

CHAPTER 3

MORPHOLOGICAL AND ANATOMICAL STUDY

Introduction

Comparative morphology and anatomy are basic approaches for taxonomic studies. Generally, taxonomic studies still rely largely on morphological and anatomical data. These data had shown great taxonomic significance and were used in classification of both major and minor categories (Jones and Luchsinger, 1987). Presently, classification of specific and infraspecific levels and complex species are still based mainly on morphological and anatomical criteria. For example, the morphological study supported a taxonomic treatment at the varietal level (Speer and Hilu, 1998). Leaf anatomy clearly facilitated the recognition of two closely related taxa and a changing taxonomic level in new combination of complex species (Herrera-Arrieta and Grant, 1994). In addition, morphology and leaf anatomy indicated close relationship and support the recognition of taxa in species complex, for example *Bouteloua aristidoides* complex and *Carex backii* complex (Columbus, 1999; Saarela and Ford, 2001).

Taxonomic status of "*Hoya parasitica* complex" in Thailand is still dubious due to its great variations in texture, shape, size and venation of leaves, sizes of flowers and shapes of corolla lobes (Kerr, 1951). So far, no further intensive study has been carried out on this plant. To unravel the taxonomic problem in "*Hoya parasitica* complex", morphological and anatomical studies are necessary.

It is hypothesized that "*Hoya parasitica* complex" in Thailand composed of some undescribed taxa. So, the exploration of all the available variables in the complex is needed in order to determine morphological and anatomical variations of each group. In this thesis, the overall morphological and anatomical variations of characters, the classification of the variations into groups or forms, together with the geographical distribution and ecological features of each recognized group in the complex were described. Then taxonomic treatment of these recognized groups were discussed and compared with the previous classification.

Study Sites

The living specimens of *Hoya parasitica* and its variations were collected from 50 localities throughout Thailand (Figure 3.1 and Table 3.1). All investigation were carried out at the Department of Botany, Faculty of Science, Chulalongkorn University.

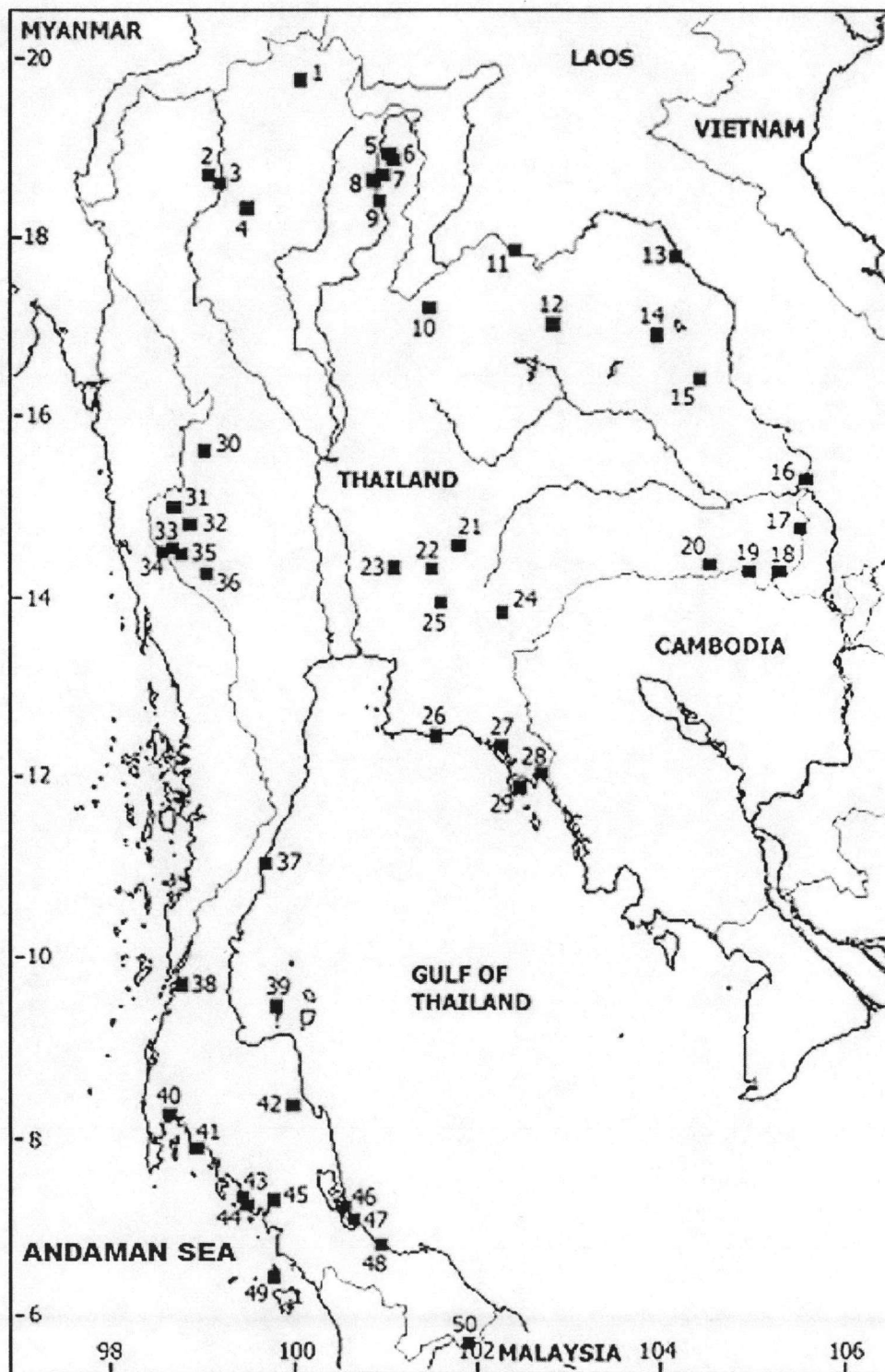


Figure 3.1 Sampling sites of "*Hoya parasitica* complex" in Thailand. (■-collecting site)

Table 3.1 Locality and collected-forms of the "*Hoya parasitica* complex" in Thailand

Site no. ^a	Locality	Form ^b
1.	Mueang, Chiang Rai Province	V
2.	Wang Bua Ban Waterfall, Chiang Mai Province	V, IX
3.	Haew Keaw, Mueang, Chiang Mai Province	VI
4.	Doi Khun Tan National Park, Lampang Province	IX
5.	Silaphet Waterfall, Pua, Nan Province	III, VII
6.	Tat Laung Waterfall, Pua, Nan Province	VII
7.	Ban Muang Wang Nhua, Phu Phiang, Nan Province	IX
8.	Phasing, Mueang, Nan Province	V
9.	Lhinan, Na Noi, Nan Province	VII, IX
10.	Pla Ba Waterfall, Phu Ruea, Loei Province	IX
11.	Than Thong Waterfall, Sri Chiang Mai, Nong Khai Province	IX
12.	Than Ngam Waterfall, Nong Wua So, Udon Thani Province	IX
13.	Tat Kham Waterfall, Ban Phaeng, Nakhon Phanom Province	IX
14.	Phu Phan National Park, Sakon Nakhon Province	IX
15.	Tat Ton Waterfall, Mukdahan Province	IX
16.	Soi Sawan Waterfall, Ubon Ratchathani Province	IX
17.	Huai Sai Yai Waterfall, Sirinthon, Ubon Ratchathani Province	IX
18.	Phu Chongna Yoi National Park, Ubon Ratchathani Province	IX
19.	Tat Hai Waterfall, Nam Yuen, Ubon Ratchathani Province	IX
20.	Sam Rong Kiat Waterfall, Khun Han, Si Sa Ket Province	IX
21.	Phu Wa Kiew Waterfall, Nakhon Ratchasima Province	IX
22.	Khao Yai National Park, Nakhon Ratchasima Province	I, IX
23.	Pu Kae, Saraburi Province	IX
24.	Pang Sida National Park, Sa Kaeo Province	IX
25.	Prachantakham, Prachin Buri Province	IX
26.	Ban Pe, Rayong Province	VIII
27.	Nam Tok Phliu National Park, Chanthaburi Province	VIII
28.	Mueang, Trat Province	VIII
29.	Ko Chang, Trat Province	VIII
30.	Thi Lo Su Waterfall, Tak Province	IX

Table 3.1 continued

Site no. ^a	Locality	Form ^b
31.	Sangkhla Buri, Kanchanaburi Province	IX
32.	Koeng Kra Wia Waterfall, Kanchanaburi Province	IX
33.	Pong Ron, Thong Pha Phum, Kanchanaburi Province	IX
34.	Pha Suk Pass, Thong Pha Phum, Kanchanaburi Province	I
35.	Ban Thamadua, Thong Pha Phum, Kanchanaburi Province	IX
36.	Sai Yok National Park, Kanchanaburi Province	IX
37.	Bang Saphan, Prachuap Khiri Khan Province	VIII
38.	Namtok Ngao National Park, Ranong Province	IX
39.	Ko Wua Ta Lub, Suratthani Province	VIII
40.	Mueang, Phangnga Province	VIII
41.	Noppharat Thara Beach, Krabi Province	VIII
42.	Khao Luang National Park, Nakhon Si Thammarat Province	I
43.	Pakmeng, Trang Province	VIII
44.	Hat Chao Mai National Park, Trang Province	VIII
45.	Thung Kai, Trang Province	VIII
46.	Sathing Phra, Songkhla Province	VIII
47.	Singhanakhon, Songkhla Province	VIII
48.	Pak Bang Sakom Beach, Songkhla Province	VIII
49.	Tarutao National Park, Satun Province	IV, VIII
50.	Sirinthon Waterfall, Waeng, Narathiwat Province	II

Note: a =Site numbers correspond to those in Fig.1;

b =Nine forms distinguished in this study.

Materials and Methods

1. Survey and collection of specimens

1.1 Branches of *Hoya parasitica* were collected from various localities throughout Thailand and were raised in the greenhouse at the Department of Botany. These transplanted plants were used for anatomical and molecular studies. They were also used for comparison with the wild collected specimens in investigating the effect of habitats on plant variations. The remainder specimens, viz. branch, leaf, flower and fruit materials were preserved in 70% ethanol for further morphological studies. In addition, three duplicates of herbarium specimens were prepared and kept at the Forest Herbarium, National Park, Wildlife and Plant Conservation Department (BKF) and the Professor Kasin Suvatabhundu Herbarium, Department of Botany, Chulalongkorn University (BCU).

1.2 Specimen collection

Detailed descriptions of all specimens collected together with habitats were thoroughly noted.

1.3 Specimens determinations

All plant samples were determined to infraspecific taxa using previous available taxonomic keys (Hooker, 1883; Constantin, 1912; Ridley, 1923; Rintz, 1978 and Kiew, 1995).

2. Morphological study

2.1 Each specimen was examined in both vegetative and reproductive characters by stereo microscope (Nikon SMZ-1B). These characters included leaf shape, venation pattern; pubescence of pedicel, sepal and petal, color and shape of sepal, petal and corona, etc.

2.2 Pollinarium study

Flowers of each specimen were collected, and preserved in 70% ethanol for further pollinarium morphological study.

2.2.1 The pollinarium samples of preserved flowers were treated in 100% ethanol at least 1 minute. The solution were drained off and left the pollinarium air dry on slide. Then pollinarium was mounted on slides in canada balsum. Pollinarium morphological observations and photographs were made under a Nikon AFX 35. Permanent type slides of all samples were deposited at BCU.

2.2.2 Descriptions of pollinarium morphology were focused on

corpusculum, translator and pollinium.

3. Anatomical study

Structure of stem and leaf were studied from transverse section through lamina and internodes as well as from surface view, prepared from both adaxial and abaxial epidermis. The techniques described by Bradbury (1973) were used throughout.

3.1 Anatomy of stem and leaf

Samples of stem and leaf were cut using Automatic MT-3 microtome (Toyozumi Dengekiki Co., Ltd.) and then the section were stained by safranin O for temporary slides. In preparation of a permanent slide, stem and leaf were fixed in FAA at room temperature for at least 24 hours. All sections were cut using a rotary microtome at 5 μm thickness without embedding. Then the sections were stained by safranin O-fast green mixture in 2-ethoxy ethanol for about 10 minutes, then they were differentiated in 2-ethoxy ethanol. After this stage the sections were cleared in xylene and mounted on slides in canada balsum.

3.2 Epidermal characters

3.2.1 LM observation: The preserved leaf samples were transferred to potassium hydroxide 5-8% and then were warm in a water-bath for 30 minutes. Then the samples were washed with distilled water. After this stage lower and upper epidermis were peeled off and stained with hematoxylin, differentiated in 70% ethanol, dehydrated in 70, 90 and 100% ethanol, respectively. Then the epidermal peels were cleared in xylene and mounted on slides in canada balsum.

3.2.2 SEM observation: Indumentum and epidermal structure were studied by SEM. The preserved materials were dehydrated with DMP (dimethoxypropan), critical-point-dried and subsequently mounted with nail polish on an aluminium stub and sputter-coated with gold for 5 minutes, then the specimens were observed by SEM model JEOL JSM-5410 LV. The SEM micrographs were taken with 1,000 to 15,000 magnifications at 15 kV.

4. Taxonomic treatment based on morphological and anatomical data

Taxonomic treatment of the "*Hoya parasitica* complex" was carried out based mainly on morphological and anatomical data. Full descriptions (including ecological and distribution data) of each group were prepared. A comprehensive key to of the "*Hoya parasitica* complex" were constructed.

