae*.



Fig. 3. A position of the inflorescence in *Zingiber officinale* Roscoe



Fig. 4. *Zingiber barbatum* Wall. illustrated by Wallich (1830) in this original protologue in “*Plantae Asiaticae Rariores*”.

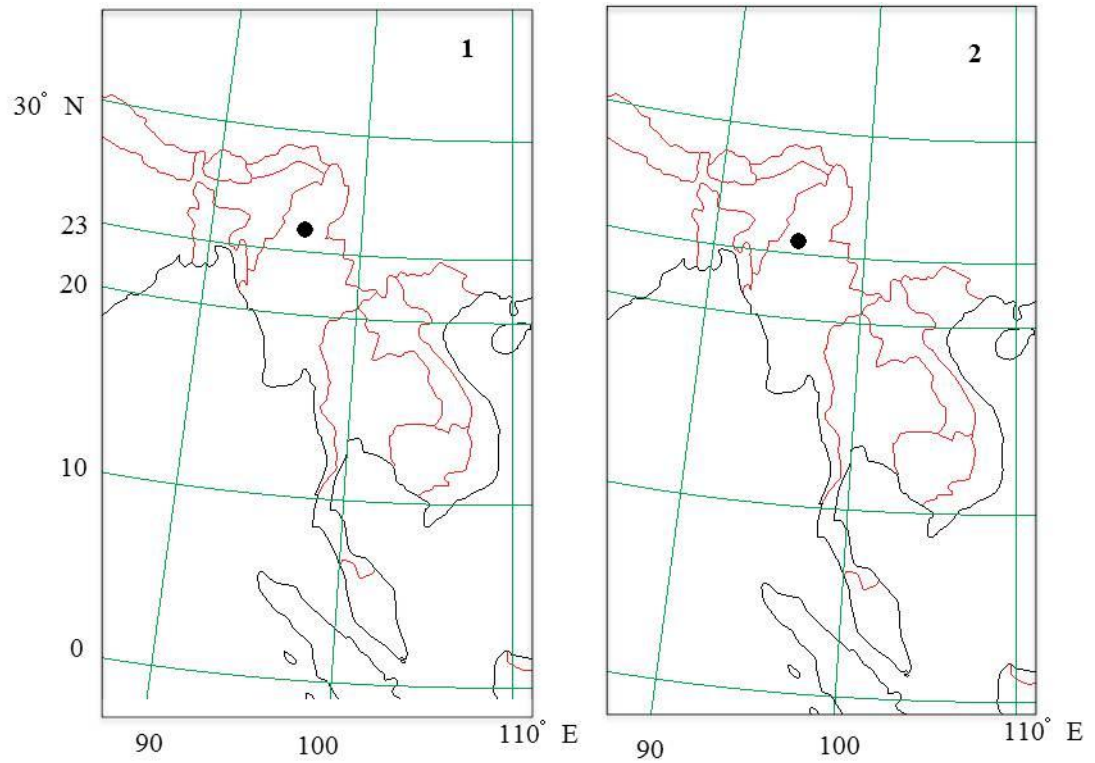


Fig. 5. Distribution map of *Zingiber* species belong to the set. *Dymczewiczia*.:
 1. *Zingiber capitatum*; 2. *Zingiber* sp. Solid symbols represent their
 distribution in Myanmar.

