CHAPTER IV

TAXONOMIC STUDY OF SOME FIGS AND THEIR POLLINATORS

4.1 TAXONOMIC STUDY

29 taxa in 26 species were classified from six subgenera (Table 4.1). 2 species in *F. benjamina* L., 2 varieties in *F. racemosa* L. and *F. hispida* L. and 2 forms in *F. fistulosa* Reinw. ex. Bl. The largest group was 11 species in subgenus *Urostigma*, followed by 8 species of *Sycomorus*. *Ficus*, *Sycidium* and *Synoecia* each with 2 species and *Pharmacosycea* with 1 species.

Two varieties of *F. benjamina*; *F. benjamina* L. var. *benjamina* and *F. benjamina* L. var. *nuda* (Miq.) Barrett. The difference between them was the former had figs with glabrous and small size, 0.8-1.5 cm. in diameter, but the latter was about 1.8-2 cm. in diameter with pubescent figs. Their pollinator was the same, *Eupristina koningsbergeri* (Grandi) (Table 4.1) and non-pollinators were the insects in *Philotrypesis* and *Ormyrus* groups.

Another monoecious species with two varieties was *F. racemosa* consisted of *F. racemosa* L. var. *racemosa* and *F. racemosa* var. *miquell* (King) Corner. The former had branchlets, young leaves and figs with bent hair, whereas the latter had densely white pubescence. Its similar pollinator was *Ceratosolen fusciceps* Mayr. In addition, inside the fig, other fig wasps of 5 species were found. They were 2 species of *Apocrypta* and 3 species of *Platyneura* (*Apocryptophagus*).

For dioecious tree, *F. hispida* was the most generally disperse. There were two varieties in study site; *F. hispida* L.f. var. *hispida* and *F. hispida* var. *badiostrigosa* Corner. Their specific pollinator was *C. solmsi* Mayr. Its distribution was in the open area, sometimes near the stream and river. It occasionally appeared as pioneer species in the area of deforestation. Their ripen fruits also attracted to animals e.g. squirrels bats and insect-eating birds.

Fig wasps represented both pollinators and non pollinators. Eight genera of pollinators found consisted of *Blastophaga, Ceratosolen, Dolichoris, Eupristina,*

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Liporrhopalum, Odontofroggatia, Platyscapa and Pleistodontes. Non pollinating fig wasps comprised of *Acophila, Apocrypta, Camarothorax, Ormyrus, Otitesella, Philotrypesis, Platyneura* (*Apocryptophagus*) and *Sycoscapter* (Table 4.1).

Table 4.1 *Ficus* and their pollinators' checklist in Chiang Mai during June 2005-May 2007.

No	***Ficus* species**	**Pollinator**	**Other fig wasps**
	Subgenus *Urostigma*		
1	*F. altissima* Bl.	*Eupristina altissima* Balakrishnan & Abdurahiman	Not seen
2	*F. benjamina* var. *benjamina* L.	*Eupristina koningsbergeri* (Grandi)	*Philotrypesis* sp. *Ormyrus* sp.
3	*F. benjamina* var. *nuda* (Miq.) Barrett.	*Eupristina koningsbergeri* (Grandi)	*Philotrypesis* sp. *Ormyrus* sp.
4	*F. curtipes* Corner	Not seen	Not seen
5	*F. drupacea* Thunb.	*Eupristina belgaumensis* Joseph	Not seen
6	*F. elastica* Roxb.	*Pleistodontes claviger* Mayr	Not seen
7	*F. lacor* Ham.	*Platyscapa* sp.	Not seen
8	*F. maclellandii* King	Not seen	Not seen
9	*F. microcarpa* L. f.	*Odontofroggatia galili* Wiebes	Not seen
10	*F. religiosa* L.	*Platyscapa quadraticeps* Mayr	Not seen
11	*F. rumphii* Bl.	Not seen	Not seen
12	*F. superba* Miq. var *japonica* Miq.	*Platyscapa* sp.	*Acophila* sp. *Camarothorax* sp. *Otitesella* sp. *Philotrypesis* sp. *Sycoscapter* sp.

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Table 4.1 *Ficus* and their pollinators' checklist in Chiang Mai during June 2005-May 2007. (continued)

No	***Ficus* species**	**Pollinator**	**Other fig wasps**
	Subgenus *Pharmacosycea*		
13	*F. callosa* Willd.	*Dolichoris malabarensis* Abdurahiman & Joseph	
	Subgenus *Sycomorus*		
14	*F. racemosa* L. var. *racemosa*	*Ceratosolen fusciceps* Mayr	*Apocrypta* sp.1 *Apocrypta* sp.2 *Platyneura* sp.1 *Platyneura* sp.2
15	*F. racemosa* L. var. *miquelli* (King) Corner	*Ceratosolen fusciceps* Mayr	*Apocrypta* sp.1 *Apocrypta* sp.2 *Platyneura* sp.1 *Platyneura* sp.2 *Platyneura* sp.3
16	*F. auriculata* Lour.	*Ceratosolen emarginatus* Mayr	*Philotrypesis longicaudata* Mayr *Platyneura* sp.
17	*F. fistulosa* Reinw ex. Bl. form1	*Ceratosolen constrictus* Mayr	Not seen
	F. fistulosa Reinw ex. Bl. form2	*Ceratosolen constrictus* Mayr	Not seen
18	*F. hispida* var. L.f. *hispida*	*Ceratosolen solmsi* Mayr	*Apocrypta bakeri* Joseph *Philotrypesis pilosa* Mayr

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Table 4.1 *Ficus* and their pollinators' checklist in Chiang Mai during June 2005-May 2007. (continued)

No	***Ficus* species**	**Pollinator**	**Other fig wasps**
	Subgenus *Sycomorus*		
19	*F. hispida* L.f. var. *badiostrigosa* Corner	*Ceratosolen solmsi* Mayr	*Apocrypta* sp. *Philotrypesis* sp.
20	*F. oligodon* Miq.	*Ceratosolen emarginatus* Mayr	*Apocrypta* sp.
21	*F. semicordata* Buch-Ham. ex. J. E. Sm.	*Ceratosolen gravelyi* (Grandi)	*Philotrypesis dunia* Joseph
22	*F. squamosa* Roxb.	*Ceratosolen* sp.	Not seen
23	*F. variegata* Bl.	*Ceratosolen appendiculatus* Mayr	Not seen
	Subgenus *Ficus*		
24	*F. ischnopoda* Miq.	*Blastophaga* sp.	Not seen
25	*F. hirta* Vahl	*Blastophaga javana* Mayr	*Philotrypesis* sp. *Sycoscapter* sp.
	Subgenus *Synoecia*		
26	*F. anserina* Corner	Not seen	Not seen
27	*F. pumila* L.	Not seen	Not seen
	Subgenus *Sycidium*		
28	*F. anastomosans* (Corner) Berg	*Liporrhopalum* sp.	*Philotrypesis* sp. *Sycoscapter* sp.
29	*F. subincisa* Buch.-Ham. ex. Smith	*Liporrhopalum* sp.	Not seen

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4.2 CHARACTERS OF *FICUS* (Berg and Corner, 2005)

Tree, shrubs, or climbers, monoecious or (functionally) dioecious, often with aerial adventitious roots (hemi-epiphytes and root climbers), rarely with uncinate hairs, usually with waxy glandular spots on he lamina beneath and/or in the node if leafy twigs. **Leaves** spirally arranged, distichous, (sub) opposite (or subverticillate); stipule fully amplexicaul to lateral, mostly free. **Inflorescences** with an urceolate receptacle, entirely enclosing the flowers (even at anthesis), bisexual or (functionally) unisexual, pronouncedly protogynous, the orifice more or less tightly closed by bract; interfloral bracts present; staminate flowers with (2-) 3-5 (or more) scarious tepals, these free in shape. **Fruit** a drupelet or an achene. **Seed** with endosperm, embryo (almost) straight with flat and equal or ± curved with conduplicate cotyledon.

KEY TO SUBGENERA OF *FICUS*

1a. Plants monoecious, the figs containing staminate flowers and pistillate flowers with different style length; leaves usually in spiral, rarely subdistichous or subopposite; lamina rare scabrous……...……...(2)

b. Plants (gyno) dioecious, the figs containing either staminate flowers and pistillate flowers with short style or only pistillate flowers with long style (or also neuter flowers); leaves often distichous or (sub) opposite……..…(4)

2a. Figs without interfloral bracts; staminate flowers near the ostiole and subtended and enveloped by 2 bracteoles. ……..….***Subg. Sycomorus***

b. Figs with interfloral bracts; staminate flowers mostly scattered among the pistillate one and without bracteoles. ……....(3)

3a. Waxy gland one, at the base of the midrib beneath; aerial adventitious roots usually present; stamen usually 1; stigma usually 1, usually distinctly papillate. ……...…***Subg. Urostigma***

b. Waxy gland two, in the axils of the basal lateral veins beneath or absent; aerial roots absent; stamens 1 or 2; stigma usually 2, without distinctly papillate. ……..…***Subg. Pharmacosycea***

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4a. Stipule often not fully amplexicual; lamina often asymmetric; bracts mostly scattered on the peduncle and not 3 in a whorl as basal bracts; pistillode (or pistil) always present in the staminate flower……..……..……...***Subg. Sycidium***

b. Stipule nearly always fully amplexicual; lamina symmetric or asymmetric; basal bracts 3, in a whorl, sometime basal or lateral bracts not distinguishable; pistillode rarely present……..……....(5)

5a. Root-climbers usually with pronounced leaf dimorphy.

……..…...***Subg. Synoecia***

b. Tree or shrubs without aerial roots and leaf dimorphy……(6)

6a. Staminate flowers near the ostiole and mostly subtended by bracteoles; figs often cauliflorous or flagelliflorous; lateral bracts often present; lamina often asymmetric; in dried material the nodes of leafy twigs often thicker than the internodes and the lamina with lead-colored spots above.

……***Subg. Sycomorus***

b. Staminate flowers scattered among the pistillate ones or near the ostiole, not subtended by bracteoles; figs mostly axillary or just below the leaves; lamina symmetric; in dried material the nodes of leafy twigs almost as thick as the internodes and lead-colored spots absent on the lamina above.

……..……***Subg. Ficus***

4.3 CHARACTERS OF FIG WASPS

4.3.1 Super family Chalcidoidae

As the previous knowledge, all of ‘fig wasps’ are the insects in family Agaonidae and Chalcididae, super family Chalcidoidae, Order Hymenoptera (Bouček, 1988). The significant characters to identify fig wasp are the main of their morphology such as antenna, head, wing, thorax**,** gaster, legs and ovipositor. The general Chalcidoidae morphologies were explained by Pitkin (2004) in figure 4.1 to 4.8

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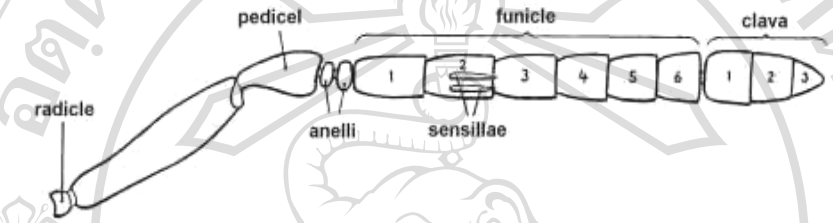

Figure 4.1 Characters of Chalcidoidae; Antenna (after Pitkin, 2004)

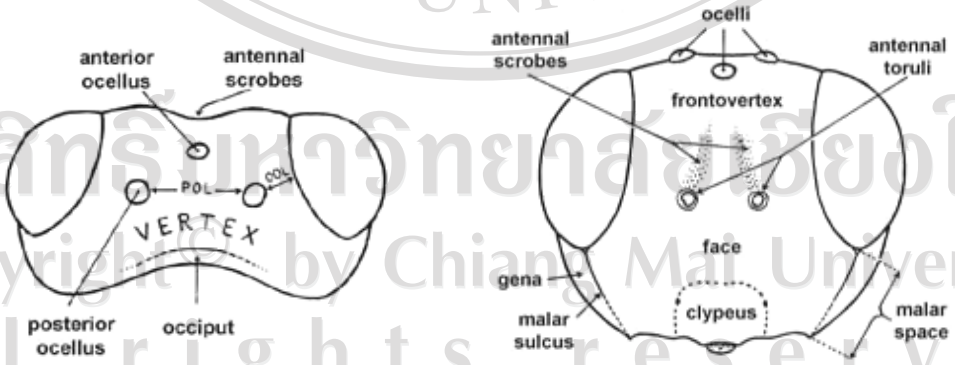

Figure 4.2 Characters of Chalcidoidae; Head (after Pitkin, 2004)

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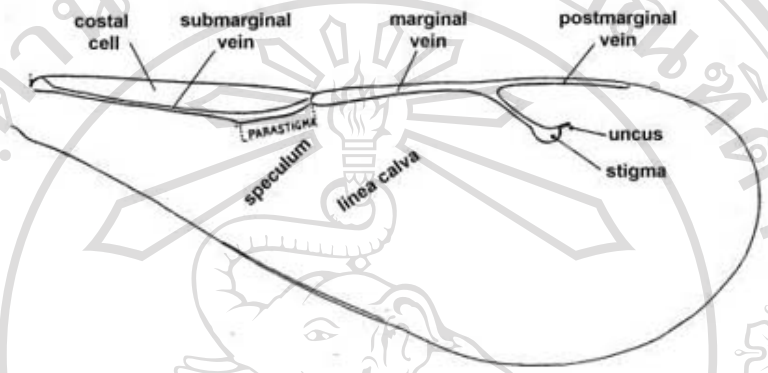

Figure 4.3 Characters of Chalcidoidae; Fore wing (after Pitkin, 2004)

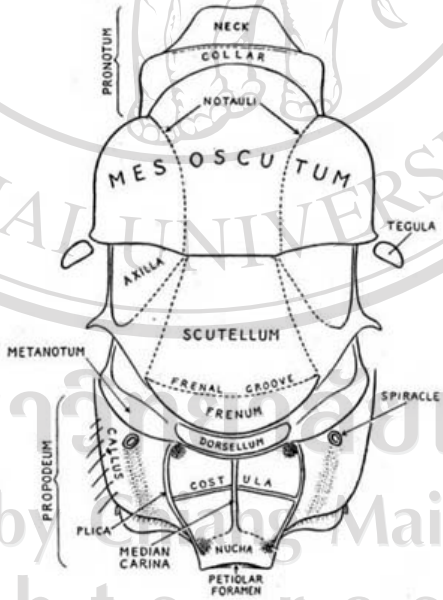

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Figure 4.4 Characters of Chalcidoidae; Thorax -dorsal view (after Pitkin, 2004)

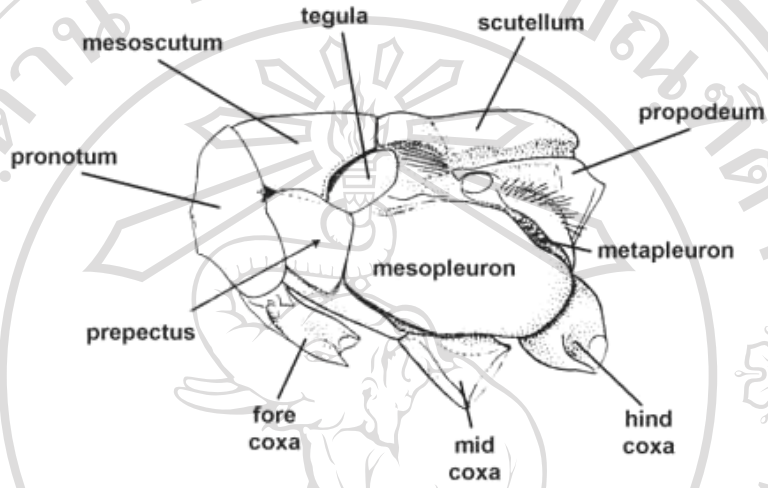

Figure 4.5 Characters of Chalcidoidae; Thorax -side view (after Pitkin, 2004)

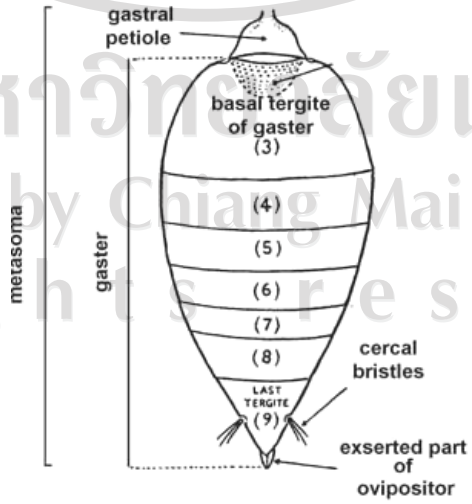

Figure 4.6 Characters of Chalcidoidae; Gaster - dorsal view (after Pitkin, 2004)

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4.3.2 Family Agaonidae

Pitkin (2004) reported that this family currently includes 76 genera and 757 species placed in 6 subfamilies as follows: Agaoninae (20/358), Epichrysomallinae (14/40), Otitesellinae (15/79), Sycoecinae (6/67), Sycophaginae (7/59), Sycoryctinae (11/151), unplaced (3/3). The first subfamily is known as pollinator function, but the others are may be parasitoids or gall-formers. Hence at least 20 genera and 358 species of pollinators were published, however more than half of them still undiscovered (if refer to 1,000 species of figs).