Results

Habitat and distribution

“*Hoya parasitica* complex” predominantly occurs in Southeast Asia, and had a wide distribution throughout Thailand. It is a long climbing epiphyte, usually grows on tree branches or trunks (Fig. 3.2A). This climbing epiphyte sometime fall down to the forest floor and start its new growth by climbing up tree trunk (Fig. 3.2B). Some fallen plants can grow in rock crevices, then thrive on rocks (Fig. 3.2C). Naturally, it grew well in shady to open habitats. Two major habitats are recognized. Firstly, it is found on trees along stream banks, in mixed deciduous forests, dry dipterocarp forests and evergreen forests in northern, north-eastern, eastern, and western to peninsular Thailand at 50-900 m elevations (Fig. 3.2D). Secondly, it is a littoral plant, grew on tree branches or on rocks, common in beach and mangrove forests, along coastal areas of islands or mainland in the eastern and southern parts of the country (Fig.3.2E). Moreover, it can grow well on trees in disturbed areas of plantations or along roadsides.



Figure 3.2 Habitats of “*Hoya parasitica* complex” in Thailand. A: site 40 (Mueang, Phangnga). B: site 44 (Hat Chao Mai National Park). C: site 39 (Ko Wua Ta Lub). D: site 18 (Phu Chongna Yoi National Park). E: site 49 (Tarutao National Park).

General morphology and anatomy

Stems

All "*Hoya parasitica* complex" are perennial climbing or twining herbs. It has a long internode, (Fig.3.3A) lenticels and bark can be observed in old stems. The stem or branch produces many adventitious roots from nodes or sometime at internodes which attach to tree-trunk or branches. Generally, stems are rounded in cross section and entirely glabrous for naked eyes (Fig.3.3B).

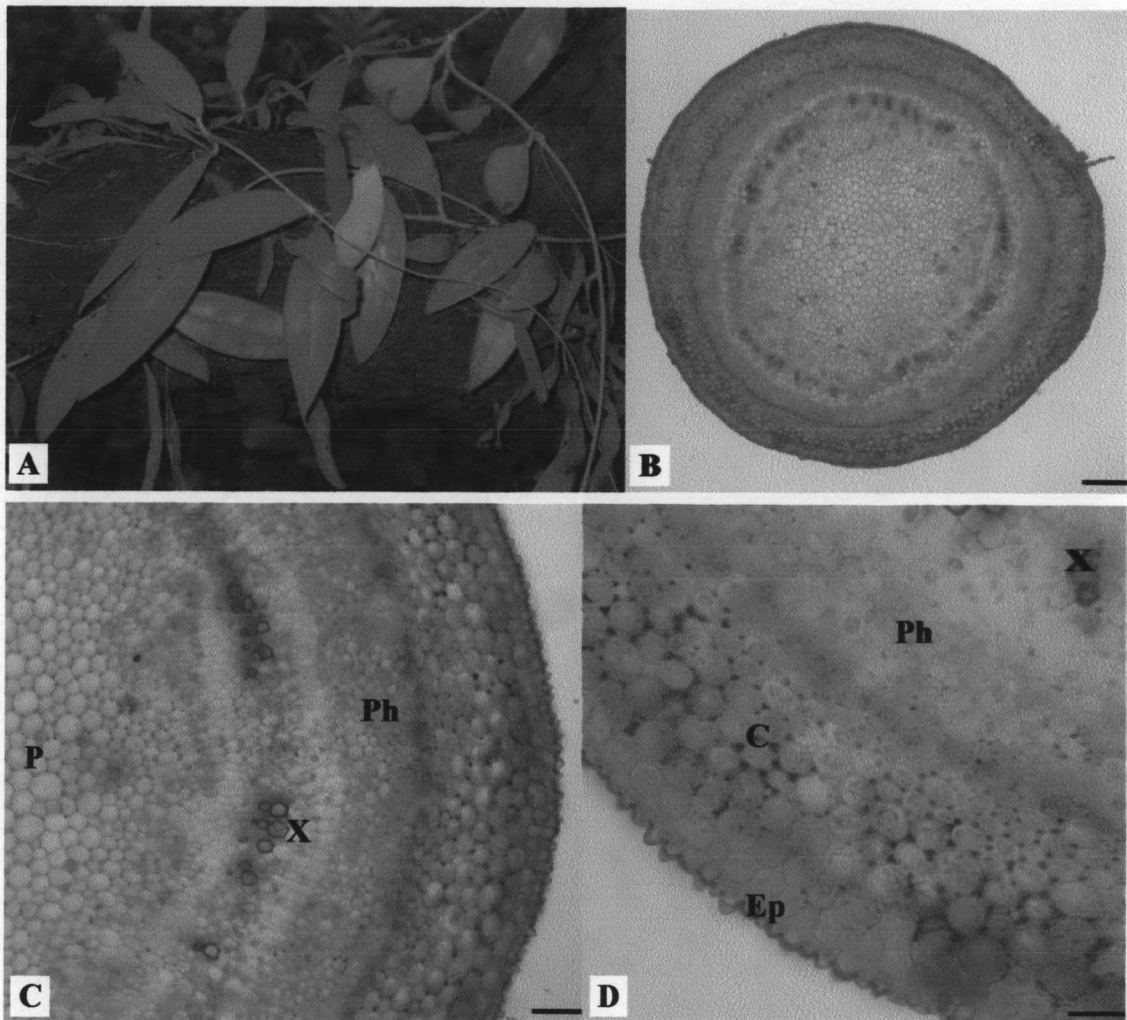


Figure 3.3 Stem of "*Hoya parasitica* complex" in Thailand. A. branch, B-D: x-section stem: primary structure (P=pith, Ph=phloem, X=xylem, C=cortex, Ep=epidermis). Specimen number (A-D: 200). Bar (B=1mm, C=0.5 mm, D= 0.25 mm)

The stem anatomy is rather uniform in cross-section (Fig.3.3B-D, 3.4A-E). The epidermis can be noticed as a distinct, relatively large-celled layer. Epidermal

cells are rectangular to square in shapes, and outer wall is usually highly thickened, the outer surface is pappilated and with thick cuticle. In old stem, periderm develop in the sub-epidermal layer. The periderm composed of thin-walled cells (Fig. 3.4C) The cortex consists of polyhedral parenchyma and usually has less than fifteen cell-layers in thickness; a layer of sclerenchyma appear between the cortex and the stele in older stems (Fig.3.4C). The stele type is an eustele and the phloem is on outer side of the xylem. The secondary phloem is composed of sieve tube elements, companion cells, and parenchyma cells. Tracheary elements of secondary xylem embedded in a matrix of fibrous cells. Pith cells are homogeneous, composed of polyhedral parenchyma cells, and occasionally some pith cells differentiated to sclerenchyma cells in older stems (Fig. 3.4D). Druses are abundant throughout the cortex, phloem, xylem and pith. Prismatic crystals are also found in the cortex and pith.

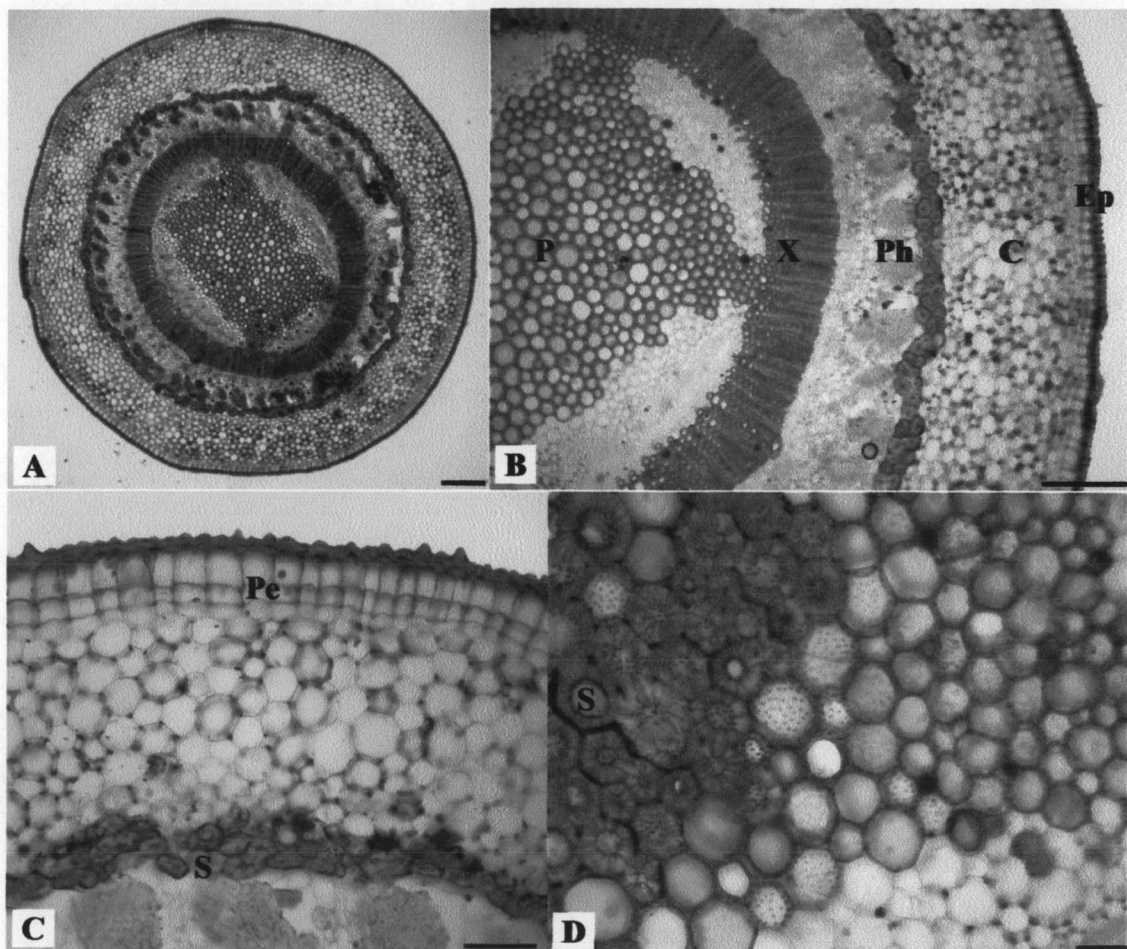


Figure 3.4 X-section stem: secondary structure. (P=pith, Ep=epidermis, C=cortex, Ph=phloem, X=xylem, Pe=periderm, S=sclerenchyma). Specimen number (A-D: 166). Bars (A= 0.25 mm, B=0.2 mm, C= 0.2 mm, D=0.05 mm)

Leaves

Leaf arrangement is opposite (Fig. 3.5A) or whorled (Fig.3.5B). The lamina is ovate or elliptic to oblong, glabrous or papillate on abaxial surface. The texture is coriaceous to succulently coriaceous, depending somewhat on habitats. The venation varied from pinnate to semi-pinnate with three or five principal veins (nerves) arising near the junction of lamina and petiole (Fig. 3.5C-E); glands present at the junction of petiole and lamina; petioles usually thick and stout, occasionally slender in mature leaves.



Figure 3.5 Leaves of "*Hoya parasitica* complex". A: opposite leaf, B: whorl leaf, C-D: 3-nerves arising from base, E: 5-nerves arising from base. Specimen number (A: 638, B: 224, C: 423, D: 285, E: 303). Bar=1 cm.

The basic type of leaf anatomy in "*Hoya parasitica* complex" is rather uniform in cross-section (Fig. 3.6A-D). Both abaxial and adaxial epidermis consist of rather small, epidermal cells of rectangular to square in shapes, the outer walls are thickened and covered with a thin waterproof layer called the cuticle. The outer surfaces of abaxial epidermis are glabrous to papillate (Fig. 3.6D, Fig. 3.7A-C). Stomata are usually confined to the abaxial surface and are on the same level with the epidermal cells. Stomatal type is cyclocytic stoma (Fig. 3.6E), in which stoma surrounded by four or more subsidiary cells forming a ring around each stoma (Metcalf, 1979). The mesophyll cells are homogeneous, composed of 20-30 layers of polyhedral parenchyma cells (rather circular or oval shape). The vascular system of midrib is composed of a simple arc-shaped strand that surrounded by sclerenchyma (Fig.3.6B). Druses crystals are present in vascular bundle and mesophyll layer.

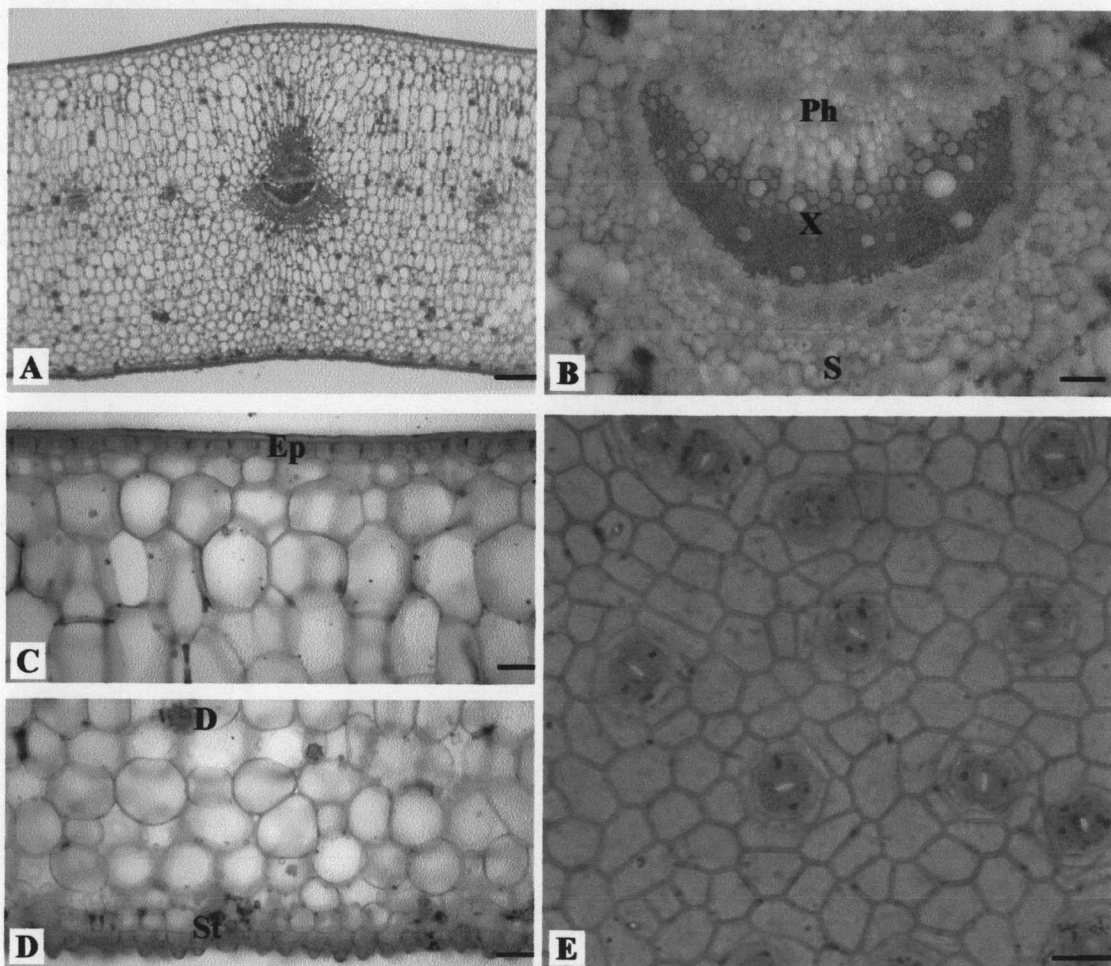


Figure 3.6 Leaf anatomy of "*Hoya parasitica* complex". A-D: X-section. A. leaf blade, B. midrib, C. adaxial surface, D. abaxial surface, E. stomata from abaxial surface. (Ep= epidermis, St= stomata, D= druses crystal, Ph= phloem, X= xylem, S= sclerenchyma). Specimen number (A-D: 380, E: 166). Bars (A=0.25 mm, B=0.05 mm, C=0.05 mm, D=0.05 mm, E= 20 μ m)

