

***Plagiopteron suaveolens* (Plagiopteraceae): an emended description**

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ABSTRACT. An amplified description of the monotypic *Plagiopteron suaveolens*, including additional details of the flowers, fruit and seed, is presented. Observations have been made on the mode of climbing, the size of the liana and vegetative reproduction. Elastic threads which conspicuously show up in torn fresh leaves are an excellent field character.

INTRODUCTION

The taxonomic position of the monotypic *Plagiopteron* has been disputed since its publication as a genus (Griffith, 1843). It was raised to family rank by Airy Shaw (1965), and in various later studies (Airy Shaw, 1973, 1979; Baas et al., 1979; Chen, 1980; Lu et al., 1989; Tang et al., 1990, Daniel, 1991) it remained as a separate family. Most recently, through DNA sequencing (Chase et al., 2002), it was placed in Celastraceae (Celastrales). Although the number of herbarium specimens and its known distributional area have been considerably augmented in recent years, some essential characteristics, such as the morphology of mature seed, remain insufficiently known. Watson & Dallwitz (1992 onwards) provide a useful, and easily accessible, summary of the family's characteristics. The following study was designed to aid the forthcoming treatment of the family Plagiopteraceae for the Flora of Thailand.

As head of the R.F.D. Centennial Botanic Garden in south-eastern Thailand, I have been able to locate and observe various wild specimens of *Plagiopteron* in the natural forest around the garden. I studied, and present below, observations on plant growth form, flowers, and seed morphology. In addition, a complete description of the solitary species is presented. For discussion and interpretation of the unique combination of characters, leading to supposed affinity with a large number of families, see Baas et al. (1979), Tang (1994, 1995), and Chase et al. (2002). Anatomical evidence led Baas (in Baas et al., 1979) to suggest that *Plagiopteron* had affinities with the Celastraceae. However, my findings confirm that *Plagiopteron suaveolens* represents a separate family close to Celastraceae.

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TAXONOMIC DESCRIPTION

PLAGIOPTERON

Griff., *Calcutta J. Nat. Hist.* 4: 244, t. 13. 1843; Benth. & Hook. f., *Gen. Pl.* 1: 238. 1862; Warb. in Engl. & Prantl, *Nat. Pflanzenfam.* III. 6a: 55. 1893; Airy Shaw, *Kew Bull.* 18: 266. 1965; Hutch., *Gen. Pl.* 2: 479. 1967; Airy Shaw in Willis, *Dict. Fl. ed.* 8: 910. 1973.

One species in E India, Myanmar, S China and Thailand.

Plagiopteron suaveolens Griff., *Calcutta J. Nat. Hist.* 4: 244, t. 13. 1843; Kurz, *Forest Fl. Burma* 1: 172. 1877; Brandis, *Indian Trees*: 93. 1906; Kanjilal, P. C. Kanjilal & A. Das, *Fl. Assam* 1: 169. 1934; Baas, R. Geesink, W.A. van Heel & J. Muller, *Grana* 18: 69. 1979; Y. X. Lu, G. B. Huang & C. F. Liang, *Guihaia* 9, 2: 171. 1989; Y. Tang, C. Y. Wu & H. Li, *Acta Bot. Yunnan.* 12, 2: 126, fig. 1. 1990.—*P. fragrans* Griff., nom. alt., op. cit.: 246; Mast. in Hook. f., *Fl. Brit. Ind.* 1: 399. 1874; Warb. in Engl. & Prantl, *Nat. Pflanzenfam.* III. 6a: 55. 1894; Airy Shaw, *Kew Bull.* 33: 428. 1979. Type of *P. suaveolens* and *P. fragrans*: Griff., l.c., Plate XIII (lectotype selected by Daniel, 1991).—*P. chinensis* X. X. Chen, *Acta Bot. Yunnan.* 2: 331, fig. 1. 1980. Type: X. X. Chen 2-0423 (Herb. Guangxi Inst. Mat. Med., not seen).