Figure 4.7 Female Agaoninae pollinator; *Pleistodontes* sp. (after Pitkin, 2004)

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female male

Blastophaga psenes

Figure 4.8 Illustration of male and female pollinators in *Blastophaga* (after Pitkin, 2004)

Key to genera of subfamily Agaoninae (Wiebes, 1994)

1. The female head is slightly too strong longer than wide. The third antennal segment is rather simple, in that the produced apex, if at all prominent, is not separate from the main part of the segment; the pedicel has no axial spines. The mandibular appendage is truly appended to the mandible; it has ventral lamellae, but mostly rows of small teeth. All male tarsi are pentamerous and the pronotum does not have anterolateral expansions.....*Pleistodontes*

   - The female head is usually not distinctly elongate. The third antennal segment has a separation between the main part and the produce apex, which itself may be divided; the pedicel has axial spines. The mandibular appendage is fuse with the body of the mandibular; it bears ventral lamellae. The male fore tarsus is bimerous, the pronotum has characteristic antero-lateral expansions *Waterstoniella*.....(2)

2. In the female, the spiracle of the eight urotergite has large, elongate peritremata, and the wing-venation is complete. The male antennae are slender, placed in deep channels, which are interiorly separated by a triangular raised area bearing usually three (rarely two) sharp frontal lobe, and the thorax (the pronotum in particular) is elongate the mid tarsi are usually pentamerous……...*Ceratosolen*

   - The spiracles are smaller and mostly subcircular- if they are larger and oval, the wing-venation is obsolete beyond the marginal vein (*Eupristina*). The male antennae are usually shorter and more clavate – if they resemble those of *Ceratosolen*, the thorax is more robust and the mid tarsi are oligomerous ……..……..……(3)

3. The ovipositor valves of the female are as long as the gaster, or longer. The antenna consists of eleven segments. The male genitalia are usually simple (not in *Dolichoris*……..……...……...…….……..….(4)

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- The ovipositor-vales are shorter than the gaster, mostly half as long or shorter, but exceptionally three-quarters of the length of the gaster. Usually the male gentalia bear cerci with claws ………………………..………...................(8)

4. The venation of the female fore wing is reduced: it is obsolete beyond the marginal vein. The male thorax is tapering caudad……………………………….....*Eupristina*
   - The venation of female fore wing is more complete, and the male thorax is not tapering caudad………………………….………………………………...…….(5)
5. The female antenna is strongly clavate………………………………………..*Deilagaon*
   - The female antenna, if at all, is not that strongly clavate……….……………….(6)
6. The median ocillous of the female is reduced. The maxilla is simple, all male tarsi are pentamerous. The pronotum usually is expanded fronted. ………………………………………………………………………..*Waterstoniella*
   - The female has all ocilli normally developed. The maxilla has a bacilliform process. The male fore tarsi usually are bimerous…...…………...…………..(7)
7. The spine of the female hypopygium bears one or two row(s) of hyaline setae the male metanotum is visible dorsally as two ear-like plates. The genitalia have (sometimes indistinct) claspers with claws….………………..……...*Dolochoris*
   - The spine of the female hypopygium does not have transverse row(s) of hyaline setae. The male metanotum and the propodeum are completely separated, or only laterally. The genitalia are simple…….……….............……. *Platyscapa*
8. The female fore tibia bear four or more dorso-apical teeth, and that of the male, seven or more………………………...……………………….…...*Kradibia*
   - The fore tibia of the female bear two or three dorsal-apical teeth, and that of the male (two)-tree or four (-five)…………………………………………………...(9)
9. The female antenna has ten segments……………………………………….(10)
   - The female antenna has eleven segments….………………………………...(11)
10. The wing-venation is partly or quite indistinct- if it is distinct and complete, then the antennal segments are four or more times as long as wide. The male mid tarsus has two or three segments……..…………………………..*Liporrhopalum*
    - The wing-venation is distinct, and the antennal segment are little longer than wide. The male mid tarsus is atrophied………………..…………..…..*Weibesia*

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11. The female mesoscutum has a longitudinal groove (fig. 2, m) – if tis is not distinct, the fore tibia bear four dorsal-apical teeth (no. 96, *W. nuda*) or three, but then the hypopygial spine does not bear a row of hyaline setae…….…. *Weibesia*

- The female mesoscutum is entire; if the fore tibia bears three dorsal-apical teeth, the hypopygial spine bears a transverse row of hyaline setae ……..…….*Blastophaga*

4.4 TAXONOMIC STUDY OF *FICUS* L.

Specimens of fig trees that represented in Chiang Mai were identified to twenty-six species. Their characters were described and their pollinators were identified. The flowering and fruiting crops, ecology and distribution were indicated.

Monoecious Figs

Subgenus *Urostigma*

1. *Ficus altissima* Bl.

กร่าง (Krang) (Figure 4.9, 4.36)

Trees, 25-30 m tall; branchlets green, ca. 1 cm thick, pubescent. Stipules 2-3 cm long, thick leathery, with silky hairs. **Leaf**: blade broadly ovate to broadly ovate-elliptic, 10-19 × 8-11 cm, thick leathery, glabrous; base broadly cuneate; margin entire; apex obtuse; basal lateral veins long; secondary veins 5-7 on each side of midvein; petiole 2-5 cm. **Figs**: axillary on leafy branchlets, paired, red or yellow when mature, ellipsoid-ovoid, 1.7-2.8 cm in diam., pubescent when very young, glabrous when mature, sessile; involucral bracts hood-like, covering young fig, scar ringlike. Male, gall, and female flowers within same fig. **Male flowers**: scattered; perianth 4, transparent, membranous; stamen 1. **Gall flowers**: perianth 4; style subapical. **Female flowers**: sessile; perianth 4; style elongated. **Fruit**: achenes, ovoid-reniform, 1x2 mm.

Flowering: March-April **Fruiting:** May-July

Ecology: generally occur in lowland, altitude 310-1,000 m

Pollinator: *Eupristina altissima* Balakrishnan & Abdurahiman

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2. *Ficus benjamina* L. var. *benjamina*

ไทรย้อยใบแหลม (Sai yoi bai laem, Golden fig) (Figure 4.10, 4.36)

Trees, up to 20 m tall, crown wide; bark smooth; main branches producing aerial roots which can develop into new trunks; branchlets pendulous, glabrous; stipules caducous, lanceolate, 0.6-1.5 cm, membranous, glabrous. **Leaf**: blade ovate to broadly elliptic, 4-8 × 2-4 cm, leathery, glabrous; base rounded to cuneate; margin entire; apex shortly acuminate, secondary veins 8-10 on each side of midvein, parallel, petiole 1-2 cm **Figs**: axillary on leafy branchlets, paired or solitary, purple, red, or yellow when mature, globose to subglobose, 0.8-1.5 cm in diam., glabrous, sessile; involucral bracts inconspicuous, triangular-ovate, glabrous, persistent. Male, gall, and female flowers within same fig. **Male flowers**: few, shortly pedicellate; perianth 3 or 4, broadly ovate; stamen 1; filament rather long. **Gall flowers**: many, perianth 3, 4 or 5, narrowly, spatulate; ovary ovoid, smooth; style lateral, short. **Female flowers**: sessile or pedicellate; perianth 3, shortly spatulate; style ± lateral, short; stigma enlarged. **Fruit:** achenes, ovoid-reniform, 1x1 mm, shorter than persistent style.

Flowering: 3 times; August, November, March **Fruiting:** September, October, May

Ecology: widespread, moist mixed forest, 310-800 m

Pollinator: *Eupristina koningsbergeri* (Grandi)

3. *Ficus benjamina var. nuda* (Miq.) Barrett.

ไทรย้อยใบแหลม (Sai yoi bai laem, Golden fig) (Figure 4.10)

The different from var. *benjamina* is the fig size 1.8-2 cm in diam. and pubescent. Pollinator: *Eupristina koningsbergeri* (Grandi)

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4. *Ficus curtipes* Corner

ไทรหิน (Sai hin) (Figure 4.11)

Trees, 5-10 m tall; epiphytic when young; stems often basally many branched; Bark pale grayish, smooth; branchlets green, 5-8 mm in diam., glabrous. Stipules lanceolate to ovate lanceolate, 1-2 cm. **Leaf**: blade narrowly elliptic to ovate-elliptic,

12-18 × 5-6 cm, thick leathery; base cuneate; margin entire; apex acute; basal lateral veins short; secondary veins 8-12 on each side of midvein, inconspicuous on both surfaces; petiole robust, 1.5-2 cm. **Figs**: axillary on leafy branchlets; paired; dark red to purplish red when mature; globose to sub-globose; 1-1.5 cm in diam.; sessile; involucral bracts green, broadly ovate, 3-4 mm. Male, gall, and female flowers within same fig. **Male flowers**: pedicellate; perianth 3; lanceolate; stamen 1. **Gall flowers**: sessile or pedicellate; perianth 4; ovary white; style subapical. **Female flowers**: sessile; style subapical, persistent, as long as achene; stigma funnelform. **Fruit**: achenes, ovoid, 1x2 mm.

Flowering: November-December **Fruiting:** December-January

Ecology: moist area, near the stream, 350-850 m

Pollinator: not seen in study areas

5. ***Ficus drupacea*** **Thunb.**

ลุงขน (Lung khon, Mysore fig) (Figure 4.12, 4.36)

Trees, 10-15 m tall; bark grayish white; branches without aerial roots; branchlets 5-9 mm in diam., densely yellowish brown woolly. Stipules yellowish brown, lanceolate, 2-3 cm, membranous, with thick hairs. **Leaf**: blade narrowly elliptic to obovate-elliptic, 15-18 × 5-9 cm, leathery, glabrous or pubescent; base rounded, ± cordate, or ± auriculate; margin entire or slightly undulate; apex acute; basal lateral veins 2-4; secondary veins 8-11 on each side of midvein; tertiary veins reticulate. **Figs**: axillary on leafy branchlets, paired, reddish orange to red and with scattered white spots, oblong, pillow-shaped, or conic-ellipsoid, 1.5-2.5 × 1-1.5(-2) cm, glabrous or densely covered with brownish yellow long hairs, inside with few or no bristles; involucral bracts orbicular to ovate lanceolate; margin ciliate. Male, gall, and female flowers within same fig. **Male flowers**: long-pedicellate; perianth 3-4, broadly ovate; stamen 1; filament short and thick; anther narrowly ellipsoid. **Gall flowers**: pedicellate; perianth connate, apically 3- or 4- lobed; ovary globose. **Female flowers**: perianth 3, white, broadly lanceolate. **Fruit:** achenes, globose.

Flowering: January-February **Fruiting:** February-March

Ecology: open area, in deciduous forest near the stream, 320-700 m

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Pollinator: *Eupristina belgaumensis* Joseph

6. *Ficus elastica* Roxb.

ยางอินเดีย (Indian rubber fig) (Figure 4.13, 4.36)

Trees, 20-30 m tall; epiphytic when young; bark smooth; Stipules dark red, ca. 10 cm, membranous; scar conspicuous. **Leaf**: blade oblong to elliptic, 8-30 × 7-10 cm, thickly leathery; base broadly cuneate; margin entire; apex acute; secondary veins many, closely parallel, inconspicuous; petiole 2-5 cm. **Figs:** axillary on leaf branchlets, paired or solitary, yellowish green, ovoid-ellipsoid, ca. 10 × 5-8 mm, subsessile; involucral bracts hoodlike, caduceus; scar conspicuous. Male, gall, and female flowers within same fig. **Male flowers**: scattered among other flowers; pedicellate; perianth 4, ovate; stamen 1; filament absent; anther ovoid-ellipsoid. **Gall flowers**: sessile; perianth 4; ovary ovoid, smooth; style subapical, curved. **Female flowers**: sessile; style persistent, long; stigma enlarged, ± capitate. **Fruit**: achenes, ovoid, tuberculate, 1x1 mm.

Flowering: December-January **Fruiting:** January-February

Ecology: plant in town, often cultivated, 310-500 m

Pollinator: *Pleistodontes claviger* Mayr

7. *Ficus lacor* Buch. Ham.

ผักเฮือด (Phak hueat) (Figure 4.14)

Tree, 12-20 m tall; bark gray, smooth; branchlets strong. Stipules pink, ca. 8-10 cm, membranous; scar conspicuous**. Leaf**: blade oblong to elliptic or ovate elliptic, purple-red when young, glabrous, 7-10 x 12-16 cm; base widely cuneate; apex acuminate; margin entire; lateral nerves 7-11 pairs; petiole 4-8 cm. **Fig** globose, ca. 10 mm wide, pale pink color with tomentose; sessile or shortly; pedunculate; basal bracts covering only the base of the body. Male, gall, and female flowers within same fig. **Male flowers**: scattered among other flowers; pedicellate; perianth 4, generally narrow; stamen 1. **Gall flowers**: sessile; perianth 4; ovary ovoid, smooth; style

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subapical, curved. **Female flowers**: sessile; perianth 4; style persistent, long; stigma enlarged, capitate. **Fruit**: achenes, ovoid, tuberculate, 1x1 mm.

Flowering: January-February **Fruiting:** February-March

Ecology: open area, in the village, 310-600 m

Pollinator: *Platyscapa* sp.

8. *Ficus maclellandii* King

ไทรย้อย (Sai yoi) (Figure 4.15, 4.36)

Trees, 15-20 m tall; bark smooth; branchlets dark brown, ribbed and densely tuberculate. Stipules lanceolate, 0.4-1 cm, sparsely appressed pilose. **Leaf**: blade oblong to ovate-elliptic, 8-13 × 4-6 cm, leathery, glabrous but occasionally pubescent when young; base rounded to cuneate; margin entire; apex acuminate to mucronate; basal lateral veins 2, prominent; secondary veins 10-13 on each side of midvein, conspicuous on both surfaces, and with cystoliths between veins; petiole 1.3-1.7 cm glabrous. **Figs**: axillary on leafy branchlets, paired, purplish red when mature, globose to conic, slightly flat, 6-8 mm in diam.; sessile; involucral bracts 2 or 3, ovate, 2.3 mm; unequal in size. Male, gall, and female flowers within same fig. **Male flowers**: few, near apical pore; sessile; perianth 4, short, narrow lanceolate; stamen 1. **Gall flowers**: sessile; perianth 4, lanceolate, ovary globose. **Female flowers**: pedicelate; perianth 4, lanceolate, short, ovary ovoid; style subapical. **Fruit:** achenes, ovoid, 1x1 mm.

Flowering: May-June, November-December **Fruiting:** June, December

Ecology: open area, 310-800 m, growing in the city

Pollinator: not seen in study areas

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9. *Ficus microcarpa* L. f.

