

## CHAPTER 4

### RESULTS

Twenty-two taxa of *Argostemma* spp. from all over Thailand were collected from July 2004 to September 2005 as follows<sup>1</sup>:

#### Genus description

Perennial herb with rhizomes or tubers. **Stem** erect, prostrate, creeping; unbranch or slightly branched. **Leaves** opposite, isophyllous, to strongly anisophyllous, either only one well developed leaf pair per plant (large leaf) or few leaf pairs in pseudo-verticillate arrangement (internode very short), or many leaf pairs scattered along stem (leafy stem), distichous arrangement. **Stipules** interpetiolar, acute or bifid. **Inflorescences** terminal, many- to few- and 1-flowered, cymose or umbel-like. Bracts free or fused. **Flowers** hermaphrodite, 4- or 5-merous, actinomorphic or slightly zygomorphic. **Calyx** persistent, chartaceous or succulent, calyx tube and lobe mostly short. **Corolla** white, either bell-shaped with a relatively long tube and short lobes or star-shaped with a short tube and long lobes, valvate in bud. **Stamens** inserted near or at base of corolla tube; filament usually free, sometimes fused at least part of their length; anther either in cone-like arrangement (anther either fused as a true anther cone, or covinent into a pseudo anther cone) or entirely free, yellow to whitish, seldom bluish; opening by longitudinal slit or apical pores; connective often prolonged in apical and sometimes enlarged. **Ovary** 2 locules,

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<sup>1</sup> Including one new record taxon for Thailand: *A. kurzii* C. B. Clarke and one new described species: *A. argostemon* K. Sridith.

each locule with numerous ovules on axile placenta; style filiform, with club- or globular- or disc-shaped; stigma exerted from anther cone. **Fruit** a capsule, crowned by persistent calyx, opening by an apical operculum. **Seeds** small, numerous.

### **The morphological characters of the studied taxa.**

#### *Star-shaped and 5-merous flower*

#### **1. Argostemma argostemon** K. Sridith, Nord. J. Bot. ( Sridith, inpress<sup>b</sup>) (Fig.1, a)

Perennial herb with tubers. **Stem** erect, unbranched, 2.5-4.6 cm, internode very short, glabrous. **Leaves** 2-3 pairs, pseudo-verticillate, strongly anisophyllous, one large leaf ovate, apex acuminate, base cordate, 6.1-9.3 by 3.7-6.3 cm, upper surface dark green with white streaks on midrib and veins, sparsely pubescent, lower surface lighter green, glabrous; petioles subobsolete. **Stipules** elliptic, tip acute, 4-6 mm long, pubescent. **Inflorescences** 4-9 flowers in compound cyme; peduncles 11-40 mm, green, glabrous; bracts 5 lobes, fuse, ovate, 3-5 mm long, glabrous; pedicels 6-11 mm, white, pubescent. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, whitish green; calyx lobes ovate, 3.8-4.0 mm long, suberect, glabrous. **Corolla** star shaped, glabrous; corolla lobes ovate, c. 6.3 mm long, spreading; corolla tube c. 2 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c. 1.3 mm long; anther connivent into a pseudo anther cone, white without apical appendage, c. 6 mm long, sagittate, semibasifixed, opening by means of longitudinal slits. **Ovary** glabrous; style filiform, c. 8.2 mm, long exerted from anther cone, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on moist rock in deciduous forest.

**Flowering** : June

**Specimens studied :** Saithip & K. Sridith & K. Maneenoon 047

**2. *Argostemma condensum*** Craib, Kew Bull. 212. 1931. (Fig.2, a)

Perennial herb with rhizomes. **Stem** prostrate, unbranched, 4-15 cm, internode c. 0.5 cm, glabrous. **Leaves** many pairs along the stem, strongly anisophyllous, distichous, oblong or elliptic, apex acute, base acute, 0.8-1.8 by 0.3-0.5 cm (big leaf), upper surface yellowish green, sparsely hairy along midrib and margin, lower surface pale green, glabrous; petioles subobsolete. **Stipules** ovate, tip acute, 4-5 mm long, glabrous. **Inflorescences** 1 (rarely 2-3) flowers; pedicels 10-22 mm, white, glabrous. **Flowers** 5-merous, slightly zygomorphic. **Calyx** chartaceous, green; calyx lobes narrowly triangular, c. 1.6 mm long, suberect, glabrous. **Corolla** star shaped, glabrous; corolla lobes ovate, c. 4 mm long, suberect; corolla tube c. 1 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 1 mm long, free; anther fused, curved in s-shape anther cone like, yellow with white apical appendage, c. 4.2 mm long, sagittate, basifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, c. 4.4 mm, long exserted from anther cone, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology :** on moist rock by stream in evergreen forest.

**Flowering :** March-June

**Specimens studied :** K. Sridith 732

### 3. *Argostemma dispar* Craib, Kew Bull.: 213. 1931. (Fig.3, a)

Perennial herb with rhizomes. **Stem** decumbent or prostrate, unbranched 9.5-19 cm long, internode 0.5-1.8 cm, densely covered with long hair. **Leaves** many pairs scattered along stem, distichous, strongly anisophyllous, big leaf oblique-lanceolate, apex acute, base oblique, 1.9-7.5 by 1.1-2.2 cm, small leaf cordate, upper surface grayish green, lower surface whitish, densely pubescent on both surfaces; petioles c. 3-8 mm long, pubescent. **Stipules** ovate, tip acute, 4-7 mm long, densely covered with long hairs. **Inflorescences** terminal or occasionally axillary, 1-11 flowers in simple cyme/compound cyme; peduncles 3-17 mm long, white, densely covered with long hairs; bracts 4 at any node, free, elliptic, c. 3 mm long, densely pubescent; pedicels 2-7 mm long, white, densely covered with long hairs. **Flowers** 5-merous, zygomorphic. **Calyx** chartaceous, light green; calyx lobes narrowly triangular, c. 1 mm long, suberect, pubescent. **Corolla** star-shaped, pubescent outside; corolla lobes narrowly triangular, 5-6 mm long, spreading and tips recurved; corolla tube c.  $\leq 2$  mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 1 mm long, free; anther fused, curved in s-shape anther cone like, yellow with white apical appendage, c. 9 mm long, oblong, semi-basifixed, opening by longitudinal slits. **Ovary** pubescent; style filiform, c. 10 mm, shortly exerted from anther cone, glabrous; stigma club shape. **Fruit** globose, pubescent. **Seeds** numerous.

