Griseliniaceae

Griseliniaceae Takh., Sist. Magnol. 209 (1987).

M.O. Dillon

Evergreen, dioecious trees, erect shrubs or trailing or vining, New Zealand species are epiphytes or hemi-epiphytes, aerial roots enlarging upon contact with the ground; stems erect to scandent or climbing, glabrous to hispidulose, rarely winged. Leaves simple, evergreen, entire to dentate or dentate-spinose, alternate and distichous or subopposite; subsessile or petiolate; petioles rugulose, glabrous or hispidulose, exstipulate, the bases dilated and subsheathing; blades coriaceous, basally oblique to equal, apically rounded to acuminate, abaxial surface penninerved or prominently 3–5-nerved from near the base, reticulate, minutely pellucid-punctate, adaxial surface smooth, drying rugulose, nitid, margins revolute or plane, strictly entire to dentate or spinose, occasionally subentire with only the apex minutely 2–3-fid. Inflorescences racemose to paniculate, terminal or axillary, subglabrous to hispidulose or glandular, drying nigrescent; bracts and bracteoles caducous. Flowers unisexual, actinomorphic, 5-merous; sepals free, valvate, squamellate, margins ciliolate to glabrous, occasionally caducous; petals 5, free, occasionally absent, subimbricate, oblong to ovate, reflexed to patent at anthesis, caducous, margins ciliolate to glabrous; stamens 5, antisepalous, filaments erect, attached outside of lobulate epigynous disc, ovary remnants obscure; anthers dithecate, tetrasporangiate, dorsifixed, dehiscence longitudinal; staminodia sometimes present in female flowers; gynoecium 3-carpellate, syncarpous, ovary inferior, trilocular in upper part, unilocular in lower part; styles 2 to 3 or rarely 4, simple, terminal, free to connate basally, persistent, subulate, divergent or recurved, placentation apical, one pendulous ovule, anatropous. Fruit 1-locular, fleshy, baccate or coriaceous, drupaceous, oval to oblong, glabrous to hispidulose-puberulent; 1-seeded. Seeds with copious endosperm; embryo minute, straight; $n = 18$.

One genus with seven spp., trans-Pacific disjunct (Argentina, Brazil, Chile, New Zealand).

Vegetative Morphology and Anatomy. All members of the family are woody, ranging from small trees or large shrubs reaching a maximum height of 10–20 m to shrubs seldom over 2 m. The growth habit is typically erect and self-supporting, but epiphytic, hemi-epiphytic, and climbing habits have been recorded (Dawson 1966). Leaves are evergreen, leathery and often shining. Stomata are generally confined to the abaxial surface of the leaves and encyclocytic. Mucilage is generated as epistomatal plugs in New Zealand species, but are absent in the one South American species investigated (Westhoff et al. 2009). An adaxial hypodermis is present, the mesophyll contains sclerenchymatous idioblasts, and minor leaf veins are without phloem transfer cells. Secretory cavities are absent, a cork cambium is present, nodes are tri-lacunar or multi-lacunar. Secondary thickening develops from a conventional cambial ring, the xylem contains vessels with horizontal, scalariform end-walls, fibers with bordered pits, and the wood parenchyma is apotracheal (Li and Chao 1954; Noshiro and Baas 1998). The effect of vesicular-arbuscular mycorrhizas on the growth of *Griselinia littoralis* has been investigated and shown to increase branching in the root system (Baylis 1958).

Inflorescences. The flowers are arranged in open, racemose to paniculate inflorescences which are borne either terminally or axillary on branchlets. The peduncles are typically subglabrous to hispidulose or glandular, nigrescent; bracts and bracteoles are caducous.

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Floral Morphology and Anatomy. Flowers are dimorphic, minute, rarely more than 5 mm in diameter. The staminate flowers have a campanulate hypanthium and are always petaliferous; ovary remnants obscure; epigynous disc nitid and producing nectar. The petals are yellow to greenish-yellow, reflexed at anthesis, and quickly caducous. Anthers are opposite the sepals and alternating with the petals. The pistillate flowers also have a hypanthium and in a few species do not have petals (*G. lucida*). Rudiments of a single whorl of stamens (staminodia) are found in the female flowers of New Zealand species (*G. littoralis* and *G. lucida*). The epigynous disc is not unlike that found in Araliaceae and trans-sepal bundles are present in the ovary (Eyde 1964). Nectar production has not been recorded. Ovary of three carpels (Kubitzki 1963), trilocular in upper part, unilocular in lower part, with 1 pendulous, anatropous ovule.

