

**SYSTEMATIC STATUS OF THE GENUS *KLEINODENDRON*  
(EUPHORBIACEAE)**

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*Summary*

The status of the Brazilian genus *Kleinodendron* Smith and Downs is reconsidered on the basis of studies of floral morphology, pollen characters, and wood anatomy. The plant does not belong to the tribe Clutieae but rather to the tribe Phyllanthaeae, and the genus cannot be separated from the genus *Savia*. Although there are some differences between the specimens of *Kleinodendron* from Santa Catarina and material of *Savia dictyocarpa* Muell. Arg. from Rio de Janeiro and São Paulo, the Santa Catarina populations are not sharply separable, and both the genus *Kleinodendron* and the species *Kleinodendron riosulense* must pass into synonymy.

The Euphorbiaceous genus *Kleinodendron* was described by Smith and Downs (1964) on the basis of specimens collected by Reitz and Klein in Santa Catarina province, Brazil. The authors noted that fruiting specimens had a resemblance in aspect to *Actinostemon*, but on the basis of the flowers proposed a new genus *Kleinodendron*, which they assigned to the tribe Clutieae sensu Pax and Hoffmann (1931). Since there was some doubt as to the affinities of the new genus, Dr. Smith persuaded Dr. William Stern to undertake an anatomical survey of the tribe Clutieae in order to better establish the systematic position of *Kleinodendron*. As a result of his study, Stern (1967) concluded that "there are no anatomically related objections to the inclusion of *Kleinodendron riosulense* in the Clutieae as delineated by Pax (1890) and amplified by Pax and Hoffmann (1931)."

In his interesting survey of the wood anatomy of genera which had been assigned to the tribe Clutieae by Pax and Hoffmann, Stern noted that the wood structure is moderately specialized with considerable variation, and pointed out that *Microdesmis* and *Pogonophora* are strikingly divergent from the other genera in their characteristics. He concluded that both these genera should be excluded from the Clutieae, and accepted (with some reservation) the proposal by Forman (1966) to transfer *Microdesmis* to the segregate family Pandaceae. More recently, I have created a separate tribe Pogonophoreae for *Pogonophora*, which has distinctive floral characters in addition to the anatomical ones pointed out by Stern (Webster, 1975).

Although he cited the palynological study of the Euphorbiaceae by Punt (1962), which indicated considerable heterogeneity in pollen characters within the tribe Clutieae, Stern made no specific comparisons between xylem characters in the genera with "Croton type" pollen and those with "non-crotonoid" pollen. This was unfortunate because, as indicated by Punt (1962) and Webster (1967, 1975), the "crotonoid" exine ornamentation pattern found in many "uniovulate" genera of Euphorbiaceae appears to be highly significant taxonomically. Of the subtribes of Clutieae as defined by Pax and Hoffman (1931), "crotonoid" pollen occurs in the Acidocrotoninae, Clutiinae, Codiainae (ex p.), Jatrophinae, and Ricinodendrinae (Punt, 1962; Webster, 1975; Webster and Lynch, ined.). Since the pollen of *Klei-*

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*nodendron* is not "crotonoid," its affinity with any of the subtribes noted above is questionable.

Hutchinson (1969) redefined the tribe Clutieae by excluding the majority of the genera referred there by Pax and Hoffmann, but still included genera with both "crotonoid" and "non-crotonoid" pollen. The Clutieae in Hutchinson's sense is still unnatural, since it includes genera placed in four different tribes (belonging to two subfamilies) by Webster (1975). Since the tribe Clutieae, as defined by criteria which omit serious consideration of pollen characters, appears to be unnatural, the comparisons of xylem anatomy made by Stern are largely irrelevant to solving the problem of the affinities of *Kleinodendron*, even though his studies do furnish valuable comparative information about other genera.

Much of the uncertainty involved in determining the affinities of *Kleinodendron* arise from the difficulty Smith and Downs (1964) had in interpreting the floral structure. They described the flowers as having the ovules solitary in each locule and 7 or 8 sepals in both sexes; but their illustration shows 7 "sepals" in the staminate flower and 5 sepals and 5 petals in the pistillate flower. Stern (1967) noted that Dr. Smith had told him that the perianth should have been described as biseriate in both sexes.