**Ecology** : ground cover on moist soil in evergreen forest.

**Flowering** : March-May

**Specimens studied** : J. Wai 48

**4. *Argostemma diversifolium*** Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 52. 1911.

(Fig.4, a)

Perennial herb with tubers. **Stem** erect, unbranched, 4.8-22.5 cm, internode very short; glabrous. **Leaves** 1-2 pairs, pseudo-verticillate, slightly anisophyllous, ovate, apex acuminate or acute, base round, 8.8-23.0 by 5.2-10.0 cm upper surface shiny green, pubescent, lower surface lighter green; petioles 3-6 mm, glabrous. **Stipules** ovate, tip acute or bifid, 7-12 mm long, glabrous. **Inflorescences** 4-14 flowers, a dense scorpioid cyme; peduncles 32-61 mm, white, pubescent; bracts 3-4, free, elliptic, 3-5 mm long, pale purple; pedicels 7-15 mm, color purple, pubescent. **Flowers** 5-merous, slightly zygomorphic. **Calyx** chartaceous, green or pale purple; calyx lobes ovate, 4-5 mm long, suberect, glabrous. **Corolla** star shaped, glabrous; corolla lobes ovate, 6.2 mm long, spreading, tip recurved; corolla tube c. 0.5 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c. 0.5 mm long; anther curved in s-shape, blueish without apical appendage, 4-5 mm long, sagittate, semibasifixed, opening by apical pore. **Ovary** glabrous; style filiform, c. 7 mm, shortly exerted from anther cone, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist limestone

**Flowering** : June-August

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 046

**5. *Argostemma elatostemma*** Hook.f. in Hook.f., Fl. Brit. Ind. 3: 45. 1880. (Fig.5, a)

Perennial herb with rhizomes. **Stem** creeping, unbranched 3-18 cm long, internode 8-17 cm with adventitious roots at any nodes, densely pubescent.

**Leaves** many pairs scattered along stem, strongly anisophyllous, distichous, big leaf ovate, apex obtuse, base auriculate-oblique, 3.2-4.9 by 1.5-2.4 cm, small leaf cordate, upper surface dark green, sparsely pubescent, lower surface whitish, densely pubescent; petioles 2-14 mm long, densely pubescent. **Stipules** ovate, tip acute, 3-4 mm long, margin ciliate. **Inflorescences** 2-8 flowers in simple or compound cyme; peduncles 22-45 mm long, white, densely covered with short fine hairs; bracts 2-3 at any node, free, linear, c. 2 mm long, green, pubescent; pedicels 3-8 mm long, white, densely pubescent. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, green; calyx lobes triangular, 1-5 mm long, suberect, densely pubescent. **Corolla** star-shaped, sparsely pubescent outside; corolla lobes lanceolate, 4-7 mm long, spreading and tip recurved; corolla tube c. 0.5 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments < 1 mm long, free; anther fused forming an anther cone like, yellow with white apical appendage, 5-6 mm long, oblong, semi-medifixed, opening by longitudinal slits. **Ovary** pubescent; style filiform, shortly exerted from anther cone  $\leq$  1 mm, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on moist soil by stream in evergreen forest.

**Flowering** : March-May

**Specimens studied** : Saithip 039

**6. Argostemma kurzii** C.B. Clarke in Hook.f., Fl. Brit. Ind. 3: 43. 1880. (Fig. 7, a)

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, unbranched, 8.3-28.2 cm, internode very short, glabrous; **Leaves** 2 pairs, pseudo-verticillate, strongly anisophyllous, one large ovate, apex acuminate, base cordate, 4.5-19.2 by 3.1-12.9 cm, upper surface shiny green, lower surface lighter

green, glabrous on both surfaces, petioles subobsolete. **Stipules** elliptic, tip acute, c. 8 mm long, glabrous. **Inflorescences** 5-18 flowers, umbel-like; peduncles 1.3-6.5 mm, green, glabrous; bracts 4, free, ovate, 10-13 mm long, glabrous; pedicels 8-12 mm, white, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, white; calyx lobes triangular, c. 1 mm long, erect, glabrous. **Corolla** semi star-shaped as corolla tube shorter than corolla lobes, glabrous; corolla lobes narrowly triangular, c. 4 mm long, reflexed; corolla tube c. 2 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c.1 mm long; anther connate into a pseudo anther cone, yellow without apical appendage, c. 2 mm long, slightly sagittate, semibasifixed, opening by an apical pore. **Ovary** glabrous; style filiform, c. 3.2 mm, long much exerted from anther cone, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist limestone in evergreen forest

**Flowering** : June

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 045

**7. *Argostemma laeve* Benn. ssp. *setosum* (Geddes) K. Sridith, Nord. J. Bot. 19(2): 178. 1999. (Fig. 8, a)**

Perennial herb with rhizomes. **Stem** prostrate and suberect, unbranched or sometimes slightly branched 9-23 cm long, internode 0.5-1.1 cm, pubescent. **Leaves** many pairs scattered along stem, strongly anisophyllous, distichous, elliptic, apex acute, base acute, 2.4-5.4 by 1.3-1.9 cm (big leaf), upper surface shiny and setose-ciliate pubescent along midrib, lower surface green, margin setose; petioles 7-14 mm long, glabrous. **Stipules** elliptic, tip acute, 5-6 by 2-3 mm, glabrous.

**Inflorescences** 1-4 flowers in simple or compound cyme; bract 4-5 at any node, free, linear, c. 3 mm long, glabrous; peduncles 9-20 mm long, white or pale green, glabrous; pedicels 7-10 mm long, glabrous. **Flowers** 5-merous, zygomorphic. **Calyx** chartaceous, green; calyx lobes narrowly triangular, erect, glabrous. **Corolla** star-shaped, entirely glabrous; corolla lobes lanceolate, 11 by 5 mm, spreading; corolla tube c. 2 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 3 mm long, free; anther fused, curved in s-shape anther cone, yellow with white apical appendage, sagittate, c. 7 mm long, semi-medifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, shortly exerted from anther cone, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist soil in evergreen forest.