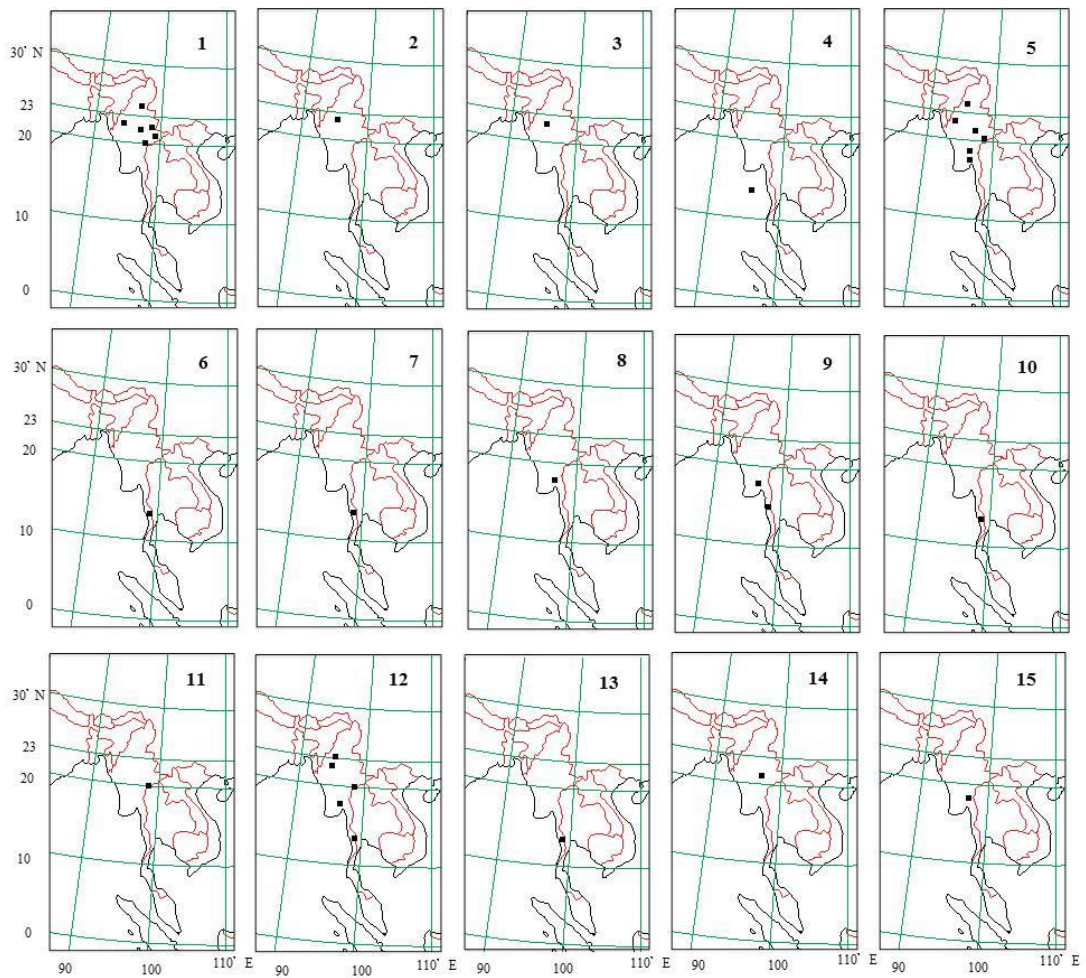


Fig. 6. Distribution map of *Zingiber* species belong to the set. *Zingiber*.

1 *Z. officinale*; 2. *Z. idae*; 3. *Z. neesanum*; 4. *Z. corallinum*; 5. *Z. montanum*;
 6. *Z. neomontanum*; 7. *Z. griffithii*; 8. *Z. gracile*; 9. *Z. parishii*; 10. *Z. tenuiscapus*;
 11. *Z. sadakornii*; 12. *Z. zerumbet*; 13. *Z. ottensii*; 14. *Z. kerrii*;
 15. *Z. gramineum*. Solid symbols their distribution in Myanmar.

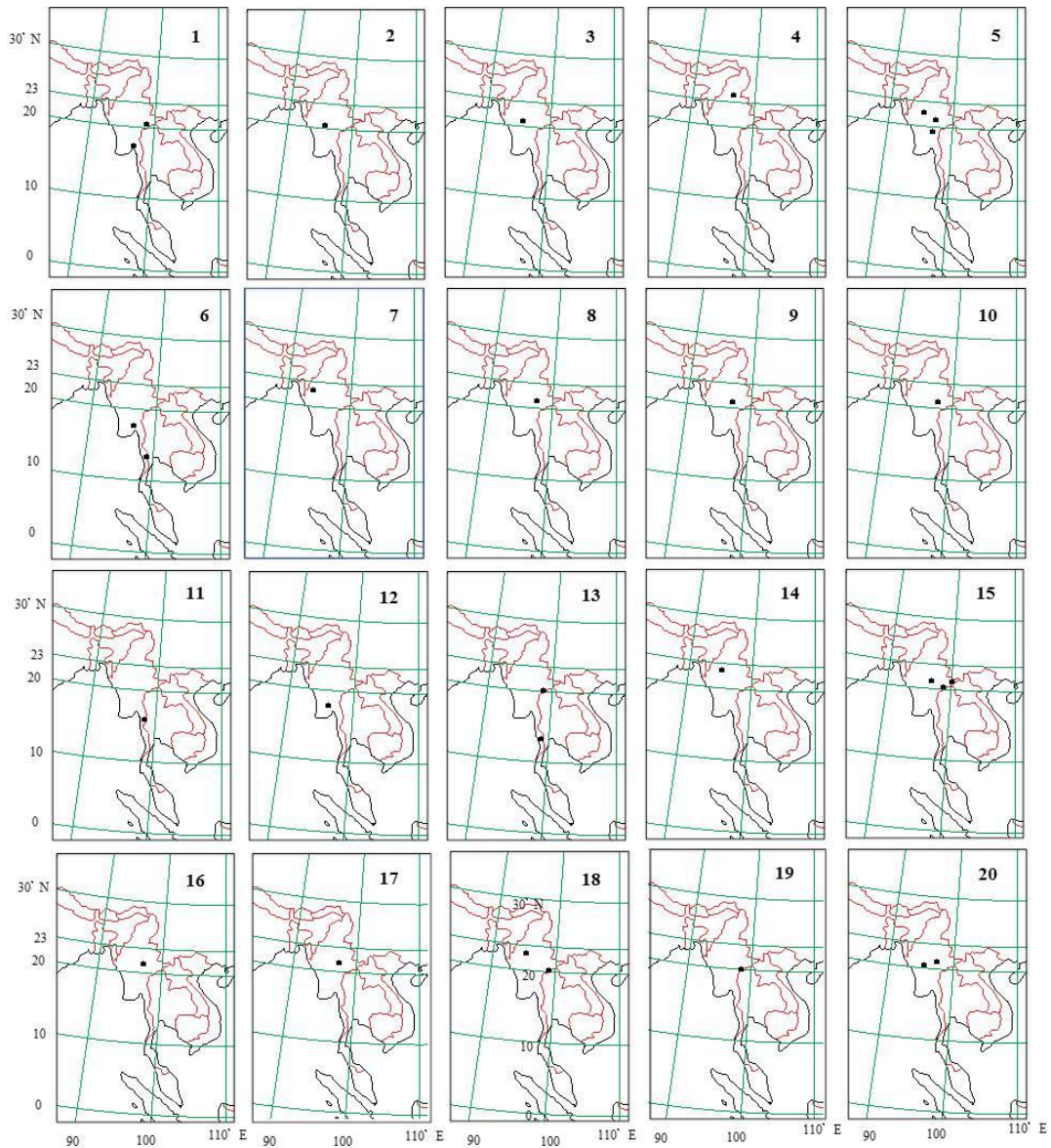


Fig. 7. Distribution map of *Zingiber* species belong to the set. *Cryptanthium*.