Liana to 30 m tall, to 11 cm diam. *Bark* grey-brown, shallowly and irregularly longitudinally fissured. *Twigs* terete, climbing by means of (opposite) axillary twigs 15–30 cm long, which hook for 180°–360° around supports; younger parts densely brown stellate hairy, hairs of mixed sizes; all fresh parts releasing elastic threads when torn. *Leaves* simple, opposite; stipules absent or minute (see note), caducous; petiole 0.7–1.2 cm long; blade (ob) ovate, orbicular or elliptic 8–15(–20) by 4–6(–9) cm, base shallowly cordate, rounded, or subcuneate, apex acute-acuminate, margin entire, adaxial surface (except nerves) glabrescent; nerves pinnate, in 4–6 pairs, the lowest, basal ones, weaker, adaxially flat. *Inflorescences* axillary to upper leaves, paniculate-thyriform, 4–11 cm long including the 2–6 cm long peduncle, bracteate, flowers in many-flowered subglobose clusters, densely hairy. *Flowers* bisexual, regular, white, fragrant; pedicel (2–)3 mm long. *Calyx* lobes 3(–4), free, apert, oblong, ca. 1 mm long. *Corolla* sympetalous in bud urceolate, ± inflated, somewhat fleshy, ca. 3 by 2 mm, densely brown hairy outside, more sparsely so inside, at apex with 3 (or 4) free valvate triangular lobes, ca. 0.5 mm long, the tube at anthesis tearing apart into 3 (or 4) oblong, recurved, secondarily formed free petals 3.5–4 mm long, remaining connate at base for only ca. 0.2 mm. *Disc* absent. *Stamens* 40(–50), free, in ±2 rows; filaments slender, terete, white, at apex slightly clavate, 2.5–4 mm long, anthers basifixed, broadly clavate, somewhat flattened, (0.3–)0.4 mm long, 4-locular, opening with one transverse apical slit. *Ovary* superior, broadly ovate-globose, faintly 3-grooved, ca. 0.8 mm long, densely brown hairy (hairs stellate, but arms long and patent), style subulate, glabrous, 1.5–2 mm long, stigma minute, ca. 0.1 mm diam., faintly 3-lobed, papillate; locules 3, each with 2 basal, collateral, anatropous ovules, filling the locule. *Fruit* one or few developing per infructescence, 3-winged, with reflexed perianth and persistent stamens, woody, indehiscent, green then brown, 1 seed produced in one of the locules, the other 2 locules remaining empty; fruiting pedicel 5–10 mm long, fruit except wings ± turbinate, 6–11 by 5–10 mm, apex flattish with minute remnant of style, hairy; fruit including wings

4–8 cm wide; wings spreading, each one growing from below the apex of the fruit, corresponding with the locules, coriaceous, elliptic-oblong, 2–3.5(–5) cm long, somewhat narrowed at base, apex rounded, 7–8 parallel-nerved, more sparsely hairy. *Seed* elliptic-oblong, subterete, at apex curved into the hollow extension of the locule towards the wing-base, 10–12 by 4(–6) mm, brownish black, very finely irregularly striate; albumen copious, white. *Embryo* large, pale yellow; cotyledons straight, elongated, swollen; plumule less than 0.1 mm long, radicle cylindrical, ca. 1 mm long.

