

JOURNAL of the ADELAIDE BOTANIC GARDENS

AN OPEN ACCESS JOURNAL FOR AUSTRALIAN SYSTEMATIC BOTANY

flora.sa.gov.au/jabg

Published by the

STATE HERBARIUM OF SOUTH AUSTRALIA

on behalf of the

BOARD OF THE BOTANIC GARDENS AND STATE HERBARIUM

© Board of the Botanic Gardens and State Herbarium,
Adelaide, South Australia

© Department of Environment, Water and Natural Resources,
Government of South Australia

All rights reserved

State Herbarium of South Australia
PO Box 2732
Kent Town SA 5071
Australia



Board of the
Botanic Gardens and
State Herbarium



A TAXONOMIC REVISION OF THE GENUS *PHYLA* LOUR. (VERBENACEAE)* IN AUSTRALIA

Ahmad Abid Munir

State Herbarium, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

Abstract

A taxonomic revision of the genus *Phyla* in Australia is presented. The following two species are recognised: *P. nodiflora*, and *P. canescens* which is recorded from Australia for the first time. Affinities and distribution are considered for the genus and each species. A key to the species is provided and a detailed description of each is supplemented by a habit sketch of a flowering branch and analytical drawings of the flowers.

Taxonomic history of the genus

The genus *Phyla* was proposed by Loureiro (1790) with one species, *P. chinensis*, the type of which came from Cochinchina. It was placed in "Tetrandria Monogynia" where it was retained by Roemer & Schultes (1818), Sprengel (1825) and Dietrich (1839). With the exception of Loureiro (1790), all the above named authors referred this genus to the family Proteaceae. In 1805, Jaum Saint-Hilaire proposed the family Primulaceae for *Phyla*, which was later accepted for the genus by Hedwig (1806) and Reichenbach (1828). Endlicher (1840) recorded this genus in the appendix of his "Genera Plantarum" under "Genera dubiae sedis et non satis nota". Almost half a century later, Greene (1899) for the first time referred this genus to the family Verbenaceae and clearly distinguished between *Phyla* and *Lippia*. The entity of *Phyla* as a genus distinct from *Lippia* was accepted by Wootton & Standley (1915), Moldenke (1939, 1940, 1940a & thereafter), Burbidge (1963), Meikle (1963), Lopez-Palacio (1974, 1977), Munir (1983, 1986) and several others. Within Verbenaceae, the subfamily Verbenoideae, tribe Lantaneae was accepted for the genus by Moldenke (1959, 1971), Lopez-Palacio (1977), Munir (1983), Raj (1983) and a few others. Many botanists, however, have retained this genus in the Verbenaceae without reference to any subfamily or a tribe.

Prior to the above history of the genus, at least two *Phyla* species were described by Linnaeus (1753) as *Verbena*. Of these two species one each was later transferred by Michaux (1803) and Kunth (1818) to *Lippia*. Since then, most *Phyla* taxa have been widely recognised as *Lippia* species. In 1840, Meisner placed *Phyla* in the synonymy of *Lippia* and referred the latter to the tribe Lippieae in the Verbenaceae. The tribe Lippieae for the *Phyla-Lippia* assemblage was later accepted by Walpers (1845). The majority of other botanists also accepted *Phyla* as a synonym of *Lippia* but referred the *Phyla-Lippia* assemblage to different tribes. For instance, Dumortier (1829) divided the Verbenaceae into two tribes Verbeneae and Viticeae with *Lippia* (s.l.) under the tribe Verbeneae. This tribe was accepted for *Lippia* s.l. (or *Phyla-Lippia* assemblage) by Bentham (1839, 1870, 1876), Spach (1840), Schauer (1847), Miquel (1858), Thwaites (1864), Bailey (1883, 1901, 1913), C.B. Clarke (1885), Durand (1888), Post & Kuntze (1904), King & Gamble (1909), Ridley (1923), Gardner (1931), Lemée (1943) and several others. In 1895, Briquet re-classified the Verbenaceae and upgraded the tribe Verbeneae to a subfamily Verbenoideae. The latter consisted of six tribes with *Lippia* s.l. (including *Phyla*) in the tribe Lantaneae. This classification was adopted by Dalla Torre & Harms (1904), H.J. Lam (1919) and Junell (1934). The majority of botanists who accepted *Phyla* as a synonym of *Lippia* retained the latter in the Verbenaceae without reference to any subfamily or a tribe.

* The present treatment of the genus *Phyla* is the twelfth in the series of taxonomic revisions in the family Verbenaceae in Australia. (See Munir, 1982, 1984a, 1984b, 1985, 1987a, 1987b, 1989, 1990a, 1990b, 1991, 1992.)

Australian history of the genus

The first Australian records of *Phyla* as circumscribed here (then under the names *Lippia* or *Zapania*) were collected by Robert Brown during 1802 - 1805 from Shoalwater Bay, Queensland. Then more specimens were collected from the same State by F.W.L. Leichhardt during 1843, T.L. Mitchell during 1847, John McGillivray during 1848, Amalie Dietrich during 1863 - 1865, John O'Shanesy during 1867 and a few others. In 1859, Augustus Oldfield collected it from Port Gregory in Western Australia. The first written record of this genus in Australia was published by Robert Brown (1810) under the name *Zapania*, which is now a synonym of *Phyla*. Later, F. Mueller (1868, 1875, 1882, 1889) recorded it as *Lippia* which name was later accepted for the genus in Australia by Bentham (1870, 1876), Bailey (1883, 1901, 1913) and others. In 1917, Ewart & Davies for the first time recorded *Lippia nodiflora* (now *Phyla nodiflora*) from the Northern Territory. This record was based on one of F. Mueller's (s.n.) collections from Victoria River gathered during the second half of the 19th century. In 1930, Ewart for the first time recorded this genus from Victoria. It was based on one of Tovey's (s.n.) collections from Williamstown acquired in January 1914. The first record of *Phyla* (then called *Lippia*) from South Australia was published by J.M. Black in his Flora of South Australia in 1929. It was based on one of J.M. Black's (s.n.) collections from the banks of Torrens Lake gathered on 5th January 1929. Since then many more records of this genus have become available from all mainland states in Australia.

In 1870, Bentham published a complete account of the Australian Verbenaceae, and listed two *Lippia* (s.l.) species namely *L. nodiflora* and *L. geminata*. Of these two species, the former belongs to the genus *Phyla* and the latter to *Lippia* (s.str.). Later, Moldenke (1959, 1971, 1980) recorded from Australia only one species, *Phyla nodiflora* with two varieties viz. var. *longifolia* Mold. from Queensland and New South Wales and var. *reptans* (Kunth.)Mold. from the Northern Territory. So far, all regional or mainland state floras in Australia have recorded only one *Phyla* species, *P. nodiflora*. In the present revision of *Phyla* in Australia, the following two species are recognised: *P. nodiflora* and *P. canescens*. *P. nodiflora* var. *longifolia* is found to be a long-leaved form of the typical variety, and the occurrence of *P. nodiflora* var. *reptans* in Australia has not been confirmed.

Chromosome numbers

The majority of available chromosome counts are reported from *P. nodiflora* of which the known count ($2n = 36$) was based on material from outside Australia. This count was first reported by Covas & Schnack (1946) and subsequently reconfirmed and/or recorded by Darlington & Wylie (1955), Sharma (1970), Fedorov (1974), Bir & Sidhu (1980), Navaneetham et al. (1982), Sidhu & Bir (1983) and others. According to Choudhary & Roy (1983), however, "the somatic complement in root tip of *P. nodiflora* showed thirty two chromosome" i.e. $2n = 32$. Apparently, this count has not been confirmed. Besides *P. nodiflora*, Fedorov (1974) has given chromosome counts of an additional 3 *Phyla* species each with $2n = 36$ chromosomes. The chromosome number $2n = 36$ in the genus *Phyla*, therefore, seems to be generally consistent as contrasted with *Clerodendrum* L. where the counts show a wide range of chromosome numbers from 24 to 184.

PHYLA Lour.

Phyla Lour., Fl. Cochinch. edn 1 (1790) 66; J. St. Hil., Expos. Fam. Natural. 1 (1805) 223; Hedwig f., Gen. Pl. (1806) 366; Roemer & Schultes, Syst. Veg. III (1818) 28, 447, n. 562; Sprengel, Syst. Veg. 1 (1825) 487; Reichb., Consp. Reg. Veg. (1828) 82, n. 1770; D. Dietr., Synop. Pl. 1 (1839) 424, 540; Endl., Gen. Pl. 2 (1840) 1330, n. 6871; Steudel, Nomencl. Bot. 2 (1841) 325; L. Pfeiffer, Nomencl. Bot. 2 (1874) 690; E. Greene, Pittonia 4 (1899) 45; Wootton & Standley, Fl. New Mexico Contr. U.S. Natl. Herb. 19 (1915) 550; Mold., Lilloa 4 (1939) 295;

Mold., Bot. Maya. Publ. Carnegie Inst. Wash. No. 522 (1940) 169; Mold. in Pulle (ed.), Fl. Suriname (1940) 270; A.D.J. Meeuse, Blumea 5 (1942) 69; Mold. in Humbert, Fl. Madagascar (1956) 3, 12; Résumé, Verbenac. etc. (1959) 237, 276, 309, 329, 335, 393, 406; Burb., Dic. Aust. Pl. Gen. (1963) 230; Meikle in Hepper (ed.), Fl. W. Trop. Afr. edn 2, 2 (1963) 435; Backer & Bakh.f., Fl. Java 2 (1965) 597; Mold. in Wiggins & D. Porter, Fl. Galáp. Isl. (1971) 494; Mold., Fifth Summary Verbenac. etc. 1 & 2 (1971) 396, 397, 472, 476, 527, 548, 593, 602, 603, 735, 737, 753; Mold., Ann. Missouri Bot. Gard. 60 (1973) 59; Jafri & Ghafoor, Fl. W. Pak. No. 77 (1974) 10; Lopéz-Pal., Revista Fac. Farm. Univ. Los Andes Merida No. 15 (1974) 70; Lopéz-Pal., Fl. Venezuela (1977) 481; Mold., Phyt. Mém. II, Sixth Summary Verbenac. etc. (1980) 375, 395, 419, 462, 463; Baines, Aust. Pl. Gen. (1981) 283; Blackall & Grieve, W. Aust. Wildfl., edn 2, IIIB (1981) 394; S.W.L. Jacobs & Pickard, Pl. N.S.W. (1981) 209; Beadle et al., Fl. Syd. Reg. edn 3 (1982) 508; Mold. in Dassan. & Fosb., Fl. Ceylon 4 (1983) 235; Munir in Morley & Toelken, Fl. Pl. Aust. (1983) 288; Raj, Rev. Palaeobot. Palynol. 39 (1983) 363, 377, t. VI, 1 - 4; Beadle, Student's Fl. NE N.S.W., Part 5 (1984) 850; Munir in Jessop & Toelken (eds), Fl. S. Aust. Part III (1986) 1175; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 366; Rimpl. & Sauerb., Chem. Syst. & Ecol. 14, no. 3 (1986) 307 - 309; Mabb., Pl. Book (1987) 449; Rye in N.G. Marchant et al., Fl. Perth Reg., Part 1 (1987) 551; Sykes in Webb et al., Fl. N.Z. 4 (1988) 1275.

Type species: P. chinensis Lour., Fl. Cochinch. edn 1 (1790) 66.

Platonia Raf., Med. Repos. 5 (1808) 352 [not Raf. 1810, nor *Platonia* Kunth 1829, nor Mart. 1829]—*fide* Moldenke (1983).

Type species: P. nodiflora (L.)Raf.

Diotheca Raf., Fl. Ludov. (1817) 74—*fide* Moldenke (1983).

Type species: D. repens Raf., loc. cit. (1817) 75.

Bertolonia Raf., Amer. Month. Mag. & Crit. Rev. 2 (1818) 267 [not *Bertolonia* DC. 1812, nor Moc. & Sessé 1825, nor Raddi 1820, nor Spinola 1809, nor Sprengel 1821]—*fide* Moldenke (1983).

Type species: ?B. crassifolia Raf.

Panope Raf., Fl. Tellur. 2 (1837) 103—*fide* Moldenke (1983).

Type: P. stoechadifolia (L.)Raf.

Piarimula Raf., Fl. Tellur. 2 (1837) 102—*fide* Moldenke (1983). Proposed as a substitute name for *Phyla* Lour.

Type: P. chinensis (Lour.)Raf.

Cryptocalyx Benth., Ann. Nat. Hist., Ser. 1, 2 (1839) 446; J. Bot. (Hooker) 2 (1840) 52; Endl., Gen. Pl. 2, Suppl. 1 (1841) 1401; Meisn., Pl. Vasc. Gen. part 2, "Commentarius" (1843) 366; Walp., Repert. Bot. Syst. 4 (1845) 57—*fide* Moldenke (1983).

