

**Morphologic and Taxonomic Studies on
Fabaceae (Tribe – Crotalarieae)
in South India**

The thesis submitted to the University of Calicut in partial fulfillment
of the requirement for the degree of
Doctor of Philosophy

By

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2004

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DECLARATION

I hereby declare that the thesis entitled **Morphologic and Taxonomic Studies on Fabaceae (Tribe – Crotalarieae) in South India** submitted by me for the award of the degree of Doctor of Philosophy of the University of Calicut is an original research work carried out by me in the Department of Botany, St. Joseph's College, Devagiri, Kozhikode. No part of the work has formed the basis for the award of any other degree or diploma.

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CERTIFICATE

This is to certify that the thesis entitled **Morphologic and Taxonomic Studies on Fabaceae (Tribe – Crotalarieae) in South India** submitted to the University of Calicut by **Mr. Sibichen M. Thomas** in partial fulfillment for the award of the degree of Doctor of Philosophy in Botany is a bonafide record of the research work carried out by him under my guidance. No part of the work has formed the basis for the award of any other degree or diploma previously.

Dr. Santhosh Nampy
(*Research Guide*)

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CONTENTS

	Page No.
INTRODUCTION	
Importance and aim of the present work	1
Review of literature	3
Area of the present study	11
Distribution and ecology	18
MATERIALS AND METHODS	
Materials	20
Methods	20
Plan of the thesis	22
EPIDERMAL FEATURES AND ITS TAXONOMIC UTILITY	
Epidermal cells	24
Stomatal complex	25
Trichomes	30
SYSTEMATIC TREATMENT	
Tribe Crotalarieae	32
<i>Crotalaria</i> L.	37
<i>Rothia</i> Pers.	198
DISCUSSION	
Comparative Morphology	201
Summary	207
BIBLIOGRAPHY	

INTRODUCTION

Sibichen M. Thomas “Morphologic and Taxonomic Studies on Fabaceae (Tribe Crotalarieae) in South India” Thesis. Department of Botany, St. Joseph's College Kozhikode , University of Calicut, 2004

INTRODUCTION

Importance and aim of the present work

Fabaceae (*nom. alt.* Leguminosae) is the third largest family of flowering plants, consisting of about 650 genera and 18,000 species (Polhill, 1981). The family consists of three subfamilies *viz.*, Caesalpinioideae, Mimosoideae and Faboideae (*nom. alt.* Papilionoideae). Crotalarieae (Benth.) Hutch., the tribe selected for the present study is one of the 19 tribes of the subfamily Faboideae (Rudd, 1991). Earlier, it was a subtribe of the tribe Genisteae Benth. Of the 11 genera recognized under this tribe only two *viz.*, *Crotalaria* L. and *Rothia* Pers. are known to occur in South India. Among them, *Crotalaria* comprises about 600 species and *Rothia* two species all over the world.

The tribe Crotalarieae can be distinguished by its annual or perennial, herbaceous or shrubby habit; simple or digitately 3-7 foliolate, alternate, stipulate leaves; small to medium sized flowers in terminal or lateral racemes, sometimes in heads or umbels; the calyx with the lobes subequal or partly fused in various ways, often bilipped in South Indian species; yellow, bluish to white petals, often with purple striations; monadelphous stamens in a sheath open on vexillar side, generally dimorphic, alternately long - basifixed and short dorsifixed anthers; sessile or stipitate, one to many ovuled ovary; style with or without a line of hairs, usually slender, curved or geniculate; minute or capitate stigma; oblong to globose, generally dehiscent, glabrous to sericeous, one to many seeded pod; obliquely cordiform – reniform, smooth seeds, sometimes with conspicuous aril. Extreme homogeneity in floral characters and wide distribution of the representative members of the tribe had been an impediment to the botanists who attempted the taxonomy of this taxon.

Revisionary work has to be undertaken on a global scale in order to obtain a comprehensive idea about a particular taxon at various levels. This

process has to be preceded by intensive systematic studies on local or regional basis. Contributions of earlier botanists like Willdenow (1802), De Candolle (1825), Don (1825), Roxburgh (1832), Wight and Arnott (1834), Bentham (1843), Baker (1876), Gamble (1918), Hutchinson (1964) *etc.*, are worth mentioning in this regard. Though these historic works are outdated and often based on herbarium specimens, they provide more informations than many of the present day floristic works. Some of the recent floristic studies, which are mere enumerations of taxa, provide very minimum details, often insufficient to serve the purpose. This is what prompted the author to undertake the present work.

Of the three genera under the tribe Crotalarieae in India, *Crotalaria*, the “Rattle box plant” is the largest genus of the family Fabaceae (Ansari, 2002). The common name comes from the loose seeds in the dried pods. In India, the genus is represented by 94 species (Sanjappa, 1992) and in South India by 66 species and 4 infraspecific taxa. It is the tropical and subtropical genus with highest degree of endemism (34 endemic species and 5 endemic varieties) in South India (Ahemdullah & Nayar, 1987). Nayar and Sastry (1987, 1988) treated 5 of the species as endangered and 9 as threatened. The above figures reflect the high degree of development of *Crotalaria* in this area and the need to conserve this taxon. In addition to the diversity and biological status, the species of this genus have significant agricultural, industrial and pharmacological importance.

Several attempts have been done in different parts of the world to sort out the phylogeny and the nomenclatural problems and to quantify the diversity of the genera concerned. Some of the recent works are Ali (1977), Niyomdham (1978), Rudd (1991), Polhill (1968, 1971, 1976 & 1982), Sanjappa (1992) and Ansari (2002). The major problem associated with many such revisionary treatments is that they are not applicable to geographical

areas outside the limit of the study. Except the enumeration of Indian legumes by Sanjappa (*l.c.*) we don't have any commendable work to cite in this regard. The Botanical Survey of India initiated a project on the revision of the genus *Crotalaria* for the "Flora of India" in the late 1970's, and has come up with a few publications such as Thothathri and Ansari (1978, 1979), Ansari and Thothathri (1985) and Ansari (1995, 1997 & 2002). The latest publication of this series, Ansari (2002), comprises only a brief sectional classification and enumeration of representative species in India. In this context, I have undertaken the present work entitled "Taxonomic and morphologic studies on Fabaceae (Tribe - Crotalarieae) in South India". The effort was taken with an objective of preparing a monograph on the tribe Crotalarieae. The area of present work was restricted to South India not only because of the usual constraints of time and other things that go with a Ph. D. programme but also, because the entire country would have been too vast and rich in biodiversity. It was felt that it would be more reliable if detailed studies on selected taxa were undertaken in a particular region.

Review of literature

Floristic studies and systematics of Indian plants had its origin during the British regime. Van Rheede (1678 – 1703) is the pioneer in this venture who had described and illustrated several hundreds of plants from Kerala including seven species of *Crotalaria* in his monumental work, "Hortus Malabaricus". This work formed the foundation for the subsequent workers like Linnaeus, Hamilton, De Candolle *etc.* They described several taxa of Indian plants based on Rheede's illustrations and also adopted the vernacular names into botanical nomenclature. The earliest formal botanical treatment of the genus *Crotalaria* is that of Linnaeus (1753). He had listed 13 species from Asia under 'Diadelphia Decandria', including 43 other genera. Of the 13 taxa

described, *C. juncea*, *C. retusa*, *C. verrucosa*, *C. laburnifolia*, *C. incana* and *C. quinquefoila* are south Indian species.

Burman (1768) also followed the same sexual system of classification of Linnaeus (*l.c.*) and included 9 species of this genus under 'Diadelphia Decandria'. Among them, *C. juncea*, *C. retusa*, *C. nana*, *C. verrucosa*, *C. laburnifolia* and *C. quinquefolia* are south Indian species. Linnaeus.f. (1781) described two more species *viz.*, *C. linifolia* and *C. bifaria* under the same class in his "Supplementum Plantarum Systematis Vegetabilium". Lamarck (1786), recognized six South Indian species in "Encyclopedie Methodique". Willdenow (1802), described four further south Indian species, namely *C. trifoliastrum*, *C. paniculata*, *C. hirta* and *C. hirsuta*, and validated two species of Rottler *viz.*, *C. prostrata* and *C. orixensis* in his "Species Plantarum".

Deviating from the Linnaean system of classification, De Candolle (1825) tried a natural system of classification in his "Prodromus Systematis Naturalis". He proposed a subgeneric classification of the genus and recognized 137 species from India. But, he neither assigned any status nor names to these subdivisions. All the species had treated under two sections *viz.*, 'Foliis simplicibus' and 'Foliis palmatis compositis 3-7 foliolatis'. Each of these sections is further divided into 4 subcategories based on certain prominent morphological characters. A subgeneric classification of this sort simplified the work of subsequent authors. De Candolle incorporated thirty-six South Indian species in this treatment. In the meantime, Don (1825) published his "Prodromus Florae Nepalensis" and recognized 7 species, including 3 South Indian elements *viz.*, *C. prostrata*, *C. alata* and *C. linifolia*.

Robert Wight had made several explorations in South India and jointly with G. A. Arnott published "Prodromus Florae Peninsulae Indiae Orientalis" in 1834. It is the first comprehensive flora of Peninsular India based on the natural system of classification. Fifty-eight species of *Crotalaria* and their

descriptions together with a subgeneric classification were given in this work. Later authors such as Bentham (1843), Baker (1876), Gamble (1918) and Ansari (2002) followed this subgeneric classification in their treatments with appropriate modifications. In 1845, Robert Wight published his well known work "Icones Plantarum" which carries 2101 illustrations of Indian plants including 15 species of *Crotalaria*. Bentham (1843), in his "Enumeration of Leguminosae, Indigenous to Southern Asia and Central and Southern Africa" adopted many of the sections of Wight and Arnott (*l.c.*) and recognized 140 species. Illustrations of *C. ramosissima*, *C. pulcherrima* and *C. berteriana* are given in 'Icones Roxburghianae' of BSI.

Botanical studies in India reached its zenith with the publication of J. D. Hooker's (1872-1897) "Flora of British India" in seven volumes. The genus *Crotalaria*, as part of Fabaceae was done by J. G. Baker (1876). He summarized the results of collections made by N. A. Dalzell, Robert Wight, Nathaniel Wallich, B. Heyne, Graham and R. H. Beddome. He had recognized 77 species from India. In the meantime several scattered papers of new descriptions and reports appeared. For example, Dalzell (1850) described two species from Maharashtra *viz.*, *C. triquetra* and *C. lutescens*. After Hooker (*l.c.*), Gamble (1918) published "Flora of Presidency of Madras". It is a comprehensive floristic account of South India and had documented 75 species of *Crotalaria* including many new taxa described during the period.

Contemporary studies have been conducted in neighboring countries and continents. Similarities in physiographic factors and climatic regimes make such works meaningful in the present study. The floristic and revisionary studies of Thwaites (1859), Trimmen (1894), Munk (1962), Kaur (1964), Ali (1966), Polhill (1968, 1971, 1982), Niyomdham (1978), Yang Chun-Yu (1980) and Rudd (1991) are worth mentioning in this regard. Several scattered papers on new varieties, subspecies, records and precursory

notes on the genus appeared during this period. Dunn (1914), Gamble (1917), Ellis (1964), Chandra and Kempanna (1963), Pataskar and Ahuja (1968), Ellis and Swaminathan (1968), Thothathri and Ansari (1978, 1979), Datta and Bagchi (1969), Ravi (1970), Nair *et al.* (1981), Ansari and Thothathri (1985), Matthew (1993), Ansari (1995, 1997, 2002), Polhill (1997), Bhatt (1999) and Sibi. *et al.* (2003) are a few among them. Local and regional floras contributed a lot in the study by providing information about the distribution of the taxa in South India. Works of Cooke (1902), Saldanha and Nicolson (1976), Matthew (1983, 1996), Saldanha (1984), Pullaiah and Chennaiah (1997), Pullaiah and Ramamurthy (2000) deserve special mention in this context.

Palynology

The anthers of *Crotalaria* are dimorphic, with two different size and shape. Palynological studies of *Crotalaria* by Huang (1972), Ferguson and Skvaria (1981) and Okolo and Gill (1986) observed same type of pollen in both types of anthers. SEM studies have been conducted in 35 species of *Crotalaria* by Lin *et al.* (1999). Exine stratification of the various *Crotalaria* species was found more or less identical. It thins gradually near the pore region where the intine is thickest. Moreover, there is no significant difference in pollen grains from the two types of anthers within each *Crotalaria* species.

According to Erdtman (1952) and Haung (1972), the pollen shape of *Crotalaria* is prolate to subprolate (categories based on the P/E ratio). However, distinctions between species can be made by the specific P/E ratio. For example, pollen grains of *C. acicularis* and *C. sessiliflora* are prolate, but the P/E ratio of the latter is larger than the former. Variation of pollen features among species of *Crotalaria* is small and therefore, pollen morphology is not a prominent criterion for distinguishing different species of the genus. The

pollen of *Crotalaria* is known to be uniformly 3-zonocolporate with reticulate exine. Vishnu-Mittre and Sharma (1962) opined that pollen grains of *Crotalaria* exhibit three types of exine pattern viz., (1) grains reticulate, lumina devoid of any ornamentation e.g. *C. dubia*, *C. medicaginea*, *C. nana*, *C. quinquefolia*; (2) grains faintly reticulate e.g. *C. albida*; (3) grains with obscure ornamentation e.g. *C. juncea* and *C. sessiliflora*. Nair (1965) believed that the colporate condition was derived from 3-colpus condition. The genus *Crotalaria* therefore, should belong to a class of relatively advanced genera of Fabaceae.

Cytology

Cytological studies in the genus were conducted in the past by Atchison (1950), Datta and Biswas (1962, 1963), Magoon *et al.* (1963), Datta and Ghoshal (1969), Boulter *et al.* (1970), Chennaveeraiah and Patil (1973) and Gupta and Gupta (1977a, 1977b). The genus *Crotalaria* exhibits a remarkable uniformity in chromosome number. Most of the species are diploid with $2n = 16$. The only exception is subsection *Incanae* of section *Incanae*, where $2n = 14$ is the predominant chromosome number Gupta and Gupta (1978). Tetraploid chromosome number of $2n = 32$ is also known in *C. massaiensis* (Boulter *et al.*, 1970). One of the reasons for the failure of cytological studies to resolve differences between species is the small size of chromosomes (Gupta & Gupta, 1978). Karyotypic analysis conducted in the genus proved that the karyotypic asymmetry is very low in *Crotalaria*. There is considerable variation in the size of the chromosomes, with large ones predominant in sections *Grandiflorae*, *Chrysocalycinae* (particularly subsection *Incanae*) and subsection *Crotalaria*, regarded here as the least derived groups, and small ones general in section *Crotalaria* subsection *Longirostres* and section *Dispermae*, regarded as relatively specialized (Polhill, 1982). Since karyotypic differences could be found within a species,

minor differences in karyotype should not be considered to have a strong bearing on taxonomy without giving due consideration to morphological differences. Hence, the evolution in the genus must have taken place due to mutations or gene recombination. Structural changes in chromosomes, if any, did not change the karyotypes in any significant manner (Gupta & Gupta, 1978).

Pollination

The genus *Crotalaria* is entomophilous. The papilionaceous corolla adapted to entomophilous pollination attracted the special attention of biologists, because it represents an example of flower morphogenesis influenced by the trophoclectic activity of pollinating and nectar-eating insects (Leppik, 1977). The pollen grains are shed into the keel before the flowers fully open. When the insect visits the flowers to obtain its nectar, the keel is depressed and the pollen extruded in small quantities. In this way, pollination occurs automatically. Meeuse (1961), Faegri and Pijl (1971) and Narang (1977) noticed the occurrence of stripes on petals as just subsidiary guiding mechanisms to attract and direct the insect visitors to the vault of nectar, situated at the deep base of the flower around the ovary. The orientation of cavae (the pouch shaped structures on wings) towards the claw region indicates that it provides an area of rough surface for the insect visitors to hold and move forward. In addition, their glandular cells may provide an unperceivable quantity of sweet liquid. While attempting to reach the nectariferous region, the bee can slip if the surface is smooth and, therefore, the roughness provided by the cavae helps the insect in maintaining balance, in its effort to suck the nectar effectively (Tewari & Nair, 1978).

Epidermal anatomy

The leaf epidermis of *Crotalaria* is composed of one layer of cells covered with a smooth cuticle, which is thick adaxially and thin abaxially. Epidermal cells are more variable in their size, shape and waviness from species to species (Parveen *et al.*, 2000). A certain proportion of epidermal cells contain mucilage, either on both surfaces or on upper surface, but it is never found on lower surface alone. Leelavathy (1976) observed that the majority of the species showed conspicuous sinuate walls on the abaxial surface. Majority of the species show anisocytic followed by anomocytic stomata (Kannabiran & Krishna Murthy, 1974). Generally the trichomes are non-glandular, uniseriate, unicellular, not branched and have one basal cell and an elongate conical tapering tip. Trichomes are long on both surfaces in some species and rather short in certain others (Parveen *et al.*, 2000).

Uses

Crotalaria is generally considered as a weed of little or no economic importance. However, it has been used for various purposes in different parts of the world. The uses can be categorized under three headings *viz.*, medicinal, agricultural and industrial, and are treated separately below.

Medicinal

Species such as *C. retusa* and *C. verrucosa* are astringent, expectorant and emetic and their leaves are used for curing pyralism, diarrhoea, scabies and impetigo. Seeds of *C. retusa* are powdered and boiled with milk and is said to be very useful for increasing body strength and life span (Sivarajan & Indira, 1994). Infusion of *C. laburnifolia* is used as gargle in sore throat and mouth inflammations. Pounded plants of *C. alata* are found to be a powerful antiseptic and is applied on septic wounds (Agarwal, 1997). Extract of *C. verrucosa* and *C. spectabilis* contain tropane alkaloids having germicidal

properties, and are given to children to expel intestinal worms. Root extract of *C. albida* is a well known purgative. Leaves of *C. juncea* is emmenagogue, abortifacient and given as antifertile agent. *C. spectabilis* contain poisonous alkaloids viz., monocrotaline ($C_{16}H_{23}O_6N$) and retorsine (Sambamurthy & Subramanyam, 1989). Anacrotaline, an alkaloid which cause depression is isolated from *C. laburnifolia*. Pyrrolizidine alkaloids from *Crotalaria* species have significant antitumorous activity in P-388 lymphocytic leukemia, L-1210 lymphoid leukemia, Lewis lung carcinoma, colon-38 and other experimental tumor systems (Govil *et al.*, 1986).

The major disadvantage of the genus is livestock poisoning in Africa (Polhill, 1982). Risk is higher in dry seasons when palatable forage is scarce for a considerable period. Crotalism is the principal syndrome, affecting nervous system, lungs and liver. *C. spectabilis*, *C. retusa* and *C. berteroana* are the three potential species and the cause is attributed to monocrotaline and related pyrrolizidine compounds. These toxins accumulate in the liver and produce long-term damage, which is often fatal. Horses and cattle are more susceptible to poisoning than sheep (Bull, 1968). Once an animal ingests a part of the 'Rattle pod plant', the pyrrolizidine alkaloids are metabolized to toxic electrophilic pyrroles, which cause alkylation reactions with amino acids and their derivatives. Dissociation of the alkylation products may result in the formation of new alkylating agents, which may cause cellular damage to persist after ingestion of the alkaloid has ceased. In the liver of poisoned animals diffusion and portal fibrosis occur with bile duct hyperplasia and toxic hepatopathy. In sheep, long-term consumption of pyrrolizidine containing plants may lead to elevated levels of liver copper followed by the hemolytic crisis of copper toxicity.

Agriculture

C. juncea is valued as an excellent green manure crop, as it produces abundant root nodules. It is cultivated throughout the tropics since it is a large, fast growing, rapidly rotting annual legume, which can be ploughed in after 8-10 weeks. It is grown in rotation with sugarcane, rice, tobacco, potato *etc.*, all of which benefit considerably by the Nitrogen and humus added to soil. These not only enrich the soil but also bring down the population of plant pathogenic organisms including nematodes. *C. micans* and *C. alata* are the other species used as green manure and in the construction of contour fences. *C. semperflorens* is grown on high tea estates in South India and affords good protection to tea bushes against wind. Sheep eats foliage of *C. micans* and *C. ferruginea* and seeds of *C. medicaginea* cooked with common salt is a good cattle feed. The seed contains fat 6 - 7 %, protein 23 - 31% and carbohydrate 40 - 42%.

Industrial

The genus *Crotalaria* has been noted for its industrial uses also. *C. juncea*, commonly called Sunn or Sann hemp provides strong fibre, more enduring than jute, used for cordage and canvass making. Being resistant to deterioration in water, it is used for making fishing nets, sail cloths and marine cordage (Sambamurthy & Subramanyan, 1989). Seed proteins of *C. medicaginea* is used in the preparation of plywood adhesive and a black dye is prepared from *C. pallida* in Madagascar. Washed and cooked seeds of *C. pallida* are nontoxic and are used as a substitute for coffee in Africa.

Area of the present study

South India, the area of present study extends from latitudes 8°4' N and 15°6' N on the West coast and 19° N on the East coast and, longitudes 74° to 85° E. It lies entirely in the tropical zone and includes the states of Andhra

Pradesh, Goa, Karnataka, Kerala, Tamil Nadu, Pondicherry and the Union territory of Mahe (Plate 1). It covers an area of 6,39,974 sq.km. and is bounded on the north by Maharashtra, Chattisgarh and Orissa and on the east by the Bay of Bengal, on the south by the Indian Ocean and on the west by the Arabian Sea. The study area comprises two floristic regions viz. the Deccan and the Malabar.

The Deccan is the largest plateau in India, stretching from the Aravallis, the Malwa, the Vindhyas, the Satpura and the Chotta Nagpur Hills in the north, almost right down to Kanyakumari (Cape Comorin) in the south. The Deccan consists of three distinctive physiographic subdivisions. (1) North Deccan plateau (2) South Deccan plateau and (3) East Deccan plateau. The second and third physiographic subdivisions fall within the present study area. The South Deccan plateau consists of Karnataka plateau, Rayalaseema uplands, Tamil Nadu uplands, and Telangana plateau. The East Deccan plateau (Dandakaranya) is a very sparsely populated rugged terrain. It is the rain shadow region of Western Ghats and is characterized by the tropical deciduous forests and in the open plains it is replaced with drought resistant species and thorny bushes.

Malabar is a long strip of land lying parallel to the coast of the Arabian Sea (Malabar Coast), west of the Western Ghats. This region is floristically rich, and includes coastal plains and a series of hill ranges of the Western Ghats. The Western Ghats, a chain of mountains along the Western border of the Deccan, overlooking the Arabian Sea on the west and run parallel to the coast of Peninsular India. The more or less continuous hill ranges have a discontinuity at Palakkad, known as the Palakkad Gap, separating the Nilgiri ranges from the Anamalais. The Ghats descend steeply in the west, whereas they merge gradually through a series of hills with the Deccan in the East. Beyond the Palakkad Gap, the Ghat continues southwards as Southern Ghats.