**Vernacular** : Pra-dub-hin-khoa-lung

**Flowering** : May-July

**Specimens studied** : Saithip 001, Saithip 031

#### **8. *Argostemma laxum* Geddes, Kew Bull.:166. 1927. (Fig. 6, a)**

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, branched, 4.5-13.0 cm, internode very short, glabrous. **Leaves** 3 pairs, pseudo-verticillate, slightly anisophyllous, apex lanceolate-acuminate, base acute, 2.4-7.5 by 0.7-1.5 cm, upper surface dark green, sparsely pubescent, lower surface lighter green, glabrous; petioles 2-13 mm, glabrous. **Stipules** ovate, tip acute or bifid, 2.6-3.0 mm long, glabrous. **Inflorescences** 2-10 flowers, compound cyme; peduncles length 7-15 mm, white, glabrous; bracts 5, free, elliptic, 2-7 mm long, glabrous; pedicels 3-5 mm, white, glabrous. **Flowers** 5-merous, slightly zygomorphic. **Calyx** chartaceous, green;



calyx lobes triangular, c. 0.8 mm long, suberect, glabrous. **Corolla** star shaped, glabrous; corolla lobes ovate, c. 5 mm long, spreading; corolla tube c. 1 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c. 0.3 mm long; anther yellow without apical appendage, c. 4 mm long, slightly sagittate, semibasifixed, opening by apical pore. **Ovary** glabrous; style filiform, c. 3.8 mm, as long as anther, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on mossy trunks in evergreen forest

**Flowering** : June-July

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 051

**9. Argostemma ophirens** Maingay ex Hook.f. in Hook.f., Fl. Brit. Ind. 3: 45. 1880.

(Fig. 9, a)

Perennial herb with rhizomes. **Stem** erect, unbranched 12-30 cm long, internode 3-8 cm, pubescent. **Leaves** many pairs scattered along stem, strongly anisophyllous, entire, elliptic, apex acute or cuspidate, base oblique, 4.8-13.2 by 1.2-5.1 cm (big leaf), upper surface green, sparsely pubescent, lower surface pale green, pubescent on the vein and midrib; petioles 3-12 mm long, pubescent. **Stipules** ovate, tip acute, 2-4 by 1.2-1.5 mm, pubescent. **Inflorescences** 4-33 flowers, a lax compound cyme; peduncles 15-37 mm long, redish, glabrous; bracts 2-3 at any node, free, lanceolate, c.1.5 mm long, glabrous; pedicels 6-12 mm long, white, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, green; calyx lobes triangular, c. 2 mm long, spreading, glabrous. **Corolla** star-shaped, glabrous; corolla lobes ovate c. 4 by 2-3 mm, spreading, tip recurved; corolla tube 0.5-1 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 1 mm long, free; anther fused,

forming an anther cone like, yellow with white apical appendage, 5-6 mm long, oblong, semi-medifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, shortly exerted from anther cone >1 mm, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist soil by stream in evergreen forest.

**Flowering** : April-June

**Specimens studied** : Saithip 038

**10. *Argostemma pictum*** Wall. in Roxb., Fl. Indica (ed. Carey & Wall.) 2: 327. 1824. (Fig. 10, a)

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, unbranched, 6-30 mm long, pubescent. **Leaves** one pairs, slightly or strongly anisophyllous, ovate or slightly triangular, apex acute, base truncate, 2.9-8.4 by 3.1-6.6 mm (big leaf), upper surface dark green with or without white streaks along midrib and veins, lower surface light green, sparsely pubescent on both surface; petiole subobsolete. **Stipules** ovate, tip acute, 1.3-4 mm long, pubescent. **Inflorescences** 6-20 flowers, a dense scorpioid cyme; peduncles 28-75 mm long, glabrous; bracts 3-6 lobes, ovate, 2-4 mm long, pubescent; pedicels 1-9 mm long, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, green, calyx lobes triangular, c. 1 mm long, spreading, glabrous. **Corolla** star-shaped, covered with very short fine hairs outside; corolla lobes narrowly triangular, c. 3.5 mm long, spreading, tips recurved; corolla tube c. 0.5 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments  $\leq$  1 mm long, merging into large connectives, free; anther connivent, forming a cone-like structure, yellow, oblong, c. 3 mm long, basifixed,

opening by longitudinal slits. **Ovary** glabrous; style filiform, c. 3.5 mm long, long exerted from anther cone > 1 mm, glabrous; stigma disc shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist soil or rock in evergreen forest.

**Flowering** : June-August

**Specimens studied** : Saithip 004, Saithip 017

**11. *Argostemma propinquum* Ridl., J. Straits Branch Roy. Asiat. Soc. 57: 53. 1911.**

(Fig. 11, a)

Perennial herb with rhizomes. **Stem** suberect, unbranched 15-40 cm long, internode 1.4-3.5 cm, densely covered with short fine hair. **Leaves** many pairs, scattered along stem, strongly anisophyllous, oblanceolate, apex acute, base oblique, 14.3-8.0 by 5.7-2.8 cm (big leaf), upper surface and margin sparsely scabrous, lower surface densely pubescent along midrib and veins; petioles 8-62 mm long, densely pubescent. **Stipules** ovate, tip acute or bifid, 9-20 mm long, sparsely pubescent on both surfaces. **Inflorescences** 4-16 flowers in compound cyme; peduncles 40-66 mm long, purplish/pinkish, densely pubescent; bracts 2-4 at any node, free, linear, c. 3 mm long, densely pubescent; pedicels 8-16 mm long, white, pubescent. **Flowers** 5-merous, actinomorphic. **Calyx** persistent, purplish /pinkish; calyx lobes ovate, c.3 mm long, suberect, densely pubescent outside. **Corolla** star-shaped, pubescent outside along veins; corolla lobes lanceolate, 5-8 mm long, reflexed with inrolled tips; corolla tube 1-1.5 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 1 mm long, free; anther fused, forming an anther cone like, yellow with white apical appendage, c. 6 mm long, oblong, semi-medifixed, opening by longitudinal slits.

**Ovary** pubescent; style filiform, shortly exerted from anther cone, glabrous; stigma globular shape. **Fruit** globose, sparsely pubescent. **Seeds** numerous.

**Ecology** : on moist soil in evergreen forest.

**Vernacular** : Lin-Ku-Rum

**Flowering** : April-June

**Specimens studied** : Saithip 028, Saithip 040, Saithip & K. Maneenoon & J. Wai 041

**12. *Argostemma rotundicalyx* K. Sridith, Nord. J. Bot. 19(2): 173. 1999. (Fig. 12, a)**

Perennial herb, attached to substrate with dense, matted roots. **Stem** suberect, unbranched, 5.3-11.4 cm long, glabrous, internode very short. **Leaves** 3-4 pairs, pseudo-verticillate, slightly anisophyllous, lanceolate or elliptic, apex acuminate, base acute, 5.3-12.3 by 3.8-4.5 cm, upper surface dark green, lower surface pale green, covered with long hair on both sides; petioles subobsolete, glabrous. **Stipules** triangular, tip acute or bifid, c. 2 mm long, pubescent. **Inflorescences** 3-12 flowers, a lax scorpioid cyme; peduncles 30-50 mm long, green, glabrous; bracts 2 at any node, free, oblong, c. 2 mm long, pubescent; pedicels 7-19 mm long, white, glabrous. **Flowers** 5-merous, slightly zygomorphic. **Calyx** chartaceous, green; calyx lobes very short, round, c. 0.2 mm long, erect, glabrous. **Corolla** star-shaped, glabrous; corolla lobes ovate, 4-14 mm long, spreading and tip slightly recurved; corolla tube c. 3 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments c. 1 mm long, free; anther fused, forming a distinctly stout anther cone, yellow with long white apical appendages 6-8 mm long, slightly basifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, 8-10 mm

long, long exserted from corolla tube, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist limestone in evergreen forest.