1. *Z. barbatum*; 2. *Z. popaense*; 3. *Z. pygmaea*; 4. *Z. chrysanthum*; 5. *Z. rubens*;
6. *Z. squarrosum*; 7. *Z. matupiense*; 8. *Z. nimmonii*; 9. *Z. ligulatum*; 10. *Z. roseum*;
11. *Z. pardocheilum*; 12. *Z. panduratum*; 13. *Z. thorelli*; 14. *Z. tereris*; 15. *Z. orbiculatum*;
16. *Z. densissimum*; 17. *Z. bradleyanum*; 18. *Z. longiligulatum*;
19. *Z. bisectum*; 20. *Z. flavomaculosum*. Solid symbols represent their distribution in Myanmar.



Fig. 8. *Zingiber capitatum* Roxb.

A: Leafy stem with inflorescence

B: Close up view of inflorescence



Fig. 9. *Zingiber* sp.

A: Leafy stem with inflorescence

B: Close up view of inflorescence

C: Rhizome with roots



Fig. 10. *Zingiber officinale* Roscoe

A: Leafy stem with inflorescence

B: Close up view of inflorescence with a single flower



Fig. 11. *Zingiber neesanum* (J. Graham) Ramamoorthy

A: Close up view of inflorescence with a flower

B: Leafy stem and ligules

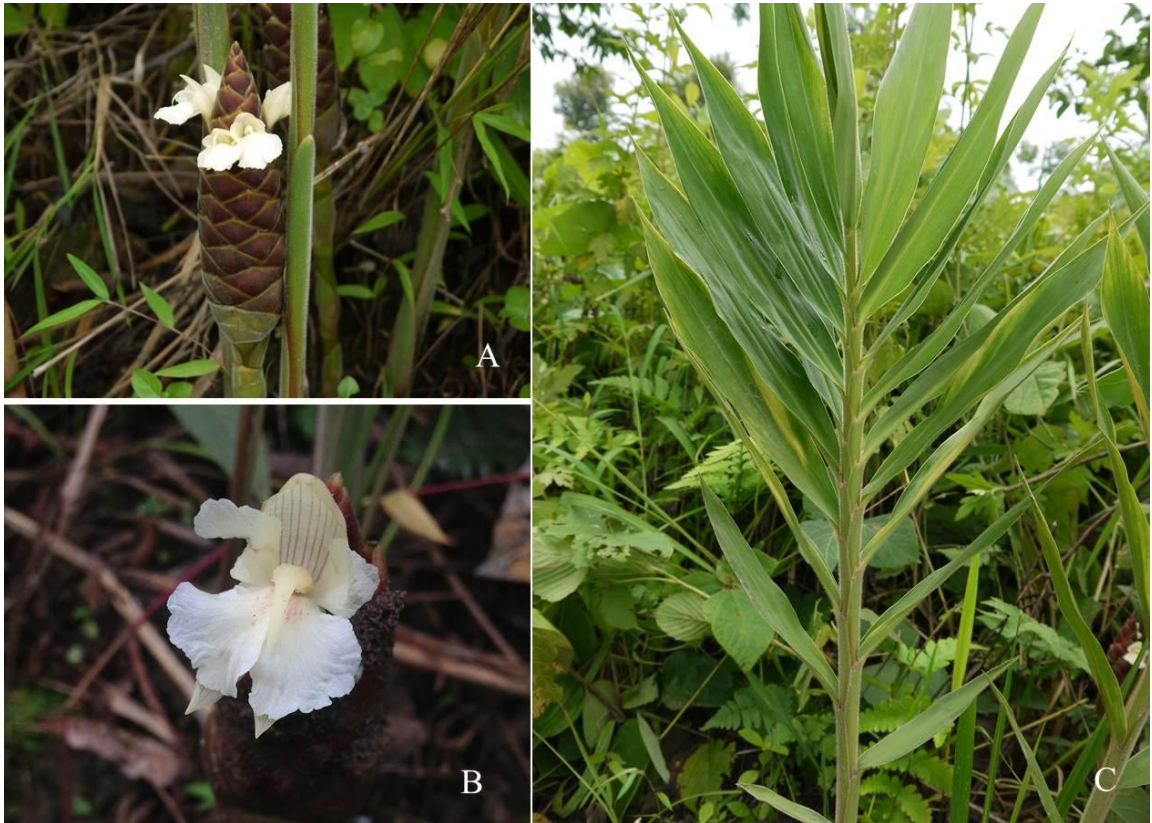


Fig. 12. *Zingiber montanum* (J. Koenig ex Retz.) Theilade

A: Inflorescence with flowers

B: Close up view of a single flower

C: Leafy stem



Fig. 13. *Zingiber neomontanum* M. M. Aung & Nob. Tanaka, **sp. nov.**

A: Inflorescence

B: Close up view of flowers

C: Leafy stem and ligules



Fig. 14. *Zingiber cf. parishii* Hook. f.

