

THE DISTICHOUS EUPHORBIACEAE GENERA OF THAILAND

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ABSTRACT. Floral character differences, especially in staminate flowers, are explained for a group of genera in Euphorbiaceae (*Breynia*, *Bridelia*, *Chaetocarpus*, *Cleistanthus*, *Flueggea*, *Glochidion*, *Leptopus*, *Margaritaria*, *Phyllanthus*, and *Sauropus*). These genera are difficult to identify, because they all look similar, with distichous leaves and fascicled or solitary flowers. Separate indented keys are provided for staminate and pistillate flowers. A multi-access key is presented for all characters. Short descriptions and figures of the staminate flowers are provided for each genus.

INTRODUCTION

Euphorbiaceae is one of the largest plant families in Thailand with ?? genera and ?? species. A group of the genera are difficult to identify, and look similar because they share two important features:

- a. The leaves are distichous (in two rows), often giving the impression that a branch with leaves is a composite leaf;
- b. The flowers are in fascicles (groups) in the axils of the leaves, and a distinct inflorescence rachis is usually absent.

In fact these genera are easy to separate when staminate (male) flowers are available. The pistillate (female) flowers and fruits often present difficulties. Fortunately, most of these genera are monoecious (both sexes present on the same plant). However, the staminate flowers may have withered before the pistillate flowers start. The genera *Bridelia* and *Cleistanthus* are the only exception, both sharing the same (distinct) type of staminate flower, but differing in the fruit type (drupe and capsule, respectively).

In this overview of the differences between the genera, *Actephila* and *Drypetes* are not included. *Actephila* has single flowers on very long pedicels in the axils of the leaves and *Drypetes* has recently been shown not to be a member of Euphorbiaceae (Stuppy 1996).

The following genera are treated: *Breynia*, *Bridelia*, *Chaetocarpus*, *Cleistanthus*, *Flueggea*, *Glochidion*, *Leptopus*, *Margaritaria*, *Phyllanthus*, and *Sauropus*. *Chorisandrachne*, *Securinega* and *Synostemon* are not included. *Securinega*, at least the S.E. Asian species, are now referred to *Flueggea* (*Securinega* is restricted to Madagascar and surrounding islands). *Synostemon* is a synonym of *Sauropus* and *Chorisandrachne* is a synonym of *Leptopus*.

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Three keys are provided: two indented (one each for staminate and pistillate flowers) and one multi-access. Short descriptions highlighting the typical characters of the genera are given, together with illustrations of the staminate flowers. The data have been obtained from Airy Shaw (1972), Webster (1994), van Welzen (1998) and Whitmore (1973).

KEY TO THE GENERA
BASED ON STAMINATE (MALE) FLOWERS

1. Petals present
 2. Disc annular. Stamens united
 3. Fruit drupe. (Leaves usually dull greyish brown when dry with scalariform venation and in one section nerves ending in marginal vein) **Bridelia**
 3. Fruit capsule. (Leaves usually shiny, different colours when dry with indistinct venation, ending before margin) **Cleistanthus**
 2. Disc lobed (lobes petal-like). Stamens free **Leptopus**
1. Petals absent (or single petal)
 4. Stamens free
 5. Flowers 5-merous with pistillode and disc lobes **Flueggea**
 5. Flowers 4-merous without pistillode and annular disc **Margaritaria**
 4. Stamens united
 6. Disc present
 7. Stamens 8, united into column. Sometimes single petal **Chaetocarpus**
 7. Stamens 3–6, only filaments united. Petals absent **Phyllanthus**
 6. Disc absent
 8. Sepals with scales inside
 9. Flowers bell-shaped or urceolate. Stamens united into rod with anthers along it **Breynia**
 9. Flowers disc-shaped. Stamens united, top bent and split umbrella-like, with anthers underneath **Sauropus**
 8. Sepals without scales **Glochidion**