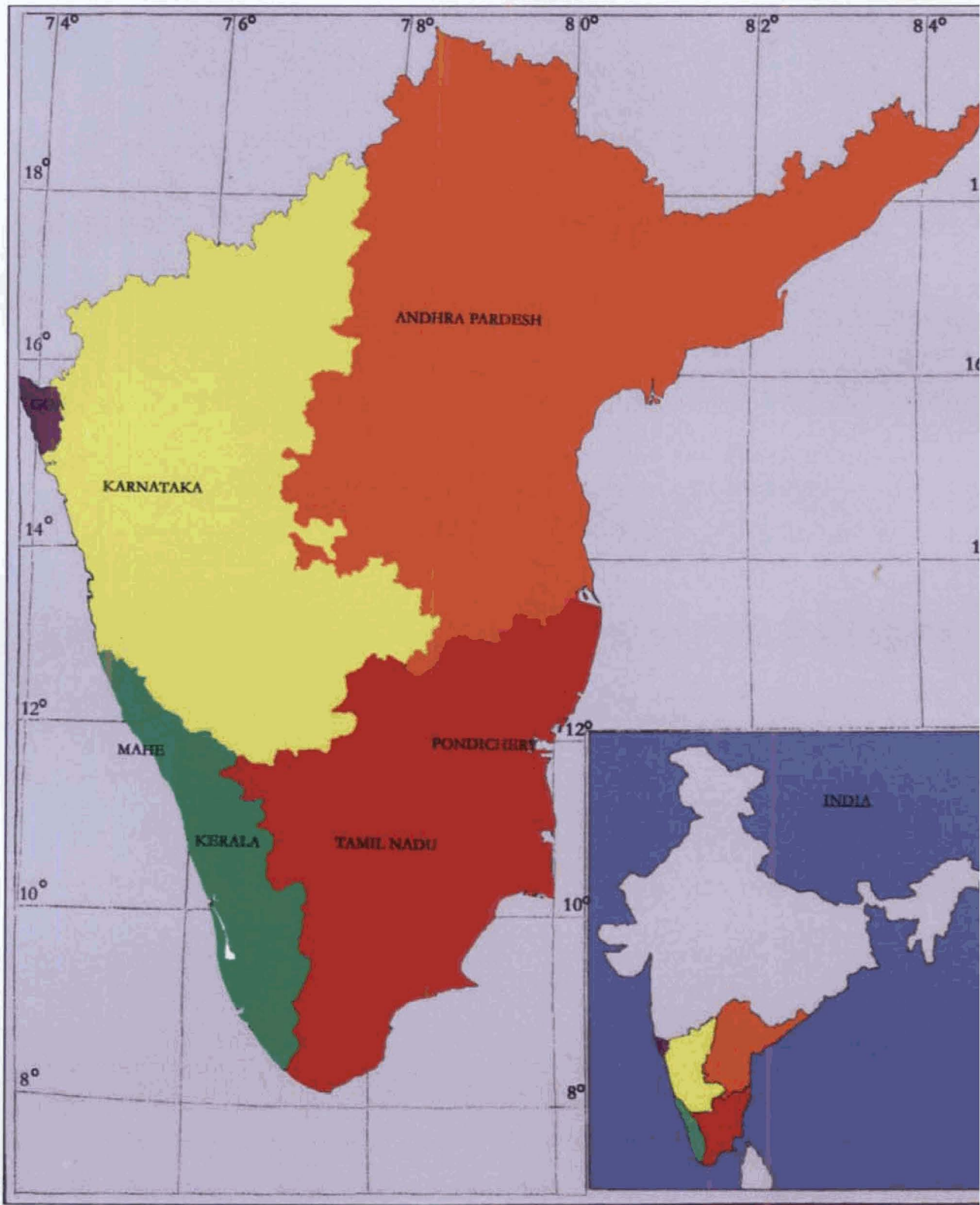


Plate 1. Map of the study area.

12A

Anamudi, the highest peak in the Western Ghats, radiate into three different sections *viz.* the Anamalais in the north; Pulneys in the south-east; and the Cardamom Hills in the south. Agastyamalai and its environs, situated at the southern end of the Western Ghats, form the most diverse and least known ecosystems in Peninsular India (Henry & Subramanyam, 1983). The whole region lies between an average altitudes ranging from 300 - 1500 m excluding the isolated peaks.

The Eastern Ghats, the eastern border of the peninsular plateau of India, are the assemblage of discontinuous ranges, hills, plateau, escarpments, buttes, narrow basins and gorges with elevations ranging from a few meters to 1750 m. The Eastern Ghats extend in northeast and southwest direction in the Indian peninsula covering an area of about 75,000 sq.km, traversing the length of the Coromandal Coast over parts of the states of Orissa, Andhra Pradesh and Tamil Nadu. Being separated from one another by major rivers like Mahanadi, Godavari, Krishna, Pennar and Cauvery, the Eastern Ghats do not form a continuous range. About 50% of forests in Andhra Pradesh lie in the Eastern Ghats. The southern-most boundary of the Eastern Ghats extends up to Pulneys. The prominent hill ranges of the Eastern Ghats in Tamil Nadu are Pachamalais, Javadi hills, Kollimalais and Shevaroy. The three main types of vegetation met on with the Eastern Ghats are northern tropical moist deciduous forests, southern moist deciduous forests and southern tropical wet evergreen forests.

Soil

Geographically, soils of India are classified in to three groups (1) Mature soils of Peninsular India (2) Alluvial soils of Indo-Gangetic Plains and (3) Scanty soils of Himalayas. The major types of soils met with Peninsular India are red soil, black soil and lateritic soil. Red soil mainly occurs in Andhra Pradesh and Karnataka while black soil is distributed in

Tamil Nadu, parts of Karnataka and Andhra Pradesh. Red soil of valleys and plains are dark and fertile. It is light, friable, porous and has low humus and water holding capacity. Many of the so-called red soil in South India exhibit no red colour. On the other hand, some red soils of lateritic origin are quite different in nature. Black colour of this soil is due to the presence of a double hydrated Ferrous and Aluminum Silicate. The soil is clayey or loamy, argillaceous, fine grained and contains a high proportion of Calcium and Magnesium Carbonates. Lateritic soils are generally reddish or yellowish-red and turn black on exposure to sun. This type of soil occurs in parts of Tamil Nadu, and in the Eastern and Western Ghats. These soils are formed in regions of alternate wet and dry seasons. Laterites are well developed on hilltops and are characterized by rich humus content. It is fertile and contains 10 - 20 percent organic matter. In Kerala, lateritic soils at low elevations show poor nutrient status, while at higher altitudes it supports plantation crops. The lateritic soil of Karnataka is comparable to Tamil Nadu, good in organic matter. In Kerala, the coastal alluviums are sandy having a low water holding capacity and nutrient status.

Climate

The climate in South India is, in general, mega thermal (Subramanyam *et al.*, 1965; Rao *et al.*, 1972). Chowdhury and Sarwade (1982) classified the homo-climatic regions of India into 5 categories *viz.*, arid region, semi-arid region, sub-humid region, humid regime and super-humid regime. Among them, South India falls under four homo-climatic types. The coastal districts of Andhra Pradesh, interior Karnataka and some districts in Tamil Nadu come under semi-arid climate. northern coastal Andhra Pradesh, southern districts of Karnataka and northern Tamil Nadu experience dry, subhumid climate, while coastal Karnataka and northern Kerala have moist subhumid type of climate. The humid regime predominates in the southern districts of Kerala

and at higher elevations around Ooty, and Conoor (Tamil Nadu), whereas super-humid climate is experienced only at Kodaikanal in Tamil Nadu.

Rainfall is the chief climatic factor that controls the vegetation of a place. Peninsular India receives both the north-east monsoon (October – December) and south-west monsoon (June - September). The former is more active in Tamil Nadu, Pondicherry, and Andhra Pradesh, while the latter is more vigorous in Kerala and coastal Karnataka. Before the onset of the south-west monsoon, there are intermittent rains in April - May *i.e.* the pre monsoon showers. The south-west monsoon starts on the west coast of South India at about the beginning of June. The Western Coast of South India receives the heaviest rainfall with more than 220 cm annually, whereas Andhra Pradesh and Tamil Nadu receive only 100-200 cm annually. The average length of the dry season is six months and the mean temperature of the coldest month is over 20° C.

Endemism

A high percentage of endemic species are found in the tropical moist deciduous and tropical semi evergreen patches of the Western Ghats and a much less number in the Eastern Ghats (Ahmedullah & Nayar, 1987). This high degree of endemism is attributed to the antiquity of the plateau. South India is a part of Gondwanaland, the landmass with a geological lineage of great antiquity. It is the second richest endemic centre after the Himalayas. Of the estimated 15,000 species of angiosperms in India, almost 12% are found to be endemic to South India. According to Ahmedullah and Nayar (*l.c.*) there are about 58 genera, endemic to peninsular India. The major centres of endemism in South India include (1) Central Western Ghats (River Kalinadi to Coorg), (2) Southern Western Ghats (Travancore, Malabar, Nilgiri, Anamalais, Palni and Tirunelveli hills complex), (3) Nilgiris, (4) Anamalai - Palni - Tirunelveli hills and (5) Eastern Ghats. The Eastern Ghats can further

be divided into two centres viz., Northern Eastern Ghats and Southern Eastern Ghats. Recent studies on the rare and threatened plants revealed the fact that more than 500 species of flowering plants in the Western Ghats are listed as rare and threatened. Most of the interesting plants described from here, have not been relocated after their type collection. Major causes of extinction are the anthropogenic interference in the form of habitat destruction or over population.

Crotalaria shows highest percentage of endemic species in South India (Table 1). Of the 66 species and 4 infra-specific taxa in South India, 33% are endemic. Among them, 9 are rare, 4 are threatened, and 4 are endangered. The centres of endemism are the centres of genetic diversity and consequently are the centres of speciation. While considering the diversity, endemism and the number of species under threat, the area selected for the present study will found to be the right choice.

Table 1. List of *Crotalaria* species endemic to South India and their distribution

Sl. No.	Name	Area of distribution
1.	<i>C. barbata</i>	S.W. Ghats, Nilgiris, Tirunelveli hills; 800 - 2400 m.
2.	<i>C. candicans</i>	S. W. Ghats, Nilgiris, Coimbatore: about 800 m.
3.	<i>C. clarkei</i>	S. W. Ghats, Nilgiris, Palni hills, Tirunelveli hills, Coimbatore: up to 1650 m.
4.	<i>C. epunctata</i>	E. Ghats, N. Circars, W. Ghats, Tirunelveli; 1350 m.
5.	<i>C. filipes.</i>	W. Ghats, Konkan, Kanara. (Plains).
6.	<i>C. fysonii</i>	S. W. Ghats, Palni hills, Madurai; above 2000 m.
7.	<i>C. grahamiana</i>	S. W. Ghats, Anamalai, Tirunelveli; upto 1800 m.

Sl. No.	Name	Area of distribution
8.	<i>C. heyneana</i>	W. Coast, Waynad, Anamalai, Palni, Nilgiris; upto 900 m.
9.	<i>C. beddomeana</i>	S. W. Ghats, Travancore, Anamalai, Palni, Nilgiris; 900 - 1200 m.
10.	<i>C. spectabilis</i>	S.W. Ghats, Nilgiri , Palni hills; above 1500 m.
11.	<i>C. longipes</i>	S. E. Ghats, Kollimalai hills of Salem, Nilgiri
12.	<i>C. lutescens</i>	W. Coast/ Ghats, Konkan (Plains), Kanara.
13.	<i>C. candicans</i> var. <i>kurnoolica</i>	E. Ghats, Kurnool Dt.
14.	<i>C. notonii</i>	S.W.Ghats, Nilgiri, Anamalais; 1200 - 1800 m.
15.	<i>C. obtecta</i>	S. W. Ghats, Nilgiri; above 1200 m.
16.	<i>C. paniculata</i> var. <i>nagarjunakondensis</i>	Deccan, Nalgonda.
17.	<i>C. peduncularis</i>	S. W. Ghats, Bangalore, Nilgiris, Anamalais; upto 1500 m.
18.	<i>C. pulchra</i>	Deccan, Karnataka, Salem of E. Ghats, Nilgiris of W. Ghats
19.	<i>C. rigida</i>	E. Coast, Thanjavoor, Coimbatore to Tirunelveli
20.	<i>C. salicifolia</i>	S. W. Ghats, Coorg, Hassan, Wayanad, Nilgiris, Madurai; Salem and S. Arcot of E. Ghats
21.	<i>C. scabra</i>	Tirunelveli, Coimbatore, Kanyakumari, Salem of E. Ghats; 1800 m.
22.	<i>C. speciosa</i>	Deccan, hills of Karnataka, E. Ghats, Ramanathapuram and Tirunelveli.
23.	<i>C. willdenowiana</i> subsp. <i>willdenowiana</i>	E. Ghats/ Coast, Chingleput, N. Arcot, Thanjavur, Salem, Ramanathapuram.
24.	<i>C. willdenowiana</i> subsp. <i>glabrifoliata</i>	Deccan, Coimbatore Dt.

Distribution and ecology

The genus *Crotalaria* is wide spread in the tropics and sub tropics and is represented by about 600 species all over the world. It is represented by 66 species and four infra-specific taxa in South India (Plate 2) of which, more than 33% are endemic (Table 1). Major collection centers of *Crotalaria* and *Rothia* in South India are given in Table 2.

Table 2. Major collection centres of *Crotalaria* and *Rothia* in South India

1. Thiruvananthapuram <i>R. indica</i> <i>C. incana</i> <i>C. pallida</i>	11. Eravikulam <i>C. fysonii</i>	20. Kakkadampoil <i>C. retusa</i> <i>C. evolvuloides</i> <i>C. pallida</i> <i>C. laburnifolia</i> <i>C. heyneana</i> <i>C. nana</i> <i>R. indica</i>
2. Thirunelveli <i>C. globosa</i>	12. Palani <i>C. fysonii</i> <i>C. spectabilis</i>	21. Ooty <i>C. incana</i> <i>C. semperflorens</i> <i>C. walkeri</i>
3. Kallar <i>C. pallida</i> <i>C. heyneana</i>	13. Chalakkudi <i>C. verrucosa</i>	22. Avalanchi <i>C. scabra</i>
4. Thenkasi <i>C. pallida</i>	14. Parambikkulam <i>C. obtecta</i> <i>C. heyneana</i>	23. Mandya <i>C. paniculata</i>
5. Ponmudi <i>C. micans</i>	15. Vazhani <i>C. heyneana</i> <i>C. retusa</i>	24. Kannur <i>C. quinquefolia</i> <i>C. verrucosa</i> <i>C. umbellata</i>
6. Achankovil <i>C. verrucosa</i>	16. Kunnankulam <i>C. verrucosa</i> <i>C. pallida</i>	25. Wayanad <i>C. walkeri</i> <i>C. alata</i> <i>C. pallida</i> <i>C. calycina</i> <i>C. speciosa</i> <i>C. stipitata</i>
7. Adimaly <i>C. multiflora</i>	17. Nelliampathy <i>C. clarkei</i> <i>C. retusa</i> <i>C. umbellata</i>	26. Mysore <i>C. pallida</i>
8. Munnar <i>C. obtecta</i> <i>C. retusa</i> <i>C. trifoliatrum</i> <i>C. fysonii</i>	18. Coimbatore <i>C. juncea</i> <i>C. willdenowiana</i>	
9. Devikolam <i>C. micans</i> <i>C. walkeri</i>	19. Shevaroy hills <i>C. alata</i> <i>C. candicans</i> <i>C. longipes</i>	
10. Periyakulam <i>C. grahamiana</i> <i>C. stipitata</i>		

- | | | |
|---|--|--|
| 27. Mandya
<i>C. umbellata</i>
<i>C. triquetra</i>
<i>C. pallida</i> | 32. Cuddappah
<i>C. angulata</i>
<i>C. hirta</i> | <i>C. angulata</i>
<i>C. fysonii</i>
<i>C. verrucosa</i> |
| 28. Chikmagalur
<i>C. verrucosa</i>
<i>C. retusa</i> | 33. Ananthapur
<i>C. ramosissima</i>
<i>C. medicaginea</i> | 37. Mehabubanagar
<i>C. bifaria</i>
<i>R. indica</i> |
| 29. Baba Budan hills
<i>C. umbellata</i> | 34. Goa
<i>C. lutescens</i>
<i>C. prostrata</i>
<i>C. filipes</i>
<i>C. triquetra</i>
<i>C. trifoliastrum</i>
<i>C. verrucosa</i>
<i>C. albida</i> | 38. Bijapur
<i>C. hirta</i>
<i>C. linifolia</i> |
| 30. Chittoor
<i>C. pulchra</i>
<i>C. medicaginea</i>
<i>C. speciosa</i>
<i>C. calycina</i>
<i>C. ferruginea</i>
<i>C. angulata</i> | 35. Bellary
<i>C. juncea</i>
<i>C. paniculata</i> | 39. Hyderabad
<i>C. fysonii</i> |
| 31. Shimoga
<i>C. pallida</i>
<i>C. triquetra</i> | 36. Kurnool
<i>C. albida</i>
<i>C. pusilla</i> | 40. Karimnagar
<i>C. prostrata</i> |
| | | 41. Nizamabad
<i>C. scabrella</i> |
| | | 42. Adilabad
<i>C. paniculata</i>
<i>C. lunulata.</i> |

Of the South Indian species of *Crotalaria*, about 30% are high altitude (1200 - 2400 m), nearly 45% prefer medium elevations (400 - 1200 m), while the remaining 25% are low altitude (0 - 400 m.) inhabitants. It is interesting to note that the species such as *C. retusa* and *C. nana* occurs from sea level to an altitude of about 2400 m. Considerable variation in morphology has been noticed among the plants collected from different altitudes. Except *C. juncea* and *C. agatiflora* subsp. *engleri* all others are wild plants. *C. beddomeana*, *C. spectabilis* and *C. agatiflora* are grown as garden plants. The majority of the species occur on waysides, waste lands, and open forest tracks. *C. evolvuloides*, and *C. heyneana* are grown as forest undergrowth. *C. umbellata*, *C. fysonii* and *C. clarkei* are seen on grass lands whereas, *C. beddomeana*, *C. semperflorens*, *C. oblecta* and *C. alata* are seen growing intermingled with forest undergrowth.

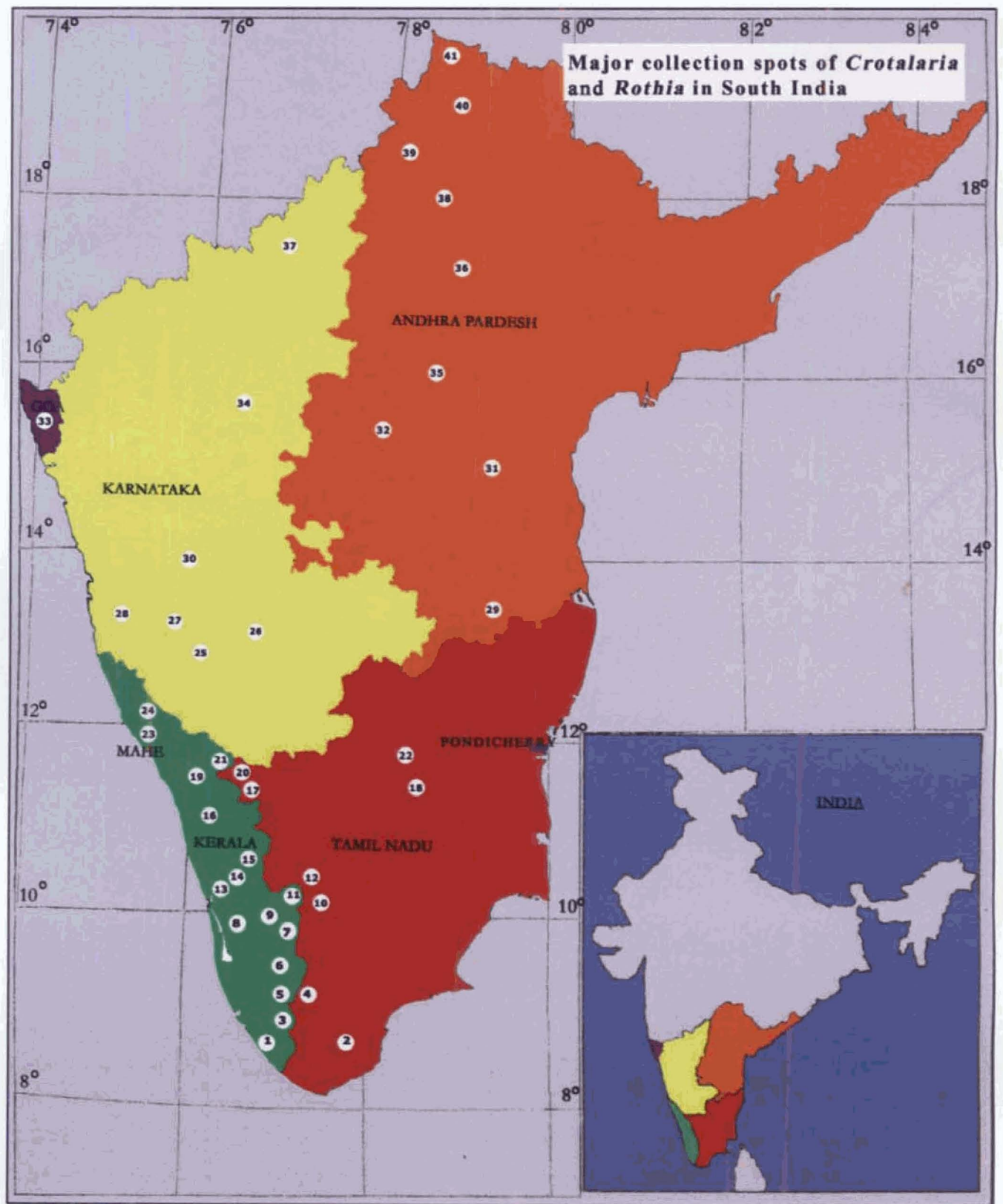


Plate 2. Distribution map of *Crotalaria* and *Rothia* in South India (Ref. Table 2).

MATERIALS AND METHODS

Sibichen M. Thomas “Morphologic and Taxonomic Studies on Fabaceae (Tribe
Crotalarieae) in South India” Thesis. Department of Botany, St. Joseph's
College Kozhikode , University of Calicut, 2004

MATERIALS AND METHODS

Materials

The present work comprises the taxonomic revision of tribe Crotalarieae in South India. It is represented by two genera viz., *Crotalaria* and *Rothia*. The genus *Crotalaria* consists of 66 species and 4 infra-specific taxa and *Rothia* is represented by *R. indica* in South India. The content of the work is based on extensive field studies and collections made from different parts of South India during the last four years. In addition to the personal collection by the author, materials deposited at Calicut University Herbarium (CALI), Central National Herbarium, Kolkotta (CAL), Botanical Survey of India, Coimbatore. (MH), Goa University Herbarium (GU), Sree Krishna Devaraya University, Ananthapur. (SKU) and Botanical Survey of India, Yercaud (YH) are also examined to study the variation pattern.

Methods

In order to study the diversity and habitat requirements exhaustive field trips were conducted throughout South India during the course of study. Specimens are collected and examined in the field as well as in laboratory; illustrations are prepared based on live specimens. Live collections are maintained in the St. Joseph's College Botanic Garden.

Identification of each species is done in consultation with types and protologues. In the event of non-availability of original type specimens cibachromes, microfiches and typtypes obtained from Royal Botanic Gardens, Kew (K), British Museum (BM) and Natural History Museum, London (BM) have been consulted. Morphological characters of every specimens are examined critically and variations are recorded. Descriptions and identification of each taxon has been done after proper determination and examination of a wide range of specimens. Except in a few cases, illustrations are based on fresh specimens. The most typical form is illustrated in all cases.

The nomenclature of each species is updated. For description of taxa, the terminology was employed as per Lawrence (1951) and Radford (1986). Distribution map is prepared based on specimens examined during the present investigation. Vernacular names are procured either from herbarium labels or from published works.