Type: C. nepetaefolia Benth.

Lippia auct. non L.: sensu Michaux, Fl. Bor. Amer. 2 (1803) 15; Sprengel, Syst. Veg. 2 (1825) 751, p.p.; Reichb., Reg. Veg. (1828) 117, p.p.; Dumort., Anal. Fam. Pl. (1829) 22, p.p.; Endl., Gen. Pl. 1 (1836) 633, n. 3684, p.p.; Benth., Ann. Nat. Hist. 2 (1839) 445, p.p.; Meisner, Pl. Vasc. Gen. Vol. 1, "Tab. Diag." (1840) 290, p.p.; Vol. 2, "Commentarius" (1840) 199, p.p.; Spach, Hist. Nat. Veg. Phan. 9 (1840) 227, p.p.; Steudel, Nomencl. Bot. 2 (1841) 54, p.p.; Walp., Repert. Bot. Syst. 4 (1845) 42, p.p.; Schauer in A. DC., Prod. 11 (1847) 572, p.p.; Miq., Fl. Ind. Bat. 2 (1856) 905, p.p.; Thwaites, Enum. Pl. Zeylan. (1861) 241, p.p.; Benth., Fl. Aust. 5 (1870) 34, p.p.; Baker, Fl. Mauritius & Seych. (1877) 252, p.p.; Benth. in Benth. & Hook.f., Gen. Pl. 2 (1876) 1142, p.p.; F. Muell., Syst. Cens. Aust. Pl. edn 1 (1882) 102, p.p.; Bailey, Synop. Qld Fl. (1883) 376, p.p.; C.B. Clarke, Fl. Brit. Ind. 4 (1885) 563, p.p.; Th. Durand, Gen. Phan. (1888) 320, p.p.; F. Muell., Sec. Syst. Cens. Aust. Pl. 1 (1889) 171, p.p.; Briq. in Engl. & Prantl, Pflanzenfam. 4, 3a (1895) 151, p.p.; Bailey, Qld Fl. 4 (1901) 1171, p.p.; Dalla Torre & Harms, Gen. Siphon. (1904) 430, n. 7145, p.p.; Post & Kuntze, Lexic. Gen. Phan. (1904) 334, 688, p.p.; King & Gamble, Mat. Fl. Mal. Penin. 4, J. Asia. Soc. Beng. 74 (1909) 797, p.p.; H.J. Lam, Verbenac. Malay. Archip. (1919) 15, p.p.; Ridley, Fl. Mal. Penin. 2 (1923) 612, p.p.; Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 141, p.p.; C. Gardner, Enum. Pl. Aust. Occ. part 2 (1930) 111, p.p.; Pei, Mem. Sci. Soc. China 1, No. 3 (1932) 10, p.p.; Junell, Symb. Bot. Upsal. 4 (1934) 31, p.p.; Lemée, Dic. Descrip. Syn. Gen. Phan. 8b (1943) 653, p.p.; J.F. Macbr., Fl. Peru (1960) 644, p.p.; Haines, Bot. Bihar & Orissa, repr. edn. 2 (1961) 740, p.p.; Prain, Beng. Pl., repr. edn. 2 (1963) 615, p.p.; Britton, Fl. Bermuda (1965) 311, p.p. excl. *L. triphylla* (L'Hér.)Kuntze; Gooding et al., Fl. Barbados (1965) 362, p.p.; T. Cooke, Fl. Pres. Bombay, repr. edn. 2 (1967) 499, p.p.; Gibson in Standley & Williams, Fl. Guatemala (1970) 206, p.p.; Adams, Fl. Pl. Jamaica (1972) 630, p.p.; Tutin in Tutin et al., Fl. Europ. 3 (1972) 123, p.p. excl. *L. triphylla* (L'Hér.)Kuntze; Howard, Fl. Lesser Antilles, Dicot. part 3 (1989) 232, p.p.

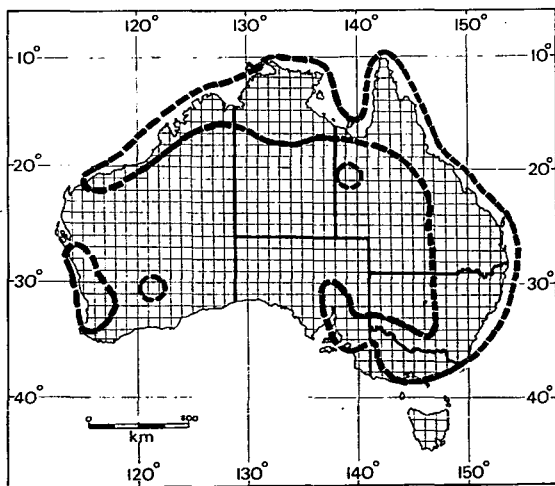
Perennial, usually procumbent or creeping herbs. *Stem* trailing or ascending, often rooting from the nodes, herbaceous, sometimes slightly woody at base, usually densely covered with appressed medifixed acute hairs. *Leaves* simple, decussate-opposite, often somewhat fleshy, serrate-dentate or sometimes almost entire, petiolate or sessile. *Inflorescence* spicate, axillary, pedunculate, usually at first capitate-globose, later ovoid to oblong-cylindrical, densely many-flowered. *Flowers* sessile, zygomorphic, bisexual, hypogynous, each in the axil of a single bract; bracts often closely imbricate, cuneate-obovate or flabelliform. *Calyx* persistent, membranous, ovoid-campanulate or compressed, with 2 keels or wings and 2-lobed, each lobe either entire or 2-toothed (*P. nodiflora*), or the rim 2- or 4-fid or 4-dentate (*P. canescens*). *Corolla* hypocrateriform; tube cylindrical or slightly dilated upwards, straight or slightly curved; lobes obliquely sub-bilabiate, spreading, 4 - 5-fid, upper lip entire to 2-lobed, lower lip 3-fid. *Stamens* 4, didynamous, included or scarcely exerted; filaments short; anthers without appendages. *Ovary* bicarpellary, syncarpous, 2-locular, with 1 ovule in each locule; style short; stigma oblique, thick. *Fruit* a schizocarp, enclosed in fruiting-calyx, ellipsoid, compressed, splitting at maturity into 2 plano-convex one-seeded mericarps. *Seeds* without endosperm.

Number of species: World \pm 11 species and several infraspecific taxa; Australia 2 species which were introduced and became naturalised.

Derivation of name

The generic name is derived from the Greek *Phylon*, meaning a tribe or race, also a swarm or school; probably in reference to the spreading mat-like growth of these species.

Distribution (Map 1)



Map 1. Distribution of genus *Phyla* in Australia

According to Moldenke (1940, 1973, 1983), Gibson (1970), Stanley (1986) and several other authors, the genus *Phyla* is widely distributed in "tropical" and "subtropical" America, with one or two species in the warmer parts of the Old World i.e. Asia and Africa. In Australia, however, it has also been recorded from the "temperate" areas.

So far only two naturalised species are found in the coastal and inland areas of mainland Australia. Of the two species, *P. nodiflora* is the most widespread in the whole genus and has been recorded from throughout the "tropics", "subtropics" as well as adjoining areas of both Eastern and Western Hemispheres. It is fairly widespread in Australia, but it does not occur in South Australia nor Victoria. The second species *P. canescens* is

widely distributed in "subtropical" and "temperate" South America, but has not been recorded from Malesia or anywhere in the Pacific Islands. Within Australia, *P. canescens* is not known to occur in the Northern Territory nor in the northern halves of Western Australia, South Australia and Queensland.

Comments

Moldenke (1959, 1971, 1980) recorded *P. nodiflora* var. *reptans* (Kunth) Mold. from Northern Territory. During the present study, however, only the typical var. *nodiflora* was found in the Northern Territory. In another publication, Moldenke (1973) states that some forms in the genus *Phyla* are widely cultivated for lawns or as soil-binders.

Rye (1987) quotes "about 30 species" in the genus *Phyla*. According to present investigations, however, there are about 11 species and nearly the same number of infraspecific taxa in the genus. Rye's figure of 30 species probably comprises species and subspecific entities.

According to Raj (1983), the pollen grains in the genus *Phyla* are "brevicolpate, prolate and elliptic in equatorial view (3:2)".

Phyla species are very variable and in order to clarify the variation found in the Australian species the range of variation of the shape of leaves and bracts is shown in Figure 3.

Affinities

Phyla is closely related to *Lippia* and *Lantana* in its inflorescence being spicate or subspicate during anthesis; flowers sessile, each subtended by a sessile bract; calyx small, thin-membranous, usually hidden by the subtending bracts; perfect stamens 4; anthers without appendage; fruit composed of 2 mericarps, mostly splitting at maturity, mericarps 1-celled and 1-seeded. Nevertheless, *Phyla* may easily be distinguished by its trailing branches rooting at the nodes and with medifixed hairs. In contrast, *Lippia* and *Lantana* are shrubs or subshrubs with simple hairs. *Phyla* can also be distinguished from *Lantana* by its calyx-rim being 2 - 4-cleft or conspicuously toothed and its fruit being small, dry, with a hard and thin or papery exocarp, separating into two 1-celled mericarps. In *Lantana*, the fruit is drupaceous with a fleshy and juicy exocarp and hard endocarp. *Phyla* and *Lippia* seem to be fairly close to each other, and for a long time have been treated by some botanists as one genus. In both genera, spikes are very dense during anthesis with imbricate flowers. However, *Lippia* can easily be identified by the characters listed above. Moreover, its spikes are not usually elongating in fruit; bracts mostly ovate or lanceolate, often more or less 4-ranked and hairs not medifixed.

In general appearance, *Phyla* is more like certain species of *Verbena* than any other genus, but this superficial similarity is deceptive. *Verbena* can easily be distinguished from *Phyla* by its stems not rooting at the nodes; spikes not densely congested during anthesis; calyx usually 5-angled, 5-ribbed, unequally 5-toothed; and fruit composed of four 1-seeded mericarps.

Greene (1899) was the first to delimit the genus *Phyla* clearly along the lines as explained above. He points out that the plant "known for a century or more before Linnaeus as *Verbena nodiflora*, was retained in the *Species Plantarum* under that name". He continues to describe *Phyla*'s affinities to *Lippia* and *Lantana* and delineates each of them to the detail that *Phyla* "is a small genus of more or less creeping perennial herbs" and has "a pubescence most characteristic, consisting of sessile forked [medifixed] hairs. This kind of pubescence occurs in several genera of the Cruciferae; but in the Verbenaceae it does not occur except in *Phyla*."

Key to the species

- 1a. Leaves non-canescens, with sharp antrorse teeth; mature spikes oblong; bracts subrhomboid to somewhat rotund; calyx lobed more than half its length; corolla usually white 1. *P. nodiflora*
- b. Leaves canescens, with blunt short teeth or almost entire, mature spikes ovoid-globose; bracts elliptic-ovate; calyx lobed not more than half its length; corolla usually lilac or pinkish 2. *P. canescens*

1. **Phyla nodiflora** (L.)E. Greene, *Pittonia* 4 (1899) 46; var. **nodiflora**.