**Flowering** : June-July

**Specimens studied** : Saithip 053

**13. Argostemma subcrassum** King, J. Asiat. Soc. Bengal 72: 152. 1903. (Fig.13, a)

Perennial herb with rhizomes. **Stem** erect, unbranched, 48.5 cm long, internode 0.4-1.2 cm, glabrous. **Leaves** many pairs scattered along stem, strongly anisophyllous, oblanceolate, apex acute or acuminate, base acute, 9.5-16.0 by 2.9-4.0 cm (big leaf), upper surface green, lower surface lighter green, glabrous; petioles 3-10 mm long, glabrous. **Stipules** ovate, tip acute or bifid, c. 4 mm long, glabrous. **Inflorescences** 5-41 flowers, a lax compound cyme; peduncles 15-26 mm long, light green, glabrous; bracts 4 at any node, free, triangular, c. 3 mm long, glabrous; pedicels 7-13 mm, white, glabrous. **Flowers** 5-merous, zygomorphic. **Calyx** succulent, green; calyx lobes triangular, 1.5-1.7 mm long, spreading, glabrous. **Corolla** star-shaped, glabrous; corolla lobes lanceolate, 6-7 mm long, spreading and tip enrolled; corolla tube c. 1 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments very short (c. < 1 mm long), free; anther fused, forming an anther cone like, yellow with white apical appendage, c.8 mm, oblong, semi-basifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, 8-9 mm, shortly exserted from anther cone, glabrous; stigma club shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist floor in shade by stream in evergreen forest.

**Flowering** : April-August

**Specimens studied :** Saithip & J. Wai 037, J. Wai 31

**14. Argostemma unifolioides** var. **glabra** King, J. Asiatic Soc. Bengal 72(2): 148. 1903. (Fig.14, a)

Perennial herb with tubers. **Stem** erect, unbranched, c. 15 cm, glabrous. **Leaves** in 1 pairs, pseudo-verticillate, strongly anisophyllous, one large leaf ovate, apex acuminate, base acute, 14-20.5 by 8.6-13 cm, upper surface dark green, glabrous, lower surface pale green, sparsely pubescent on margin and midrib; petioles subobsolete. **Stipules** ovate, tip acute, 5-6 mm long, glabrous. **Inflorescences** 9-14 flowers in compound cyme (rarely scorpioid cyme); peduncles 50 mm long, green, glabrous; bracts 4 lobes, fuse at base, ovate, c. 3 mm long, glabrous; pedicels 4-13 mm, white, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, green; calyx lobes triangular, c. 0.8 mm long, spreading, glabrous. **Corolla** star-shaped, glabrous; corolla lobes narrow ovate to lanceolate, c. 5.2 mm long, spreading; corolla tube c. 1.3 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments 0.5 mm long, free; anther fused, forming an anther cone, yellow with white apical appendage, c. 4 mm long, oblong, semibasifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, c. 5.2 mm, long exerted from anther cone, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology :** on moist rock in evergreen forest.

**Flowering :** October-December

**Specimens studied :** Saithip 054, K. Sridith 746

**15. Argostemma verticillatum** Wall. in Roxb., Fl. Indica (ed. Carey & Wall.) 2: 324. 1824. (Fig.15, a)

Perennial herb with rhizomes or tubers. **Stem** erect, unbranched, 2.9-3.9 cm, internode very short, glabrous. **Leaves** 2 pairs, pseudo-verticillate, strongly anisophyllous, elliptic, apex acute, base acute, 2.3-5.0 by 0.7-1.2 cm (big leaf), upper surface dark green, pubescent on margin and midrib, lower surface lighter green, glabrous; petioles subobsolete. **Stipules** elliptic, tip acute, 2-3 mm long, glabrous. **Inflorescences** 2-7 flowers, a lax compound cyme; peduncles 7-17 mm, green, glabrous; bracts 4, free, elliptic, c. 2.8 mm long, glabrous; pedicels 3.5-6 mm, green, glabrous. **Flowers** 5-merous, slightly zygomorphic. **Calyx** chartaceous, green; calyx lobes triangular, c. 0.2 mm long, spreading, glabrous. **Corolla** star-shaped, glabrous; corolla lobes narrowly triangular, c. 4.3 mm long, suberect; corolla tube c. 0.2 mm long. **Stamens** 5, inserted at the base of the corolla tube; filaments 1.8 mm long, fused; anther free, connivent into a anther cone, yellow with white apical appendage, c. 2 mm long, oblong, basifixed, opening by oblique elongated pore. **Ovary** glabrous; style filiform, c. 3.2 mm, shortly exerted from corolla tube, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist rock in evergreen forest

**Flowering** : June-July

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 052

*Star-shaped and 4-merous flower*

**16. Argostemma khasianum** C.B. Clarke in Hook.f., Fl. Brit. Ind. 3: 43. 1880.

(Fig.16, a)

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, unbranched, 3.5 cm long, internode very short, pubescent. **Leaves** in 2 pairs, pseudo-verticillate, slightly anisophyllous, elliptic, apex acute, base attenuate, 16 by 6 cm, sparsely pubescent on both leaf surface; petioles 1 mm long, glabrous. **Stipules** very small, much reduced. **Inflorescences** 3 flowered, a lax scorpioid cyme; peduncles 18 mm long, white, densely pubescent; bracts 4, free, elliptic, c. 1.3 mm long, pubescent; pedicels c. 2 mm long, white, pubescent. **Flowers** 4-merous, actinomorphic. **Calyx** chartaceous, green; calyx lobes ovate, c. 1 mm long, spreading, densely pubescent. **Corolla** star-shaped, pubescent outside; corolla lobes narrowly triangular, c. 2 mm long; corolla tube  $\leq$  c. 0.3 mm long. **Stamens** 4, inserted at the base of the corolla tube; filaments c. 0.5 mm long, free; anther fused, forming an anther cone like, yellow with white apical appendage, c. 2.2 mm long, oblong, basifixed, opening by longitudinal slits. **Ovary** pubescent; style filiform, c. 2 mm long, include in anther cone, glabrous; stigma bilobate. **Fruit** globose, pubescent. **Seeds** numerous.