Herbarium specimens are prepared by the conventional method. Duplicates of the specimens are deposited in St. Joseph's College Herbarium (SJC), Calicut University Herbarium (CALI) and Central National Herbarium (CAL). The specimens were examined with Leica MZ 7.5 Binocular Microscope. Dried specimens soaked in water for 4 - 5 hours or over night and then boiled in water prior to microscopic observations. Metric system has been followed in all kinds of measurements. Data on flowering and fruiting time, ecology and altitude have been gathered mostly from field study and rarely from the literature or herbarium sheets. Some of the specimens referred to Dr. Polhill for comments were deposited at Kew Herbarium (K).

The epidermal features and their taxonomic utility in the systematics of the genus *Crotalaria* is also attempted in the present study. This study is conducted in 20 species of *Crotalaria*. Majority of specimens were collected afresh from the St. Joseph's College Botanic Garden and the remaining were obtained from herbarium specimens. Epidermal peels were taken from inter coastal areas of the mature leaves. Both upper and lower epidermal peels were stripped off, washed in water and stained with aqueous safranin, and mounted on clean micro-slides using 50% glycerol. The semi permanent micro-preparations were examined under microscope and camera lucida diagrams of epidermis were drawn at x 400. The measurements were taken using micrometer and quantitative data are based on an average of five readings. The parameters observed were epidermal cell shape, cell wall nature, stomatal type, stomatal index and trichome features. Epidermal cell frequency,

stomatal frequency and trichome frequency are given as number of cells per sq. mm leaf area. Stomatal index was calculated by using the standard formula. The qualitative and quantitative data are given in separate tables.

Plan of the thesis

The thesis begins with an introduction dealing with the systematic position of the tribe Crotalarieae, its general characters, the significance of the present study, review of literature, the salient features of the area of study and its suitability and a brief account of the distribution and ecology of the representative members. The materials and methods and plan of the thesis are given in the second chapter. The third chapter analyses the epidermal features and their taxonomic utility in the systematics of the genus *Crotalaria*. An attempt has been made to test the suitability of epidermal features in the segregation of species and their consistency at species level with special reference to the genus *Crotalaria*. Data on qualitative and quantitative parameters are also provided.

Systematic treatment of the tribe is dealt with in the fourth chapter. It consists of the history of the tribe Crotalarieae, general characters, key to the genera, typification of the genus and subgeneric classification. Two genera are recognized under this tribe in South India. Each genus is provided with a detailed account on its history, circumscription, relevant bibliographical data, synonymy, distribution, ecology, discussion on infra-generic classification and key to sections. The sections are treated alphabetically. The species under each section are also treated in the same pattern. Under each section, key to species is given. For every species the following information is provided: correct nomenclature, relevant synonymy, vernacular names, if any, detailed description, distribution and ecology in addition to phenological data. Notes on economic importance, special features, nomenclature and taxonomy are given wherever found relevant. Besides, the specimens collected and

examined by the author from the area of present study and the herbarium specimens consulted at various Herbaria are given at the end of each species. They are cited by state, district, and place in alphabetical order. Illustrations are provided for most of the species. A brief account of comparative morphology and the major findings of the author are detailed in the discussion. The bibliography on literature cited is also provided.

EPIDERMAL FEATURES AND ITS TAXONOMIC UTILITY

Sibichen M. Thomas “Morphologic and Taxonomic Studies on Fabaceae (Tribe
Crotalarieae) in South India” Thesis. Department of Botany, St. Joseph's
College Kozhikode , University of Calicut, 2004

**EPIDERMAL FEATURES AND ITS
TAXONOMIC UTILITY**

Epidermal cells

Epidermis of the genus *Crotalaria* is composed of one layer of cells covered with a smooth cuticle, which is thick on upper surface and thin on lower surface. Qualitative and quantitative data on the epidermal cells and outgrowths of 20 species of *Crotalaria* (Table 3) are given in Table 4 and 5 respectively. The cells are mostly irregular and rarely polygonal in shape irrespective of its position. Cells of lower epidermis are smaller in size and larger in number compared to the upper epidermis. However, in *C. laburnifolia* and *C. spectabilis* the situation is reverse. The number of cells vary from 400 - 3000 per sq. mm. Cells are generally anisodiametric, but isodiametry is observed in the upper epidermis of *C. longipes* and *C. retusa*. Thin and straight or slightly curved or wavy cell walls are noticed in majority of the species studied. *C. laburnifolia* is distinct in its thin and sinuous cell wall on both surfaces. Similar pattern is seen in the lower epidermis of *C. heyneana* and *C. incana*. Though a general consistency is observed in cell size, number, and shape in epidermal cells of individual species there is variation in accordance with their spatial distribution. For example terminal and marginal cells are found smaller than the intercostals cells in the middle region of the leaf.

Table 3. List of *Crotalaria* species studied

Sl. No.	Species	Locality	Specimen cited
1.	<i>C. agatiflora</i> subsp. <i>engleri</i>	Kodaikanal	SJC No.610
2.	<i>C. alata</i>	Wayanad	SJC No.747
3.	<i>C. fysonii</i>	Munnar	SJC No.608
4.	<i>C. grahamiana</i>	Munnar	SJC No.611
5.	<i>C. heyneana</i>	Bot. Garden,SJC	SJC No.699
6.	<i>C. incana</i>	Thiruvananthapuram	SJC No.702

Sl. No.	Species	Locality	Specimen cited
7.	<i>C. juncea</i>	Thrissur	SJC No.680
8.	<i>C. laburnifolia</i>	Bot. Garden, SJC	SJC No.626
9.	<i>C. longipes</i>	Yercaud	SJC No.728
10.	<i>C. lutescens</i>	Goa	SJC No.719
11.	<i>C. candicans</i>	Gudalloor	SJC No.728
12.	<i>C. multiflora</i>	Bot. Garden, SJC	SJC No.671
13.	<i>C. mysorensis</i>	Valayar	SJC No.712
14.	<i>C. pallida</i>	Bot. Garden, SJC	SJC No.610
15.	<i>C. peduncularis</i>	Gudalloor	SJC No.643
16.	<i>C. quinquefolia</i>	Kozhikode	SJC No.683
17.	<i>C. retusa</i>	Bot. Garden, SJC	SJC No.624
18.	<i>C. spectabilis</i>	Kodaikanal	SJC No.682
19.	<i>C. triquetra</i>	Goa	SJC No. 721
20.	<i>C. verrucosa</i>	Kunnamkulam	SJC No.620

Stomatal Complex

Of the 20 species of the genus examined, except *C. agatiflora*, *C. longipes* and *C. heyneana*, the rest are amphistomatic. Anomocytic or anisocytic stomata are found in majority of the species, very occasionally paracytic (*C. mysorensis* and *C. quinquefolia*) and diacytic (*C. agatiflora*) stomata also. These findings are in agreement with Kannabiran and Krishnamurthy (1971) and Parveen *et al.*, (2000). As in other bifacial leaves, *Crotalaria* too have considerably higher number of stomata on the lower surface. However, *C. incana* exhibits more or less the same stomatal index on both surfaces. *C. agatiflora*, the tree species and many woody shrubs are hypostomatic, while the shrubby plants are amphistomatic.

Table 4. Qualitative data on foliar epidermal features in *Crotalaria* species

Sl. No.	Species	Epidermal cell shape		Epidermal cell wall		Stomatal complex	
		Upper	Lower	Upper	Lower	Upper	Lower
1.	<i>C. agatiflora</i>	Polygonal Irregular	Polygonal Irregular	Thin Straight	Thin Straight	Absent	Anomocytic Rarely Diacytic
2.	<i>C. alata</i>	Polygonal Anisodiametric	Irregular Anisodiametric	Thin Straight - Curved	Thin Straight - Wavy	Mostly Anomocytic Rarely anisocytic	Mostly Anisocytic
3.	<i>C. fysonii</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight - Curved	Thin Straight - Wavy	Mostly Aniso Rarely Anomocytic	Anomocytic
4.	<i>C. grahamiana</i>	Irregular Anisodiametric	Irregular anisodiametric	Thin Straight - Curved or Wavy	Thin Straight - Wavy	Mostly Anisocytic Rarely Anomocytic	Anomocytic rarely Anisocytic
5.	<i>C. heyneana</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thick Straight - Wavy	Thin Sinuous	Absent	Anomocytic
6.	<i>C. incana</i>	Irregular Anisodiametric	Mostly Isodiametric	Thin Sinuous	Thin Sinuous	Mostly Anomocytic Rarely Paracytic	Anomocytic
7.	<i>C. juncea</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight - Wavy	Thin Straight - Wavy	Anisocytic	Anisocytic or Anomocytic
8.	<i>C. laburnifolia</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Sinuous	Thin Sinuous	Anomocytic or Anisocytic	Anomocytic or Anisocytic
9.	<i>C. longipes</i>	Polygonal Isodiametric	Irregular Anisodiametric	Thin Straight	Thin Straight - Curved	Absent	Anisocytic
10	<i>C. lutescens</i>	Irregular Anisodiametric	Irregular Isodiametric	Thin Straight - Wavy	Thin Straight - Wavy	Anisocytic	Anisocytic

Sl. No.	Species	Epidermal cell shape		Epidermal cell wall		Stomatal complex	
		Upper	Lower	Upper	Lower	Upper	Lower
11	<i>C. madurensis</i>	Irregular Anisodiametric	Polygonal Aniso diametric	Thin Straight -Curved	Thin Straight -Curved	Anisocytic rarely Anomocytic	Anisocytic rarely Anomocytic
12	<i>C. multiflora</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight - Curved	Thick Sinuous	Anisocytic	Anisocytic rarely Anomocytic
13	<i>C. mysorensis</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Wavy	Thin Straight - Wavy	Anisocytic rarely Paracytic	Anisocytic rarely Paracytic
14	<i>C. pallida</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thick Straight-Wavy or Sinuous	Thick Sinuous	Anisocytic	Mostly Anisocytic Rarely Anomocytic
15	<i>C. peduncularis</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight -Wavy	Thick Straight -Wavy	Mostly Anomocytic Rarely Anisocytic	Anomocytic or Anisocytic
16	<i>C. quinquefolia</i>	Irregular Wavy	Irregular Curved	Straight - Curved	Wavy	Anisocytic	Paracytic
17	<i>C. retusa</i>	Polygonal Isodiametric	Irregular Anisodiametric	Straight	Wavy	Anisocytic	Anomocytic
18	<i>C. spectabilis</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight - Wavy	Thin Straight - Wavy	Anisocytic	Anisocytic rarely Anomocytic
19	<i>C. triquetra</i>	Irregular Anisodiametric	Polygonal Anisodiametric	Thin Straight -Curved	Thick Straight - Curved	Mostly Anomocytic Rarely Anisocytic	Anomocytic or Anisocytic
20	<i>C. verrucosa</i>	Irregular Anisodiametric	Irregular Anisodiametric	Thin Straight - Wavy	Thin Straight - Curved	Anomocytic or Anisocytic	Mostly Anomocytic Rarely Anisocytic

Table 5. Quantitative data on foliar epidermal features in *Crotalaria* species

Sl. No.	Species	Epidermal cell Frequency/sq. mm		Stomatal Frequency/sq. mm		Stomatal Index		Trichome features			
		Upper	Lower	Upper	Lower	Upper	Lower	No. of hairs/sq.mm		Length of hairs	
								Upper	Lower	Upper	Lower
1	<i>C. agatiflora</i> subsp. <i>engleri</i>	2181	2961	---	389	---	11.61	51	78	0.18 - 0.42	0.24 - 0.51
2	<i>C. alata</i>	416	727	38	207	8.37	22.16	39	52	25 - 70	30 - 70
3	<i>C. fysonii</i>	519	649	12	220	2.26	25.31	12	39	0.36 - 0.93	0.3 - 0.78
4	<i>C. grahamiana</i>	1870	831	363	467	16.25	35.97	90	---	0.27 - 0.45	---
5	<i>C. heyneana</i>	3056	1246	---	311	---	19.97	12	67	0.18 - 0.25	0.12 - 0.15
6	<i>C. incana</i>	545	623	129	129	19.97	17.15	---	26	---	0.21 - 0.36
7	<i>C. juncea</i>	1974	2597	311	831	13.6	24.24	78	91	0.09 - 0.3	0.21 - 0.56
8	<i>C. laburnifolia</i>	1091	727	116	182	9.61	20.02	---	---	---	---
9	<i>C. longipes</i>	1870	1610	---	194	---	10.75	51	64	0.24 - 0.6	0.15 - 0.3

Sl. No.	Species	Epidermal cell Frequency/sq. mm		Stomatal Frequency/sq. mm		Stomatal Index		Trichome features			
								No. of hairs/sq.mm		Length of hairs	
		Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
10	<i>C. lutescens</i>	779	727	168	103	17.74	12.40	---	---	---	---
11	<i>C. madurensis</i>	883	831	38	181	4.12	17.88	26	77	0.15 - 0.6	0.18 - 0.3
12	<i>C. multiflora</i>	675	753	207	363	23.46	32.53	38	25	0.105 - 0.29	0.075 - 0.29
13	<i>C. mysorensis</i>	571	831	233	207	28.89	19.94	---	12	---	650 - 750
14	<i>C. pallida</i>	701	1194	181	259	20.52	17.82	---	52	---	0.195 - 0.315
15	<i>C. peduncularis</i>	805	935	233	311	22.45	24.96	---	---	---	---
16	<i>C. quinquefolia</i>	935	883	519	363	35.69	29.13	----	78	---	0.18 - 0.33
17	<i>C. retusa</i>	779	805	12	285	1.5	26.09	----	64	---	0.18 - 0.3
18	<i>C. spectabilis</i>	467	987	103	286	18.07	22.46	12	117	0.18 - 0.27	0.195 - 0.3
19	<i>C. triquetra</i>	623	1350	103	259	14.18	16.09	---	---	---	---
20	<i>C. verrucosa</i>	467	831	78	155	14.31	15.72	12	26	0.12-0.165	0.12--0.27

The lowest stomatal index (1.5) is noticed in the upper epidermis of *C. retusa* while *C. grahamiana* have the highest value (35.97). Lower epidermis having lowest stomatal index (10.75) is noticed in *C. longipes* and highest (35.97) in *C. grahamiana*. The figures indicate the fact that while the stomatal index ranges from 1.5 – 35.65 in the upper epidermis, the range is narrow (10.75 – 35.97) in the lower epidermis. Species having same stomatal frequency viz., *C. triquetra* and *C. spectabilis* shows different stomatal index because, the index is determined by not only the number of stomata but also the size of the epidermal cells. Moreover, a correlation between the stomatal frequency or index and the habitat of the species concerned could not be derived. Stomatal type also not found to be strictly species specific. The same species shows more than one type of stomata and some times they cannot even distinguish unless we resort to its morphogenetic studies.

Trichomes

Trichomes are very common in *Crotalaria*. They are all unicellular epidermal outgrowths. Size, shape, length, and frequency of trichomes are important characters in the taxonomy of *Crotalaria*. Unlike in many other genera, in *Crotalaria* the hairs do not show much variation except in length, density and origin. They are unbranched, uniseriate, non glandular and have one basal cell and an elongate conical tapering tip. Despite the homogeneity, it becomes significant due to their distribution pattern.

Trichome frequency and length of various species are summarised in Table 5. Species such as *C. triquetra*, *C. peduncularis*, *C. lutescens* and *C. laburnifolia* are distinct by their glabrous leaves while *C. grahamiana*, *C. incana*, *C. mysorensis*, *C. pallida* and *C. retusa* have glabrous upper and pubescent lower surface. Members are tomentose throughout except pods in the sect. *Erectae* but the whole plant is glabrous in sect. *Glaucæ*. Trichome frequency is usually higher on lower epidermis than upper epidermis and the

density vary from 12 - 50 per sq. mm on upper and 12 - 117 on lower epidermis. The shortest hairs (0.009 mm long) are seen on the upper epidermis of *C. juncea* and longest (2.04 mm long) are observed in *C. mysorensis*. Moreover, in many species the hairs exhibit a wide range in length. Here also I am unable to find out a correlation between altitudinal variation and indumentum pattern.

SYSTEMATIC TREATMENT

Sibichen M. Thomas “Morphologic and Taxonomic Studies on Fabaceae (Tribe
Crotalarieae) in South India” Thesis. Department of Botany, St. Joseph's
College Kozhikode , University of Calicut, 2004

SYSTEMATIC TREATMENT

Tribe Crotalarieae

Crotalarieae (Benth.) Hutch., Gen. Fl. Pl. 1: 364. 1964; Polhill, Bot. Syst. 1: 317. 1976, In: Polhill & Raven (eds.), Adv. Leg. Syst. 339. 1981, *Crotalaria* in Africa and Madagascar 3. 1982; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7. 183. 1991; Van Wyk, Contrib. Bolus Herb. 13: 265. 1991; & Schutte In: Crisp & Doyle (eds.), Adv. Leg. Syst. 7: 283. 1995.

Type genus: *Crotalaria* L.

Genisteeae subtribe Crotalariinae Benth. (1865), as 'Crotalarieae' Borbonieae Hutch. (1964); Lotoonideae Hutch. (1964).

Herbs or shrubs or very rarely small trees. Leaves simple or digitately 3-7 foliolate, usually pulvinate. Flowers in terminal or leaf opposed racemes, rarely paniculate and exceptionally heads. Calyx 5 lobed, generally subequal, often bilipped. Standard petal with two basal appendages; wing petals with intercostal cavae; keel petals obtuse, pointed or beaked. Stamens joined into a sheath open basally; anthers generally dimorphic, basifixed and dorsifixed alternately. Ovary sessile or subsessile or stalked, few to many ovuled; style glabrous or with 1-2 lines of hairs; stigma terminal, minutely capitate. Pods diverse, oblong-clavate or globose-subglobose, 1 to many seeded, dehiscent or not. Seeds usually oblique cordiform, less often reni-form; radicular lobe usually prominent, hilum small; sometimes with a conspicuous aril.

The arrangement of stamens is a major criterion in the classification of the subfamily. In classical concept of the tribe Genisteeae as defined by Bentham (1865) and Taubert (1893), the subtribe Crotalariinae (Crotalarieae) is separated from Genisteeae and Cytisinae by their monadelphous stamens having the sheath split above. In *Crotalaria* the tube is generally split, but quite frequently the margins of the sheath are more or less

coherent, although the tube so formed seems always to be open at the very base.

The Crotalariaeae forms part of a newly identified monophyletic clad, the “core Genistoids” which includes Crotalariaeae, Genisteeae, Podalyrieae, Thermopsidaeae, Euchresteeae and parts of the “*Sophora* group” (Crisp *et al.*, 2000). The current knowledge of the Crotalariaeae was reviewed by Van Wyk (1991) and Van Wyk and Schutte (1995). The most conspicuous change was the exclusion of the *Argyrolobium* group. This group consists of six genera viz. *Argyrolobium* Eckl. & Zeyh, *Dichilus* DC, *Melolobium* Eckl. & Zeyh., *Anarthrophyllum* Benth., *Sellocharis* Taub. and *Polhillia* Stirton. Presently the above group belongs to in the tribe Genisteeae, rather than in the tribe Crotalariaeae, where they were previously placed (Polhill, 1981). New insight in the relationships within the tribe came mainly from chemosystematic studies of alkaloids (Van Wyk & Verdoorn, 1990). Despite a lack of defining characters, the monophyly of the tribe as circumscribed here is well supported by molecular evidence (Crisp *et al.*, 2000) and by cladistic analysis of morphological, cytological and chemical characters (Van Wyk & Schutte, 1995).

Cladistic analysis suggested an early diversification of the genera with uniform anthers and lupanine type esters of quinolizidine alkaloids (*Pearsonia* Dummer, *Rothia* and *Robynsiophyton* Wilczek) followed by the poorly known *Spartidium* Pomel and the so called “Cape group of Genera” (Polhill, 1981), which however now includes *Lotononis* (DC) Eckl. & Zeyh. and *Crotalaria* L. The exclusion of the *Argyrolobium* group, based on morphological and chemical characters, is strongly supported by DNA sequence data. This group seems either basal to the Crotalariaeae or perhaps more likely basal to the rest of the Genisteeae (Van Wyk & Schutte, 1995). Due to reticulate and overlapping patterns of character state distribution in the

Crotalarieae sensu stricto, generic delimitation is intricate and subject to mis-interpretation. Several of the large and diverse genera are either monophyletic or paraphyletic depending on the choice of characters. As currently circumscribed, the tribe includes 11 genera and about 1114 species. Genera included are *Lebeckia* Thunb., *Wiborgia* Thunb., *Rafnia* Thunb., *Aspalathus* L., *Spartidium* Pomel, *Crotalaria* L., *Bolusia* Benth., *Lotononis* (DC) Eckl. & Zeyh., *Pearsonia* Dummer, *Rothia* Pres. and *Robynsiophyton* Wilczek. Most of these genera are African but, with a few ranging in to Asia, Australia and America. Of the three genera reported from India, *Crotalaria*, *Rothia* and *Lotononis*, the former two occurs in South India while the latter is restricted to northern parts of India.

Key to the Genera

1. Leaves simple or 3-7 foliolate; petals yellow or bluish white, with or without purple striations; anthers dimorphic; basifixed oblong and dorsifixed ovoid; style curved or geniculate; pod oblong or globose or subglobose *Crotalaria*
1. Leaves 3-foliolate; petals white to pale pink or lilac, without striations; anthers subequal, subspherical, dorsifixed; style straight; pod linear-oblong, compressed *Rothia*

Review of the genus *Crotalaria*

Crotalaria L. is widespread in the tropics and subtropics, primarily of the southern hemisphere. The genus comprises about 600 species (Polhill, 1982) all over the world. The name "*Crotalaria*" is derived from a Greek word referring to the rattling of the seeds in the inflated pods. Infra generic relationships are poorly known but the genus seems to have originated in Africa, with more recent diversification into other regions of the world. In South India, the genus is represented by 66 species and 4 infra-specific taxa.

It was Linnaeus (1753) who first described the genus *Crotalaria*. He has included 13 species under this genus, of which 6 are from Southern Peninsular India. Van Rheede (1678-1703) in his "Hortus Malabaricus" mentioned about this genus and described five species from the Malabar Coast. Subsequently, many botanists studied the genus for the Asian tropics. Among them, Roth (1821) and Don (1825) are the pioneers. Out of the seven species reported by Don (*l.c.*) in his "Prodromus Florae Nepalensis" four occur in India. The contribution of De Condolle (1825) is worth mentioning in solving the ambiguity of the generic limit.

Wight and Arnott (1834) in their "Prodromus Florae Peninsulae India Orientalis" subdivided the genus into 13 sections. This was the maiden attempt of this kind, which paved the path for the subsequent workers. They separated the genus *Priotropis* Wight & Arn. based on *Crotalaria cytisoides* Roxb. from *Crotalaria*, noting that it differs from the latter by its flattened pod. Moreover, *Priotropis* and the monotypic genus *Heylandia* DC. were maintained for long time, despite the well known fact that they agree entirely with *Crotalaria* in vegetative and floral characters. But Harms (1934) considered that *Priotropis* in East Africa cannot be distinguished in the absence of the characteristic legumes and he indicated his discontent in the treatment. Peltier (1959) in his revision of *Crotalaria* in Madagascar described the sect. *Coursia* to accommodate species of same alliance having flattened, few seeded legumes in that area. But, Polhill (1968) was of the opinion that if the two genera are incorporated within *Crotalaria*, then their species do not constitute distinct section rather; they fall entirely within the natural subdivisions of the genus. Hence, *Priotropis* and *Heylandia* are treated as synonyms of *Crotalaria* and this treatment has been accepted by later authors like Niyomdham (1978) and Rudd (1991).