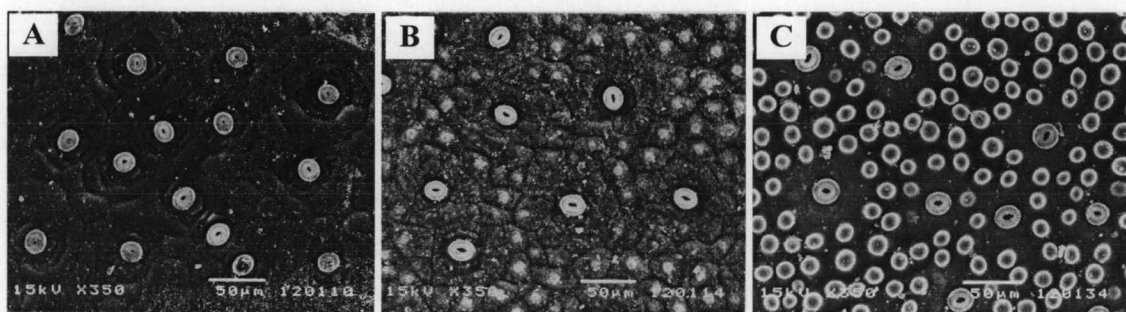


Figure 3.7 Scanning electron micrographs on abaxial surface of leaves in “*Hoya parasitica* complex”. A: indumentum absent; B: minute and scattered indumentum; C: dense indumentum. Specimen number (A: 166, B: 303, C: 384). Bar=50 µm.

Flowers

The inflorescences are axillary, in negative geotropic umbelliform with almost equal pedicels (Fig.3.8A-B); flowers are actinomorphic (Fig. 3.8C), 5-merous; with slender pedicels; calyxes are glabrous or covered with hairs on abaxial surface and margin, with a small gland alternately arranged between calyx lobes; corolla in rotate form, usually creamy white, glabrous on abaxial surface, covered with minute hairs on adaxial surface, reflexed when in full bloom, becoming closed at the end of flowering period; corolla lobes ovate-triangular with acute or acuminate apex, inflexed (bent inwards) between corona scales; coronas longer than the corolla tube, coronal scales ovate-elliptic or ovate-lanceolate; the first inner angle abruptly apiculate, and slightly raised, the outer angle broad or narrowly acute, concave on the upper surface usually with a median ridge; anthers 5, laying just below the inner coronal scale, each producing two pollen masses or pollinia, each pollen mass from adjacent anther lobes connected by short translator arms with a corpusculum, forming a pollinarium; pollinium flattened, oblong, truncate at the top, with narrow translucent longitudinal wing; corpusculum dark brown or black (Fig. 3.8E). Fruits are black or green follicles, pod-like, straight and glabrous (Fig. 3.8D).

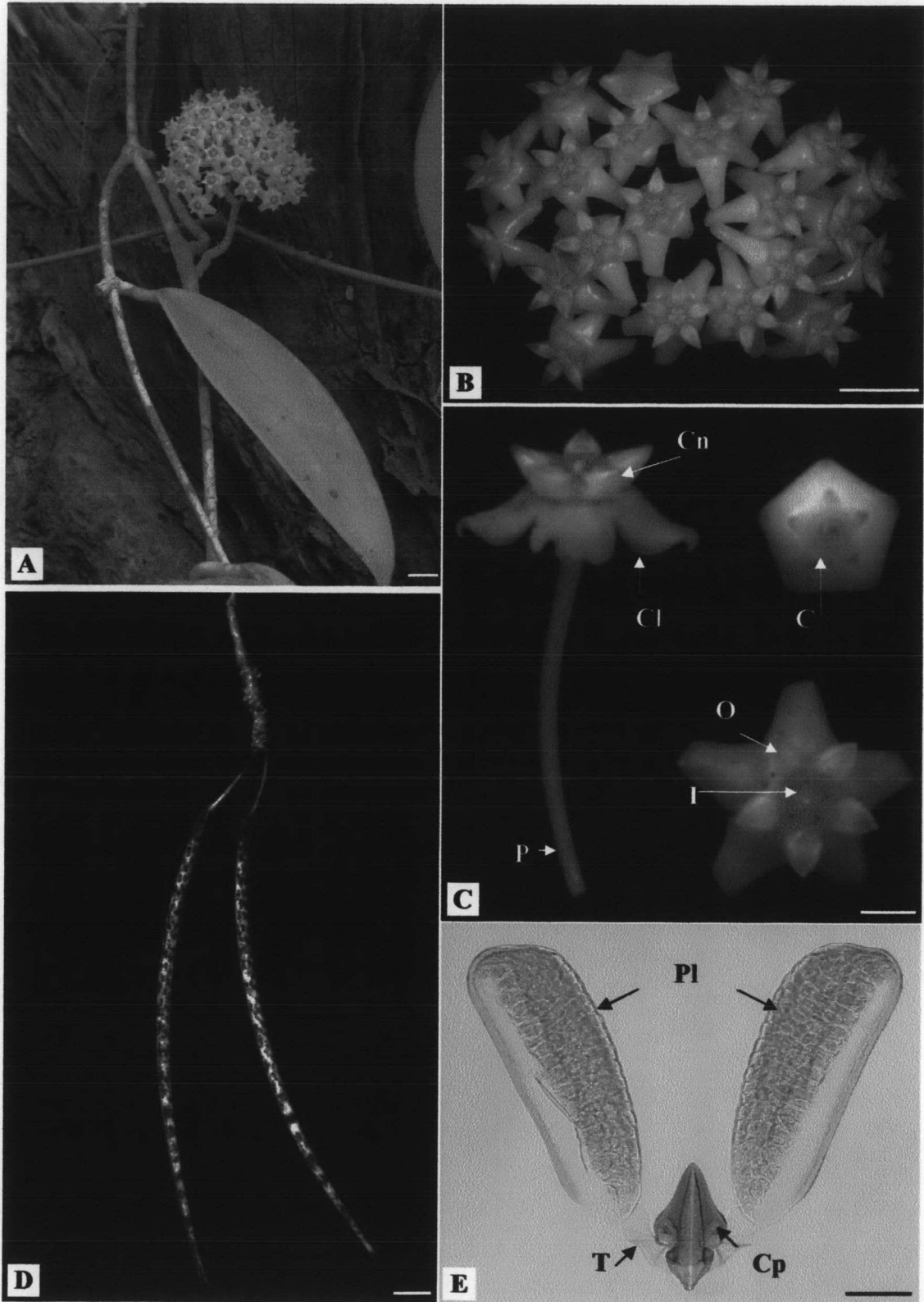


Figure 3.8 Reproductive parts of "*Hoya parasitica* complex". A-B: inflorescences, C. flowers, D. fruits, E. pollinarium. (P= pedicel, Cl= corolla, C= calyx, Cn = corona, O= outer angle corona, I= inner angle, Pl= pollinia, T= translator, Cp= corpusculum). Specimen number (A: 685, B: 135, C: 3, D: 473, E: 312). Bar (A-B=1 cm, C=0.25 cm, D=1 cm, E=100 μ m).

Comparative morphology

Despite the great variations in habitat, leaf shape, forms of leaf base, venation pattern of leaf, forms of sepal and corona. It can be tentatively classified the variations of the complex into 9 forms by comparisons of qualitative morphological characters. These forms were then named as group I-IX (residual form). A key to forms and description are presented below.

Key to forms of wild *H. parasitica* complex in Thailand

1. Sepals lanceolate, longer than the corolla tubes **Form I**
1. Sepals ovate, equal in length or shorter than corolla tubes
 2. Leaves with prominent basal nerves, extending from base to apex, veins conspicuous
 3. Leaf base rounded to cordate
 4. Coronal scales ovate-lanceolate, corpusculum narrowly oblanceolate-oblong **Form II**
 4. Coronal scales ovate-elliptic, corpusculum broadly triangular-oblong **Form III**
 3. Leaf base cuneate **Form IV**
 2. Leaves with unclear basal nerves, mostly extending about half way to apex, veins obscure
 5. Leaf base rounded to subcordate
 6. Coronal scales ovate-elliptic, petioles stout **Form V**
 6. Coronal scales ovate-lanceolate, petioles slender **Form VI**
 5. Leaf base cuneate to obtuse
 7. Coronal scales ovate-elliptic **Form VII**
 7. Coronal scales ovate-lanceolate
 8. Leaves relatively narrow, 1.8-(3.8)-5.8 cm wide, base cuneate. Littoral plants **Form VIII**
 8. Leaves broad, 4-(5.8)-7.6 cm wide, base variable. Inland plants. **Form IX**

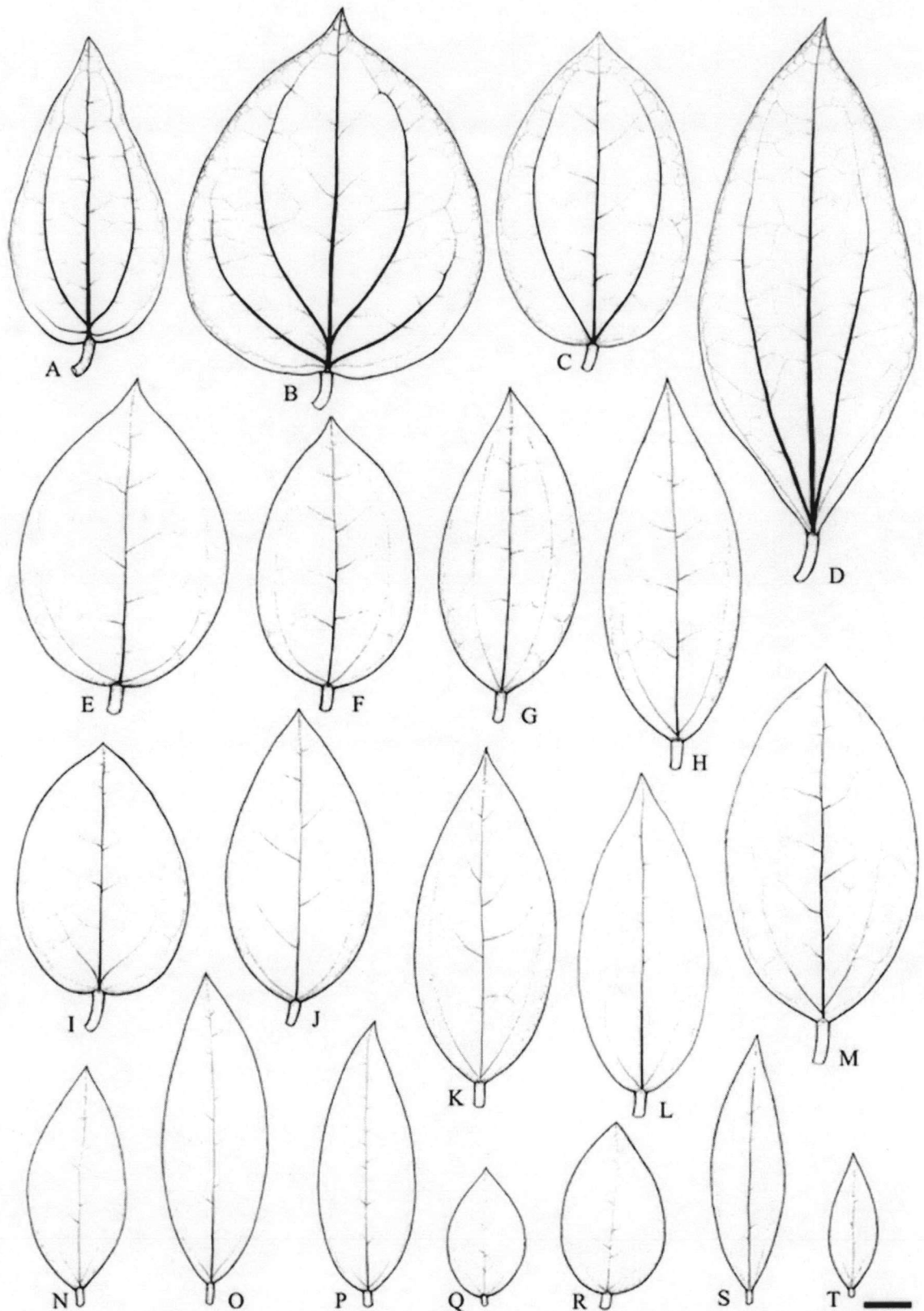


Figure 3.9 Leaves of "*Hoya parasitica* complex". A: Form I, (166). B: Form II (303). C: Form III (380). D: Form IV (320). E-F: Form V, E (404), F (378). G-H: Form VII, G (385), H (384). I: Form VI, (289). J-M: Form IX, J (559), K (436), L (3), M (258). N-T: Form VIII, N (120), O (670), P (660), Q (585), R (243), S (213), T (202). Numbers in parenthesis denoted the collector number. Bar = 2 cm.

