

Diversity and useful products in some Verbenaceous member of Melghat and Amravati regions, Maharashtra, India

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ABSTRACT

Ingole SN. 2011. Diversity and useful products in some Verbenaceous member of Melghat and Amravati regions, Maharashtra, India. *Biodiversitas* 12: 146-163. Verbenaceae is a large family of very diverse habit. The present study deals with detailed characteristics, distribution and economically important products of some verbenaceous members of Melghat and Amravati regions. During the survey twenty members belonging to fourteen genera of Verbenaceae were collected. Some members occur abundantly either in wild or cultivated state like *Lantana camara* L. var. *aculeata* Mold., *Lantana flava* Medik., *L. nivea* Vent., *Glandularia bipinnatifida* (Schauer) Nutt., *Duranta erecta* L., *Vitex negundo* L., *Volkameria inermis* L., *Clerodendrum phlomidis* L. f., *Clerodendrum splendens* G. Don, *Nyctanthes arbor-tristis* L. etc. while *Petrea volubilis* L., *Gmelina arborea* Roxb., *G. philippensis* Cham., *Stachytarpheta jamaicensis* (L.) Vahl., *S. mutabilis* (Jacq.) Vahl., *Rothea serrata* (L.) Steane & Mabb., *Holmskioldia sanguinea* Retz. are not much common and occur in limited locations. *Phyla nodiflora* (L.) Greene, a creeping much-branched herb is found typically in wet places. *Tectona grandis* L. f. occurs very variable in size according to its habitat and is common dominant tree in forest of Melghat and also planted in plains. *Clerodendrum infortunatum* L., a gregarious tomentose shrub is exclusively found in shades of forest at limited spots in higher elevations of Melghat. The various members are not only beautiful ornamentals but also the source of important medicinal products useful in a broad range of diseases including skin disorders and snake remedies; they contain alkaloids, sterols, saponin, glucosides, dyes etc. and are economically quite important e.g. as high quality timber. On basis of morphological diversity the generic key is provided.

Key words: Verbenaceae, diversity, Melghat, Amravati, medicinal plants.

INTRODUCTION

Verbenaceae is a comparatively a large family composed of about 35 genera and about 1000 species (Atkins 2004). The name Verbenaceae was given by Persoon (1806) and has been conserved over older name Pyrenaceae (Vent 1799). In India it is represented by nearly 22 genera and more than 110 spp, some of the members being only grown as ornamentals. Verbenaceae is a widely distributed family of very diverse habit. They may be trees, shrubs or herbs, lianas occur fairly commonly, but no general distinctive habit is peculiar to the family as a whole.

Verbenaceae is a family of mainly tropical flowering plants. The plants in Verbenaceae can usually be recognized by combination of traits, containing trees, shrubs and herbs notable for heads, spikes, or clusters of small flowers, many of which have aromatic smell (Stevens 2001), with opposite leaves and flowers with slightly bilateral corolla symmetry. Their fruits are fleshy or dry, generally with two or four seeds, often dividing into two or four segments (Marx et al. 2010).

Herbs, lianas, shrubs or trees, sometimes with prickles or thorns; stems usually square in cross-section; usually with iridoids; often with phenolic glycosides. Hairs simple, gland-headed, with ethereal oils (including terpenoids), and

non-glandular, usually unicellular, sometimes calcified or silicified. Leaves opposite or occasionally whorled, simple, sometimes lobed, entire to serrate, with pinnate venation; stipules lacking. Inflorescences indeterminate, the lateral units individual flowers or appearing as individual flowers or appearing as individual flowers, forming racemes, spikes, or heads, terminal or axillary. Flowers bisexual, bilateral. Sepals 5, connate, the calyx tubular to bell shaped, persistent, occasionally enlarged in fruit. Petals 5 (but sometimes seemingly 4 fusion of the upper pair), connate, the corolla weakly 2-lipped, the lobes imbricate. Stamens 4, didynamous; filaments adnate to corolla; pollen grains usually tricolpate, exine thickened near apertures. Carpels 2, connate, ovary superior, unlobed to ± 4 -lobed, 2-locular but appearingly 4-locular due to development of false septa, but sometimes 1 carpel suppressed and then appearing only 2-locular, with axile placentation; style not apically divided, terminal; stigma usually 2-lobed, conspicuous, with well developed receptive tissue. Ovules 2 per carpel (i.e. usually 1 in each apparent locule), each marginally attached (attached directly to margins of false partitions), with 1 integument and a thin walled megasporangium. Nectar disc usually present. Fruit a drupe with 2 or 4 pits (single and 2-lobed in *Lantana*), or a schizocarp splitting into 2 or 4 nutlets; endosperm lacking (Judd et al. 2002).

Family Verbenaceae traditionally divided into different tribes such as I. Phrymeae, II. Stilbeae, III. Chloantheae, IV. Verbenae, V. Viticeae, VI. Caryopteridae, VII. Symphoreae, and VIII. Avicenniae (Bentham and Hooker 1862-1883). According to recent phylogenetic studies (Cantino 1992; Olmstead et al. 1993, 2000, 2001; Wagstaff and Olmstead 1997) Verbenaceae is not the family it used to be and these studies have shown that numerous genera traditionally classified in Verbenaceae belong instead in Lamiaceae. The biggest change involves the wholesale transfer of some 10 tribes and over 50 genera to the Lamiaceae (Cantino et al. 1992). Several smaller groups have been segregated into their own or other families as well. What remains in Verbenaceae s.s. comprises most of Briquet's (1895) subfamily Verbenoideae. Competing morphology-based classifications that rely on different traits conflict in significant ways (Marx et al. 2010). Molecular studies by Marx et al (2010) based on analysis of 7 chloroplast DNA regions for 109 species, representing all genera except one monotypic genus; provide inference into evolutionary relationships in Verbenaceae. The molecular phylogeny shows that name of the traditional classifications reflect phylogenetic relationships very well. Marx et al (2010) presented a new tribal classification, including one new tribe, Neospartoneae trib. nov. Eight clades are recognized as tribes viz. Casselleae, Citharexyleae, Duranteae, Lantaneae, Neospartoneae trib. nov., Petreeae, Priveae and Verbenae. Lantaneae and Verbenae together form a derived clade that comprises approximately two thirds of the species in Verbenaceae. The genera like *Clerodendrum*, *Gmelina*, *Holmskioldia*, *Tectona*, *Vitex*, etc. are now moved to Lamiaceae (GRIN 2011). The difficulty that led to confusion in distinguishing Verbenaceae from Lamiaceae had to do with the degree of separation of the locules and the position of the style, used by many treatment and keys (e.g. Cronquist 1981) to distinguish the families. However, the fundamental distinction has to do with where the ovules attach in relation to the false partitions that divide each carpel into two locules. In Verbenaceae, the ovules attach directly to the margins of the false carpel septa, whereas in Lamiaceae, the ovules attach to the sides of the in rolled carpel walls (Marx et al. 2010).

In the present work, 14 traditional genera of Verbenaceae occurring in the Amravati and Melghat region are studied. According to molecular research given by Marx et al (2010), the following tribes are recognized in which the studied genera are classified. Petreeae Briquet i.e. *Petrea volubilis* L., Duranteae Bentham i.e. *Duranta erecta* L., *Stachytarpheta jamaicensis* Vahl., *Stachytarpheta mutabilis* (Jacq.) Vahl., Verbenae Dumortier i.e. *Glandularia bipinnatifida* (Schauer) *Phyla nodiflora* (L.) Greene), Lantaneae Endlicher i.e. *Lantana camara* L. Nutt. Rest of the genera falls in tribe Viticeae of Bentham and Hooker (1862-1883), e.g. *Tectona*, *Gmelina*, *Clerodendrum*, *Holmskioldia*, and *Vitex*, which are excluded from Verbenaceae, once were the part of it. Hence, all are also taken for the present study. Some workers had suggested inclusion of *Nyctanthes arbor-tristis* L. in Verbenaceae. Therefore it has been also studied.

MATERIALS AND METHODS

The plant materials for the present study were collected from different habitats in Amravati district (Maharashtra, India). Regular survey was made in different localities of this district including forest area of Melghat, plane cultivated area and various local gardens for cultivated members. Herbarium specimens of collected plants were made and macrocharacters were studied in the field. Geographical and ecological factors were carefully considered while recording microvariations in the species. The collection was made in accordance with the flowering season to enable the collection of the flowering material and proper diagnosis. The investigatory vegetative and floral critical study of the species was carried out in the laboratory by using dissecting and binocular microscope. The identifications were checked with reference to standard floras. Describing major venation pattern, terminology of Hickey (1973, 1979) is followed. The list of genera and species collected during present investigation is summarized as follows (Table 1).

Table 1. The genera and species of Verbenaceae collected during present investigation in Melghat and Amravati regions, Maharashtra, India.

Tribe	Genus	Species epithet
Durateae	<i>Duranta</i>	<i>erecta</i> L.
	<i>Stachytarpheta</i>	<i>jamaicensis</i> Vahl. <i>mutabilis</i> (Jacq.) Vahl.
Lantaneae	<i>Lantana</i>	<i>camara</i> L. <i>flava</i> Medik. <i>nivea</i> Vent.
Petreeae	<i>Petrea</i>	<i>volubilis</i> L.
Verbenae	<i>Glandularia</i>	<i>bipinnatifida</i> (Schauer) Nutt.
Viticeae	<i>Clerodendrum</i>	<i>infortunatum</i> L. <i>phlomidis</i> L. f. <i>splendens</i> G. Don
	<i>Gmelina</i>	<i>arborescens</i> Roxb. <i>philippensis</i> Cham.
	<i>Holmskioldia</i>	<i>sanguinea</i> Retz.
	<i>Nyctanthes</i>	<i>arbor-tristis</i> L.
	<i>Phyla</i>	<i>nodiflora</i> (L.) Greene
	<i>Rotheca</i>	<i>serrata</i> Steane & Mabb.
	<i>Tectona</i>	<i>grandis</i> L. f.
	<i>Vitex</i>	<i>negundo</i> L.
	<i>Volkameria</i>	<i>inermis</i> L.

RESULTS AND DISCUSSION

Clerodendrum infortunatum L.

Clerodendrum infortunatum L. Sp. Pl. 637.1753, *Clerodendrum viscosum* Vent. Jard. Malm. : t. 25.1803; C. B. Cl in Hook. f. Fl. Brit. India 4: 594.1885; Cooke, Fl. Pres. Bombay 2: 513.1958 (Repr.); Naik Fl. Marathwada 698.1998; Singh et al. Fl. Mah. 2: 691.2001; Yadav and Sardesai, Fl. Kolhapur Dist. 372.2002; Almeida Fl. Mah. 4: 119.2003.

A perennial, gregarious, tomentose shrub 2.5-3 m high, woody, branches yellow, villous, branchlets purplish-green,

bluntly quadrangular, densely pubescent, with yellowish silky hairs. Leaves 15-19x9-10.5 cm, ovate, villous on both sides, more so on nerves and with small obscure glands beneath, acuminate, serrate, cordate at base; petioles 21-22x0.5-0.9 cm, cylindrical, pubescent. Flowers 4.1 cm long, pinkish-white in large terminal cymose, pubescent, erect panicles, 15-30x10-20 cm, upper branches and calyces reddening; pedicels 0.5-0.6 cm long, pubescent; bracts 1x0.4-0.5 cm, leafy, deciduous, boat shaped, ovate, hairy, green-purplish, gland dotted at tips, acute, entire. Calyx 1.5x0.8 cm, campanulate, divided up to base into 5 segments, segments equal, large, 1.5x0.7 cm, broadly lanceolate-ovate, silky pubescent on both sides, purplish-red, gland dotted outside, 3-veined, acute, entire, persistent, much enlarged in fruit. Corolla 3.1 cm long, white with pinkish-purple tinge at throat, tube 1.9 cm long, slender, straight; limb 2 cm across, somewhat oblique, lobes 5, spreading, nearly equal, 1.1x0.7-0.8 cm, ovate-oblong, concave, pubescent outside, obtuse, entire. Stamens 4, inserted below the throat, much exserted, longer 3-3.5 cm long, shorter 2.8-3 cm long; filaments slender, filiform, basally purplish, distally white, glabrous; anthers 0.4x0.2 cm, oblong, cells parallel, deep brown, glandular, dorsifixed, introrse. Ovary 0.15x0.1 cm, elongate, glabrous, green, 4-lobular, 4-celled; 1-ovule in each cell; style 3.5 cm long, much exserted, filiform, pinkish-purple, glabrous; stigma purple, glabrous. Drupes 0.6-0.8 cm in diameter, globose, black, enclosed by pinkish-red enlarged calyx (Figure 24).