In the present study our conclusions on the generic limits of the genus *Crotalaria* are in corroboration with Polhill (1982). *Crotalaria* appears to be closely related to *Lotononis*, as the two genera are unique in the family for their accumulation of several macro cyclic pyrrolizidine alkaloids (Van Wyk & Verdoorn, 1990).

Bentham (1843) in his classical work "Enumeration of the Leguminosae indigenous to Southern Asia and Central and Southern Africa" adopted the sections proposed by Wight and Arnott (*l.c.*) and modified them to some extent to accommodate the wide array of species. The circumscription of the genus *Crotalaria* is also changed slightly to include *C. leptocarpa* with laterally compressed pods. But, Baker (1914) excluded it, stating that inflated pod is one of the four primary distinguishing characters of the genus. The very four distinguishing characters of the genus are (1) generally free calyx lobes, (2) beaked keel petals, (3) monadelphous stamens and (4) the inflated pod.

Crotalaria is easily distinguished by its subequally lobed calyx; standard petal with a short claw and two small appendages at the base inside; wings bear cavae, in the intercostal areas of the proximal half; keel petals produced in to a distinct beak; stamens monadelphous, with the sheath split above at least at the very base; anthers dimorphic: long, basifixed, oblong and short, dorsifixed ovoid seen alternately; ovary stipitate having style with one or two lines of hairs towards the stigma and inflated pod. The above characters are not invariably correlated and an exception of one or two is not infrequent.

Typification of the Genus

Linnaeus (1753) described thirteen species under the genus *Crotalaria*, of which *C. lotifolia* (as '*latifolia*') and *C. laburnifolia* alone have been

considered for typification. Hitchcock and Green (1929) selected *C. laburnifolia* as the 'historic type of the generic name' and this was adopted by Phillips (1951) and Hutchinson (1964) overlooking the prior selection of *C. lotifolia* as type by Britton and Brown (1913). When the two proposals were placed before 'Index Nominum Genericorum' for typification *C. lotifolia* has been accepted as type species on the ground of its prior choice, unless it can be demonstrated that Linnaeus's generic description is based primarily on some other species.

Linnaeus's (1754) description matches both species reasonably well, except that the calyx is said to have the tube protracted on the lower side (tripartite, with the lower lip tri-fid), the ovary hairy and legume short. These characters fit best to *C. lotifolia* than *C. laburnifolia*, which has the calyx equally lobed, ovary glabrous and the legume is supported on an exceptionally long stipe. Further it is true that his concept of the genus is more focused to *C. lotifolia* than *C. laburnifolia*. While considering the prior choice and the circumscription of the original generic description, it is more reasonable to accept *C. lotifolia* as the type.

Crotalaria L.

Crotalaria L., Sp. Pl. 714. 1753, Gen. Pl. ed. 5: 320. 1754; Burm., Fl. Indica 155. 1768 (repr. ed. 1984); Willd., Sp. Pl. 3(2): 1802; Roth, Nov. Plant. Sp. 332. 1821; DC., Prodr. 2: 124. 1825 (repr. ed. 1989); Don, Prodr. Fl. Nepal. 241. 1825; Roxb., Fl. Indica 3: 259. 1832; Wight & Arn., Prodr. 1: 180. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 472. 1843; Baker In: Hook.f., Fl. Brit. India 2: 65. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon. 2: 8. 1894; Cooke, Fl. Bombay 1: 319. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 106. 1914; Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995); Polhill, Kew

Bull. 22(2): 169-185. 1968, Fl. Trop. E. Africa 2: 817. 1971; Bisby, New Phytol. 72: 699. 1973; Saldan. & Nicolson, Fl. Hassan 239. 1976; Ali In: Fl. W. Pakistan 110: 40. 1977; Niyomdham, Thai For. Bull. 11. 106. 1978; Mani. & Sivar., Fl. Calicut 77. 1982; Polhill, *Crotalaria* in Africa and Madagascar 3. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 353. 1983; Saldan., Fl. Karnataka 1: 428. 1984; Chandrabose & Nair, Fl. Coimbatore 87. 1987; Ramach. & Nair, Fl. Cannanore 129. 1988; Vajrav., Fl. Palghat 148. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 185. 1991; Sanjappa, Leg. India 115. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 137. 1994; Sasi. & Sivar., Fl. Thrissur 133. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 249. 1997; Sivar. & Mathew, Fl. Nilambur 177. 1997; Matthew, Fl. Palni Hills 1: 295. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 156. 2000.

Type species: *C. lotifolia* L.

Goniogyna DC., Ann. Sci. Nat., ser. 1: 91. Jan. 1825.

Type species: *G. hirta* (Willd.) Ali based on *Hallia hirta* Willd.

Heylandia DC., Prodr. 2: 123. Nov. 1825, nom superfl. based on *Goniogyna*

Type species: *H. hebecarpa* DC.

Priotropis Wight & Arn., Prodr. 1: 180. 1834.

Type species: *P. cytisoides* (Roxb.) Wight & Arn. based on *Crotalaria cytisoides* Roxb.

Herbs or shrubs, very rarely small trees. Leaves alternate, simple or digitately 3-7 foliolate; stipules filiform to foliaceous, rarely decurrent or exceptionally wanting; petiole short or long, if long articulate, pulvinate (not always). Flowers in terminal or leaf opposed racemes, rarely paniculate or umbellate, exceptionally in heads; bract minute, subulate to foliaceous, rarely reflexed; bracteoles in pairs, inserted on pedicel or calyx, variably developed. Calyx five lobed, glabrous or puberulous to velvety; lobes subequal, margins

fused at different levels. Corolla usually yellow with or without deep purple striations, rarely violet-white with purple striations, included or exerted. Standard petal ovate to orbicular, glabrous, or tomentose, either throughout or along the mid-vein, with two appendages at the base inside; wing petals ovate to oblong, usually smaller than keel, rarely enclosing the keel; keel petals rounded to angled, generally produced into a well developed beak. Stamens all joined by their filaments to form a sheath, bearing long and short filaments alternately with dorsifixed, ovoid anthers and basifixed, oblong anthers respectively. Ovary oblong to ovoid, glabrous to sericeous, sessile or stipitate; style long, curved or geniculate with one or two lines of hairs along the margin; stigma expanded or not, hairy. Pods small globose or sub-globose to large oblong to clavate, glabrous to pubescent or velvety, 2 to many seeded. Seeds mostly obliquely cordiform, rarely with a conspicuous aril.

Generic Subdivisions

In "Miscellaneous notes on African species of *Crotalaria* L.", Polhill (1968) states that the high degree of morphological diversity of this genus greatly facilitates the differentiation of individual species and the variations between the species is so reticulate that a sectional classification of the genus is rather difficult. However, the review of the literature revealed that attempts had been made by earlier botanists to classify the genus. The maiden attempt in this regard is that of Wight and Arnott (1834). They described 13 sections, apparently natural groups, based on a number of correlated characters in their "Prodromus Florae Peninsular India Orientalis". This sectional classification was later adopted by many workers and modified accordingly to meet their needs. A detailed account of this classification is dealt towards the end of this section.

Subsequently, Meisner (1837) in his "Plantarum Vascularium Genera" divided the genus into four subgenera and Endlicher (1840), into seven groups

without specifying any rank in his "Genera Plantarum". These works have not been found much useful because, primarily they are bibliographic compilations and the divisions appear not to be based on variation patterns of plants. Bentham (1843) in his revision of the subfamily represented in India, Asia Minor and Africa concluded that the genus *Crotalaria* is so natural that he could not find any positive characters to divide the genus in to sections. However, he segregated the species into 18 groups by following the divisions of Wight and Arnott (*l.c.*). Among these groups, the first seven comprises the series *Simplicifoliae*, the rest the *Foliatae*. The grouping of many of the species within these series seems quite natural. Later, Baker (1876) in "Flora of British India" and Gamble(1918) in "Flora of Presidency of Madras" adopted the same system without much modifications as they were largely based on Peninsular Indian species.

Baker (*l.c.*) accommodated the entire species of *Crotalaria* of British India under 10 sections. He has modified Wight and Arnott's classification by redistributing the species of various sections, merging closely allied sections and creating new sections. These changes are quite justifiable while considering the area of study. Baker added *Arenariae* Benth., to accommodate *C. burhia*, characteristic to desert places. Similarly, he abolished the sections *Fulvae* Wight & Arn. and *Bracteatae* Wight & Arn. by merging them into the section *Eriocarpae*. The section *Sphero carpae* Wight & Arn. also has been redistributed under *Diffusae*. Likewise, section *Micro carpae* comprising *C. nana* and *C. umbellata* were conveniently placed in the section *Calycinae*. Moreover, Baker divided the section *Trifoliolatae* into *Dispermae* and *Polyspermae* and renamed the section *Polyphyllae* of Wight and Arnott as *Multifoliatae*.

Meanwhile, Harvey (1862) in his "Flora Capensis" divided the sect. *Trifoliolatae* simply based on the number of flowers in the racemes, into

Oliganthae and Racemosae. This concept was adopted by Baker (1871) in his "Flora of Tropical Africa" and retained Simplicifoliae and Oliganthae, and the group Racemosae was substituted with four groups viz. Chrysocalycinae, Spherocarpae, Oocarpae and Cylindrocarpae based on the shape of the legume and arrangement of flowers. Taubert (1893) in Engler and Prantl's "Pflanzenfamilien" followed the concept of Bentham with slight modifications. His system consists of four sections based on foliar characters viz., Simplicifoliae, Unifoliolatae, Trifoliolatae and Multifoliolatae. The section Simplicifoliae is further divided into seven series and Trifoliolatae into ten series. Various series are distinguished by vegetative and floral characters following Bentham (*l.c.*).

Gamble (1918) followed the generic subdivisions adopted by Baker (1876). Except the omission of the section Arenarieae (Benth.) and the merger of subsections of Trifoliolatae viz. Dispermae and Polyspermae, virtually there is no difference between treatment of Baker (1876) and Gamble (1918). Gamble (*l.c.*) omitted the section Arenarieae since there is no xerophytic species of *Crotalaria* in Peninsular India. Both authors had retained most of the sections of Wight and Arnott like Alatae, Diffusae, Calycinae, Erectae and Eriocarpae.

E. G. Baker (1914) in his revision of African species adopted the groups Simplicifoliae, Spherocarpae, and Chrysocalycinae of his father, J.G. Baker, and added two more natural groups at the same rank, viz. the Spinosae (branchlets of the peduncle spine tipped) and Farctae (legumes packed with hairs inside). The rest of the species is placed under the section *Crotalaria* which is divided into five subsections. Among them, subsection Stipulosae is mostly natural but others are quite artificial. Species with few flowered racemes are placed in Oliganthae and the rest is distributed on the basis of flower size between Grandiflorae, Mediocriflorae and Parviflorae. This

system was adopted by Harms (1915) in Engler's "Pflanzenwelt Afrikas" and Peltier (1959) for the treatment of this genus in Madagascar. Peltier (*l.c.*) added another section *Coursia* for two species having laterally compressed and few-seeded pods.

Wilczek (1953) proposed a different classification for the genus. He observed a number of species in Congo have simple and trifoliolate or unifoliolate and trifoliolate leaves on the same plant and hence a primary division based on these characters must be regarded as artificial. He divided the genus into six groups. The first two are equivalent to the sections *Spinosa* Bak.f. and *Tetralobocalyx* Harms. Species with sessile leaves forms the third section. The rest of the species were subdivided based on the nature of stipule. Torre (1962) found the above classification as a good artificial system for the African species and he adopted it for the key in his "Conspectus Florae Angolensis".

Polhill (1968) commented that none of these systems are entirely satisfactory on a global basis. He suggested that it is by no means easy to propose any different system, which is both workable and reasonably natural because, "the genus is a large and very natural one, with a remarkable diversity of characters, which at first seem to reappear in almost every combination. The affinity of small groups of clearly related species in most case is reticulate, with few marked discontinuities in the pattern of variation". He agrees with Wilczek (*l.c.*) that a primary division of the genus on the leaf-type is not at all satisfactory because, the same species do have more than one type of leaves. Besides this, the *Simplicifoliae* of Baker is quite a heterogeneous group, the members showing many features in common with totally alien groups of species with compound leaves. The complexity of the problem is something correlated with prolificacy of the genus and that is centered on Africa and America, where the greatest diversity of the genus is

found. However, Polhill (1982) recognized eight sections viz., Grandiflorae, Chrysocalycinae, Hedriocarpae, Genuculatae, Schizostigma, Calycinae, Crotalaria and Dispermae mainly based on the nature of keel, calyx, style, raceme and pod.

It is quite significant to note that the revisionary studies are very minimum in recent past, particularly in India. The classification of Wight and Arnott (1834) and Bentham (1843) works quite well in India, but, a few anomalies can be noticed. *C. orixensis*, for example, is included in the section Trifoliolatae because of its trifoliolate leaves, though it is more allied to section Diffusae in its diffuse habit, leaf opposed lateral raceme *etc.* Similarly, *C. clarkei* was wrongly placed under section Eriocarpae instead of being treated under section Diffusae. Despite these shortcomings, the system is much satisfactory and they form the stepping stone of subsequent Indian workers.

Except the enumeration of Legumes by Sanjappa (1992), we have no publications of this sort in the recent past. Niyomdham's (1978) "Revision of *Crotalaria* in Thailand" and Rudd's (1991) "Revised Handbook of Flora of Ceylon" are the two exceptions in this regard. In the above works authors did not attempt general aspects of the genus including classification. However it covers a good number of Indian elements. Ansari (2002) enumerated the species diversity of this genus in India which provides a framework for the subgeneric classification. Except the addition of a few subsections and redistribution of species, his classification is largely based on the works of earlier authors (Wight & Arnott, 1834; Bentham, 1843; Baker, 1876; Gamble, 1918).

In the present work the author adopted a modified format to classify the genus at sectional level. The genus has been divided into 8 sections viz., Alatae, Calycinae, Diffusae, Erectae, Eriocarpae, Glaucae, Hedriocarpae and

Polyphyllae. The sect. Diffusae and Calycinae are characterized by annual, herbaceous habit and lateral, leaf-opposed racemes. But in Calycinae the racemes are terminal and become lateral by the elongation of the branch when flowering is considerably advanced, while in Diffusae the peduncles are leaf opposed, *i.e.*, when the flowers begin to expand. The sections such as Calycinae, Eriocarpae and Hedriocarpae are further divided into subsections. The sect. Calycinae is divided into subsect. Calycinae and Exsertae; Eriocarpae into subsect. Eriocarpae and Paniculatae and Hedriocarpae into subsect. Dispermae and Hedriocarpae. Though the sectional classification is in corroboration with many earlier authors (Wight & Arnott, 1834; Bentham, 1843; Baker, 1876; Gamble, 1918), some vital changes in the systematic position of certain species has been attempted.

Key to the Sections

- 1a. Leaves simple 2
- 1b. Leaves compound 7
- 2a. Stipules decurrent as a persistent wing to the branchlets 1. Alatae
- 2b. Stipules not as above 3
- 3a. Racemes lateral, leaf opposed; flowers few, often 1 or 2;
diffuse herbs 2. Diffusae
- 3b. Racemes terminal; flowers many; erect herbs or shrubs 4
- 4a. Plants glabrous throughout 3. Glaucae
- 4b. Plants variously hairy 5
- 5a. Pods hairy; flowers in simple or branched racemes..... 4. Eriocarpae
- 5b. Pods glabrous; flowers always in racemes 6
- 6a. Pods shorter or slightly exceeding the calyx; flowers in
short racemes or umbels; usually herbs 5. Calycinae
- 6b. Pods 2 or many times longer than calyx; flowers in
elongated racemes; usually under shrubs 6. Erectae

- 7a. Leaves 3-foliolate.....7. Hedriocarpae
 7b. Leaves 5-7 foliolate..... 8. Polyphyllae

Sect. **Alatae** Wight & Arn., 1: 181. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 478.1843; Baker in Hook. f., Fl. Brit. India 2: 65. 1876 (repr. ed.1879); Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995).

Type species: *C. scabrella* Wight & Arn. (Lectotype designated by Polhill, 1968).

Erect or semi erect herbs or shrubs. Leaves simple; stipule decurrent as a persistent wing to the branchlets; lamina hairy on both surfaces. Racemes lateral, springing from the branch a little below the node and on the opposite side, few flowered. Pods oblong or clavate, glabrous, stipitate, many seeded. Seed obliquely cordiform, arillate.

Notes. Wight and Arnott (1834: 181) established the sect. *Alatae* to include 3 species viz., *C. rubiginosa* sensu Wight & Arn., *C. scabrella* Wight & Arn. and *C. wightiana* Grah. ex Wight & Arn. Members of this section are easily distinguished by their decurrent stipule and mountainous habitat. Subsequently, Bentham (1843) included 23 species including 19 American species under this section. Gamble (1918) recognized 7 species under *Alatae*, which include his own new species, and 3 other new species described by Fyson (1914). However, the present taxonomic judgement is in favour of recognizing only 3 species from South India viz., *C. alata* Ham. ex Don, *C. scabrella* and *C. wightiana*, others being reduced to synonymy. *C. rubiginosa* sensu Wight & Arn. belongs to *C. wightiana* while *C. bidiei* is conspecific with *C. alata*. The three species described by Fyson viz., *C. conferta*, *C. ovalifolia* and *C. bourneae* have been treated as synonyms of *C. scabrella* as the differentiating characters are quantitative and overlap consistently.

Key to the Species

- 1a. Herbs or under shrubs, 0.3 - 0.6 m tall; branches ascending or decumbent; pods less than 2.5 cm long 2. *C. scabrella*
- 1b. Shrubs, 0.75 - 1.5 m tall; branches ascending; pods more than 4 cm long 2
- 2a. Leaves variable in shape, broadly elliptic or lanceolate or oblong; stipular wing acuminate; lamina gray tomentose on both surfaces, beak of the keel twisted to 90° 1. *C. alata*
- 2b. Leaves invariably obovate to broadly elliptic; stipular wing acute; lamina silky wooly on both surfaces, beak of the keel twisted to 180° 3. *C. wightiana*

1. *C. alata* Ham. ex Don, Prodr. Fl. Nepal. 241. 1825; DC., Prodr. 2: 124. 1825 (repr. ed. 1989); Baker In: Hook. f., Fl. Brit. India 2: 69. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995); Polhill, *Crotalaria* in Africa and Madagascar 372. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Saldan., Fl. Karnataka 1: 430. 1984; Sanjappa, Leg. India 116. 1992.

Type: Nepal, *Hamilton* (holotype: BM).

C. bidiei Gamble, Kew Bull. 27. 1917.

C. bialata sensu Hara, Fl. East. Himalaya 146. 1966, non Schrank, 1819.

(Fig. 1, Pl. 3 C)

Erect, annual or short-lived perennial herb with a few ascending branches, 0.6 - 1 m tall. Stems and branches terete, brown tomentose. Leaves simple; stipules decurrent down as 2 - 5 mm wide wing, produced into a

recurved hook at the apex; petioles 1.5 - 3 mm long, densely tomentose; lamina 3 - 5.5 x 6 - 8 cm, broadly elliptic or lanceolate or oblong; base broadly attenuate; apex acute, slightly mucronate, veins not prominent beneath, chartaceous, gray tomentose on both surfaces. Racemes 5 - 10 cm long, lateral, 1 - 4 flowered. Flowers 1.8 cm long and 1 cm across; bracts 10 x 4 mm, ovate-acuminate, pubescent; bracteoles 8 x 2 mm, lanceolate, inserted on calyx tube, appressed to sepals; pedicel 5 mm long. Calyx as long as corolla, bilipped, densely pubescent; lobes sub equal, upper two (1.8 x 0.2 cm), triangular - lanceolate, connate $\frac{1}{2}$ their length; lower lobes 1.1 x 0.2 cm, triangular - subulate, connate basally. Corolla slightly exserted; standard petal 1.8 x 1.6 cm, pale yellow, elliptic to obovate, midvein pubescent at apex; wing petals 1 x 0.5 cm, oblong; keel petals 1.3 x 0.5 cm, rounded at the middle, beak twisted to about 90°. Staminal sheath 5 mm long; filaments 8 mm and 4 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 4 x 1 mm; style 10 mm long, geniculate; stigma expanded, hairy. Pods 4 - 4.5 x 1.1-1.3 cm, oblong, glabrous, 20 - 25 seeded; stalk 2 - 3 mm long. Seeds 3 mm diam., obliquely cordiform, dark brown, smooth, shining, arillate.

Distribution and ecology: *C. alata* is distributed in India, China, Bhutan and South East Asia. In South India, it is occasional, found as an undergrowth in moist deciduous forests at higher altitudes. It flowers from July – November and fruits from December – February.

Notes: Gamble (1917) described *C. bidiei* from South India based on the specimen *C. A. Barber*, 5627. However, our studies based on live materials and cibachrome and typotype of the type specimen proved that *C. alata* and *C. bidiei* are conspecific. Hara (1966) adopted the name *C. bialata* Schrank (1819) for this species, but *C. bialata* seems more likely to have been based

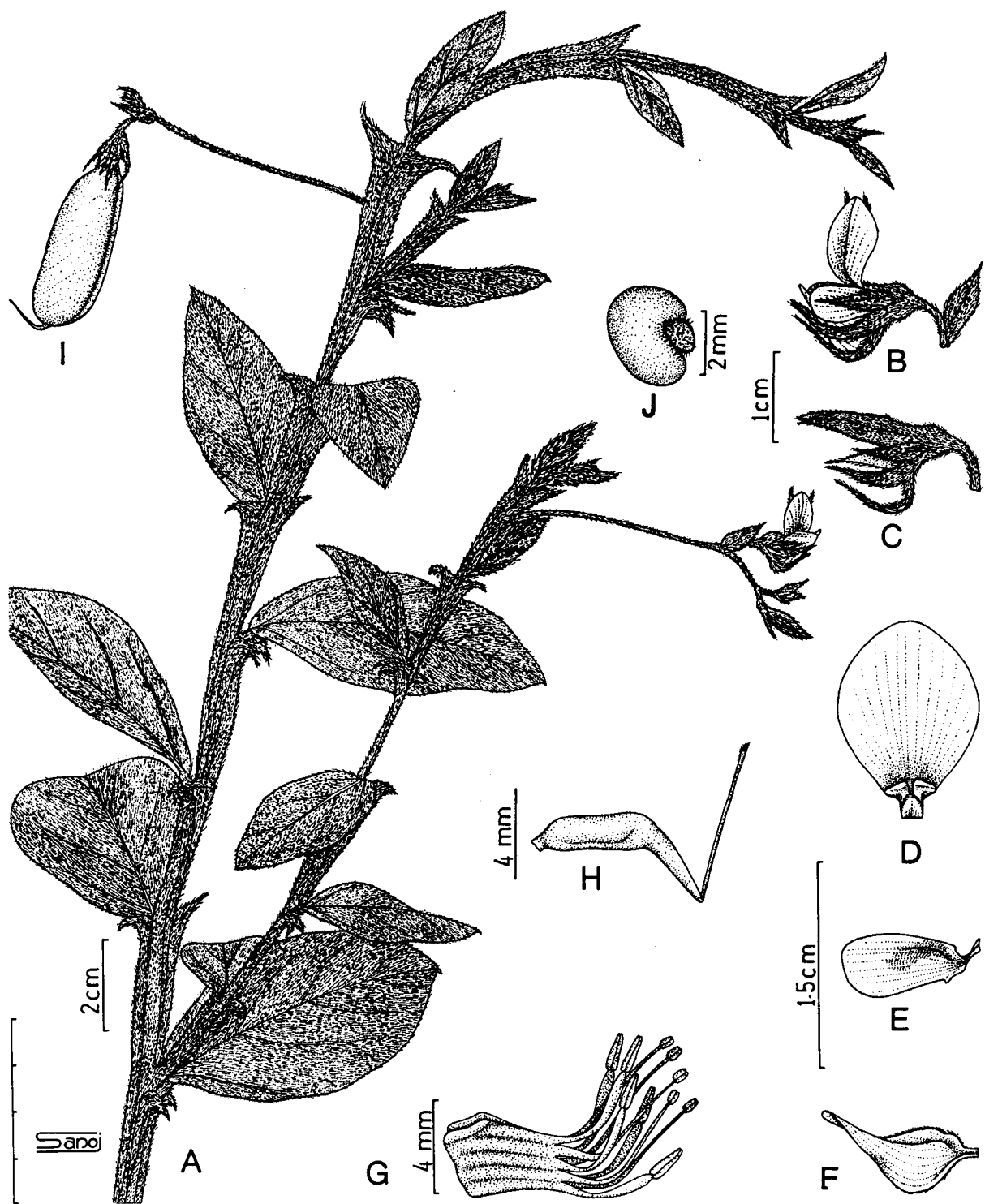


Fig. 1. *C. alata* Ham. ex Don: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen* 747).

on an American plant, possibly *C. pilosa* Mill. The stipules, bracts and pods of *C. bialata* do not match with those of *C. alata*.