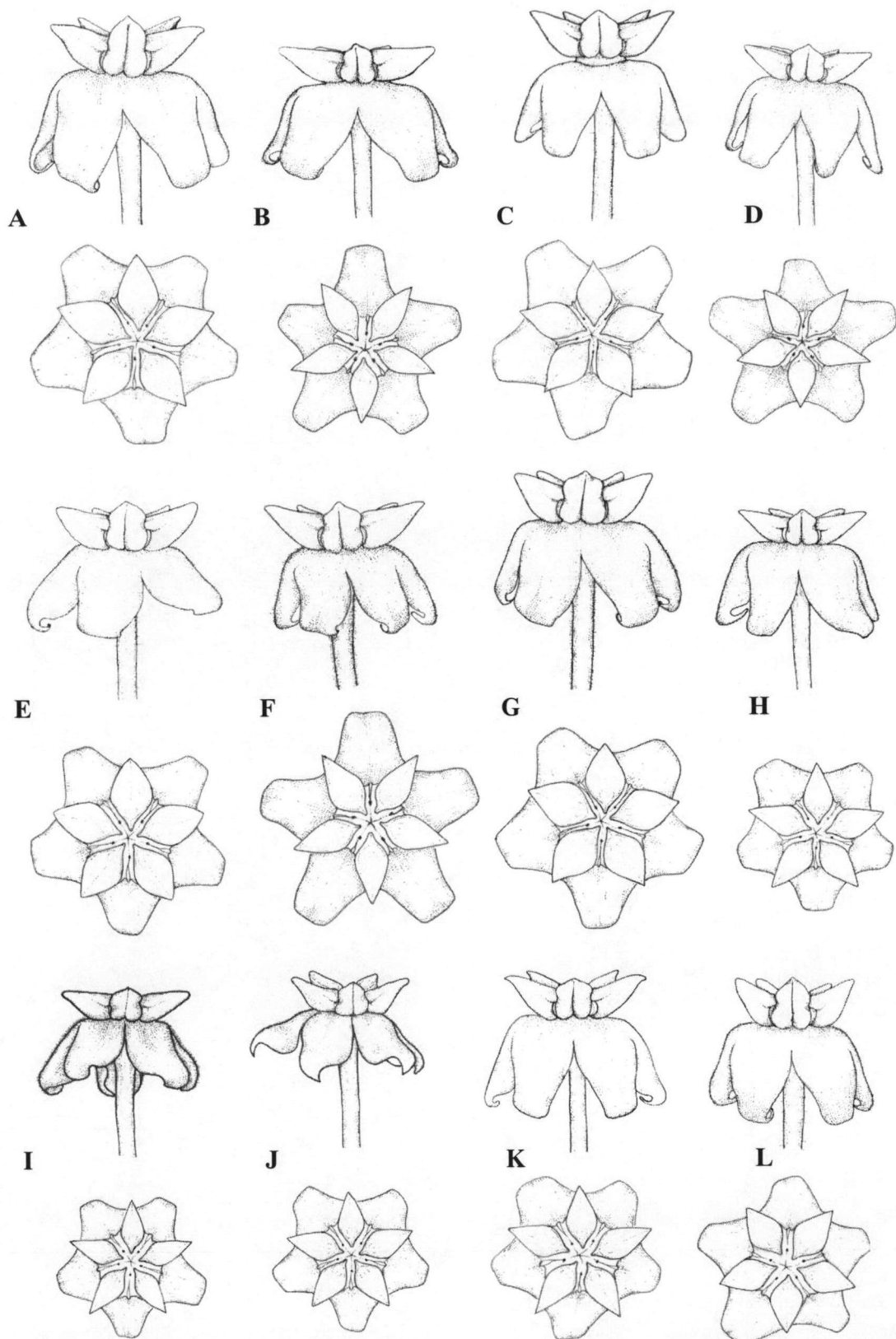


Figure 3.10 Flowers of "*Hoya parasitica* complex" (lateral and top view). A: Form I (166). B: Form II (303). C: Form III (380). D: Form IV (320). E: Form V (404), F: Form VI (289), G: Form VII (364). H-I: Form VIII, H (660), I (202). J-L: Form IX, J (436), K (258) L (559). Numbers in parenthesis denoted the collector number. Bar=5 mm.

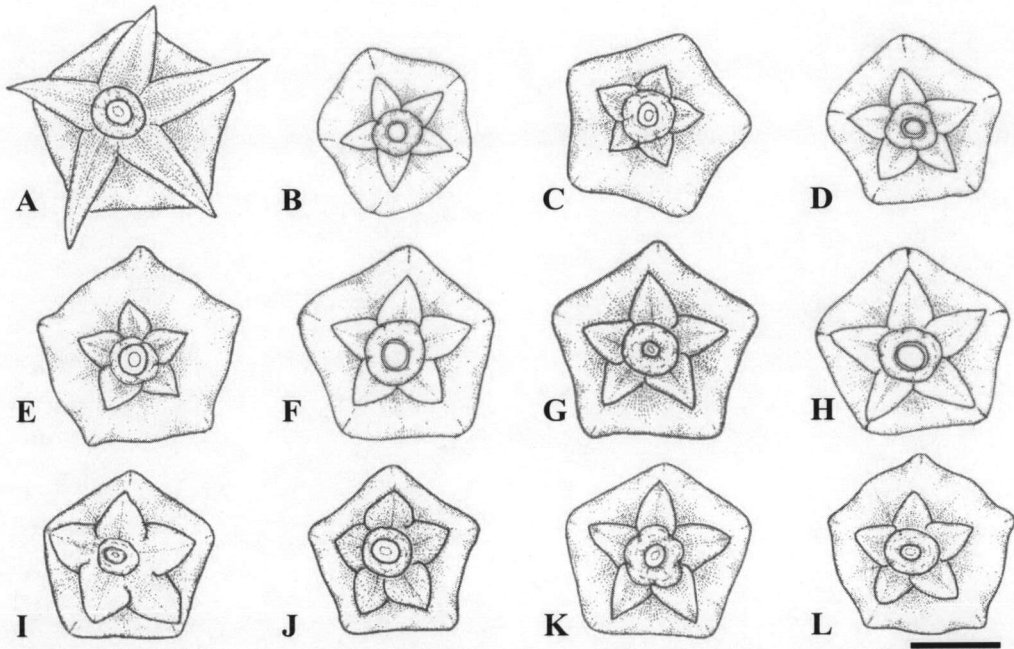


Figure 3.11 Flowers of “*Hoya parasitica* complex” showing sepals (bottom view). A: Form I (166). B: Form II (303). C: Form III (380). D: Form IV (320). E: Form V (404), F: Form VI (289), G: Form VII (384). H-I: Form VIII, H (660), I (202). J-L: Form IX, J (436), K (258) L (559). Numbers in parenthesis denoted the collector number. Bar=5 mm.

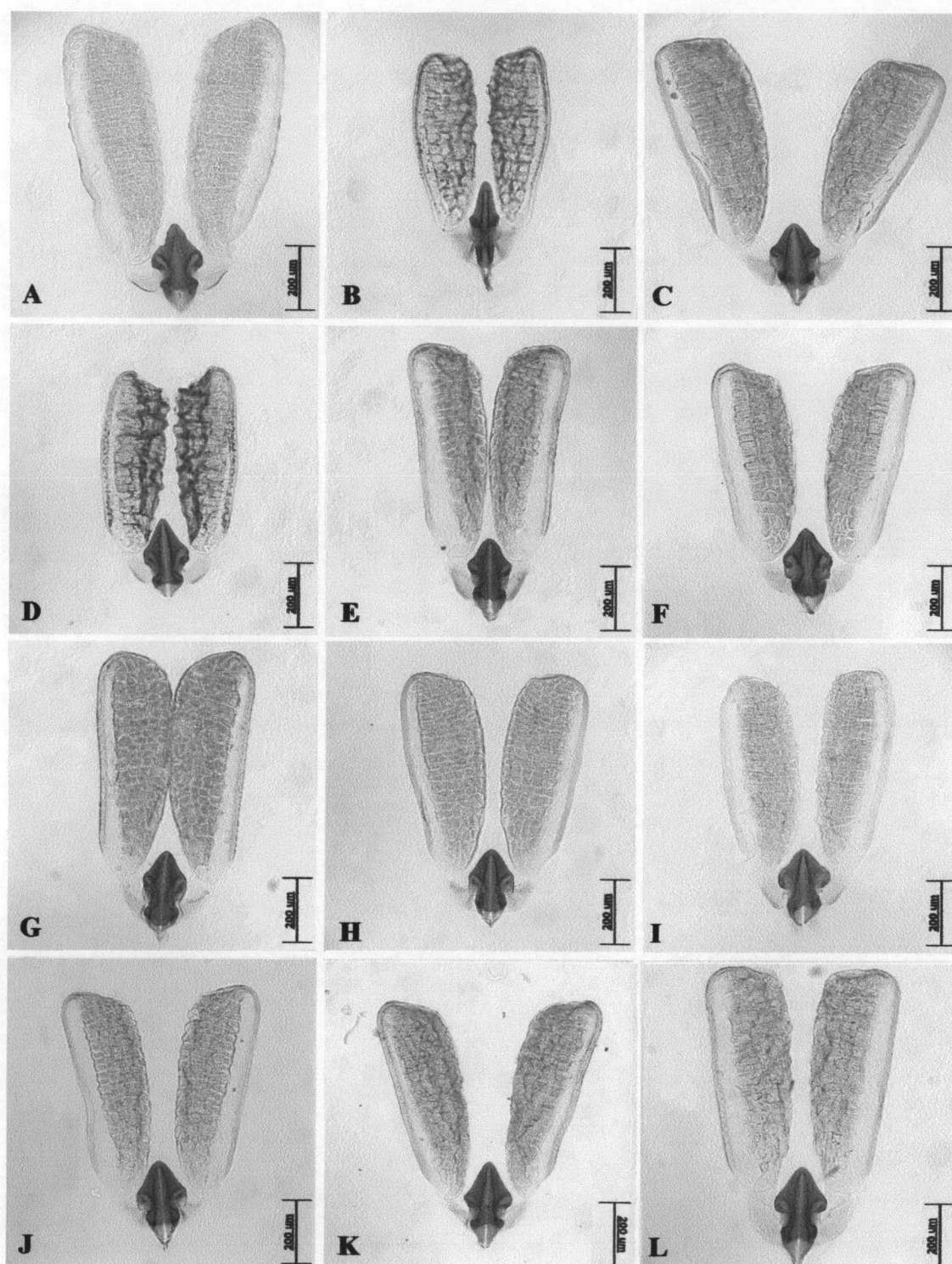


Figure 3.12 Twin-pollinia of “*Hoya parasitica complex*”. A: Form I (166). B: Form II (303). C: Form III (380). D: Form IV (320). E: Form V (404), F: Form VI (289), G: Form VII (384). H-I: Form VIII, H (660), I (202). J-L: Form IX, J (436), K (258), L (559). Numbers in parenthesis denoted the collector number. Bar= 200 μm .

Form I (Figures 3.9-3.12A, 3.13.1A-C)

Leaves rigidly coriaceous, broad ovate to oblong with rounded to cordate base, 13.8-(17.8)-19.1 cm long, 6.8-(8.7)-10.1 wide; nerves 3-5, prominent, extending from base to apex, the other veins conspicuous; glabrous on both surface; petiole slender, 2.7-(3.4)-3.9 cm long. **Inflorescence** 7-(30)-65 flowered, peduncle 1.5-(2.9)-4.7 cm long; pedicel glabrous, 2-(2.3)-3 cm long. **Sepal** lanceolate, longer than corolla tube, 4.9-(5.4)-5.6 mm long, 2-(2.1)-2.2 mm wide. **Corolla** creamy white, 1.6-(1.9)-2.1 cm diam. **Coronal scale** broad ovate, 4.2-(4.5)-4.8 mm long, 2.2-(2.4)-2.6 mm wide, the outer angle slightly erected and white, apiculus of the inner angle raised and pink. **Pollinia** oblong, 0.62-(0.63)-0.64 mm long, 0.21-(0.23)-0.24 mm wide; translator short; corpusculum triangular-oblong, 0.16-0.18 mm long, 0.12-0.13 mm wide.

Ecology and distribution.— A long climbing epiphyte, usually on trees along stream banks, in moist evergreen forest, in the eastern, western and southern parts of the country at 700-900 m elevations.

Specimens examined.— Kanchanaburi [Thong Pha Phum: Manit Kidyue 465, 466]. Nakhon Ratchasima [Khao Yai: Manit Kidyue 360, 997]. Nakhon Si Thammarat [Khao Luang: Manit Kidyue 166]

Form II (Figures 3.9-3.12B, 3.13.1D-F)

Leaves coriaceous, broadly ovate or rhombic with cordate base, 14.7-(15.9)-16.7 cm long, 11.3-(12.3)-13.2 cm wide; nerves 3-5, prominent, extending from base to apex, veins conspicuous; hairs minute, scattering on the abaxial surface; petiole slender, 1.8-(2.1)-2.2 cm long. **Inflorescence** 10-(26)-49 flowered, peduncle 2.5-(3.3)-4.3 cm long; pedicel glabrous, 1.7-(1.9)-2.0 cm long. **Sepal** ovate, 1.8-(1.9)-2.0 mm long, 1.5-(1.7)-1.8 mm wide. **Corolla** creamy to yellowish white, 1.4-1.5 cm diam. **Coronal scale** ovate-lanceolate, 3.5-(3.8)-4.0 mm long, 1.5-(1.6)-1.7 mm wide, the outer angle flatted and pinkish white, apiculus of the inner angle raised and pink. **Pollinium** oblong, 0.45-0.46 mm long, 0.15-0.16 mm wide; translator short; corpusculum narrowly oblanceolate-oblong, 0.2-0.22 mm long, 0.07-0.08 mm wide.