A: Leafy stem with inflorescence

B: Inflorescence in mature with age



Fig. 15. *Zingiber tenuiscapus* Triboun & K. Larsen

A: Close up view of inflorescence with single flower

B: Leaves and ligules



Fig. 16. *Zingiber sadakornii* Triboun & K. Larsen

A: Leaves and ligules

B: Inflorescence with flowers



Fig. 17. *Zingiber zerumbet* (L.) Roscoe ex Sm.

A: Inflorescence with flowers

B: Leaves and ligules



Fig. 18. *Zingiber ottensii* Valetton.

A: Leafy stem and ligules.

B: Inflorescence with flowers.



Fig. 19. *Zingiber kerrii* Craib.

A: Leafy stem and ligules

B: Inflorescence with flowers

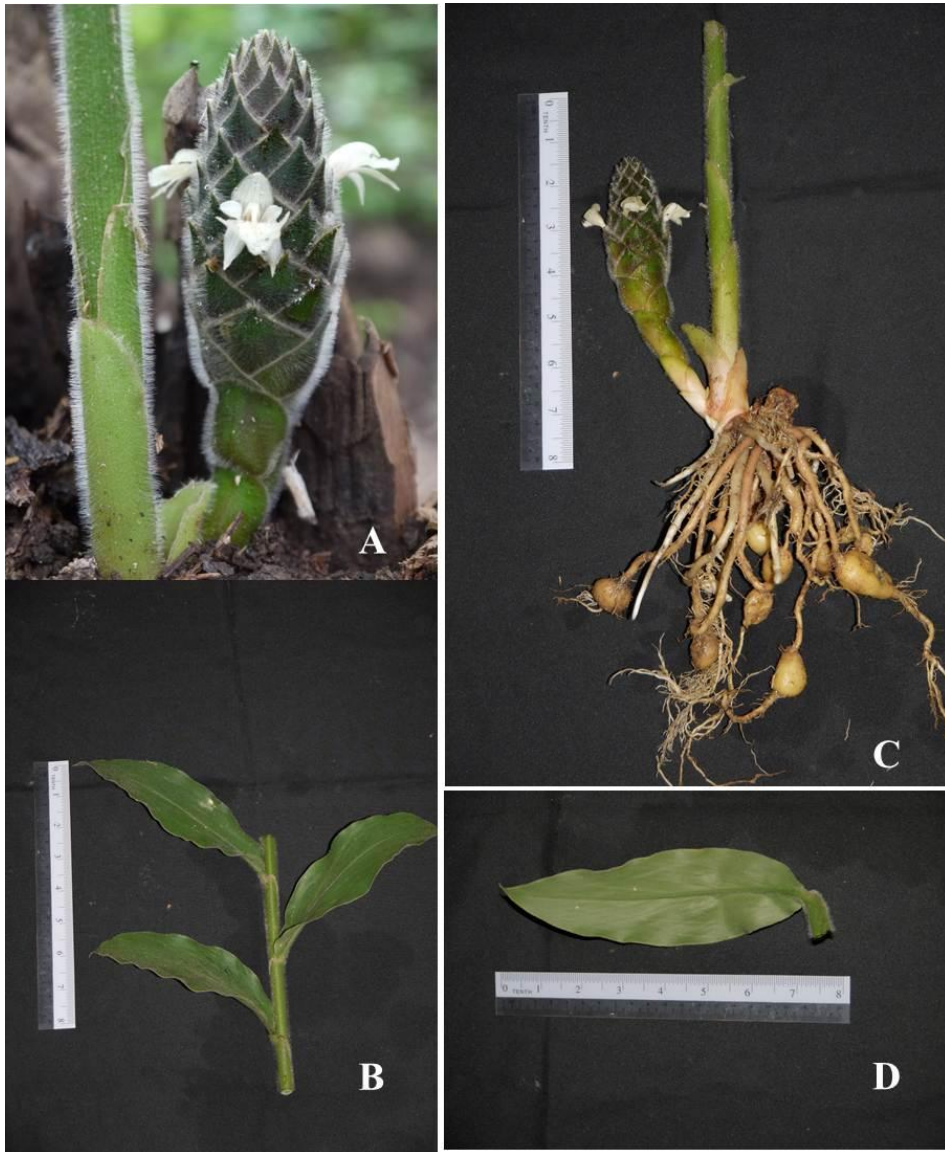


Fig. 20. *Zingiber barbatum* Wall.

A: Inflorescence with flowers

B: Leaves and ligules

C: Inflorescence and rhizome with tubers

D: Leaf blade



Fig. 21. *Zingiber popaense* Nob. Tanaka

A: Inflorescence with flowers

B: Leafy stem and ligules

C: Close up view of flower and inflorescence

D: Roots with tuber. (Tanaka 2012)

