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## Polygalaceae

Polygalaceae Hoffmanns. & Link, Fl. Portug. 1:62 (1809), nom. cons.

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Trees, lianas, shrubs, subshrubs, or perennial as well as annual herbs. Indumentum, if present, consisting of simple, unicellular or sometimes uniseriate hairs with a smooth or verrucate surface. Stems mostly terete, occasionally angular or winged; branches sometimes spine-tipped. Leaves usually alternate, sometimes opposite or verticillate, sessile or petiolate, simple, estipulate; nectariferous glands sometimes present at the base of the petiole or on the leaf blade. Inflorescences terminal or axillary, simple or compound racemes, panicles, or rarely flowers solitary. Flowers bisexual or allegedly functionally unisexual (*Balgoya*), hypogynous,  $\pm$  actinomorphic to zygomorphic, subtended by a bract and two prophylls which are often early caducous. Calyx pentamerous, the sepals subequal to strongly unequal (in Polygalaceae, the lateral ones are very large and petaloid), free, partly connate, or fused into a tube, caducous or persistent. Corolla pentamerous or trimerous, the petals free from each other, subequal to strongly irregular, the abaxial one often boat-shaped or developed into a carina (keel), which may be trilobed at apex or provided with a crest. Flowers white, yellow, pink, purple or blue, the abaxial petal (carina) often of contrasting colour. Stamens (2–)5–8(–10); filaments free, adnate to corolla lobes and/or fused into a sheath; anthers 2–4-sporangiate. Nectary absent or present, tending to be annular in genera with bilocular fruits and unilateral in those with unilocular fruits. Ovary 2–8-carpellate, syncarpous, usually with as many locules as carpels, occasionally unilocular (*Xanthophyllum* and pseudomonomerous genera), each locule with a single pendulous, epitropous ovule, except *Xanthophyllum* with 4–40 ovules in its single locule. Style straight or curved to geniculate, sometimes laterally compressed, distally undivided or bilobed with 1–2 stigmatic areas. Fruits capsules, sometimes dry and indehiscent, and occasionally winged (samaras), drupes or berries. Seeds glabrous or hairy, those of capsules and some berries often crowned

by a  $\pm$  prominent exostome aril (caruncle), or possessing other types of arillar outgrowths.

A cosmopolitan family of 21 genera and 800–1,000 species having its centre of diversity in tropical and subtropical areas.

**VEGETATIVE MORPHOLOGY.** Polygalaceae show a wide variety of life-forms, comprising annual and perennial herbs, subshrubs, shrubs, lianas and trees. The tallest trees may reach 50 m (*Xanthophyllum*), whereas lianas attain a length of up to 30 m (e.g. *Balgoya*). The longevity of perennials is poorly known, but two species of *Muraltia* are reported to obtain an age of more than 50 years whereas *Polygala bracteolata* lives for only 8 years (van Wilgen and Forsyth 1992). Some herbs are achlorophyllous and myco-heterotrophic (*Epirixanthes*). Hairs, if present, are simple and unicellular, or sometimes uniseriate in *Bredemeyera* and *Xanthophyllum* (Metcalf and Chalk 1950). Presence of verrucae on the hairs has been reported in *Balgoya*, *Monnina*, *Pteromononina* and *Securidaca* (Marques 1989, 1996; Verkerke 1991; Eriksen, unpubl. data). Anomalous growth of the stem is typical of Moutabeae and some Polygalaceae, especially among lianas. Polygalaceae are usually unarmed. However, spine-tipped branches are present in *Hualania*, *Muraltia*, *Securidaca*, *Bredemeyera microphylla*, several species of *Acanthocladus*, and in a few *Polygala*. In addition, *Moutabea* typically has short spines on the twigs.

The leaves are simple with an entire margin, sometimes needle-like, reduced to scales, or absent (e.g. *Hualania colletioides*). Venation is mostly brochidodromous. The insertion of the leaves is usually alternate, rarely opposite or verticillate (as in some *Polygala*). Stipules are absent but several genera are equipped with stalked or sessile glands (extrafloral nectaries) at the leaf and inflorescence nodes. These have in older literature incorrectly been referred to as stipules. Glands may also oc-

cur on various parts of the leaves (Weberling 1974; Eriksen 1993a).