Specimens examined: ANDHRA PRADESH: Ananthapur Dt: Mahendragiri R.F., *Ramamurthy* 17601 (SKU). Visakapattanam Dt.: Chintappalli, *Subba Rao* 54027, Mulayaguda, Borra caves, *Pullaiah & Chennaiah* 7412 (SKU); Vedurappalli, *Subba Rao* 42765 (MH). KERALA: Kannur Dt.: Chandanathode, *Ramachandran* 13340 (MH). Wayanad Dt.: Muthanga forest, *Sibichen & Joby* 747 (SJC). TAMIL NADU: Nilgiri Dt.: Nilgiris, *Beddome* 12506 (MH). Salem Dt.: Yercaud, Near BSI Campus, *Sibichen* 787 (SJC).

2. *C. scabrella* Wight & Arn., Prodr. 1: 181. 1834 (repr. ed. 1976); Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 141 & 2: t. 105. 1932 (repr. ed. 1977); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 101. 1983; Vajrav., Fl. Palghat 153. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 189. 1991; Sanjappa, Leg. India 130. 1992; Matthew, Kew Bull. 48. 758. 1993, Ills. Fl. Palni Hills t. 172. 1996; Sivar. & Mathew, Fl. Nilambur 181. 1997; Matthew, Fl. Palni Hills 1: 309. 1999.

Type: *Wight* Cat. no. 692 (K).

C. conferta Fyson, Bull. Misc. Inform. Kew 183. 1914

C. bourneae Fyson, Bull. Misc. Inform. Kew 183. 1914

C. ovalifolia Fyson, Bull. Misc. Inform. Kew 184. 1914

C. rubiginosa var. *scabrella* (Wight & Arn.) Baker In: Hook.f., Fl. Brit. India 2: 70. 1876 (repr. ed. 1879).

(Fig. 2)

Erect, annual herbs or short-lived perennials with stiff ascending or decumbent branches, 0.3 to 0.6 m tall. Stems and branches terete, rusty tomentose or diffuse brown sericeous. Leaves simple; stipules decurrent down

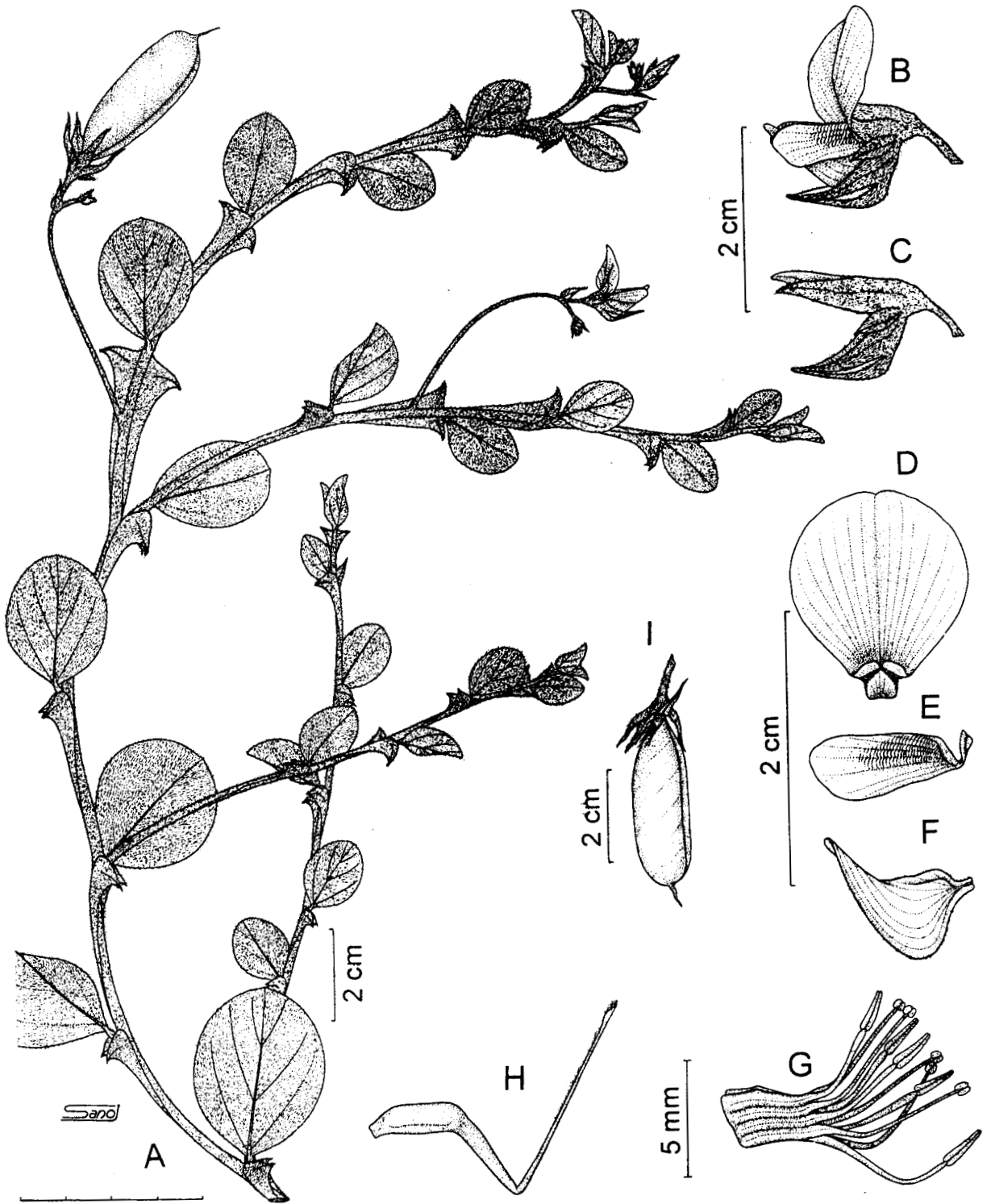


Fig. 2. *C. scabrella* Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen 727).

14

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as 4 - 8 mm wide wing, upper part dilated to acute apex; petioles 1 mm long, tomentose or sericeous; lamina 1.5 - 2.2 x 1 - 1.3 cm, broadly ovate to elliptic, base broadly attenuate, apex obtuse or rounded, mucronate, appressed rusty tomentose or diffuse gray pubescent on both surfaces. Racemes 2 - 5 cm long, 1 - 3 flowered, lateral, arising a little below the node, opposite to the leaf. Flower 1 cm long and 1.2 cm across; bracts 3 x 2 mm, ovate; bracteoles 4 x 1.5 mm, acuminate, inserted on calyx tube, appressed to sepals; pedicel 5 - 8 mm long. Calyx bilipped, tube 2 mm long, rusty tomentose; upper two lobes 10 x 2 mm larger than lower three (8 x 1.5 mm), acuminate, connate $\frac{1}{2}$ their length; lower lobes 8 x 1.5 mm, narrow, connate at the base. Corolla hardly exerted, yellow; standard petal 1.3 x 0.8 cm, obovate, glabrous except along the midvein; wing petals 10 x 3 mm, oblong; keel petals 8 x 5 mm, ovate, angular at the base, inner margin wooly, beak twisted to 180°. Staminal sheath 2 mm long, glabrous, filaments 6 mm and 4 mm long alternately with ovoid (0.5 mm long) and oblong anther (0.2 mm long) respectively. Ovary 4 x 1.5 mm, glabrous; stipe 5 mm long; style 8 mm long, geniculate; stigma expanded, hairy. Pods 2 - 2.5 x 0.6 - 0.8 cm, clavate, base attenuate, apex obtuse, 16 - 20 seeded; stalk 1.5 - 2.5 mm long. Seeds 4.5 mm diam., brownish black, laterally compressed, obliquely cordiform, arillate.

Distribution and ecology: It is distributed in South India and Sri Lanka and occurs at an altitude of 1800 - 2400 m. *C. scabrella* shows a tendency towards erect habit, larger leaves, flowers and pods and also denser indumentum as the altitude lowers.

Notes: *C. scabrella* is highly polymorphic and exhibits high degree of variation in relation to habitat. Many earlier workers treated these morphoforms as distinct species. Fyson (1914) described 3 species, viz., *C. conferta*, *C. bourneae* and *C. ovalifolia* from within a radius of 150 km of Palni hills. They were separated mainly based on quantitative characters like

shape of leaves, indumentum pattern and inflorescence. In all other respects the plants are similar. Moreover, in many cases these characters found overlap consistently. Detailed studies lead us to the conclusion that they all are conspecific to *C. scabrella*. Fyson (*l.c.*) also admitted that there is chance of merger of these species.

Specimens examined: KERALA: Idukki Dt.: Chinnar, Mangaladevi, *Jomy* 12463 (CALI); Mangappara, *Rajesh* 789 (SJC); Munnar, Mattupetty, *Abdul Jabbar* 43953 (TBGRI). Malappuram Dt.: Nilambur forest, Kunda Hills, *Philip Mathew* 33871 (CALI). TAMIL NADU: Madurai Dt.: Kodaikanal, *Anonymous* 12502 (MH). Nilgiri Dt.: Gudallore, Way to Needle Rock *Sibichen* 727 (SJC).

3. *C. wightiana* Grah. ex Wight & Arn., Prodr. 1: 181. 1834 (repr. ed. 1976); Trimen, Handb. Fl. Ceylon 2: 12. 1894; Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 141. 1932; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 101. 1983; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 189. 1991; Sanjappa, Leg. India 130. 1992; Matthew, Kew Bull. 48. 758. 1993, Illus. Fl. Palni Hills t. 172. 1996, Fl. Palni Hills 1: 309. 1999.

Type: India, *Wall.* Cat. no. 5358 A (K).

C. rubiginosa sensu Wight & Arn., Prodr. 1: 181. 1834, non Willd., 1802.

C. rubiginosa var. *wightiana* (Grah. ex Wight & Arn.) Baker In: Hook. f., Fl. Brit. India 2: 70. 1876.

(Fig. 3)

Erect, annual shrub with several ascending branches, 0.75 - 1.5 m tall. Stems and branches terete, appressed silky tomentose. Leaves simple; stipules decurrent down as 8 - 18 mm wide wing, upper part dialated into an acute apex; petioles 2 - 3 mm long, tomentose; lamina 3.8 - 6.5 x 2 - 5 cm, obovate

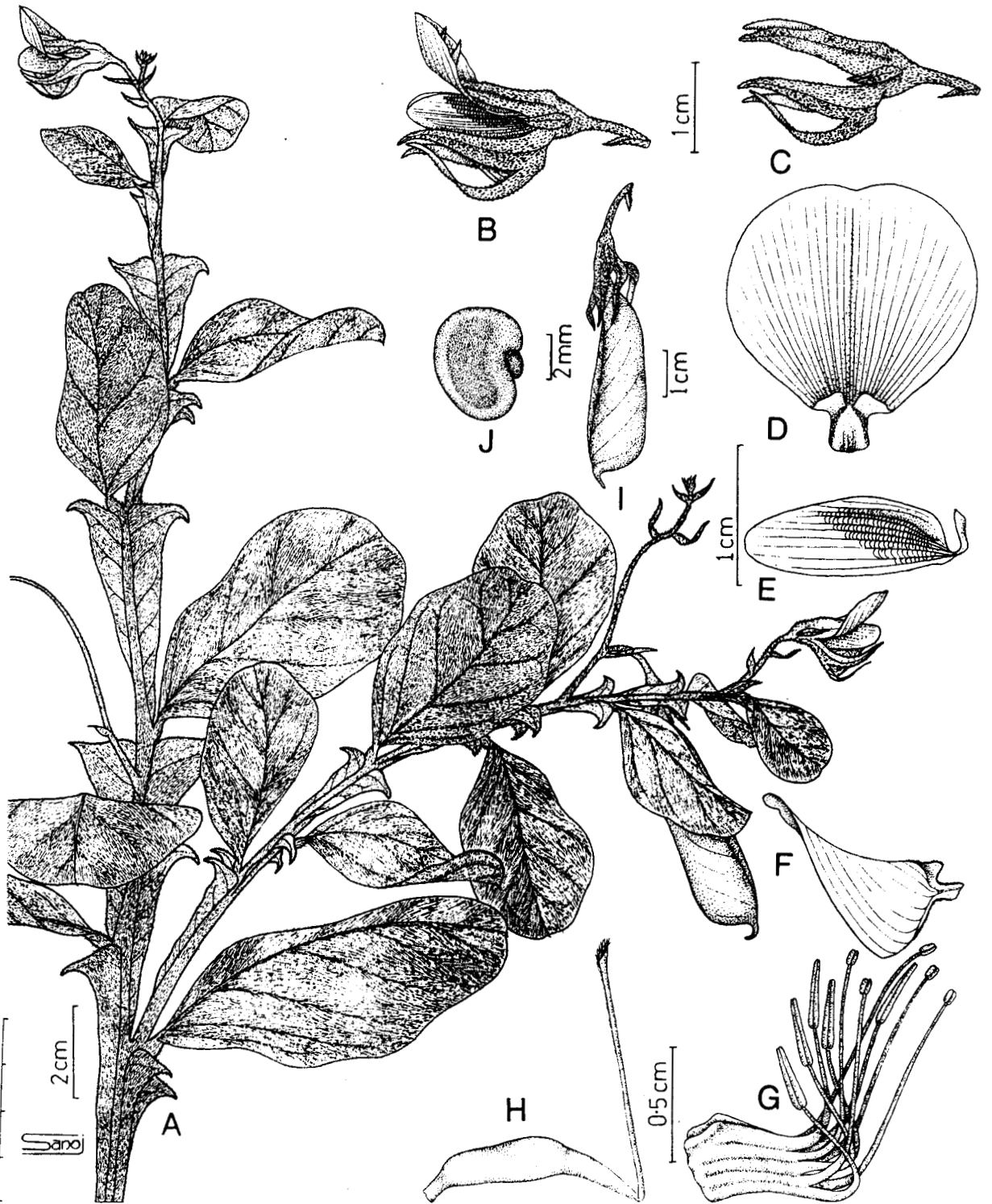


Fig. 3. *C. wightiana* Grah. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeccium; I. Pod; J. Seed (From Sibichen & Nampy 673).

or broadly elliptic; base broadly attenuate; margin slightly reflexed; apex rounded to obtuse, slightly mucronate, veins prominent beneath, appressed silky wooly on both surfaces. Racemes 5 - 15 cm long, lateral, 1 - 6 flowered. Flowers 2.2 cm long and 1.2 cm across; bracts 4 mm long, foliaceous, ovate-acuminate, pubescent on both surfaces; bracteoles 6 mm long, foliaceous, lanceolate, inserted on calyx tube, appressed to sepals; pedicel 8 - 10 mm long, pubescent. Calyx bilipped, densely pubescent; tube 3 mm long; lobes sub equal, upper two (1.8 x 0.6 cm), lanceolate, connate about $\frac{1}{2}$ their length; lower lobes (1.1 x 0.2 cm), triangular - subulate, connate only at the base. Corolla slightly exserted; standard petal 1.8 x 1.8 cm, obovate, pale yellow, midvein pubescent near the apex; wing petals 1.7 x 0.5 cm, oblong; keel petals 1.7 x 0.8 cm, ovate, angular at the base, outer and inner margin hairy at the base, beak twisted about 180°. Staminal sheath 4 mm long, filaments 9 mm and 7 mm long alternately, with ovoid (0.5 mm long) and oblong (3 mm long) anthers respectively. Ovary 7 x 2 mm, style 1.3 cm long, geniculate, hairy along the margin; stigma expanded, hairy. Pods 4.2 - 4.5 x 1 - 1.2 cm, oblong, glabrous, 24 - 28 seeded; stalk 7 mm long. Seeds 4 mm diam., obliquely cordiform, dark brown, smooth, shining, arillate.

Distribution and ecology: *C. wightiana* is distributed in South India and Sri Lanka and is common on bunds in tea plantations. It prefers an altitudinal range of 1200 - 2400 m. The plant flowers from August - November and bears fruits throughout the year.

Notes: In lower altitudes, *C. wightiana* appears as a shrub and is wooly through out, but at higher altitudes the plant grows smaller with diffuse indumentum.

Specimens examined: KERALA: Idukki Dt.: Devikolam, *Sebastine* 17565 (MH), *Sibichen & Nampy* 673 (SJC); Swamykkayam, *Jomy* 13104 (CALI). TAMIL NADU: Coimbatore Dt.: Kurudimalai, *Viswanathan* 788 (MH).

Madurai Dt.: Kodaikanal, Silver Cascade, *Jacob* 16096; Tiger Sholai, *Deb* 30942, *Chandrabose* 53379 (MH). Nilgiri Dt.: Conoor, Lamb's Rock, *Rathakrishnan* 39101 (MH). Salem Dt.: Yercaud, *Dwarakan* 78809 (MH).

Sect. **Diffusae** Wight & Arn., Prodr. 1: 188. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 475. 1843; Baker In: Hook.f., Fl. Brit. India 2: 66. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 281. 1918 (repr. ed. 1995); Polhill, Kew Bull. 22: 301. 1968, *Crotalaria* in Africa and Madagascar 248. 1982; Ansari In: Rao (ed.), Adv. Leg. Res. 161. 2002.

Type species: *C. bifaria* L. (Lectotype designated by Polhill, 1968)

Sect. **Sphaerocarphae** Wight & Arn., Prodr. 1: 190. 1834.

Mostly prostrate herbs with diffuse trailing branches. Leaves simple, stipulate or not, if present small, not decurrent. Racemes lateral from the beginning and may become leaf opposed at age, few to many (1-15) flowered. Pod globose-ovoid or oblong, hairy or glabrous; 2 - many seeded.

Notes: The sect. *Diffusae* was originally established by Wight and Arnott (1834) and included eight species from South India. Later authors like Bentham (1843), Baker (1876) and Gamble (1918) maintained this section in their treatment. However, Bentham (1843) placed 13 species under this section and divided it into 3 subsections based on the shape and indumentum of the pod viz. "Legumine hirta subglobosa, Legumine oblongo glabro, Legumine oblongo hirsuto". While, Polhill (1968, 1982) treated this and other sections such as *Alatae*, *Eriocarphae*, *Sphaerocarphae* and *Podocarphae* of Wight and Arnott (*l.c.*) synonymous with sect. *Calycinae*. But this treatment is not admissible in the present context. Ansari (2002) retained the section *Diffusae* and recognized 16 species from India. But, he ascribed it to Bentham (1843). We consider sect. *Sphaerocarphae* of Wight and Arnott (*l.c.*) characterized by globose pods also belongs to this section.

Compared to other sections, sect. Diffusae is rather complex due to the high frequency and homogeneity of the members. It is closely allied to sect. Calycinae in having annual herbaceous habit and lateral, leaf-opposed racemes. However, in Calycinae the racemes are terminal from the beginning and may become lateral by the elongation of the branch when flowering is considerably advanced while in Diffusae the peduncles are leaf opposed even when the flowers begin to expand. Species such as *C. clarkei* and *C. triquetra* that were included previously under section Eriocarpae by Gamble (1918) and under Calycinae by Ansari (2002) are now treated under section Diffusae. Similarly, species such as *C. albida*, *C. pusilla* and *C. linifolia* are now transferred from Diffusae to Calycinae. Thus altogether 15 species are included under this section, including a new species from South India.

Key to the Species

- | | | |
|-----|---|--------------------------|
| 1a. | Pods globose | 2 |
| 1b. | Pods ovoid or oblong | 3 |
| 2a. | Pods >1 cm diam., villous; 15 - 20 seeded | 2. <i>C. angulata</i> |
| 2a. | Pods < 0.8 cm diam, sparsely pilose; 2 – 4 seeded | 9. <i>C. globosa</i> |
| 3a. | Pods ovoid, much inflated | 4 |
| 3b. | Pods oblong, not much inflated | 5 |
| 4a. | Leaves ovate to orbicular, chartaceous, arranged dorsiventrally on prostrate branches | 14 |
| 4b. | Leaves elliptic-lanceolate, subcoriaceous, arranged obliquely ascending on erect or straggling branches. | 12. <i>C. multiflora</i> |
| 5a. | Pods glabrous | 6 |
| 5b. | Pods hairy | 10 |
| 6a. | Stipules absent | 7 |
| 6b. | Stipules present | 8 |

- 7a. Stems and branches decumbent, pilose; corolla exerted;
pods 8-10 seeded 7. *C. filipes*
- 7b. Stems and branches ascending, silky sericeous;
corolla hardly exerted; pods 15 - 20 seeded 13. *C. prostrata*
- 8a. Branches ascending; flowers > 1.2 cm long;
pods > 2.5 cm long 6. *C. ferruginea*
- 8b. Branches prostrate; flowers < 0.6 cm long;
pods < 1 cm long 9
- 9a. Racemes many (8 - 15) flowered, densely on
short peduncle 1. *C. acicularis*
- 9b. Racemes few (3 - 6) flowered, laxly at the end of
arcuate peduncle 11. *C. humifusa*
- 10a. Stems and branches 3 - 4 angled 11
- 10b. Stems and branches terete 12
- 11a. Pods < 2 cm long, tomentose ; bract lanceolate 14. *C. triquetra*
- 11b. Pods > 3 cm long, hirsute; bract cordate, deltate 4. *C. clarkei*
- 12a. Leaves ovate-orbicular, margin revolute, peduncle
wiry; flowers restricted to the apex 8. *C. fysonii*
- 12b. Leaves elliptic, margin not revolute; peduncle sturdy;
flowers uniformly distributed 13
- 13a. Leaves small, variable, ovate – orbicular – lanceolate;
flowers < 1.2 cm long; seeds obliquely cordate 5. *C. evolvuloides*
- 13b. Leaves large, invariably broadly elliptic; flowers
> 2 cm long; seeds cordate 10. *C. hirsuta*
- 14a. Pods sparsely puberulous; bracts deltate;
racemes 1 or two flowered 3. *C. bifaria*
- 14b. Pods thinly sericeous; bracts subulate;
racemes 2-8 flowered 15. *C. kurisumalayanum*

1. *C. acicularis* Buch. Ham. ex Benth. In: Hook., Lond. J. Bot. 2: 476. 1843; Baker In: Hook. f., Fl. Brit. India 2: 68. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Niyomdham, Thai For. Bull. 11: 117. 1978; Pullaiah & Chennaiah, Fl. Andhra Pradesh 2: 252. 1997; Pullaiah & Ramamurthy, Fl. East Ghats 2: 158. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 162. 2002.