Ecology and distribution.— A long climbing epiphyte in moist evergreen forest, usually on trees along stream banks, restricted to Bala forest, peninsular Thailand at about 200 m elevations.

Specimens examined.— Narathiwat [Sirinthon Waterfall: Manit Kidyue 303, 304, 305, 306].

Form III (Figures 3.9-3.12C, 3.13.1G-I)

Leaves rigidly coriaceous, broadly ovate with subcordate base, 14-(14.6)-15.3 cm long, 5.9-(7.4)-8 wide; nerves 3, prominent, extending from base to apex, veins conspicuous; covered with dense hairs on abaxial surface; petiole stout, 1.1-(1.9)-2.1 cm long. **Inflorescence** 22-(43)-59 flowered, peduncle 3.1-(4.5)-7.4 cm long; pedicel sparsely pubescent, 1.9-(2.2)-2.4 cm long. **Sepal** ovate, 1.8-(1.9)-2 mm long, 1.4-(1.6)-1.8 mm wide. **Corolla** yellowish white, 1.4-1.5 cm diam. Coronal scale ovate-elliptic, 3.5-(3.6)-3.8 mm long, 1.7-(2.0)-2.2 mm wide, the outer angle slightly erected and white, apiculus of inner angle raised and pink. **Pollinium** oblong, 0.5-0.6 mm long, 0.19-0.22 mm wide; translator short; corpusculum triangular-oblong, 0.17-0.19 mm long, 0.11-0.12 mm wide.

Ecology and distribution.—A long climbing epiphyte in mixed deciduous forest, or on rocks along stream banks, at about 400 m elevations, confined to northern Thailand.

Specimens examined.— Nan [Silaphet Waterfall: Manit Kidyue 380, 381, 382].

Form IV (Figures 3.9-3.12D, 3.13.1J-L)

Leaves large coriaceous, elliptic-oblong, with cuneate base, 18-(19.3)-20.4 cm long, 7.3-(7.7)-8 cm wide; nerves 3, prominent, extending from base to apex, veins conspicuous; covered with dense hairs on abaxial surface; petiole slender, 2-(2.5)-2.9 cm long. **Inflorescence** 65-(68)-71 flowered, peduncles 5.6-(7.3)-9.1 cm long; pedicel glabrous, 2-(2.2)-2.3 cm long. **Sepal** small ovate, 1.7-1.8 mm long, 1.5-1.6 mm wide. **Corolla** creamy white, 1.2-1.3 cm diam. **Coronal scale** ovate-lanceolate, 3.4-(3.5)-3.6 mm long, 1.82-(1.86)-1.91 mm wide, the outer angle slightly erected and white, apiculus of the inner angle short raised and pink. **Pollinium** oblong, 0.45-0.46 mm long, 0.17-0.18 mm wide; translator short; corpusculum

triangular-oblong, 0.16-0.17 mm long, 0.11-0.12 mm wide.

Ecology and distribution.—A long climbing epiphyte on tree branches along stream banks in evergreen forest, restricted to Tarutao Island, peninsular Thailand.

Specimens examined.— Satun [Tarutao National Park: Manit Kidyue 320, 321, 322].

Form V (Figures 3.9E-F, 3.10-3.12E, 3.13.2A-F)

Leaves coriaceous to succulently coriaceous, ovate with round to subcordate base, 8.6-(12.5)-16.2 cm long, 5-(7.1)-10 cm wide; nerves 3, extending about half way to apex or slightly longer, veins obscure; covered with dense hairs on abaxial surface; petiole stout, 0.5-(1.2)-2.9 cm long. **Inflorescence** 21-(43)-87 flowered, peduncle 0.6-(3.0)-6.5 cm long; pedicel glabrous to pubescent, 1.9-(2.3)-2.8 cm long. **Sepal** ovate, 1.45-(1.8)-2.1 mm long, 1.4-(1.6)-1.9 mm wide. **Corolla** creamy white, 1.3-(1.5)-1.6 cm diam. **Coronal scale** ovate-elliptic, 3.1-(3.7)-4.4 mm long, 1.9-(2.2)-2.4 mm wide, the outer angle slightly erected to erected and white, apiculus of inner angle short raised and pink. **Pollinium** oblong, 0.51-(0.55)-0.64 mm long, 0.18-(0.2)-0.21 mm wide; translator short; corpusculum triangular-oblong, 0.15-(0.19)-0.23 mm long, 0.11-(0.12)-0.14 mm wide.

Ecology and distribution.— On tree branches by stream banks in mixed deciduous to dry dipterocarp forests, northern Thailand at about 300-600 m elevations.

Specimens examined.— Chiang Rai. [Mueang: Manit Kidyue 404, 405, 406, 407, 407/2, 407/3, 408, 409, 409/2, 409/3, 409/4]; Chiang Mai [Wang Bua Ban Waterfall: Manit Kidyue 292, 293, 294, 295, 296, 312, 313, 411, 413, 414, 414/2, 415, 416, 417, 417/2, 417/3, 418, 419, 425]; Nan [Meang: Manit Kidyue 331, 332, 333, 378, 378/2, 378/3, 378/4, 378/5, 378/6, 378/7, 379, 379/2, 379/3, 379/4, 379/5, 379/6, 379/7, 379/8, 379/9, 379/10].

Form VI (Figures 3.9I, 3.10-3.12F, 3.13.2G-I)

Leaves succulently coriaceous, broadly ovate, subcordate at base, 11-(11.2)-11.6 cm long, 7.4-(8.0)-8.3 cm wide; not distinctly acrodromous venation, the lowest pair extending about half way to apex; veins obscure; covered with dense hairs on abaxial surface; petiole slender, 1.5-(2.2)-3 cm long. **Inflorescence** 26-(29)-30

flowered, peduncle 3.5-(5.8)-7.1 cm long; pedicel pubescent, 1.7-(1.8)-1.9 cm long. **Sepal** ovate, 2-(2.2)-2.3 mm long, 1.6-(1.7)-1.8 mm wide. **Corolla** creamy white, 1.3-(1.4)-1.5 cm diam. **Corona scale** ovate-lanceolate, 3.6-(3.7)-3.8 mm long, 1.8-1.9 mm wide, the outer angle slightly erected and white, apiculus of inner angle short raised and pink. **Pollinium** oblong, 0.49-(0.5)-0.54 mm long, 0.17-0.18 mm wide; translator short; corpusculums triangular-oblong, 0.17--0.19 mm long, 0.11-0.12 mm wide.

Ecology and distribution.— On tree branches in dry dipterocarp forests at 350 m elevations, northern Thailand.

Specimens examined.— Chiang Mai [Haew Keaw: Manit Kidyue 288, 289, 290, 291].

Form VII (Figures 3.9G-H, 3.10-3.12G, 3.13.2J-L)

Leaves coriaceous to succulently coriaceous, ovate-oblong with cuneate to obtuse base, 10.4-(13.9)-17.9 cm long, 4.3-(5.6)-7.8 cm wide; 3 nerves, extending about half way to apex or slightly longer, veins obscure; covered with dense hairs on abaxial surface; petiole stout, 0.8-(1.4)-2.1 cm long. **Inflorescence** 9-(31)-52 flowered, peduncle 0.6-(3.4)-8.1 cm long; pedicel glabrous to pubescent, 1.8-(2.3)-2.6 cm long. **Sepal** ovate, 1.5-(1.9)-2.4 mm long, 1.4-(1.6)-2.0 mm wide. **Corolla** creamy white, 1.5-(1.6)-1.8 cm diam. **Coronal scale** ovate-elliptic, 3.4-(3.7)-4.1 mm long, 2.1-(2.2)-2.5 mm wide, the outer angle erected and white, apiculus of inner angle short raised and pink. **Pollinium** oblong, 0.54-(0.58)-0.62 mm long, 0.19-(0.2)-0.24 mm wide; translator short; corpusculum triangular-oblong, 0.16-(0.18)-0.21 mm long, 0.11-(0.12)-0.15.

Ecology and distribution.— On tree branches by stream banks in mixed deciduous to dry dipterocarp forests at about 300-600 m elevations, northern Thailand.

Specimens examined.— Nan [Silaphet Waterfall: Manit Kidyue 325, 326, 327, 328, 329, 383, 384/1, 384/2, 384/3, 384/4, 384/5, 384/6], [Tat Laung Waterfall: Manit Kidyue 342, 343, 344, 345, 385, 385/2, 386, 387], [Lhinan: Manit Kidyue 391, 392, 393, 394, 395, 396, 402, 402, 403]

Form VIII (Figures 3.9N-T, 3.10-3.12 H-I, 3.13.3A-L, 3.13.4A-F)

Leaves succulently coriaceous, narrowly ovate or elliptic to oblong, cuneate or rarely obtuse at base, 5-(9.6)-15 cm long, 1.8-(3.8)-5.8 cm wide, indistinct acrodromous venation, the lowest pair extending about half way to apex; veins obscure; covered with dense hairs on abaxial surface; petiole stout, 0.3-(1.2)-2.8 cm long. **Inflorescence** 10-(28)-77 flowered, peduncle 0.8-(3.8)-11.4 cm long; pedicel glabrous to pubescent, 1.2-(1.7)-2.6 cm long. **Sepal** ovate, 1.4-(2.0)-2.9 mm long, 1.1-(1.7)-2.6 mm wide. **Corolla** creamy, greenish and pinkish white to white with brown, pink and violet at apices, 1.1-(1.3)-1.6 cm diam. **Coronal scale** ovate-lanceolate, 2.9-(3.5)-4.2 mm long, 1.5-(1.7)-2.1 mm wide, the outer angle flattened to erected and white, apiculus of inner angle short raised and white to pink. **Pollinium** oblong, 0.40-(0.48)-0.56 mm long, 0.15-(0.18)-0.2 mm wide; translator short; corpusculum triangular-oblong, 0.13-(0.16)-0.2 mm long, 0.10-(0.12)-0.14 mm wide.

Ecology and distribution.— A littoral plant, on tree branches or on rocks, common in beach forests, coastal areas of island or mainland in eastern and peninsular Thailand.

Specimens examined.— Rayong [Ban Pe: Mani Kidyue 80,81,82,83, 84,85,94,95,96, 99,100]; Chanthaburi [Nam Tok Phliu National Park: Mani Kidyue 110, 111, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 132, 133, 134, 135, 136]; Trat [Mueang: Mani Kidyue 163, 164, 250], [Ko Chang: Mani Kidyue 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668]; Prachuap Khiri Khan [Bang Saphan: Mani Kidyue 622, 623, 624]; Suratthani [Ko Wua Ta Lub: Mani Kidyue 584, 585, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595]; Phangnga [Mueang: Mani Kidyue 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 671, 672, 673, 674, 675, 676, 677, 678]; Krabi [Noppharat Thara Beach: Mani Kidyue 579, 580, 581, 582, 583, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643]; Trang [Pakmeng: Mani Kidyue 693, 694, 695, 696, 697], [Hat Chao Mai National Park: Mani Kidyue 628, 629, 630, 631, 632, 633], [Thung Kai: Mani Kidyue 66, 67, 68, 69, 70, 71, 72, 73, 74]; Songkhla [Sathing Phra: Mani Kidyue 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 240, 241, 242, 243, 244, 245, 246, 247, 248], [Singhanakorn: Mani Kidyue 212, 213, 216, 217, 218, 219, 220, 221,

222], [Pak Bang Sakom Beach: Manit Kidyue 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618]; Satun [Tarutao National Park: Manit Kidyue 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 596, 597, 598, 599, 600, 602, 603, 604, 605, 606].

Form IX (residual group; Figures 3.9J-M, 3.10-3.12J-L, 3.13.4G-L, 3.13.5-6A-L)

Leaves coriaceous to succulently coriaceous, ovate or elliptic to oblong, cuneate or obtuse at base, 7.7-(12.9)-18.6 cm long, 4-(5.8)-8.6 cm wide, indistinctly acrodromous venation, the lowest pair extending about half way to apex; veins obscure; covered with dense hairs on abaxial surface; petiole stout, 0.5-(1.5)-3.2 cm long. **Inflorescence** 5-(27)-75 flowered, peduncle 0.3-(3.8)-14.3 cm long; pedicel glabrous to pubescent, 1.3-(2.0)-2.9 cm long. **Sepal** ovate, 1.3-(1.9)-3 mm long, 1.1-(1.6)-2.1 mm wide. **Corolla** creamy, greenish and pinkish white, 1.1-(1.4)-1.8 cm diam. **Coronal scale** ovate to ovate-lanceolate, 2.8-(3.5)-4.4 mm long, 1.5-(1.9)-2.4 mm wide, the outer angle slightly erected to erected and white, apiculus of inner angle short raised and white to pink. **Pollinium** oblong, 0.41-(0.51)-6.43 mm long, 0.16-(0.19)-0.22 mm wide; translator short; corpusculums triangular-oblong, 0.14-(0.17)-0.21 mm long, 0.10-(0.12)-0.15 mm wide.

Ecology and distribution.— Along stream banks in mixed deciduous to dry dipterocarp forests at about 100-600 m elevations, sporadically occurs throughout northern, north-eastern, eastern, western to peninsular Thailand.