KEY TO THE GENERA
BASED ON PISTILLATE (FEMALE) FLOWERS

1. Petals present
 2. Disc annular. Stamens united
 3. Ovary 2-locular (in fruit often becoming 1-locular). Fruit drupe. (Leaves usually dull greyish brown when dry with scalariform venation and in one section nerves ending in marginal vein.) **Bridelia**
 3. Ovary 3-locular. Fruit capsule. (Leaves usually shiny, different colours when dry with indistinct venation, ending before margin.) **Cleistanthus**
 2. Disc lobed (lobes petal-like). Stamens free **Leptopus**
1. Petals absent (or single petal)
 4. Ovary (and fruit) covered with echinate hairs **Chaetocarpus**
 4. Ovary (and fruit) glabrous or with normal, non-stinging hairs
 5. Flowers with disc
 6. Disc consisting of separate glands **Phyllanthus**
 6. Disc annular
 7. Flowers 5-merous **Flueggea**
 7. Flowers 4-merous **Margaritaria**
 5. Flowers without disc

8. Ovary 3–25-locular (mainly 3-locular). Styles usually united in a knob or column, toothed at the apex, sometimes free, then 2–2.5 mm long and flower with 2(3) sepals (*G. sericeum*) **Glochidion**
8. Ovary 3-locular. Sepals 6. Styles either free and shorter than 2 mm or if united, split and lobes spreading like crescent-moons
9. Stigmas usually separate, erect; seldom united and spreading crescent-moon-like, but then clear style present. Leaves usually drying blackish **Breynia**
9. Stigmas united, sessile (style absent), lobed, lobes spreading like crescent moons. Leaves drying brownish (though sometimes very darkly so) **Sauropus**

MULTI-ACCESS KEY TO THE GENERA

To use this key start with any character, choosing one which is the easiest to observe. Make a list of all 10 names (*Breynia*, *Bridelia*, *Chaetocarpus*, *Cleistanthus*, *Flueggea*, *Glochidion*, *Leptopus*, *Margaritaria*, *Phyllanthus*, and *Sauropus*). Take the first character and delete the names which do not possess the character state observed. For example, if the plant has 6 staminate petals (character 1), then only the genera *Breynia*, *Glochidion*, *Leptopus*, *Phyllanthus*, and *Sauropus* are left. If the plant has separate disc glands (character 5), then only *Leptopus* and *Phyllanthus* are left (*Flueggea* was already deleted). If a pistillode is present (character 8), then only *Leptopus* is left and this should be the correct identification.

Names in bold indicate that the genus only has one character state, e.g. *Chaetocarpus* only has 4 staminate sepals (character 1). If a name appears in italics, then the taxon is polymorphic and has more than one character state (e.g. *Phyllanthus* has 4, 5, or 6 staminate sepals).

Staminate flower

1. Number of staminate sepals
 - Sepals 4: **Chaetocarpus**, **Margaritaria**, *Phyllanthus*.
 - Sepals 5: **Bridelia**, **Cleistanthus**, **Flueggea**, *Leptopus*, *Phyllanthus*.
 - Sepals 6: **Breynia**, **Glochidion**, *Leptopus*, *Phyllanthus*, **Sauropus**.
2. Aestivation of staminate sepals
 - Imbricate: **Breynia**, **Chaetocarpus**, **Flueggea**, **Glochidion**, **Leptopus**, **Phyllanthus**, **Sauropus**.
 - Valvate: **Bridelia**, **Cleistanthus**.
3. Scales on inside of staminate sepals
 - Absent: **Bridelia**, **Chaetocarpus**, **Cleistanthus**, **Flueggea**, **Glochidion**, **Leptopus**, **Margaritaria**, **Phyllanthus**.
 - Present: **Breynia**, **Sauropus**.
4. Number of staminate petals
 - 0(1): **Breynia**, **Chaetocarpus** (sometimes 1), **Flueggea**, **Glochidion**, **Margaritaria**, **Phyllanthus**, **Sauropus**.
 - 5(6): **Bridelia**, **Cleistanthus**, **Leptopus** (sometimes 6).
5. Staminate disc
 - Absent: **Breynia**, **Glochidion**, **Sauropus**.
 - Annular: **Bridelia**, **Chaetocarpus**, **Cleistanthus**, **Margaritaria**.
 - Separate glands: **Flueggea**, **Leptopus**, **Phyllanthus**.