Dop in Lecomte (ed.), *Fl. Gén. Indo-Chine* 4 (1935) 780; Mold., *Lilloa* 4 (1939) 296, 297; Mold., *Bot. Maya Area*, Publ. Carnegie Inst. Wash. No. 522 (1940) 171; A.D.J. Meeuse, *Blumea* 5 (1942) 69; Mold. in Humbert (ed.), *Fl. Madagascar* (1956) 13, fig. II, 1 - 3; E. Robertson in J. Black's *Fl. S. Aust.* edn 2, 4 (1957) 719; Specht in Specht & Mounford, *Rec. Amer. Aust. Sci. Exped. to Arnhem Land* 3 (1958) 289; Mold., *Résumé Verbenac. etc.* (1959) 195, 197, 199, 201, 204, 206, 464; Santapau, *Rec. Bot. Surv. Ind.* 16, 2nd edn (1960) 188; Meikle in Hutch. & Dalz., *Fl. W. Trop. Africa* 2, 2nd edn (1963) 437; Backer & Bakh.f., *Fl. Java* 2 (1965) 597; Mold., *Fifth Summary Verbenac. etc* 1 & 2 (1971) 314, 325, 330, 332, 337, 341, 342, 347, 367, 898; Chippendale, *Proc. Linn. Soc. New South Wales* 96 (1972) 256; Mold., *Ann. Missouri Bot. Gard.* 60 (1973) 63; Fed., *Chrom. Numb. Fl. Pl.*, repr. edn (1974) 216; Jafri & Ghafoor, *Fl. W. Pak.* No. 77 (1974) 11, fig. 2 C-E; Lopez-Pal., *Fl. Venezuela, Verbenaceae* (1977) 489, fig. 115; Lopez-Pal., *Revista Fac. Farm. Univ. Los Andes* No. 20 (1979) 30; Mold., *Phytologia Mém II, Sixth Summary Verbenac. etc* (1980) 286, 296, 308, 316, 321, 327, 332, 337, 340, 417, 421, 431, 452 - 454; Baines, *Aust. Pl. Gen.* (1981) 283; Blackall & Grieve, *W. Aust. Wildfls*, 2nd edn, part III B (1981) 394; G.M. Cunn. et al., *Pl. West. N.S.W.* (1981) 568; J. Green, *Cens. Vasc. Pl. W. Aust.* (1981) 89; N.G. Marchant & Perry, *W. Aust. Herb. Res. Notes* No. 5 (1981) 127; C.C. Towns., *Fl. Turkey* 7(1982)32; Beadle et al., *Fl. Syd. Reg.* 3rd edn (1982) 508; Mold. in Dassan. & Fosb., *Fl. Ceylon* 4 (1983) 236; Raj, *Rev. Palaeob. Palynol.* 39 (1983) 363, t. VI, 1 - 4; N. Beadle, *Student Fl. N.-E. N.S.W.*, part 5 (1984) 850; Peekel, *Fl. Bismarck Archip.* (1984) 474, fig. 757; Meikle, *Fl. Cyprus* 2(1985)1249; Stanley in Stanley & Ross, *Fl. S.E. Qld* 2 (1986) 367; Dunlop, *Checklist Vasc. Pl. N.T.* (1987) 80; Rye in N.G. Marchant et al. (eds), *Fl. Perth Region*, part 1 (1987) 551; Lazarides et al., *Checklist Fl. Kakadu Nat. Pk & Env. N.T.* (1988) 26; H. Keng, *Conc. Fl. Sing.* (1990) 192; Cantino, *J. Arn. Arb.* 71 (1990) 334, 339, 355 & 361; Jansen et al. (eds), *Pl. Resource S.E. A.* (1991) 135, 241; Rye et al., *Fl. Kimberley Reg.* (1992) 789, fig. 241A; Verdc., *Fl. Trop. E. Afr.* (1992)25, fig. 4.

Type: As for *Verbena nodiflora* L.

Verbena nodiflora L., *Sp. Pl.* edn 1, 1 (1753) 20, *basionym*; Burm., *Fl. Ind.* (1768) 12, t. 6, fig. 1; Willd., *Enum. Pl. Hort. Berol.* (1809) 632; Roxb., *Hort. Beng.* (1814) 4.

Type: "Clayton 448, from Virginia U.S.A., undated (BM, lectotype—*fide* B. Verdcourt, 1992; isolectotypes in Herb. LINN, microfiche!). See comments.

Verbena capitata Forssk., *Fl. Aegypt-Arab.* (1775) 10; Blanco, *Fl. Philip.* edn 1 (1877) 26—*fide* Moldenke (1983).

Type: Collected on Danish Expedition to Egypt and Arabia during 1761 - 1763, *loc. incert.* (C-Herb. Forsskål microfiche!).

Blairia nodiflora (L.)Gaertn., *Fruct. Sem. Pl.* 1 (1788) 266, t. 56—*fide* Moldenke (1983).

Type: As for *Verbena nodiflora* L.

Phyla chinensis Lour., *Fl. Cochinch.* 1 (1790) 66—*fide* Moldenke (1983).

Type: *Loureiro s.n.*, Cochinchina, *loc. incert.* (?BM, n.v.).

Zapania nodiflora (L.)Lam., *Tabl. Encycl. Méth. Bot.* 1 (1791) 59, t. 17, fig. 3; Pers., *Synop. Pl.* 2 (1807) 140; R. Br., *Prod. Fl. Nov. Holl.* (1810) 514; Sprengel, *Pl. Min. Cogn. Pugill.* 2 (1813) 70 - as "nudiflora".

Type: As for *Verbena nodiflora* L.

Lippia nodiflora (L.)Michaux, *Fl. Bor.-Amer.* 2 (1803) 15; Kunth in Humb., *Bonpl. & Kunth, Nov. Gen. & Sp. Pl.* 2 (1818) 264; Sprengel, *Syst. Veg.* 2 (1825) 751; Blume, *Bijdr. Fl. Ned. Ind.* (1826) 821; Wight, *Ill. Ind. Bot.* (1831) t. 173b, fig. 2; Walp., *Repert. Bot. Syst.* 4 (1845) 49; Schauer in A. DC., *Prod.* 11 (1847) 585; Wight, *Icon. Pl. Ind. Orient.* 4 (1849) 11, t. 1463; Miq., *Fl. Ind. Bat.* 2 (1858) 905; F. Muell., *Fragm.* 6 (1868) 151; Benth., *Fl. Aust.* 5 (1870) 35; F. Muell., *Fragm.* 9 (1875) 4; *Syst. Cens. Aust. Pl.* 1 (1882) 102; Bailey, *Synop. Qld Fl.* (1883) 376; C.B. Clarke in Hook.f., *Fl. Br. Ind.* 4 (1885) 563; Maxim., *Bull. Acad. Sci. St. Petersb. sl.* 31 (1887) 73; *Mél. Biol.* 12 (1887) 251; F. Muell., *Sec. Syst. Cens. Aust. Pl.* 1 (1889) 171; Bailey, *Cat. Indig. & Nat. Pl. Qld* (1890) 35; F.B. Forbes & Hemsley, *J. Linn. Soc.* 26 (1890) 251; Kuntze, *Gen. Pl.* 2 (1891) 508; Trimen, *Handb. Fl. Ceylon* 3 (1895) 347; Diels in *Bot. Jahrb.* 29 (1900) 547; Bailey, *Qld Fl.* 4 (1901) 1171; Maiden & Betche, *Proc. Linn. Soc. New South Wales* 31 (1906) 738; King & Gamble, *J. As. Soc. Beng.* 74, part 2 (1909) 797; Pulle, *Nova Guinea*, 8 Bot. (1910) 401; Bailey, *Compr. Cat. Qld Pl.* (1913) 382; Ewart & Davies, *Fl. N. Terr.* (1917) 236; H.J. Lam, *Verbenac. Malay. Archip* (1919) 16; *Bull. Jard.*

Bot. Buitenzorg Ser. III, 3 (1921) 5; Merr., Enum. Philip. Fl. Pl. 3 (1923) 381; Ridley, Fl. Mal. Penin. 2 (1923) 612; Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 142; Merr. in Ling. Sci. J. 5 (1927) 157; Péi, Verbenac. China. Mém. Sci. Soc. China 1 (1932) 10; Junell, Symb. Bot. Upsal. 4 (1934) 31, fig. 56a - c; Duthie, Fl. Gang. Plain 2, repr. edn (1960) 84; J.F. Macbr., Fl. Peru, Field Mus. Nat. Hist. 13 (1960) 651 *p.p. excl. syn. L. canescens* Kunth, *Phyla canescens* (Kunth)E. Greene, *P. nodiflora* (L.)E. Greene var. *canescens* (Kunth)Mold. and *P. nodiflora* (L.)E. Greene var. *repens* (Kunth)Mold.; Haines, Bot. Bihar & Orissa 2, repr. edn (1961) 740; Sastri (ed.), Wealth Ind. Vol. 6 L.-M (1962) 142; Britton, Fl. Bermuda (1965) 312 & fig. 332; T. Cooke, Fl. Pres. Bombay 2, 2nd repr. edn (1967) 499; Fed., Chrom. Numb. Fl. Pl., repr. edn (1974) 716; D. Gibson, Fl. Guatemala, Fieldiana (Bot.) 24(9), No. 1 & 2 (1970) 212; Adams, Fl. Pl. Jamaica (1972) 630; Tutin in Heywood *et al.* (eds), Fl. Europ. 3 (1972) 123; Choudhry & Roy, Cytologia 48 (1983) 732, 738, 739 & fig. 6a; Howard, Fl. Lesser Antills, part 3 (1989) 233, fig. 94 upper left.

Type: As for *Verbena nodiflora* L.

Verbena repens Bertol., Rar. Ital. Pl. Dec. 2 (1806) 27—*fide* Moldenke (1983).

Type: (?BOLO, n.v.). According to Stafleu & Cowan, [Taxonomic Literature Vol. 1: A - G (1976) 202] "Bertoloni's herbarium and types were partly destroyed, the remaining are in BOLO". No type cited with the protologue.

Platonia nodiflora (L.)Raf., Med. Repos. N.Y. 5 (1808) 352 - as "nudiflora"—*fide* Moldenke (1983).

Type: As for *Verbena nodiflora* L.

Verbena sarmentosa Willd., Enum. Hort. Berol. (1809) 632—*fide* Moldenke (1983).

Type: "Habitat in India orientali", undated (B-Willdenow Herb. no. 11122 microfiche!).

Zapania repens (Bertol.)Bertol., Rar. Ital. Pl. Dec. 3 (1810) 27—*fide* Moldenke (1983).

Type: As for *Verbena repens* Bertol.

Bertonia crassifolia Raf., Chloris Aetn. (1815) 5—*fide* Moldenke (1983).

Type: ?P-DU, n.v.

Lippia repens (Bertol.)Sprengel, Syst. Veg. 2 (1825) 752.

Type: As for *Verbena repens* Bertol.

Lippia sarmentosa (Willd.)Sprengel, Syst. Veg. 2 (1825) 752—*fide* Moldenke (1983).

Type: As for *Verbena sarmentosa* Willd.

Zapania crassifolia (Raf.)Raf., Herb. Raf. (1833) 66—*fide* Moldenke 91983).

Type: As for *Bertonia crassifolia* Raf.

Piarimula chinensis (Lour.)Raf., Fl. Tellur. 2 (1836) 102—*fide* Moldenke (1983).

Type: As for *Phyla chinensis* Lour.

Lippia nodiflora (L.)Michaux var. *vulgaris* Walp., Repart. Bot. Syst. 4 (1845) 49—*fide* Moldenke (1983).

Type: non cit.

Lippia nodiflora (L.)Michaux var. *repens* (Bertol.)Schauer in A. DC., Prod. 11 (1847) 586; H.J. Lam, Bull. Jard. Bot. Buitenzorg Ser. III, 3 (1921) 5—*fide* Moldenke (1983).

Type: As for *Verbena repens* Bertol.

Lippia nodiflora (L.)Michaux var. *sarmentosa* (Willd.)Schauer in A. DC., Prod. 11 (1847) 585; H.J. Lam, Bull. Jard. Bot. Buitenzorg, Ser. III, 3 (1921) 5—*fide* Moldenke (1983).

Type: As for *Verbena sarmentosa* Willd.

Lippia nodiflora (L.)Michaux var. *normalis* Kuntze, Rev. Gen. Pl. 2 (1891) 508—*fide* Moldenke (1983).

Type: "Anam: Turong. Java" (NY, n.v.).

Phyla nodiflora (L.)Greene var. *longifolia* Mold., Phytologia 2 (1941) 22; Résumé Verbenac. etc. (1959) 197, 201, 210, 464; Fifth Summary Verbenac. etc. 1 & 2 (1971) 330, 337, 347 & 899; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes No. 20 (1979) 20; Mold., Ann. Missouri Bot. Gard. 60 (1973) 65; Stanley in Stanley & Ross, Fl. S.-E. Qld 2 (1986) 367—*fide* Gibson (1970).

Type: T.G. Yuncker, J.M. Koepper & K.A. Warner (No. 8327), in sandy soil on the beach at Salado, in the vicinity of La Ceiba, Atlantida, Honduras 10.vii.1938 (NY, holotype, n.v.).

Phyla nodiflora (L.)E. Greene var. *antillana* Mold., Phytologia 40 (1978) 468—*fide* Howard (1989).

Type: N.L. Britton, E.G. Britton & J.F. Kemp (No. 83), on a hillside at Judith's Fancy, St. Croix, Virgin Island, 17 - 25.iii.1923 (NY, holotype, n.v.).