ไทรย้อยใบทู่ (Sai yoi bai thu) (Figure 4.16, 4.37)

Trees, 15-25 m tall, crown wide; bark dark gray; branches producing rust-colored aerial roots when old; stipules lanceolate, ca. 0.8 cm. **Leaf**: blade elliptic to

obovate, 4-8 × 3-4 cm, leathery, leaf dark brown when dry; base rounded cuneate; margin entire; apex obtuse; basal lateral veins long; secondary veins 3-10 on each side of midvein; petiole 5-10 mm. **Figs**: axillary on leafy branchlets or on leafless older branchlets, paired, yellow to slightly red when mature, depressed globose, 6-8 mm in diam., inside with a few short bristles among flowers, sessile; involucral bracts broadly ovate, persistent. Male, gall, and female flowers within a same fig. **Male flowers**: scattered; sessile or pedicellate; filament as long as anther. **Gall and Female flowers**: perianth 3, broadly ovate, membranous; style lateral; stigma short, clavate. **Fruit**: achenes, ovoid, 1x1 mm.

Flowering: April-June, August-September **Fruiting:** May-July, October

Ecology: open area, near the river, often cultivated in the city, 310-700 m

Pollinator: *Odontofroggatia galili* Wiebes

10. *Ficus religiosa* L.

โพศรีมหาโพ (Pho si maha pho, Sacred fig tree) (Figure 4.17, 4.37)

Trees, 15-25 m tall, banyans, strangling figs with adventitious roots, epiphytic when young, crown wide when mature; bark gray, smooth or longitudinally; branchlets grayish brown, sparsely pubescent when young. Stipules ovate, small, apex acute. **Leaf**: blade triangular-ovate, 9-17 × 8-12 cm, leathery; base broadly cuneate to cordate; margin entire or undulate; apex acute to acuminate; basal lateral veins 2; secondary veins 5-7 on each side of midvein; petiole slender, at least as long as half of leaf blade. **Figs**: axillary on leafy branchlets, paired or solitary, red when mature, globose to depressed globose, 1-1.5 cm in diam., smooth; peduncle 4-9 mm; involucral bracts ovate. Male, gall, and female flowers within same fig. **Male flowers**: few, near apical pore; sessile; perianth 2- or 3-lobed; margin revolute; stamen 1; filament short. **Gall flowers**: subsessile; perianth 3- 4, short, ovary oblong, smooth; style short; stigma enlarged, 2-lobed. **Female flowers**: sessile; perianth 4, short, narrow lanceolate; ovary oblong, smooth; style and stigma short. **Fruit**: achenes, oblong, 1x1 mm.

Flowering: March-April **Fruiting:** May-June

Ecology: open area, both in town and in deciduous forest, 310-750 m

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Pollinator: *Platyscapa quadraticeps* Mayr

11. *Ficus rumphii* Bl.

โพขี้นก (Pho khi nok) (Figure 4.18, 4.37)

Trees, 15 m tall; usually epiphytic; bark gray, wrinkled when dry. Stipules caducous, ovate-lanceolate, 1.5-2.5 cm; scar conspicuous, glabrous. **Leaf**: leaf blade cordate to ovate-cordate, 6-13 × 6-11 cm, leathery, glabrous; base cordate to broadly cuneate; apex acute to acuminate; basal lateral veins 4; secondary veins 5 or 6 on each side of midvein; petiole 6-8 cm. **Figs**: axillary on leafy branchlets, paired or in small clusters on leafless older branchlets, with dark spots when young, dark purple when mature, globose, 1-1.5 cm in diam., sessile; involucral bracts orbicular, small; apical bracts navel-like. Male, gall, and female flowers within same fig. **Male flowers**: few, scattered among other flowers; sessile; perianth 3, spatulate; stamen 1; filament as long as anther. **Gall flowers**: sessile; perianth 3, lanceolate, shorter than ovary. **Female flowers**: perianth 4, narrow lanceolate, shorter than ovary; ovary white, ovoid, smooth; style persistent; stigma clavate. **Fruit:** achenes thin, tuberculate, 1x1 mm.
Flowering: July-August, September **Fruiting:** August-September, October
Ecology: open area, 100-700 m
Pollinator: not seen in study areas

12. *Ficus superba* var. *japonica* Miq.

ไกร, เลียบ (Liap) (Figure 4.19, 4.37)

Trees, without aerial roots, bark brown. Stipules 5-10 cm long and leafy on the opening shoots, closely puberulous to subglabrous, pink. **Leaf**: leaf spirally arranged, glabrous, 5-8 x 9-15 cm, elliptic to oblong-elliptic; base truncate-subcordate to rounded, thinly coriaceous; lateral nerves 7-9(-10) pairs; basal nerves 2-3 pairs; petiole 4-16 cm. **Figs**: ramiflorous in pairs and in small clusters on woody on the twigs and branches, rarely in the leaf-axils; fig-body 7-11 mm wide, ripening white to pink, purple and black; peduncle 2-15 mm long. **Male flowers**: ostiolar in 2-3 rings; sessile; perianth bifid, membranous. **Gall-flowers**: sessile or with a short pedicel; perianth 3-4, free, reddish; ovary red-brown. **Female Flowers**: as the gall-flowers, but subsessile; style

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long, internal bristles none or few. **Fruit**: achene, subglobose, 1x1 mm.

Flowering: January-February **Fruiting:** February-March

Ecology: deciduous forest, in the village, 320-500 m

Pollinator: *Platyscapa* sp.

Subgenus *Pharmacosycea*

13. *Ficus callosa* Willd.

มะเดื่อกวาง (Ma duea kwang) (Figure 4.20, 4.37)

Trees, 25-35 m tall; bark gray to pale gray, hard; branchlets wrinkled when dry. Stipules ovate-lanceolate, 1-1.8 cm, pubescent. **Leaf**: blade broadly elliptic, 15-30 × 8-20 cm, leathery, scabrid on lower surface; base rounded to broadly cuneate; margin entire; apex obtuse or mucronate; secondary veins 8-11 on each side of midvein, prominent on both surfaces; petiole 3-9 cm. **Figs**: axillary on normal leafy stem, paired or solitary, yellow when mature; pear-shaped-ellipsoid, 1.2-2.5 × 1-1.5 cm, pubescent; base attenuate into a 1 cm stalk; apical pore flat; peduncle 1-1.2 cm; involucral bracts lanceolate-ovate, ca. 2 mm. Male, gall, and female flowers within same fig. **Male flowers**: near apical pore or scattered; subsessile; perianth 3-5, spatulate; stamen 1, filaments long. **Gall flowers**: subsessile; perianth 4, broadly lanceolate; stigma short. **Female flowers**: subsessile; perianth deeply 4-lobed, broadly lanceolate; style subapical, long and thin; stigma deeply 2-branched. **Fruit**: achenes, obovoid, 1x2 mm.

Flowering: August, October **Fruiting:** September, November

Ecology: open area, cultivated in town, 310-500 m

Pollinator: *Dolichoris malabarensis* Abdurahiman & Joseph

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Subgenus *Sycomorus*

14. *Ficus racemosa* L. var. *racemosa*

มะเดื่ออุทุมพร (Ma dduea utum phon) (Figure 4.21)

Trees, 25-30 m tall; monoecious; bark grayish brown, smooth. Stipules ovate-lanceolate, 1.5-2 cm. **Leaf**: ovate-lanceolate, 5-8 x 10-15 cm, glabrous; base cuneate;

margin entire; apex acute, young leaf blades and figs with bent hairs. Petiole 2-6 cm. **Figs**: paired or cluster on leafy branchlets, reddish orange when mature; pear-shaped, 2-5 cm in diam.; basally attenuated into a stalk; peduncle ca. 1 cm; involucral bracts triangular-ovate. Male, gall, and female flowers within same fig. **Male flowers**: near apical pore; subsessile; perianth 3 or 4, spatulate; stamens 2. **Gall flower:** both short and long pedicel present; perianth broadly with 3 or 4 toothed; style lateral. **Female flowers**: short pedicel; perianth broadly; apex 3 or 4 toothed; style lateral and long; stigma clavate. **Fruit**: achene, subglobse, 1x2 mm.

Flowering: year-round **Fruiting:** year-round

Ecology: riverside, along the stream, moist forest, 310-1,200 m

Pollinator: *Ceratosolen fusciceps* Mayr (Figure 4.42, 4.44)

15. *Ficus racemosa* L. var. *miquelli* (King) Corner

มะเดื่ออุทุมพร (Ma dduea utum phon) (Figure 4.21)

The different from var. *racemosa* is branchlets, young leaf blades, and figs densely covered with straight white pubescence.

Dioecious Figs

16. *Ficus auriculata* Lour.

เดื่อหว้า (Duea wa) (Figure 4.22, 4.38, 4.41)

Trees, 4-10 m tall, crown elongated and wide; dioecious; bark grayish brown, rough; branchlets reddish brown, 1-1.5 cm thick; leafless in middle of stem, pubescent. Stipules reddish purple, triangular-ovate, 1.5-2 cm, adaxially shortly pubescent. **Leaf**: alternate; leaf blade broadly ovate-cordate, 15-55 × 15-27 cm, glabrous or puberulent on midvein or secondary veins; base cordate to occasionally rounded; margin dentate; apex obtuse; basal lateral veins 4-6; secondary veins 3 or 4 on each side of midvein; petiole thick, 5-8 cm. **Figs**: on specialized leafless branchlets at base of trunk and main branches, reddish brown, pear-shaped, depressed globose, or top-shaped, with 8-12 conspicuous longitudinal ridges, 3-6 cm in diam., shortly pubescent when young, glabrescent when mature; peduncle 2-6 cm, thick, pubescent; involucral bracts triangular-ovate; apical bracts in 4 or 5 rows, broadly triangular-ovate, imbricate,

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rosulate. **Male flowers**: sessile; perianth 3, transparent, broadly spatulate, thinly membranous; stamens 2; filaments long; anthers ovoid. **Gall flowers**: perianth 3, apically free, covering ovary; style lateral; stigma enlarged. **Female flowers**: pedicellate or sessile; calyx lobes 3; ovary ovoid; style lateral. **Fruit**: achene, subglobose, 1x2 mm.

Flowering: 2 times; March, August **Fruiting:** 2 times; May, October

Ecology: forests in moist valleys, 600-2,000 m

Pollinator: *Ceratosolen emarginatus* Mayr

17. *Ficus fistulosa* Reinw. ex Bl.

ชิ้งแดง (Ching deang) form1 (Figure 4.23, 4.38, 4.41)

Small trees, bark dark brown; branchlets hispid. Stipules ovate-lanceolate, 1-2 cm. **Leaf**: alternate; leaf blade obovate to oblong, 10-20 × 4-8 cm, papery; base obliquely cuneate to rounded; margin entire or coarsely serrate; apex mucronate; basal lateral veins short; secondary veins 6-9 on each side of midvein; petiole 1.5-4 cm. **Figs**: on short branchlets on main branches, reddish orange or yellow when mature, globose, 1.5-2 × 1.5.-2.2 cm, subglabrous, smooth, apical pore not open; peduncle 0.8-2.4 cm. **Male flowers**: few, near apical pore; pedicellate; perianth 3 or 4; stamen 1; filament short. **Gall flowers**: sessile; perianth very short or absent; ovary obovate, smooth; style lateral, thin; stigma enlarged. **Female flowers**: pedicellate; perianth absent; style persistent, long, clavate. **Fruit:** achenes obliquely cubic, with small tubercles, 1x1 mm.

Flowering: February-April **Fruiting:** March-July

Ecology: forests along streams, 310-1,200 m

Pollinator: *Ceratosolen constrictus* Mayr

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***Ficus fistulosa* Reinw. ex Bl.**

ชิ้งขาว (Ching Khao) form2 (Figure 4.24)

Small trees, bark dark brown; branchlets hispid. Stipules ovate-lanceolate, 1-2 cm. **Leaf**: alternate; leaf blade obovate to oblong, 10-20 × 4-8 cm, papery; base obliquely cuneate to rounded; margin entire or coarsely serrate; apex mucronate; basal

lateral veins short; secondary veins 6-9 on each side of midvein; petiole 1.5-4 cm. **Figs**: on short branchlets on main branches, reddish orange or yellow when mature, globose, 1.5-2 × 1.5.-2.2 cm, subglabrous, smooth; apical pore not open; peduncle 0.8-2.4 cm. **Male flowers**: few; near apical pore; short pedicel; perianth 3 or 4, enclosing; stamen 2; filament short. **Gall flowers**: sessile; perianth very short; ovary obovate, smooth; style lateral, thin; stigma enlarged. **Female flowers**: perianth tubular, enclosing base of pedicel; style persistent, long, clavate. **Fruit:** achenes obliquely cubic, with small tubercles, 1x1.5 mm.

Flowering: May-July **Fruiting:** July-August

Ecology: forests along streams, moist area, 310-1,200 m

Pollinator: *Ceratosolen constrictus* Mayr

18. *Ficus hispida* L. f. var. *hispida*

มะเดื่อปล้อง (Ma duea plong) (Figure 4.25)

Shrubs or small trees, coarsely hairy, dioecious. Stipules usually 4 and decussate on leafless fruiting; branchlets, ovate-lanceolate. **Leaf**: opposite, with short thick hairs; blade ovate, oblong, or obovate-oblong, 10-25 × 5-10 cm, thickly papery; hispid on both surface; base rounded to cuneate; margin entire or toothed; apex acute; secondary veins 6-9 on each side of midvein; petiole 1-6 cm. **Figs**: axillary on fascicle from main stem, branch or leaf axile, covered by pale hairs, solitary or paired, yellow or red when mature, top-shaped, 1-3 cm in diam., with short scattered hairs; pedunculate; involucre bracts present; lateral bracts sometimes present. **Male flowers**: many, near apical pore, subsessile; perianth 3, broadly lanceolate, thinly membranous; stamen 1; filament long. **Gall flowers**: pedicellate; perianth absent; style subapical, short, thick. **Female flowers**: perianth absent; style lateral, long, hairs; ovary subglobose. **Fruit**: achene, subglobose, 1x2 mm.

Flowering: year-round **Fruiting:** year-round

Ecology: along streams, or moist soil areas, 310-1,500 m

Pollinator: *Ceratosolen solmsi* Mayr (Figure 4.42)

19. *Ficus hispida* var. *badiostrigosa* Corner

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มะเดื่อปล้อง (Ma duea plong) (Figure 4.25)

The different from var. *hispida* was figs on stolon which creeping on the ground or under ground (geocarpic figs), covered with dark brown hairs.

Flowering: year-round **Fruiting:** year-round

Ecology: along streams, or moist soil areas, in the village, 310-1,500 m

Pollinator: *Ceratosolen solmsi* Mayr

20. *Ficus oligodon* Miq.

เดื่อหลวง (Duea luang) (Figure 4.26)

Trees, 5-10 m tall; crown wide; dioecious; bark gray, smooth; branchlets sparsely pubescent. Stipules caducous, ovate-lanceolate, 1-1.5 cm, glabrous or puberulent. **Leaf**: alternate; blade obovate-elliptic to elliptic, 12-25 × 6-23 cm, papery; base shallowly cordate to broadly cuneate; margin irregularly toothed on apical 2/3; apex acute to acuminate; veins with sparse slender white hairs when young; basal lateral veins extending to middle of blade or beyond; secondary veins 4 or 5 on each side of midvein and abaxially prominent; petiole 4-8 cm. **Figs**: clustered on short branchlets of old stems, dark red when mature, pear-shaped to globose, with 4-6 longitudinal ridges and small tubercles, 2-3.5 cm in diam., puberulent, basally attenuated into a short stalk, apical pore depressed, bracts ovate and rosulate; peduncle 2.5-3.5 cm; involucral bracts triangular-ovate. **Male flowers**: near apical pore; shortly pedicellate; perianth 3, connate, thinly membranous; stamens 2; filament long. **Gall flowers**: many, on middle or lower part of fig; pedicellate to sessile; perianth 3, connate, narrow lanceolate, thinly membranous; ovary obovoid; style lateral, short. **Female flowers**: pedicellate; perianth 3, narrow lanceolate; style lateral, longer than in gall flowers. **Fruit**: achenes, obovoid, smooth, 1.5x2 mm.