6. Number of stamens
- 3: **Breynia**, *Glochidion*, *Phyllanthus*, **Sauropus**.
 - 4: *Glochidion*, **Margaritaria**, *Phyllanthus*.
 - 5: **Bridelia**, **Cleistanthus**, **Flueggea**, *Glochidion*, *Leptopus*, *Phyllanthus*.
 - 6: *Glochidion*, *Leptopus*, *Phyllanthus*.
 - 8: **Chaetocarpus**.
7. Union of stamens
- Free, exserted: **Flueggea** (Fig. 5).
 - Free, included: **Leptopus** (Fig. 7), **Margaritaria** (Fig. 8), *Phyllanthus*.
 - Filaments united, anthers all branching off in same place, anthers at end of filaments: **Bridelia** (Fig. 2), **Cleistanthus** (Fig. 4), *Phyllanthus*.
 - Filaments united, anthers branching off in same place, anthers underneath filaments: **Sauropus** (Fig. 10).
 - Filaments united, anthers branching off freely at different levels: **Chaetocarpus** (Fig. 3).
 - Filaments united, anthers seemingly united, triangular appendix on anther: **Glochidion** (Fig. 6), *Phyllanthus*?
 - Filaments united, anthers united: **Breynia** (Fig. 1), *Phyllanthus*?
8. Presence of pistillode
- Absent: **Breynia**, **Glochidion**, **Margaritaria**, **Phyllanthus**, **Sauropus**.
 - Present, grown together with stamens: **Bridelia**, **Chaetocarpus**, **Cleistanthus**.
 - Present, free from stamens: **Flueggea** (large, exserted), **Leptopus** (small, included).

Pistillate flower

9. Number of pistillate sepals
- 2(3): *Glochidion*.
 - 4: **Chaetocarpus**, **Margaritaria**, *Phyllanthus*.
 - 5: **Bridelia**, **Cleistanthus**, **Flueggea**, *Leptopus*, *Phyllanthus*.
 - 6: **Breynia**, *Glochidion*, *Leptopus*, *Phyllanthus*, **Sauropus**.
10. Aestivation of pistillate sepals: see staminate sepals (character 2)
11. Number of pistillate petals: see staminate sepals (character 4)
12. Pistillate disc
- Absent: **Breynia**, **Glochidion**, **Sauropus**.
 - Annular: **Bridelia**, **Chaetocarpus**, **Cleistanthus**, **Flueggea**, **Margaritaria**.
 - Separate glands: **Leptopus**, *Phyllanthus*.
13. Number of locules per ovary
- 2: **Bridelia** (often 1 developing in fruit).
 - 3: **Breynia**, *Chaetocarpus*, **Cleistanthus**, **Flueggea**, *Glochidion*, **Leptopus**, **Margaritaria**, *Phyllanthus*, **Sauropus**.
 - 4: *Chaetocarpus*, *Glochidion*, *Phyllanthus*.
 - 5–8: *Glochidion*, *Phyllanthus*.
 - More than 8: *Glochidion*.

14. Number of ovules per ovary locule
- 1: **Chaetocarpus**.
 - 2: **Breynia, Bridelia, Cleistanthus, Flueggea, Glochidion, Leptopus, Margaritaria, Phyllanthus, Sauropus**.
15. Hairs on ovary
- Stinging (echinate) hairs: **Chaetocarpus**.
 - Glabrous or normal hairs (not stinging): **Breynia, Bridelia, Cleistanthus, Flueggea, Glochidion, Leptopus, Margaritaria, Phyllanthus, Sauropus**.
16. Stigmas
- Separate, erect: *Breynia, Glochidion*.
 - United, forked and spreading: *Breynia, Bridelia, Chaetocarpus, Cleistanthus, Flueggea, Leptopus, Margaritaria, Phyllanthus, Sauropus*.
 - United, tubular: *Glochidion*.