Embryology. Ovule morphology has only been investigated in one species and the ovules were found to be unitegmic and crassinucellate (Philipson 1977).

Pollen Morphology. Pollen shed as single grains. Pollen grains are 3-aperturate; colporate, ellipsoidal, and with a complete tectum with striate surface (Ferguson and Hideux 1978; Tseng 1980). Images of *Griselinia* pollen are available at Australian Pollen and Spore Atlas (APSA 2007).

Karyology. Only one reported chromosome count of $n = 18$ exists for the family (Federov 1969).

Reproductive Systems and Pollination. All members of the family are dioecious. The gynoecium of staminate flowers is obscure, but rarely rudimentary stamens are found in the pistillate flowers. *Griselinia littoralis* is reported to be wind-pollinated; however, insect pollination probably is the most common mode of pollination when nectar is present (Percival 1961).

Fruit, Seed, Dispersal. The presence of small (<10 mm long, 5 mm in diameter), fleshy, red to purple fruits may suggest some type of animal mediated dispersal (Takhtajan 2000). Testa probably many-layered, outer two (and esp. third) layers with thickened walls.

Phytochemistry. Jensen and Nielsen (1980) investigated five *Griselinia* species and isolated the iridoid glucoside, griselinoside, from *G. littoralis*, *G. lucida*, *G. ruscifolia*, and confirmed that iridoids are elaborated in both New Zealand and South American species. The occurrence of griselinoside in *Aralidium*, *Torricellia* and *Griselinia* suggests affinities; however, the same compound was also isolated from *Verbena* (Damtoft et al. 1983). Reports indicate that the family is not cyanogenic and lacks proanthocyanidins and ellagic acid (Watson and Dallwitz 1992). Petroselinic acid has been isolated and is present as a major component in many species of Apiaceae and Araliaceae (Breuer et al. 1987).

Systematics and Affinities. The family is monogeneric with the seven species of *Griselinia*. The history of familial placement has been complex. Early accounts suggested placement in families such as Euphorbiaceae and Juglandaceae (see Taubert 1892). Endlicher (1850) placed *Griselinia* in the Araliaceae and Hooker (1867) was the first to position it as a member of the Cornaceae. Taubert (1892) accepted the placement in the Cornaceae and established two sections, *Decostea* Taub. and *Griselinia* ("*Eugriselinia*" Taub.). Wangerin (1910) in his treatment of the Cornaceae placed *Griselinia* in tribe Griselinieae Wangerin where it was grouped with *Melanophylla*. Philipson (1967) was the first worker to question the placement of *Griselinia* in the Cornaceae, contending that it shared many features with the Araliaceae and Escalloniaceae, and differed from the Cornaceae by the alternate arrangement of the leaves, nodal anatomy, the presence of a hypodermis below the upper epidermis of leaves, encyclocytic stomata, the presence of spiral thickenings in both vessels and fibers, imbricate petals, free or only shortly connate stylodia, a usually 1-locular ovary, and baccate fruits. Takhtajan (1980) treated *Griselinia* as a monogeneric family and allied it with *Garrya* (Garryaceae). Takhtajan (1987) proposed the valid familial name, since Cunningham's (1791–1839) published name for the father and son team of Johann Reinhold Forster (1729–1798) and Johann Georg Adam Forster (1754–1794) in the Annuals of Natural History was a typographic error (Earp 2013). Earp (2014) has submitted a proposal to conserve the generic name. Takhtajan (1997) established the order Griseliniales for the family, while

Thorne (1968), Dahlgren (1980), and Cronquist (1981) considered it an anomalous member of the Cornaceae. Thorne (1992, 2001) placed it as a monogeneric family with relationships outside of the Cornales. Eyde (1987) also recognized that *Griselinia* was misplaced in the Cornaceae and suggested familial rank.

Xiang et al. (1993) and Xiang and Soltis (1998) examined *rbc*L sequence data and suggested *Griselinia* be removed from the Cornaceae and grouped it with *Aralidium* and *Torricellia* (both Torricelliaceae) and more distantly with *Aralia* (Araliaceae), *Pittosporum* (Pittosporaceae), and *Sanicula* (Apiaceae). Plunkett et al. (1996) also examined *rbc*L sequences and confirmed that the Apiales form a monophyletic group with Pittosporaceae along with *Griselinia*, *Melanophylla* (Malagasy endemic), *Torricellia* (E. Himalayas to W. China) and *Aralidium* (W. Malaysia). Plunkett (2001) and Lundberg (2001) both suggested that Torricelliaceae and Griseliniaceae are successive clades near the base of Apiales (Soltis et al. 2011).