**Ecology** : on moist limestone by stream in evergreen forest.

**Flowering** : June

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 049



*Bell-shaped and 5-merous flower*

**17. Argostemma ebracteolatum** Geddes, Kew Bull.: 165. 1927. (Fig.17, a)

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, unbranched, c. 12 cm, internode very short, glabrous. **Leaves** 2-3 pairs, pseudo-verticillate, slightly anisophyllous, elliptic or ovate, apex acute or acuminate, base acute or attenuate, 5.4-6.5 by 1.6-2.0 cm, upper surface dark green, pubescent, lower surface lighter green, pubescent; petioles 7 mm, pubescent. **Stipules** very small and caduceous. **Inflorescences** c. 20 flowers in compound cyme; peduncles c. 5 mm, whitish, pubescent; bracts 5, free, narrowly triangular, 2.1 -6.2 mm long, pubescent outside; pedicle c. 5 mm, white, pubescent. **Flowers** 5-merous, actinomorphic. **Calyx** chartaceous, green; calyx lobes ovate, c. 2.7 mm, erect, densely pubescent outside. **Corolla** bell shaped, densely pubescent outside; corolla lobes triangular, c. 1.3 mm long, spreading; corolla tube c. 0.9 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c. 0.7 mm long; anther yellow without apical appendage, c. 1.9 mm long, sagittate, semibasifixed, opening by apical pore. **Ovary** glabrous; style filiform, c. 1 mm, shortly exerted from corolla tube, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on moist rock by the nature trail.

**Flowering** : June-July

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 048

**18. *Argostemma lobulatum* Craib var. *variabile* K. Sridith, Nord. J. Bot. 19(2): 177. 1999. (Fig.18, a)**

Perennial herb, attached to substrate with dense, matted roots. **Stem** suberect, unbranched, 8.2-12.5 cm, internode very short, glabrous. **Leaves** 3 pairs, pseudo-verticillate, strongly anisophyllous, leaves lanceolate or slightly falcate, apex acuminate, base attenuate or oblique, 9.9 -16 by 3.3 - 4.1 cm (big leaf), upper surface shiny green with sparsely short hairs, lower surface lighter green with sparsely short hairs on margin; petioles 3-25 mm, texture glabrous. **Stipules** ovate, tip acute, 5-10 mm long, glabrous. **Inflorescences** 2-9 flowers, a lax compound cyme; peduncles c. 38 mm, white, glabrous; bracts 5, fused at base, ovate, c. 3 mm long, glabrous; pedicels c. 8 mm, white, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** succulent, white; calyx lobes broad triangular, 1-2 mm long, spreading, glabrous. **Corolla** bell-shaped, glabrous; corolla lobes triangular, 2-3 mm long, spreading; corolla tube c. 2 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments c. 0.7 mm long; anther, pale yellow without apical appandage, c. 2 mm long, oblong, semibasifixed, opening by longitudinal slits. **Ovary** glabrous; style filiform, c. 5.2 mm, long exerted from anther cone, glabrous; stigma globular shape.

**Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist rock in evergreen forest

**Flowering** : July-August

**Specimens studied** : Saithip 006, Saithip 019

**19. Argostemma puffii** K. Sridith, Nord. J. Bot. 19(2): 175. 1999. (Fig. 19, a)

Perennial herb with tubers. **Stem** erect, unbranched, c. 13.3 cm, internode very short, glabrous. **Leaves** 3-4 pairs, pseudo-verticillate, slightly anisophyllous, elliptic, apex acute, base acute, 7.4-9.0 by 2.7-3.9 cm (big leaf), upper surface dark green, pubescent, veins white, lower surface whitish, glabrous; petioles 15-30 mm. **Stipules** ovate, tip bifid, c. 2 mm long, glabrous. **Inflorescences** 8-12 flowers, a lax compound cyme; peduncles c. 34 mm, white, glabrous; bracts 5 at any node, fused at base, triangular, c. 0.2 mm long, glabrous; pedicels 3-4 mm, white, glabrous. **Flowers** 5-merous, actinomorphic. **Calyx** persistent, green; calyx lobes triangular, 0.8 -1.0 mm long, spreading, glabrous. **Corolla** bell shaped, glabrous; corolla lobes ovate, c. 1.2 mm long, spreading, tip recurved; corolla tube c. 1.2 mm long. **Stamens** 5, free, inserted at the base of the corolla tube; filaments 0.5-1.0 mm long; anther connivent into an anther cone, yellow without apical appendage, c. 1.7 mm long, oblong, connective with 3-lobe outgrowth on abaxial side, opening by longitudinal slits. **Ovary** glabrous; style filiform, 3-4 mm, long exerted from anther corolla lobe, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on moist limestone in evergreen forest.

**Flowering** : August

**Specimens studied** : Saithip 025

*Bell-shaped and 4-merous flower*

**20. Argostemma neurocalyx** Miq., Ann. Mus. Ludg.-Bat. 4(8): 229.1869. (Fig. 20, a)

Perennial herb with tubers. **Stem** erect, unbranched, 2-50 mm long, internode very short, pubescent. **Leaves** one or two pairs, slightly (or rarely strongly anisophyllous), ovate or triangular, apex acute, base obtuse, 3.1-8.5 by 2-6.5 mm, upper surface dark green and sparsely hairy with or without white dot or streaks along midrib and veins, lower surface light green and covered with short fine hair; petiole subobsolete. **Stipules** triangular, acute at tip 1-9 mm long, pubescent. **Inflorescences** 3-21 flowers, an umbel-like; peduncles 28-57 mm long, glabrous; bracts 4 lobes, ovate, 3-4 mm long, pubescent; pedicels 3-9 mm long, pubescent. **Flowers** 4-merous, slightly zygomorphic. **Calyx** chartaceous, pale green; calyx lobes triangular c. 1 mm long, spreading, sparsely pubescent outside. **Corolla** bell-shaped, glabrous; corolla lobes triangular, 0.4-1 mm long, slightly reflexed; corolla tube 0.4-1 mm long. **Stamens** 4, free, inserted near the base of the corolla tube; filaments c. 0.5 mm long, adnate to corolla tube; anther yellow without apical appendage, oblong, c. 2 mm long, basifixed, opening by subapical pores. **Ovary** sparsely pubescent; style filiform, c. 2-3 mm long, shortly exerted from corolla tube, glabrous; stigma globular shape. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist rock by the stream in evergreen forest.