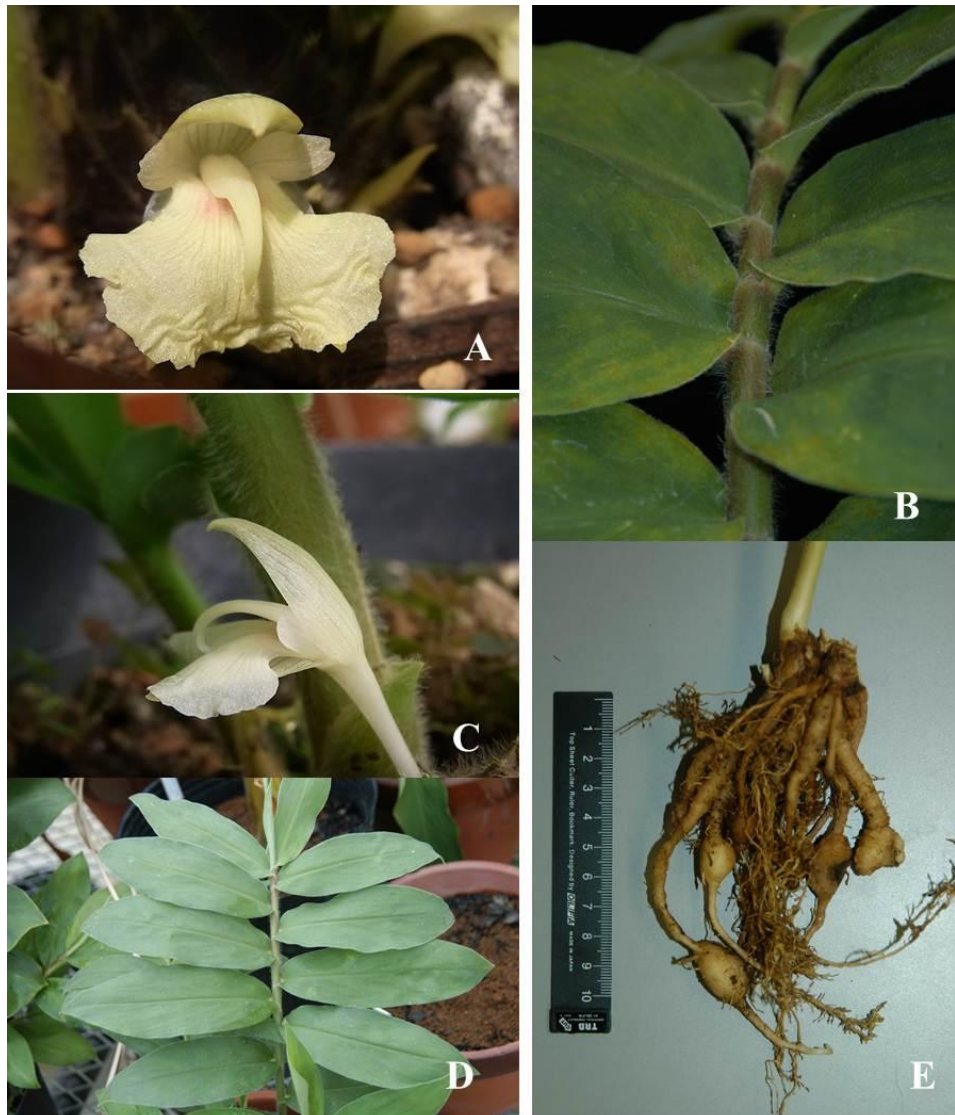


Fig. 22. *Zingiber pygmaea* M. M. Aung & Nob. Tanaka, sp. nov.

A: Front view of flower

B: Leafy stem and ligules

C: Side view of flower

D: Leafy stem with leaves

E: Roots with tubers



Fig. 23. *Zingiber rubens* Roxb.

A: Leafy stem and ligules

B: Inflorescence arising from rhizomes

C: Close up view of inflorescence with bracts and flower



Fig. 24. *Zingiber squarrosus* Roxb.

A: Inflorescence with flowers

B: Young fruits

C: Leaves and ligules



Fig. 25. *Zingiber matupiense* M. M. Aung & Nob. Tanaka, sp.nov.