Flowering: September-April **Fruiting:** May-June

Ecology: valleys, along streams or moist soil areas, 500-2,100 m

Pollinator: *Ceratosolen emarginatus* Mayr

21. *Ficus semicordata* Buch.-Ham. ex Sm.

เดื่อปล้องหิน (Duea plong hin) (Figure 4.27, 4.40, 4.41)

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Trees, 3-10 m tall, crown flat, spreading and umbrella-like; bark gray, smooth; branchlets white or brown pubescent; stipules red, lanceolate, 2-3.5 cm, membranous, subglabrous. **Leaf**: distichous, densely covered with stiff hairs; blade oblong-lanceolate, strongly asymmetric, 18-28 × 9-11 cm; base obliquely cordate on one side and auriculate on other side; margin with small teeth or entire; apex acuminate; basal lateral veins 3 or 4 on auriculate side of leaf blade, and extending into auriculate base; secondary veins 8-14 on each side of midvein; petiole thick, 5-10 mm. **Figs**: on pendulous, eventually prostrate, leafless branchlets, underground at maturity; solitary, reddish purple when mature, globose, 1-1.5 cm in diam., stiffly hairy; peduncle 5-10 mm; involucral bracts pubescent; lateral bracts present. **Male flowers**: near apical pore; perianth 3, red, lanceolate, longer than stamens, stamens 1 or 2; filaments short; anthers white. **Gall flowers**: perianth 4 or 5, linear-lanceolate; style lateral, short. **Female flowers**: basal bracteole 1; perianth 4 or 5; ovary ovoid-ellipsoid; style lateral, long; stigma cylindric, shallowly 2-lobed. **Fruit:** achenes, broadly ovoid, 1x1.5 mm.

Flowering: March, August, December **Fruiting:** April, September, January

Ecology: forest margins, valleys, along trails, 600-1,900 m

Pollinator: *Ceratosolen gravelyi* (Grandi)

22. *Ficus squamosa* Roxb.

เดื่อผา (Deua pha) (Figure 4.28, 4.38)

Shrubs, small, erect, rooting adventitiously; branchlets and petioles densely coarsely brown hairy. Stipules lanceolate, 5-10 mm. **Leaf**: spirally arranged, clustered apically on branchlets, densely covered with stiff thick rust-colored hairs; blade oblanceolate to oblong, 4.5-13 × 1.2-3.2 cm, papery, with long thick rust-colored hairs on midvein but sparsely pubescent on other veins; base narrowly cuneate; margin entire or apically sparsely toothed; apex acuminate; basal lateral veins short; secondary veins 6-8 on each side of midvein, apically curved and looped at margin.; petiole 0.5-1 cm. **Figs**: axillary or branchlets from old stems, solitary, globose, 1.5-2 cm in diam., with prominent longitudinal ridges, densely covered with thick rust-colored hairs or villous, basally attenuated into a ca. 8 mm stalk; pedunculate; involucral bracts unequal. **Male flowers**: perianth 3 or 4; stamen 1; anther ovoid to

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obovoid. **Gall flowers**: subsessile; perianth absent; ovary smooth; style lateral, short, stigma tubular. **Female flowers**: similar to gall flowers; style persistent silk-like, with long hairs. **Fruit**: achenes rhombic-ovoid, with hairs, 1x1 mm

Flowering: January-March, May-July **Fruiting:** April-May, July-October

Ecology: moist forests, near the stream or on the rock in stream and falls, 700-1,200 m

Pollinator: *Ceratosolen* sp.

23. *Ficus variegata* Blume

ผุก (Phuk) (Figure 4.29)

Trees, 7-15 m tall; bark gray to grayish brown, smooth; branchlets green, sparsely pubescent. Stipules ovate-lanceolate, 1-1.5 cm, glabrous. **Leaf**: alternate; leaf blade broadly ovate to ovate-elliptic, 10-17 cm, thick papery, pubescent when young; base rounded to shallowly cordate; margin entire, undulate, or shallowly toothed; apex acute, acuminate, or obtuse; basal lateral veins 4, outer 2 thin and short; secondary veins 4-16 on each side of midvein; petiole 2.5-6.8 cm. **Figs**: clustered on shortly tuberculate branchlets from old stem, red, with green stripes and spots when mature, globose to depressed globose, 2.5-3.5 cm in diam., apex slightly depressed and navel-like; apical pore convex; bracts ovate; peduncle 2-4 cm, slender; involucral bracts caduceus; scar ringlike. **Male flowers**: near apical pore, sessile; perianth 3 or 4, broadly ovate; stamens 2, filaments basally connate. **Gall flowers**: near apical pore; calyx 4- or 5-lobed; transparent, membranous, lanceolate; style lateral, short; stigma funnelform. **Female flowers**: perianth 3 or 4, connate at base, thinly membranous, linear lanceolate; style persistent, as long as achenes, broadly in the mid; stigma clavate, glabrous. **Fruit:** achenes obovoid, finely tuberculate, 1.5x1 mm.

Flowering: April-May, December-January **Fruiting:** May, January

Ecology: valleys or moist open areas

Pollinator: *Ceratosolen appendiculatus* Mayr

Subgenus *Ficus*

24. *Ficus ischnopoda* Miq.

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ลูกคล้าย (Luk khlai) (Figure 4.30, 4.39, 4.41)

Shruby trees, 2-3 m tall; bark gray; branchlet internodes red, short. Stipules linear-lanceolate, ca. 8 mm. **Leaf**: clustered apically on branchlets; blade elliptic-lanceolate to oblanceolate, 4-13 × 1.3 cm, both surfaces glabrous; apex acuminate; basal lateral veins short; secondary veins 7-15 on each side of midvein, and apically curved; petiole 5-8 mm. **Figs**: axillary on leafy or older leafless branches, solitary or occasionally paired, conic to spindle-shaped, with longitudinal ridges 1.2 × 0.5-0.8 cm; basally attenuate into a short stalk; peduncle 1-1.5 cm; involucral bracts 3 or 4, semipersistent. **Male flowers**: near apical pore; pedicellate; perianth 3 or 4, oblanceolate; stamens 2; anthers ellipsoid. **Gall flowers**: subsessile; perianth 4, short; ovary globose; style lateral, short. **Female flowers**: subsessile; perianth 4, short; style persistent, long; stigma 2-lobed, hairs. **Fruit:** achenes, reniform, 1x1.5 mm

Flowering February-June **Fruiting:** May-August

Ecology: river banks, on the crack rock in the stream or falls, 310-2,200 m

Pollinator: *Blastophaga* sp.

25. *Ficus hirta* Vahl

เดื่อขน (Duea Khon) (Figure 4.31)

Shrubs or small trees; branchlets leafless in middle, golden yellow or brown hirsute. Stipules red, ovate-lanceolate, 1.3 cm, membranous, pubescent. **Leaf**: alternate, brown hirsute; blade simple or palmately 3-5-lobed, 8x25 cm, glabrous or golden yellow hirsute; base cuneate; rounded, or shallowly cordate; margin entire or with small serrations; apex acute to acuminate; basal lateral veins 2-4; secondary veins 4-7 on each side of midvein; petiole 1.8 cm. **Figs**: axillary on normal leafy shoots, paired, globose, 1-3 cm in diam., with long stiff spreading golden yellow or brown hairs and also pubescent. **Male flowers**: pedicellate; perianth 4, red, lanceolate; stamens 2 or 3; anthers ellipsoid, longer than filaments. **Gall flowers**: sessile; perianth 4, broadly lanceolate; ovary globose, smooth; style lateral, short; stigma funnelform. **Female flowers**: sessile or pedicellate; perianth 4; style persistent, long, thin; stigma clavate. **Fruit:** achenes ellipsoid-globose, smooth, 1x1.5 mm.

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Flowering: December, April, September **Fruiting:** January, May, October
Ecology: forests, forest margins, open areas; low elevations
Pollinator: *Blastophaga javana* Mayr

Subgenus ***Synoecia***

26. *Ficus anserina* Corner - (Figure 4.32, 4.39, 4.41)

Shrubs, scandent; old branchlets glabrous, young branchlets densely covered with coarse dark brown hairs. Stipules caducous, lanceolate, ca. 4 cm. **Leaf**: distichous, sparsely pubescent; blade brown when dry, oblong to narrow elliptic, 30-35 × 10-15 cm, leathery, densely covered with brownish red short pubescence; base cuneate to occasionally rounded; margin entire; apex shortly acuminate; basal lateral veins not extending to 1/3 of leaf blade length; secondary veins 5-7 on each side of midvein, petiole ca. 1 cm. **Figs**: pear-shaped, 6-9 × 4-6 cm, ridged on surface, densely covered with rust-colored scale-like hairs; peduncle 3-15 mm. **Male flowers**: near apical pore; pedicel long; perianth 4, oblanceolate, unequal in size; stamens 2; filaments very short; anthers oblong, mucronate. **Gall flowers**: perianth 5, slightly recurved; involucral bracts reniform, pubescent, spatulate; style subapical. **Female flowers**: subsessile; perianth 4; style subapical, long. **Fruit**: achenes oblong, slightly depressed, 2-2.5 mm.

Flowering: March-May, Septeber **Fruiting:** June-August, October
Ecology: rain forests, forests, mountain slopes, limestone areas, 400-1400 m
Pollinator: not seen in study areas

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27. *Ficus pumila* L.

มะเดื่อเถา (Ma duea thao) (Figure 4.33, 4.39, 4.41)

Shrubs, climbers or scandent; rooting branchlets sterile. Stipules lanceolate, with yellow brown silk-like hairs. **Leaf**: distichous; blade different in shape, ovate-cordate, ovate-elliptic, or oblong-ovate, 5-12 × 2-5 cm; base rounded to slightly

cordate; margin entire; apex obtuse, acute, or acuminate; veins conspicuous, honey comb-like; basal lateral veins elongated; secondary veins 3 or 4 on each side of midvein. **Figs**: axillary on normal leafy branches, solitary, yellowish green to pale red when mature, pear-shaped to globose or cylindric, 4-8 × 3-5 cm, shortly yellow pubescent when young; basally attenuate into a short stalk; apical pore truncate, or acuminate; peduncle to ca. 1 cm, thick; involucral bracts triangular-ovate, densely covered with long pubescence, persistent. **Male flowers**: many, in several rows near apical pore; pedicel long, perianth 3 or 4, linear; stamens 2; filaments short. **Gall flowers**: sessile; perianth 3 or 4, linear; style lateral, short; stigma funnelform. **Female flowers**: pedicellate; perianth 4. **Fruit**: achenes, globose, 2x2.5 mm.

Flowering: May-August **Fruiting:** May-August

Ecology: cultivated plant, native plant from South China through Malaysia

Pollinator: not seen in study areas

Subgenus ***Sycidium***

28. *Ficus anastomosans* Berg - (Figure 4.34, 4.40)

Shrubs, terrestrial, sometime subscandent. growing on the rock; bark slightly coarse. Branchlets drying brown. **Leaf**: distichous; lamina elliptic to ovate-elliptic, asymmetric, 3.5-7 × 2.5-4 cm, subcoriaceous; base round to obtuse; margin crenate-dentate to sublobate; apex obtuse to acute; basal lateral veins short; secondary veins 5-7, on each side of midvein; petiole thick, 3-5 mm. **Figs**: axillary on normal leafy shoots, solitary or paired, globose or subglobose-shaped, 4-7 mm in diam., hairy; peduncle very short, purple red in seed fig and orange yellow in gall fig. **Male flowers**: sessile; perianth 2-3, lanceolate; stamen 2; filament long, red. **Gall flowers**: pedicellate; perianth 3-4, transparent; style short, lateral; ovary obliquely ovoid. **Female flowers**: perianth 3-4, thin, transparent, linear; style persistent, lateral, short; stigma enlarged. **Fruit**: achenes ellipsoid, keeled, with tubercles, 1x1 mm.

Flowering: May-July **Fruiting:** July-August

Ecology: limestone mountain, crack of the rock, open and dry areas, 500-900 m

Pollinator: *Liporrhopalum* sp. (Figure 4.42)

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29. *Ficus subincisa* Buch.-Ham. ex Smith

มะเดื่อน้อย (Ma duea noi) (Figure 4.35, 4.40)

Shrubs or small trees, 1-3 m tall; bark dark grayish; branchlets reddish brown, slender, narrowly winged. Stipules caducous, linear to lanceolate, ca. 5 cm. **Leaf**: blade obovate-oblong to elliptic-lanceolate, 4-12 × 2-5 cm, papery; base cuneate; margin apically undulate or with a few blunt teeth; apex long-caudate; basal lateral veins short; secondary veins 5-7 on each side of midvein; oblique to near margin then looped; petiole 4-6 mm. **Figs**: axillary on normal leafy shoots, solitary, when mature, reddish orange in seed fig and yellow in gall fig, ellipsoid to globose, 0.6-2.5 cm in diam., smooth or tuberculate and lenticellate; peduncle 2-10 mm; involucral bracts triangular. **Male flowers**: near apical pore; pedicellate; perianth 4; stamen 1. **Gall flowers**: subsessile; perianth 3; ovary smooth; style lateral; stigma shortly funnelform. **Female flowers**: pedicellate; perianth 3; style lateral, long; stigma enlarge. **Fruit**: achenes, lens-like, smooth, 1x1 mm.

Flowering: May-July **Fruiting:** September-October

Ecology: moist forests, along streams, valleys, 400-2,000 m

Pollinator: *Liporrhopalum* sp.

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Figure 4.9 *Ficus altissima* Bl.; a. fruiting branch, b. leaf, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

Figure 4.10 *Ficus benjamina* L.; a. fruiting branch and leaves, b. hairy fruit of *F. benjamina var. nuda* (Miq.) Barrett., c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.11 *Ficus curtipes* Corner; a. leaves, b. long section of syconium c. male flower, d. gall flower, e. female flower (seed)

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Figure 4.12 *Ficus drupacea* Thunb.; a. fruiting branch, b. long section of syconium c. male flower, d. gall flower, e. female flower (seed)

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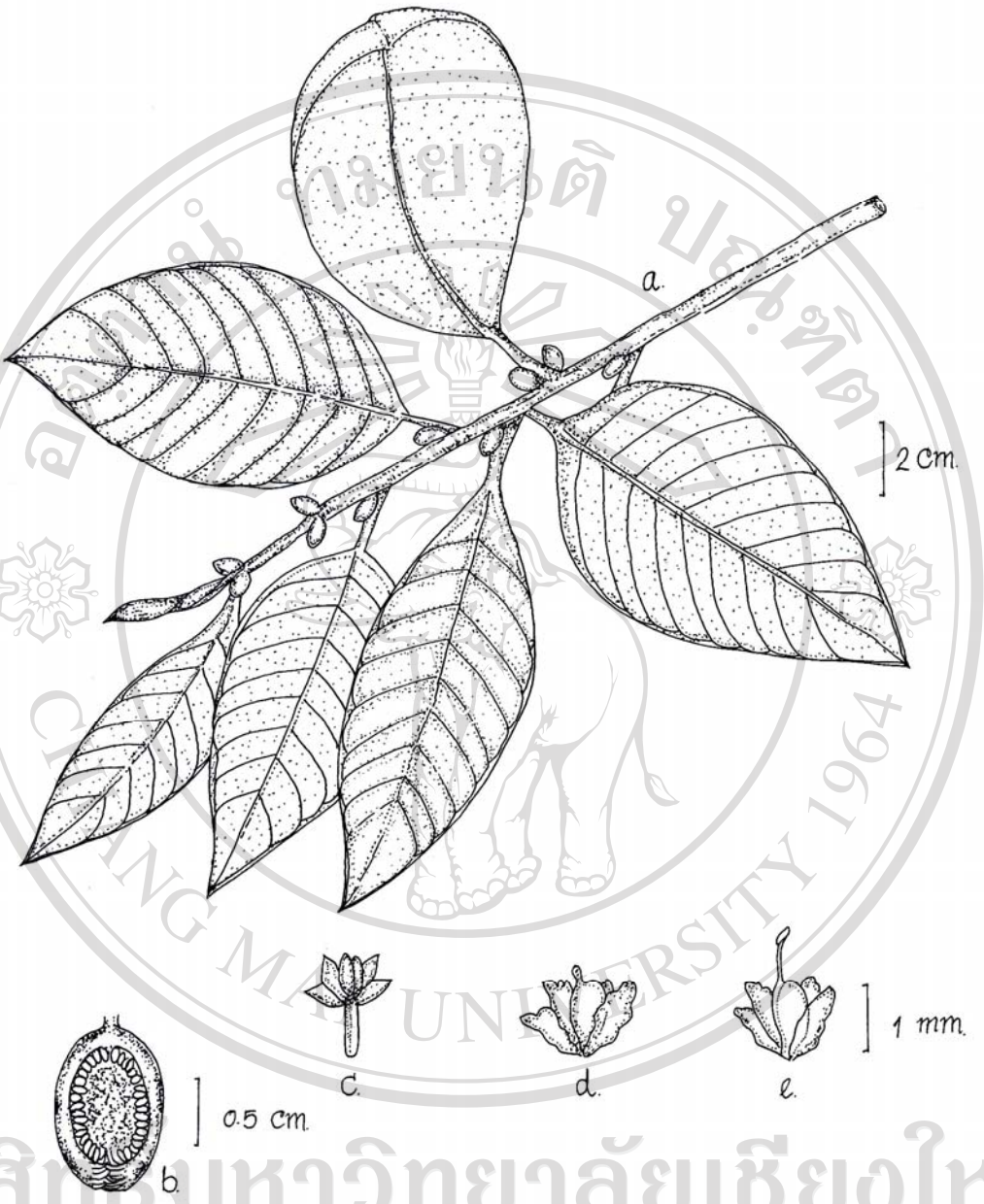