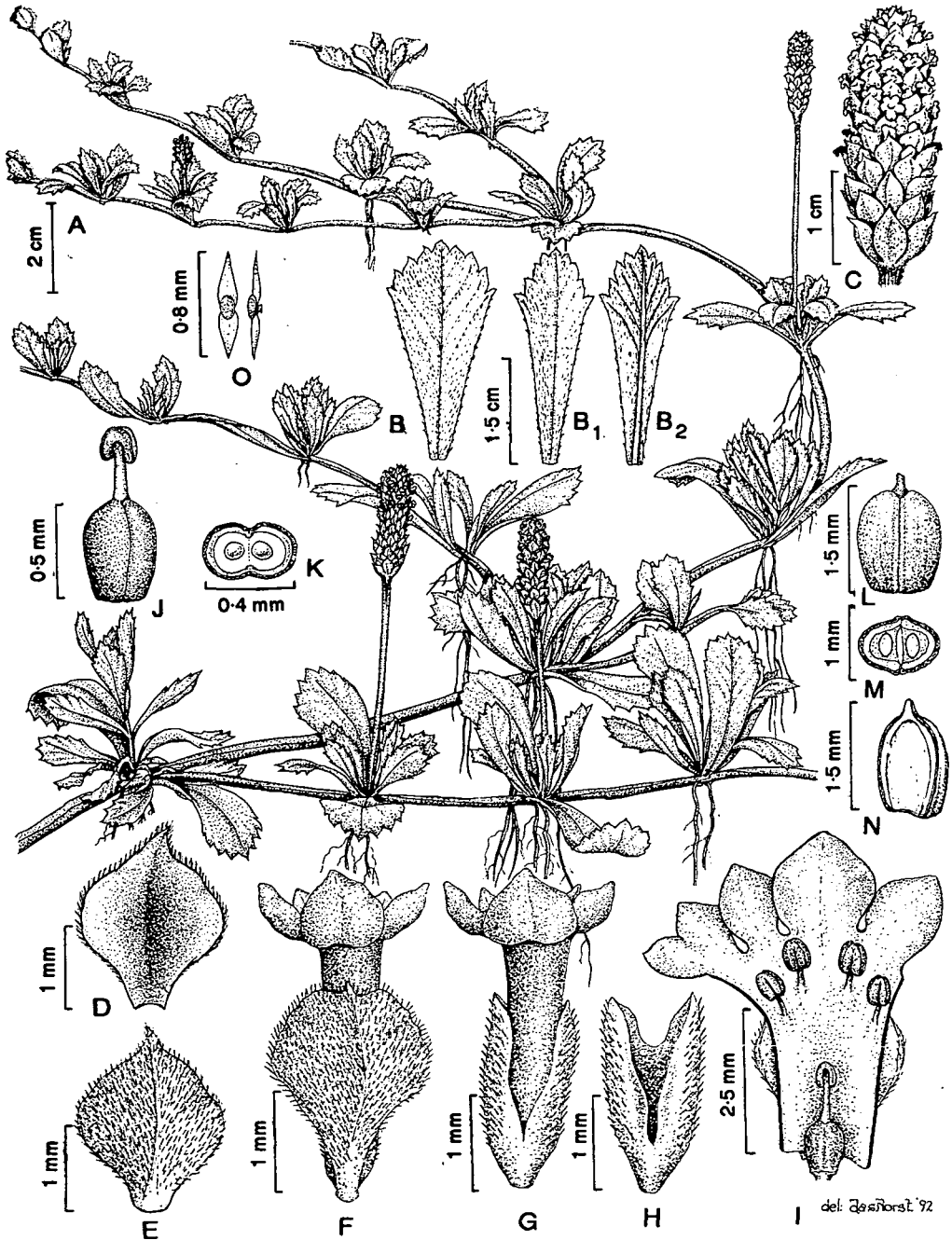


Fig. 1. *Phyla nodiflora* (L.) E. Greene var. *nodiflora* (A-O, C.R. Dunlop 7796: DNA). A, habit sketch of a flowering branch; B & B1, leaves showing adaxial (upper) view; B2, leaf showing abaxial (lower) view; C, cylindrical spike; D, bract showing adaxial view; E, bract showing abaxial view; F, flower with bract; G, flower with deeply lobed calyx; H, calyx lobed almost to base; I, flower longitudinally cut open showing androecium and gynoecium, and glabrous inner surface; J, ovary; K, transverse section of ovary; L, fruit; M, transverse section of fruit; N, fruitlet (mericarp); O, medifixed or malpighiaceus hairs.

Description (Fig. 1)

A prostrate creeping herb, often covered with appressed medifixed hairs. *Stem* and branches tetragonous to cylindrical, usually 30 - 95 cm long, with slender procumbent or ascending flowering branches, purplish-green, strigose or pubescent-puberulous. *Leaves* subsessile or shortly petiolate; lamina spatulate, oblanceolate or cuneate-obovate, decurrent or attenuate into the petiole, with sharp antrorse teeth in the upper half, strigose or pubescent-puberulous, (7-) 10 - 50 (-70) mm long, (2.5-) 3 - 7 (-10) mm wide. *Inflorescence* solitary in leaf axils, pedunculate; spikes very dense, many-flowered, elongate-oblong or cylindrical when mature, (5-) 10 - 25 (-30) mm long, (4-) 5 - 8 (-10) mm diam.; peduncle slender, usually much longer than the subtending leaves, (30-) 40 - 100 (-110) mm long, appressed pubescent or sometimes almost glabrous. *Bracts* greenish or purplish, sessile, subequalling the corolla-tube, ovate-rotundate or subrhomboid-cuneate, truncate, mucronate, with membranous margins, 2.5 - 3 mm long, 2 - 3 (-3.5) mm wide, appressed strigose outside (abaxially), glabrous inside (adaxially). *Calyx* hyaline-membranous, flattened, slightly 2-keeled with a line of fine hairs on each keel, lobed to more than halfway or almost to the base, somewhat irregularly 4-toothed, 1.5 - 2 mm long. *Corolla* usually white or purplish-white, slightly surpassing the bracts, glabrous excepting a few hairs outside at the base of lobes, 3 - 4 (-4.5) mm long; lobes spreading, 2.5 - 3 mm across, 2-lipped, 4 - 5-lobed, the lower-lip twice as long as the upper, about half as long as the tube; tube cylindrical, glabrous, 2 - 2.5 mm long. *Stamens* included, inserted in corolla-throat; filaments short; anthers minute. *Ovary* globose, glabrous, 2-celled, 2-ovuled, 0.3 - 0.4 mm diam.; style short with capitate or subpelate stigma, 0.3 - 0.5 mm long. *Fruit* ellipsoid-globose, glabrous, 1 - 2 mm long, 1 - 1.5 mm diam., splitting at maturity into 2 mericarps, each 1-seeded.

Representative specimens (collections seen: Australian 193, non-Australian 119)

AUSTRALIA: WESTERN AUSTRALIA: *Dunlop 7796*, Chile Head, 11.iv.1988 (BRI, DNA, NSW, PERTH); *Foulkes 19*, Roebuck Plains, SW Kimberley, 8.x.1984 (PERTH); *Gardner 3107*, Millstream Deep Reach Pool, Fortescue River, 22.viii.1932 (PERTH 2 spec.); *Keighery & Alford 1285*, Lake Coolungup, 5 km E of Safety Bay, 19.iii.1987 (PERTH); *Lullfitz L6093*, Roebuck Plain, Broome, 27.v.1968 (DNA, PERTH); *Lullfitz & Mackenzie s.n.*, 172 km N of Kununurra, 2.xi.1969 (PERTH); *Oldfield s.n.*, Murchison River, undated (MEL 583739).

NORTHERN TERRITORY: *Baker 11411*, Cobourg Peninsula, 1.viii.1964 (DNA); *Chippendale 7989*, Beatrice Hill, 64.37 km SE of Darwin, 23.iii.1961 (BRI, CANB, CBG, DNA, K, NSW); *Dunlop 2234*, Bing Bong Station, 7.vi.1971 (CANB, DNA, MEL); *Evan M3037*, Eusey Park, 5.iv.1990 (CANB, DNA, K, MEL); *Henshall 883*, Peron Island, 29.x.1974 (CANB, DNA); *Lack & McKean B303*, Humpty Doo, CSIRO Rice Farm, 25.i.1972 (CANB, DNA, K, L); *F. Mueller s.n.*, Victoria River, -.x.1955 (MEL 583741); *Munir 6101*, Annesley Point, 2.vi.1988 (AD, MEL, DNA); *Must 862*, Forestry Block, Wooner Road, 3.xi.1971 (CANB, DNA, K); *Specht 1181*, Oenpelli, 13.x.1948 (AD, BRI, CANB, K, MEL, NSW); *Telford 8362 & Wrigley s.n.*, Obiri Rock area, Kakadu National Park, 15.viii.1980 (BISH, CBG); *Thomson 2500*, Lake Eames area, 1 km E of Vanderlin Island, Sir Edward Pellow Group, 23.vii.1988 (DNA); *Waddy 630*, E coast on Groote Eylandt, 23.i.1977 (DNA); *Wightman 3177 & Smith s.n.*, Goulburn Island, Billabong area, 14.x.1986 (DNA).

QUEENSLAND: *Batianoff & McDonald 287*, 12 km N of Cattle Pt, 28 km S of Yeppoon, 15.vii.1977 (BRI); *Bick & White s.n.*, Stradbroke Island, -.iv.1916 (BRI, NSW); *Blake 15621 & Webb s.n.*, Torilla, between Broad Sound and Shoalwater Bay, 18.iv.1945 (BRI 273259); *Dietrich 184*, near Brisbane River, 1863-65 (AD, BM, BRI, CANB, NSW); *Durrington 1166*, Moreton Island, 16 km SSE of Tangalooma Point, 9.x.1973 (BRI 173227); *Forster 6477 & Reilly s.n.*, Lake Patricia, Weipa, 3.iii.1990 (BRI); *Hubbard 4461*, Fraser Island, 15.x.1930 (BRI, K); *O'Shanesy 83*, Rockhampton, 10.viii.1867 (MEL); *Pajmans 1949*, Maryborough area, upper tidal flat near mouth of Burrum River, 2.vi.1976 (CANB 2 spec.); *Thomson 860*, 10 km W of Massacre Inlet, Wentworth Station, 1.xii.1984 (AD, DNA); *Thozet s.n.*, Mouth of the Fitzroy River, undated (MEL 583726).

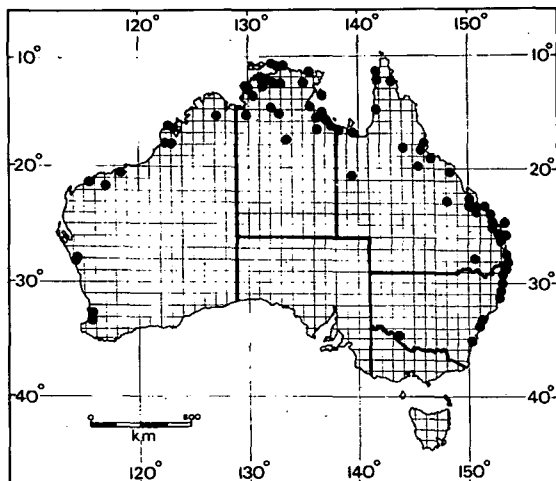
NEW SOUTH WALES: *Bäuerlen 614*, Lennox Head, -.xi.1891 (MEL, NSW); *Coveny 12454*, Bishop & Murray s.n., Red Rock, 17.xii.1986 (CANB, MEL); *Constable s.n.*, Corindi Beach, 12.87 km N of Woolgoolga, 30.iv.1956 (K, NSW 37337); *Fairoett 238*, Ballina, Richmond River, 1877 (MEL 583744); *Forsyth s.n.*, Byron Bay, -.xi.1898 (MEL 583748, NSW 231618); *Hara s.n. & Coveny 3528*, 4.8 km W of Yamba, 21.ii.1971 (BRI, K); *Lucas 71*, Balranald, 1878 (MEL); *Stackhouse s.n.*, Clarence River, 1881 (MEL 583722).

AUSTRALIAN CAPITAL TERRITORY: *Auber s.n.*, Jervis Bay, 23.ii.1966 (CBG 015000).

PAPUA NEW GUINEA: *Henty NGF 49731*, Erap, Lae subdistrict, Morobe district, 7.xi.1974 (A, BISH, BRI, CANB, E, K, L, M, NSW, US).

COCOS (KEELING) ISLANDS: *Telford 9952 & Howard s.n.*, West Island, at settlement, 1.v.1985 (AD, CBG, K); *Williams 201 & Noor s.n.*, loc. cit. 19.v.1986 (CBG, PERTH).

Distribution and ecology (Map 2)



Map 2. Distribution of *P. nodiflora* var. *nodiflora* in Australia

the State, and the only one known in the Kimberley region, is near Wyndham.

In the Northern Territory, the distribution is mainly in the tropical northern half with the majority of localities around Darwin, in Kakadu National Park and on Cobourg Peninsula. From inland, it has been recorded from near Elliot, Bing Bong Station and along Roper River near Eley Park. There are several localities in the coastal areas of the Gulf of Carpentaria. Its occurrence on off-shore islands of the State has been recorded from Peron Island, Croker Island, Goulburn Island, Elcho Island, Groote Eylandt, Maria Island and Sir Edward Pellow Group of Islands.