Examination of the flowers in the original collections (and in others which have become available since then) shows that neither the 1964 nor the 1967 description of the floral morphology is correct. However, anyone who dissects flowers from these collections will sympathize with Smith and Downs' difficulties, because the flowers—which appear with the expanding leaves—are of fragile consistency, and the parts are not easy to interpret. The perianth parts show a tendency towards spiral arrangement, and (as Smith noted) the inner and outer perianth parts are not very clearly differentiated. In the staminate flower, the perianth is usually 5–7-merous, and could be interpreted either as apetalous with 5–7 sepals, or as having 5 sepals with 0–2 petals in the inner "whorl." In the pistillate flower, the perianth is 10–12-merous and more or less biseriate, although the inner parts are scarcely more "petaloid" than the outer ones. However the structures are interpreted, it is the illustration in Smith and Downs (1964) which is most nearly correct, not the descriptions.

The discrepancy between the perianth of the staminate and pistillate flowers of *Kleinodendron* is not particularly surprising, since it occurs in a number of Euphorbiaceae, but usually (as in *Croton*) the petals are reduced in the pistillate rather than in the staminate flowers. The imperfect differentiation between the outer and inner perianth parts may be significant, because in various characters *Kleinodendron* appears to be unspecialized; the lack of clear distinction between petals and sepals may therefore be an indication of phylogenetic unspecialization.

The relatively primitive position of *Kleinodendron* in the Euphorbiaceae was not appreciated by Smith and Downs because of a crucial error in their description of the gynoeceum. They described the ovules as solitary in each locule, whereas in fact the ovules are paired, but one of each pair aborts during fruit development, resulting in a capsule with the seeds solitary in each locule. This occurrence of paired ovules negates the assignment of *Kleinodendron* to the "uniovulate" tribe Clutieae by Smith and Downs, and indicates that (in conjunction with other characters) the plant should be referred to the subfamily Phyllanthoideae (sensu Webster, 1975).

If *Kleinodendron* is accepted as belonging to the subfamily Phyllanthoideae, it is not difficult to ascertain its approximate position. In the generic key of Pax and Hoffmann (1931), a specimen of *Kleinodendron* will run down to the vicinity of the genus *Savia*. It is notable that the abortion of one of the two ovules to yield solitary seeds in the chambers of the fruit is common in *Savia*, and was utilized by Urban (1903) as a diagnostic character for sections within the genus. By Urban's criteria, *Kleinodendron* would most closely agree with sect. *Savia* (*Eusavia*). Now, it is notable that Mueller (1874) described a single species of *Savia* from Brazil: *S. dictyocarpa* Muell. Arg., which he regarded as closely related to the West Indian *S.*

*sessiliflora* (Sw.) Willd., the type species of *Savia* (and the only species referred by Urban to sect. *Savia*). However, there are some discrepancies between Mueller's description and the characters of *Kleinodendron*, especially the description of the petals in the pistillate flower as much shorter than the sepals and the ovary as glabrous. In the Santa Catarina collections of *Kleinodendron* the petals (inner tepals) are about as long as the sepals, and the ovary is densely hirsutulous.

The comparison of *Kleinodendron* with *Savia dictyocarpa* is complicated by the fact that yet another similar Brazilian plant has been described as *Securinea guaraiuva* by Kuhlmann (1935). Kuhlmann's plant, collected in São Paulo, is well illustrated except that he unfortunately did not have material of the pistillate flower. Since he saw only the apetalous staminate flowers, it is understandable that he described the plant as a *Securinea* rather than as a *Savia*.

Evidence from pollen morphology and wood anatomy indicate that *Kleinodendron riosulense*, *Savia dictyocarpa*, and *Securinea guaraiuva* are very similar and certainly congeneric taxa. In all three taxa the pollen grains are subglobose, 3-colporate, angulaperturate, reticulate-semitectate, with diameters of 25–30  $\mu$ ; they are very similar to the pollen grains of *Savia sessiliflora* as described under his "*Savia* type" by Punt (1962).