Field notes. Gregarious, tomentose shrub with long petioled villous ovate, serrate leaves. At limited spots in Melghat in higher elevations. Flowers opening time: 6 to 8 pm. Major venation pattern pinnate brochidodromous. Flowers and Fruits: June to December.

Distribution: In Maharashtra, Kerala, Andamans, Burma, Taiwan and Indonesia.

Habitat and ecology: In shade of forests at limited spots at higher elevation in Chikhalda (Melghat) not common.

Vernacular name: Bhandira (Marathi)

Uses. In Indonesia, is used for gonorrhoea, juice as lotion. The leaves and roots are employed externally for tumors and skin disorders (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

Clerodendrum phlomidis L. f.

Clerodendrum phlomidis L. f. Suppl. 292.1781, *Clerodendrum multiflorum* (Burm. f.) O. Ktze. Rev. Gen. Pl. 3: 526.1891. *Volkameria multiflorum* Burm. f. Fl. Ind. 137, t. 45, f. 1.1786. C. B. Cl. in Hook. f. Fl. Brit. India 4: 590.1885; Cooke, Fl. Pres. Bombay 2: 511.1958 (Repr.); Naik Fl. Marathwada 698.1998; Singh et al. Fl. Mah. 2: 690.2001; Yadav and Sardesai Fl. Kolhapur Dist. 371.2002; Almeida Fl. Mah. 4: 116.2003.

A large scrambling, bitterly aromatic shrub or small tree, 4-8 m tall. Bark light-brown; branches pubescent, lenticellate, often drooping. Leaves 4-6x3.5-6 cm, broadly ovate to subrhomboid, pubescent, brittle, acute, crenate-dentate, undulate, subentire or entire, variously toothed in midportion, subcordate at base; petioles 1.8-2.5 cm long, densely pubescent. Flowers 4 cm long, medium sized,

white or pink, fragrant in small dichotomous axillary cymes forming a rounded terminal panicle, 9-11 cm long, pedicels 0.3-0.5 cm long, finely pubescent; bracts 0.4-0.7x0.15-0.4 cm, caducous, obovate or lanceolate, leafy, pubescent on both the sides, shortly acuminate, entire, cuneate at base, with distinct median nerve. Calyx 1x0.9 cm, campanulate, 5-toothed, green, segments divided half way down, glabrous, unaltered or very slightly enlarged in fruit, segments equal, ovate, glabrous or very finely hairy, with median nerve, shortly acuminate. Corolla white or pink, 3.5 cm long, limb 2.1 cm across; tube 2.5x0.1 cm, long, slender, straight, greenish-white, with 4-5 obscure stripes, very finely pubescent outside and with shining hairs inside, limb more or less oblique, with 5 spreading 1x0.5 cm, nearly equal, elliptic, finely pubescent on lower side, glabrous above, obtuse, entire lobes. Stamens 4, inserted below the throat, much exserted, longer 2 cm long, shorter 0.8 cm long; filaments filiform, white, purplish distally, pubescent below, anthers 0.2x0.1 cm, oblong, cells parallel, deep purplish-brown, dorsifixed, introrse. Ovary 0.2x0.15 cm, globose, green, papillate, 4-partite, 4-celled; 1-ovule in each cell; style 3.5-3.6 cm long, much exserted, filiform, white-purplish at top, glabrous; stigma glabrous, purplish. Drupes 0.6x0.5 cm, broadly obovoid, succulent, 4-lobed with 1-pyrene in each, sometimes lobes suppressed, wrinkled, depressed, enclosed by persistent calyx (Figures 19, 20).

Field notes. A large scrambling bitterly aromatic shrub or small tree with drooping branches and sub-rhomboid, brittle, crenate-dentate to entire leaves. Flowers white or rarely rosy pink. Flowers opening time: 8 to 9 pm. Major venation pattern actinodromous. Flowers and Fruits: October to January.

Distribution: In Kerala, Maharashtra and Himalayan regions of India and few Asian countries.

Habitat and ecology: Common throughout the plains in hedges and along banks of nalas. Also planted as a field-hedge.

Vernacular name: Taikal (Marathi)

Uses. Useful in inflammation, root is used as bitter tonic and given in convalescences and measles (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

Clerodendrum splendens G. Don

Clerodendrum splendens G. Don in Edinb. Phil. J. 9: 349.1824 non A Cheval. 1920; Bailey, Man. Cult. Pl. 845.1949; Naik, Fl. Marathwada 2: 700.1998. Singh et al. Fl. Mah. 2: 703.2001.

Woody, handsome straggling shrub reaching to great height. Leaves 11-14x8-12 cm, wide ovate, glabrous, deep green above, purplish marginally, pubescent on nerves beneath, short acuminate, entire, cordate-rounded at base, petioles 0.4 cm long, glabrous, thick, cylindrical, purplish. Flowers 2 cm long, crimson in much branched cymose roundish panicles, 9-10 cm long, peduncles 2.8x0.25 cm, quadrangular, compressed, finely pubescent or nearly glabrous, purplish-green; pedicels 1 cm long, cylindrical, finely pubescent, brownish-green; bracts small, lower ones slight larger, in pairs at forks, 0.25-0.3 cm long, less than 0.1 cm across, linear, shorter than calyx, glabrous or finely

pubescent, brownish, very acute, entire. Calyx 0.5-1x0.5-0.6 cm, campanulate, base globose, divided more than half way down into 5 segments, equal, 0.35-0.7x0.2-0.3 cm, lanceolate, very acute, entire, persistent, not much enlarged in fruit, basally green, deep pinkish-red tinged, glabrous, midvein pale-red. Corolla bright red-scarlet, crimson, 0.4 cm long, hypocrateriform, limb 2 cm across; tube 1.5-2x0.15-0.2 cm, slender, straight, slight oblique near limb, bright red, yellow tinged at bottom, with 9-pale yellowish-red stripes, conspicuous inside, glabrous; limb more or less oblique, with 5 spreading, subequal, oblong, concave, obtuse, entire or crenulate lobes, anterior middle lobe 0.15x0.5 cm, rest 1.2x0.6 cm, glabrous. Stamens 4, inserted below the throat, much exserted, longer 2 cm long, shorter 1.6-1.7 cm long; filaments slender, filiform, pale yellowish up to half way, pale red distally, shortly hairy upwards, glabrous below, twined at maturity; anthers 0.3x0.25 cm, oblong, cells parallel, deep brown-grey, dorsifixed, extrorse. Ovary 0.2x0.3 cm, globose, pale green or yellowish, glabrous, glaucous, 4-lobular, 4-celled; 1-ovule in each cell; style 4 cm long, much exserted, filiform, red, glabrous; stigma shortly 2-fid, red, glabrous (Figure 23).

Field notes. Woody handsome scandent shrub with entire cordate-rounded shortly acuminate leaves. Flowers opening time: 1 to 1.30 pm. Major venation pattern pinnate brochidodromous. Flowers and Fruits: December to February.

Distribution: In Kerala Ceylon.

Habitat and ecology: Grown as ornamental, grown along trellis and walls in gardens for its showy blossoms and screen of foliage; propagated from stem cuttings.

Vernacular name: Sankrant Vel (Marathi)

Common name: Flaming Glorybower (English)

Uses. Beautiful ornamental along trellis and walls in gardens. In Malaya, infusion of vegetative parts is drunk as a purgative and applied externally to distended abdomen (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Duranta erecta* L.**

Duranta erecta L. Sp. Pl. 637.1753. *D. repens* auct. non L. 1753. *D. plumieri* Jacq. Select. Strip. Arn. 186.1763; C. B. Cl. in Hook. f. Fl. Brit. India 4: 560.1885; Cooke, Fl. Pres. Bombay 2: 518.1958 (Repr.); Singh et al. Fl. Mah. 2: 704.2001; Yadav and Sardesai Fl. Kolhapur Dist. 372.2002; Almeida Fl. Mah. 4: 120.2003.

An evergreen, perennial, bushy shrub up to 14 m high, with drooping branches, bearing axillary thorns, stem lenticellate, pale brownish, branchlets appressed hairy. Leaves 4-7.5x2-3.5 cm, ovate, softly hairy on both sides, acute, subentire or serrate, cuneate and slight asymmetric at base, petioles 0.6-0.7 cm long, softly pubescent. Flowers 1 cm long, purple or bluish-white, borne in profusion in terminal erect or drooping panicles or loose racemes, 6-8 cm long, daughter axes shorter, softly pubescent, green; pedicels 0.2-0.3 cm long, shortly pubescent, lasting longer along with peduncles, bracts lower 0.5-0.6x0.3 cm, subulate, leafy, acute, green, entire, caducous, shorter than calyx, softly pubescent, upper ones 0.05-0.1x0.2 cm, narrow-ovate. Calyx 0.5x0.2 cm, tubular, 5-toothed,

yellowish-green, softly pubescent outside, orange colored in fruits, segments distinct, 0.4x0.1 cm, unequal, 3 slight longer, triangular, acute, Corolla purple or bluish-white, 0.7 cm long, limb 0.4 cm across, slight 2-lipped, tube 0.4x0.15 cm, oblique, softly hairy inside and outside, lobes 0.2x0.1 cm, broad, obtuse, hairy on both sides, yellowish at throat. Stamens 4, included, inserted at middle of tube, longer 0.2 cm long, shorter 0.15 cm long, filaments glandular, anthers 0.5 cm long, yellow, dorsifixed, introrse. Carpels 4, ovary 0.1x0.07 cm, globose, green, glabrous, tetralocular, 2-ovules in each cell, style 0.2-0.3 cm long, glabrous, stigma capitate, papillose. Drupes 1.2x0.7-0.8 cm, fleshy, globose-obovoid, glabrous, glaucous, orange colored at maturity, falling off with persistent orange calyx, and part of pedicel. Seeds 8 (Figures 11, 12).

Field notes. An evergreen bushy shrub. Flowers opening time: 8 to 9 am. Major venation pattern : pinnate semicraspedodromous. Flowers and Fruits: throughout the year.

Distribution: Native in South America, Florida-Brazil range and West Indies.

Habitat and ecology: Grown as hedge plant.

Vernacular names: Vilayati mendi (Marathi).

Common name: Golden dew drops (English).

Uses. Grown as hedge. Leaves contain saponin and fruits contain alkaloid analogous to narcotine. Seeds yield oil (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Glandularia bipinnatifida* (Schauer) Nutt.**

Glandularia bipinnatifida (Schauer) Nutt. in DC. Prodr. 11: 553.1847; *Verbena bipinnatifida* Bailey, Man. Cult. Pl. 840.1949; Naik Fl. Marathwada 707.1998; Singh et al. Fl. Mah. 2: 706.2001; Yadav and Sardesai Fl. Kolhapur Dist. 375.2002; Almeida Fl. Mah. 4: 133.2003.

A prostrate decumbent, perennial herb; stem hirsute. Leaves 3.5x6.4 cm (0.4 cm across the middle part), deeply pinnatifid, linear-oblong segments 2.5-4.5 cm long, hirsute on both sides, acute, decurrent at base. Flowers 2.5 cm long, medium sized, showy, pink-purplish or white in dense, solitary capitate-corymbose spikes 2-5 cm long, elongating in fruit; bracts 0.7-0.8x0.1 cm, lanceolate, conspicuous, slight shorter than calyx, acute, hairy, entire, green. Calyx 1.3x0.2 cm, tubular, 5-toothed, 5-ribbed, densely pubescent on ribs, setaceous, segments acuminate. Corolla pink-purplish, 2.2 cm long, limb 1.3 cm across, more or less 2-lipped; tube 1.5x0.1 cm, slight longer than calyx, cylindric, slight oblique, hairy inside; limb with 5 spreading lobes, unequal, oblong, retuse or emarginate, posterior lobe largest 0.8x0.4cm, 2-laterals 0.7x0.3 cm, 2-anterior smallest, 0.6x0.3 cm, glabrous. Stamens 4, inserted at middle of corolla tube, included, longer 0.2 cm long, shorter 0.1 cm long, anthers 0.05 cm long, yellow, dorsifixed, introrse. Ovary 0.2x0.07 cm, globose-elongate, glabrous, pale-green, 4-lobed, 4-celled, 1-ovule in each cell; style 1.3 cm long, white, glabrous, stigma minute, green, bifid, sticky. Fruits 0.3x0.1 cm, dry, elongate-oblong, 4-lobular, enclosed in calyx, black on ripening, splitting into 4, 1-seeded pyrenes (Figures 8, 9).