Thailand.— NORTHERN: Lampang [Amphoe Mae Tha, Ban Sam Kha, *Phonsena & Banchong* 4262 (BKF)]; NORTH-EASTERN: Kalasin [King Amphoe Don Chan, Dong Mae Phet, *Phonsena* 3381 (BKF, RFD, Centennial Botanic Garden)]; EASTERN: Nakhon Ratchasima [specimen not located]; SOUTH-EASTERN: Sa Kaeo [Khao Ang Rue Nai Wildlife Sanctuary, RFD, Centennial Botanic Garden, *Phonsena* 3235, 3369 & 3462 (BKF, RFD, Centennial Botanic Garden); *De Wilde et al.* 22291 (L); Pang Sida National Park, *Phonsena* 3379 (BKF, RFD, Centennial Botanic Garden)]; Chachoengsao [Khao Ang Rue Nai Wildlife Sanctuary, Ban Phu Thai, *Thaithong* s.n. (BCU)]; Rayong [specimen not located], Trat [specimen not located]; Chanthaburi [Khao Soi Dao Wildlife Sanctuary, *van Beusekom et al.* 2112 (BKF, L); *Maxwell* 74-673 (AAU, BKF, L); *Phonsena* 433, 3241 & 3460 (BKF, RFD, Centennial Botanic Garden); *Phonsena et al.* 3523 (BKF, L, RFD., Centennial Botanic Garden); Pong Nam Ron-Pilin, *Larsen* 32174 (AAU, BKF); west of Soi Dao, *Larsen et al.* 32203 (AAU, BKF, L)].

Distribution.— India (Silhet), Myanmar (Tenasserim), China (Guangxi).

Ecology.— In open evergreen forest, secondary forest (evergreen forest type), open deciduous forest, or sometimes at the edge of cultivation; soil over granite, or sandy soil; 80–430 m altitude. Flowering September–November; fruiting: October–January.

Vernacular.— Khruea sam pik (เครือสามปีก) (Chanthaburi); Thao duk ngu (เถาตุกงู) (Nakhon Ratchasima).

Uses.— The stem, boiled with herbs, is used to treat osteoporosis.

FIELD OBSERVATIONS

Growth form

The plant appears to reiterate from near its base by sapling-like shoots several metres long. These later seek support against the stems of slender trees or other lianas, clambering by means of short, leafy axillary shoots from one or both the opposite leaf axils of the main stem, twisting the full 360° around the supporting stem (Fig. 3B). Apparently, not all the leaf axils behave like this, though "clambering arms" can be found on several nodes successively. The curving of the lateral shootlets is possibly thigmotactic, being induced by the stimulus of touching a suitable support. Injured roots in places where the forest soil has been cleared and removed by bulldozing, frequently appeared to produce sprouts quite far away (to ca. 10 m) from the parent liana. Seed germination and development of the seedling in the wild has not, yet, been seen.

Elastic threads

When breaking or tearing fresh leaves or twigs (and other parts of the plant) numeric elastic threads, up to 4 cm long, appear (Fig. 3F), a phenomenon well known in Celastraceae. Griffith (1843) and later authors suggested that these are produced from "spiral vessels", [Airy Shaw (1973) calls them "latex canals"]. Baas (in Baas et al., 1979) indicated that the elastic material represents "gutta-percha", that is coagulated protoplasmatic material, present in the thin-walled fibres, and frequent in tissue sheathing or near the vascular system.

Cellular bodies

The "curious cellular bodies" found along the margins of the young leaves (Griffith, l.c.) were not seen in this study.

Stipules

Stipules were reported as absent by e.g. Griffith (l.c.), Airy Shaw (1965, 1973), but as present, minute, and caducous by later authors, e.g. Kanjilal et al. (1934), Geesink (in Baas et al., 1979). Despite extensive observations I was unable to find stipules.

Flowers

Geesink (in Baas et al., l.c.) suggested that the apert calyx lobes, 3(-5), might represent stipules, forming an epicalyx. The corolla, composed of recurved, valvate lobes should then be called the calyx of an apetalous flower. I found the calyx almost always to consist of only three apert segments, and also the corolla to be composed of three parts, alternating with the calyx segments. As the ovary is 3-locular the flowers are, clearly, 3-merous. Authors such as Kurz (1877), Masters (1874), Warburg (1894) or Kanjilal et al. (1934) describe the calyx and corolla as 5-partite, but I could find no evidence to support this contention. My observations coincide with those of Chen (1980) who also found 3-partite flowers in China. Further examination of material from India and Myanmar is clearly required to confirm the occurrence of 3-partite flowers.