Distribution in Queensland is mainly along the east coast, particularly in the area from the New South Wales border to the Atherton Tableland. Further north, there is one locality near Temple Bay and others on the western side of Cape York Peninsula especially near Weipa, the Edward River settlement, Wentworth Station and Bentinck Island. From the interior of Queensland, it has been collected near Mt. Isa, at Junction Creek and at Peak Downs Station.

In New South Wales, it occurs in the coastal area to Sydney in the south. Within this range, the majority of localities are in the area between Port Macquarie and Tweed Heads. Further south, one locality is near Jervis Bay (A.C.T.) and another along the Murrumbidgee River near Balranald.

Collections from outside Australia have been examined from Papua New Guinea, Cocos (Keeling) Island, New Caledonia, Samoa, Indonesia, Thailand and the Philippines.

Growing in moist or wet soil of fields, lawns, hillsides, clearings, savannas, beaches, dry riverbeds, the edges of ponds and thickets. Also found in wet meadows and along irrigation ditches. Occurs from "sea level to c. 1400 m altitude".

According to Moldenke (1983), *P. nodiflora* var. *nodiflora* is "widely distributed throughout the subtropical and tropical portions of both the Eastern and Western Hemispheres". Cunningham et al. (1981) consider it to be an introduced and a naturalised weed in Australia. It occurs in all mainland States except South Australia and Victoria. The majority of localities in each state are in the coastal areas. A few collections, however, are known from the interior where it grows along the river banks and near lakes.

The localities in Western Australia are comparatively few and well scattered. Main distribution in this State is around Perth, Geraldton, along the North West Coastal Highway and the Great Northern Highway. The most northerly locality in

Comments

The type of this taxon has been cited somewhat differently by various authors. In the protologue, Linnaeus (1753) cited the type: "Habitat in Virginia". In 1982, Townsend recorded the type as "a cultivated specimen (holo. BM—Hb. Cliff!)". A year later, Moldenke (1983) reported the type as "Clayton 448 from "Virginia (LINN)". Subsequently, Meikle (1985) cited only "in Virginia". Recently, however, Verdcourt (1992) recorded the type as "U.S.A. Virginia, Clayton 448 (BM, lecto.)". In a separate note, Verdcourt (1992) has made further comment on the type and states: "Townsend gives the type as 'a cultivated specimen (holo. BM—Hb. Cliff!.)' but Linnaeus cites 5 syntypes and gives the locality as Virginia. I have therefore accepted the specimen forming the basis of the *Gronovius* reference as lectotype". The present author has seen all Linnaeus's syntypes on microfiche and accepts Verdcourt's (1992) selection of the lectotype for this species.

According to Moldenke (1940a), *P. nodiflora* var. *nodiflora* is "especially pernicious in moist sandy soil. As is to be expected in the case of a species with such a wide distribution and weedy habit, it is extremely variable and polymorphic. A number of forms have been segregated and named, and, indeed, many specimens, representing the extremes in variation, certainly give every indication of being worthy of nomenclatural segregation. Examination of a large series of specimens, however, shows that these forms overlap and intergrade so completely, even in the same locality and often on the same plant, that it hardly seems desirable to give them nomenclatural recognition". The above comments are equally applicable to the Australian collections of this variety (see Fig. 2 for range of variation in shape of leaves). Thus, the var. *longifolia* recorded from Australia by Moldenke (1959, 1971, 1973, 1980) and Stanley (1986) does not seem to be a distinct variety. The characters used to distinguish it from the typical variety overlap and intergrade so completely in the range of Australian specimens examined, that it is not possible to draw a definite line between the two taxa. The var. *longifolia* seems to be a somewhat long-leaved form of the typical variety. Therefore, following Gibson (1970), it has been placed in the synonymy of the latter.

Moldenke (1959, 1971, 1980) also reported var. *reptans* (Sprengel)Mold. from the Northern Territory in Australia. In a later publication by Moldenke (1983), he distinguished this variety from the typical form by its leaves being "much larger in size, often 3 - 4.5 cm long and 1.5 - 2.5 cm wide, the teeth often more spreading, and the larger venation (midrib and secondaries) quite firm, distinct, and prominulous on the lower surface". In a few other publications e.g. Britton & P. Wilson (1925), D. Gibson (1970) and Moldenke (1939, 1940), this taxon has been distinguished chiefly by its leaf-blades being thin-textured, venation quite prominent beneath and impressed above. During present investigation, a range of collections from the Northern Territory has been examined and no specimen with uniformly large-sized leaves and distinctly prominent venation beneath has been found. Neither has any such specimen been found in any other Australian collection of this species. Therefore, the existence of var. *reptans* in Australia has not been confirmed.

According to Bentham (1870), *P. nodiflora* is "the commonest species of all" those known in this genus. In his view, "it is very variable in the breadth of the leaves, the size of the spikes and flowers, the points and teeth of the bracts, &c."

In view of the large number of synonyms included under this species, E. Greene (1899) comments that "if all that passes under this name is one species, it certainly has a most remarkable geographic range, being found in the tropical and subtropical parts of all the continents and of every archipelago that lies within those lines. It is curious that Linnaeus names only "Virginia" as the habitat of the species, while it had been known as thoroughly indigenous to the Mediterranean region of the Old World for at least a hundred years before his day".

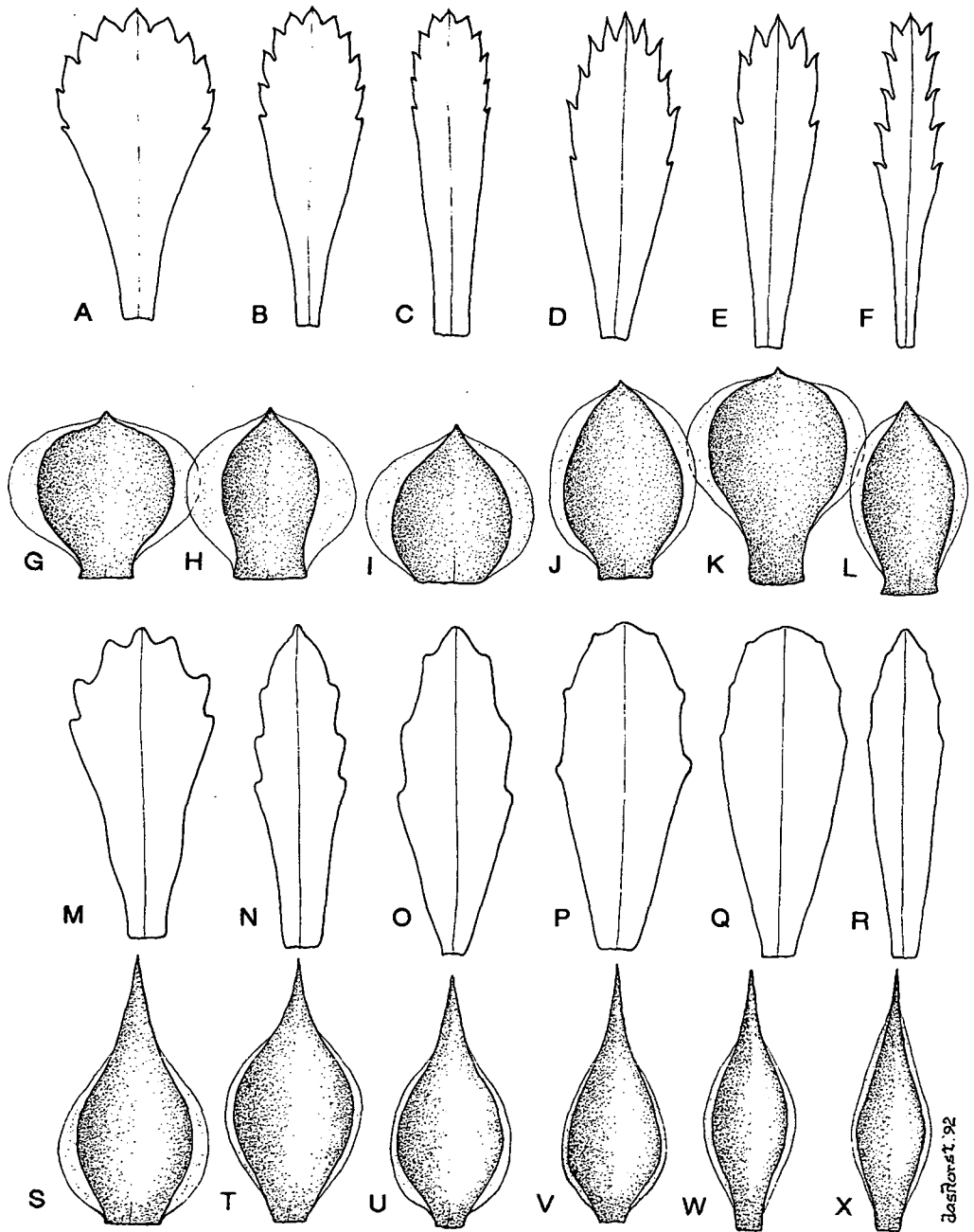


Fig. 2. Range of variation in shape of leaves (A-F, M-R) and bracts (G-L, S-X) of *Phyla nodiflora* (L.)E. Greene var. *nodiflora* (A-L) and *Phyla canescens* (Kunth)E. Greene (M-X). (A, R.L. Specht 1181: MEL; B, N. Byrnes 1082 & J.R. Maconochie s.n.: AD; C, W.A. Cusack 213: MEL; D, G.J. Keighery 3907: PERTH; E, C.R. Dunlop 7796: DNA; F, C.R. Dunlop 2234: DNA; G, R. Collins BC182: CBG; H, C.R. Dunlop 2234: DNA; I, M. Evans 3037: DNA; J, M. Lazarides 8730: CANB; K, D. Bowman 85: DNA; L, L. Durrington 3: BRI; M, H.J. Eichler 17159: AD; N, M.D. Crisp 6990: CBG; O, R. Bates 6787: AD; P, A.W. Bell 97: AD; Q, D.E. Symon 12970: AD; R, H.I. Aston 2728: MEL; S, H.J. Eichler 17159: AD; T, P.M. Kloot s.n.: CANB 352037; U, H.I. Aston 2728: MEL; V, A.C. Beaglehole 55713: MEL; W, J. Henshall s.n.: MEL; X, H. Dillewaard 384 & M. Olsen s.n.: CANB).

All *Phyla* collections from South Australia and Victoria are found to belong to the second species, *P. canescens*. *P. nodiflora* was probably introduced into Australia during the last century and has now become naturalised in most mainland states.

Among its many vernacular names in various parts of the world, some popular ones are: "Fog-fruit", "Cape-weed", "Godet's-weed", "Link-weed", "Lippia-grass", "Mat-grass", "Spanish-bush" and "Cidron". In Australia, the common names used for this species are: "Lippia", "Fog-fruit", "Phyla", "Carpet-weed", "Mat-grass" or "No mow grass".

Affinities

Within the species, *P. nodiflora* var. *nodiflora* is closely related to var. *reptans* (Kunth)Mold. in its stem being herbaceous and trailing, rooting at nodes; leaf-blades cuneate-ovate, spatulate, or narrowly oblanceolate, usually dentate only from the widest part to the apex; peduncles much longer than the flower-spikes. According to Moldenke (1940a, 1983), however, var. *reptans* "differs from the typical form of the species, in being usually more densely strigose throughout and in having the leaves thinner in texture, often rhomboid, broadly rhomboid-elliptic, or even rhomboid-ovate, with the teeth usually more salient and the larger venation (midrib and secondaries) firmer, more or less impressed above and conspicuously prominulous or prominent beneath". Both varieties occur in almost similar habitat. In distribution, var. *reptans* is considered by Moldenke (1940a) as occurring "practically throughout the range of the species". As mentioned before under "Comments", the presence of var. *reptans* in Australia has not been confirmed.

Var. *nodiflora* seems fairly close to *P. canescens* in its habit, shape of leaves and size of peduncles. Nevertheless, *P. canescens* may easily be distinguished by its stem and leaves being greyish or canescent, leaves with blunt short teeth or almost entire, mature spikes ovoid-globose, bracts elliptic-ovate or elliptic-lanceolate, calyx lobed to not more than halfway and corolla usually lilac or somewhat pinkish.

2. *Phyla canescens* (Kunth)E. Greene, Pittonia 4 (1899) 48; C.C. Towns., Fl. Turkey 7(1982)32.

Type: As for *Lippia canescens* Kunth.

Lippia canescens Kunth in Humb., Bonpl. & Kunth, Nov. Gen. & Sp. Pl. 2 (1818) 263, **basionym**; Sprengel, Syst. Veg. 2 (1825) 751; Cham. in Linn. 7 (1832) 213; Walp., Repert. Bot. Syst. 4 (1845) 48; Sevenson, Amer. J. Bot. 33 (1946) 480; Schauer in A. DC., Prod. 11 (1847) 585; J. Black, Fl. S. Aust. edn 1 (1929) 698; Mold., Fifth Summary Verbenac. etc. 2 (1971) 552, **prosyn.**; Tutin in Tutin, Heywood et al. (eds), Fl. Europ. 3 (1972) 123.