Field notes. A prostrate decumbent herb with pinnatifid leaves. Flowers opening time: 11.30 am to 12 pm. Major venation pattern actinodromous. Flowers and Fruits: throughout the year.

Distribution: Cultivated in many gardens of India.

Habitat and ecology: Grown in gardens as an ornamental.

Common name: *Dacota* vervain (English)

Uses. Useful for beautifying landscape, but susceptible to dampness (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Gmelina arborea* Roxb.**

Gmelina arborea Roxb. Pl. Cor. 3: 42, t. 246.1815; C. B. Cl in Hook. f. Fl. Brit. India 4: 581.1885; Cooke, Fl. Pres. Bombay 2: 504.1958 (Repr.); Naik Fl. Marathwada 707.1998; Singh et al. Fl. Mah. 2: 692.2001; Yadav and Sardesai Fl. Kolhapur Dist. 372.2002; Almeida Fl. Mah. 4: 121.2003.

A medium-sized, unarmed, deciduous tree, 15 m tall. Bark smooth, whitish-grey, young parts pale-yellow, tomentose, covered with fine white mealy pubescence. Leaves large 17-17.5x10 cm, cordate, pubescent, mature ones glabrous above, fulvous-tomentose beneath, shortly acuminate, entire, young leaves often with few large distant teeth, cordate at base, petioles 5-8 cm long, cylindric, puberulous with shining glands at top. Flowers showy, 2.5-3.5 cm long, brownish-yellow, usually in small, opposite decussately arranged small cymes of about 3 flowers along the axis of a densely fulvous-hairy terminal panicles about 14-20 cm long; buds clavate, angular, pedicels 0.8-0.9 cm long, densely fulvous-hairy, bracts 0.1x0.05 cm, lower ones ovate, upper linear-lanceolate, entire, acute, caducous, leaving scars, densely pubescent with whitish hairs. Calyx 0.4-0.5x0.6 cm, broadly campanulate, 5-toothed, teeth unequal, small, distinct, triangular, acute, anterior two larger, gland dotted with roundish small glands, posterior 3 densely fulvous-hairy, persistent, unaltered in fruit. Corolla 3-5 cm long, limb 2 cm across, brownish-yellow, 2-lipped, infundibuliform, ventricose in upper part, deciduous, tube 1.5x0.8 cm, oblique, above 1.1 cm across, yellow inside, hairy on both sides; limb oblique, spreading, 5-lobed, 2-lipped, upper lip small, deeply divided into 2-oblong, obtuse lobes, 1-1.2x1-1.2 cm, lower lip large, 3-lobed, the middle lobe largest, much longer, broader, 2.1x2 cm, bright yellow, brownish marginally, projecting forward with conspicuous mid nerve, elevating from the lower side, ovate, sub-obtuse, with undulate-crenulate margin; lateral lobes smaller 1.6x1.5-1.6 cm, brownish-yellow, obovate-rounded, with inconspicuous mid nerve, lobes densely hairy outside with whitish, soft hairs. Stamens 4, inserted little below the throat, longer 2 cm. long, shorter 1.5 cm long, bright yellow, shorter than the corolla, with short, fine, yellowish papillate hairs; anthers 0.2x0.1 cm, conspicuous, deep brown-orange, oblong, dorsifixed, introrse. Ovary 0.4-0.5x0.3-0.5 cm, globose, pale-green, whitish below with distinct rim at top around stylar base, glabrous, 4-celled, 1-ovule in each cell, style 2.1-2.3 cm long, slender, yellow, glabrous, stigma yellow, shortly 2-fid with subequal arms. Drupes 2.3-2.5x2 cm, smooth,

obovoid, fleshy, green when young, turning orange-yellow on ripening with whitish dots concentrated basally (Figure 14).

Field notes. Natural or cultivated medium sized, unarmed, deciduous tree with grey smooth bark, occasional in Melghat. Flowers opening time: Early hours of morning. Major venation pattern pinnate festooned brochidodromous. Flowers and Fruits: February to May.

Distribution: Scattered in deciduous forests in the greater parts of India and Andamans, up to an altitude of 5000 ft.

Habitat and ecology: Occasional in Melghat forests, common in deciduous forests, planted in plains.

Vernacular name: Shivan (Marathi)

Common name: Grey teak (English).

Uses. Wood is used for furniture, carriages, printing box, musical instruments, picture frames, artificial limbs etc. and employed for bridges. All plant parts useful in medicine; leaf juice is used for ulcers. Flowers are given blood diseases. Root is an ingredient of Ayurvedic preparation "Dasamula". Bark and roots contain traces of alkaloid. Root is bitter tonic. Leaves are used as a feed for silk worms (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Gmelina philippensis* Cham.**

Gmelina philippensis Cham. In Linnaea 7: 109.1832. *G. hystrix* Schult. ex Kurz in J. As. Soc. Bengal 39.81.1870; C. B. Cl in Hook. f. Fl. Brit. India 4: 582.1885; Cooke, Fl. Pres. Bombay 2: 505.1958 (Repr.); Naik Fl. Marathwada 702.1998; Singh et al. Fl. Mah. 2: 704.2001; Yadav and Sardesai Fl. Kolhapur Dist. 372.2002; Almeida Fl. Mah. 4: 122.2003.

A thorny sprawling shrub, branches drooping, spines axillary in pairs, short. Leaves 7-8x3.5-4 cm, elliptic, glabrous, glaucous beneath with scattered round glands, young leaves often trilobed with 3 equidistantly placed teeth; petioles 1x0.05 cm. Flowers large, showy 5-6x2.5 cm, yellow with 0.2 cm long pedicels in pendulous panicles, upto 15-22 cm long, enclosed in large 3.3x2 cm, showy, membranous, purple veined bracts, broadly ovate, acute or shortly acuminate, entire. Calyx 0.6x0.6 cm, broadly campanulate, 5-toothed, teeth short, unequal, anterior two gland dotted with 2 small roundish glands, persistent, unaltered in fruit. Corolla large, bright yellow, 5-6 cm long, limb 2.5 cm across, 2-lipped, infundibuliform, ventricose in upper part, deciduous, tube 1.5x0.3 cm, oblique, with sticky white sap, pubescent outside; lobes 5, upper lip 2-lobed, 2.5x2 cm, anterior laterals 1.6x1.2 cm, middle 1.2x1.4 cm, slight crenulate. Stamens 4, inserted below the throat, shorter than the corolla, longer 2.5 cm long, shorter 1.3 cm long, bright yellow hairy, anthers 0.3x0.2 cm, deep brown, oblong, dorsifixed, introrse. Ovary 0.4x0.3 cm, globose, with bulging outgrowth below, pale-green, with distinct green rim at top, glabrous, 4-celled, 4-lobed, 1-ovule in each cell, style 3.8 cm long, slender, pale-yellow, curved distally, glabrous; stigma very shortly and unequally 2-fid, pale-yellow, longer arm 0.2 cm, glabrous. Drupes 1.5-2.3x1-1.5 cm, succulent,

glabrous, obovoid, green, white dotted throughout, yellow on ripening (Figure 15).

Field notes. A thorny sprawling shrub, with drooping branches. Thorns axillary in pairs. Flowers opening time: 6 to 7 am. Major venation pattern pinnate brochidodromous. Flowers and Fruits: August to February.

Distribution: Grown in gardens of India.

Habitat and ecology: Grown in gardens, not common.

Vernacular name: Shivan (Marathi)

Uses. In Malaya, the plant is pounded with lime and applied with poultice to the throat for relieving cough. Grown as ornamental for beautiful pendulous inflorescence (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Holmskioldia sanguinea* Retz.**

Holmskioldia sanguinea Retz. Obs. 6: 31.1791; C. B. Cl in Hook. f. Fl. Brit. India 4: 590.1885; Cooke, Fl. Pres. Bombay 2: 518.1958 (Repr.); Naik Fl. Marathwada 702.1998; Singh et al. Fl. Mah. 2: 705.2001; Yadav and Sardesai Fl. Kolhapur Dist. 372.2002; Almeida Fl. Mah. 4: 122.2003

A perennial, straggling evergreen shrub, 3-5 m high, branches drooping, puberulous. Leaves 7-8x4-4.5 cm, ovate, pubescent along nerves beneath, acuminate, entire or sometimes finely serrate, cordate at base; petioles 1.3 cm long. Flowers 2.8 cm long, red or yellow in axillary and terminal panicles of cymes, 2.5-5 cm long, puberulous, with saucer shaped petaloid calyx; pedicels 0.6-0.9 cm long, thin, bracts small, 0.2x0.1 cm, ovate, deciduous, shorter than pedicels and calyx; bracteoles 2, small. Calyx upto 2.5 cm in diameter, spreading broadly and uniformly from base upward, obconic, membranous, red to orange, glabrous inside, with fine reticulum of veins, margin entire, obscurely sinuate. Corolla dark red, 2-2.5 cm long, tubular, cylindric, curved, tube 1.4x0.2 cm, widening upward, with 6-8 stripes, hairy outside, limb 0.8x0.5-0.6 cm, oblique, somewhat 2-lipped, with 5 short lobes, hairy outside, convolute outwardly, lower lip 0.3-0.4 cm across, upper smaller, 0.25 cm across. Stamens 4, inserted half way above in tube, shortly exerted, longer 1.1.5 cm long, shorter 0.95 cm long, filaments red, hairy, papillose, glandular; anthers 0.15x0.1 cm, ovate, cells parallel, papillose, glandular, dorsifixed, introrse. Ovary 0.15x0.2 cm, obtuse or obscurely depressed, glandular, green, 4-lobular, imperfectly 4-celled; 1-ovule in each cell, laterally attached; style 1.2 cm long, red, shortly exerted, glabrous; stigma shortly 2-fid. Mature ovary 0.4-0.5 cm long, obovoid, black, included in enlarged calyx (Figures 25, 26, 27).

Field notes. A straggling evergreen shrub with drooping branches and ovate, entire, acuminate leaves and red or yellow flowered forms. Flowers opening time: Midnight to early hours of morning. Major venation pattern pinnate brochidodromous. Flowers and Fruits: October to January.

Distribution: Throughout India including Himalayas, Burma, Madagaskar.

Habitat and ecology: Grown in gardens, not much common.

Common names: Chinese hat (English), Cup saucer (English), Coolies hat (English)

Uses. Plant is eaten by sheep and goats. The wood is light red and moderately hard grown as ornamental (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Lantana camara* L. var. *aculeata* (L.) Mold.**

Lantana camara L. var. *aculeata* (L.) Moldenke in Torreyia 34: 9. 1934. *L. aculeata* L. Sp. Pl. 627. 1753; *L. camara auct. non* L. 1753; C. B. Cl. In Hook. f. Fl. Brit. India 4: 562.1885; Cooke, Fl. Pres. Bombay 2: 498. 1958 (Repr.); Naik Fl. Marathwada 703.1998; Singh et al. Fl. Mah. 2: 693. 2001; Yadav and Sardesai Fl. Kolhapur Dist. 374.2002; Almeida Fl. Mah. 4: 123.2003.

A straggling or scandent aromatic shrub, 2-3.5 m tall, stem brown with stout recurved prickles, branchlets opposite. Leaves 5-8x3.5-5 cm, ovate, scabrous, rugose above, hairy, acute, crenate-serrate, rounded at base, petioles 3x0.15-0.2 cm, pubescent. Flowers 1.5x2-2.5 cm, pink, red, yellow-orange turning into pink-orange in axillary, opposite, pedunculate capitate spikes, 1.5x2-2.5 cm, elongating in fruit, peduncles 3-4 cm long, 4-angled, scabrous, hairy; bracts 0.7x0.15 cm, linear, conspicuous, longer than calyx, acuminate or acute, entire, subsistent, pale-green, pubescent, lower ones 0.8-0.9x0.3 cm, leafy, ovate. Calyx 0.15x0.1 cm, truncate, obscurely toothed, persistent, membranous, hairy, pale-green. Corolla yellow-orange changing to pink, 2 cm long, salver shaped, deciduous; tube 1.5-2x0.1-0.15 cm, oblique, hairy, limb 0.4 cm across, lobes 4-5, spreading, bigger ones 0.5x0.3 cm, smaller 0.2x0.2 cm, rounded, acuminate, glabrous. Stamens 4, inserted about middle of tube, included, longer and shorter filaments less than 0.1 cm long, anthers less than 0.1x0.1 cm, oblong, yellow, basifixed, introrse. Ovary less than 0.1x0.1 cm, glabrous, green, 2-celled, ovule solitary, attached laterally, close to the base of each cell, style 0.15 cm long, thin, glabrous, stigma oblique, bilobular, subcapitate, glandular, sticky. Drupes 0.4x0.4 cm, globose, shining, green, fleshy, black on ripening, separating into two 1-celled, 1-seeded pyrenes (Figure 1).