Fruit

17. Fruit type
- Drupe / Berry: **Bridelia, Phyllanthus**.
 - Drupaceous capsule (leathery, opening very late): **Breynia, Flueggea, Phyllanthus, Sauropus**.
 - Dry capsule, easily splitting: **Chaetocarpus, Cleistanthus, Glochidion, Leptopus, Margaritaria, Phyllanthus**.
18. Hairs on fruit: See pistillate flower (character 15)
19. Covering on seed (aril)
- Seeds naked: **Breynia, Bridelia, Cleistanthus, Glochidion, Leptopus, Phyllanthus, Sauropus**.
 - Seeds covered in upper part: **Chaetocarpus**.
 - Seeds completely covered: **Flueggea, Margaritaria**.

DESCRIPTIONS

Breynia J.R.Forst. & G.Forst. (Fig. 1).

Staminate flowers bell-shaped or urceolate; sepals 6, imbricate, with scales on inside, closing flower in bud; petals absent; disc absent; stamens 3, united, rot-like with anthers around apex; pistillode absent. *Pistillate flowers*: sepals 6, imbricate; petals absent; disc absent; ovary 3-locular, 2 ovules per locule; stigmas usually in a apical depression, bilobed, all lobes usually separate, seldom united on style and then lobes crescent moon-shaped. *Fruits* drupaceous capsules, dehiscing tardily, glabrous to covered with soft hairs. *Seeds* naked.

Bridelia Willd. (Fig. 2).

Staminate flowers: sepals 5, valvate, without scales on inside; petals 5, smaller than sepals; disc annular; stamens 5, filaments grown together and with pistillode, anthers free, spreading. *Pistillate flowers*: sepals 5, valvate; petals 5, smaller than sepals; disc

annular; ovary 2-locular, ovules 2 per locule; style present, stigmas apically bilobed and spreading. *Fruits* drupes, 1- (leaves with veins uniting into marginal vein) or 2-locular (leaves with veins looped and joined submarginally), glabrous. *Seeds* naked.

Chaetocarpus Thwaites (Fig. 3).

Staminate flowers: sepals 4, imbricate, without scales on inside; petals absent or a single, sepaloid; disc annular; stamens 8, united together and with pistillode, anthers branching off alternately. *Pistillate flowers*: sepals 4, imbricate; petals absent; disc annular; ovary 3- or 4-locular, 1 ovule per locule, covered with echinate hairs; style present; stigmas apically bilobed and spreading. *Fruits* easily dehiscent capsules, covered with stinging hairs. *Seeds* covered with aril in upper part only.

Cleistanthus Hook.f. ex Planch. (Fig. 4).

Staminate flowers: sepals 5, valvate, without scales on inside; petals 5, smaller than sepals; disc annular; stamens 5, filaments grown together and with pistillode, anthers free, spreading. *Pistillate flowers*: sepals 5, valvate; petals 5, smaller than sepals; disc annular; ovary 3-locular, 2 ovules per locule; style present; stigmas apically bilobed, spreading. *Fruits* easily dehiscent capsules, glabrous or covered with soft hairs. *Seeds* naked.

Flueggea Willd. (Fig. 5).

Staminate flowers: sepals 5, imbricate, without scales on inside; petals absent; disc consisting of 5 separate, thick glands; stamens 5, free, exserted; pistillode large, consisting of 3 large, hooked stigmas, exserted. *Pistillate flowers*: sepals 5, imbricate; petals absent; disc annular; ovary 3-locular, 2 ovules per locule; style present; stigmas apically bilobed and spreading. *Fruits* drupaceous capsule, dehiscent tardily. *Seeds* completely covered by an aril.

Glochidion J.R.Forst. & G.Forst. (Fig. 6).

