
Turneraceae

Turneraceae Kunth ex DC., Prodr. 3:345 (1828), nom. cons.

M.M. ARBO

Herbs, shrubs or rarely trees, erect or decumbent, frequently with serial axillary buds; hairs usually present, simple in most genera, sometimes stellate, forward directed-stellate in *Piriqueta*, often glandular. Leaves alternate, simple, entire, crenate or toothed, sometimes pinnatifid or revolute-ericoid, rarely very narrow, sessile or petiolate, pinnately veined, sometimes glandular-punctate, often with extrafloral nectaries; stipules usually small or 0, well-developed in *Erblichia* and some *Turnera*. Flowers mostly solitary, occasionally epiphyllous, sometimes in monochasial or dichasial inflorescences or in capitula or racemes. Flowers homostylous or heterostylous, regular, perfect, tetracyclic, generally upright, the pedicels provided with 2 prophylls; sepals 5, frequently connate, lobes quincuncial; petals 5, unguiculate, contorted, sometimes ligulate, free or the claw adnate to the calyx and then forming a 10- to pluriveined, cylindric, campanulate or funnel-shaped floral tube, the floral tube sometimes with fringed corona or 5 glands or lobes between corona and androecium; stamens 5, antepetalous, sometimes exserted, the filaments free or partially adnate to the calyx or floral tube; anthers tetrasporangiate, commonly dorsifixed but nearly basifixed in *Erblichia* and *Turnera* series *Turnera*, dehiscing longitudinally; gynoecium 3-carpellate, ovary superior or slightly half-inferior, 1-locular; ovules anatropous, crassinucellate, 1-numerous on parietal placentae, rarely (*Stapfiella*) 1 basal ovule; stylodia 3, distinct, filiform, connivent or divergent at the base; stigmas generally brush-like. Fruits 3-valved loculicidal capsules, sometimes dressed with the persistent torn perianth, dehiscence generally from apex. Seeds 1-many, obovoid, straight or curved; seed coat crustaceous and dark brown or blackish when ripe; aril plump, membranous when dry; endosperm fleshy; embryo straight.

A family of ten genera and about 200 species, distributed from North to South America and in Africa, including Madagascar and the Mascarene Islands.

VEGETATIVE ANATOMY. The indumentum is made up of simple, stellate and glandular hairs. The simple hairs are unicellular in *Erblichia*, *Mathurina*, *Stapfiella* and most *Turnera*, usually with thick walls, sometimes with ornamented cuticle. There are also microhairs in some species of *Turnera* (Arbo 2004), simple multicellular hairs in *Hyalocalyx*, *Streptopetalum*, *Tricliceras* (Berger 1919) and in some species of *Piriqueta*, *Turnera* and *Erblichia* (in the latter, they are restricted to leaf axils). The stellate hairs are multicellular, tufted in *Adenaea* and a few *Turnera*, with a bulging foot in *Loewia* and some *Piriqueta*. The glandular hairs are stipitate-capitate in *Turnera* series *Papilliferae* and sessile-capitate in most *Turnera* series *Annulares*, *Microphyllae* and some *Leiocarpae*; microcapitate hairs are frequent in *Piriqueta* and several series of *Turnera*; clavate hairs are found in some species of *Piriqueta* and *Turnera* series *Turnera*; *Piriqueta*, *Stapfiella*, *Streptopetalum*, *Tricliceras* and *Turnera collotracha* have setiform glandular emergences/hairs with distinct swollen basis and very small head (Gonzalez and Arbo 2004).

Leaf epidermis is uniseriate; in surface view, the cells may be polygonal or irregular with undulating walls, frequently containing tannins in *Erblichia*, *Piriqueta* and *Turnera*; stomata are often present on both surfaces or sometimes confined to the abaxial surface (*Mathurina*, *Turnera* spp.), and are anomocytic in *Piriqueta* and *Turnera*, paracytic in *Streptopetalum* and *Tricliceras*, and sometimes anisocytic. Mucilage cells are occasionally present. The mesophyll is generally dorsiventral, often with druses, isobilateral in some species of *Turnera* and *Streptopetalum*. Sieve-element plastids belong to the Ss type, containing only starch (Behnke 1991).

The extrafloral nectaries are localised at the margins of the petiole or blade basis or, more rarely, on the lower leaf surface; they are discoid or cup-shaped and vascularized. The secretory tissue

is a glandular parenchyma covered by a biseriate palisade epidermis; nectar secretion is transcuticular; in *Turnera* series *Turnera*, there is a secretory device which externally looks like a pore (Gonzalez 1996).

Colleters are common; four types are recognized in *Turnera* and *Piriqueta*, based on their morphology (Gonzalez 1998). The glands along the margin of *Adenaea* petals seemingly are colleters.