The corolla, which is rather fleshy in structure, appears sympetalous in bud, and only tears into three, nearly free recurved lobes on anthesis. Using microscopic study of stained anatomical cross-sections taken through various levels of the tube, I verified that the lobes are largely truly connate for ca. $\frac{4}{5}$ of their length, and are not adnate (microtome sections tear apart easily because the elastic threads are also present in the corolla tube). Interestingly, though sympetaly was noted by Griffith (l.c.) in Plate XIII, it was not mentioned by him in the description. In the literature the flowers are often described as greenish, but living flowers are pure white (Fig. 3D).

It should be noted that flowers and fruit from Thailand are considerably stouter than those seen in collections made in the botanical garden at Bogor (plants originating from cuttings taken from plants from Sylhet that were grown in Calcutta).

Winged fruit

Only one or a few of the 50–100 bisexual flowers of each paniculate inflorescence develop into a fruit (Fig. 3E). The flowers are pure white and fragrant, with the many white stamens exerted, suggesting insect pollination. However, there are no hard data on this species' pollination biology. The fruit is conspicuously 2-, 3- or 4-winged, and superficially resembles the fruit of some Tiliaceae, Malpighiaceae and Celastraceae: however, the first two families do not appear to be closely related to *Plagiopeteron*. The wing-like follicles of *Loeseneriella* (Celastraceae-Hippocratioideae) are of completely different origin to the wings in *Plagiopeteron*. In *Hiptage* (Malpighiaceae) the wings develop from appendages already visible on the ovary. In *Plagiopeteron* the ovary (Fig. 1C, J, K) is devoid of any trace of the later developing wings; they develop from areas below the apex of the ovary. Although the fruit was described as indehiscent by Kurz (1877), later authors supposed the fruit to split into three 1-winged parts. In fact, field observations show that the fruit detaches in an entire state and remains so, even when it has fallen on the ground. The fruits always contain only one seed which develops in one of the three locules. It appears that the fruits never open. However, germination of the seed has not yet been observed.

Seed

The seed is \pm oblong with a curious hook at its apex (Fig. 2, D–F). The large, elongated cotyledons are thick and carnose, not flat as in the Celastraceae. The albumen is copious, white, in section contrasting with the thin, black seedcoat. The embryo is large, straight, and pale yellowish.

SYSTEMATIC POSITION OF *PLAGIOPTERON*

As stated above, recent molecular research places *Plagiopeteron* in the Celastraceae (Celastrales) (Chase et al., 2002). Previous authors variously discussed its position (see above), until Baas et al. (1979) concluded, on widely-based reasoning, that it could best be accommodated as a monotypic family in the Malvales. In the same paper, however, on anatomical grounds Baas (l.c.) repeatedly pointed to strong affinities with Celastraceae (Celastrales): a relationship which was emphatically denied by pollen evidence. Tang (1995) corroborated *Plagiopeteron*'s affinity with the Celastraceae on the basis of leaf and stem anatomy: a finding congruent with embryological evidence (van Heel, in Baas et al., l.c.; Tang, 1994), where the presence of an endothelium in the embryo sac is particularly significant. This latter character is said to be characteristic of many sympetalous families, and it is relevant to recall that the corolla in *Plagiopeteron* now appears to be truly sympetalous in the bud stage (a sympetalous corolla is also found in Scytopetalaceae of the Malvales). The thickened cotyledons of *Plagiopeteron* are also rather unlike those in the Celastraceae. One of the most conspicuous similarities with some of the Celastraceae is the occurrence of "elastic threads" easily seen when living parts of the plant are torn apart (see above). Mature old wood has not yet been investigated anatomically.