A: Leaves and ligules

B: Close up view of flower

C: Close up view of inflorescences with flowers

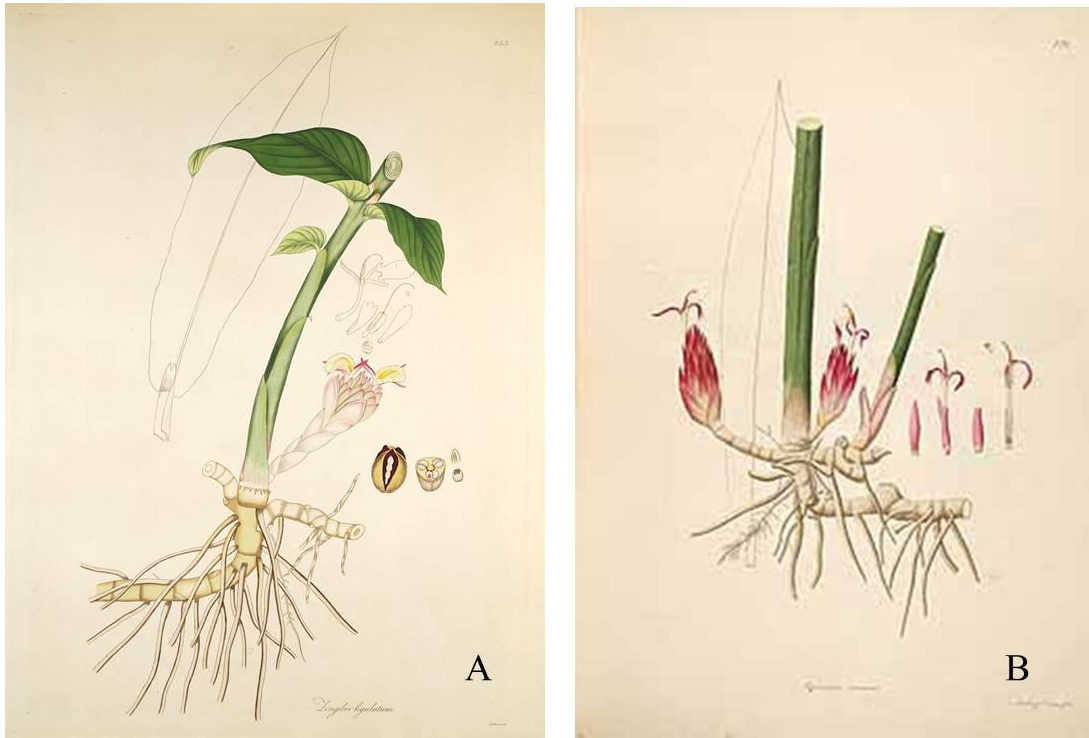


Fig. 26. A: *Zingiber ligulatum* Roxb. B: *Zingiber roseum* (Roxb.) Roscoe



Fig. 27. *Zingiber thorelli* Gagnep.

A: Inflorescence with flowers

B: Leafy stem



Fig. 28. *Zingiber tereris* M. M. Aung & Nob. Tanaka, **sp. nov.**

A: Leaves and ligules

B: Close up view of flowers

C: Side view of inflorescence with bracts and back view of
flowers and leafless sheath