Type: *Wall.* Cat no. 5390 A (K).

Prostrate annual herb with trailing branches, up to 50 cm long. Stems and branches slender, terete, sparsely pilose. Leaves simple, sessile; stipules 2 - 3.5 x 0.5 mm, lanceolate, pilose; lamina 0.5 - 2 x 0.5 - 1.4 cm, ovate-orbicular, base obliquely subcordate, apex obtuse to rounded, sparsely pilose on both surfaces, punctate beneath, chartaceous. Racemes 2 - 7 cm long, all lateral, leaf opposed, 8 - 15 flowered, peduncle silky haired. Flower 4 mm long and 3 mm across; bracts 2.5 x 1 mm, cordate-acuminate; bracteoles 2 mm long, subulate, inserted on calyx tube at the cleft; pedicels 3 mm long. Calyx as long as corolla, densely sericeous, deeply bilipped; upper lobes 4 x 1.5 mm, lanceolate, connate $\frac{1}{2}$ at the base; lower lobes 4.5 x 0.5 mm, narrow, lanceolate. Corolla pale yellow, hardly exceeding the calyx; standard petal 4 x 3.5 mm, suborbicular, glabrous; wing petals 4 x 1 mm, oblong, with a basal claw; keel petals 5.5 x 2 mm, ovate-acute, angular at the middle, beak twisted to 180°, exceeding the wing petals. Staminal sheath 1 mm long, filaments 1.5 mm and 3 mm long alternately with oblong (0.5 mm long) and ovoid (0.2 mm long) anthers respectively. Ovary 2.5 x 1 mm, sessile, glabrous; style 3 mm long, geniculate, pubescent along the margin; stigma expanded. Pods 7 x 3 mm, sessile, oblong, not much inflated, glabrous, 15 - 20 seeded. Seeds 1.25 mm diam., obliquely cordate, laterally compressed, pale brown.

Distribution and ecology: *C. acicularis* is distributed in India, Indonesia, China, Malesia, Myanmar, Nepal, and Philippines. It is very rare in India, seen in open grasslands and evergreen forests up to an altitude of 1000 m (Pullaiah & Ramamurthy, 2000). During our field explorations we could not come across this species anywhere from South India. This species is poorly represented in various Indian Herbaria.

Notes: *C. acicularis* resembles *C. humifusa* Grah. ex Benth. in its general habit and morphology. Both are prostrate herbs with trailing, slender branches having ovate-orbicular leaves; lateral, leaf opposed racemes; oblong many seeded pod. But the former can be easily distinguished from the latter by the fairly compact arrangement of flowers on the raceme and 15 - 20 seeded pod as against few flowered lax raceme and 6 - 8 seeded pod as in *C. humifusa*.

Specimens examined: KERALA: Idukki Dt.: Erattayar, Mohanan 74616; Kumili, Meebold 810 (CAL). TAMIL NADU: Ganjam Dt.: Dadanagia, Gamble 13729 (CAL).

2. *C. angulata* Mill., Gard. Dict. ed. 8: 9. 1768; DC., Prodr. 2: 135. 1825 (repr. ed. 1989); Saldan. & Nicolson, Fl. Hassan 241. 1976; Mani. & Sivar., Fl. Calicut 77. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 361. 1983; Malathi In: Nair & Henry, Fl. Tamil Nadu Analysis 1: 95. 1983; Saldan., Fl. Karnataka 1: 431. 1984; Chandrabose & Nair, Fl. Coimbatore 88. 1987; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 123. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 203. 1991; Sanjappa, Leg. India 116. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 253. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 159. 2000.

Type: “wrongly attributed to India” “Campeachy” (Campeche, Mexico), Houstoun *s.n.* (holotype: BM)

Astragalus biflorus L., Mant. 273. 1771.

C. biflora (L.) L., Mant. 570. 1771; Wight & Arn., Prodr. 1: 190. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 475. 1843; Baker In: Hook.f., Fl. Brit. India 2: 66. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 9.1894; Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995).

C. nummularia Willd., Sp. Pl. 3: 979. 1802.

(Fig. 4)

Prostrate annual herb with profuse trailing branches from the stout rootstock, up to 50 cm long. Stems and branches wiry, villous. Leaves simple, estipulate, subsessile; petioles less than 1 mm long, hispid; lamina 1.2 - 1.8 x 1 - 1.6 cm, broadly ovate - suborbicular, base rounded-obtuse, slightly oblique, margin entire, apex obtuse, chartaceous, appressed villous on both surfaces. Racemes 1 - 2 cm long, lateral, 1 or 2 flowered. Flower 8 mm long and 4 mm across; bracts 2.5 mm long, setaceous; bracteoles 1.5 mm long, setaceous, produced on the pedicel near calyx tube; pedicels 2 mm long, hispid. Calyx deeply five cleft, hairy; tube 1.5 mm long; lobes 5; upper two (4 x 1 mm) larger than laterals (3 x 1 mm), the lower most one (5 x 0.5 mm) linear-acuminate. Corolla yellow, slightly exserted; standard petal 6 x 4 mm, orbicular, glabrous; wing petals 5 x 1.5 mm, oblong with a basal claw; keel petals 6 x 3 mm, ovate, angular at the middle, beak twisted to 180°. Staminal sheath 1 mm long, glabrous; filaments 4 mm and 2 mm long alternately with ovoid (0.25 mm long) and oblong (1mm long) anthers respectively. Ovary 3.5 x 1.5 mm, hirsute; style 5 mm long, geniculate, twisted; stigma slightly expanded, oblique, ciliated at apex. Pods 1-1.2 cm diam., globose, villous, 15 - 20 seeded; stalk 1.5 mm long. Seeds 2 - 2.5 mm diam., cordate, brown, laterally compressed.

Distribution and ecology: Since Miller (1768) erroneously cited the type as from Campeachy (Campeche, Mexico), many authors following Senn (1939)

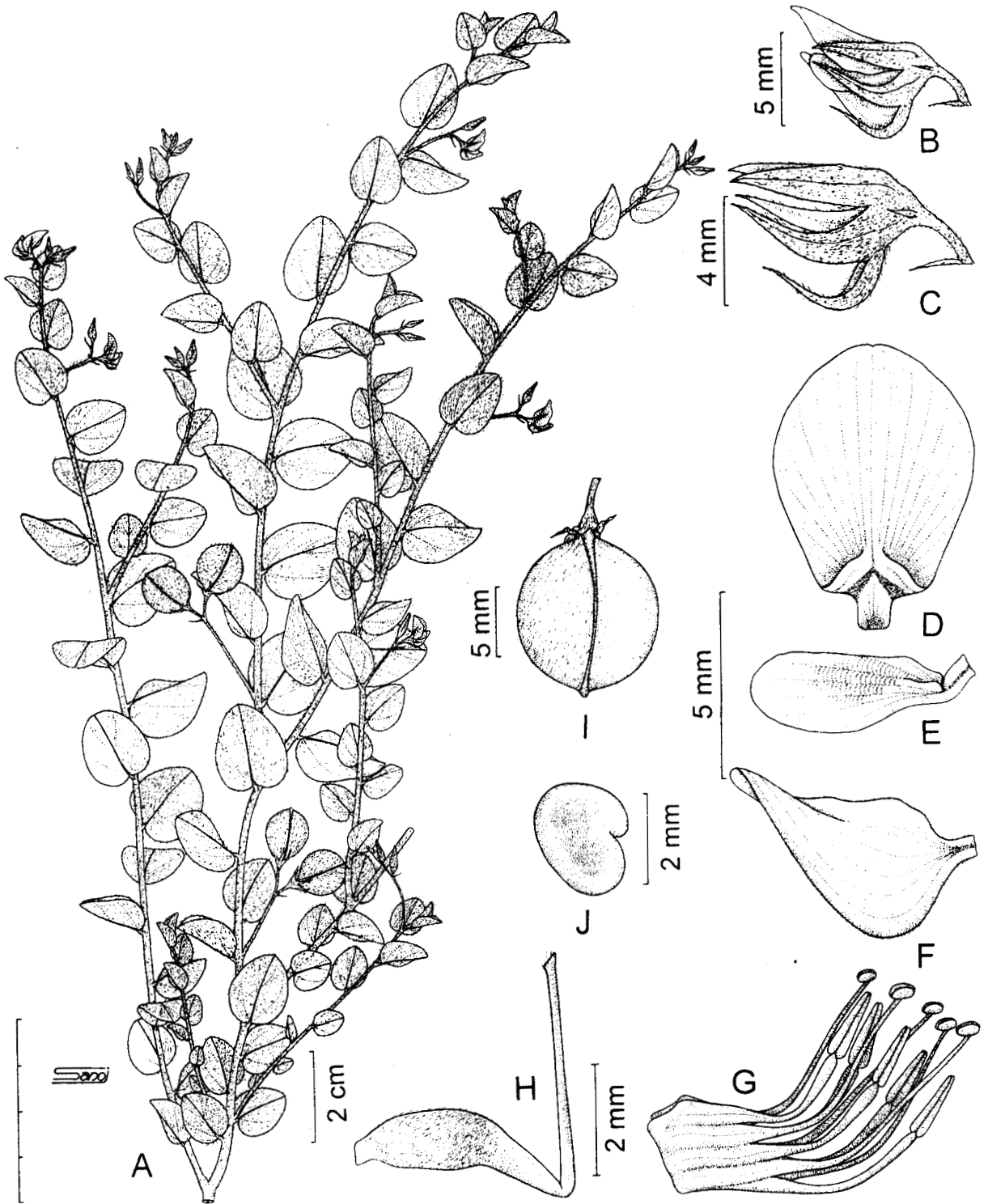


Fig. 4. *C. angulata* Mill.: A. Habit; B. Flower; C. Calyx; D. Standard petal E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Prabhakar 11714).

considered *C. angulata* as a North American species synonymous with *C. rotundifolia* (Watt.) Gmelin, which is found in United States and Mexico (Rudd, 1991). However, *C. angulata* is known to occur only in India, Sri Lanka and Indonesia (Sanjappa, 1992).

C. angulata is occasional in moist and dry deciduous forests. It also occurs in plains, foothills, scrub jungles, waysides, river-banks and grazing ground. It flowers from November to January and fruits from December to February.

Notes: *C. angulata* and *C. globosa* are closely related and are characterized by their prostrate, profusely trailing habit and globose pods. But, they differ in the size of leaves and pods. Leaves and pods of *C. angulata* is twice as large as that of *C. globosa*. Similarly, the pods are 15 - 20 seeded in *C. angulata* while it is 2 - 4 seeded in *C. globosa*.

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Kalasamudram R.F., *Yesoda* 1173 (SKU). Chittoor Dt.: Thalakona, *Sri Ramamurthy* 19132 (SKU). Cuddupah Dt.: Lankamalai R.F., *Reddy* 13107 (SKU). Kurnool Dt.: Balugram, *Pullaiah & Raju* 2747; Gundlabrahmeswarau, *Sunitha* 20228; Ramanapenta, *Raju* 2381 (SKU). Medak Dt.: Lingareddypally, *Prabhakar* 11714 (SKU). KARNATAKA: Mysore Dt.: Yelwala, *Sreenath & Gurudev Singh* 10272 (MH). KERALA: Thrissur Dt.: Parambikulam submergible area, *Sebastine* 15320 (CAL). TAMIL NADU: Anna Dt.: Madurai, *Battalagundu, Sudharshan* 449 (CAL). Coimbatore Dt.: Gandhi Memorial Library, *Chandrabose* 28921; Kurudimalai, *Subramanyam* 1816; Maruthamalai, *Sebastine* 438; Pollachi, Thekkumalai, *Sebastine* 1498 (CAL). Madurai Dt.: Vaiyapatti, near Usilampatti, *Ravikumar* 2730 (CAL). Ramanathapuram Dt.: Pamban, *Balasubramanian* 1017; Ramanathapuram, *Balasubramanian* 1127 (CAL). South Arcot Dt.: Ulunderpet, *Mathew &*

Perumal 20034 (CAL). Thanjavoor Dt.: Chengipatti, *Ragupathi* 879 (CAL).
Thiruchirappalli Dt.: Peramangalam, *Matthew & Manoharan* 19254 (CAL).

3. *C. bifaria* L. f., Suppl. Pl. 322. 1781; Lamarck, Ency. Méthodique 2: 198. 1786; Willd., Sp. Pl. 3: 979. 1802; DC., Prodr. 2: 127. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 188. 1834 (repr. ed. 1976); Wight, Ic. t. 30. 1839; Benth. In: Hook., Lond. J. Bot 2: 477. 1843; Thw., Enum. Plant. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook.f., Fl. Brit. India 2: 69. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 313: 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Saldan. & Nicolson, Fl. Hassan 1: 241. 1976; Matthew, Fl. Tamilnadu Carnatic 3: 362. 1981; Matthew, Illus. Fl. Tamilnadu Carnatic 2: t. 189. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Saldan., Fl. Karnataka 1: 432. 1984; Sanjappa, Leg. India 117. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 254. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 162. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 162. 2002.

Type: Indian Peninsula, *Wight* (K).

C. dichotoma Roth., Nov. Sp. 340. 1821.

(Fig. 5)

Spreading procumbent herb, branches up to 60 cm long. Stems and branches terete, puberulant. Leaves simple; stipules 5 x 2 mm, ovate-acuminate, reflexed; petioles 2 mm long, puberulous; lamina 3 - 4.5 x 3 - 3.5 cm, orbicular-ovate, lower ones orbicular and upper ones ovate-lanceolate, base rounded, slightly oblique, apex rounded-sub acute, glabrescent above and puberulous beneath, chartaceous. Racemes 5-10 cm long, leaf opposed, 1 or 2 flowered. Flower 2 cm long and 2.2 cm across; bracts 8 x 5 mm, ovate-acuminate or deltoid, persistent; bracteoles 1 mm long, minute, subulate,

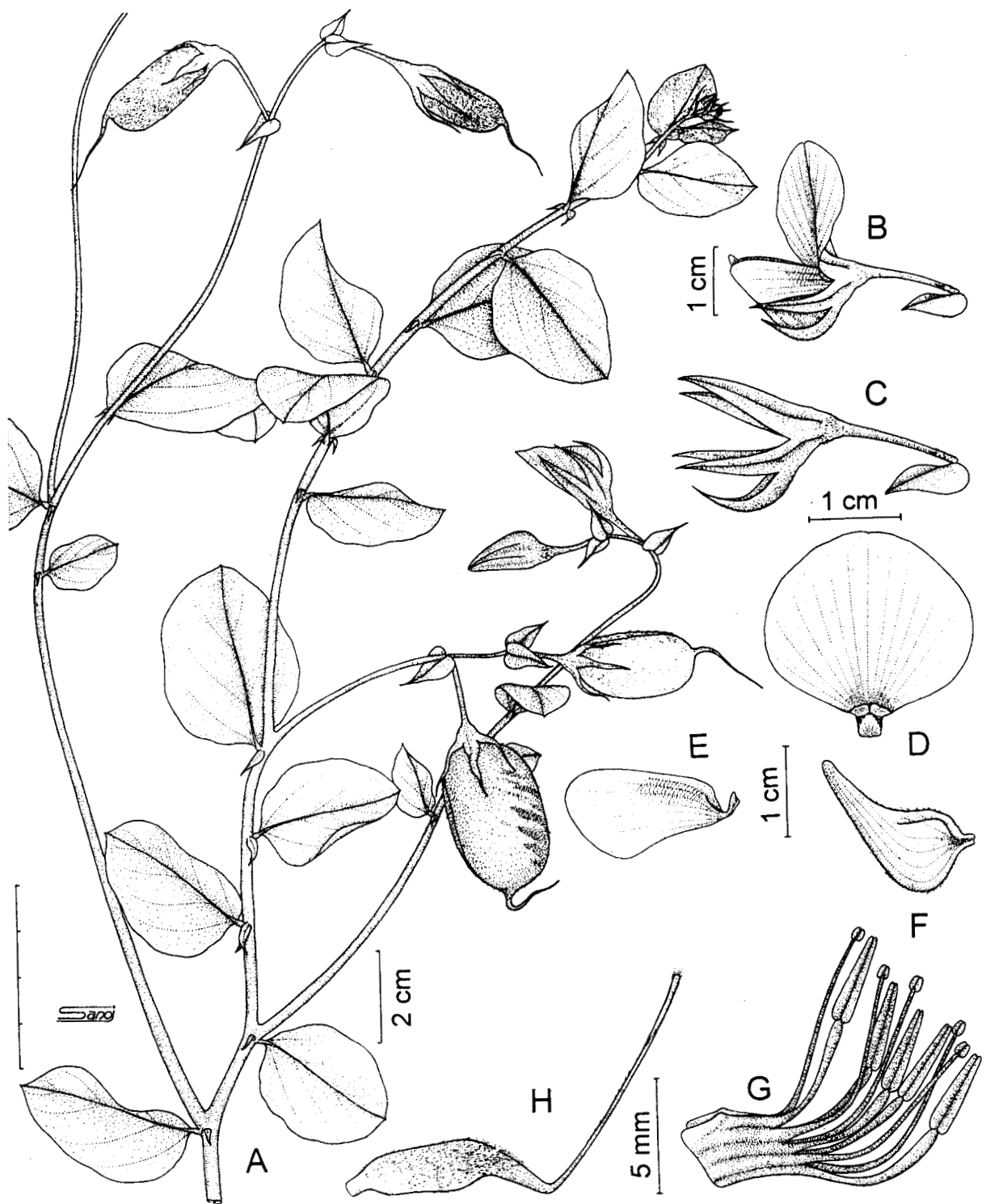


Fig. 5. *C. bifaria* L. f.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium (From Sandhyarani & Ramamurthy 17100).

inserted below the middle of the pedicel. Calyx sparsely pubescent, deeply five lobed; lobes equal 1.6 x 0.4 cm, acuminate, foliaceous, green, purple along the margin. Corolla yellow, slightly exerted. Standard petal 2.2 x 2.2 cm, orbicular, yellow with purple veins, mid vein pubescent on the back; wing petals 2 x 1 cm, obovate, purple; keel petals 1.8 x 0.9 cm, ovate, rounded at the base, with a long twisted beak, outer margin woolly or lanate. Staminal sheath 4 mm long; filaments 10 mm and 4 mm long alternately with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 5 x 2 mm, glabrous except along the outer and inner margin; stipe 1.5 mm long; style 13 mm long hairy along the margin, not geniculate. Pods 3.5 x 2.5 cm, ovoid, much inflated, sparsely puberulous, usually mottled with purple, 10 - 12 seeded. Seeds 4 mm diam., obliquely cordate, pale brown, glabrescent.

Distribution and ecology: *C. bifaria* is distributed in India and Sri Lanka (Sanjappa, 1992). In India it is not very common, represented only by a few collections from Karnataka and Andhra Pradesh. During my field trips, I could not come across this species anywhere from South India. It flowers and fruits from August to December.

Notes: *C. bifaria* is closely allied to *C. kurisumalayanum* in having large showy flowers and much inflated, ovoid pod. But the former can be distinguished by its procumbent herbaceous habit, deltate bracts, few flowered racemes and sparsely puberulous, pods as against the perennial suffruticose habit, subulate bracts, many flowered racemes and thinly sericeous pod. Among the specimens studied under *C. bifaria*, *Ramesh* and *Ramesh* 9261 (CAL), is notably small. Unlike in typical specimens, its keel petals are white in colour with purple striations.

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Bapanakunta, *Sandhyarani & Ramamurthy* 17100 (SKU). Ranga Reddy Dt.: Lingapalli, *Silar Mohammed* 12756 (SKU). KARNATAKA: Bijapur Dt.: Kasmatagi,

Ramesh & Ramesh 9261 (CAL). Hassan Dt.: Bourdalboore State forest,
Saldanha & Kesavamurthy 3317 (CAL).

4. *C. clarkei* Gamble, Bull. Misc. Inform. Kew 27. 1917, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Ramach. *et al.*, J. Econ. Tax. Bot. 5(1): 136. 1984; & Nair, Fl. Cannanore 130. 1988; Sanjappa, Leg. India 118. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 255. 1997; Matthew, Illus. Fl. Palni Hills t. 160. 1996; Fl. Palni Hills 1: 299. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 165. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: South India, Nilgiris, *Gamble* 15622 (CAL).

(Fig. 6)

Suffruticose, annual herb with short stem bearing long or short branches, may be ascending or decumbent. Stems and branches slender, 3 - 4 angled, sparsely pilose. Leaves simple, sub sessile; stipules 1 - 3 x 0.5 - 1 mm, lanceolate, foliaceous, glabrous above and puberulous beneath; petioles less than 1 mm long; lamina 1.8 - 3.8 x 0.5 - 1 cm, elliptic - lanceolate or oblong, base obtuse, margin slightly revolute, apex rounded or acute, glabrous above and sparsely appressed rusty tomentose beneath, chartaceous. Racemes 5 - 12 cm long, lateral, leaf opposed at age, lax, 2 - 5 flowered. Flowers 1.2 cm long and 0.7 cm across; bracts 2 x 1.5 cm, cordate, brown sericeous out and glabrous in; bracteoles 1 mm long, minute, subulate, setaceous, inserted on base of the calyx tube; pedicels 3.5 mm long, sericeous. Calyx bilipped, brown tomentose, tube 3 mm long; lobes more or less equal (7 x 2.5 mm), triangular, acuminate. Corolla pale yellow without striations; standard petal 1 x 0.5 cm, ovate, golden tomentose at the distal end; wing petals 7 x 3 mm, oblong with a basal claw; keel petals 10 x 5 mm, subangular at near the base, inner margin lanate; beak twisted to 90°. Staminal sheath 3 mm long,

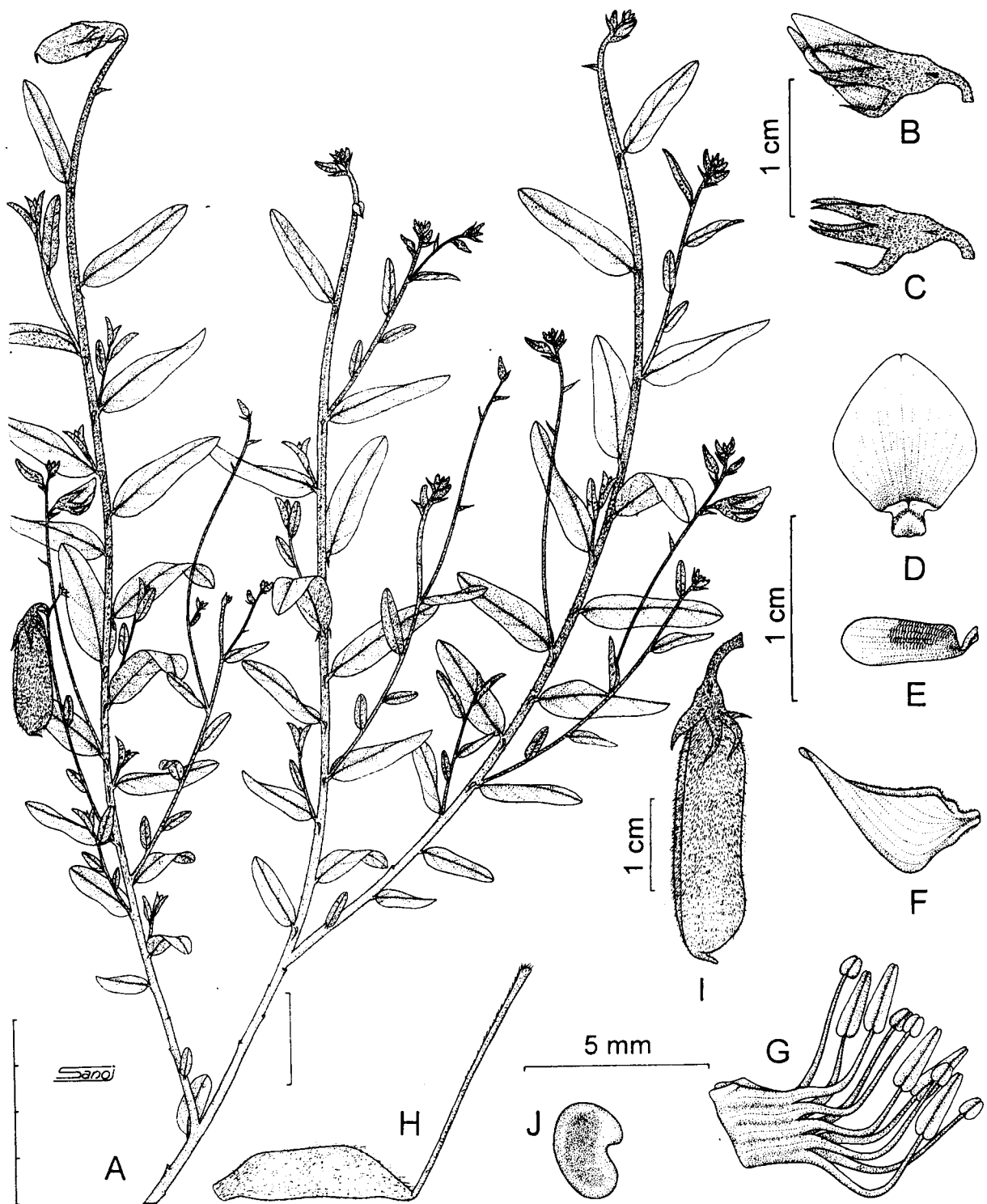


Fig. 6. *C. clarkei* Gamble: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Joby 751).

filaments 5 mm and 3 mm long alternately with ovoid (0.5 mm) and oblong (1 mm) anthers respectively. Ovary 5.5 x 1.5 mm, stipitate, golden sericeous; style 7 mm long, geniculate; stigma slightly expanded, hairy. Pods 3 x 0.8 cm, oblong, brown hirsute, 18 – 20 seeded; stalk 5 mm long. Seeds 2 mm diam., obliquely cordate, dark brown.