Figure 4.13 *Ficus elastica* Roxb.; a. fruiting branch, b. long section of syconium c. male flower, d. gall flower, e. female flower (seed)

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Figure 4.14 *Ficus lacor* Buch. Ham.; a. leaf, b. fruiting branch, c. young leaves and stipule, d. long section of syconium, e. flowers arrangement, f. male flower, g. gall flower, h. female flower (seed)

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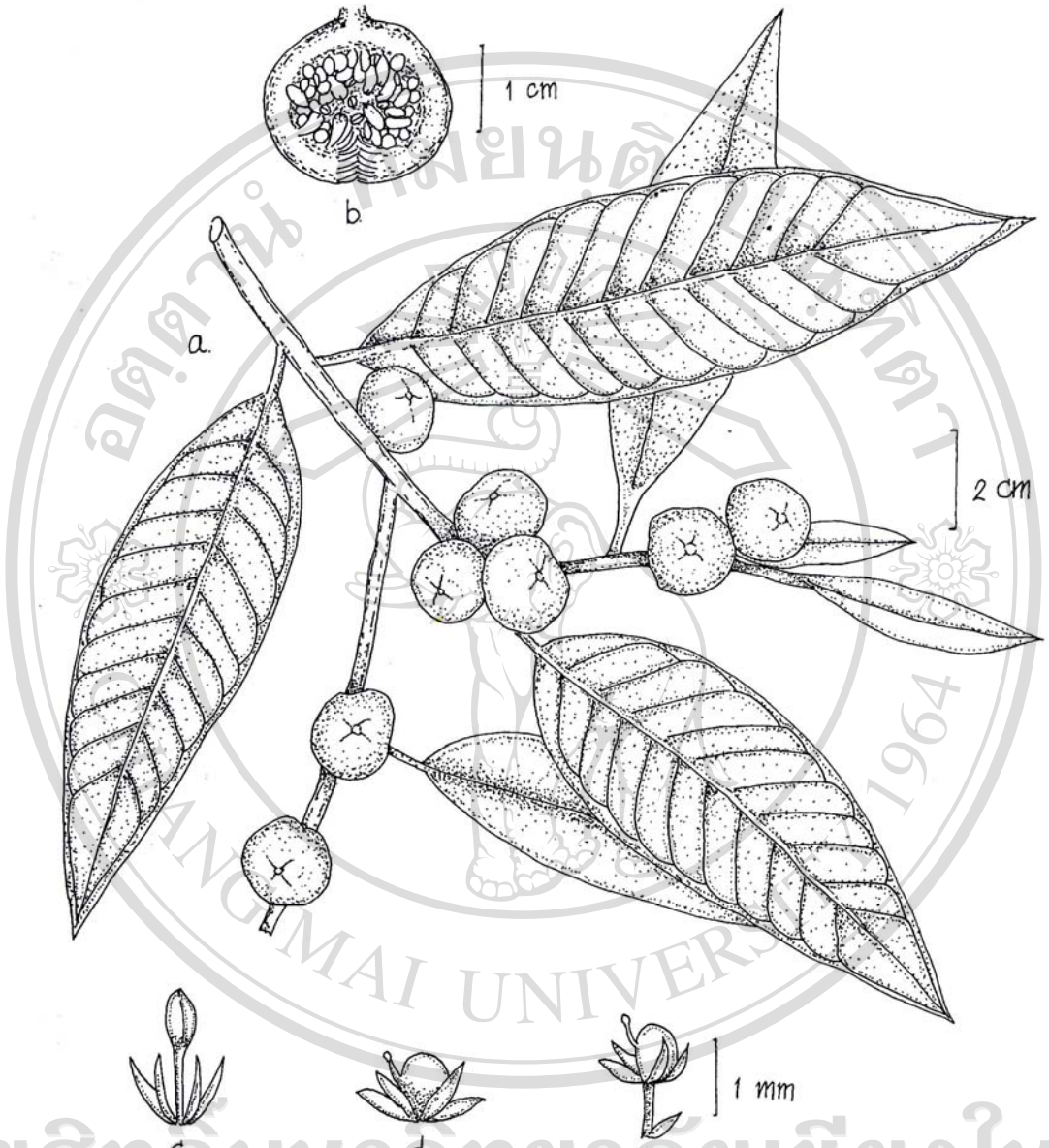

Figure 4.15 *Ficus maclellandii* King; a. fruiting branch, b. long section of syconium, c. male flower, d. gall flower, e. female flower (seed)

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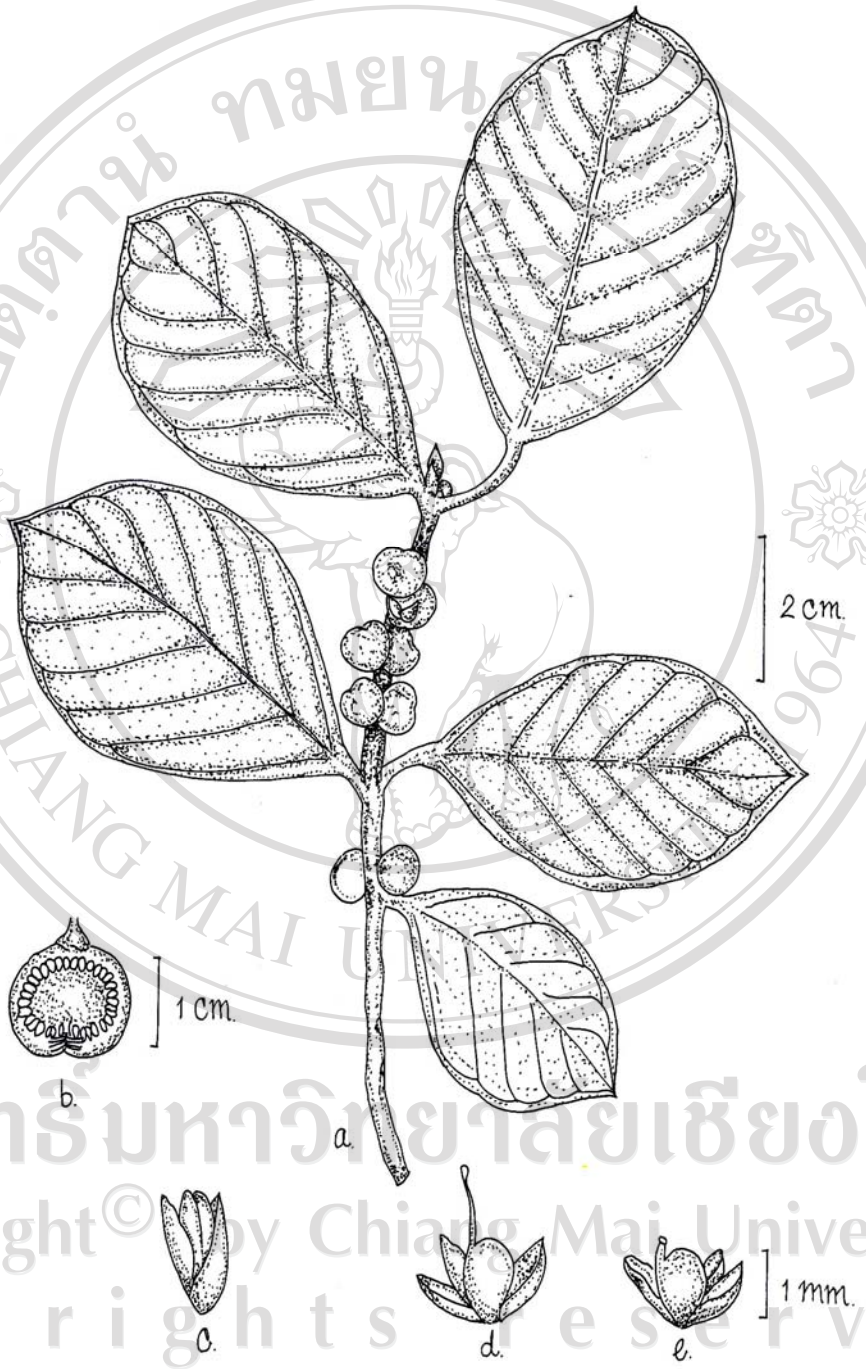

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Figure 4.16 *Ficus microcarpa* L. f.; a. fruiting branch, b. long section of syconium, c. male flower, d. female flower (seed), e. gall flower

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Figure 4.17 *Ficus religiosa* L.; a. fruiting branch, b. pair of fruits, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.18 *Ficus rumphii* Bl.; a. fruiting branch, b. long section of syconium, c. male flower, d. gall flower, e. female flower (seed)

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Figure 4.19 *Ficus superba* var. *japonica* Miq.; a. fruiting branch, b. stipule, c. fruiting on trunk, d. long section of syconium, e. male flower, f. gall flower, g. female flower (seed)

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Figure 4.20 *Ficus callosa* Willd.; a. fruiting branch, b. long section of syconium, c. male flower, d. gall flower, e. female flower (seed)

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Figure 4.21 *Ficus racemosa* L.; a. leaves, b. fruiting branch, c. hairy fig of *F. racemosa var. miquelli* (King) Corner, d. long section of syconium, e. male flower, f, g. gall flower, h. female flower (seed)

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Figure 4.22 *Ficus auriculata* Lour.; a. leaf, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

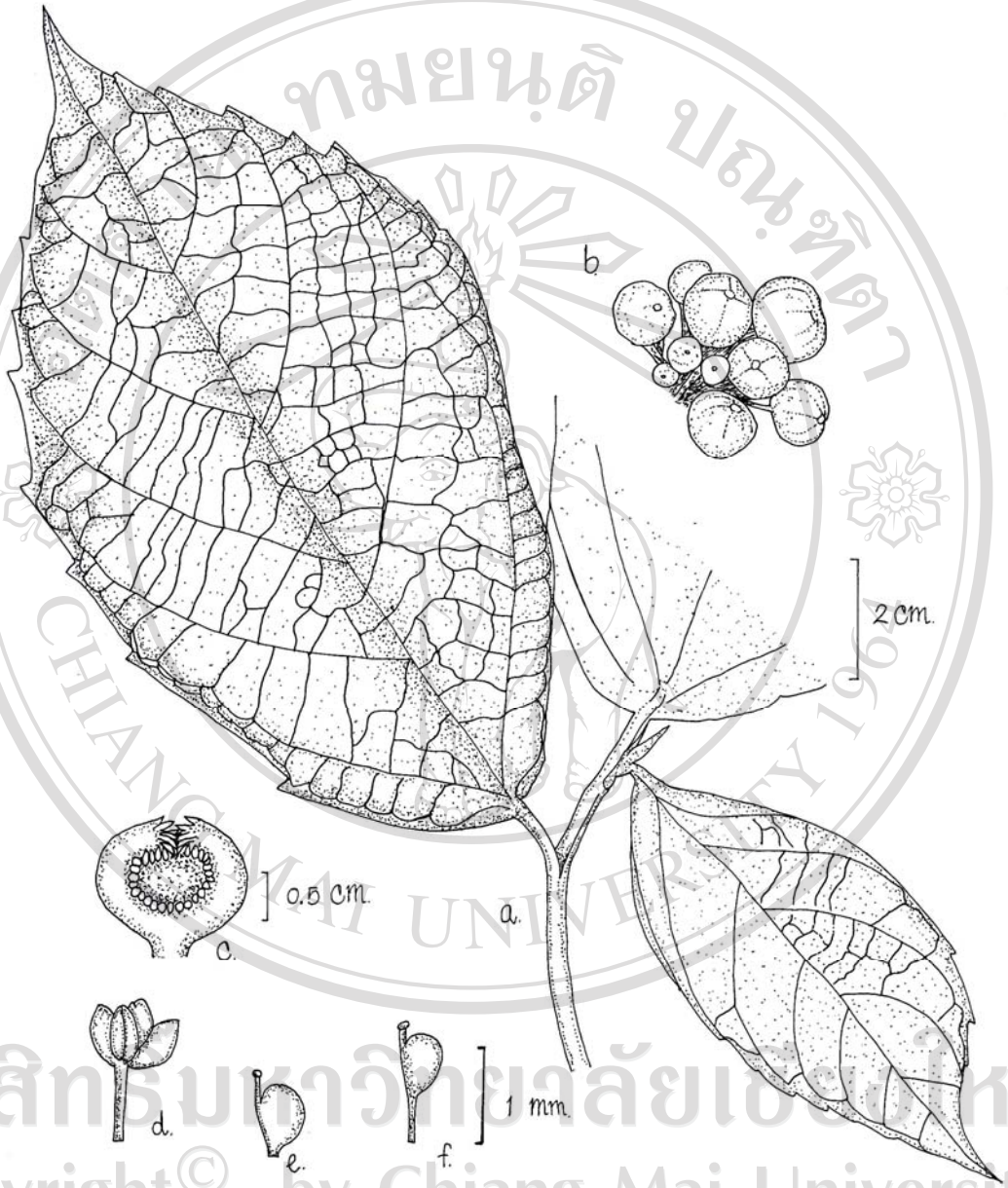

Figure 4.23 *Ficus fistulosa* Reinw. ex Bl.(red flowers); a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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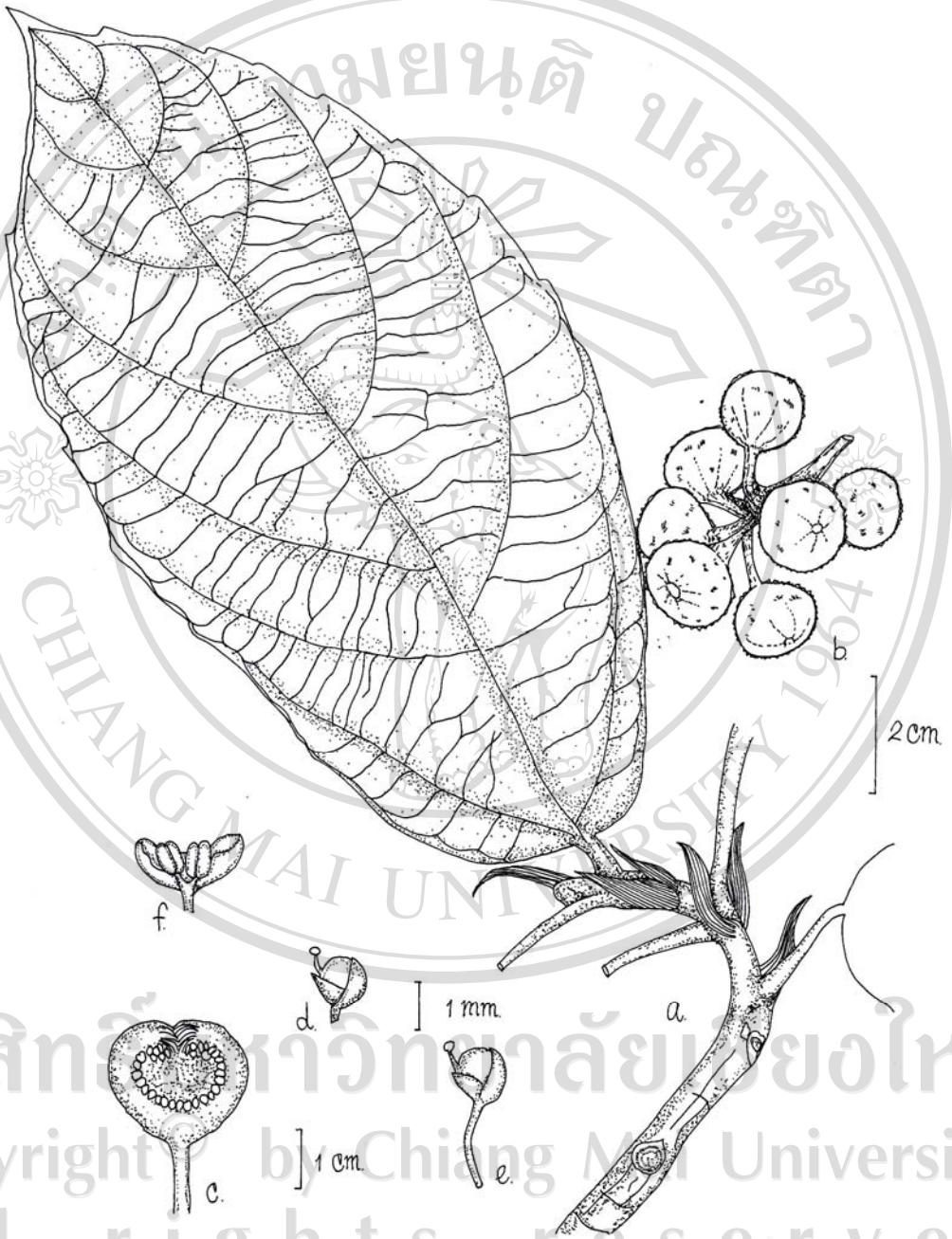