Type: *Humboldt s.n.*, "Crescit in litore Oceoni pacifici juxta urbem Truxillo: item Lamam iater et portum callao," Peru, undated (P, isotype!).

Phyla nodiflora (L.)E. Greene var. *canescens* (Kunth)Mold., Phytologia 1 (1934) 98; Mold., Verbenac. & Avicen. Trinidad & Tobago, Lilloa 4 (1939) 297; Mold., Résumé Verbenac. etc. (1959) 157, 221, 311, 315, 334, 393, 394, 464; Fifth Summary Verbenac. etc. 1 & 2 (1971) 277, 367, 552, 561, 600, 601, 667, 899; Phytologia Mem. II, Sixth Summary Verbenac. etc. (1980) 358, 415, 419, 431; Webb et al., Fl. New Zealand 4 (1988) 1275, fig. 121C; J.H. Ross (ed.), Cens. Vasc. Pl. Vic. edn 4(1993)181.

Type: As for *Lippia canescens* Kunth.

Phyla nodiflora auct. non (L.)E. Greene: sensu L. Bailey, Man. Cult. Pl. (1949) 842, *p.p. quoad syn. Lippia canescens* Kunth & *Phyla nodiflora* (L.)Greene var. *canescens* (Kunth)Mold.; J.H. Willis, Handb. Pl. Vic. 2 (1972) 579; Munir in Jessop & Toelken (eds), Fl. S. Aust. part 3 (1986) 1175, fig. 544B; Munir in Jessop (ed.), List Vasc. Pl. S. Aust. edn III (1989) 87; Cooke, S. Aust. Naturalist 65 (1991) 65, *quoad spec. M. Zwartz* 56, from Head of Gilbert, S.A., 8.ii.1990 (ADA 10798).

Lippia nodiflora (L.)Michaux f. *canescens* (Kunth)Kuntze, Gen. Pl. 2 (1891) 508.

Type: As for *Lippia canescens* Kunth.

Lippia nodiflora auct. non (L.)Michaux: Ewart, Fl. Vic. (1930) 974; J.F. Macbr., Fl. Peru, Field Museum Nat. Hist. 13 (1960) 651, *p.p. quoad syn. Lippia canescens* Kunth, *Phyla canescens* (Kunth)E. Greene and *Phyla nodiflora* (L.)Greene var. *canescens* (Kunth)Mold.

Phyla nodiflora (L.) E. Greene var. *rosea* (D. Don) Mold., *Résumé Verbenae* etc. (1959) 465.
 Type: As for *Zapania nodiflora* (L.) Lam. var. *rosea* D. Don

Zapania canescens (Kunth) Gibert, *Enum. Pl. Montev.* (1873) 44.
 Type: As for *Lippia canescens* Kunth.

Zapania nodiflora (L.) Lam. var. *rosea* D. Don in Sweet, *Brit. Fl. Gard. Ser.* 2, 3 (1834) t. 225.
 Type: Mr. Knight's s.n. collection, originally introduced from Chile, by Mr. Hugh Cuming (LINN). Plate 225 in Sweet, *Brit. Fl. Gard. Ser.* 2, 3: 1934, derived from Mr. Knight's s.n. coll.!

Lippia nodiflora (L.) Michaux var. *rosea* (D. Don) J.F. Macbr., *Fl. Peru, Field Museum Nat. Hist.* 13 (1960) 651.
 Type: As for *Zapania nodiflora* (L.) Lam. var. *rosea* D. Don.

Lippia nodiflora var. *sarmentosa* auct. non (Willd.) Schauer: Ewart, *Fl. Vic.* (1930) 974.

Lippia nodiflora var. *repens* auct. non (Bertol.) Schauer: Ewart, *Fl. Vic.* (1930) 974.

Description (Fig. 3)

Perennial herb with procumbent or ascending flowering branches, more or less conspicuously hoary (canescent) throughout with medifixed hairs. *Stem* branched, almost cylindrical or obtusely tetragonal, somewhat woody at base, rooting at the nodes. *Leaves* subsessile or shortly petiolate, obovate to oblanceolate, with a long-cuneate base, (5-) 10 - 20 (-30) mm long, (2-) 3 - 7 (-10) mm wide, entire or bluntly toothed above the middle, rounded or subobtusate at the apex, more or less canescent; petiole 2 - 5 mm long. *Spikes* ovoid to oblong-ovoid, (3-) 5 - 8 (-10) mm diam.; peduncles slender, usually much longer than the subtending leaves, canescent-pubescent or almost glabrous, (10-) 15 - 45 (-65) mm long. *Bracts* ovate, elliptic-ovate or elliptic-lanceolate, entire, more or less long acuminate, with a very narrow membranous margin, (1.5-) 2 - 3 mm long, 1 - 2 mm wide, appressed canescent-pubescent outside (abaxially), glabrous inside (adaxially). *Calyx* lobed to not more than halfway, 1.5 - 2.5 mm long, canescent outside, glabrous inside. *Corolla* mauve, lilac or whitish-pink, 3 - 4 mm long, glabrous outside excepting a narrow band of short hairs at the base of lobes, glabrous inside; lobes unequal, 2-lipped, spreading to 3 mm across; tube 2 - 3 mm long. *Stamens* inserted about the middle of the corolla-tube. *Ovary* globose, glabrous, \pm 0.5 mm diam.; style short, \pm 0.5 mm long, glabrous, with \pm capitate stigma. *Fruit* ellipsoid-globose, glabrous, 1 - 1.5 mm diam.

Representative specimens (collections seen: Australian 92, non-Australian 25)

AUSTRALIA: WESTERN AUSTRALIA: *Gardner 9545*, Mount Charlotte Reservoir, Kalgoorlie, -.xi.1949 (PERTH); *Hocking s.n.*, Tammin, 2.v.1953 (PERTH 2 spec.); *Reynolds s.n.*, Northam, -.iv.1964 (PERTH).

SOUTH AUSTRALIA: *Bell 97*, between Maclaren Flat and Blewitt Springs, Noarlunga, 23.xii.1976 (AD 2 spec., ZT); *Copley 931*, northern end of Bute main street, N. Yorke Peninsula, 4.xii.1966 (AD, MEL); *Eichler 17159*, roadside in Fullarton, Nelson Street, 28.i.1963 (AD); *Ising s.n.*, Banks of Torrens Lake, 24.i.1927 (AD); *Southcott s.n.*, S.E. corner of Parklands, Adelaide, 1.i.1960 (AD, COLO, CAL, CAL, CANB, CHR, E, F); *Symon 3900*, N.E. of Clare, 16.xii.1965 (AD, CANB, DAV, SPN); *Symon 13087*, N. of Berri on outskirts of township, Upper River Murray, 20.i.1983 (AD 2 spec., CANB, K, L. MO, US); *Symon 13775*, Fleurieu Peninsula, roadside on Chaffey's Road at Chapei Vale Winery, 25.i.1984 (AAU, AD 2 spec., BH, CANB, K); *Womersley 433 & Symon s.n.*, 1.5 km W of Nelwood Homestead, Murray region, 11.ix.1979 (AD); *Zwarts 56*, Head of Gilbert River, 8.ii.1990 (ADA).

QUEENSLAND: *Dillewaard 384 & Olsen s.n.*, 5 km SW of Brookstead, 5.ii.1981 (BRI, CANB, K); *Filet s.n.*, Toogoolawah, 24.vii.1964 (BRI 058465); *Kleinschmidt s.n.*, Cecil Plains, north branch Condamine, -.xii.1968 (BRI 087805); *Pedley 372*, 5.8 km W of Westmar, 15.i.1959 (BRI, CANB); *Roberts & Craig s.n.*, Toobeah, 26.v.1961 (BRI 028161); *Stevens s.n.*, Kianga, Dawson Valley, 6.iii.1965 (BRI 057775); *White 12582*, Darling Downs, Tummaville, 19.i.1944 (BRI 268481).

NEW SOUTH WALES: *Cunningham & Milthorpe 4622*, Darling River, Anabranche on Wentworth - Renmark road, 27.iv.1976 (NSW); *Leigh 5346*, Lake Edge, c. 40 km S.W. of Deniliquin, 18.xii.1964 (NSW); *Michael & Gray s.n.*, Flemington Saleyards, Sydney, 23.x.1969 (CANB 332085, NSW 231620); *Pajmans 3950*, Macquarie Marshes, bank of northern by-pass Channel, 35 km NW of Quambone, 16.xii.1980 (CANB); *Semple 1070*, Moola, 3.21 km N. of Balranald, 13.i.1981 (NSW 231762); *Waite 1813*, Wentworth, 13.ii.1955 (NSW); *Wilson 874*, Talmoi Lagoon, c. 48 km NW of Moree, 27.xii.1974 (NSW); *Wilson 5684*, Lachlan River, 8 km W. of Jemalong Weir on Condobolin road, 29.xi.1983 (K, MO, NSW).

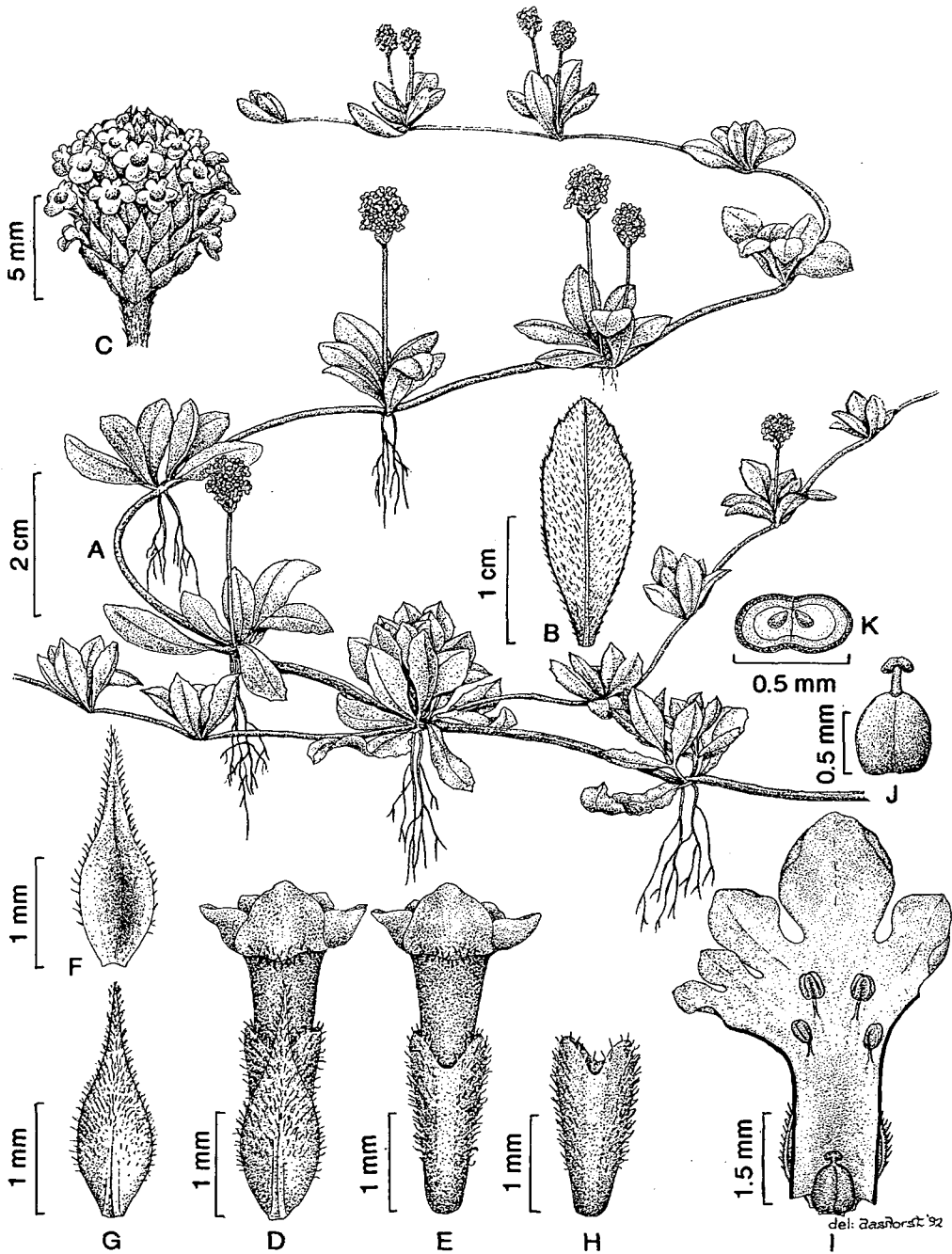
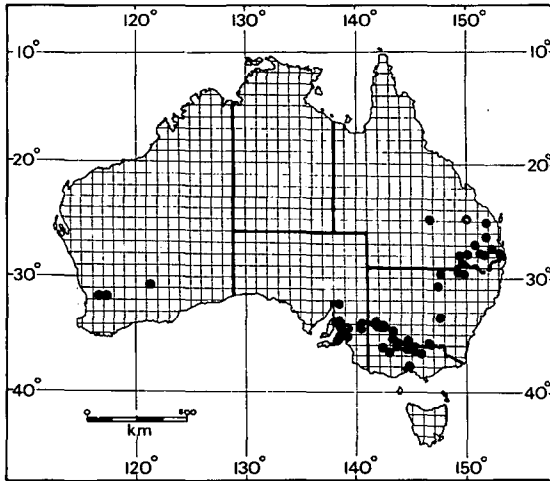


Fig. 3. *Phyla canescens* (Kunth) E. Greene (A-K, D.E. Symon 12970: AD). A, habit sketch of a flowering branch; B, leaf with almost entire margin; C, globose spike; D, flower with bract; E, flower without bract; F, bract showing adaxial (inside) view; G, bract showing abaxial (outside) view; H, calyx with short lobes; I, flower longitudinally cut open showing androecium and gynoecium, and glabrous inside; J, ovary; K, transverse section of ovary.