Field notes. A straggling or scandent aromatic shrub, with stout recurved prickles. Flowers opening time: about 6.30 to 7.00 pm. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: throughout the year.

Distribution: Native in Tropical America.

Habitat and ecology: Very common throughout in diverse habitats, common in waste places. Gregarious in many parts of Melghat.

Vernacular names: Ghaneri (Marathi), Raimuni (Marathi)

Uses. Leaves contain tannins, sugars, and resin, lantadenes, steroid such as lancamarone. Bark contains quinine with strong antipyretic and antispasmodic properties. The flowers yield volatile oil similar to that of leaf oil. Leaves and twigs for green manure in forest, polishing woods, substitute for tea. Fruits edible. Stems are used as toothbrush. A decoction is given in case of tetanus, rheumatism, malaria, etc (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976)

***Lantana flava* (L.) Medik.**

Lantana flava Medik. in Ait. Acad. Theod. Palat. 3: 225.1775; *L. camara* var. *flava* Mold. Fl. Ceylon 4: 299.1983; Almeida Fl. Mah. 4: 124.2003.

An ornamental small shrub, 60-90 cm high; prickles on branches small, obscure. Leaves 6.5-7x2.8-3 cm, narrowly ovate, acute at base, serrate, teeth smaller, petioles 0.8-1.0 cm long. Flowers sulphur yellow. Calyx 1.5x0.1 cm, teeth somewhat distinct (Figure 2).

Field notes. Ornamental shrub. Flowers opening time: 6 to 7 pm. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: throughout the year.

Distribution: Native in Tropical America.

Habitat and ecology: Planted in gardens

Vernacular names: Ghaneri (Marathi)

Uses. Planted in gardens, in landscaping, beautification of avenues.

***Lantana nivea* Vent.**

Lantana nivea Vent.; *L. camara* var. *nivea* Vent. Bailey Cyclop. Amer. Hort. 884.1900; Gopalswamy Iyeng. Gard. Ind. Ed. 2: 276.1935; Moldenke in Lilloa 4: 290.1939; Bailey Manu. Cult. Pl. ed. 2: 842.1949; Almeida Fl. Mah. 4: 124.2003.

A shrub 2.5 m high. Leaves 4-10x2.3-5 cm, lanceolate-ovate or narrowly ovate, finely serrate, petioles 1-2x0.12 cm. Flowers white. Calyx 0.15x0.1 cm, obscurely toothed. Corolla 1.5x0.6-0.7 cm, white, when young, yellow tinged at mouth (Figure 3).

Field notes. Ornamental shrub. Flowers opening time: 6 to 7.30 pm. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: throughout the year.

Distribution: Native in Tropical America.

Habitat and ecology: Planted commonly in gardens

Vernacular names: Ghaneri (Marathi)

Uses. Popular ornamental, planted in gardens.

***Nyctanthes arbor-tristis* L.**

Nyctanthes arbor-tristis L. Sp. Pl. 6.1753; C. B. Cl in Hook. f. Fl. Brit. India 3: 603.1882; Cooke, Fl. Pres. Bombay 2: 176.1958 (Repr.); Naik Fl. Marathwada 525.1998; Almeida Fl. Mah. 3a: 190.2001. Singh et al. Fl. Mah. 2: 311.2001.

A large shrub or small tree, upto 10 m high, with greyish-green rough bark. Very scabrous all over with short, stiff whitish hairs, branchlets opposite, sharply quadrangular, strigose. Leaves 9-11x3.2-7.5 cm, opposite, ovate, scabrous above, densely pubescent beneath, conspicuously so on nerves, main nerves conspicuous beneath, acuminate, entire or toothed with one or few large distant teeth; petioles 0.5-0.8x0.2 cm, hairy, stout, lower mature leaves with shorter ones. Flowers 2 cm long, delightfully fragrant, white with orange tube, sessile in bracteate fascicle of 3-5 in each pedunculate head, arranged in trichotomous cymes; peduncles sharply 4-angled, slender, pubescent, axillary, solidary and in terminal trichotomous cymes, arranged in pyramidal panicle 15-18

cm long, each fascicle 6-8 cm long, with 4-bracts forming involucre at base, central flower ebracteate, one pair larger, outwards, each one 0.9x0.8 cm, slight smaller inwards, each 0.75-0.9x0.7-0.8 cm, pairs diagonally arranged, bracts herbaceous, ovate or suborbicular with central prominent nerve at which margins folded inwardly, scabrous, finely pubescent and shining inside, glabrous outside, apiculate, mucronate, entire. Calyx 0.6-0.7x0.5 cm, narrowly campanulate, truncate, obscurely 5-toothed, hairy outside, glabrous inside, faint green, persistent, unaltered in fruit; segments less than 0.05-0.1x0.3 cm. Corolla with orange tube and white limb, 1.3 cm long, hypocrateriform, deciduous, opens in evening and falls off in the morning, glabrous, tube 1-1.1x0.4-0.5 cm, cylindrical, straight, finely ribbed, orange colored; limb 2.5-3 cm across, white, 4-8 lobed, lobes 1.6-1.8x0.9 cm, unequally divided at apex, oblong-obcordate, margins outwardly rolled, cuneate at base, twisted in bud. Stamens 2, short, equal, 0.6-0.7 cm long, epipetalous, inserted near the top of tube, included; filaments completely adnate to the tube, glabrous, deep orange-yellowish; anthers 0.3x0.1-0.15 cm, pale brown, dorsifixed, introrse. Ovary 0.2cm long, pale green, glabrous, 2-celled; 1-ovule in each cell; style 0.4 cm long, pale green, glabrous; stigma subcapitate, green. Capsules 1.8x1.5 cm, suborbicular or obcordate, much compressed, finely pubescent, chartaceous, reticulately veined, mucronate, 2-celled, green when young, pale-brown at splitting stage, separating into 2-flat, 1-seeded carpels (Figure 28).

Field notes. Small tree with grayish green bark. very scabrous all over. Flowers opening time: 7 to 8 pm. Major venation pattern pinnate festooned brochidodromous. Flowers and Fruits: August to December.

Distribution: Wild in Sub-Himalayan region up to 1500 m from Chenab to Nepal, also in Rajashtan, Madhya Pradesh.

Habitat and ecology: Frequent all along the hilly western borders of Satpuras occurring wild and in natural habitat, growing gregariously covering dry steep hill sides and rocky grounds. It is cultivated in gardens and courtyards of houses for its fragrant flowers.

Vernacular names: Parijatak (Marathi), Khurasli (Marathi)

Common name: Night jasmine (English)

Uses. The bright orange corolla tube contains a coloring matter nyctanthin, a glucoside. The corolla tubes were formerly used for dyeing silk. Sometimes in conjunction with safflower, turmeric, indigo. Grown in gardens and courtyards for fragrant flowers (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Petrea volubilis* L.**

Petrea volubilis L. Sp. Pl. 625.1753; Bailey, Man. Cult. Pl. 843.1949. Cooke, Fl. Pres. Bombay 2: 518.1958 (Pepr.); Naik Fl. Marathwada 705.1998; Singh et al. Fl. Mah. 2: 705.2001; Yadav and Sardesai Fl. Kolhapur Dist. 374.2002; Almeida Fl. Mah. 4: 126.2003.

An extensive perennial liana, up to 10 m high, stem ash-colored, covered with grayish pubescence, lenticellate. Leaves 14-16x6.5-8 cm, elliptic, scabrous above, pubescent

on nerves beneath, acute or shortly acuminate, entire, undulate, lobate at base; petioles 0.7x0.15 cm, cylindric, pubescent. Flowers 2-2.3 cm long, showy, purple in pendulous, 15-19 cm long axillary racemes, remarkable for large persistent calyx, remaining long after fallen corollas, rachis slender, green below, purplish upwards, densely covered with soft whitish pubescence; pedicels slender, 1.8 cm long, cylindric, purplish-green, densely pubescent with shining hairs, bracts 1.5x0.4 cm, caducous, distinct with young flowers, linear, shorter than calyx, acute, entire, softly hairy with shining hairs, older ones leaving a dot like scar, older bracts apparently slight extraxillary. Calyx campanulate, petaloid, purplish-blue, often becoming green, dry in fruits, tube 0.5x0.25 cm, narrow at base, slight expanded above, densely pubescent outside, lobes 5, 2.2-2.5x0.4-0.5 cm, spreading, radiating, star shaped, equidistantly placed, oblong, sub-acute or rounded, posterior two, slight smaller, each 1.8-1.9x0.4 cm, with reticulum of fine veins and prominent midvein 5, very short 0.2x0.05 cm, acute, alternating scally papillae present in throat, densely pubescent outside with whitish shining hairs. Corolla deep violet, often deciduous, funnel shaped, 2.2x2.3 cm; tube 0.6-1.7x0.3 cm, short, cylindric, oblique, glabrous, whitish at base, distally purple with obscure purplish stripes, short shining hairs outside, hairy inside; lobes spreading, somewhat unequally 2-lipped, intensely purple, posterior lobe 0.4x0.3 cm, oval-oblong, sub-acute with distinct white patch, roundish, showing 3 distinct, prominent veins, merging into fine reticulum, posterior pair 0.9-1.2x0.5 cm, anterior one 1.3-1.4x0.7 cm. Stamens 4, equal, inserted at mouth of corolla tube, filaments 0.15 cm long, delicate, white-purplish, finely pubescent, anthers 0.7 cm long, oblong, brownish-purple, basifixed, extrorse. Ovary very small, 0.1x0.15 cm, oblong, obscurely bilobed, ovate acute, green, glabrous with yellowish small dot like gland at a side, obscurely 2-celled, 1-ovule in each cell, style 0.2 cm long, reddish-purple below, white distally, slight bent basally, glabrous; stigma oblique, deep purplish, very shortly 2 fid. Drupes enclosed in calyx, 2 celled, 2 seeded. After corolla falls off, fruiting calyx later on after long time falls off on ground by floating in rotating fashion like a wheel, along with air current, pedicels and peduncle persistent for quite a long time even after calyx and corolla fall off (Figure 10).

Field notes. An extensive liana with ash colored stem. Flowers opening time: 9.30 to 11 am. Major venation pattern pinnate brochidodromous. Flowers and Fruits: December to March.

Distribution: Native in Tropical America.

Habitat and ecology: Grown as ornamental in gardens.

Common names: Purple Wreath (English), Queen's Wreath (English)

Uses. Grown as ornamental in gardens for beautiful purple colored star shaped calyces and deep blue corollas.

***Phyla nodiflora* (L.) Greene**

Phyla nodiflora (L.) Greene in Pittonia 4: 46.1899; Sant. In Rec. Bot. Surv. India 16(1): 211.1967 (3rd Rev. ed.). *Verbena nodiflora* L. Sp. Pl. 20.1753. *Lippia nodiflora* (L.) A. Rich. in Michaux, Fl. Bor. Amer. 2:

15.1803; C.B.Cl. in Hook. f. Fl. Brit. India 4: 563.1885; Cooke, Fl. Pres. Bombay 2: 499.1958 (Repr.); Naik Fl. Marathwada 705.1998; Singh et al. Fl. Mah. 2: 693.2001; Yadav and Sardesai Fl. Kolhapur Dist. 374.2002; Almeida Fl. Mah. 4: 126.2003.

Perennial, much branched, prostrate, creeping herb, rooting at nodes, stem appressed hairy with white medifixed hairs, finely 5-6 ribbed. Leaves 2-2.6x1 cm, obovate to spatulate, upper half serrate, teeth sharp, 3-5, appressed hairy on sides, thick, fleshy, rounded, shortly mucronate, attenuate at base. Flowers very small, 0.35 cm long, whitish-yellowish-pink, usually in 7-9 whorls in axillary cylindrical 0.6-0.9x0.6 cm condensed spikes, elongate and spicate in fruit; peduncles 2-3.5 cm long, born on upright branches from the axil of one only of each pair of leaves, lower bracts larger, 0.2x0.2 cm, elliptic-round, upper smaller, 0.5x0.1-0.2 cm, obovate, purplish at apex, mucronate, glabrous, cuneate at base, shorter than corolla, herbaceous, margins membranous, hairy. Calyx 0.15 cm long, membranous, purplish at tip, deeply 2-lobed, compressed, mitre shaped, pubescent on back, 2-linear, acuminate lobes closely enclosing the fruit, projecting beyond it. Corolla whitish-yellowish changing to pink, mouth deep pink, 0.35 cm long, limb 0.3 cm across, unequally 2-lipped, glabrous, pushed off as a calyptra by ripening fruit, tube cylindric, straight, limb 2-lipped, upper lip bifid, erect, 0.1x0.05 cm, lower lip 3-lobed, central lobe largest, 0.15x0.1 cm, cordate, mucronate, rests narrowly ovate, subacute, 0.1x0.05 cm. Stamens 4, filaments less than 0.1 cm long, included; anthers ovate, less than 0.1x0.1 cm, dorsifixed, introrse. Ovary small, 0.05 cm long, glabrous, green, 2-lobed, 1-2 ovules in each cell, laterally attached near the base of cell, style 0.15 cm long, glabrous, stigma oblique, sub-capitate. Drupes 0.2-.3x0.2 cm, ellipsoid, dry, enclosed in the accrescent calyx, two 1-seeded plano-convex pyrenes (Figures 4, 5).