Evidence from wood anatomy, to be presented in detail by Dr. Mennega, (ined.), shows that the three taxa agree in having vessels without tyloses, non-septate thick-walled fibers, silica grains in the rays, and diffuse uniseriate bands of parenchyma. In contrast, other species of *Savia* lack rhombic crystals. The wood, as well as the pollen, of the three taxa is so similar that the plants involved must be closely related.

Comparison of reproductive structures in the three described taxa is made somewhat difficult by scantiness of material and difficulty in correlating staminate flowers, pistillate flowers, and fruits. Among the samples from Rio de Janeiro, São Paulo, and Santa Catarina, there is variation in number of tepals in staminate flower, fruiting pedicel length, and position of the articulation on the fruiting pedicel. However, there are no consistent patterns of concurrent variation which would enable one to sharply distinguish three taxa. In all fruiting samples, the seeds are similar and scarcely exceed 4 mm in length; none have been observed which approach the 6–7 mm dimensions cited for *Securinea guaraiuva* by Kuhlmann. Although future studies based on more comprehensive samples may possibly indicate sufficient geographic differentiation so that *Kleinodendron riosulense* could be distinguished from the plants of Rio and São Paulo at the subspecific level, there is at present insufficient supporting evidence. At our current state of knowledge, therefore, it appears that all these Brazilian populations should be assigned to the single species *Savia dictyocarpa* Muell. Arg.

The systematic relationships of *Savia dictyocarpa* are of some interest with regard to the phytogeography of the genus *Savia*. As suggested by Mueller (1874), the most closely related species may be the West Indian *S. sessiliflora* (Sw.) Willd., which has similar foliage and articulate fruiting pedicels supporting capsules with solitary seeds in each locule. Unfortunately, Mueller described *S. dictyocarpa* from inadequate material, and his description appears to be misleading. The ovary in all Brazilian specimens examined is densely hirsutulous, not glabrous as described by Mueller, and the petals (inner tepals) do not appear to be shorter than the sepals. It is rather difficult to find good diagnostic characters separating *S. dictyocarpa* from *S. sessiliflora*, as indicated by the fact that in their key Pax and Hoffmann (1922) separate them purely by geographical distribution! However, there does appear to be a difference in the staminate flowers, which in *S. sessiliflora* usually have 5 small rudimentary petals much shorter than the sepals (as illustrated by Fawcett and Rendle, 1920), whereas in *S. dictyocarpa* there are 5–7 tepals, the inner 2 of which (if construed as petals) are not notably shorter than the outer ones. There are apparently additional differences, such as shorter fruiting pedicels in the West Indian plants,

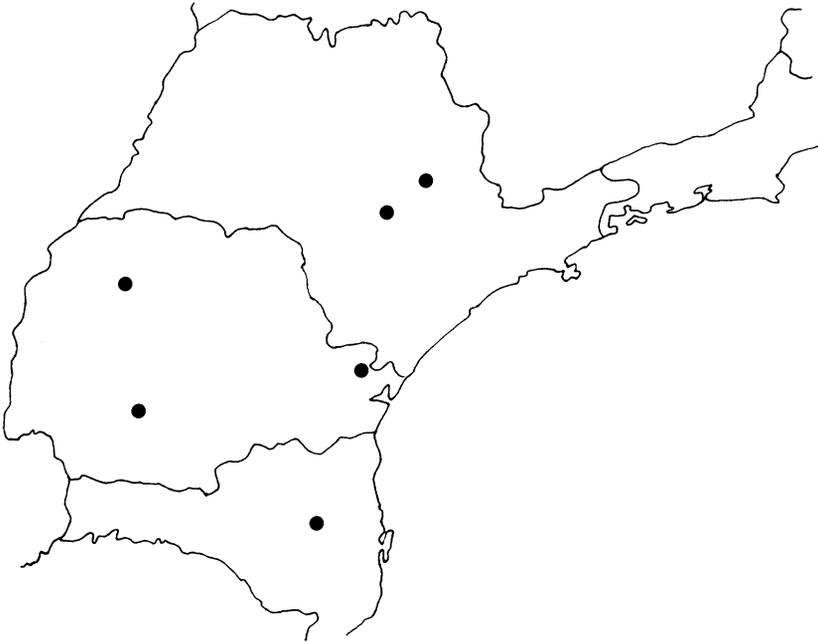


Fig. 1. Distribution of *Savia dictyocarpa* (Brazil, states of São Paulo, Paraná, and Santa Catarina).

which seem to furnish distinctions on the basis of an admittedly inadequate sample. Tentatively, then, it appears that *S. dictyocarpa* and *S. sessiliflora* are best regarded as very closely related but distinct species of *Savia* sect. *Savia*.