Staminate flowers: sepals 6, imbricate, without scales on inside; petals absent; disc absent; stamens 3–6, filaments united, anthers seemingly united but free, on top of connective teeth-like appendix; pistillode absent. *Pistillate flowers*: sepals 2, (3), 6, imbricate; petals absent; disc absent; ovary 3–25-locular, 2 ovules per locule; stigmas either free, often apically bilobed, and long (more than 2 mm) or united into tube with dentate apex. *Fruits* easily splitting capsules, glabrous or covered with soft hairs. *Seeds* naked.

Leptopus Decne. (Fig. 7).

Staminate flowers: sepals 5 or 6, imbricate, without scales on inside; petals 5 (or 6), smaller than sepals; disc consisting of separate glands, petal-like; stamens 5 or 6, free, included in flower; pistillode small, included. *Pistillate flowers*: sepals 5 or 6, imbricate; petals 5 (or 6), smaller than sepals; disc consisting of separate glands; ovary 3-locular, 2 ovules per locule; style present; stigmas lobed, spreading. *Fruits* easily splitting capsules, glabrous. *Seeds* naked.

Margaritaria L.f. (Fig. 8).

Staminate flowers: sepals 4, imbricate, without scales on inside; petals absent; disc annular; stamens 4, free, included in flower; pistillode absent. *Pistillate flowers*: sepals 4, imbricate; petals absent; disc annular; ovary 3-locular, 2 ovules per locule; style present; stigmas apically bilobed, spreading. *Fruits* easily splitting capsules, glabrous. *Seeds* completely covered by an purple-blue aril.

Phyllanthus L. (Fig. 9).

Staminate flowers: sepals 4–6, imbricate, without scales on inside; petals absent; disc consisting of separate glands; stamens 4–6, various, free to united in various ways (like *Bridelia*, *Glochidion*, and perhaps like *Sauropus*); pistillode absent. *Pistillate flowers*: sepals 4–6, imbricate; petals absent; disc consisting of separate glands; ovary 3–8-locular, 2 ovules per locule; style absent or present; stigmas usually apically bilobed and often crescent moon-like. *Fruits* berries or drupaceous (tardily splitting) or easily dehiscent capsules, glabrous or with soft hairs. *Seeds* naked.

Sauropus Blume (Fig. 10).