Distribution and ecology: *C. clarkei* is endemic to South India (Sanjappa, 1992). It is occasional, and grows on bare grassy slopes or on open forest tracts at an altitude of 800 - 1400 m. It flowers from December to February and fruits from March to April.

Notes: *C. clarkei* is least represented in Indian Herbaria. We could not find any specimens of *C. clarkei* other than the type material in CAL. Ramachandran (1984) rediscovered this species from Brahmagiri in Kannur district of Kerala, about a century after its original collection by Clarke (1870). I have collected this species from two distinct habitats, one from Nelliampathy in Palakkad district and the other from Kulamavu in Idukki district in Kerala at an altitude of ca. 800 - 1200 m. The specimens collected from the grassy slopes (SJC 751) are short and copiously branched compared to the tall and less branched ones (SJC 764) collected from forest tracts.

Gamble (1918) placed *C. clarkei* under the sect. Eriocarpae because of its excluded, hairy pod. While considering its diffuse, semi erect, herbaceous habit and lateral, leaf opposed, few flowered racemes, it is more appropriate to treat this species under the sect. Diffusae than Eriocarpae.

Specimens examined: KERALA: Idukki Dt.: Kulamavu - Idukki way side, Sibichen & Joby 764 (SJC); Munnar, Lockhart gap, Abdul Jabbar 43935 (TBGRI). Kannur Dt.: Brahmagiri, Ramachandran 62109 (MH). Palakkad Dt.: Nelliampathy, Pulayanpara, Sibichen & Joby 751 (SJC); Silent Valley, Valiyaparathode, Sabu 10092 (CALI).

5. *C. evolvuloides* Wight ex Wight & Arn., Prodr. 1: 188. 1834 (repr.ed.1976); Benth. in Hook., Lond. J. Bot. 2: 477. 1843; Thw., Enum. Plant. Zeyl. 81. 1859 (repr. ed. 1864); Baker in Hook.f., Fl. Brit. India 2: 68. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 10. 1894; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Malathi in Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 364. 1983; Saldan., Fl. Karnataka 1: 433. 1984; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 125.1988; Vajrav., Fl. Palghat 150. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 201. 1991; Sanjappa, Leg. India 119. 1992; Sasi. & Sivar., Fl. Thrissur 134. 1996; Sivar. & Mathew, Fl. Nilambur 179. 1997; Matthew, Fl. Palni Hills 1: 300. 1999.

Type: India, *Wall.* Cat. no. 5410 (K).

C. evolvuloides var. *acutifolia* Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Ramach. & Nair, Fl. Cannanore 130. 1988. Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 255. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 167. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 158. 2002.

(Fig. 7)

Annual herb with several trailing or straggling branches, 15 – 50 cm long. Stems and branches terete, sparsely pubescent. Leaves simple, subsessile; stipules 3 mm long, subulate, sparsely pubescent; lamina 1 - 3.3 x 1 - 2.3 cm, ovate - elliptic - lanceolate - oblong, base slightly oblique, apex acute - mucronate. Racemes lateral, leaf opposed, 5 – 15 cm long, lax, 3 - 7 flowered. Flower 10 mm long and 7 mm across; bracts 3 mm long, ovate; bracteoles 1 mm long, linear. Calyx bilipped, tomentose; lobes equal (6 mm), acuminate, connate at the base. Corolla exserted; standard petal 8 x 6 mm, ovate, yellow with purple striations; wing petals 7 x 4 mm, oblong with a

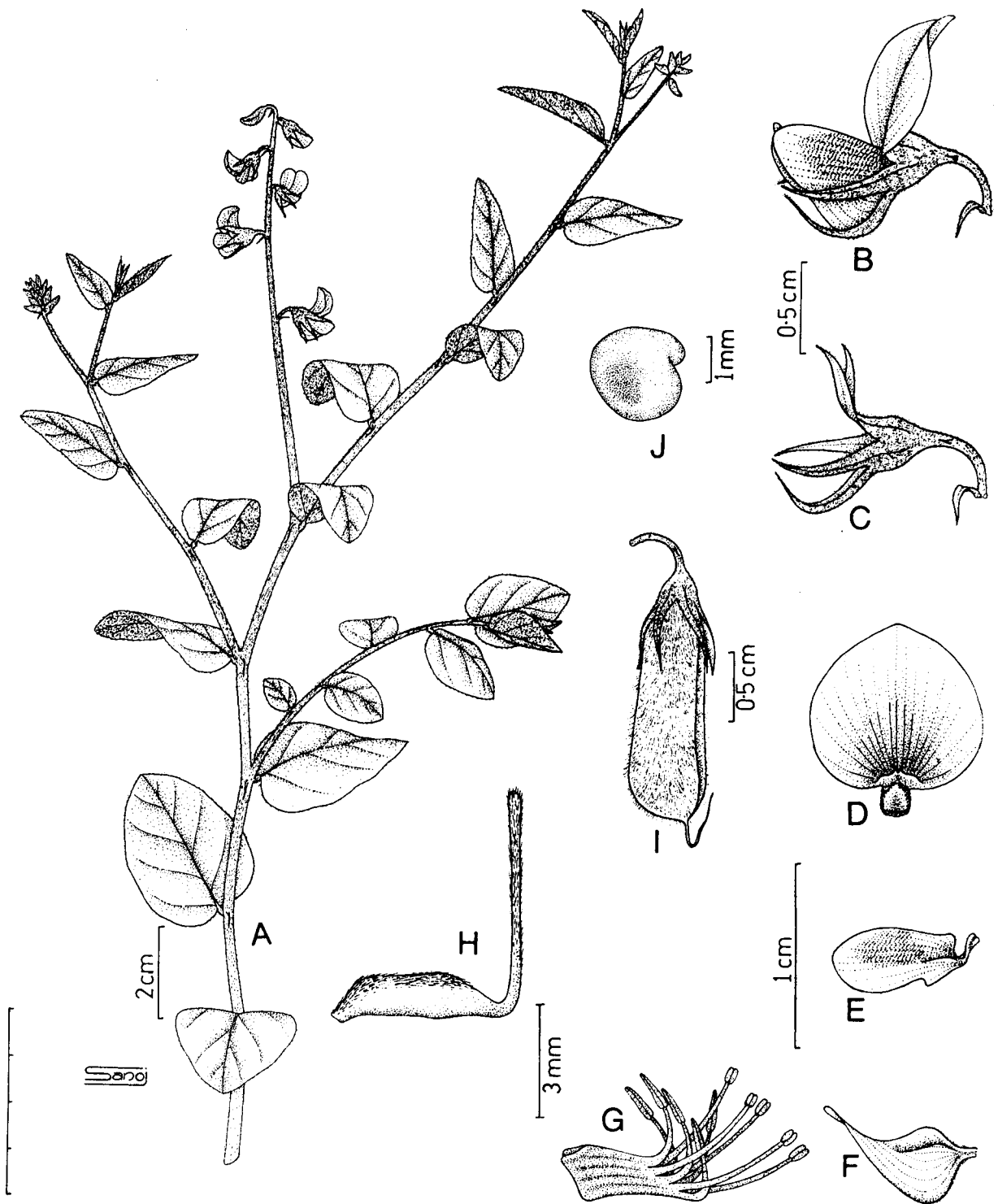


Fig. 7. *C. evoluloides* Wight ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen 642).

basal claw; keel petals 8 x 4 mm, pale yellow, angular at the base, beak twisted to 180°. Staminal sheath 3 mm long; filaments 3 mm and 2 mm long alternately with ovoid (0.5 mm) and oblong (1 mm) anthers respectively. Ovary 0.5 mm long, pubescent along the inner margin; style 5 mm long, geniculate, hairy towards apex; stigma swollen, hairy. Pod 1.25 x 0.4 cm, oblong, hirsute, 8 - 10 seeded. Seeds 1.5 - 2 mm diam., brown, obliquely cordate, granulose.

Distribution and ecology: *C. evolvuloides* is distributed in Peninsular India and Sri Lanka (Rudd, 1991). It is a common undergrowth in moist deciduous forests up to an altitude of 1500 m and rarely on wastelands. It produces flowers and fruits from September to April.

Notes: Gamble (1918) described the variety *C. evolvuloides* var. *acutifolia* based on the description "acute, elliptic, mucronate rather prominently nerved leaves". Critical observation of live and herbarium specimens from various localities lead me to the conclusion that *C. evolvuloides* exhibits high degree of variability in leaf shape. Even in the same specimen, the leaves are ovate, elliptic, lanceolate and oblong with round or acute or mucronate apex. Moreover, veins are generally raised underneath. Hence var. *acutifolia* is treated here as conspecific with *C. evolvuloides* as envisaged by Ansari (1991).

Specimens examined: KERALA: Idukki Dt.: Anachuruli, Jomy 14279 (CALI); Kattappana, Kalvari Mount, Sibichen & Joby 763 (SJC). Kannur Dt.: Kannothe R.F., Ramachandran 58206 (MH). Kozhikkode Dt.: East Devagiri, Sibichen 642; Kakkadompoil, Sibichen & Nampy 640 (SJC). Malappuram Dt.: Kanjirakkadavu, Philip Mathew 33035; Karulai, Philip Mathew 33555 (CALI); Nedumkayam, Philip Mathew 32275 (CALI), Fischer 3844 (CALI). Palakkad Dt.: Agali forest, Vajravelu 26318 (MH); Dhoni, Fischer 1606 (CALI), Elavampadam, Deepthi & Sibichen 663 (SJC); Siruvani Riverside,

Vajravelu 60663 (CAL). Thrissur Dt.: Parambikulam, *Sebastine* 15303 (MH); Peechi, *Sasidharan* 3745 (CALI). Wayanad Dt.: Muthanga forest, *Sibichen & Dinesh Raj* 780 (SJC). TAMIL NADU: Coimbatore Dt.: Kurudimalai, *Subramanyam* 1479; Noyil River side, *Chandrabose* 29038; Thekkumalai, *Sebastine* 1711 (CAL).

6. *C. ferruginea* Grah. ex Benth. In: Hook., Lond. J. Bot. 2: 476. 1843; Thw., Enum. Pl. 81. 1859 (repr. ed. 1864); Baker In: Hook.f., Fl. Brit. India 2: 68. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 10. 1894; Gamble, Fl. Pres. Madras. 1: 282. 1918 (repr. ed. 1995); Niyomdham, Thai For. Bull. 1: 131. 1978; Saldan., Fl. Karnataka 1: 433. 1984; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 199. 1991; Sanjappa, Leg. India 119. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 256. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 167. 2000.

Type: *Wall.* Cat. no. 5358 (K).

C. pilosissima Miq., Fl. Ind. Bat. 1: 327. 1855.

C. ferruginea var. *pilosissima* (Miq.) Baker In: Hook.f., Fl. Brit. India 2: 68. 1876 (repr. ed. 1879)

Suffrutescent herb with several ascending branches, 0.5 - 0.75 m high. Stems and branches terete, ferruginous-tomentose. Leaves simple, subsessile; stipule 3 - 6 x 1 - 2 mm, lanceolate-acuminate, deflexed, persistent; lamina 3 - 7 x 1.5 - 4 cm, ovate-elliptic-oblong, base cuneate, margin entire, reflexed, apex obtuse, chartaceous, punctate, rusty, appressed pubescent on both surfaces. Racemes 5 - 15 cm long, terminal become leaf opposed, lax, 1 - 4 flowered. Flower 1.2 cm long and 0.8 cm across; bracts 4 x 1.5 cm, lanceolate, reflexed; pedicel 4 mm long, rusty villous; bracteoles 4 x 1 mm, lanceolate, inserted on calyx, appressed to sepals. Calyx ferrugino-villous, deeply bilipped; upper two lobes 10 x 2 mm, triangular acuminate; lower

three lobes 9 x 1 mm, linear acuminate. Corolla yellow, not exserted; standard petal 1.3 x 1.1 cm, broadly elliptic, truncate or emarginated at apex, glabrous, except along the mid vein on the back side; wing petals 10 x 4 mm, oblong; keel petals 10 x 4 mm, angled, abruptly rounded in the lower half, beak twisted to 180°. Staminal sheath 2 mm long, glabrous; filaments 4.5 mm and 3 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 3 x 1 mm, oblong, sessile, glabrous; style 1.3 cm long, geniculate, hairy along the inner margin; stigma expanded, hairy. Pods 2.5 x 0.8 cm, oblong, glabrous, shortly stalked, 18 - 20 seeded. Seeds 3 mm diam., cordate, brown.

Distribution and ecology: *C. ferruginea* is distributed in India, Sri Lanka, Indonesia, Taiwan, Philippines, Bhutan and Myanmar (Sanjappa, 1992). I could not collect this species anywhere from South India during my collection trips. It is hardly represented in MH but plenty of specimens of this species from central and northern states of India are available at CAL. *C. ferruginea* flowers and fruits throughout the year.

Notes: *C. ferruginea* is quite variable in density and arrangement of hairs; size and shape of leaves and length of racemes. The indumentum pattern seems to be correlated with habitat. The hairs being more dense on plants growing in exposed places. Niyomdham (1978) suggested a close resemblance of this species to *C. chinensis* L., but the former is quite distinct due to its persistent, deflexed, acuminate and large stipule.

Specimens examined: ANDHRA PRADESH: Visakapatanam Dt.: Anjodigedda, Pullaiah & Chennaiah 7423; Arakku valley, Balakrishnan 624 (SKU).

7. *C. filipes* Benth. In: Hook. f., Lond. J. Bot. 2: 475. 1843; Baker In: Hook. f., Fl. Brit. India 2: 66. 1876 (repr. ed. 1879); Cooke, Fl.

Bombay 1: 312. 1902; Rama Rao, Fl. Plants Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Saldan., Fl. Karnataka 1: 433. 1984; Sanjappa, Leg. India. 131. 1992.

Type: *Wall.* Cat. No. 5421 (K).

C. trichophora Benth. ex Baker In: Hook. f., Fl. Brit. India 2: 67. 1876.

C. filipes Benth. var. *trichophora* (Benth. ex Baker) Cooke, Fl. Bombay 1: 312. 1902.

(Fig. 8)

Prostrate annual herb with trailing branches up to 40 cm long. Stems and branches filiform, glabrescent. Leaves simple, estipulate, subsessile; lamina 0.8 - 1.4 x 0.4 - 1 cm, ovate-cordate, base cordate, slightly oblique, apex obtuse-acute, chartaceous, covered with scattered silky hairs on both surfaces. Racemes 1.5 - 5 cm long, slender, lateral, leaf opposed, 1 - 3 flowered. Flower 5 mm long and 6 mm across; bract 1.5 mm long, lanceolate, sparsely hirsute; bracteoles 0.5 mm long, subulate, sparsely hirsute, produced on pedicel near the calyx. Calyx hirsute, lobes subequal, upper two lobes 2 x 1 mm, triangular, lateral lobes 1.5 x 0.5 mm, triangular, lower one 1.5 x 0.5 mm, narrow acuminate, calyx tube 1 mm long. Corolla yellow with pink striations, shortly exserted; standard petal 3.5 x 0.8 mm, erect, orbicular; wing petals 2.5 x 1 mm, obovate, apex rounded, keel petals 3 x 2.5 mm, rounded at the middle, beak short and twisted. Staminal sheath 1 mm long; filaments 1.5 mm and 1 mm long alternately with ovoid (0.25 mm) and oblong (0.75 mm) anthers respectively. Ovary 1 mm long, glabrous; style 3 mm long, geniculate, hairy along the margin, stigma oblique. Pod 8 x 4 mm, oblong, glabrous; stipe 0.5 mm long, 8 - 10 seeded. Seeds 1 mm diam., cordate, brown.

Distribution and ecology: *C. filipes* is endemic to India (Sanjappa, 1992). Cooke (1902) described it as common in Bombay and Salsette. However, *C. filipes* is not common in South India and I have collected this species only

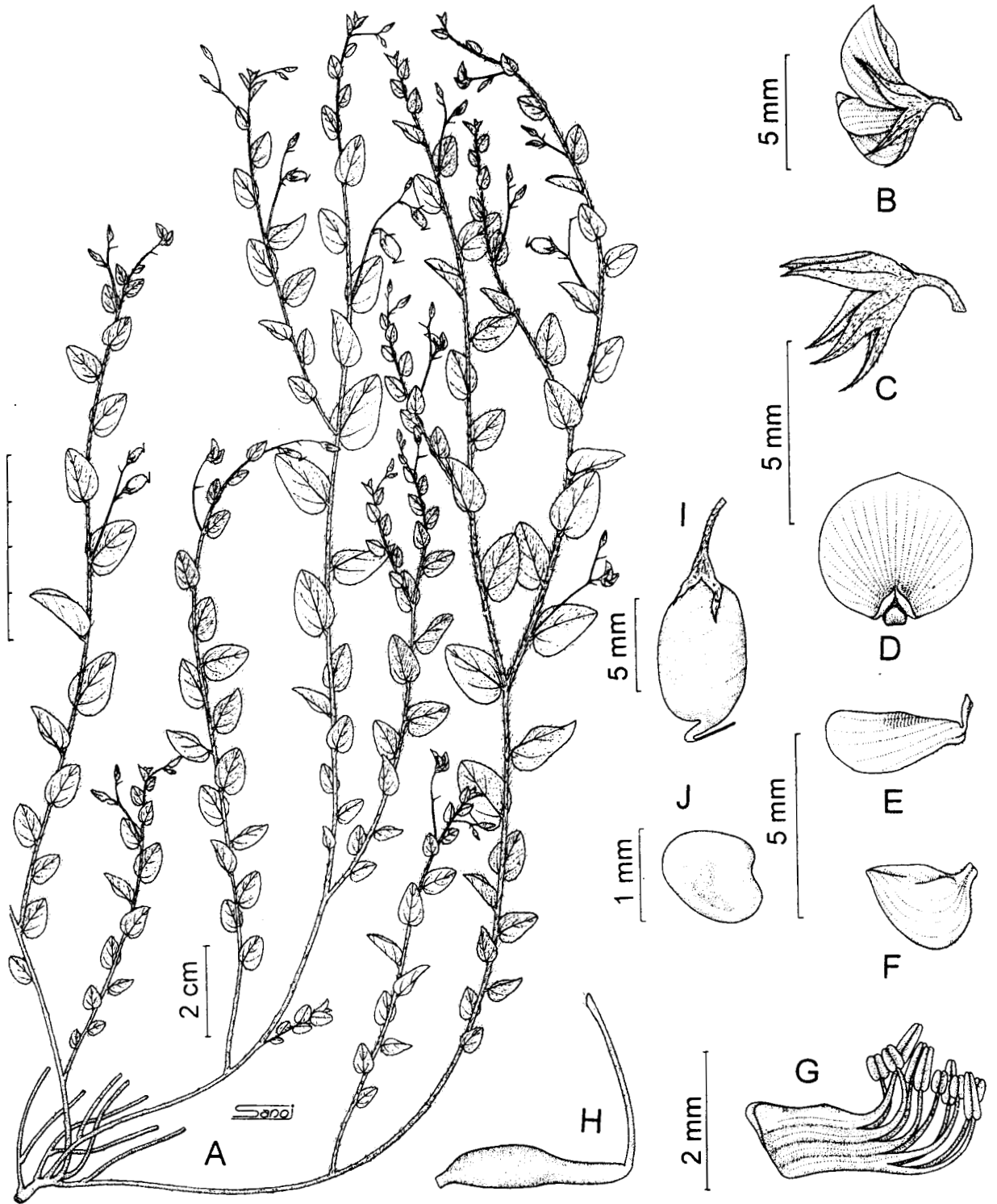


Fig. 8. *C. filipes* Benth.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen & Nampy* 718).

from the dry lateritic soils of Goa University Campus at an altitude of 70 m. The plant flowers and fruits from October to May.

Notes: Baker (1876) described the species *C. trichophora* which subsequently been reduced as a variety of *C. filipes* by Cooke (1902). Except the hairiness and somewhat larger leaves, there is nothing to separate *C. trichophora* from *C. filipes* and hence it is treated as a synonym.

Specimens examined: GOA: North Goa, Goa University Campus, *Sibichen & Nampy* 718 (SJC). KARNATAKA: North Kanara Dt.: Anshi - Sadashivagada Road, *Sreenath & Ramesh* 10934 (CAL). South Kanara Dt.: Padubidri - Belnannu Road, *Saldanha & Prakash* 4081 (CAL).

8. *C. fysonii* Dunn, Kew Bull. 26: 1914; Gamble, Fl. Pres. Madras 1: 283. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 144 & 2: t. 108. 1932 (repr. ed. 1977); Malathi In: Nair & Henry, (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Sanjappa, Leg. India 120. 1992; Matthew, Ills. Fl. Palni Hills 161. 1996, Fl. Palni Hills. 1: 300. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 168. 2000; Ansari In: Rao (eds.), Adv. Leg. Res. 162. 2002.

Type: India, *Fyson 276* (syntype: K).