Fig. 29. *Zingiber orbiculatum* S.Q. Tong

A: Leafy stem and ligules

B-C: Inflorescence with flowers

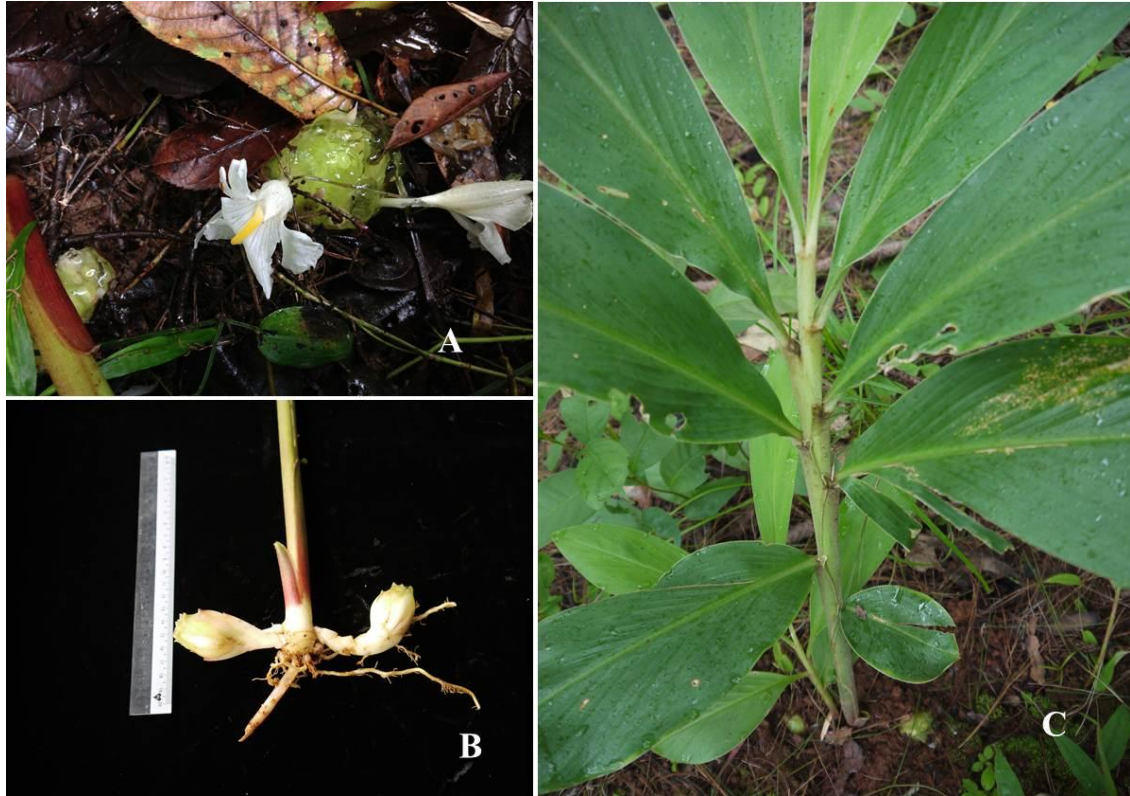


Fig. 30. *Zingiber densissimum* S.Q. Tong & Y.M. Xia

A: Inflorescence covered with gelatinous substance

B: Inflorescences (side view) arising from rhizome

C: Leafy stem and ligules



Fig. 31. *Zingiber bradleyanum* Craib

A: Inflorescence with single flower

B: Leafy stem and characteristic ligules

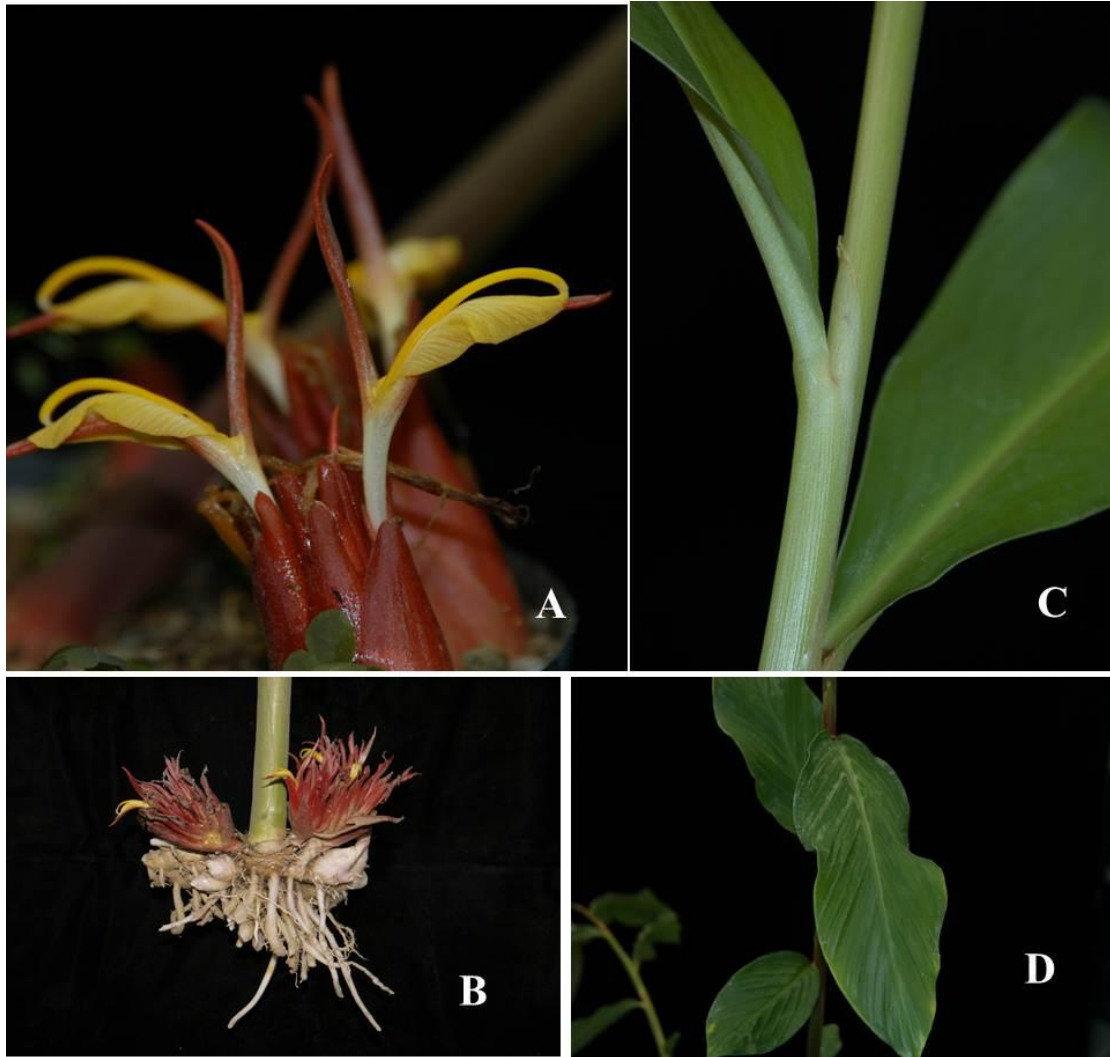


Fig. 32. *Zingiber longiligulatum* S.Q. Tong

A: Inflorescences with flowers

B: Inflorescences with rhizomes

C: Leaves and ligule

D: Leaves *Photo:* A, C, D: Nobuyuki Tanaka, B: Mu Mu Aung



Fig. 33. *Zingiber bisectum* D. Fang

A: Leaves and ligules

B: Close up view of flowers

C: Close up view of inflorescence with bracts and flowers



Fig. 34. *Zingiber flavomaculosum* S.Q. Tong

A: Inflorescences with flowers

B: Leaves and ligules