VICTORIA: *Aston* 2728, E. of Vinifera, c. 1 km E. of where the road from Vinifera to Woorinen South joins the Murray Valley Highway, 16.xii.1988 (BRI, MEL, RSA); *Beaglehole* 33428 & *Henshall s.n.*, c. 1 km upstream from Red Cliffs Pumping Station on Murray River, 27.iii.1970 (MEL); *Beaglehole* 55713, c. 7.5 km N.N.W. of Kerang, 26.iv.1977 (CANB, MEL); *Beaglehole* 76501, Mullinger Swamp Wildlife Reserve, 13.iii.1984 (MEL); *Beaglehole* 84890, Warracknabeal Roadside Reserve, 7.x.1986 (MEL); *Chesterfield* 2552, Junction of Goulburn River and Murray River, 23.xi.1988 (CANB, MEL); *Jensen* 118, railway track, S. Kensington, Melbourne, 8.xii.1977 (MEL 1502258); *Macfarlane* 1466, adjacent to Piambie State Forest, 31.xii.1982 (LTB, MEL); *Smith* 67/65, near N.W. of Birchip, 10.iii.1967 (AD, MEL).

Distribution and ecology (Map 3)



Map 3. Distribution of *P. canescens* in Australia

and Renmark.

It has been collected frequently along both sides of the Murray River in Victoria and New South Wales. A few inland Victorian localities are near Warracknabeal, St Arnaud, Lake Boort Reserve, Shepparton and near the junction of the Goulburn and Murray Rivers. The southernmost record in that state is on the Yarra River near Melbourne. In the north of New South Wales it has been recorded from N.W. of Moree near Broadwater Creek, Angedool, Talmoi Lagoon and Gingham Channel. Further inland, one locality is to the N.W. of Quambone in Macquarie River Marshes and other along the Lachlan River near Condobolin township. It has also been reported from the suburb of Flemington near Sydney.

In Queensland, it is known chiefly in the south-eastern corner of the state where all known localities except one are found between 24° and 29°S and between 149° and 154°E. Within this limit, most localities are along the Dawson River, Condamine River, Weir River and their tributaries. The locality outside the above limit is near Mount Playfair between Tambo and Springsure.

According to collectors' field notes, it is a prostrate matted herb growing chiefly on flood plains in heavy clay soil. It is also known from swamps and along the banks of rivers, near lakes and in moist-wet areas around water-holes. It is known to grow commonly in *Eucalyptus camaldulensis* forest on heavy grey clay soil.

Outside Australia, *P. canescens* has been recorded by Moldenke (1959, 1971, 1980) from the U.S.A., Mexico, Ecuador, Peru, Paraguay, Chile, Argentina, Egypt, Ethiopia, Mascarene Islands (Mauritius), and southern India. So far, it has not been recorded from Malesia or any Island in the Pacific Ocean.

In Australia, *P. canescens* is known to occur in Western Australia, South Australia, Victoria, New South Wales and Queensland. Distribution in Western Australia is known only along the Great Eastern Highway near Northam, Tammin and Mt. Charlotte north of Kalgoorlie. In South Australia, the occurrence is chiefly in the Northern and Southern Lofty regions, and along the banks of the Murray River near Loxton

Comments

The occurrence of *P. canescens* in Australia is recorded here for the first time. Within Australia, specimens have been previously identified as *Lippia nodiflora*, *Lippia nodiflora* var. *repens* and *Phyla nodiflora*. Lately, however, several collections of this taxon are found annotated as *Phyla nodiflora* var. *canescens*. This varietal name, however, has never been recorded in any Australian publication. It is worth noting that *P. canescens* is the only *Phyla* species known to occur in South Australia and Victoria. Otherwise, this species has been recorded from all mainland states except Northern Territory. So far, it has not been reported from Tasmania.

According to collectors' field notes, this taxon is considered to be spreading rapidly and could be a menace in cultivated areas. In the opinion of one collector (*E. Jurgs s.n.*: BRI 015723), there is a fear of its becoming a pest and "can be killed by spraying with 2, 4-D weed killer". The plant seems to be drought resistant and could perhaps become a serious weed if not controlled at an initial stage. Another collector (*C. Waugh s.n.* BRI 268479) states: "it shows promise as a lawn grass, being evergreen, low growing, close matted and easily mown. Wherever it grows, all grasses and weeds are completely smothered by it and nothing appearing through it. It seems to be a very destructive weed with strong underground stems".

D. Don (1834) described it as "forming a compact patch, which, when in flower, has a very pretty effect, being then adorned with innumerable heads of pink blossoms, marked with a yellow spot. It is nearly, if not quite, hardy; and is highly ornamental, whether kept in pots, or planted in a rock-work. A mixture of sandy peat and loam will be found to suit it well; and it is easily increased by slips, for almost every branch is supplied with roots." According to Moldenke (1959, 1971, 1980) it has been under cultivation in the U.S.A., France and England.

In Flora Europaea, Tutin (1972) described its corolla as "densely pubescent without". During present investigation, however, the corolla is found to be glabrous all over excepting a narrow hairy band outside at the base of lobes only.

It has been known by various common names viz: "carpet weed", "grey fog-fruit" or "pink-flowered knotted Zappania".

Affinity

P. canescens is closely related to *P. nodiflora* and has been often treated as a synonym or a variety of *P. nodiflora*. For similarities and differences between these two species see "Key to the species" and "affinity" under *P. nodiflora*.

Acknowledgements

The author is grateful to Drs J.P. Jessop and H.R. Toelken for comments on the draft of this manuscript; to Miss G. Denny, Librarian, Adelaide Botanic Gardens for help in procuring the relevant literature; Mr G.R.M. Dashorst for preparing the illustrations; to Miss M. Eadsforth for typing the manuscript.

Thanks are also due to the Directors/Curators of the following herbaria for the loan of herbarium specimens: ADA, BISH, BM, BRI, CANB, CBG, DNA, F, GH, JCT, K, L, LTB, MEL, NE, NSW, P, PERTH, QRS.

References

- Bailey, F.M. (1883). Verbenaceae. "A Synopsis of the Queensland Flora". 375-381. (J.C. Beal, Govt Printer: Brisbane).
 Bailey, F.M. (1901). Verbenaceae. "The Queensland Flora". Part 4: 1164-1185. (H.J. Diddams & Co.: Brisbane).

- Bailey, F.M. (1913). Verbenaceae. "Comprehensive Catalogue of Queensland Plants". 381-387. (Govt Printer: Brisbane).
- Bentham, G. (1839). Enumeration of Plants collected by Mr. Schomburgk, British Guiana. *Ann. Nat. Hist.* 2: 445-451.
- Bentham, G. (1870). Verbenaceae. "Flora Australiensis". Vol. 5: 31-70. (L. Reeve & Co.: London).
- Bentham, G. (1876). Verbenaceae. In Bentham, G. & Hooker, J.D. "Genera Plantarum". Vol. 2: 1131-1160. (L. Reeve & Co.: London).
- Bir, S.S. & Sidhu, M. (1980). Cyto-palynological studies on weed flora of cultivable lands of Patiala district (Punjab). *J. Palynology* 16: 85-105.
- Black, J.M. (1929). Verbenaceae. "Flora of South Australia". 1st edn. Part 4: 515-746. (Govt Printer: Adelaide).
- Briquet, J. (1895). Verbenaceae. In Engler, A. & Prantl, K. "Die natürlichen Pflanzenfamilien". Part 4, 3a: 132 - 182. (Wilhelm Engelmann: Leipzig).
- Britton, N.L. & Wilson, P. (1925). Descriptive Flora-Spermatophyta. Porto Rico and the Virgin Islands. *Sci. Surv. Porto Rico & Virgin Isl.* 6: 137-152.
- Brown, R. (1810). Verbenaceae. "Prodromus Florae Novae Hollandiae et Insulae Van-Diem". 510-514. (Richard Taylor & Co.: London).
- Choudhry, S.S. & Roy, R.P. (1983). Karyological studies and trend of speciation in some members of Verbenaceae. *Cytologia* 48: 735-740.
- Clarke, C.B. (1885). Verbenaceae. In Hooker, J.D. "The Flora of British India". Vol. 4: 560-604. (L. Reeve & Co.: Ashford).
- Covas, G. & Schnack, B. (1946). Número de cromosomas en Antófitas de la region de Cuyo (República Argentina). *Rev. Argentina Agron.* 13: 153-166.
- Cunningham, G.M. et al. (1981). Verbenaceae. "Plants of western New South Wales". 568-570. (New South Wales Government: Sydney).
- Dalla Torre, C.G. & Harms, H. (1904). Verbenaceae. "Genera Siphonogamarum ad Systema Englerianum Conscripta". 429-434. (Wilhelm Engelmann: Leipzig).
- Darlington, C.D. & Wylie, A.P. (1955). Verbenaceae. "Chromosome Atlas of Flowering Plants". 322-324. (George Allen & Unwin Ltd.: London).
- Dietrich, D.N.F. (1839). Tetrandria Monogynia. "Synopsis Plantarum". Vol. 1: 417-549. (B.F. Voigt: Weimar).
- Don, D. (1834). *Zappania nodiflora* var. *rosea*. "British Flower Garden". Series 2. Vol. 3. Plate 225.
- Dumortier, B.C.J. (1829). Verbenaceae. "Analyse Familles des Plantes". 22. (J. Casterman: Tournay).
- Durand, Th. (1888). Verbenaceae. "Index Generum Phanerogamorum". 319-322. (Dulau & Co.: London).
- Endlicher, S. (1840). Appendix. Genera dubiae sedis et non satis nota. Genera Plantarum Secundum Ordines Naturalis Disposita. 1327-1333. (Fr. Beck: Vienna).
- Ewart, A.J. & Davies, O.B. (1917). Verbenaceae. "Flora of the Northern Territory". 235-239. (McCarron, Bird & Co.: Melbourne).
- Ewart, A.J. (1930). Verbenaceae. "Flora of Victoria". 973-976. (University Press: Melbourne).
- Fedorov, A. (1974). Verbenaceae. "Chromosome Numbers of Flowering Plants". Reprint edn. 714-718. (Otto Koeltz: Koenigstein).
- Gaertner, J. (1788). Centuria Quarta. "De Fructibus et Seminibus Plantarum". Vol. 1: 244-275. (G.H. Schramm: Tübingen).
- Gardner, C.A. (1931). Verbenaceae. "Enumeratio Plantarum Australiae Occidentalis". Part 3: 111-113. (Govt Printer: Perth).
- Gibson, D.N. (1970). Verbenaceae. In Standley, P.C. & Williams, L.O. "Flora of Guatemala". *Fieldiana* (Botany). Vol. 24, Part 9: 167-236.
- Greene, E.L. (1899). Neglected generic types - I. *Pittonia*. Vol. 4: 45-49.
- Hedwig, R.A. (1806). Addenda et Emendanda. Classis Quarta. "Genera Plantarum Secundum Characteres Differentiales". 366-378. (I.H. Recalm: Leipzig).
- Howard, R.A. (1989). Verbenaceae. "Flora of the Lesser Antilles. Leeward and Windward Islands". Vol. 6. Dicotyledoneae - Part 3: 212-241. (Arnold Arboretum, Harvard University, Massachusetts: Jamaica Plain).
- Jaume Saint-Hilaire, J.H. (1805). Primulaceae. "Exposition des Familles naturelles et de la Germination des Plantes". Vol. 1: 218-226. (Treuttel et Würtz: Paris).
- Junell, S. (1934). Zur Gynäceummorphologie und Systematik der Verbenaceen und Labiaten. *Symb. Bot. Ups.* 4: 1-219.
- King, G. & Gamble, J.S. (1909). Verbenaceae. "Material for a Flora of the Malayan Peninsula". Vol. 4: 1004-1079. (W. Newman & Co.: London).
- Kunth, C.S. (1818). Verbenaceae. In Humboldt, F.W.H.A., Bonpland, A.J.A. & Kunth, C.S. "Nova Genera et Species Plantarum". Vol. 2: 244-285. (Librairie grecque-latine-allemande: Paris).
- Lam, H.J. (1919). "The Verbenaceae of the Malayan Archipelago". (M. De Waal: Groningen).
- Lemée, A. (1943). Verbenaceae. "Dictionnaire descriptif et Synonymique des Generes de Plantes Phanerogames". Vol. 8b: 650-657. (Imprimerie Commerciale et Administrative: Brest).
- Linnaeus, C. (1753). Diandria Monogynia. "Species Plantarum". edn 1, Vol. 1: 6-27. (Laurentius Salvius: Stockholm).
- Lopez-Palacio, S. (1974). A las Verbenaceae par la Flora de Venezuela. *Revista Fac. Farm. Univ. Los Andes. Merida* No. 15: 9-131.
- Lopez-Palacio, S. (1977). Verbenaceae. "Flora de Venezuela". 18-643. (Universidad de Los Andes: Merida, Venezuela).
- Loureiro, J. de (1790). Tetrandria Monogynia. "Flora Cochinchinensis". Vol. 1: 63-90. (Typis et expensis academicis: Lisbon).
- Meikle, R.D. (1963). Verbenaceae. In Huber, H., Hepper, F.N. & Meikle, R.D. "Flora of West Tropical Africa". Vol. 2: 432-448. (Crown agents for Oversea Governments and Administration: London).