**VEGETATIVE ANATOMY.** Wood and leaf anatomy of *Xanthophyllum* were described in detail by Bridgewater and Baas (1982) and Dickison (1973) respectively, and Styer (1977) examined Moutabeae. An account of the leaf anatomy in *Balgoya* was given by Baas (1991) and of the wood anatomy by Détienne (1991). Other records are extracted from Metcalfe and Chalk (1950). The vessels of the wood are predominantly solitary, 60–150 µm in diam., sometimes up to 500 µm in *Xanthophyllum*. The perforation plates are usually simple, transverse and slightly oblique, but rounded in Moutabeae. Tyloses can be found in Moutabeae and in some *Xanthophyllum*. Intervascular pitting is alternate in Moutabeae but rare in genera with solitary vessels. Rays are usually uniseriate, sometimes biseriate or multiseriate. In Polygaleae, wood parenchyma is mostly paratracheal whereas *Xanthophyllum* has apotracheal as well as paratracheal parenchyma. The axial parenchyma of Moutabeae has been variously described due to the irregular configuration of the wood caused by included phloem. In order to provide a consistent terminology, Styer (1977) divides the parenchyma into three groups: (1) diffuse and tangential apotracheal, (2) diffuse paratracheal with wings and (3) aliform (vasicentric) paratracheal. The last type is only found in small amounts. The fibres are equipped with distinctly bordered pits and are present in both radial and tangential walls. The pith contains both lignified and unlignified cells in which, in some species, stone cells have been recorded (Solereder 1908). Included phloem of the “concentric” type is present in climbers.

The mesophyll of leaves with a broad lamina is usually dorsiventral, although *Carpolobia* is known to have uniform tissue. Among narrow-leaved species, *Comesperma*, *Polygala* and some species of *Muraltia* have centric tissue whereas other species of *Muraltia* (those formerly assigned to *Nylandtia*) have uniform tissue. Cells on the abaxial side are often provided with knob-like papillae. The outer walls of the epidermal cells are occasionally strongly thickened. Lysigenous secretory ducts have been found in leaves and stems of several species of *Polygala* (Holm 1929). Stomata may be present on both the adaxial and the abaxial side, or be confined to the lower side. The stomata are usually paracytic or anomocytic, rarely anisocytic

(*Xanthophyllum*) or cyclocytic (*Balgoya*). Stomata are absent in the achlorophyllous genus *Epirixanthes*. The nodal anatomy of *Xanthophyllum* is unilacunar with a broad trace departing from the cauline stele (Dickison 1973). Sieve-tube plastids of the S type have been recorded in Polygalaceae (Behnke 1981).

**INFLORESCENCE STRUCTURE.** The inflorescences may be axillary or terminal. They are usually racemose (Saint-Hilaire and Moquin-Tandon 1828), a character shared with Fabaceae (Prenner 2004). The pedicels may be very short, making the raceme spike-like. In *Bredemeyera* and *Barnhartia*, the inflorescences are usually branched and form panicles. Panicles also occur in *Polygala*, *Xantho-*

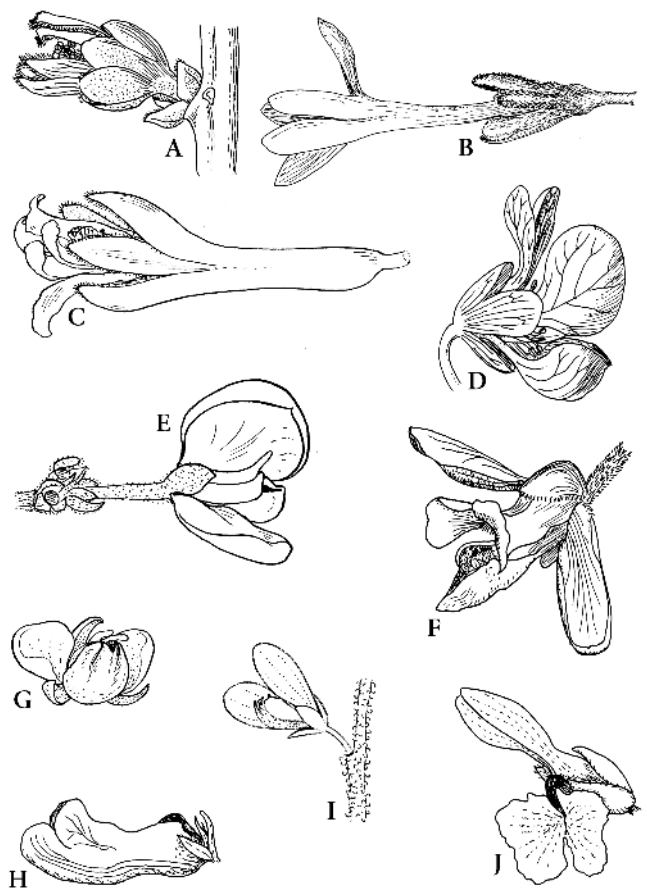


Fig. 125. Polygalaceae, flowers. A *Xanthophyllum papuanum*  $\times 4$ . B *Diclidanthera penduliflora*  $\times 3$ . C *Moutabea aculeata*  $\times 4$ . D *Xanthophyllum ramiflorum*  $\times 4$ . E *Acanthocladus guayaquilensis*  $\times 4$ . F *Bredemeyera floribunda*  $\times 4$ . G *Monnina reticulata*  $\times 4$ . H *Salomonina cantoniensis*  $\times 17$ . I *Polygala boliviensis*  $\times 6$ . J *Muraltia heisteria*  $\times 4$ . (A, D Eriksen, redrawn from van der Meijden 1982; C, E, G, I from Tind in Eriksen et al. 2000; B, F, H, J orig. Eriksen)