**Flowering** : June-August

**Specimens studied** : Saithip 014, Saithip 018, Saithip & K. Sridith & K. Maneenoon

042

**21. *Argostemma neurosepalum*** Bakh.f., Blumea. 7: 331. 1953. (Fig. 21, a)

Perennial herb, attached to substrate with dense, matted roots. **Stem** erect, unbranched, 2.0-4.0 cm long, internode very short, pubescent. **Leaves** 2-3 pairs, pseudo-verticillate, slightly or strongly anisophyllous, leaf lanceolate or elliptic, apex acute, base acute, 4.6-15.2 by 1.9-3.7 cm (big leaf), upper surface dark green, sparsely pubescent, lower surface lighter green, sparsely pubescent; petioles 2-15 mm long, pubescent. **Stipules** triangular, tip bifid, c. 1 mm long, pubescent. **Inflorescences** 1-15 flowers, an umbel-like; peduncles 1.6-3.6 cm long, green, pubescent; bracts 4 lobes at any node, ovate, 2-4 mm long, pubescent; pedicels 6-14 mm long, pubescent. **Flowers** 4-merous, slightly zygomorphic. **Calyx** chartaceous, pale green; calyx lobes triangular, c. 1 mm long, spreading, sparsely pubescent outside. **Corolla** bell-shaped, glabrous; corolla lobes triangular, 2-4 mm long, slightly reflexed; corolla tube 2-3 mm long. **Stamens** 4, free, inserted near the base of the corolla tube; filaments c. 0.5 mm long; anther yellow without apical appendage, oblong, c. 3 mm long, semi-medifixed, opening by subapical pores. **Ovary** sparsely pubescent; style filiform, c. 4 mm long, shortly exerted from corolla tube, glabrous; stigma globular shape, yellow. **Fruit** globose, glabrous. **Seeds** numerous.

**Ecology** : on moist limestone in evergreen forest.

**Flowering** : June

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 044

**22. *Argostemma plumbuem*** Craib, Kew Bull.: 263. 1916. (Fig. 22, a)

Perennial herb with tubers. **Stem** erect, unbranched, c. 0.5 cm, internode very short, pubescent. **Leaves** 2-3 pairs, pseudo-verticillate, slightly

anisophyllous, oblong to slightly rounded, apex round, base rounded, 4.5-5.2 by 4.0-4.5 cm, upper surface dark green with white dot on mid rib and veins, pubescent, lower surface lighter green, pubescent; petioles subobsolete. **Stipules** very small. **Inflorescences** 6-9 flowers, a lax compound cyme; peduncles 40 mm, green, pubescent; bracts 4, free, narrowly triangular, c. 2 mm long, pubescent; pedicels 3-7 mm, white, pubescent. **Flowers** 4-merous, slightly zygomorphic. **Calyx** chartaceous, pale green; calyx lobes triangular, 2 mm long, spreading, pubescent outside. **Corolla** bell shaped, pubescent outside; corolla lobes triangular, c. 2 mm long, slightly recurved; corolla tube c. 2 mm long. **Stamens** 4, free, inserted at the base of the corolla tube; filaments 1 mm long; anther yellow without apical appendage, oblong, c. 3 mm long, yellow, semibasifixed, opening by apical pore. **Ovary** glabrous; style filiform, c. 3.5 mm, shortly exerted from corolla tube, glabrous; stigma globular shape. **Fruit** not seen.

**Ecology** : on moist rock in stream

**Flowering** : June-December

**Specimens studied** : Saithip & K. Sridith & K. Maneenoon 050

### **Results of the chromosomal study**

The somatic chromosome numbers of 21 species and one subspecies of the genus *Argostemma* from four morphological groups were examined from corolla part in the young flowering buds. All taxa have the same chromosome numbers  $2n = 22$ . ( Table1, Figures 1b - 22b).

The microsporocytes of two taxa : *A. laeve* Benn. ssp. *setosum* (Geddes) K. Sridith and *A. kurzii* C.B. Clark (star-shaped and 5-merous flower group) showed 11 bivalent with normal segregation (Figures 7c, 8c).

The chromosomes of *Argostemma* are relatively very small size. The satellites were found in one chromosome pair of four taxa : *A. condensum* Craib, *A. diversifolium* Ridl., *A. laeve* Benn. ssp. *setosum* (Geddes) K. Sridith (star-shaped and 5-merous flower group) (Figures 2b, 4b, 7b) and *A. lobulatum* var. *variabile* (Geddes) K. Sridith (bell-shaped and 5-merous flower group) (Figure 18b).

**Table 1** Chromosome numbers of *Argostemma* spp. in Thailand.

Morphological characteristics		Scientific name	2n	n
Corolla shape	Number of corolla lobe			
Star-shaped	5-merous	<i>A. argostemon</i>	22	11II
		<i>A. condemsum</i>	22	
		<i>A. dispar</i>	22	
		<i>A. diversifolium</i>	22	
		<i>A. elatostemma</i>	22	
		<i>A. kurzii</i>	22	
		<i>A. laeve</i> ssp. <i>setosum</i>	22	
		<i>A. laxum</i>	22	
		<i>A. ophirensis</i>	22	
		<i>A. pictum</i>	22	
		<i>A. propinquum</i>	22	
		<i>A. rotundicalyx</i>	22	
		<i>A. subcrassum</i>	22	
		<i>A. unifolioides</i> var. <i>glabra</i>	22	
		<i>A. verticillatum</i>	22	
			4-merous	
Bell-shaped	5-merous	<i>A. ebracteolatum</i> ,	22	
		<i>A. lobulatum</i> var. <i>variabile</i>	22	
		<i>A. puffii</i>	22	
	4-merous	<i>A. neurocalyx</i>	22	
		<i>A. neurosepalum</i>	22	
		<i>A. plumbeum</i>	22	