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Figure 4.24 *Ficus fistulosa* Reinw. ex Bl.(white flower); a. leaves, b. figs, c. long section of syconium, d. gall flower, e. female flower (seed), f. male flower

Figure 4.25 *Ficus hispida* L.f. var. *hispida*; a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f, g. female flower (seed)

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Figure 4.26 *Ficus oligodon* Miq.; a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.27 *Ficus semicordata* Buch.-Ham. ex Sm.; a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.28 *Ficus squamosa* Roxb.; a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.29 *Ficus variegata* Blume; a. leaves, b. figs, c. long section of syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.30 *Ficus ischnopoda* Miq.; a. fruiting branch, b. long section of male syconium, c. long section of female syconium, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.31 *Ficus hirta* Vahl.; a. fruiting branch, b. long section of male syconium, c. male flower, d. gall flower, e. female flower (seed)

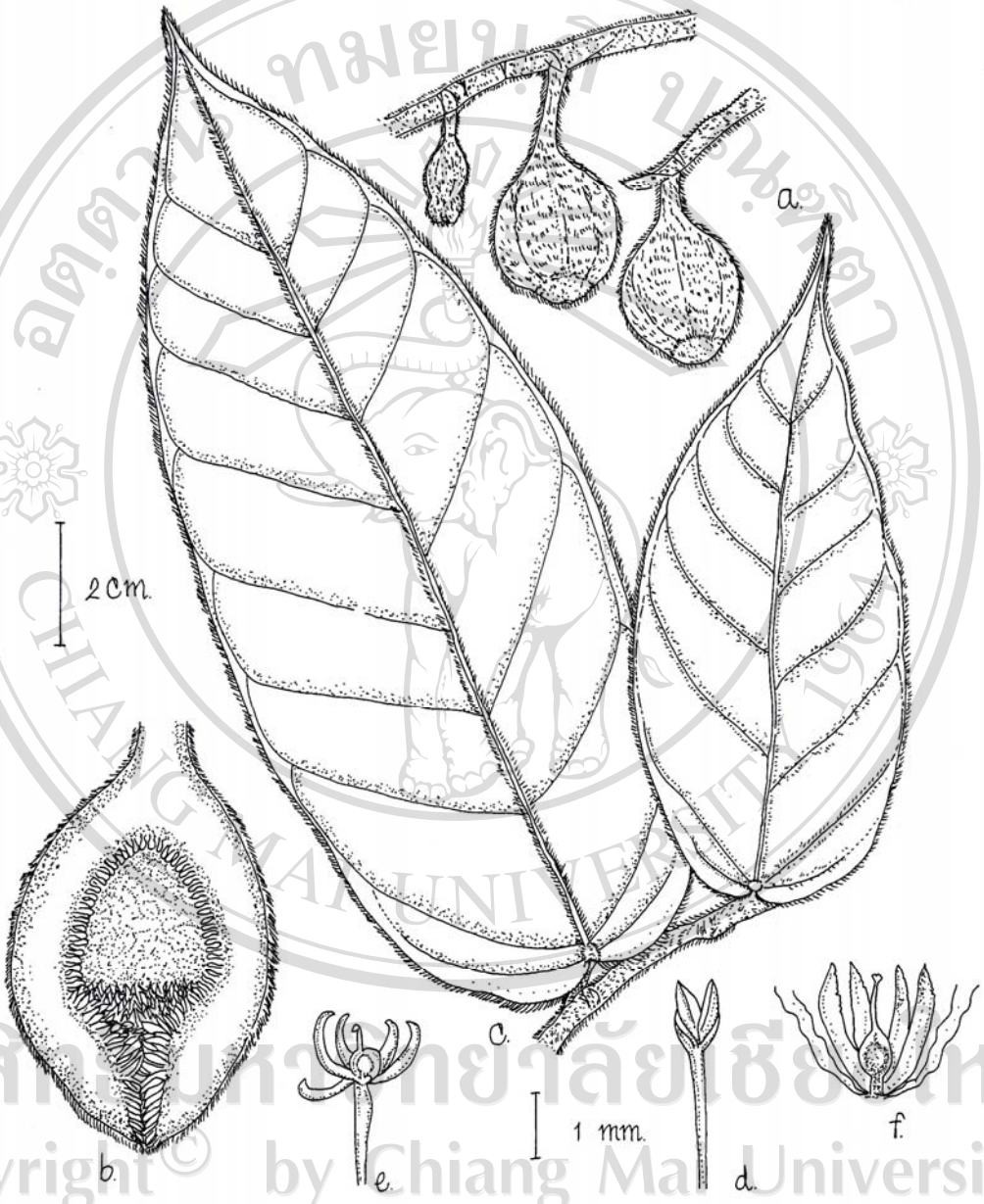

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Figure 4.32 *Ficus anserina* Corner; a. fruits, b. long section of male syconium, c. leaves, d. male flower, e. gall flower, f. female flower (seed)

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Figure 4.33 *Ficus pumila* L.; a. fruiting branch, b. long section of male syconium, c. male flower, d. gall flower

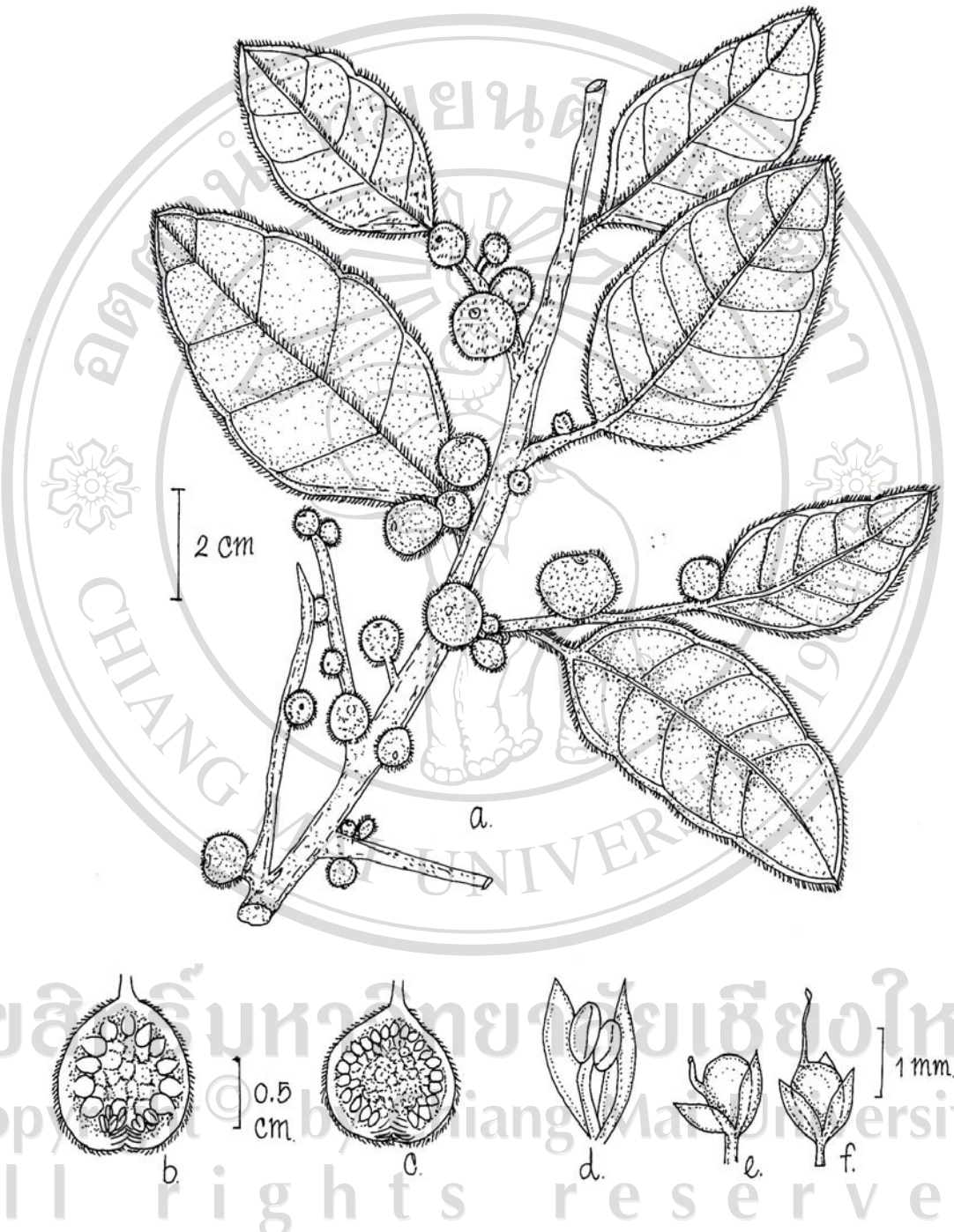

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Figure 4.34 *Ficus anastomosans* (Corner) Berg; a. fruiting branch, b. long section of male syconium, c. long section of female syconium, d. male flower, e. gall flower, f. female flower

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Figure 4.35 *Ficus subincisa* Buch.-Ham. ex Sm.; a. fruiting branch, b. long section of syconium, c. male flower, d. gall flower, e. female flower (seed)

4.5 ECOLOGY AND DISTRIBUTION

The fig trees were found from 310 to 1,200 m asl. The native and cultivated plants occurred in different habitats. Some species survive in unique habitats, whereas some can thrive everywhere. However, most fig trees were often found in the moist areas such as waterfalls, streams and river bank. Some figs found in the high elevation, about 800-1,200 m. of altitude, *F. auriculata*, *F. semicordata*, *F. fistulosa*, *F. subincisa*, *F. oligodon* and *F. anserina*. In the upper land, temperature reduced to 10 º C in the winter and reached to 31º C in the summer (Inthanon Research Station of Royal Project Foundation, 2007).

The others were normally distributed lower than that e.g. *F. altissima, F drupacea, F. benjamina, F. elastica, F. lacor, F. microcarpa and F. religiosa*. They were represented in general throughout the forest and urban areas. Meanwhile, some species e.g. *F. racemosa*, *F. hispida*, *F. squamosa* were dispersed both in the lowland and highland.

A couple species of 'rheophytic shrubs', which were low bushy shrubs with creeping stem, in rocky beds of quick running stream were *F. squamosa* and *F. ischnopoda*. The former species grow on the rock or ground near the stream. Their fruits originate on the branches at the water level or under. In their fruits, this species was adapted to have a brush long hair of stigma which persists when fruiting. That may promote the success of dispersal and establishment. The latter can grow both on the ground of river bank and on the rock in the water as well. The plant was bigger in size than *F. squamosa* and showy fruiting. Hence, their fruits were attractive to many bird, that the persistent stigma was hairless shorter than the former species.

The lithophytes growing on cracked rock were *F. anserina* and *F. anastomosans*. The first one was a woody climber in moist forests, while another was a small shrub occurring on limestone in open arid mountain and its ecology range was narrow in the Thailand, Myanmar, and Celebes (Indonesia) (Berg and Corner, 2005). Both fig species and their pollinators were small in population at the studied site. In each crop, there were more than fifty percent of aborted figs.

Several habits of fig trees represented were, for example, shrub, climber, tree and a special character of some groups called 'strangler'. Most members of subgenus *Urostigma* started growing as epiphytes and become strangler when mature. Eight

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species were both natural and cultivated plants including *Ficus altissima*, *F. benjamina*, *F. lacor*, *F. microcarpa*, *F. religiosa*, *F. superba* var. *japonica*, *F. callosa* and *F. hispida*.

Their pollinators were mostly found in each fig specimens except 5 species, i.e. *F. curtipes, F. rumphii*, *F. pumila*, *F. maclellandii* and *F. anserina,* that only flower and fall. The common species of monoecious were *F. benjamina*, *F. lacor, F. religiosa* and *F. racemosa*. They were strangler plants that were mainly birds' food and usually dispersed by them. Except the last species, *F. racemosa*, that its fruits are usually preserved by some small mammals such as squirrels, fruit eating bats and insect- eating birds. Hence, its seedling occasionally found under its crown or at the river bank.

The number of flowering and fruiting times are diverse in each fig tree. The shorter one is only a time a year and it can be 5-6 times in some species such as *F. racemosa* and *F. hispida* (Table 4.2). Both species can release the large number of fig wasps in each crop.

Table 4.2 The characters, habits and appearance of *Ficus* and their pollinators in Chiang Mai during June 2005-May 2007.

No	*Ficus* species	Sexual system	Pollinators present?	Habits	Crop / year
1	*F. altissima* Bl.	M	Yes	E /T	1-2
2	*F. benjamina* L.var. *benjamina*	M	Yes	E /T	2-3
3	*F. benjamina* var. *nuda* (Miq.) Barrett.	M	Yes	E /T	2-3
4	*F. curtipes* Corner	M	No	E /T	1
5	*F. drupacea* Thunb.	M	Yes	T	1
6	*F. elastica* Roxb.	M	Yes	E/T	1
7	*F. lacor* Ham.	M	Yes	E /T	1
8	*F. maclellandii* King	M	Yes	T	1-2
9	*F. microcarpa* L.f.	M	Yes	E /T	1-2

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10	*F. religiosa* L.	M	Yes	E /T	1-2

Table 4.2 The characters, habits and appearance of *Ficus* and their pollinators in Chiang Mai during June 2005-May 2007. (continued)

No	*Ficus* species	Sexual system	Pollinators present?	Habits	Crop / year
11	*F. rumphii* Bl.	M	No	E /T	1-2
12	*F. superba* Miq. var. *japonica* Miq.	M	Yes	E /T	1
13	*F. callosa* Willd.	M	Yes	T	1-2
14	*F. racemosa* L. var. *racemosa*	M	Yes	ST	5-6
15	*F. racemosa* var. *miquelli* (King) Corner	M	Yes	ST	5-6
16	*F. auriculata* Lour.	D	Yes	ST	1-2
17	*F. fistulosa* form1, form2	D	Yes	ST	1-2
18	*F. hispida* var. *hispida* L.f.	D	Yes	ST	5-6
19	*F. hispida* var. *badiostrigosa* Corner	D	Yes	ST	5-6
20	*F. oligodon* Miq.	D	Yes	T	1-2
21	*F. semicordata* Buch.-Ham. ex J. E. Sm.	D	Yes	ST	2-3
22	*F. squamosa* Roxb.	D	Yes	R/L	2-3
23	*F. variegata* Blume	D	Yes	T	1-2
24	*F. ischnopoda* Miq.	D	Yes	R/L	2-3
25	*F. hirta* Vahl	D	Yes	S	2-3
26	*F. anserina* Corner	D	No	C/L	1-2
27	*F. pumila* L.	D	No	C	2-3
28	*F. anastomosans* (Corner) Berg	D	Yes	C/L	2-3
29	*F. subincisa* Buch.-Ham. ex Smith	D	Yes	S	2-3

M= monoecious, D=dioecious, E= epiphytes, T= tree, S= shrub, ST= small tree,

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C= climbing, R, = rheophytes, L= lithophytes

4.6 DISCUSSION AND CONCLUSION

The publications of taxonomic study on figs in Thailand are still a few numbers. In this study, the neighbors' floras were used.