Specimens examined.- Chiang Mai [Wang Bua Ban Waterfall: Manit Kidyue 281, 282, 283, 284, 285, 299, 300, 301, 412]; Lampang [Doi Khun Tan National Park: Manit Kidyue 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 380, 410]; Nan [Phu Pieng: Manit Kidyue 388, 389, 390], [Rhinan: Manit Kidyue 398, 399], Loei [Pla Ba Waterfall: Manit Kidyue 689, 690, 691, 692]; Nong Khai [Than Thong Waterfall: Manit Kidyue 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568]; Udon Thani [Than Ngam Waterfall: Manit Kidyue 420, 421, 422, 423, 424]; Nakhon Phanom [Tat Kham Waterfall: Manit Kidyue 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505]; Sakon Nakhon [Phu

Phan National Park: Manit Kidyue 427, 228, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441]; Mukdahan [Tat Ton Waterfall: Manit Kidyue 484, 485, 486, 487, 488, 489, 490, 491, 492]; Ubon Ratchathani [Soi Sawan Waterfall: Manit Kidyue 540, 541, 542, 543, 544], [Huai Sai Yai Waterfall: Manit Kidyue 479, 480, 481, 482, 483], [Phu Chongna Yoi National Park: Manit Kidyue 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528], [Tat Hai Waterfall: Manit Kidyue 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539]; Sri Sa Ket [Sam Long Kiat Waterfall: Manit Kidyue 506, 507, 508, 509, 510, 511]; Nakhon Rat Chasima [Phu Wa Kiew Waterfall: Manit Kidyue 545, 546, 547, 548, 549, 550], [Khao Yai National Park: Manit Kidyue 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377]; Saraburi [Pu Kae: Manit Kidyue 307, 308, 309]; Prachin Buri [Prachantakham: Manit Kidyue 315,316,317,318]; Sa Kaeo [Pang Sida National Park: Manit Kidyue 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30]; Tak [Thi Lo Su Waterfall: Manit Kidyue 570]; Kanchanaburi [Sangkhla Buri: Manit Kidyue 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 458, 460, 461, 462, 463], [Koeng Kra Wia Waterfall: Manit Kidyue 475, 476], [Pong Ron, Thong Pha Phum: Manit Kidyue 258, 259, 442, 443, 444, 445, 446], [Ban Thamadua, Thong Pha Phum: Manit Kidyue 140, 141, 142, 158, 165, 473, 474], [Sai Yok National Park: Manit Kidyue 150, 151, 152, 153, 155, 156, 157, 159, 160, 162]; Ranong [Namtok Ngao National Park: Manit Kidyue 644, 645, 646, 647, 648].

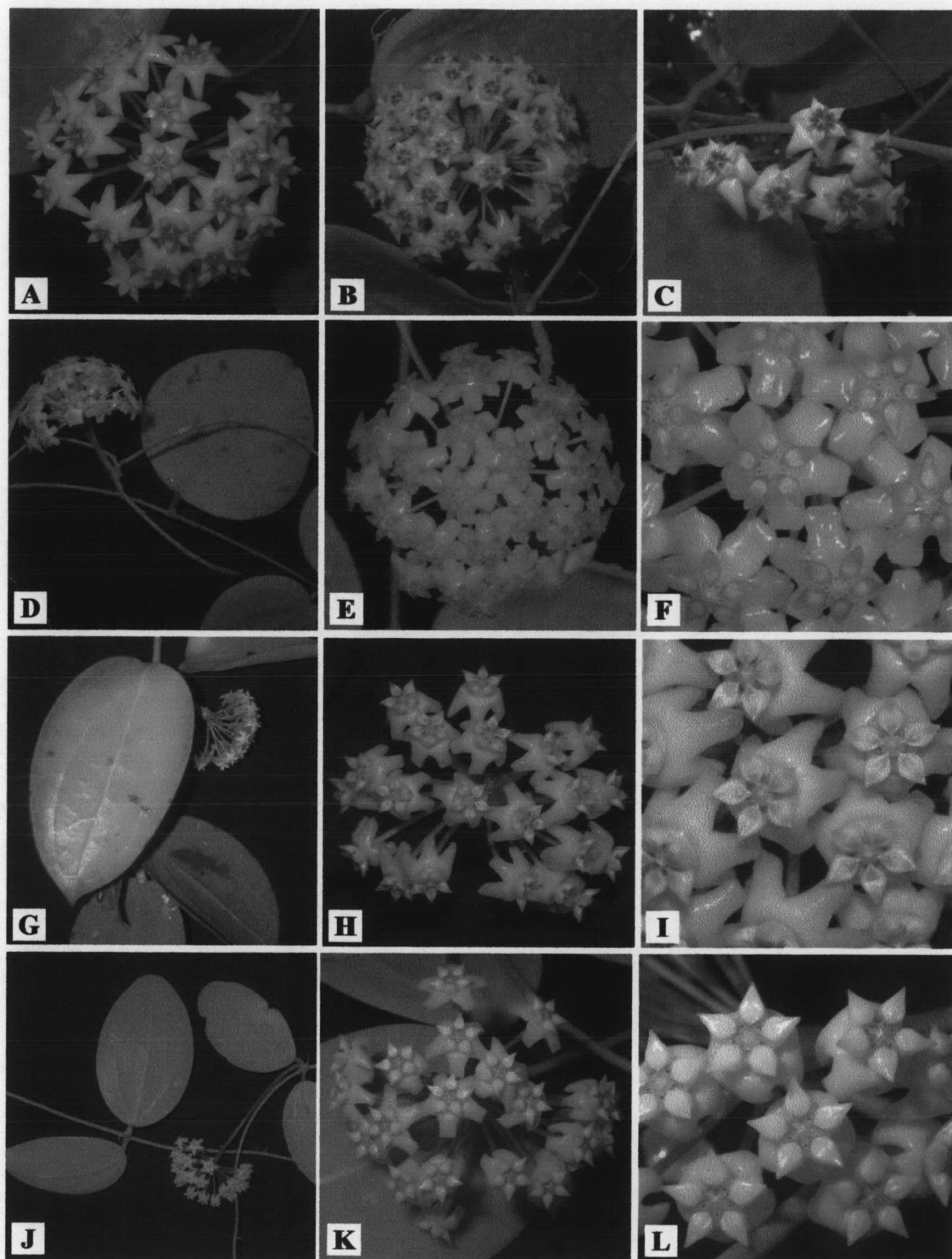


Figure 3.13.1 Flowers of "*Hoya parasitica* complex". A-C: Form I, A. Site 22 (997), B. Site 34 (465), C. Site 42 (166). D-F: Form II, D. Site 50 (303), E-F. Site 50 (305). G-I: Form III, Site 5 (380). J-L: Form IV, Site 49 (320). Numbers in parenthesis denoted the collector number.

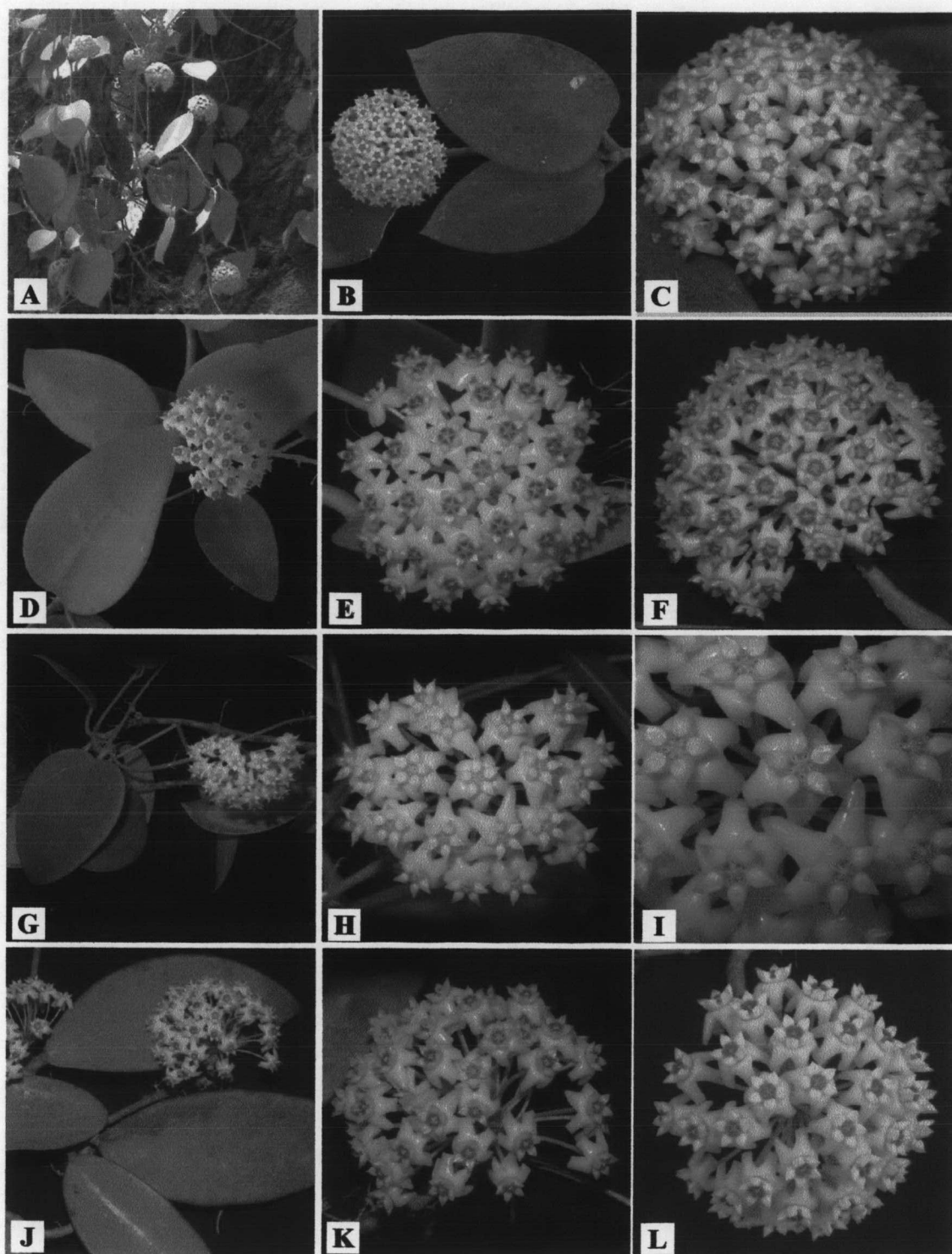


Figure 3.13.2 Flowers of “*Hoya parasitica* complex”. A-F: Form V, A-B. Site 1 (404), C. Site 1 (408), D-E. Site 2 (312), F. Site 8 (379). G-I: Form VI, Site 3 (288). J-L: Form VII, J-K. Site 5 (384), L. Site 9 (392). Numbers in parenthesis denoted the collector number.

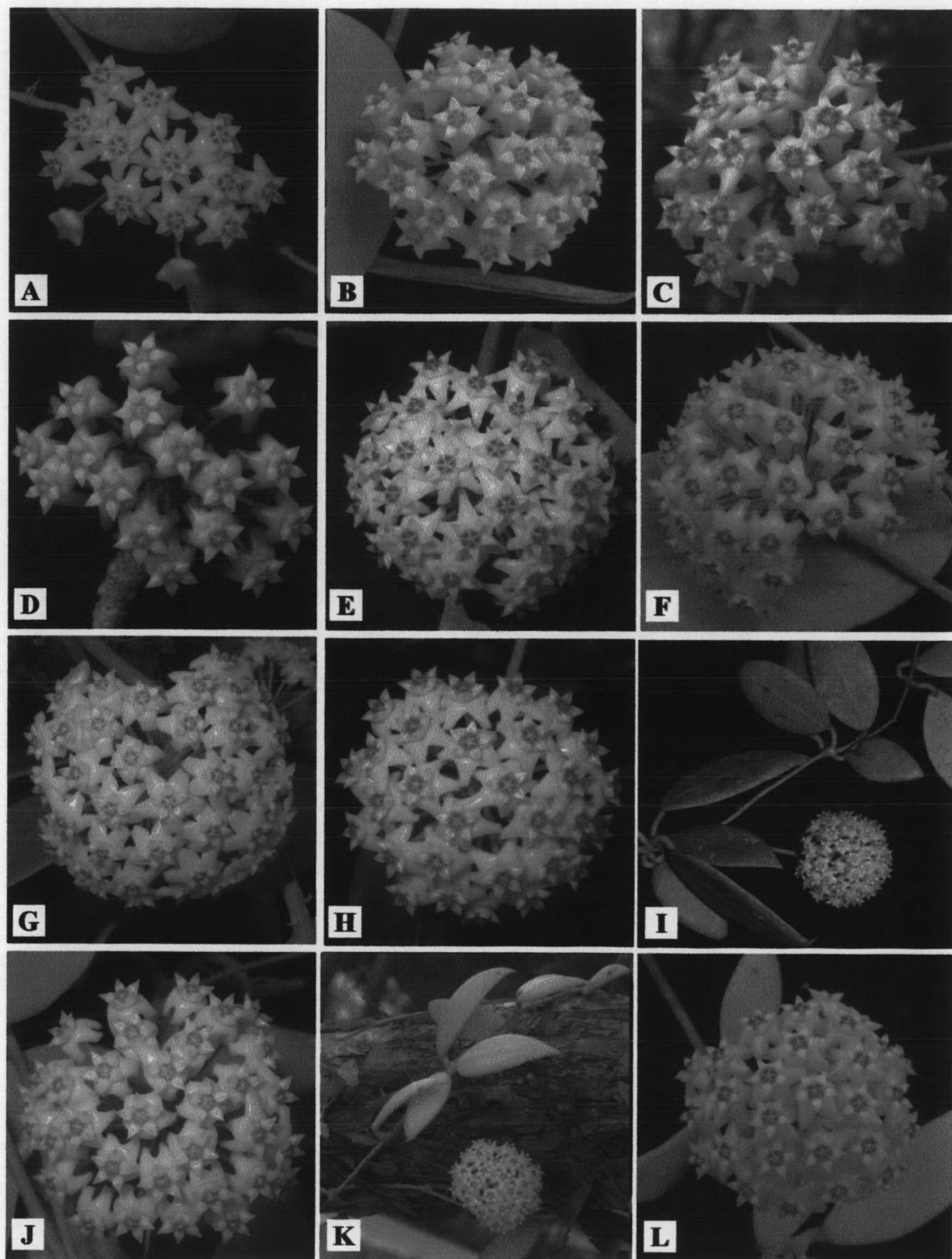


Figure 3.13.3 Flowers of “*Hoya parasitica* complex”. A-L: Form VIII, A. Site 37 (622), B. Site 39 (585), C. Site 40 (685), D. Site 41 (579), E. Site 43 (693), F. Site 44 (630), G. Site 45 (66), H. Site 46 (243), I. Site 47 (213), J. Site 48 (607), K-L Site 49 (202). Numbers in parenthesis denoted the collector number.