### Star-shaped and 5-merous flower

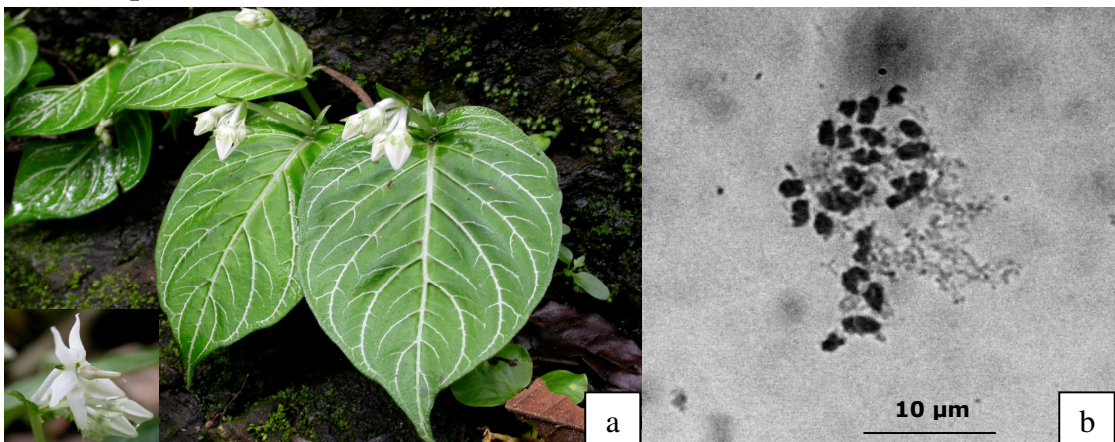


Figure 1 *Argostemma argostemon* K. Sridith

a. Habit    b. Chromosome numbers  $2n = 22$

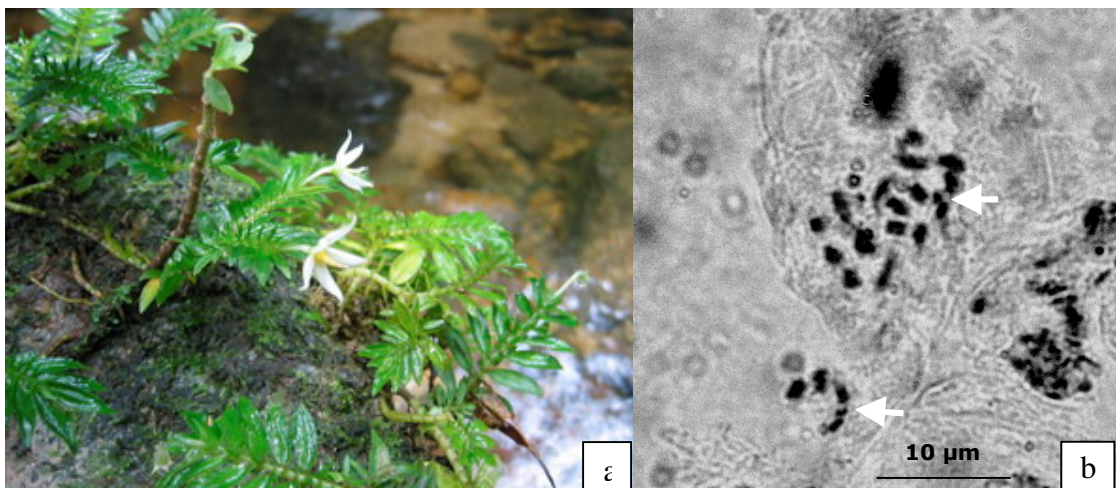


Figure 2 *Argostemma condensum* Craib

a. Habit    b. Chromosome numbers  $2n = 22$

Arrows point out the satellites

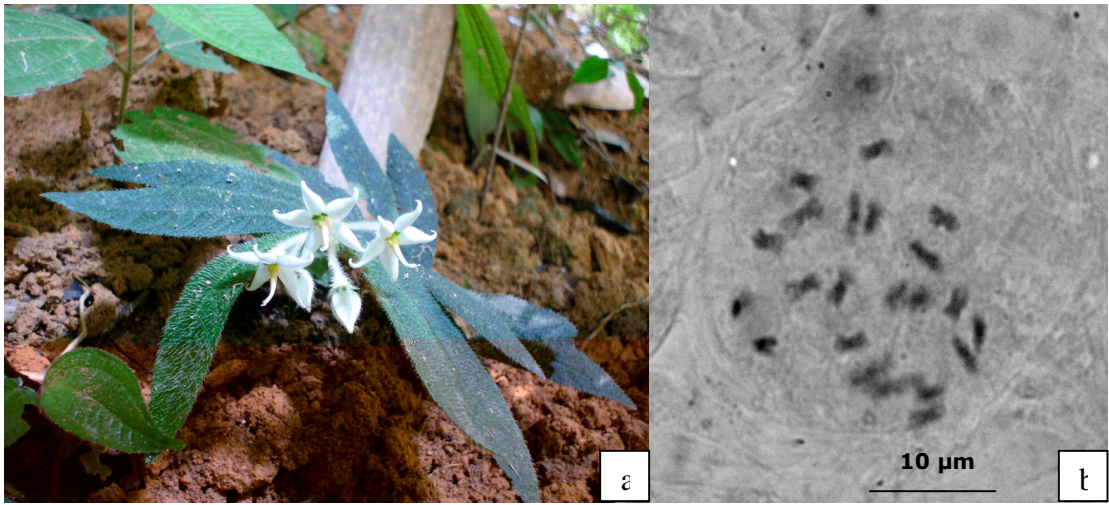


Figure 3 *Argostemma dispar* Craib

a. Habit    b. Chromosome numbers     $2n = 22$

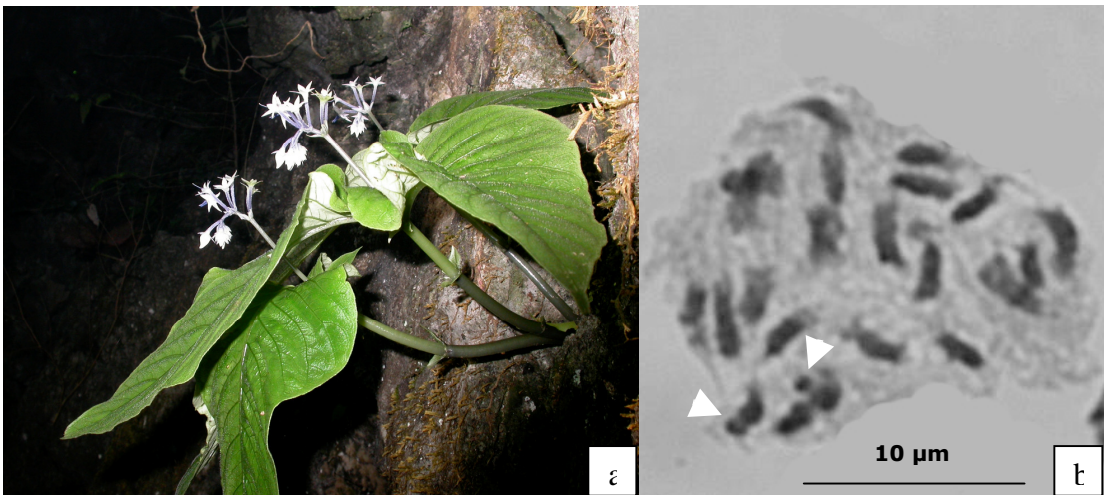


Figure 4 *Argostemma diversifolium* Ridl.