Field notes. Much branched, prostrate, creeping herb, stem appressed hairy with medifixed hairs. Flowers opening time: 1 to 1.30 pm. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: July to December.

Distribution: throughout India.

Habitat and ecology: In wet places, almost throughout India, ascending 900 m in the hills. Common in marshy places, frequent throughout, along lake margins, drains, near water taps, water margins in streams and rivers.

Vernacular names: Gour Mundi (Marathi), Ratoliva (Marathi)

Uses. Plant is valued for making lawns. The leaves are eaten in Ceylon and an infusion is taken as tea in Philippines. Plant possesses cooling diuretic properties, used to cure pain in knee joints. Fresh plant is applied for maturants for boils, swollen cervical glands and chronic ulcers (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Rothea serrata* Steane & Mabb.**

Rothea serrata Steane & Mabb. Novon 8: 206 (1998), *Clerodendrum serratum* (L.) Moon. Cat. 46.382,1824; C. B. Cl in Hook. f. Fl. Brit. India 4: 592.1885; Cooke, Fl.

Pres. Bombay 2: 512.1958 (Repr.). *Volkameria serrata* L. Mant. 90.1767; *Clerodendrum serratum* (L.) Moon.; Naik Fl. Marathwada 699.1998; Singh et al. Fl. Mah. 2: 691.2001; Yadav and Sardesai Fl. Kolhapur Dist. 371-2.2002; Almeida Fl. Mah. 4: 117.2003;

An erect, perennial shrub, 1-2 m tall, branches bluntly quadrangular or hexangular. Leaves 14-18x6.5-7.5 cm, opposite or in whorls of 3, where branches hexangular, elliptic-obovate, mature ones glabrous, mucronate, sharply serrate, cuneate at base; petioles 0.6 cm long, stout. Flowers 3x1.3 cm, showy, dull light-blue in pubescent dichotomous cymes, each in axile of a large leafy bract, collectively forming attractive, long lax terminal pyramidal erect villous panicle 15-25 cm long; pedicels 0.4 cm long, shortly hairy, twisted; bracts 1.2-2.5 cm long, smaller 0.6-0.7x0.2 cm, obovate to lanceolate, pubescent, shorter than calyx, acute, entire, medianly nerved, subsistent, colored. Calyx 0.6 cm long, cup-shaped, pubescent, truncate, unaltered in fruit, segments very small, less than 0.1 cm long, equal, triangular, acute. Corolla pale blue, 2.4 cm long; tube 0.9-1x0.2 cm, cylindrical, oblique at the mouth, hairy inside at the staminal insertion, limb 1.3-2 cm across, 2-lipped, with the large lower lobe, often appearing upper in flower, dark bluish-purple, lobes 5, spreading, unequal, 0.9-1x0.6 cm, larger 1.6x0.5 cm, oblong-elliptic, shortly clawed, concave, pubescent on outer side, glabrous inside, with reticulum of veins, obtuse. Stamens 4, inserted below the throat, much exerted, longer 2.7 cm long, shorter 2.1 cm long, filaments curved, purplish, densely hairy at base; anthers 0.25x0.15 cm, oblong, cells parallel, brownish, dorsifixed, extrorse. Ovary 0.3x0.2 cm, green, glabrous, globose, 4-lobed, 4-celled; 1-ovule in each cell; style 3.1 cm long, exerted, purplish-white, glabrous; stigma glabrous. Drupes 0.8x0.6-1.2 cm, obovoid, fleshy, purplish-black at maturity, 2-4 lobed (Figure 21, 22).

Field notes. An erect shrub with bluntly quadrate or hexangular branches with opposite or whorled sharply serrated leaves. Flowers opening time: 5 to 7 pm. Major venation pattern pinnate eucamptodromous. Flowers and Fruits: September to December.

Distribution: In Kerala, A.P., Maharashtra, Sikkim, Malaya and Cambodia.

Habitat and ecology: Frequent in Melghat valleys and shady slopes. Occasional in hedges in the periphery of hilly tract.

Vernacular name: Bharangi (Marathi)

Uses. Having antiallergic and antihistamine property. Root is pungent and bitter, antihelminthic, useful in bronchitis, asthma, fever, hiccough. Leaves are one of the snake remedies (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

Stachytarpheta jamaicensis (L.) Vahl.

Stachytarpheta jamaicensis (L.) Vahl., Enum. Pl. 1: 206.1804; Rajendran & Daniel in Bull. Bot. Surv. India 34: 167.(1992) 1997. *Verbena jamaicensis* L. Sp. Pl. 1753. *Stachytarpheta indica auct. non* (L.) Vahl. 1804; C.B.Cl. in Hook. f. Fl. Brit. India 4: 564.1885 p.p.; Cooke, Fl. Pres. Bombay 2: 501.1958 (Repr.) p.p.; Singh et al. Fl. Mah. 2:

696.2001; Yadav and Sardesai Fl. Kolhapur Dist. 375.2002; Almeida Fl. Mah. 4: 130.2003.

A perennial, herbaceous undershrub, 1 m high, dichotomously branched, lower branches woody, young branches hairy. Leaves 8-10x3-4.5 cm, ovate, rugose, rough above, villous on the nerves beneath, acute, sharply serrate, base tapering decurrent into obscure petioles. Flowers 2.9x1.2 cm, bluish-violet, more or less half immersed in rachis, arranged in long slender, softly hairy, terminal spikes 16-45x5 cm, the rachis shallowed beneath each flower; bracts 0.5x0.15-0.2 cm, lanceolate, conspicuous, shorter than calyx, acuminate, green, scarious and hairy marginally, entire. Calyx 0.6x0.2-0.22 cm, tubular, elongate, persistent, somewhat compressed, 4-toothed, segments less than 0.1 cm long, distinct, acute, membranous, medianly green nerved. Corolla deep blue-violet, with whitish tinge at bottom of tube, 1.4x0.9-1.2 cm; tube 0.9x0.2 cm, slender with abundant colorless sugary sap, cylindrical, curved, oblique, hairy inside, limb 1.2 cm across, lobes 5, spreading, unequal, rounded, posterior 2-lobes 0.5-0.6x0.7-0.9 cm, anterior lobes 3, middle one smallest, 0.6x0.3 cm, laterals 0.6x0.5 cm, glabrous. Stamens 2, perfect of lower pair, inserted at middle of tube, included, staminodes 2, minute; filaments less than 0.1 cm long, slender, whitish, thin, hairy below, anthers 0.3x0.1 cm, cells vertical, divaricate, glabrous, pale yellow-reddish, dorsifixed, extrorse. Ovary 0.15x0.05 cm, oblong-elongate, green, glabrous, 2-celled, 1-ovule in each cell, attached laterally near the base of the cell; style 0.7-0.8 cm long, exerted, filiform, white, glabrous; stigma deep green, capitate, shortly 2-fid. Drupes 0.2-0.3x0.1 cm, elongate-oblong, enclosed in calyx, black on ripening, splitting into two 1-seeded pyrenes (Figure 6).

Field notes. Herbaceous undershrub with dichotomous branching. Flowers opening time: Early hours of morning. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: July to December.

Distribution: Native in America, throughout India, Car Nicobar Islands.

Habitat and ecology: It is a native of America, occasionally planted in gardens as an ornamental. Commonly naturalized on Chikhald plateau.

Common name: Porter coral weed (English)

Uses. Leaves contain glucoside stachytarphine and an alkaloid. In Java, stem tips are eaten as a flavoring. In Brazil leaves are used for adulterating tea and exported to Europe. It is also used for treating intestinal worms and stomach ailments, juice for cataract. An infusion of bark is used against Diarrhea. The leaves are used in cardiac troubles and rubbed on sprains (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

Stachytarpheta mutabilis (Jacq.) Vahl

Stachytarpheta mutabilis (Jacq.) Vahl, Enum. Pl. 1: 209.1804; Bor & Raiz. Some Beautiful Indian Climbers and Shrubs 152. 1990 (Repr.). *Verbena mutabilis* Jacq. Coll. Bot. 2: 334.1758; Singh et al. Fl. Mah. 2: 705.2001; Almeida Fl. Mah. 4: 131.2003

An undershrub, woody at base, up to 1.80 m high; branches pubescent Leaves 5-6x4 cm, ovate, scabrous,

rugose above, pubescent beneath, acute or shortly acuminate, serrate-dentate, teeth not sharp, rounded, base decurrent into obscure petioles. Flowers 2.7x1 cm, crimson-rose, in stout, terminal, 30-60x0.6 cm spikes, bracts 1x0.3 cm, sharply acuminate, projecting into a fine shaft, shorter than calyx, margins scarious, hairy, entire. Calyx 1.3x0.23 cm, 4-toothed, segments acute, membranous, medianly green nerved. Corolla rose, 1.5-2.5 cm long; tube 1.5x0.3 cm, slender, with pale pink stripes, bright rose-red-pink, whitish inside at mouth and bottom, with nectar, cylindrical, curved, oblique, hairy inside; limb 1cm across, unequally 5-lobed, lobes spreading, darker above with dark pink tinge, posterior lobes 3, 0.6x0.3 cm, equal, large, cordate, round, emarginate, anterior left lobe deeply unequally bilobed, smallest lobe 0.5x0.2 cm, central; right lobe 0.5x0.4 cm, smaller, cordate, shining, finely pubescent at lower side and marginally. Stamens 2, perfect of lower pair, inserted at middle of corolla tube, included, staminodes 2, indistinct; filaments 0.1 cm long, hairy below, pale-yellowish, anthers 0.3x0.1 cm, cells vertical, divaricate, pale-yellow, reddish, dorsifixed, extrorse. Ovary 0.15x0.5 cm, oblong-elongate, green, glabrous, 2-celled, 1-ovule in each cell, attached laterally near the base of cell; style 0.7-0.8 cm, exserted, filiform, white, glabrous, stigma deep green, capitate, shortly 2-fid. Drupes 0.2-0.3x0.1 cm, elongate-oblong, black on ripening, enclosed in calyx, splitting into two 1-seeded pyrenes (Figure 7).

Field notes. Ornamental undershrub. Flowers opening time: Early hours of morning. Major venation pattern pinnate semicraspedodromous. Flowers and Fruits: July to December.

Distribution: Native in Tropical America.

Habitat and ecology: Cultivated in plains.

Common name: Coral weed (English)

Uses. Leaves used for adulterating tea and are pounded with lime are applied to swollen wounds and sores. Plant is useful for treatment of tumors (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976) besides an ornamental, which became rare in Amravati.

***Tectona grandis* L. f.**

Tectona grandis L. f. Suppl. 151.1781; C. B. Cl. in Hook. f. Fl. Brit. India 4: 570.1885; Cooke, Fl. Pres. Bombay, 2: 503.1958 (Repr.); Naik Fl. Marathwada 707.1998; Singh et al. Fl. Mah. 2: 696.2001; Yadav and Sardesai Fl. Kolhapur Dist. 375.2002; Almeida Fl. Mah. 4: 131.2003.