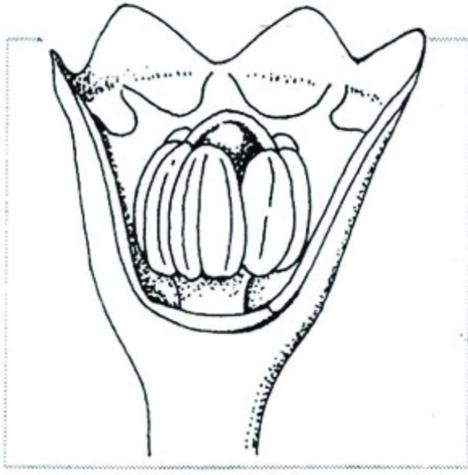
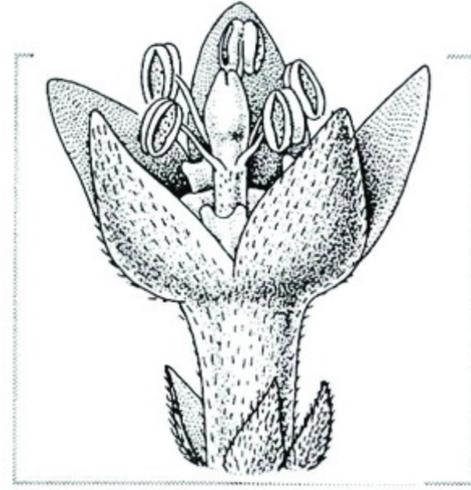
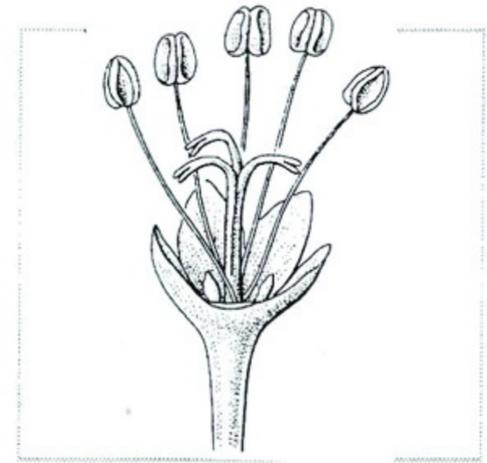
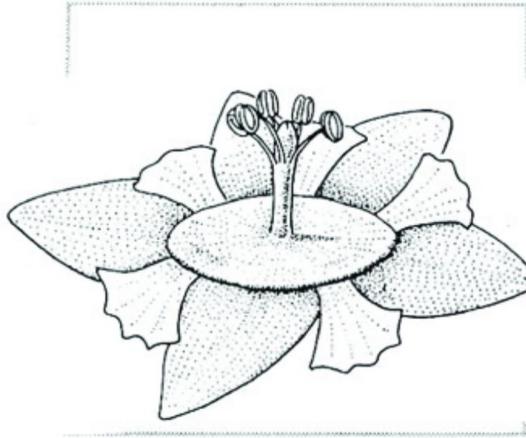
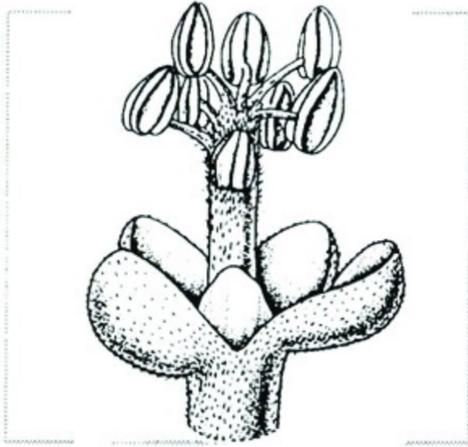
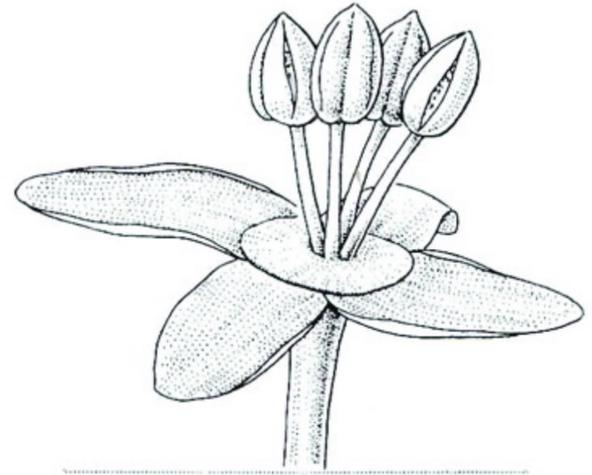
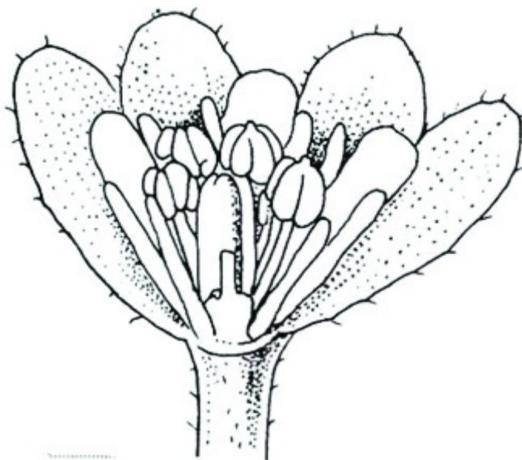
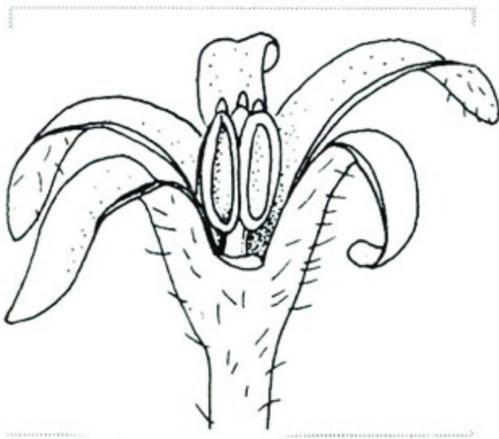
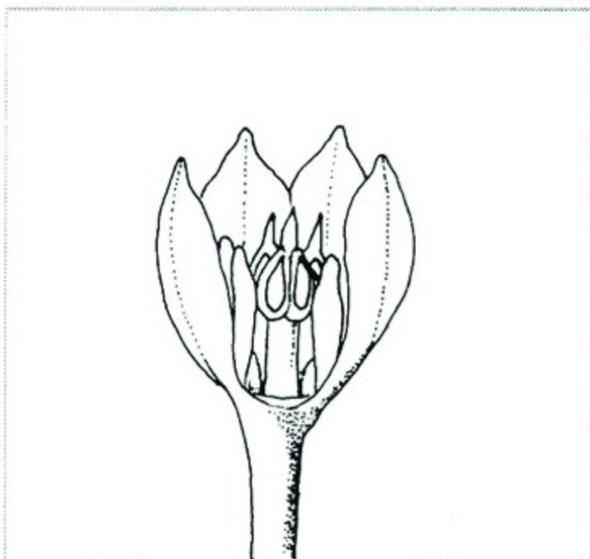
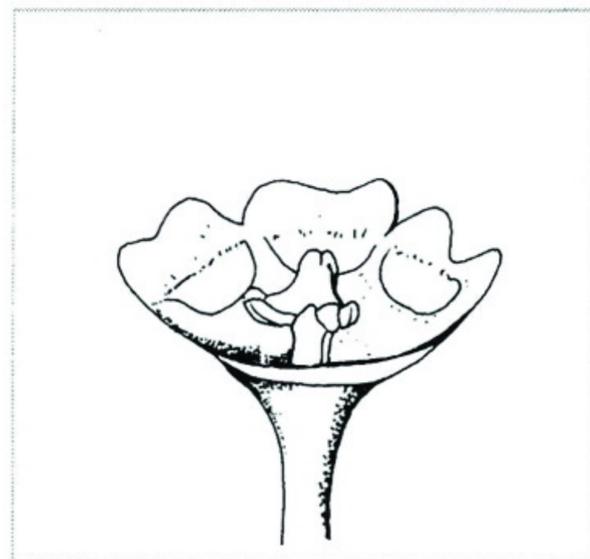
Staminate flowers disc-like; sepals 6, imbricate, with scales on inside, pointing towards stamens and filling space between anthers; disc absent; stamens 3, united, filaments split, spreading horizontally with anthers underneath; pistillode absent. *Pistillate flowers*: sepals 6, imbricate; petals absent; disc absent; ovary 3-locular, 2 ovules per locule; style usually absent; stigmas apically bilobed, spreading crescent moon-like. *Fruits* drupaceous capsules, tardily dehiscent, glabrous or with soft hairs. *Seeds* naked.

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Fig. 1. Staminate flower of *Breynia*.Fig. 2. Staminate flower of *Bridelia*.Fig. 3. Staminate flower of *Chaetocarpus*. Fig. 4. Staminate flower of *Cleistanthus*. Fig. 5. Staminate flower of *Flueggea*.Fig. 6. Staminate flower of *Glochidion*. Fig. 7. Staminate flower of *Leptopus*. Fig. 8. Staminate flower of *Margaritaria*.Fig. 9. Staminate flower of *Phyllanthus*.Fig. 10. Staminate flower of *Sauropus*.