a. Habit    b. Chromosome numbers     $2n = 22$

Arrows point out the satellites

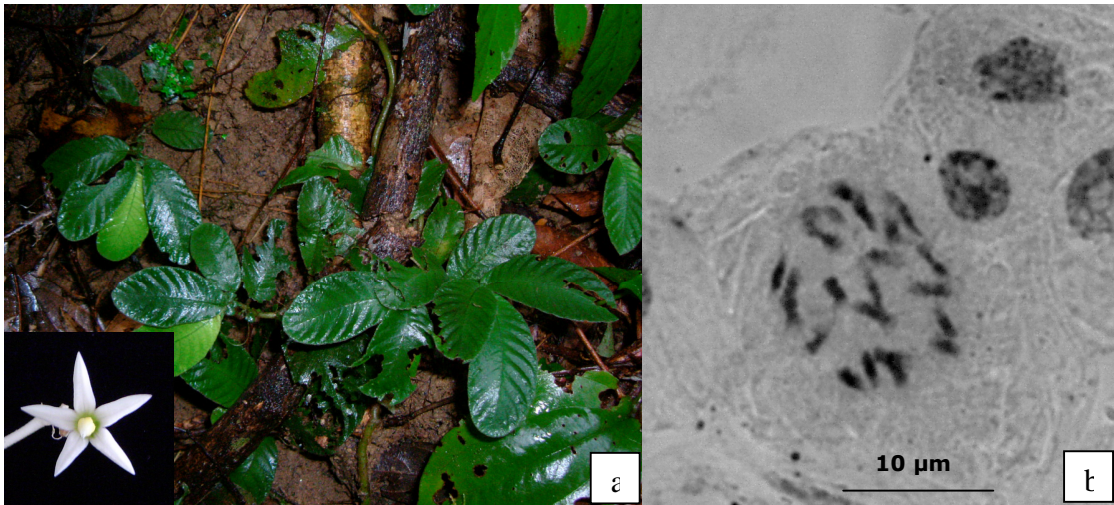


Figure 5 *Argostemma elatostemma* Hook.f.

a. Habit    b. Chromosome numbers     $2n = 22$



Figure 6 *Argostemma laxum* Geddes

a. Habit    b. Chromosome numbers     $2n = 22$

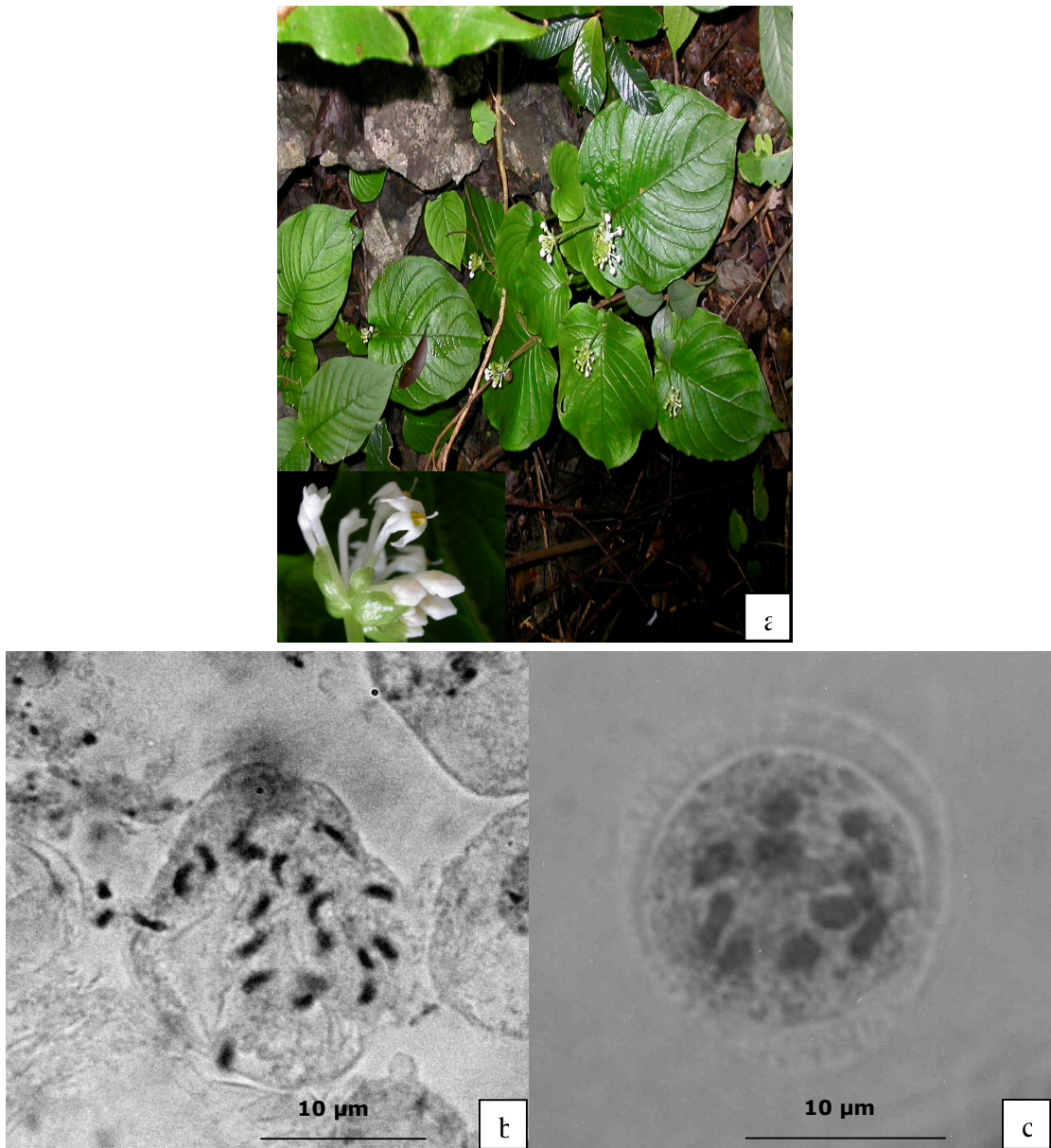


Figure 7 *Argostemma kurzii* C.B. Clark

a. Habit

b. Chromosome numbers  $2n = 22$

c. Microsporocyte shows 11III



Figure 8 *Argostemma laeve* Benn. ssp. *setosum* (Geddes) K. Sridith

a. Habit

b. Chromosome numbers  $2n = 22$

c. Microsporocyte shows 11II

Arrows point out the satellites