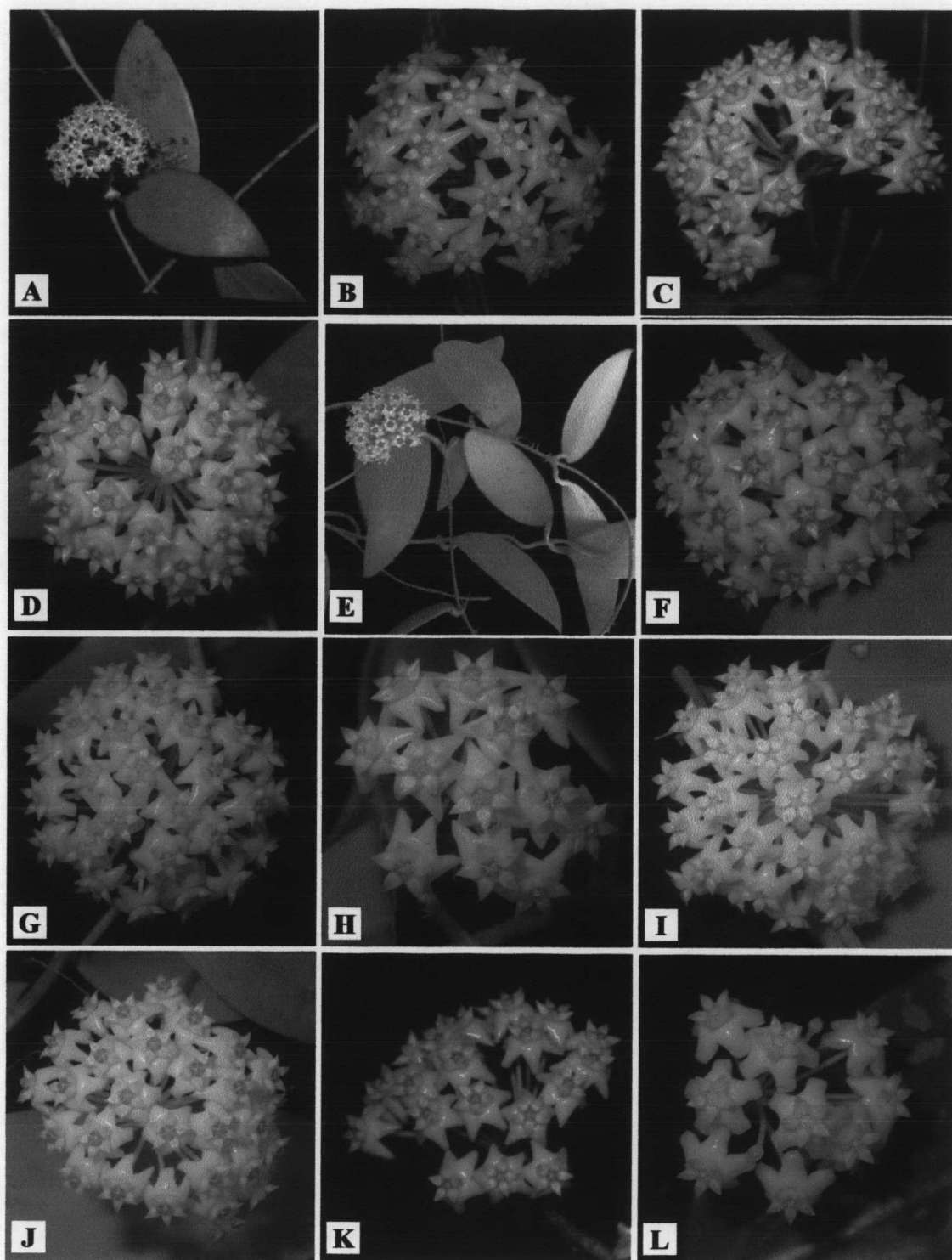


Figure 3.13.4 Flowers of “*Hoya parasitica* complex”. A-F: Form VIII, A. Site 27 (120), B. Site 27 (135), C. Site 26 (80), D. Site 28 (163), E-F. Site 29 (660). G-L:Form IX, G. Site 31 (456), H. Site 32 (476), I. Site 33 (444), J. Site 35 (473), K. Site 36 (155), L. Site 38 (645). Numbers in parenthesis denoted the collector number.

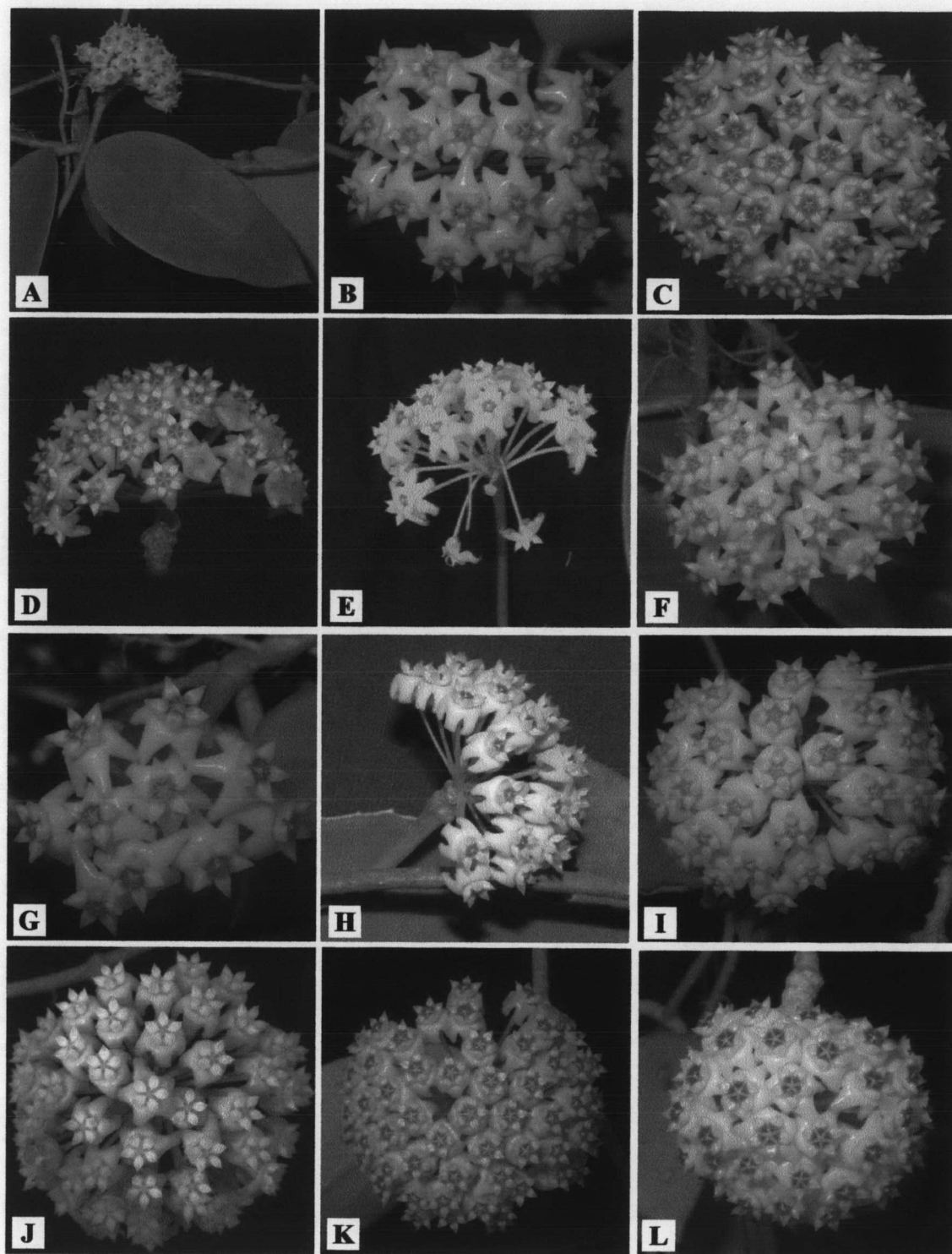


Figure 3.13.5 Flowers of “*Hoya parasitica* complex”. A-L: Form IX, A-B. Site 2 (285), C. Site 7 (388), D. Site 9 (398), E. Site 4 (410), F. Site 10 (561), G. Site 11 (568), H. Site 12 (420), I. Site 13 (504), J. Site 14 (427), K. Site 15 (487), L. Site 16 (541). Numbers in parenthesis denoted the collector number.

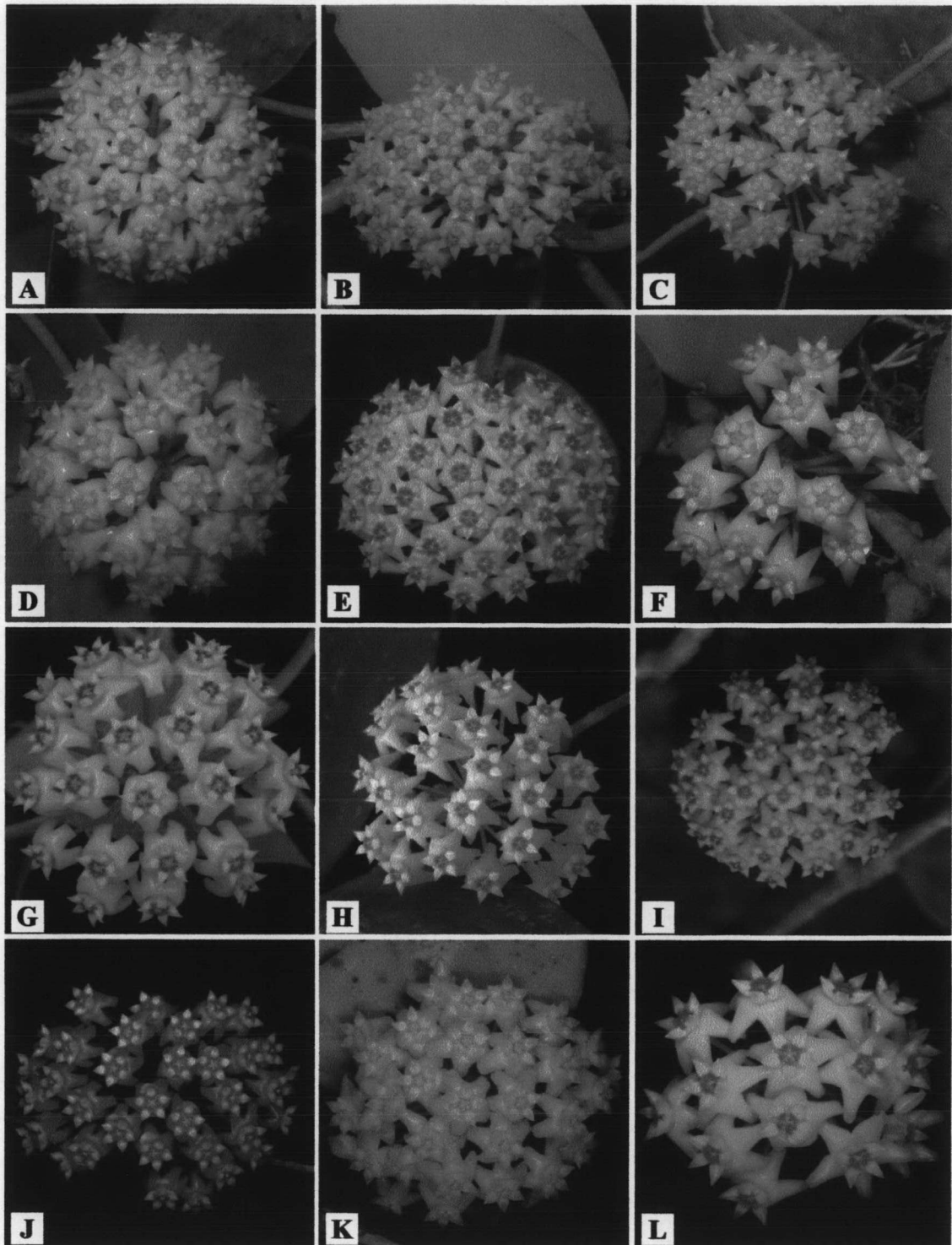


Figure 3.13.6 Flowers of "*Hoya parasitica* complex". A-L: Form IX, A. Site 17 (481), B. Site 18 (515), C. Site 19 (535), D. Site 20 (509), E. Site 21 (548), F. Site 22 (370), G. Site 23 (307), H. Site 25 (318), I. Site 24 (1), J. Site 24 (14), K. Site 24 (30), L. Site 30 (570). Numbers in parenthesis denoted the collector number.

Anatomy of "*Hoya parasitica* complex"

The stem and leaf anatomy of members of *Hoya parasitica* in Thailand were rather uniform. The results were described in the part of general anatomy. The nine morphological forms recognized were not distinct in anatomical character of stems. Nevertheless, considering leaf anatomy, they were somewhat distinct in epidermal characters. The stomata of all forms were cyclocytic stoma but each was different in density (number per area). The epidermal cells of the nine forms were rectangular to square in shapes and fairly differ to each others in size. However, these variations were not clear and could not be served to recognize forms I-IX (Figure 3.14).