A large deciduous tree with rounded crown, very variable in size according to its habitat, 20-50 m tall. Dark buff colored bark peeling off in longitudinal flakes; young branches stellately tomentose. Leaves very large, 40-42x21.5 cm, elliptic-ovate or obovate, scabrous, deep green, apparently glabrous above, lower surface stellate gray or tawny tomentose, pale green, with elevating prominent yellow, thick main veins and midrib, acute, entire, slight undulate or very finely serrate, cuneate at base, petioles 3-7x0.7-1 cm or very short, thick, soft stellate grayish-brown tomentose. Flowers small, 0.7x0.5 cm, white, fragrant in erect large terminal cymose panicles,

about 30 cm long, bracts in pairs at each fork, lower 1x0.4 cm, grayish-brown, stellately tomentose, uninerved, upper bracts smaller 0.5x0.23 cm, linear-lanceolate, acute; peduncle stellately tomentose; pedicel 0.2 cm long. Calyx 0.3-0.4x0.3 cm, campanulate, persistent, stellately tomentose, lobes 5-6, 0.2-0.3x0.2 cm, spreading, subequal, linear, acute, in fruit enlarged upto 2x1.2 cm or more, inflated, globose, bright-green, enclosing fruit, more or less crumpled, reticulately veined. Corolla white, purplish tinged at throat, 0.5x0.5-0.6 cm, rosaceous, lobes 5-6, equal, 0.3x0.2 cm, undulate, with adaxial central groove, spreading, regular, deciduous, finely stellate hairy on nerves beneath; tube very short, 0.1 cmx0.2 cm, straight. Stamens 5-6, inserted near the base of corolla rim, equal, exserted, alternating with lobes; filaments 0.3 cm long, slender, white, hairy; anthers less than 0.1x0.1 cm, ovate-round, with distinct parallel cells, bright brown-yellowish, papillose, dorsifixed, extrorse. Ovary 0.2x0.2 cm, fleshy, densely tomentose, greenish, base bright orange, 4-celled; ovule solitary in each cell; style 0.3-0.4 cm long, exserted, white, with conspicuous tuft of white hairs basally, stigma very shortly 2-fid, papillose. Drupes 0.5x0.7 cm, subglobose, more or less 4-lobed, densely stellate hairy, enclosed in enlarged calyx. *Tectona grandis* plant material collected from different places many times show minor variations in some morphological characters as height of plant, length of petiole, margin and base of lamina and in some microcharacters. They found to be correlated as trees with shorter height, showing bushy appearance bearing entire, elliptic leaves with longer petioles and where major venation pattern is Pinnate Brochidodromous and marginal ultimate venation is looped and trees which are taller with ovate-elliptic broader leaves and very short petiole, showing finely serrated margin of lamina where venation is Pinnate Fестоoned Bronchidodromous in lower and Brochidodromous in upper portion (Figure 13).

Field notes. A large deciduous tree with rounded crown, very variable in size according to its habitat, stellately tomentose. Flowers opening time: 8 to 10.30 am. Major venation pattern pinnate brochidodromous. Flowers and Fruits: June to September.

Distribution: Indigenous to peninsular India and Madhya Pradesh.

Habitat and ecology: Very common and the dominant tree in forests of Melghat, deciduous forests and other hilly tracts. Planted in the plains.

Vernacular names: Sag (Marathi), Sagwan (Marathi)

Common name: Teak (English).

Uses. It enjoys world wide reputation as a quality timber and used in construction of bridges, lorry bodies, carts and carriages, agricultural implements and heavy packing cases, for making musical instruments, used in chemical industries and labs' bench tops. Powder of wood is said to use in ailing skin inflammation. Leaves contain 6% tannin & use for dyeing silk. Bark contains betulinic acid (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Vitex negundo* L.**

Vitex negundo L. Sp. Pl. 638.1753; C. B. Cl in Hook. f. Fl. Brit. India 4: 583.1885; Cooke, Fl. Pres. Bombay 2: 508.1958 (Repr.); *V. trifolia* Grah. Cat. Bombay Pl. 155.1839 non L.; Naik Fl. Marathwada 708.1998; Singh et al. Fl. Mah. 2: 699.2001; Yadav and Sardesai Fl. Kolhapur Dist. 376.2002; Almeida Fl. Mah. 4: 135.2003.

A large, aromatic shrub or a small slender tree, 3.5 m high, branchlets grayish-white, finely tomentose. Leaves 3-5 foliate, leaflets variable in size, terminal 8-10.5x2-2.7 cm, laterals smaller, ovate-lanceolate, nearly glabrous above, white tomentose beneath, attenuate, entire, sometimes finely serrate, acute at base, base slight asymmetric in lateral leaflets. Common petioles 5-6 cm long, petiolules of terminal leaflet 1-1.3 cm long, lateral leaflets with very short petiolules, finely tomentose. Flowers bluish-purple or white, small, 0.7-0.8 cm long, in pedunculate, branched tomentose cymes, about 16 cm long, opposite along the quadrangular tomentose rachis of a large, terminal, compound, pyramidal panicle about 23-30 cm long, bracts less than 0.1 cm long, lanceolate, caducous, shorter than calyx, finely tomentose, entire, pale brownish-green. Calyx 0.4x0.2 cm, campanulate, white tomentose, 5-toothed, teeth triangular, 0.4 cm long, equal, persistent, enlarged in fruit. Corolla 0.7-0.8 cm long, limb 0.3 cm across, white or pale-purple, with dark bluish-purple tinge inside throat, tomentose outside, hairy inside at the insertion of stamens; tube 0.1 cm long, straight, slender, limb 5-lobed, 2-lipped, middle lobe of the lower lip largest 0.4 cm long, upper lip small, 0.1x0.1 cm, divided to the base into 2-obtuse lobes, lower lip large, 0.4x0.5 cm with 2-short oblong obtuse lateral lobes 0.1x0.15 cm and largest central broadly obovate, crenulate lobe 0.4x0.3 cm with distinct median nerve and dark purple shaded curved part. Stamens 4, inserted at the throat, exerted, longer 0.4 cm long, shorter 0.25 cm long, filaments slender, whitish, densely hairy at the base, at insertion with long, whitish-purplish, distinct bunch of hairs, anthers less than 0.05 cm, deep purple-brown, dorsifixed, introrse, cells parallel, pendulous, later divaricate. Ovary minute, less than 0.1x0.1 cm, globose-oblong, pale-green, glabrous, glandular, 4-celled, 1-ovule in each cell; style 0.5 cm long, filiform, exerted, white-purplish, glabrous; stigma whitish, shortly 2-fid, glabrous. Drupes 0.3x0.25-0.3 cm, globose-ovoid, 4-seeded, black on ripening, enclosed at base of slight enlarged calyx (Figure 16).

Field notes. A large aromatic shrub or small tree with grayish-white bark, finely tomentose branchlets and 3 to 5 foliate leaves. Flowers opening time: Early morning to 11 am. Major venation pattern pinnate brochidodromous. Flowers and Fruits: July to February.

Distribution: Throughout India, ascending to altitude of 1500 m in outer Himalayas and other Asian countries.

Habitat and ecology: Common as hedges along fields and waste places, in beds of streams and rivers.

Vernacular name: Nirgudi (Marathi)

Uses. Plant is useful for planting against the soil erosion and afforestation, also the hedge plant. It is one of the common plants of Indian medicine. Leaves as tonic and

insect repellent. Its antibacterial activity with presence of steroids, alkaloids, tannins, and phenols is reported. Plant is stomachic, useful in promoting hair growth, eye diseases, and inflammation and is anthelmintic (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).

***Volkameria inermis* L.**

Volkameria inermis L. Sp. Pl. 637.1753, L. *Clerodendrum inerme* (L.) Gaertn. Fruct. Sem. 1: 271, t.75.1788; C. B. Cl in Hook. f. Fl. Brit. India 4: 589.1885; Cooke, Fl. Pres. Bombay 2: 511.1958 (Repr.). Naik Fl. Marathwada 698.1998; Singh et al. Fl. Mah. 2: 690.2001; Yadav and Sardesai Fl. Kolhapur Dist. 371.2002; Almeida Fl. Mah. 4: 115.2003.

A straggling much branched, glabrescent, strongly smelling shrub, 2.5 m high, branchlets purplish-green. Leaves variable, 4-6x2.5-3.5 cm, and elliptic, glabrous, obtuse, entire, cuneate at base, petioles 0.8-1 cm long, finely pubescent. Flowers 3.5 cm long, white, with pink tinge in axillary pedunculate cymes, usually 3-flowered, peduncles 2.5-3 cm long, slender; pedicels 0.9 cm long, bracts 0.2 cm long, minute, shorter than calyx, linear, glabrous, finely acute, entire, green, bracteoles minute. Calyx 0.5x0.4 cm, campanulate, 5-toothed, teeth acute, 0.1x0.15 cm, distinct, triangular, with purplish tips, glabrous, leathery, accrescent. Corolla white, with purple tinge at tips, 4.7 cm long, hypocrateriform, tube 3.3x0.2 cm, straight, slender, glabrous outside, hairy inside; lobes subequal, 1-1.1x0.5-0.6 cm, shortly clawed, narrow-ovate, oblong, sub-acute to obtuse, with crenulate margins, glabrous. Stamens 4, inserted slight below the throat, longer 5 cm long, shorter 3.5 cm long; filaments hairy and whitish at base, deep purple, shining, much exerted, twining at maturity, anthers 0.2x0.1 cm, oblong, cells parallel, deep brown, dorsifixed, extrorse. Ovary 0.2x0.15 cm, slight elongate, green, glabrous, 4-lobed, 4-celled; 1-ovule in each cell; style 5 cm long, much exerted, filiform, basally white, deep purple distally, glabrous, shining; stigma deep purple, acutely 2-fid, arms 0.2 cm, glabrous. Drupes 0.6-1.2 cm long, pyriform, succulent, 4-chambered, black at maturity, encircled by veined, enlarged calyx, separating into 4-woody pyrenes of which 1-3 are sometimes suppressed (Figures 17, 18).

Field notes. Straggling much branched, glabrescent, strongly smelling shrub with entire elliptic leaves. Flowers opening time: 4.45 to 6 pm. Major venation pattern pinnate brochidodromous. Flowers and Fruits: July to December.

Distribution: In Maharashtra, Kerala and throughout India. In Australia, China and Mauritius.

Habitat and ecology: Common in village outskirts, usually grown as hedge plant.

Vernacular names: Baad (Marathi), Koynel (Marathi), Vanjai (Marathi)

Uses. Leaves contain sterols and are employed as febrifuge, antiperiodic and quinine substitute in fever in India and smeared with oil applied to wounds. In pacific area the bark is used in making baskets. Boiled roots useful in curing rheumatism (Wealth of India 1950, 1952, 1956, 1959, 1962, 1966, 1976).



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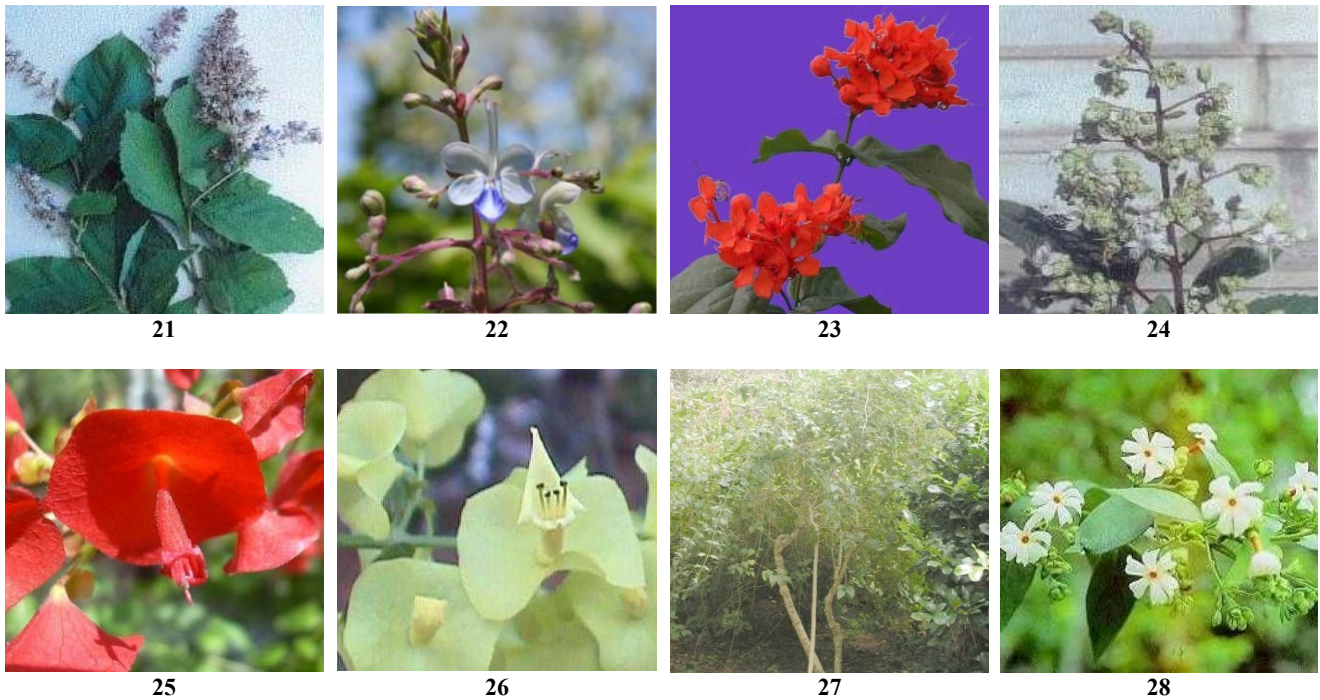
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Figures: 1. *Lantana camara* var. *aculeata*, 2. *Lantana flava* (www.wellgrowhorti.com), 3. *Lantana nivea*, 4. *Phyla nodiflora*-spike, 5. *Phyla nodiflora*, 6. *Stachytarpheta jamaicensis*, 7. *Stachytarpheta mutabilis*, 8. *Glandularia bipinnatifida* (http://src.sfasu.edu), 9. *Verbena bipinnatifida*-leaves, 10. *Petrea volubilis*, 11. *Duranta erecta*, 12. *Duranta erecta*-Fruits, 13. *Tectona grandis*-enlarged inflated calyx enclosing fruit, 14. *Gmelina arborea*, 15. *Gmelina philippensis*, 16. *Vitex negundo*, 17. *Volkameria inermis*, 18. *Volkameria inermis*-fruits, 19. *Clerodendrum phlomidis*-white flowers (www.flickr.com), 20. *Clerodendrum phlomidis*-rosy pink flowers, 21a. *Rothea serrata*-leaves, 21. *Rothea serrata*-flower, 22. *Clerodendrum splendens*, 23. *Clerodendrum infortunatum*, 25. *Holmskioldia sanguinea*-red flowers, 26. *Holmskioldia sanguinea*-yellow flowers, 27. *Holmskioldia sanguinea*-Habit, 28. *Nyctanthes arbor-tristis*.