### Systematic Treatment

***Savia dictyocarpa*** Muell. Arg. in Mart. Fl. Brasil. 11(2): 704. 1874; Pax & Hoffm. Das Pflanzenr. IV. 147. XV (Heft 81): 185. 1922. Type: Rio de Janeiro, Glaziou 5986 (G).

*Securinea guaraiuva* Kuhlmann, Arq. Inst. Biol. Veg. Rio de Jan. 1: 241, Figs. 1–6. 1935. Type: São Paulo, Horto Florestal da Companhia Paulista, Rio Claro, Navarro de Andrade (RB 6866; U, isotype).

*Kleinodendron riosulense* Smith & Downs, Sellowia 16: 177, Figs. 1–10. 1964. Type: Santa Catarina, Rio do Sul, Matador, Reitz & Klein 13942 (US).

Dioecious tree up to 25 m high, with smooth bark; twigs glabrous or hirtellous (when young), brownish, lenticels obscure to moderately prominent; foliage deciduous; stipules caducous, narrowly lanceolate to linear-attenuate, hirsutulous, 2–4.5 mm long; petioles 2–5 mm long, hirsutulous; leaves ovate to elliptic, mostly 3–7(–14) cm long, 1.5–4(–6) cm broad, cuspidate-acuminate, rounded at base, margins entire; veins mostly 7–10 on a side, prominulous on both faces. Staminate flowers subsessile in axillary glomerules; sepals 5–7, imbricate, hirsutulous on the back, 1–2.2 mm, long margins ciliate; petals 0–2(–5), usually reduced, less than 1 mm long; disk 1–1.8 mm across, glabrous; stamens 5 (rarely 4 or 6), free, filaments 1–2 mm long; anthers glabrous or sparsely hirtellous, 0.6–0.8 mm long; pistillode c. 1–1.5 mm high, 2–3-fid, sericeous. Pistillate flowers with hirsutulous pedicels becoming 7–14 mm long in fruit, articulated above the base; sepals 5 or 6, imbricate, 1.5–1.8 mm long; petals usually 5 or 6, sometimes

reduced, mostly 2–2.4 mm long, similar in texture to the sepals; ovary densely hirsutulous; styles bifid, 0.8–1.5 mm long; capsules globose, 3-carinate, distinctly reticulate-venose, 8–10 mm in diameter; columella basally thickened, 4–6 mm long; seeds solitary in each locule, ellipsoid, smooth, shiny, dark brown, 3.7–4.1 mm long, 2.8–3.3 mm broad.

Distribution: forested areas, southern Brazil, below 500 m elevation (Fig. 1); flowering Oct., Nov.

Specimens examined: Brazil. Rio de Janeiro: Reserva florestal da Fabrica Aliança, Laranjeiras [cultivated], Kuhlmann RB 20821 (DAV). São Paulo: Rio Claro, Horto Florestal da Companhia Paulista, Navarro de Andrade RB 6866 (U, isotype of *Securinega guaraiuva*); Anhembi, Fazenda Barreiro Rico, Kuhlmann 4515 (MICH, US); São Paulo, Jardim Botânico, Kuhlmann IBSP 52789 (US). Paraná: Fazenda Lagoa, S of Rio Ivaí, 15 km E of São Tomé, Lindeman & de Haas 852 (U); 10 km W of Cerro Azul, near Casa Branca, Lindeman & de Haas 2293, 2298 (U). Santa Catarina: Mun. Rio do Sul, Matador, Lourteig 2300 (U), Reitz 6164 (US), Reitz & Klein 7344 (US), 7556 (U, US), 13940 (US), 13942 (US 2423806, holotype of *Kleinodendron riosulense*), 13943 (US).

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