Twenty-six fig species found in the study sites, Chiang Mai. Most of the fig trees had their specific pollinators, except *Ficus auriculata* and *F. oligodon* that shared the same species of *Ceratosolen emarginatus* Mayr as the pollinator. The pollinators of *F. curtipes, F. rumphii*, *F. pumila*, *F. maclellandii* and *F. anserina* could not be found in the survey.

The widespread fig species usually possessed a large number of individuals of pollinators. However, the number varied in each season. The figs with a small number of fig wasp populations were *F. ischnopoda* and *F. subincisa*. Many figs aborted in a few weeks. It might be as a result of the small population of the fig trees in the wild. The ripen fruits of *F. racemosa* was served many kind of animals so that they can distribute lots of seedling. Number and size of figs in each crop was one of the reasons to promote them. However, some fig species produced a small size such as *F. benjamina*, but the large number of their figs attracted many kinds of bird, which help them planting new generation, also the same as *F. microcarpa* and *F. lacor*.

Sometimes the complication caused by local name of the plant, e.g. fig tree that we call 'Sai' in Thai is the one of sacred tree that the people avoid to cut down, indeed many figs in *Urostigma* usually name to 'Sai' such as *F. benjamina*, *F. macrocarpa*, *F. curtipes*, *F. maclellandii.* Another pair of missing usually occurs between *F. religiosa* 'Pho' and *F. rumphii* 'Pho khi nok' that people often have wrong selecting to plant.

The population of the fig pollinators was diverse in each fig species. The widespread fig species usually present a large number of their pollinators. However, they were different occurred in each season. For instance, *F. racemosa*, the production of pollinator offspring was higher in dry season (January and November) than rainy season (Wang *et al*., 2005, and our observation). The fig with less number of fig wasp population were *F. anserin*a, *F. subincisa* and *F. anastomosans*, many figs failed without entering. The results may be the small population fig trees in the wild. Besides the pollinators, that effect to size of both populations, their dispersal carriers

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was also the important factor. The results showed that the animal attractive figs usually success to disperse and get more new generation.

There were diverse types of fig tree characters represented such as leaf shape and syconium. However, within the species of dioecious fig, male and female figs always present the same characters in the wild. For the study of their morphology, it difficult to separate male from female tree until their syconium occurred.

The ripen fruits of many figs served many kind of animals so that they can distribute lots of their seedling. Some figs produced a large number of seeds in each crops and success to distribute in nature such as *F. racemosa*, *F. hispida* and *F. auriculata*. Whereas, some figs have small size of syconium as well as produce not many seeds.

In order to complete the knowledge of fig biology and classification, future studies on the details of interaction between figs and fig wasps should be of valuable works. It would be support the knowledge of fig diversity, distribution and also conservation of natural ecosystem.

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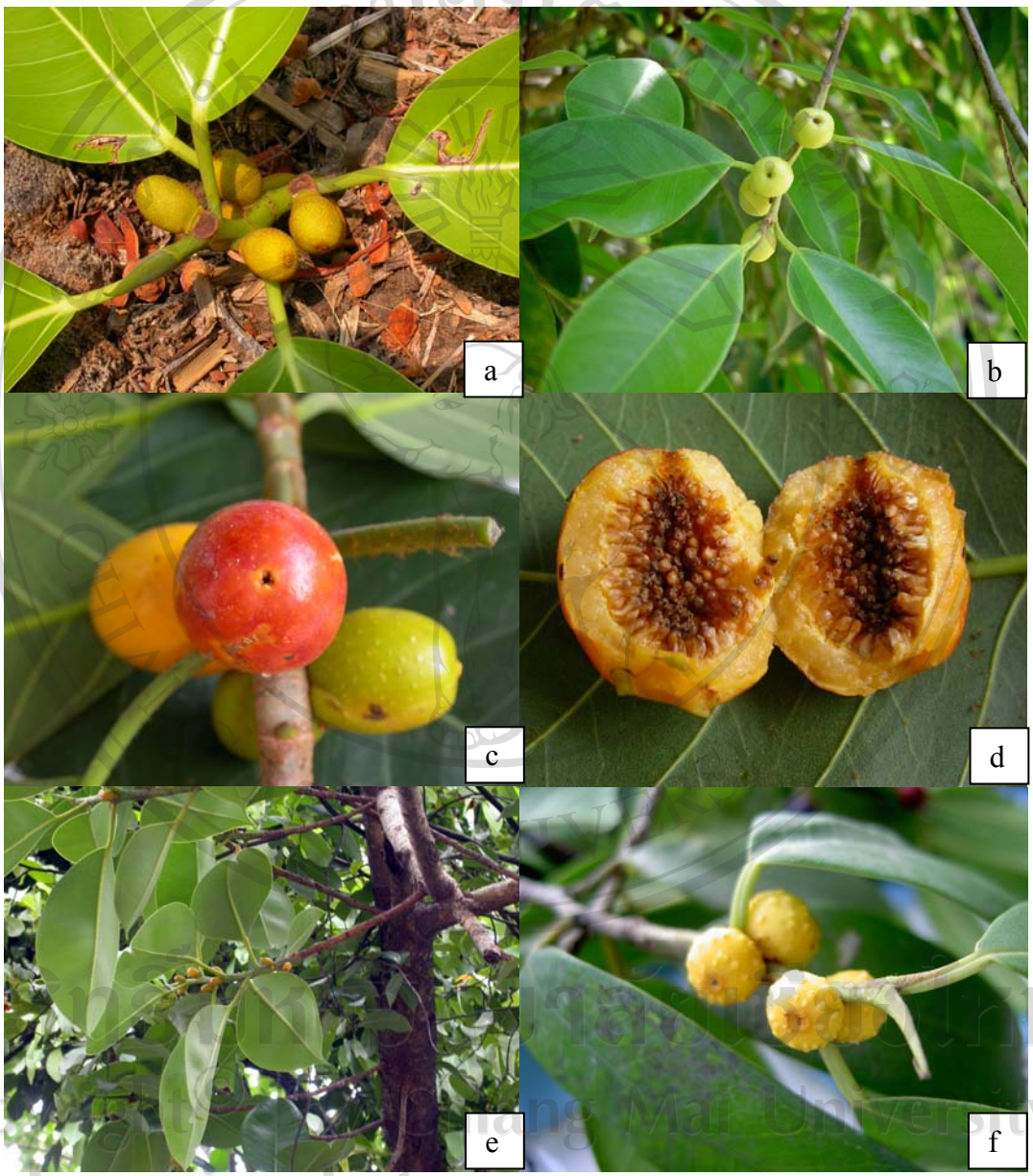

Figure 4.36 Some figs in subgenus *Urostigma*; *a. F. altissima, b. F. benjamina, c. F. drupacea, d. F. drupacea* (long section), *e. F. elastica*, *f. F. maclellandii*

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Figure 4.37 Some figs in subgenus *Urostigma*; *a. F. microcarpa, b. F. microcarpa (long section), c. F. religiosa, d. F. rumphii, e. F. superba* and subgenus *Pharmacosycea f. F. callosa*

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Figure 4.38 Some figs in subgenus *Sycomorus*; *a. F. auriculata* (tree), *b. F. auriculata* (figs), *c. F. fistulosa* (fig), *d. F. fistulosa* (leaves), *e. F. squamosa* (fig), *f. F. squamosa* (leaves)

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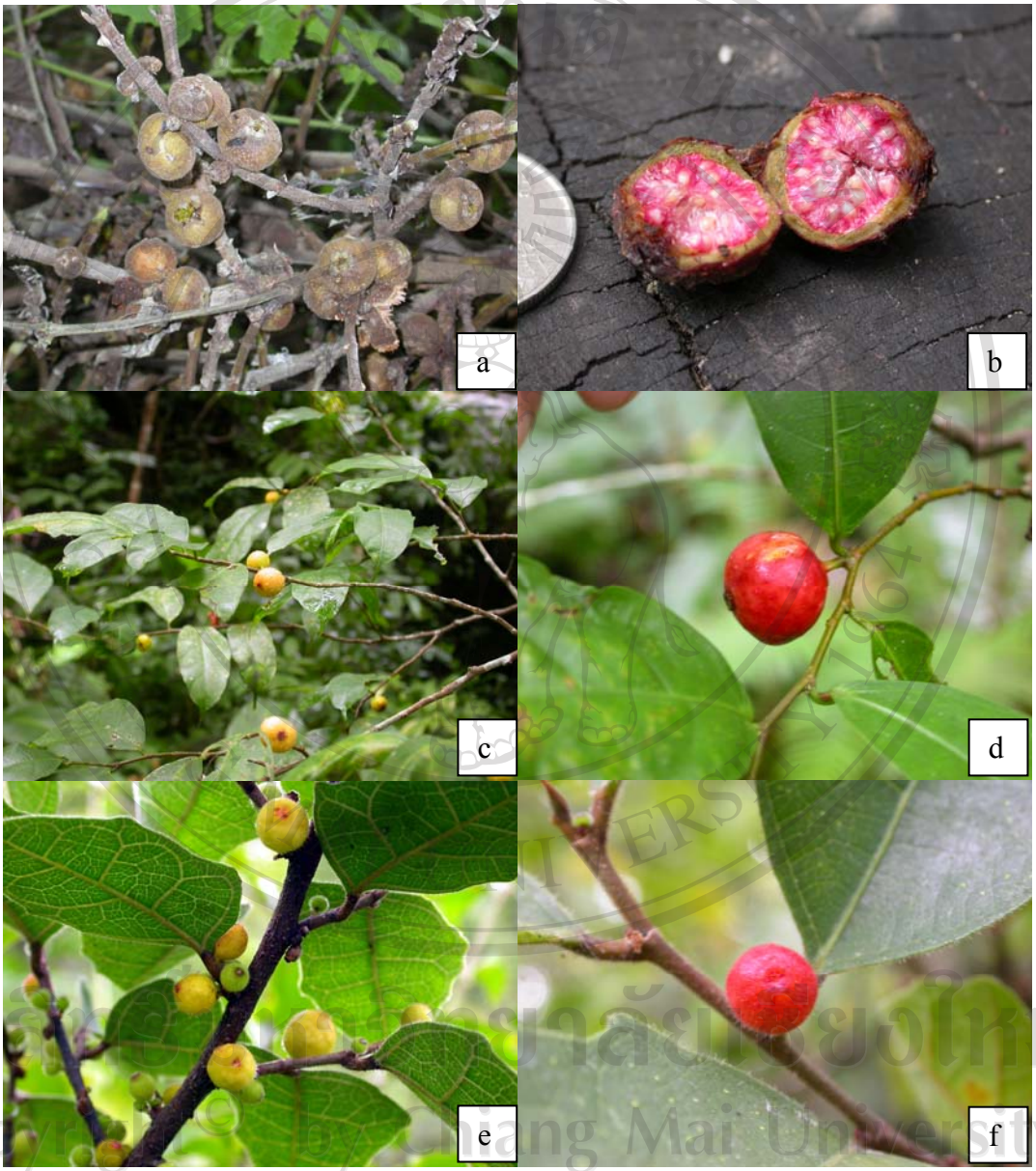

Figure 4.39 Some figs in subgenus *Sycomorus*; *a. F. semicordata*, *b. F. semicordata* (long section); subgenus *Sycidium*; *c. F. subincisa* (male), *d. F. subincisa* (female), *e. F. anastomosans* (male), *f. F. anastomosans* (female)

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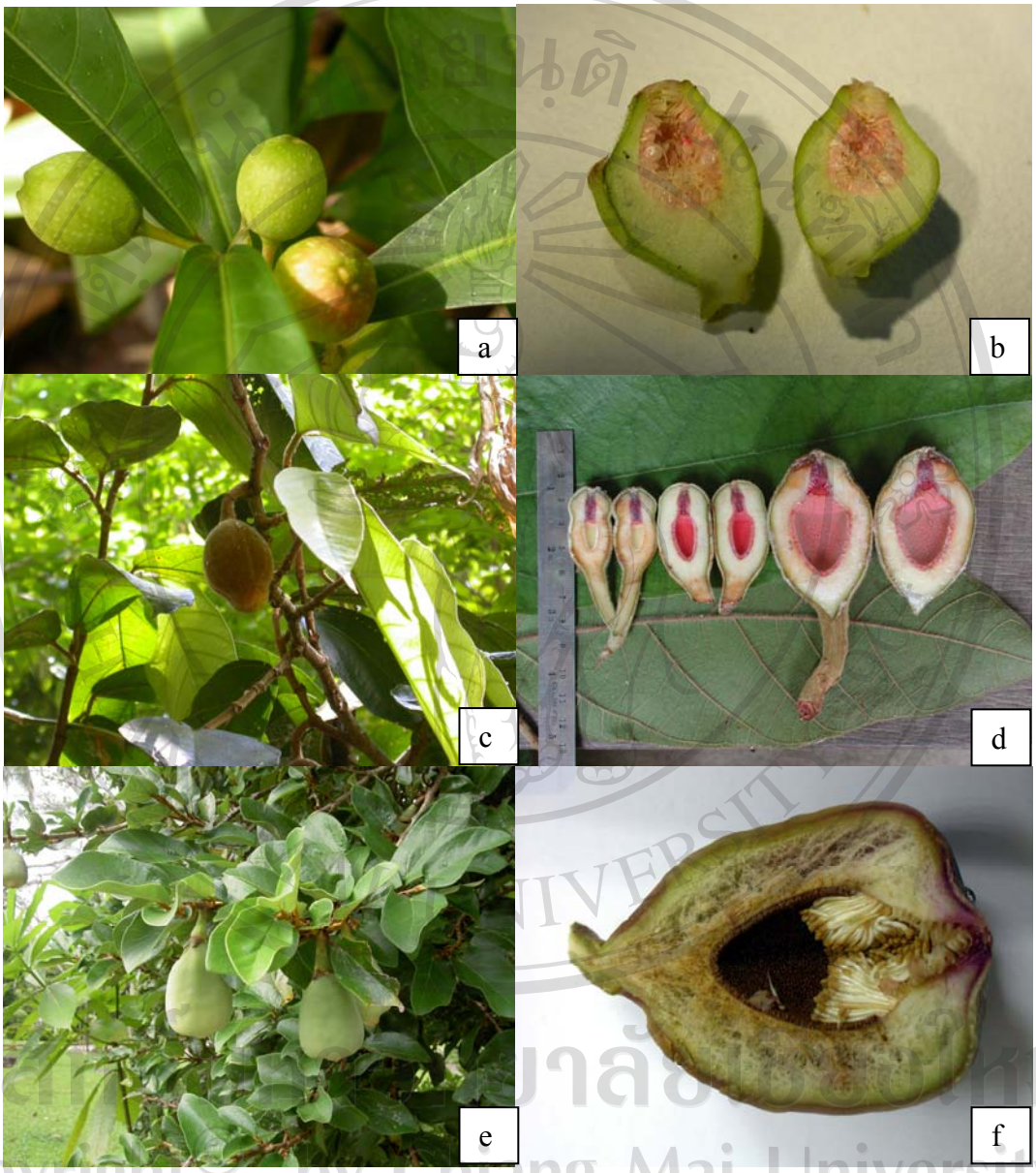