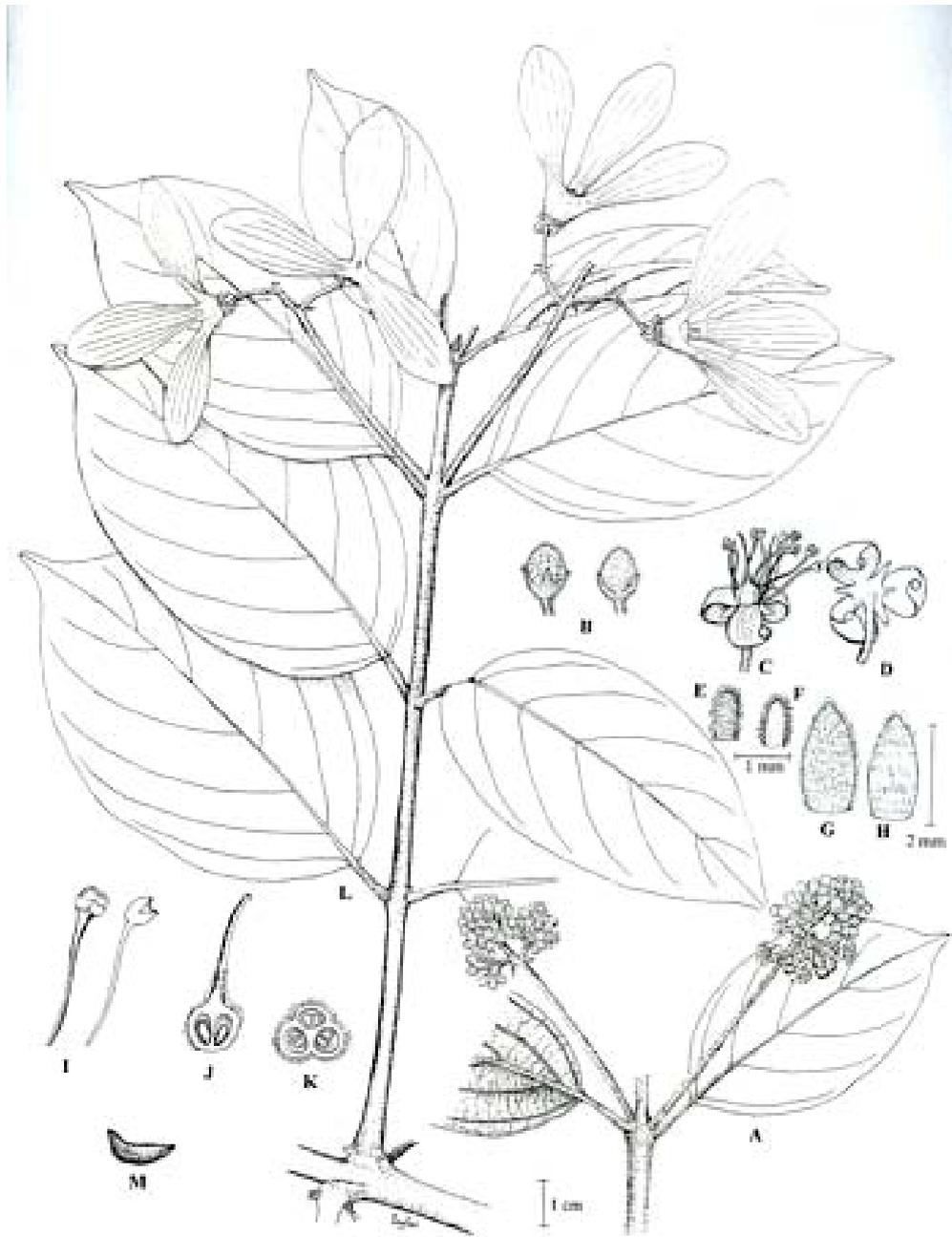


Figure 1. *Plagiopteron suaveolens* Griff.: A. inflorescence ; B. flower buds, showing variable position of the segment of the outer sepals whorl; C. open flower; D. ditto from below; E. sepal outside; F. sepal inside; G. petal outside; H. petal inside; I. stamens; J. pistil; K. ovary, cross section, showing two ovules per locule; L. fruiting branch; M. seed. All from P. Phonsena 3241. Drawn by O. Kerdkaew.