C: Close up view of flowers

D: Inflorescences with rhizomes

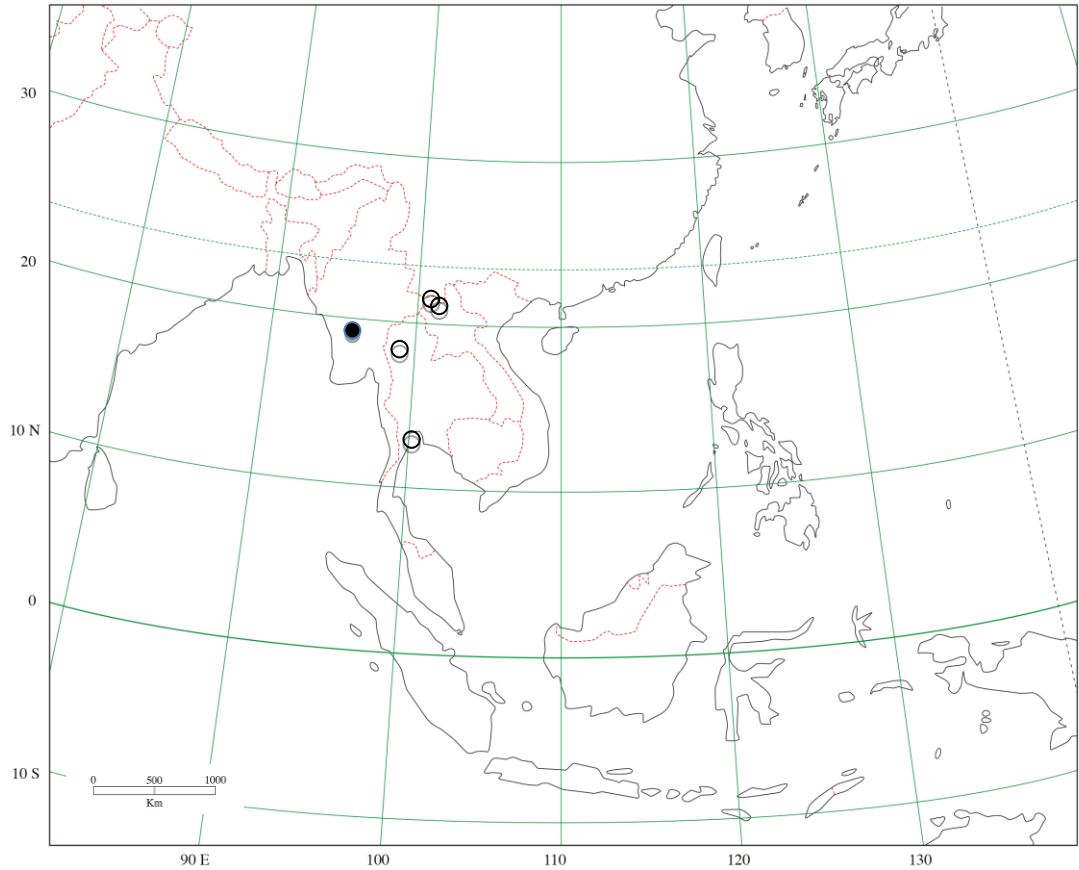


Fig. 35. Distribution map of *Zingiber flavomaculosum* S.Q.Tong. Solid circle indicates the new habitat in Myanmar, and open circles indicate the previous range of distribution based on Tong (1987), and Triboun (2006).



Fig. 36. Marketing of *Zingiber officinale* in the local area.

A-B: Local market at Pyin Oo Lwin Township

C-D: Local market at Loikaw Township

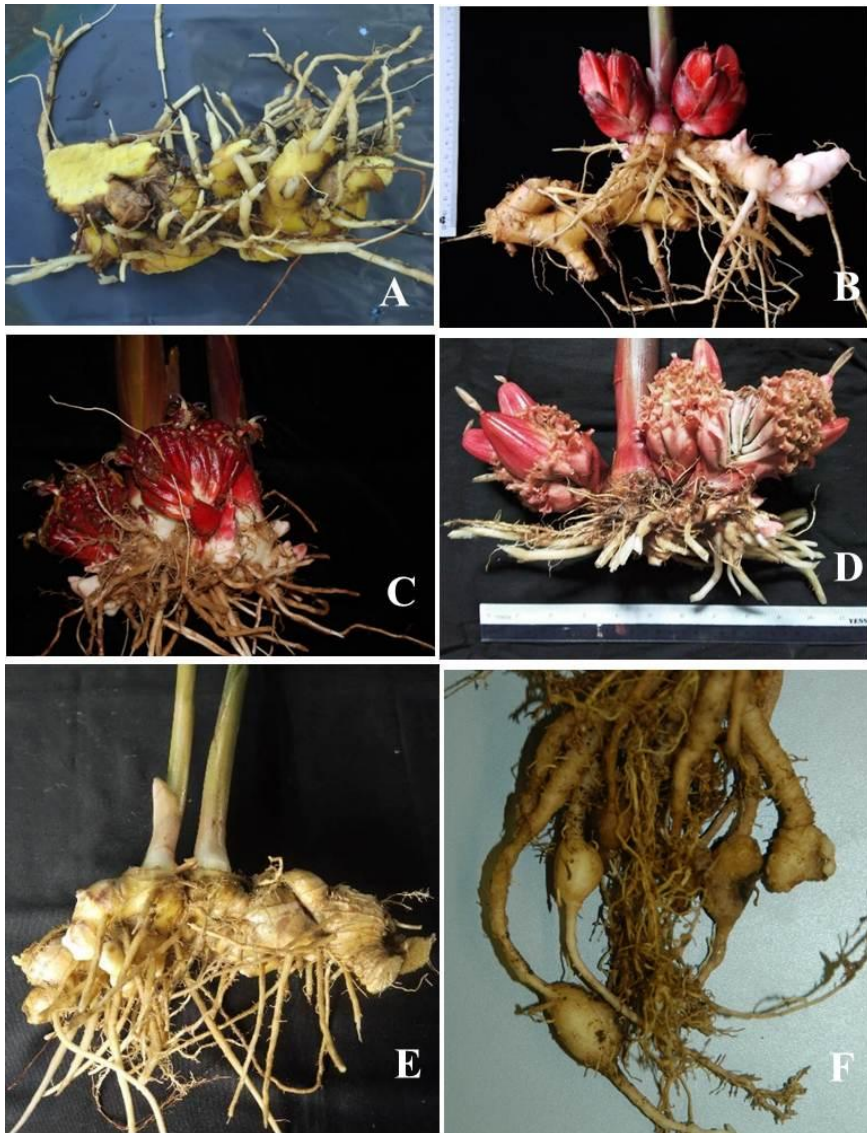


Fig. 37. *Zingiber* species used as traditional medicine by Myanmar people.

A: Rhizomes of *Z. montanum*

B: Rhizomes and young fruits of *Z. orbiculatum*

C: Inflorescences and rhizomes of *Z. flavomaculosum*

D: Young fruits and rhizomes of *Z. squarrosum*

E: Rhizomes of *Z. zerumbet*

F: Tubers of *Z. pygmaea*



Fig. 38. Marketing of *Zingiber capitatum* in the local area.

A: Local market at Myitkyina Township

B: Rhizome of *Z. capitatum*