Morphological diversity

Regarding morphological diversity, the studied species share the prominent characteristic features of the family Verbenaceae:

Diverse habits

Verbenaceae has diverse habits, namely (i) Herbs i.e. *Phyla nodiflora* a prostrate creeping and *Glandularia bipinnatifida* prostrate decumbent herbs (ii) Herbaceous undershrubs i.e. *Stachytarpheta jamaicensis* and *S. mutabilis* (iii) Shrubs i.e. *Lantana camara* var. *aculeata*, var. *nivea* are straggling or scandent shrubs with recurved prickles, *L. camara* var. *flava* is small shrub (iv) Liana i.e. *Petrea volubilis* (v) Large shrub or small tree i.e. *Vitex negundo*, (vi) Trees i.e. *Gmelina arborea* a medium sized deciduous and *Tectona grandis* a large deciduous.

Holmskioldia sanguinea is straggling evergreen shrub with drooping branches. *Volkameria inermis* is straggling much branched, *Rothea serrata* is erect, *Clerodendrum infortunatum* is gregarious, tomentose, *Duranta erecta* a bushy and *Gmelina philippensis* sprawling spinous with drooping branched, *Clerodendrum splendens* is large climbing, shrub. *Nyctanthes arbor-tristis* is large shrub or small scabrous tree. Bark is characteristic for certain species.

Plants with typical strong or bitter aroma

Lantana camara var. *aculeata* with typical strong, *Volkameria inermis*, *Clerodendrum phlomidis*, *Vitex negundo* with typical bitter aroma.

Quadrangular stems

In all species. *Nyctanthes arbor-tristis* stem quadrangular, strigose.

Simple or occasionally compound leaves

Simple leaves in all species studied, compound 3-5 foliate in *Vitex negundo*. Leaves exstipulate, petiolate or sessile, entire, sub-entire, serrate, or crenate-serrate, dentate, opposite decussate.

Flowers

Bisexual, mostly zygomorphic, rarely sub-regular, usually without fragrance, sessile or shortly pedicellate. Flowers in *Tectona grandis* as well as in *Nyctanthes arbor-tristis* sub-regular, with delightful fragrance. Flowers are very small, minute in *Phyla nodiflora* and largest, showy in *Gmelina arborea* and *G. philippensis*.

Inflorescence

A spike, raceme, head, cyme or panicle. In *Lantana camara* it is capitate spike, in *Phyla nodiflora* is condensed cylindrical spike (head). In *Glandularia bipinnatifida*

corymbose, terminal spike. In *Duranta erecta*, *Petrea volubilis* racemes or panicle of racemes, and panicle of cymes in *Tectona grandis*, *Gmelina arborea*, *G. philippensis*, *Vitex negundo*, *Volkameria inermis*, *Clerodendrum phlomidis*, *Rothea serrata*, *Clerodendrum infortunatum*, *C. splendens* and *Holmskioldia sanguinea*. In *Nyctanthes arbor-tristis* it is in bracteate fascicle of 3 to 5, in each pedunculate head, arranged in trichotomous cymes.

Bracts

Verbenaceae have various bracts, namely: (i) Flowers bracteate. Bracts small, caducous, subulate or linear in *Petrea volubilis*, *Duranta erecta*, *Gmelina arborea*, *Vitex negundo*, *Volkameria inermis*, *Clerodendrum phlomidis*, subsistent, colored in *Rothea serrata*, glabrous brownish in *Clerodendrum splendens*, ovate, green in *Holmskioldia sanguinea* (ii) Conspicuous, green, leafy, linear, longer than calyx-in *Lantana camara* var. *aculeata*, *L. flava*, *L. nivea* (iii) Acuminate, shorter than calyx-in *Stachytarpheta jamaicensis*, sharply acuminate projecting into a shaft in *S. mutabilis*, slight shorter than calyx in *Glandularia bipinnatifida* (iv) Grayish-brown, longer than calyx, stellately tomentose in pairs at each fork in *Tectona grandis*. Conspicuous, elliptic-round, obovate, mucronate with purplish tip in *Phyla nodiflora*. Large, showy, membranous, purple veined enclosing calyx in *Gmelina philippensis*. Leafy, boat shaped, green-purplish, gland dotted at tips in *Clerodendrum infortunatum*. In all species bracts are entire.

Bracteoles

Generally absent but noted in *Volkameria inermis* and *Holmskioldia sanguinea* and are small, similar to their bracts.

Calyx

Persistent, limb 4 to 5 partite or toothed, aestivation usually valvate, enlarged or unaltered in fruits. It is truncate, obscurely toothed, membranous in *L. camara* var. *aculeata*, *L. flava*, *L. nivea*; membranous, deeply 2-lobed, mitre shaped, compressed in *Phyla nodiflora*; tubular, elongate, compressed, membranous, 4-toothed in *Stachytarpheta jamaicensis* and *S. mutabilis*; tubular, 5-toothed, 5-ribbed, setaceous in *Glandularia bipinnatifida*; tubular, unequally 5-toothed, yellowish green, orange colored in fruits in *Duranta erecta*; campanulate, petaloid, purplish-blue, dry and green in fruiting, with star shaped radiating subequal 5-lobes with reticulum, and calyx papillae at throat in *Petrea volubilis*. Their reference is given as large involucriform epicalyx (in System of Botany Descriptive and Analytical by J.D. Hooker, Reprint 1986), campanulate, stellately tomentose, with 5-6 spreading subequal lobes, inflated in fruiting in *Tectona grandis*; broadly campanulate with small 5-unequal teeth, anterior two larger gland dotted in *Gmelina arborea* and *G. philippensis*; campanulate, with tomentose, with 5 equal teeth in *Vitex negundo*; campanulate, glabrous with 5 acute, purplish tipped teeth in *Volkameria inermis*; campanulate, green with 5-segments divided half way down in *Clerodendrum phlomidis*; cup-shaped, truncate with 5

small, equal segments in *Rothea serrata*; campanulate, with globose base glabrous, divided more than half way down into 5 equal segments, deep pinkish-red tinged in *C. splendens*, campanulate, divided up to base into 5 large, equal, silky pubescent, purplish-red gland dotted in *Clerodendrum infortunatum*; saucer shaped, spreading broadly and uniformly from base upward, obconic, 2.5 cm in diameter, petaloid, red to orange or yellow, with fine reticulum with entire or obscurely sinuate margin in *Holmskioldia sanguinea*. In *Nyctanthes arbor-tristis* it is narrowly campanulate, truncate, obscurely, 5-toothed, pale green, and unaltered in fruits.

In majority of species studied, calyx is pubescent outside or on both sides. It is persistent, unaltered or very slightly altered in fruits in *Lantana camara* var. *aculeata*, *L. flava*, *L. nivea*, *Stachytarpheta jamaicensis*, *S. mutabilis*, in *Phyla nodiflora* it is closely enclosing the fruit, *Glandularia bipinnatifida*, *Petrea volubilis*, *Gmelina arborea*, *G. philippensis*, *Clerodendrum phlomidis*, *Rothea serrata*, *C. splendens*, *Holmskioldia sanguinea*. It is enlarged or much enlarged in *Duranta erecta*, *Tectona grandis* in which it is enclosing fruit, *Vitex negundo*, *Volkameria inermis*, much enlarged and reddish in *Clerodendrum infortunatum*.

Corolla

Tubular, limb 4 to 5 fid, usually unequal and labiate, rarely regular. Aestivation imbricate or quincuncial. Form of corolla salver shaped with oblique tube in *Lantana camara* var. *aculeata*, *L. flava*, *L. nivea*, tubular, unequally 2-lipped with straight tube in *Phyla nodiflora*, tubular with spreading emarginate or entire lobes in *Stachytarpheta jamaicensis*, *S. mutabilis*, funnel shaped with oblique tube in *Petrea volubilis*, 2-lipped with slight oblique tube and oblong retuse or emarginate lobes in *Glandularia bipinnatifida*, slight 2-lipped with obtuse lobes and oblique tube in *Duranta erecta*, regular with 5 to 6 spreading lobes in *Tectona grandis*, 2-lipped, infundibuliform, ventricose in upper part with oblique tube in *Gmelina arborea* and *G. philippensis*, limb 2-lipped with straight tube in *Vitex negundo*, hypocrateriform in *Volkameria inermis*, *Rothea serrata* and *Clerodendrum* (all species), tubular with very short lobes oblique tube in *Holmskioldia sanguinea*. In *Nyctanthes arbor-tristis* it is rotate or hypocrateriform and with distinct twisted aestivation. Corolla lobes in majority of species unequal. Corolla tube hairy inside or outside or on both sides or glabrous. In *Vitex negundo* hairy inside at insertion of stamens. In *Duranta erecta* hairy inside, lobes hairy or glabrous. In *Tectona grandis* lobes are finely stellately tomentose on nerves beneath. Floral colour ranging from white, yellow-white, pink, orange-pink, yellow, yellowish-brown, crimson rose, deep bluish purple, white with purplish tinge at throat.

Stamens

4, Didynamous by arrest of the fifth, sometimes 2 by arrest of the 3 upper, very rarely 5 fertile, epipetalous on the corolla tube or throat, filaments hairy, glandular or glabrous, included or exerted; anthers 2-celled sometimes diverging, dehiscence longitudinal. Stamens only 2, by

arrest of 3 in *Stachytarpheta jamaicensis* and *S. mutabilis*, 4 and equal in *Petrea volubilis*, 5-6 in *Tectona grandis*, filaments glandular in *Duranta erecta*, papillate in *Gmelina arborea*, hairy in *G. philippensis*, densely hairy at base in *Vitex negundo* and *Rothea serrata*; glabrous shining twined at maturity in *Volkameria inermis*, *C. splendens*, *Clerodendrum infortunatum*, pubescent below in *Clerodendrum phlomidis*, red, hairy, papillose, glandular in *Holmskioldia sanguinea*.

In *Nyctanthes arbor-tristis* stamens are 2 and they are completely adnate to tube, but their number is 2 by arrest is doubtful; anthers usually described as dorsifixed and extrorse, but in present observation both types dorsifixed and occasionally basifixed and introrse or extrorse conditions are found. Anthers are dorsifixed except in *Lantana camara* in all varieties, *Petrea volubilis* where they are basifixed Extrorse condition is observed in *Stachytarpheta jamaicensis*, *S. mutabilis*, *Petrea volubilis*, *Tectona grandis*, *Volkameria inermis*, *Rothea serrata*, *Clerodendrum splendens*. In *Nyctanthes arbor-tristis* they are dorsifixed and introrse. Stamens included in *Lantana camara* in all varieties, *Phyla nodiflora*, *Stachytarpheta jamaicensis*, *S. mutabilis*, *Verbena bipinnatifida*, *Petrea volubilis*, *Duranta erecta*, much exerted in *Vitex negundo* *Volkameria inermis*, *Clerodendrum phlomidis*, *Rothea serrata*, *Clerodendrum splendens*, *C. infortunatum* and little exerted in *Holmskioldia sanguinea*, filaments are white, purplish, yellow, and red in different members. They are twisted in all species of *Clerodendrum*, *Rothea serrata* and *Volkameria inermis*. In *Nyctanthes arbor-tristis* stamens are included, filaments petaloid and completely adnate to corolla tube.