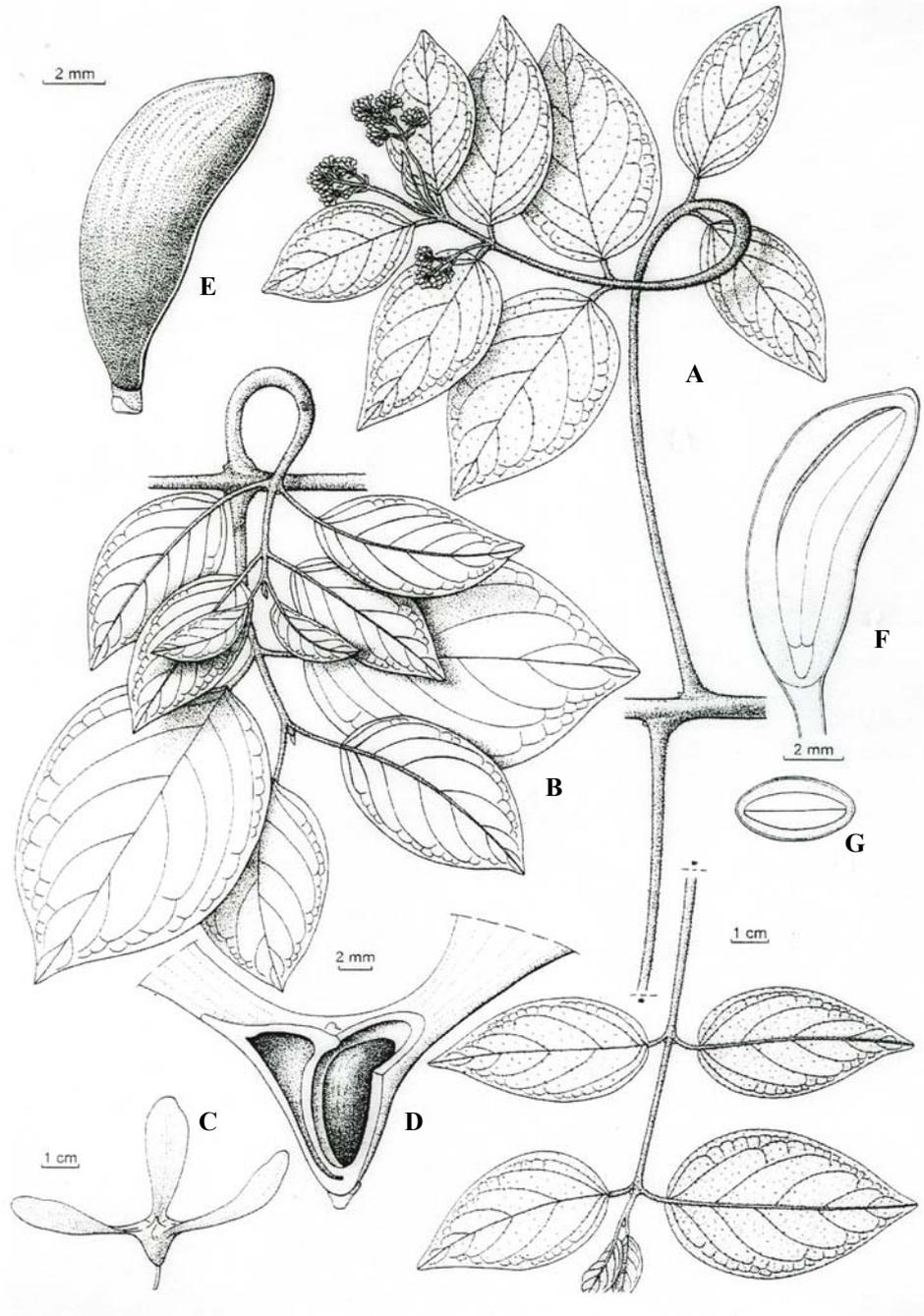


Figure 2. *Plagiopteron suaveolens* Griff.: A. & B. portions of twisting branches: C. fruit: D. ditto, longitudinal section (wings partly removed), showing one seed; E. seed; F. ditto, longitudinal section; G. ditto, cross section. All from *De Wilde et al.* 2229. Drawn by Anita Walsmit Sachs-Jansen.