Clokie (2001) investigated infrageneric relationships with an array of molecular markers (*rpo*A, *trn*L-F, *trn*H-K and ITS) and confirmed the monophyly of the genus. Her phylogenetic results suggested that the present-day distribution of *Griselinia* represents a dispersal event from New Zealand to South America, a view shared by Dillon and Muñoz-Schick (1993) based on comparative morphology. Clokie (2001) placed the timing of a putative dispersal at ca. 52 million years ago, after the estimated 95–80 million years ago for the physical separation of South America from Australasia. Nicolas and Plunkett (2014) have dated the crown-group in the Griseliniaceae at around 12.1 m.y.o.

PALAEOBOTANY. The first appearance of pollen in the fossil record is from New Zealand in the Miocene (Mildenhall 1980).

DISTRIBUTION AND HABITATS. The family has a trans-Pacific disjunct distribution between austral South America and New Zealand. All the South American species are confined to Chile and adjacent Argentina (Prov. Chubut) with an additional disjunction to south and southeastern Brazil, including the states of Minas Gerais, Paraná, Rio Grande do Sul, Rio de Janeiro, São Paulo, and Santa Catarina. The local environments vary greatly, from mesic, evergreen rain forest environments of austral Chile (sea level–1300 m) to dry coastal quebradas of the Atacama Desert in northern Chile (400 m). Southern Brazilian populations are found in *Araucaria* forests and range north to remnants of the Atlantic coastal forest (400–2700 m). The New Zealand species are distributed from near-ocean sites to montane forests of North and South Islands. One species, *G. littoralis*, is introduced in Australia as an ornamental and naturalized in Tasmania (Baker 2009).

Only one genus:

1. ***Griselinia*** G. Forst. Fig. 76

Griselinia G. Forst., Fl. Ins. Austr.: 75 (1786), nom. cons., non Scop. (1777).
Decostea Ruiz & Pav., Fl. Peruv. Prodr.: 130 (1794).
Pukateria Raoul, Ann. Sci. Nat., Bot. III, 2: 120 (1844).

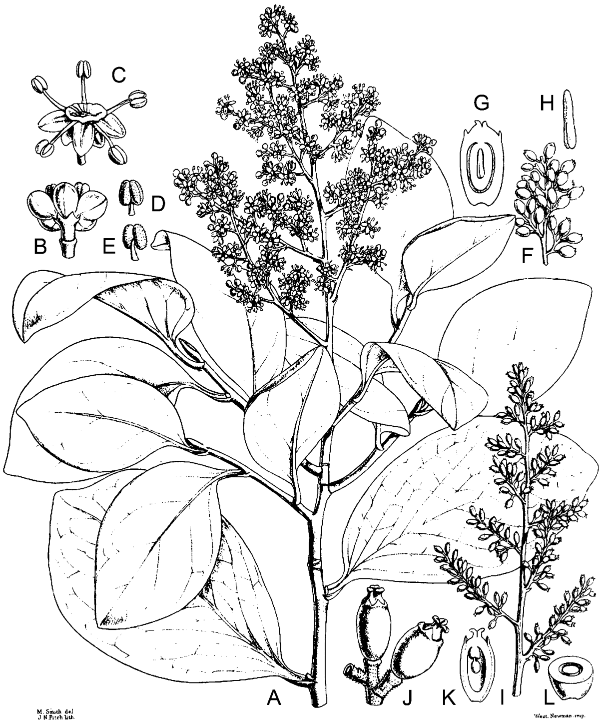

Fig. 76. Griseliniaceae. *Griselinia lucida*. **A** Flowering male branch. **B** Male flower-bud. **C** Fully expanded male flower. **D** Anther ventral view. **E** Anther dorsal view. **F** Fruiting female branchlet. **G** Longitudinal section of fruit. **H** Embryo. **I** Flowering female inflorescence. **J** Female flowers. **K** Section of ovary showing the pendulous ovule. **L** Transverse section of ovary. (Cheeseman 1914; drawn by Matilda Smith)

Description as for family.

Seven species with a trans-Pacific disjunct distribution between New Zealand (two spp.) and Chile (five spp.); two species also in Argentina (Prov. Chubut); one variety of a Chilean species disjunct in southern and southeastern Brazil. Dillon and Muñoz-Schick (1993) monographed *Griselinia*, considering Griseliniaceae a monogeneric family and described a new northern Chilean desert species.

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