Figure 4.40 Some figs in subgenus *Ficus*; *a. F. ischnopoda*, *b. F. ischnopoda* (long section), subgenus *Synoecia; c. F. anserina, d. F. anserina* (long section), *e. F. pumila, f. F. pumila* (long section)

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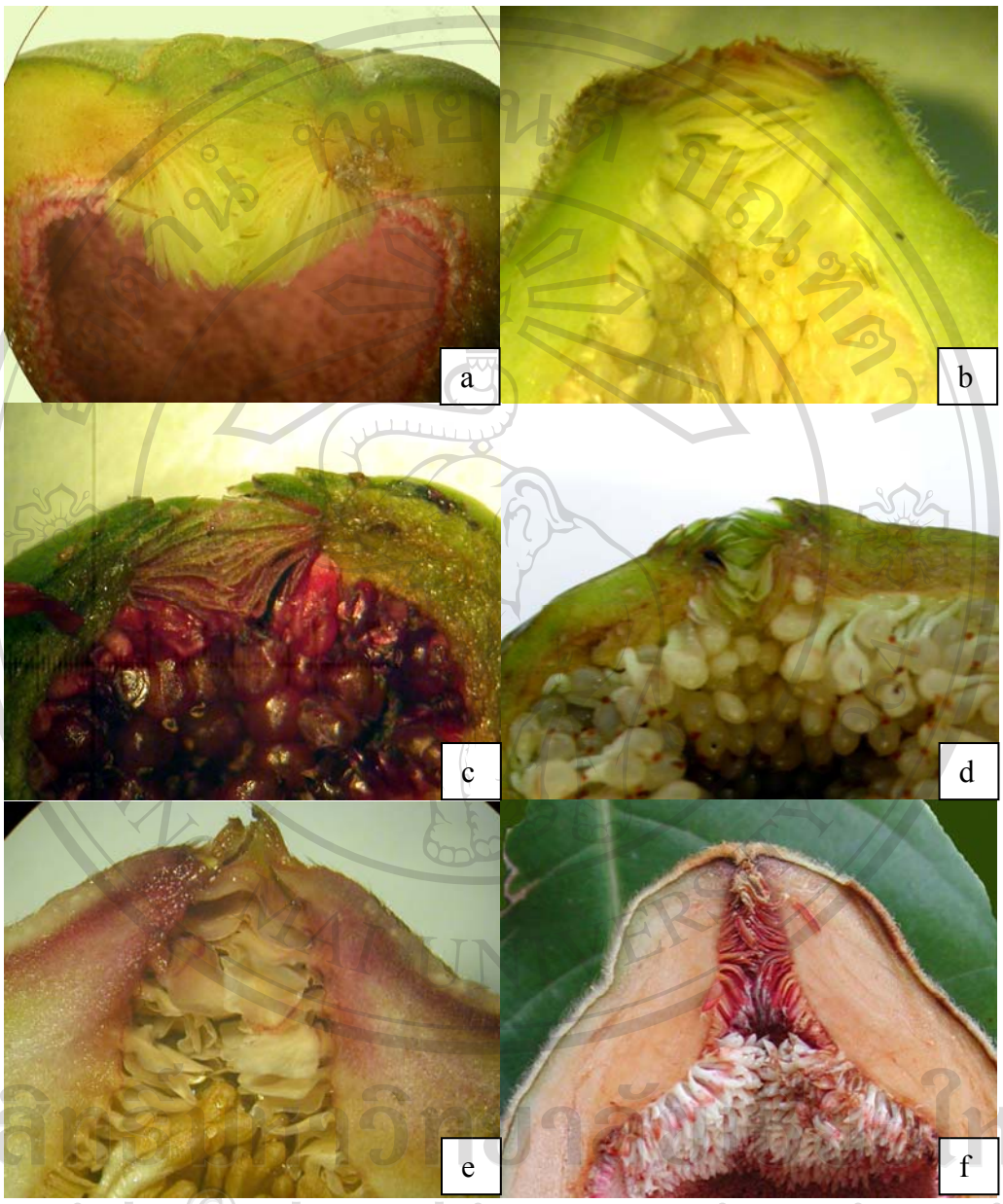

Figure 4.41 The variation of fig ostiolar bracts: *a. F. auriculata, b. F. ischnopoda, c. F. fistulosa, d. F. semicordata, e. F. pumila, f. F. anserina*

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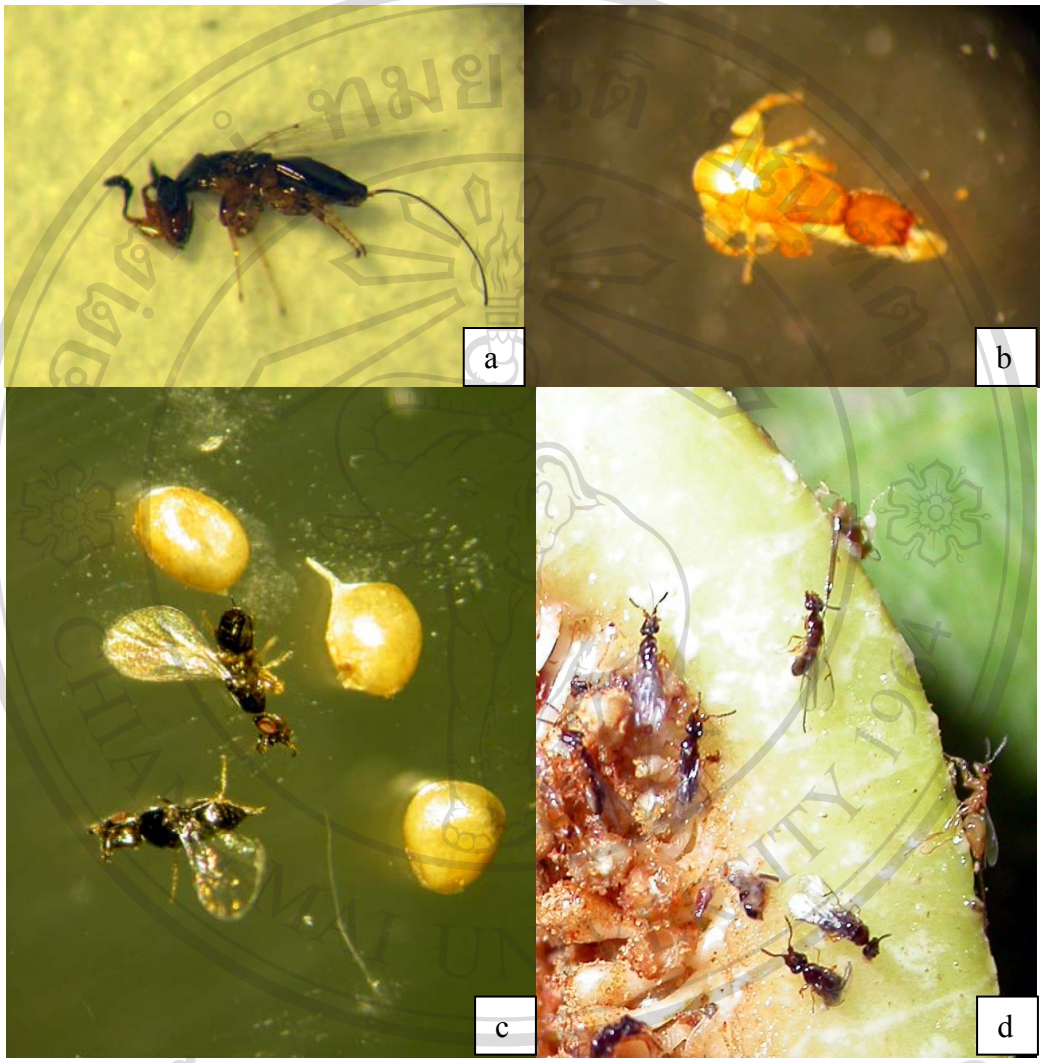

Figure 4.42 Some fig wasps: *Ceratosolen fusciceps; a.* female, *b.* male: pollinators of *F. racemosa, c. Liphorrhophalum* sp. (female), female pollinator of *F. anastomosans, d. C. solmsi*., female pollinator of *F. hispida*

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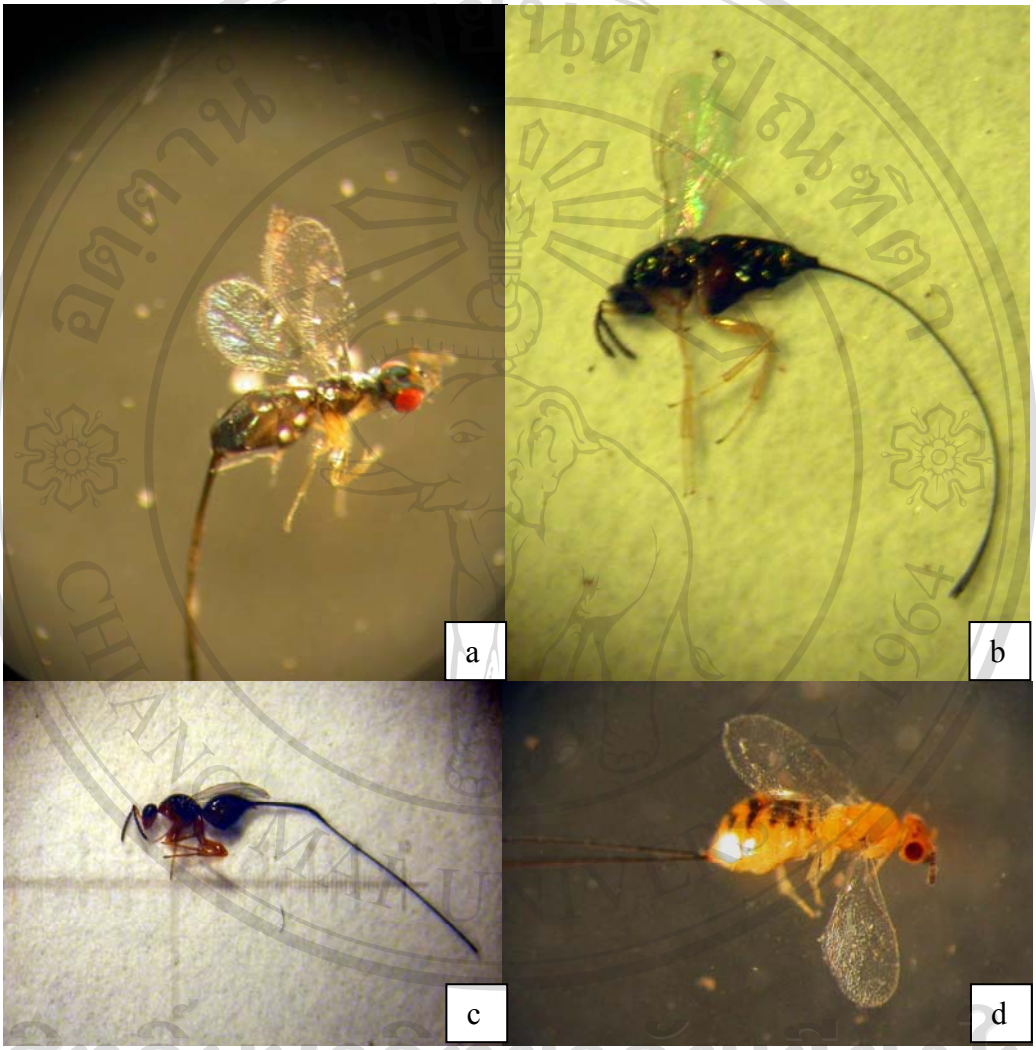

Figure 4.43 Some female non pollinating wasps:
a. Apocrypta sp1, *b. Apocrypta* sp2, *c. Philotrypesis* sp., *d. Platyneura* sp. (*Apocryptophagus*)

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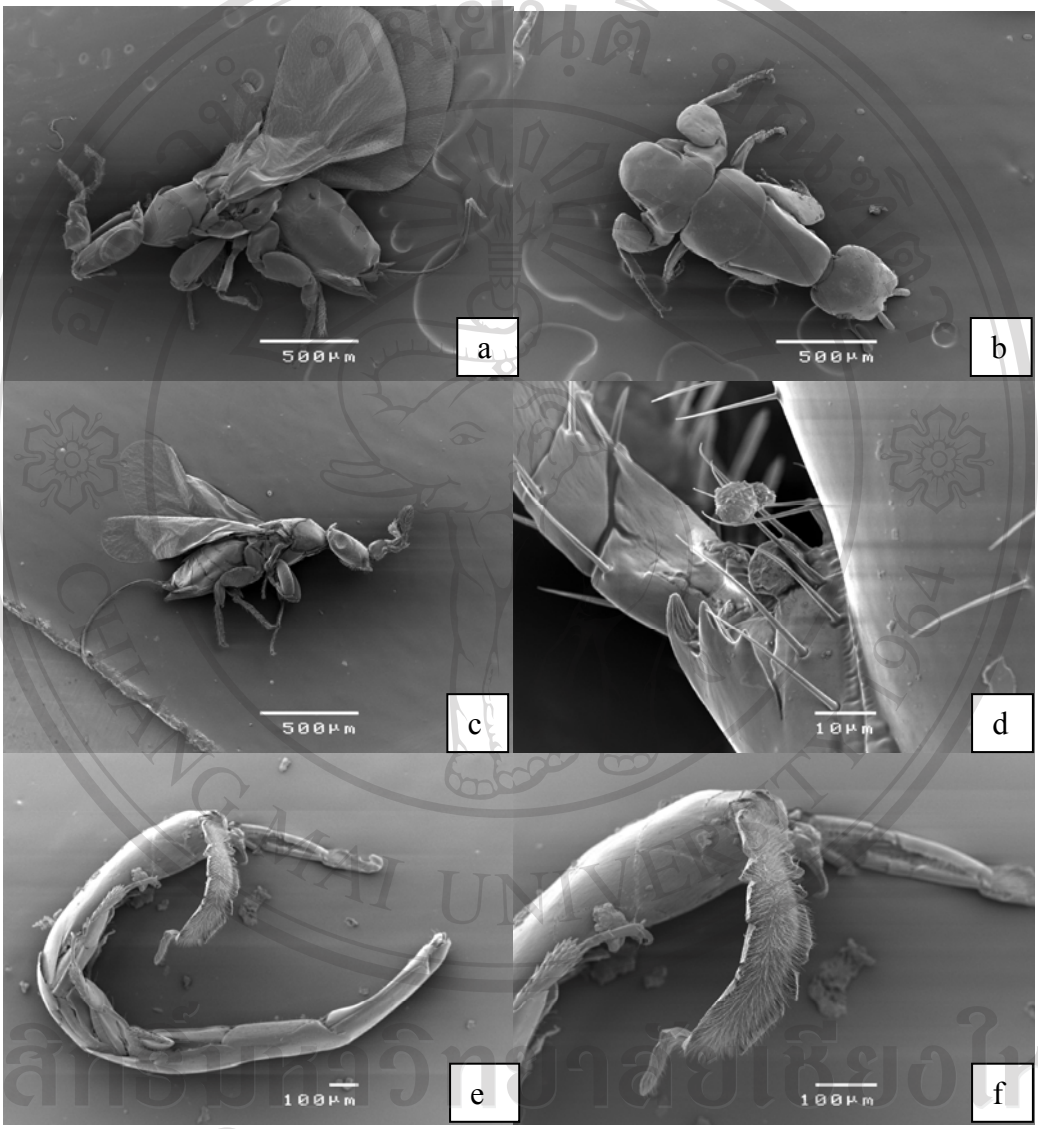

Figure 4.44 The illustrations of some fig wasps under SEM: *Ceratosolen fusciceps*, *a.* male, *b.* female: *Eupristina* sp., *c. female*, *d. female with pollen grains*: *Platyneura* sp., *e., f.* male

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