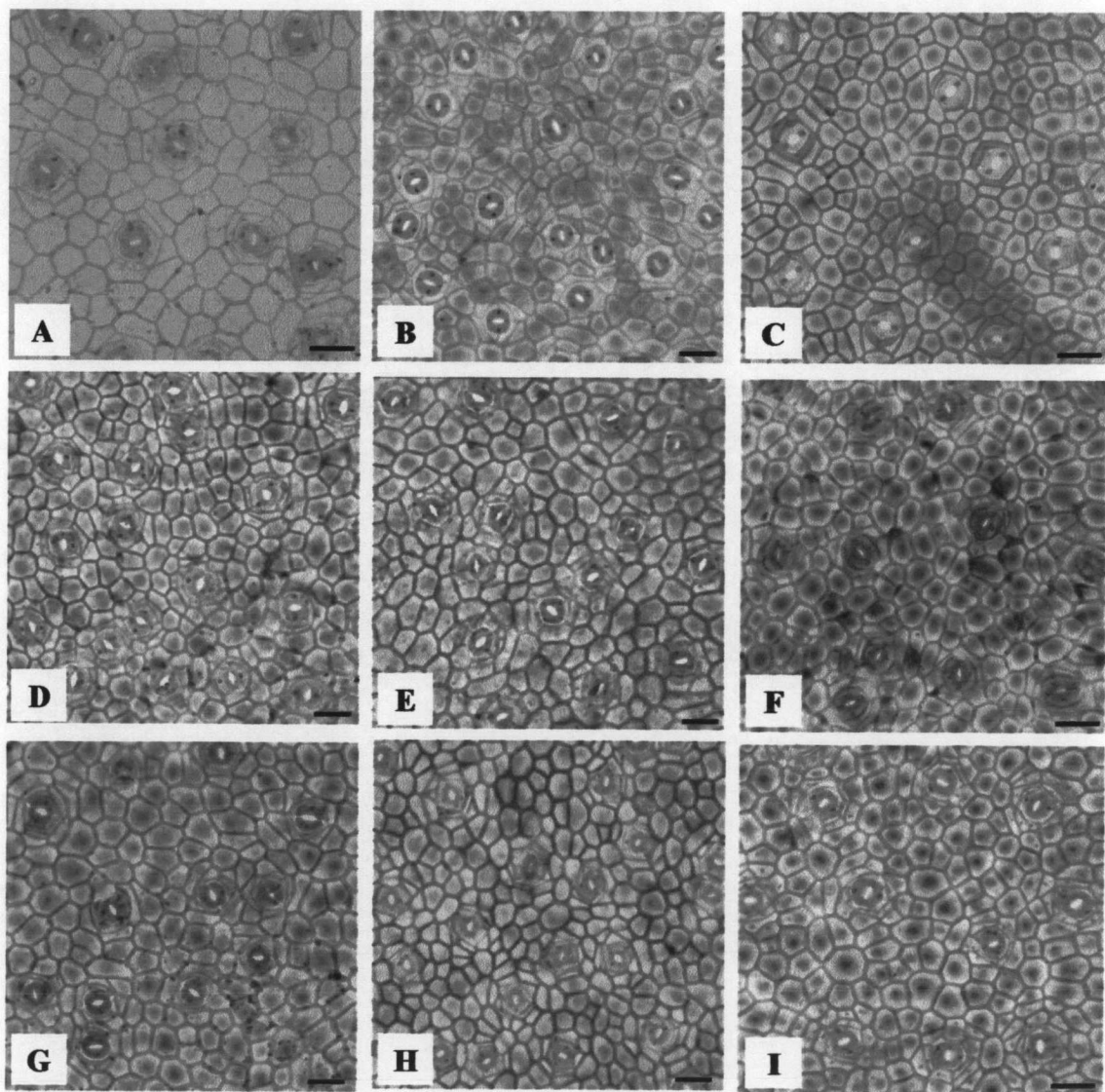


Figure 3.14 Stomata and epidermal cell on abaxial surface of leaves of nine forms. A: Form I (166). B: Form II (303). C: Form III (380). D: Form IV (320). E: Form V (312). F: Form VI (289). G: Form VII (384). H: Form VIII (66), I: Form IX (258). Numbers in parenthesis denoted the collector number. Bar=25 μ m.

Only the character of indumentum on abaxial surface of leaves was an indicative character for distinguishing the nine forms whereby three groups could be separated. The first groups consisted of form I whose leaf was glabrous. The second group included form II whose leaf has minute and scatter indumentum. The last group contained forms III-IX which have leaves with dense indumentum being variable in size (Figure 3.15).

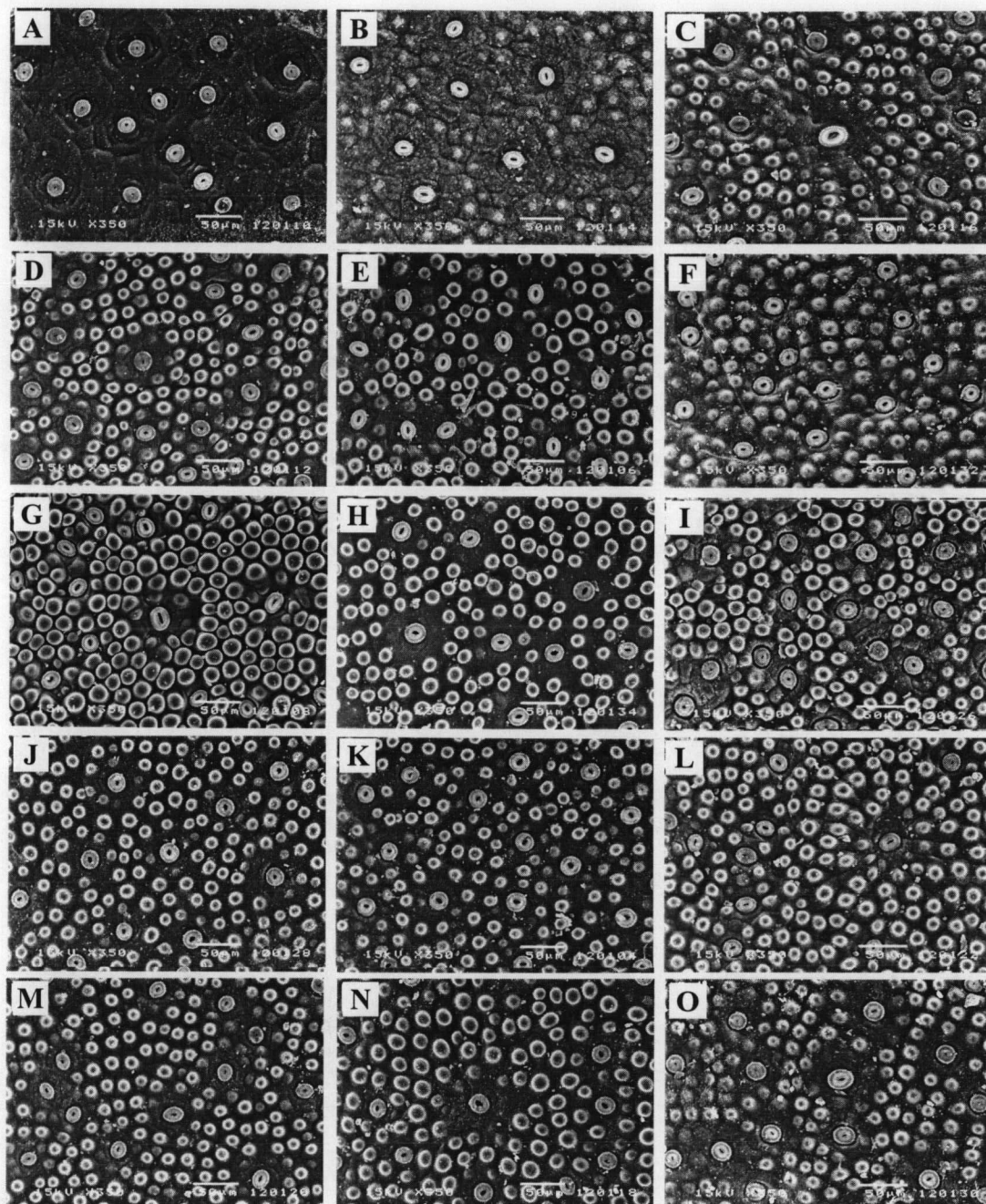


Figure 3.15 Scanning electron micrographs on abaxial surface of leaves of nine forms. A: Form I (166). B: Form II (303). C: Form III (380). D: Form IV (320). E-F: Form V, E (312), F (378). G: Form VI (289), H: Form VII (384). I-K: Form VIII, I (585), J (636), K (202). L-O: Form IX, L (429), M (3), N (508), O (258). Numbers in parenthesis denoted the collector number. Bar=50µm.

Discussion and Conclusion

The result from this present study indicated that nine morphological forms can be recognized based on leaf shape, form of leaf base, leaf venation, leaf indumentum, shape of sepal, and shape of coronal scale. However, the *Hoya parasitica* specimens could not be consistently allocated into forms based on lamina texture, color of flower and hair. Lamina texture was slightly discontinuous variables. This variation appeared to be related to growing conditions in different habitats (Hill, 1988). Color of flowers has been reported to be highly variable in this species (Kiew, 1995). In this study, we found that the color of corolla varied from white, creamy white, yellowish white, greenish white, pinkish white to white with brown, pink and violet at apices. Hair is occasionally found on stem, corolla (adaxial surface), calyx (abaxial surface) and pedicel. Surface of young stem and new branches varied from glabrous to pubescent or caducous in mature branches, but some plants are consistently glabrous. Pedicel is also varied from glabrous to densely pubescent. In contrast, in some populations hairiness varied from glabrous to densely pubescent, while the others were only glabrous or pubescent. Hair on corolla varied from minutely pubescent (almost glabrous to the naked eye) to densely pubescent (obvious to the naked eye). All of the above characters (lamina texture, color of flower and hair) are varied and still not reliable characters for distinguishing taxa of this complex.

Regarding the habitats and distributions, the 9 recognized forms of the complex occur in different floristic regions and habitats throughout the country. It was found that form I, II and IV occur in rather humid forests with medium to low light conditions, while the other forms usually grow in dry habitat to some extent. These differences possibly related in part to the degree of succulence and size of leaves that allow plants to withstand different light conditions (Forster and Liddle, 1991). Naturally, the members of the complex occur in a wide range of habitats in Thailand. Anyway, the habitat and distribution of the 9 forms are more or less overlap and they are more or less useful characters to distinguish taxa in the complex.

In addition, the collected plants which are kept in the greenhouse condition during three years still have most characters of leaves and flowers similar to those found when being collected in natural habitats. However, the thickness of leaves and

color of flowers of the collected plants in greenhouse somewhat varies from those grow in natural conditions. Furthermore, in some plants, the colors of flowers are different from the nature, for example, pinkish white flowers that occur in sunny habitats when being kept in the green house change to creamy white flowers. Indeed, thickness of leaves and color of flowers were found to vary under different growth conditions (Forster and Liddle, 1991; Taiz, L. and Zeiger, E., 2002), thus are not significant diagnostic characters for identification.

Form I corresponds to the previous described species, *Hoya rigida* Kerr (Kerr, 1939). The result from this study shows good diagnostic characters to recognize this species based on leaf shape, venation, sepal shape and ratio of corolla tube length to sepal length. Form II is some what close to *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz, but having minute hairs scattering over the abaxial surface, and the shape of the corpusculum is oblanceolate-oblong. While, Rintz (1978) described to *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz, and from his illustrations showed the lower surface of leaves with dense hairs and triangular-oblong corpusculum. The result from this study indicated that form II is clearly distinguished from the *H. parasitica* s. l. Since it has some diagnostic characters (leaf broad ovate with cordate base; 3-5 prominent nerves, extending from base to apex, hairs minute, scattering on the abaxial surface; corpusculum oblanceolate-oblong) which do not match to any previous described taxa, thus it may be treated as a new species. In addition, the fragrance of flowers in Form II tends to differ from the other forms.

Form III and Form IV have conspicuously discrete vegetative characters. Form III shares leaves characters with *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz in having ovate leaves, basal main veins extending to apex and the veins are conspicuous, but differ from the latter by the ovate- elliptic coronal scale and confine to lowland of northern Thailand, while *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz has ovate-lanceolate coronal scale and occurs in Malaysia, common on limestone hill. Form IV is an intermediate form between *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz and *H. parasitica* (Roxb.) Wall. ex Wight var. *parasitica*. It shares venation pattern with the variety *citrina*, while leaf shape is elliptic-oblong with cuneate base, this character is similar to the

variety *parasitica*. It is evident that Form III and Form IV do not correspond to the previously described varieties. Therefore these two forms should be considered as new varieties of "*Hoya parasitica* complex" and treated as undescribed taxa. However, these forms are rather rare, each being found only at one site.

Form V-IX have some discontinuity in flower and leaf characters. They can not be clearly distinguished into distinct species or varieties. Although, plants of form VIII and IX correspond to previous infraspecific taxon, *H. parasitica* (Roxb.) Wall. ex Wight var. *parasitica*. It is characterized by elliptic leaf, cuneate base, obscure veins and the lowest basal pair of main veins extending about halfway to apex, while the form V-VII do not best fit to this taxon. Form V-VII have broad ovate or elliptic to oblong leaf, obtuse to rounded at base and varied in coronal scale shape. However, they are more comparable to var. *parasitica* than the other two previously described varieties, i.e. *H. parasitica* (Roxb.) Wall. ex Wight var. *critina* (Ridl.) Rintz and var. *hendersonii* Kiew which having ovate leaves, cordate base, 3 prominent nerves extending from base to apex and the other veins are conspicuous. Thus forms V-IX should be treated as variable forms of *H. parasitica* (Roxb.) Wall. ex Wight var. *parasitica*.

In conclusion, the proposed cryptic new species and new varieties of "*Hoya parasitica* complex" in Thailand need to be researched further and definitive taxonomic conclusions reached. Such study is not part of this Chapter.