Carpels

2, Syncarpous, ovary superior, mostly 4-lobular, 2 to 4 partite with mostly 1, occasionally 2-ovules in each locule, appearing in axile placentation. Style terminal. Stigma simple capitate or unequally shortly 2-fid. In *Duranta erecta* carpels 4, syncarpous and 2-ovules per locule.

Fruits

Mostly drupaceous, fleshy or dry separating into 1-seeded pyrenes. It is dry in *Phyla nodiflora*, *Stachytarpheta jamaicensis*, *S. mutabilis*, stellately tomentose, fleshy in *Tectona grandis*. It is succulent, fleshy in most species, black at maturity in *Lantana camara*, *L. flava*, *L. nivea*, *Volkameria inermis*, *Clerodendrum infortunatum*, *Rothea serrata*, *Clerodendrum phlomidis*, orange in *Duranta erecta*, yellowish-orange in *Gmelina arborea*, yellow in *G. philippensis*. In *Nyctanthes arbor-tristis* it is suborbicular, much compressed, chartaceous 2-celled, green when young and brown at splitting stage, separating into 2-flat 1-seeded carpels. In *Clerodendrum splendens* fruits are undeveloped (not seen).

Key to genera

The morphological generic key for separation of genera studied is given as:

1. Herbs or under shrubs
2. Leaves divided into linear divisions *Glandularia*

2. Leaves not divided into linear divisions
 - 3 Prostrate herbs; flowers white or pale-pink; fertile stamens 4 *Phyla*
 3. Erect undershrubs, flowers blue, fertile
1. Shrubs or trees
 4. Leaves palmately compound *Vitex*
 4. Leaves simple
 5. Inflorescence racemose
 6. Woody climbers; calyx lobes longer than corolla tube, purple colored *Petrea*
 6. Woody straggling shrubs, calyx lobes shorter than corolla tube, green
 7. Flowers in capitate spikes; fruits 2-seeded purplish-black *Lantana*
 7. Flowers in paniced racemes; fruits 8-seeded, yellow *Duranta*
 5. Inflorescence cymose
 8. Corolla lobes contorted; stamens 2; fruits capsular *Nyctanthes*
 8. Corolla lobes imbricate; stamens 4 to 6, fruits drupaceous
 9. Large trees, corolla regular; stamens equal; fruits enclosed in much inflated calyx *Tectona*
 9. Shrubs or medium-sized trees; corolla irregular, stamens didynamous; fruits not as above
 10. Medium sized trees, calyx with 2 to 7 nectary glands *Gmelina*
 10. Scandent shrubs, calyx without nectary glands
 11. Calyx rotate, saucer shaped, entire *Holmskioldia*
 11. Calyx campanulate, not saucer shaped, 5-toothed or 5-partite *Clerodendrum*
 12. Flowers white *Volkameria*
 12. Flowers purplish *Rothea*

Discussion

The species in present study are traditionally falling into two tribes Verbeneae and Viticeae (Bentham and Hooker, 1862-1883). This division of tribes and their subtribes are treated by Bentham as being more natural than any subsequently proposed schemes. The divisions are on main basis of: (i) Tribe-Verbeneae-Inflorescence indefinite (ii) Tribe-Viticeae-Inflorescence cymose, definite.

The studied characters are in accordance with this scheme. The notable aspects are: (i) Though in tribe Verbeneae, inflorescence of indefinite type. The flower numbers are not too large, as that in tribe Viticeae, where they are in many cases numerous. In *Nyctanthes arbor-tristis* flowers sessile in bracteate fascicle of 3-5 in each pedunculate head (ii) Majority of plants are propagated by seeds and vegetative cuttings. Purely vegetatively propagated species is *Clerodendrum splendens*.

As tribal characterization is mainly based on inflorescence nature, occurrence of mixed types of forms found in these two tribes.

Interestingly Pande and Pande (2001) reported hitherto unreported and abnormal epiphytic habit of *Lantana camara* for the first time from the Kumaon Himalaya but

such abnormal epiphytic habit for *L. camara* is yet neither reported nor observed from the local region.

Floral morphology of *Phyla nodiflora* observed with similar characters as noted by Maheshwari (1954).

In *Rotheca serrata* leaves are opposite decussate with quadrangular stems and in whorls of 3 with hexangular stems. This correlation may be on basis of fundamental principles of shoot organization as discussed by Kaplan (2001) in relation to relationship of leaf to stem. According to his discussion, the shoots of higher plants are typically characterized as being differentiated into nodes and internodes. The nodes, by definition, are sites of leaf insertion, whereas the internodes are considered to be the stem units that typically elongate between the points of leaf insertion. Each internode is not just stem, but a compound structure consisting of decurrent leaf bases, that run along the length of the internode below it and hence periphery of stem transection is actually adnated leafbase tissue adnating with it and these components being inseparable, the term "Shoot" is used. If the point of leaf insertion, in fact is not restricted to nodes but runs along the length of what traditionally has been called the internode, then one could predict that the transectional shape of an internode will reflect the pattern of phyllotaxis of its shoot. In shoots with an opposite and decussate phyllotaxis, internodes are square as a consequence of the four diagonal orthostichies of leaf insertion. By contrast, internodes in shoots with a two ranked or distichous phyllotaxis have a bilaterally symmetrical or elliptical shape, reflecting their alternate pattern of leaf insertion. Internodes with a helical or polystichous phyllotaxis exhibit a polygonal outline. Leaf insertions extend along the length of an internode because the leaves are initiated from the periphery of the shoot apex before there is any significant extension of the internodes. Since the incipient internode is such short region, a part of the leaf base, is inevitably included with shoot elongation. However, this relationship is observable in primary body and becomes obscure or lost in secondary one. Hence reason behind ternate leaves in *Rotheca serrata* with hexagonal outline of stem can be understood. It is also can be understood in general that Verbenaceous stem is quadrangular as having opposite decussate phyllotaxy.

In *Clerodendrum phlomidis* rarely pink flowered forms are found but otherwise these variants are similar in major morphological and anatomical details and are forms of same species.

Tectona grandis showing minor but distinct morphological variations in leaf margin, (entire or serrulate), petiole length (very short or longer) and tree form (bushy or tall), which are paralleling the finer anatomical differences, also may be treated as different genetical clones. Variation refers to the observable differences in individuals for a particular trait. These differences may partly be due to genetic factors and partly due to the environmental effects. From the studies, it is inferred that considerable genetic variation in field height and collar diameter exists among clones of *Tectona grandis* (Gera et al. 2001). Large variations were found both within and between the five-tested provenances regarding heartwood percent and content of silica and calcium by

Kjar et al (1999). Genetic differentiation between populations of *Tectona grandis* L.f. was examined in 9 quantitative characters and 10 allozyme loci by Kjar et al (1996) and large differences between populations were revealed in the quantitative traits. According to authors the larger differentiation between populations in morphological traits than in allozyme markers is probably a result of adaptation through natural selection and possibly, a higher mutation rate in allozyme loci.

These type of minor variations specially observed in leaf margins in many studied species of the Verbenaceae in which the original leaf margin is entire but in same plant or different some varied leaves are noticed as in *Vitex negundo*, where leaf margin entire but some variants show finely serrulate margin; in *Gmelina philippensis* same plant having younger leaves tridentate with distally placed teeth; in *G. arborea* young leaves are with distantly placed teeth; in *Holmskioldia sanguinea* some leaves may be finely serrulate. In *Nyctanthes arbor-tristis* same plant may possess majority of leaves as entire but at the same time many are with distantly placed teeth.

Atkins (1996) placed *Holmskioldia sanguinea* Retz. in Labiatae (Lamiaceae). Many floras also retained it under Verbenaceae but according to recent studies it is placed in Lamiaceae.

The family Verbenaceae has been circumscribed much more broadly by most systematics (e.g. Cronquist 1981) and separated from Lamiaceae by the presence of terminal (vs. gynobasic) style. Judd et al (2002) included only the traditional subfamily Verbenoideae (excluding the tribe Monochileae). As traditionally delimited Verbenaceae are paraphyletic, while Lamiaceae are polyphyletic. In order to make Lamiaceae monophyletic, nearly two-thirds of the genera usually included within Verbenaceae (e.g. *Callicarpa*, *Clerodendrum*, *Vitex*, and *Tectona*) are transferred to Lamiaceae (Cantino 1992; Cantino et al. 1992; Thorne 1992). As redefined, Verbenaceae can be distinguished from Lamiaceae by their indeterminate racemes, spikes, or heads (vs. inflorescences with an indeterminate main axis and cymosely branched lateral axes, these often reduced and forming pseudowhorls); ovules attached on the margins of false septa (vs. ovules attached on the sides of false septa); simple style with conspicuous, 2-lobes stigma (vs. usually apically forked style with inconspicuous stigmatic region at the tip of each style branch); pollen exine thickened near apertures vs. not thickened; and nonglandular hairs exclusively unicellular (vs. multicellular, uniseriate). In addition, the flowers tend to be less strongly two lipped. The style of Verbenaceae is exclusively terminal, while in Lamiaceae it varies from terminal to gynobasic.

The inclusion of *Petrea* within Verbenaceae is not supported by cpDNA data alone (Olmstead et al. 1993; Wagstaff and Olmstead 1997; Wagstaff et al. 1998), but it is supported by combination of morphology and cpDNA sequences (Cantino 1992).

Emphasis on different traits has resulted in Conflict between taxonomic systems in Verbenaceae, but none of the traditional systems align well with the molecular

phylogeny, which suggests that homoplasy is rampant in all of the traits used in those classifications (Marx et al. 2010).

Briquet's (1895) treatment of the family has been the one most widely accepted. His classification is based on the number of locules in each carpel, the number of ovules in each locule, and inflorescence morphology. This classification was not accepted by Junell (1934), who suggested that abortion of a carpel had occurred independently several times; this is confirmed by study of Marx et al (2010), in which *Baillonia*, *Casselia*, tribe Petreeae, tribe Neospartoneae, a clade in tribe Duranteae, and tribe Lantaneae except *Coelocarpum* all have unicarpellate ovaries.

Some authors (e.g. Troncoso 1974) have used fruits as a diagnostic trait for tribes; for example, fleshy or dry fruits, further divided, or not, into mericarps; this also according to Marx et al (2010) has proved misleading for defining groups within Verbenaceae. All members of tribes Petreeae, Casselieae, Neospartoneae, and Citharexyleae (except *Rehdera*), as well as *Duranta* and *Lanta*, have fleshy fruits, and the rest have dry fruits, which shows that this character does not support suprageneric groups consistent with these phylogenetic results.

Inflorescence morphology and structure have been misunderstood and not correctly interpreted until recent studies (Martinez et al. 1996; Martinez and Mulgura 1997; Mulgura et al. 1998, 2002; Drewes and Martinez 1999). Consequently, classifications based on racemose or spicate flowering shoots in the terminal or axillary position (Schauer 1847; Briquet 1895) have been unnatural. A compound inflorescence with both terminal and branched lateral flowering shoots, termed a "heterothetic paniculiform pleiobotryum," has been suggested to be the primitive or central form in Verbenaceae, from which other forms were derived through processes such as condensation, reduction and truncation (Martinez et al. 1996). Lantaneae generally have flowering shoots only in axillary positions (homothetic pleiobotrya), a derived condition from the heterothetic pleiobotrya found in most other tribes, except Casselieae.

Traditional tribal classifications based on morphology have been misleading with respect to evolutionary relationships in Verbenaceae (Marx et al. 2010). The results presented by Marx et al (2010) permit the realignment of genera into a new tribal classification, which recognizes a new tribe, Neospartoneae. The phylogeny presented by him can serve as a basis for further work to better understand the evolution of traits, such as fruit and inflorescence architecture, which have misled previous systematists studying Verbenaceae.

CONCLUSION

The verbenaceous members of Melghat and Amravati regions of Maharashtra, India show morphological diversity within the family limits and are important plant species regarding their useful products and ornamental value. There is clear demarcation of morphological characters of Bentham and Hooker's tribes Verbeneae and

Viticeae in which studied genera and species are accommodated. According to recent molecular studies and classification, the tribe Verbeneae is retained in Verbenaceae and splitted into different tribes, while genera of Viticeae are transferred into Lamiaceae.

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