Figure 3. *Plagiopteron suaveolens* Griff. A. stem; B. portions of twisting branches; C. inflorescences; D. flowers; E. infructescence; F. elastic threads from leaves and twig. Photographed by Phonsena.

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REFERENCES

- Airy Shaw, H. K. 1965. Diagnoses of new families, new names, etc., for the seventh edition of Willis's 'Dictionary'. Kew Bulletin 18: 266–267.
- _____. 1973. *Plagiopteron*. In: Willis, J. C. (ed.). A dictionary of the flowering plants and ferns, ed. 8, p. 910. University Press, Cambridge.
- _____. 1979. The genus *Plagiopteron* (Plagiopteraceae) recorded for Thailand. Kew Bulletin 33: 428.
- Baas, P., Geesink, R., van Heel, W. A. & Muller, J. 1979. The affinities of *Plagiopteron suaveolens* Griff. (Plagiopteraceae). Grana 18: 69–89.
- Bentham, G. & Hooker, J. D. 1862. Genera Plantarum. Volume 1. Lovell, Reeve & Co., London.
- Chase, M. W., Zmarzty, S., Lledó, M. D., Wurdack, K. J., Swensen, S. M. & Fay, M. F. 2002. When in doubt, put it in Flacourtiaceae: a molecular phylogenetic analysis based on plastid *rbcL* DNA sequences. Kew Bulletin 57: 141–181.
- Chen, X. X. 1980. Plagiopteraceae—a new record from China and new species. Acta Botanica Yunnanica 2: 331–333.
- Daniel, P. 1991. The alternative names of the type of *Plagiopteron* (Plagiopteraceae). Taxon 40: 619–620.
- Griffith, W. 1843. On some remarkable plants in the H. C. Botanic Gardens, Calcutta. Calcutta Journal of Natural History 4: 244–246.
- Hutchinson J. 1967. The genera of flowering plants. Volume 2. Clarendon Press, Oxford.
- Kanjilal, U. N., P. C. Kanjilal & A. Das. 1934. *Plagiopteron* Griff. Flora of Assam 1: 169–170.
- Kurz, S. 1877. *Plagiopteron*, Griff. Forest Flora of British Burma 1: 172.
- Lu, Y. X., G. B. Huang & C. F. Liang. 1989. Study on the endemic plants from Guangxi. Guihaia 9: 119–186.
- Masters, M. T. 1874. *Plagiopteron* In: Hooker, J. D. (ed.). Flora of British India 1: 399. Reeve & Co., London.
- Tang, Y, Wu, C. Y. & Li, H. 1990. The revision of the genus *Plagiopteron*. Acta Botanica Yunnanica 12: 126–128.
- Tang, Y, Wu, C. Y & Li, H. 1994. Embryology of *Plagiopteron suaveolens* Griffith (Plagiopteraceae) and its systematic implications. Botanical Journal of the Linnean Society 116: 145–157.
- _____. 1995. Leaf and stem anatomy of *Plagiopteron suaveolens* and its systematic significance. Acta Bototanica Yunnanica 17: 439–444.
- Warburg, O. 1893. *Plagiopteron*. In: Engler, A. & Prantl, K. (eds.). Die natürlichen Pflanzenfamilien III.6a: 55.
- Watson L. & Dallwitz M. J. 1992 onwards. The Families of Flowering Plants: Descriptions, Illustrations, Identification, and Information Retrieval. Version: 14th December 2000. <http://biodiversity.uno.edu/delta/>.