- Meikle, R.D. (1985). Verbenaceae. "Flora of Cyprus". Vol. 2: 1247-1254. (The Bentham - Moxon Trust, Royal Botanic Gardens, Kew: London).
- Meisner, C.F. (1840). Verbenaceae. "Plantarum Vascularium Genera secundum Ordines Naturales Digesta ...". Vol. 1. "Tabulae Diagnosticae": 290-292. Vol. 2. "Commentarius": 197-200. (Libraria Weidmannia: Leipzig).
- Michaux, A. (1803). Didymia Angiospermia. "Flora Boreali-Americana". Vol. 2: 13-26. (Typis Caroli Creplet, fratres Levrault: Paris).
- Miquel, F.A.W. (1858). Verbenaceae. "Flora Indiae Batavae". Vol. 2: 856-913. (C.G. van der Post: Amsterdam).
- Moldenke, H.N. (1939). The Verbenaceae and Avicenniaceae of Trinidad and Tobago. *Lilloa*. Vol. 4: 283-336.
- Moldenke, H.N. (1940). Verbenaceae. In Pulle, A. "Flora of Suriname". Vol. 4, Part 2: 257-277. (Koloniaal Instituut: Amsterdam).
- Moldenke, H.N. (1940a). The Eriocaulaceae, Verbenaceae, and Avicenniaceae of the Yucatan Peninsula. *Publ. Carnegie Inst. Wash.* No. 522: 148-223.
- Moldenke, H.N. (1959). "A Résumé of the Verbenaceae, Avicenniaceae, Stilbaceae, Symphoremaceae and Eriocaulaceae of the World as to valid Taxa. Geographic Distribution and Synonymy". (H.N. Moldenke: Mountain, New Jersey).
- Moldenke, H.N. (1971). "A Fifth Summary of the Verbenaceae, Avicenniaceae, Stilbaceae, Dicrostylidaceae, Symphoremaceae, Nyctanthaceae, and Eriocaulaceae of the World ..." etc. Vols 1 & 2. (H.N. Moldenke: Wayne, New Jersey).
- Moldenke, H.N. (1973). Verbenaceae. Flora of Panama. *Ann. Missouri Bot. Gard.* 60: 41-48.
- Moldenke, H.N. (1980). "Phytologia Memoirs II. A Sixth Summary of the Verbenaceae, Avicenniaceae, Stilbaceae, Chloanthaceae, Symphoremaceae, Nyctanthaceae, and Eriocaulaceae of the World etc." (H.N. & A.L. Moldenke: Plainfield, New Jersey).
- Moldenke, H.N. (1983). Verbenaceae. In Dassanayake, M.D. & Fosberg, F.A. "A Revised Handbook to the Flora of Ceylon". Vol. 4: 196-487. (Amerind Publishing Co. Pvt. Ltd.: New Delhi).
- Mueller, F.v. (1868). "Fragmenta Phytographiae Australiae". Vol. 6. (Govt Printer: Melbourne).
- Mueller, F.v. (1875). "Fragmenta Phytographiae Australiae". Vol. 9. (Govt Printer: Melbourne).
- Mueller, F.v. (1882). Verbenaceae. "Systematic Census of Australian Plants". Part 1. Vasculares: 102-103. (McCarron, Bird & Co.: Melbourne).
- Mueller, F.v. (1889). Verbenaceae. "Second Systematic Census of Australian Plants. Part 1. Vasculares: 171-173. (McCarron, Bird & Co.: Melbourne).
- Munir, A.A. (1982). A taxonomic revision of the genus *Callicarpa* L. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 6(1): 5-39.
- Munir, A.A. (1983). Verbenaceae. In Morley, B.D. & Toelken, H.R. "Flowering Plants in Australia". 287-291. (Rigby Publishers: Adelaide).
- Munir, A.A. (1984a). A taxonomic revision of the genus *Premna* L. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 7(1): 1-43.
- Munir, A.A. (1984b). A taxonomic revision of the genus *Gmelina* L. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 7(1): 91-116.
- Munir, A.A. (1985). A taxonomic revision of the genus *Viticipremna* H.L. Lam (Verbenaceae). *J. Adelaide Bot. Gard.* 7(2): 181-200.
- Munir, A.A. (1986). Verbenaceae. In Jessop, J.P. & Toelken, H.R. "Flora of South Australia". Part III: 1173-1178. (Govt Printer: Adelaide).
- Munir, A.A. (1987a). A taxonomic revision of the genus *Vitex* L. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 10(1): 31-79.
- Munir, A.A. (1987b). A taxonomic revision of the genus *Faradaya* F. Muell. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 10(2): 165-177.
- Munir, A.A. (1989). A taxonomic revision of the genus *Clerodendrum* L. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 11(2): 101-173.
- Munir, A.A. (1990a). A taxonomic revision of the genus *Glossocarya* Wallich ex Griffith (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 13: 17-34.
- Munir, A.A. (1990b). A taxonomic revision of the genus *Huxleya* Ewart (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 13: 101-173.
- Munir, A.A. (1991). A taxonomic revision of the genus *Oncinocalyx* F. Muell. (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 14(1): 77-84.
- Munir, A.A. (1992). A taxonomic revision of the genus *Stachytarpheta* M.Vahl (Verbenaceae) in Australia. *J. Adelaide Bot. Gard.* 14(2): 133-168.
- Navaneetham, N.R. et al. (1982). Karyomorphological highlights in two species of *Lippia* Linn. *Proc. Ind. Sci. Congr. Assoc.* 69(3-VI): 232.
- Post, T.V. & Kuntze, O. (1904). "Lexicon Generum Phanerogamarum". (Deutsche Verlags-Anstalt: Stuttgart).
- Raj, B. (1983). A contribution to the pollen morphology of Verbenaceae. *Rev. Palaeobot. & Palynol.* 39: 343-422.
- Reichenbach, H.G.L. (1828). Labiatae. "Conspectus Regni Vegetabilis per Gradus naturalis evoluti". Part 1: 115-117. (Carolus Cnobloch: Leipzig).
- Ridley, H.N. (1923). Verbenaceae. "The Flora of Malay Peninsula". Vol. 2: 611-642. (L. Reeve & Co. Ltd.: London).
- Roemer, J.J. & Schultes, J.A. (1818). Tetrandria Monogynia. "Caroli a Linne Equitis Systema Vegetabilium secundum classes Ordines Genera Species ...". Vol. 3: 1-481. (J.C. Cotta: Stuttgart).
- Rye, B.L. (1987). Verbenaceae. In Marchant, N.G. et al. "Flora of the Perth Region". Part 1: 550-552. (Western Australian Herbarium: Perth).
- Schauer, J.C. (1847). Verbenaceae. In De Candolle, A. "Prodromus Systematis Naturalis Regni Vegetabilis". Vol. 11: 522-700. (Victoris Masson: Paris).

- Sharma, A.K. (1970). Annual Report, 1967-1968. *Res. Bull. Univ. Calcutta* (Cytogenetics Lab.) 2: 1-50.
- Sidhu, M. & Bir, S.S. (1983). Karyological studies on weeds on cultivable land in Punjab, India. *Trop. Pl. Sci. Res.* 1: 1-13.
- Spach, E. (1840). Verbenaceae. "Histoire Naturelle des Végétaux Phanérogames". Vol. 9: 223-243. (Librairie Encyclopédique de Roret: Paris).
- Sprengel, K. (1825). Tetrandria Monogynia. "Caroli a Linnei ... Systema Vegetabilium". Edn 16, Vol. 1: 377-490. (Dietrich: Gottingen).
- Standley, T.D. (1986). Verbenaceae. In Standley, T.D. & Ross, E.M. "Flora of south-eastern Queensland". Vol. 2: 364-374. (Queensland Department of Primary Industries: Brisbane).
- Thwaites, G.H.K. (1861). Verbenaceae. "Enumeratio Plantarum Zeylaniae". Part 4: 241-244. (Dulau & Co.: London).
- Townsend, C.C. (1982). Verbenaceae. In Davis, P.H. "Flora of Turkey". Vol. 7: 31-35. (The University Press: Edinburgh).
- Tutin, T.G. (1972). Verbenaceae. In Tutin, T.G. et al. "Flora Europaea". Vol. 3: 122-123. (The University Press: Cambridge).
- Verdcourt, B. (1992). Verbenaceae. In Polhill, R.M. "Flora of Tropical East Africa": 1-155. (A.A. Balkema: Rotterdam).
- Walpers, W.G. (1845). Verbenaceae. "Repertorium Botanices Systematicae". Vol. 4: 3-134. (Fr. Hofmeister: Leipzig).
- Wootton, E.O. & Standley, P.C. (1915). Verbenaceae. Flora of New Mexico. *Contr. U.S. Natl. Herb.* Vol. 19: 548-551.

Index to Scientific Names

Names

New names and combinations are in **bold**. Synonyms, misapplied, misspelt, illegitimate or invalid names are in *italics*.

Page numbers

Page numbers in **bold** refer to main taxonomic treatment. Page numbers asterisked refer to figures and maps.

- Bertolonia* 111
crassifolia 111, 115
Blairia nodiflora 114
Clerodendrum 110
CRUCIFERAE 113
Cryptocalyx 111
nepetaefolia 111
Diotiotheca 111
repens 111
Lantana 113
Lippia 109, 110, 111, 113
canescens 115, 121, 122
geminata 110
nodiflora 110, 114, 115, 121, 125
var. normalis 115
var. repens 115, 122
var. reptans 125
var. rosea 122
var. sarmentosa 115, 122
var. vulgaris 115
f. canescens 121
repens 115
sarmentosa 115
triphylla 111
Panope 111
stoechadifolia 111
Phyla 109, 110, 112*, 113, 121, 125
canescens 109, 110, 112, 113, 115, 120, 121, 123*, 124*, 125
chinensis 109, 111, 114, 115
nodiflora 109, 110, 111, 112, 113, 114, 115, 119, 121, 125
var. antillana 115
var. canescens 115, 121, 125
var. longifolia 110, 115, 119
var. nodiflora 113, 114, 116*, 118*, 119, 120, 121
var. reptans 110, 113, 115, 119, 121
var. rosea 122
Piarimula 111
chinensis 111, 115
Platonia 111
nodiflora 115
PRIMULACEAE 109
PROTEACEAE 109
TETRANDRIA MONOGYNIA 109
Verbena 109, 113
capitata 114, 115
nodiflora 113, 114, 115
sarmentosa 115
repens 115
VERBENACEAE 109, 113
:LANTANEAE 109
:LIPPIEAE 109
:VERBENEAE 109
:VERBENOIDEAE 109
:VITICEAE 109
Zapania 110
canescens 122
crassifolia 115
nodiflora 114, 122
var. rosea 122
repens 115