The primary stem is usually pilose and circular in cross section, exceptionally it is costate (*Turnera trigona*). The cortex consists of collenchyma, parenchyma, and sometimes fibre strands; its width varies considerably. The vascular bundles are collateral, open, and the interfascicular parenchyma is usually very narrow. The phloem strands usually have fibre caps, the sieve tubes have simple plates. The vessels are small, their perforations mostly simple. Sometimes there are vascular bundles in the cortex, leaf traces running upwards through the cortex. The pith is generally parenchymatous, sometimes containing sclereids. Crystals and tannin cells occur frequently, especially in the cortex and pith. Secondary growth develops from an annular vascular cambium, the cork cambium being more or less superficial (Berger 1919; Gonzalez 2000).

Wood structure is known only in *Erblichia*, *Piriqueta* and *Turnera*. The vessels are very small to medium-sized, solitary or in 2–6-multiples, with spiral thickening or pitted and simple perforations. Parenchyma is apotracheal, sometimes scanty. Rays are heterogeneous and abundant. Libriform fibres have thick walls and minute bordered pits. Occasionally, crystals and starch grains are seen in parenchyma cells (Record and Hess 1943; Gonzalez 2000).

INFLORESCENCES AND FLOWERS. Inflorescences are axillary or terminal; they are cymose in *Stapfiella*, *Streptopetalum*, *Tricliceras* and some species of *Piriqueta* and *Turnera* series *Salicifoliae*, and racemose in *Turnera* series *Anomala*, *Capitatae* and some species of *Leiocarpae*; solitary flowers occur in *Adenaea*, *Erblichia*, *Hyalocalyx*, *Loewia*, *Mathurina* and most species of *Piriqueta* and *Turnera*. Epiphyllous flowers are found in *Turnera* series *Turnera* and *Leiocarpae*.

The flowers are ephemeral and frequently showy. The sepals are nearly free in *Erblichia* and *Mathurina*, but connate into a tube in all other genera. The petals are clawed; the blade is yellow, sometimes red, orange, pink or white, now and

then with a basal purple spot, ligulate in *Tricliceras*. They are free in *Erblichia* and *Mathurina*, whereas the claw is adnate to the calyx and forms a short or lengthy floral tube in the other genera. In *Hyalocalyx*, the main bundles of the petals are connected with the lateral ones of the sepals. A corona is variously present, free in *Mathurina* and *Erblichia*, narrow, fringed and attached to the floral tube at the throat in *Piriqueta* (Fig. 161C). The staminal filaments are inserted at the base of the calyx or floral tube (*Adenaea*, *Erblichia*, *Hyalocalyx*, *Piriqueta*, *Tricliceras* and several series of *Turnera*: flowers hypogynous), or the filaments are adnate to the floral tube (*Turnera* series *Turnera* and *Anomala*: flowers perigynous). These latter taxa have five nectariferous pockets, or the nectaries may be borne on the sepals (*Mathurina* and *Stapfiella*), on the floral tube (*Streptopetalum*, *Tricliceras*, *Piriqueta* and *Turnera*) or on the staminal filaments (*Turnera*).

FLORAL ANATOMY. A detailed study of the floral anatomy of *Piriqueta* and *Turnera* has been undertaken by Gonzalez (1993, 2000, 2001). The lateral bundles of the sepal lobes branch off the main bundles of the petals. There are also distinctive, common sepal-stamen traces. The corona of *Piriqueta* and the ligule on the petals of some species of *Turnera* are of similar structure, lacking vascularization. The glandular tissue of the nectaries includes the epidermis and the underlying parenchyma; nectar is secreted through anomocytic stomata. The anther wall is made up of epidermis, endothecium, middle layers and glandular tapetum. The gynoecium has a transmission tissue on the inner surface of the ovary and placentae, ascending within the stylodia and on the smooth stigmata.

REPRODUCTIVE SYSTEMS. Most species bloom in the morning and the flowers survive only a few hours. *Adenaea*, *Erblichia* and *Mathurina* are homostylous, the other genera mainly heterostylous. Most species have long- and short-styled flowers but some, for instance, *Piriqueta morongii*, *Turnera macrophylla*, *T. sidoides*, have long-, short- and homostylous flowers. Usually, homostyly is linked with self-compatibility and heterostyly with self-incompatibility (Shore and Barrett 1985).

Some species of *Loewia*, *Streptopetalum* and *Tricliceras*, besides being heterostylous, have three long and two short stamens in the one flower, and sometimes in *Streptopetalum* there are stylodia of different length. Unfortunately, there is no information about compatibility in these genera.