(Fig. 9)

Prostrate trailing herb with perennial root stock, branches many, wiry, tomentose, up to 50 cm long. Leaves simple, subsessile; stipule 1 mm long, subulate; petioles less than 1 mm long, densely sericeous; lamina 1.2 - 2 x 0.75 - 1.5 cm, ovate-orbicular, base slightly oblique, margin revolute, apex rounded or subacute, glabrescent to sparsely sericeous above and sericeous beneath, nerves raised underneath and obscure above, sub-coriaceous. Racemes 10 - 20 cm long, terminal become leaf opposed, 4 - 6 flowered. Flower 1.8 cm long and 0.75 cm across, restricted towards apex; bracts 4 x 2

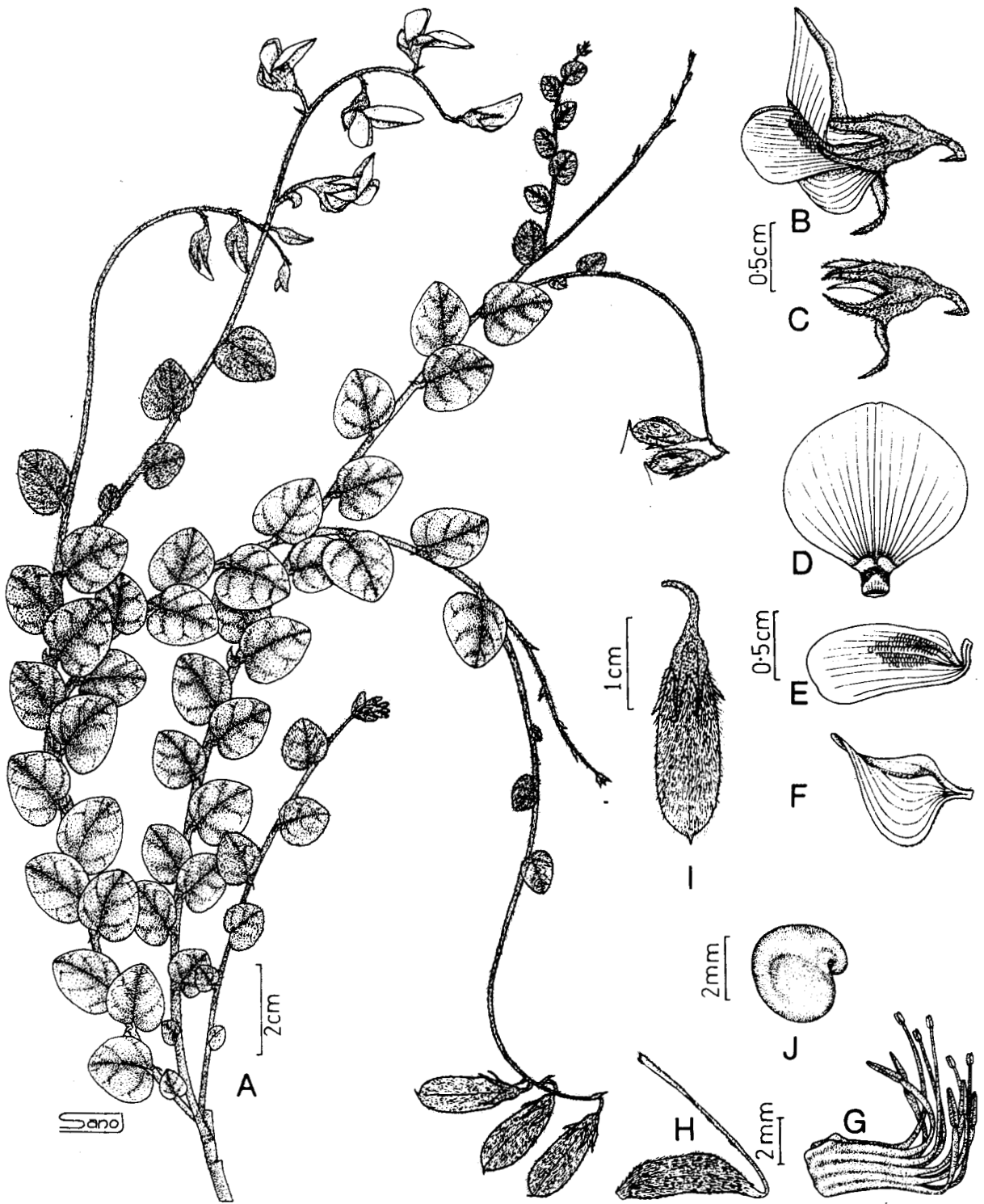


Fig. 9. *C. fysonii* Dunn: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Joby 763).

mm, lanceolate; bracteoles 1 mm long, linear, inserted near the middle of the pedicel; pedicel 5 mm long, tomentose. Calyx bilipped, brown sericeous; tube 4 mm long; upper two lobes 9 x 3 mm; lower three lobes 8 x 2 mm, narrow, acuminate. Corolla yellow with purple striations; standard petal 1.5 x 1.3 cm, orbicular to ovate; wing petals 12 x 6 mm, oblong; keel petals 12 x 7 mm, lanate and rounded at the middle, beak twisted to 180°. Staminal sheath 5 mm long; filaments 7 mm and 5 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 5 x 1.5 mm, white silky tomentose; stipe 1mm long; style 1 cm long, geniculate; stigma expanded and hairy. Pods 2 x 0.5 cm, oblong, brown, sericeous, 10 - 12 seeded. Seeds 2 mm diam., laterally compressed, obliquely cordiform, brownish black and granulose.

Distribution and ecology: *C. fysonii* is rare and endemic to India (Ahmedullah & Nayar, 1987). It is a prostrate, trailing herb in grassy slopes and way sides at higher elevations (1500 – 2400 m).

Notes: Gamble (1918) described the variety viz., *C. fysonii* var. *glabra* endemic to Palni hills, characterized by its glabrous leaves, flowers and pods. However, I could not find this variety even after extensive survey in South India. The few specimens at CAL labelled as *C. fysonii* var. *glabra* all belong to *C. fysonii*. Matthew (1999) also commented that at first sight the plant is distinct but it falls within the range of the variability of the species.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Eethakayal Mandapam, *Subba Rao* 46900 (CAL). Kurnool Dt.: Ramanapenta, *Ellis* 32629 (CAL). Visakapatanam Dt.: Arakku valley, *Balakrishnan* 503; Donkaragi, near Mangapadu, *Subba Rao* 29671 (CAL). KARNATAKA: Bangalore Dt.: Bangalore, *Meebold* 11330 (CAL). Mysore Dt.: Bandipur, *Meebold* 11543 (CAL). KERALA: Idukki Dt.: Devikolam, *Sebastine* 17524 (CAL); Kallarpara, *Sibichen & Nampy* 679; Kattappana, Kalvari Mount,

Sibichen & Joby 763; Munnar, Eravikulam National park, *Sibichen & Nampy* 608 (SJC); Pettimudi, *Shetty* 26586 (MH); Umayamala, *Abdul Jabbar* 45560 (TBGRI). Wayanad Dt.: Muthanga, *Balakrishnan* 42096 (CAL). TAMIL NADU: Coimbatore Dt.: Akkamalai, *Ansari* 1159 B; Anamalai, *Joseph* 13405 (CAL); Vellaigiri Hills, *Raju* 261 (MH). Madurai Dt.: Kodaikanal, *Chandrabose* 53383 (CAL); Manalur, Brook peak, *Ravikumar* 2411 (MH); Poolathur, *Chandrabose* 51669; Tiger sholai, *Munch* 24 (CAL). Vattakkanal, *Deb* 30494, 30957; Vellaigiri hills, *Raju* 261 (MH). Nilgiri Dt.: Mudumalai R.F., *Sebastine* 7336 (CAL). Palni hills, Bear sholai, *Sibichen & Nampy* 695 (SJC); Salem Dt.: Ramanathapuram Dt.: Mudaliaruthu, *Srinivasan* 60963 (CAL). Thirunelveli Dt.: Sengaltheri, *Hooper & Ramswami* 39236 A (CAL). Yercaud, *Matthew & Venugopal* 18709 (CAL).

9. *C. globosa* Wight & Arn., Prodr. 1: 190. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 475. 1843; Baker In: Hook. f., Fl. Brit. India 2: 66. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 206. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Nayar & Sastry, Red Data Book 2: 112. 1988; Sanjappa, Leg. India 120. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 256. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 168. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 162. 2002.

Type: *Wall.* Cat. no. 5412 (K).

Prostrate, annual herb with several trailing branches from the rootstock. Stems and branches slender, wiry, gray pubescent. Leaves simple, estipulate, sub sessile; lamina 8 - 12 x 6 - 12 mm, ovate to orbicular, base slightly oblique, apex obtuse, sparsely sericeous on both sides, chartaceous. Racemes 1 - 2 cm long, leaf opposed, 1 or 2 flowered. Flower 5 mm long and 2 mm across; bracts and bracteoles subulate, setaceous; pedicel 1 mm long, gray sericeous. Calyx bilipped, densely sericeous; tube 1 mm long; lobes

subequal, upper two lobes 5 x 1.2 mm, triangular, acuminate, connate nearly $\frac{1}{2}$ their length, lower three lobes 4 x 0.75 mm, narrow, linear. Corolla yellow, hardly exerted; standard petal 6 x 4 mm, ovate, apex retuse, glabrous outside; wing petals 5 x 2.5 mm, obovate; keel petals 5 x 3 mm, ovate, angular at the base, beak exceeding the wing and twisted to 180°. Staminal sheath 1 mm long, filaments 3 mm and 2 mm long alternately with ovoid (0.2 mm) and oblong (1 mm) anthers respectively. Ovary 1.5 x 1 mm, sessile, hairy; style 6 mm long, geniculate, broad and hairy on one side towards apex; stigma hairy. Pods 4–8 x 3–6 mm, globose, sessile, sparsely velutinous when mature, 2 - 4 seeded. Seeds 2 mm diam., yellowish brown, obliquely cordiform.

Distribution and ecology: *C. globosa* is endemic to South India (Sanjappa, 1992) and is described as rare by Nayar and Sastry (1988). It usually grows among grasses on hill slopes.

Notes: *C. globosa* resembles *C. angulata* in having trailing branches, orbicular to ovate leaves and globose pod. But the leaves and pods are smaller in the former when compared to the latter. Moreover, the pod is 2 - 4 seeded in *C. globosa* while it is 15 - 20 seeded in *C. angulata*.

Specimens examined: TAMIL NADU: Thiruelveli Dt.: Ambasamudram, *Abdul Jabbar* 43997 (TBGRI).

10. *C. hirsuta* Willd., Sp. Pl. 3: 978.1802; DC., Prodr. 126. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 188. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 477. 1843; Baker In: Hook.f., Fl. Brit. India 2: 68. 1876 (repr. ed. 1879); Rama Rao, Fl. Plts. Travancore 105, 1914; Gamble, Fl. Pres. Madras 1: 283. 1918 (repr. ed. 1995); Saldan., Fl. Karnataka 1: 434. 1984; Vajrav., Fl. Palghat 150. 1990; Sanjappa, Leg. India 121. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 256. 1997; & Ramamurthy, Fl. East. Ghats 2: 170. 2000.

Type: *Wall.* Cat. no. 5413 B (K).

Annual diffuse herb with a few ascending branches, up to 0.75 m high. Leaves simple; stipules 3 - 5 mm long, lanceolate, setaceous, reflexed; petioles 1- 2 mm long, hirsute; lamina 3.4 - 7 x 2.2 - 3.6 cm, ovate, base obtuse, slightly oblique; apex acute - mucronate, chartaceous, glabrescent above and hairy along the veins beneath, ciliate. Racemes 5 - 15 cm long, lateral, leaf opposed, 1 - 5 flowered. Flower 2.2 cm long and 1.5 cm across; bracts 4 x 1 mm, lanceolate, recurved; pedicel 5 mm long, hirsute; bracteoles very minute, inserted near the middle of the pedicel. Calyx hairy, deeply five cleft; lobes 8 x 1 mm, more or less equal in size, linear-acuminate, shorter than corolla. Corolla yellow, exserted; standard petal 2 x 1.6 cm, ovate with two appendages at the base, yellow with reddish brown spots; wing petals 1.4 x 0.5 cm, oblong, with a basal claw; keel petals 1.8 x 1 cm, ovate, rounded at the base, beak twisted to 180°. Staminal sheath 3 mm long, glabrous; filaments 8 mm and 3 mm long alternately with ovoid (0.25 mm long) and oblong (1.5 mm long) anthers respectively. Ovary 3 x 1.5 mm, sessile, densely hirsute; style 1 cm long, hairy along the ventral margin; stigma oblique, hairy. Pods 2 x 0.8 cm, oblong, sessile, strigosely hirsute, 8 - 10 seeded. Seeds 3 mm diam., obliquely cordate, dark brown, laterally compressed.

Distribution and ecology: *C. hirsuta* is distributed in India and Myanmar (Pullaiah & Chennaiah, 2000). In South India, it is very rare and is known only from Andhra Pradesh. However, most of the specimens available at CAL are from Rajasthan. It is occasional in dry deciduous forests. The plant flowers and fruits from September to April.

Specimens examined: ANDHRA PRADESH: Guntur Dt.: Mangalagiri R.F., *Rammurthy* 17632, *Sandhyarani & Ramamurthy* 21620 (SKU). Kurnool Dt.: Balugram R.F., *Raju Reddy* 2743 (SKU). Ranga Reddy Dt.: Lingapalle,

Central University Campus, *Silar Muhammed* 12749 (SKU). Visakapatnam Dt.: Amantagiri, Galikonda, *Pullaiah & Chennaiah* 7392 (SKU).

11. *C. humifusa* Grah. ex Benth. In: Hook., Lond. J. Bot. 2: 476.1843; Baker In: Hook. f., Fl. Brit. India 2: 97. 1876 (repr. ed. 1879); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995); Saldan. & Nicolson, Fl. Hassan 242. 1976; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 87. 1983; Saldan., Fl. Karnataka 1: 434. 1984; Vajrav., Fl. Palghat 150. 1990; Sanjappa, Leg. India 121. 1992; Sasi. & Sivar., Fl. Thrissur 134. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 257. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 172. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 172. 2002.

Type: *Wall.* Cat. no. 5421 (K).

(Fig. 10 & 11)

Prostrate, annual herb, with several trailing branches, 5 - 30 cm long. Stems and branches filiform, arcuate, ferruginous hispid. Leaves simple; stipules 1.5 mm long; subsessile; lamina 1.8 - 2.6 x 1.5 - 2.1 cm, orbicular to ovate, base rounded, apex obtuse, sericeous on both surfaces, chartaceous glabrescent above and hairy along the veins beneath, ciliate. Racemes 6 -15 cm long, lateral, leaf opposed, 3 - 6 flowered on arcuate peduncle. Flower 3 - 4 mm long and 3 mm across; bracts and bracteoles 1.5 mm long, subulate, setaceous; bracteoles inserted near the base of the calyx tube; pedicel 3 mm long, ferrugino tomentose. Calyx 3 - 4 mm long, exceeding the corolla, brown-silky sericeous; tube 1 mm long; lobes subequal; upper two lobes lanceolate, connate except at the apex; lower three acuminate, connate only at the base. Corolla included; standard petal 3 x 1.5 mm, ovate-oblong, yellow without purple striations; wing petals 3 x 1mm, oblong; keel petals 4 x 2 mm, pale yellow, angular at the middle, beak partially twisted. Staminal sheath 1-

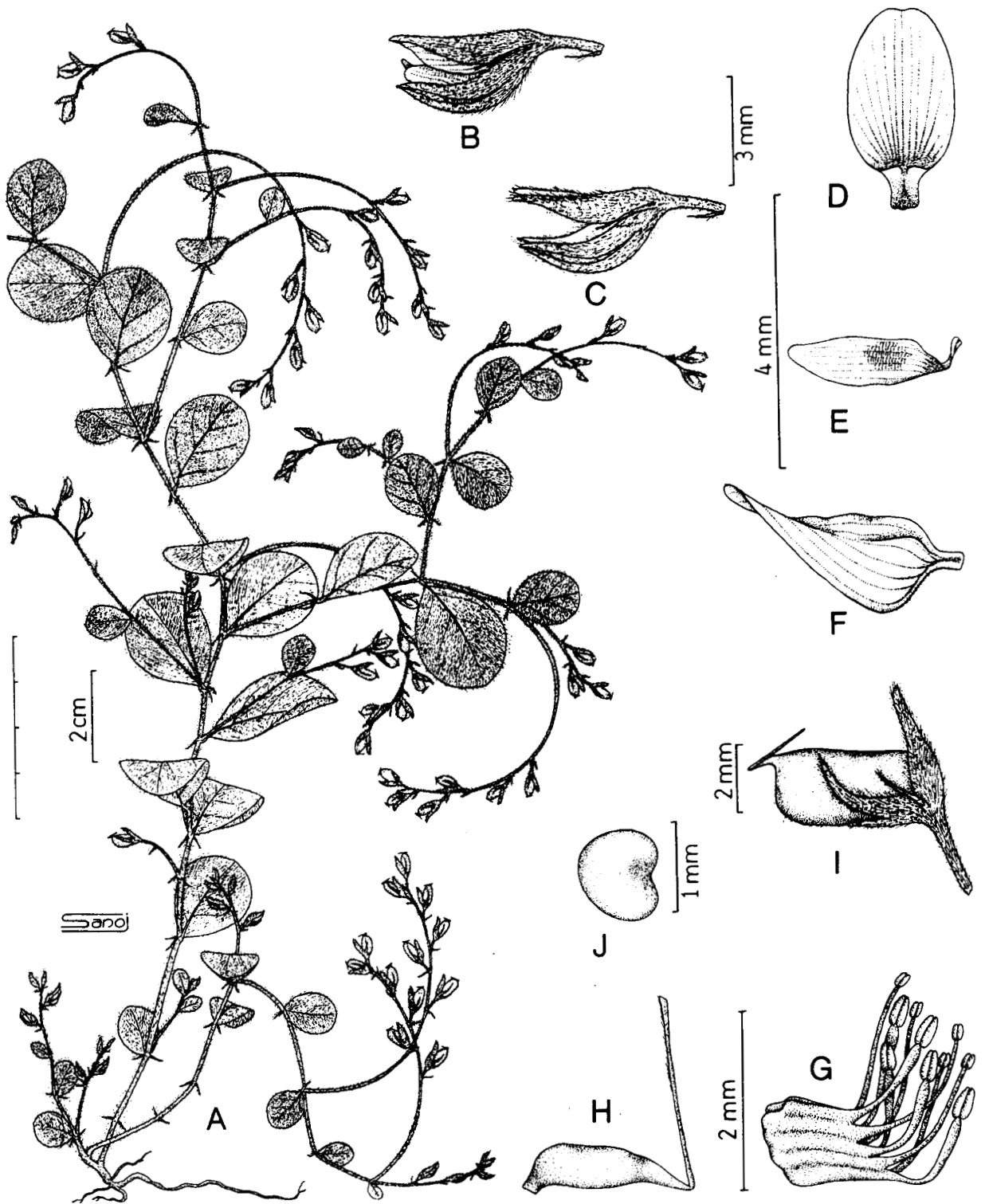


Fig. 10. *C. humifusa* Grah. ex Benth.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen & Nampy 669).

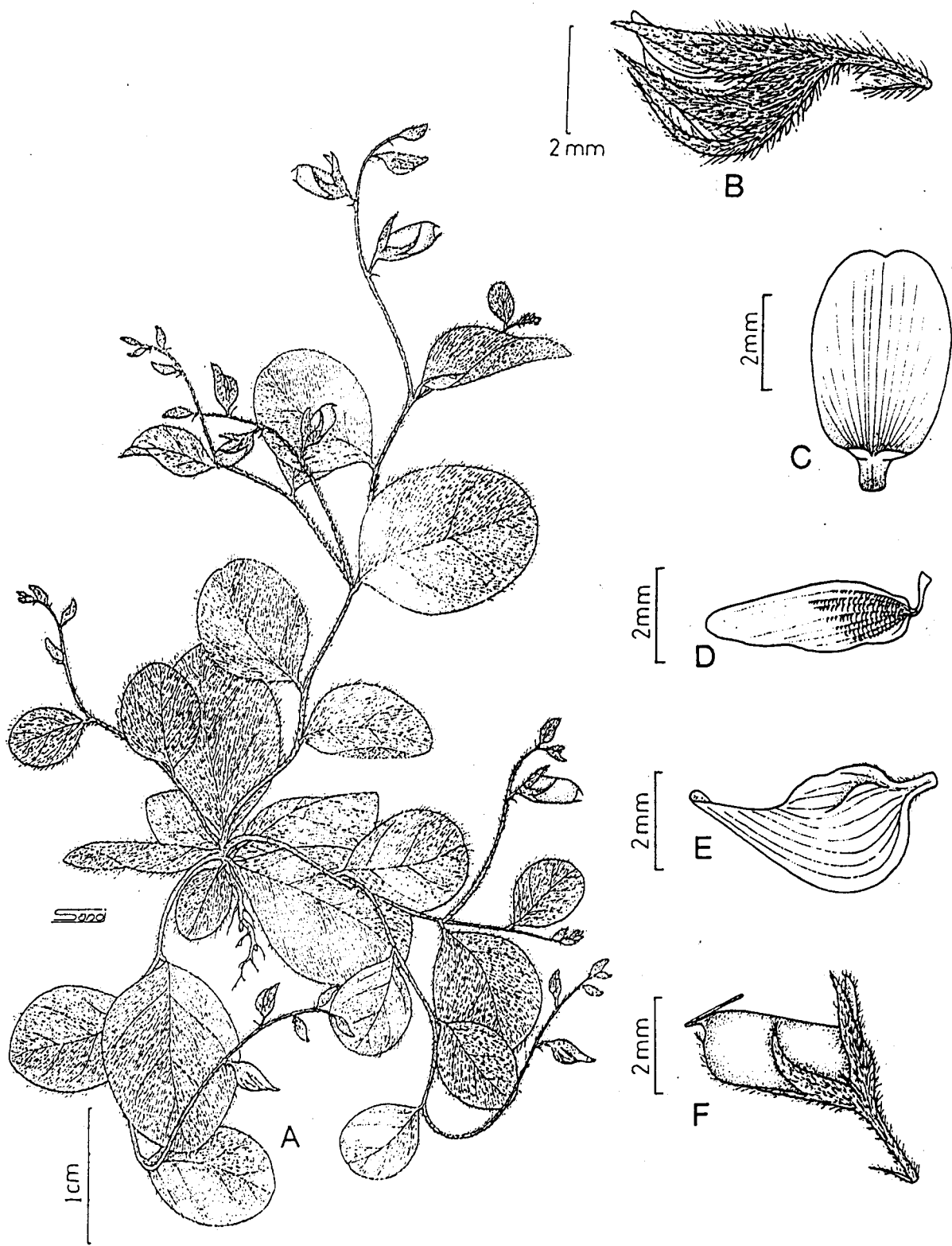


Fig. 11. *C. humifusa* Grah. ex Benth.: - Small morphoform A. Habit; B. Flower; C. Standard petal; D. Wing petal; E. Keel petal; F. Pod (From Sibichen & Nampy 168).

1.5 mm long; filaments 2 mm and 1 mm long alternately with ovoid (0.25 mm long) and oblong (0.5 mm long) anthers respectively. Ovary 2 x 1 mm, glabrous; style 3 mm long, geniculate, hairy on one side towards apex. Pods 5 x 2 mm, oblong, glabrous, sessile, 6 - 8 seeded. Seeds 0.5 mm diam., brownish - black, cordate.

Distribution and ecology: *C. humifusa* is distributed in India, Bhutan, Malesia and Nepal (Sanjappa, 1992). We have collected this species from tea estates and also from exposed lateritic slopes in higher elevations. It flowers and fruits from October to January.

Notes: During my field explorations, I have collected two distinct growth forms of this species. Both are from more or less the same altitude (ca. 1200 - 1500 m). The small form (Fig. 11) is prostrate, found in fully exposed lateritic slopes having a rosette of leaves at the base with short branches (ca 3 - 5 cm long) while the large form (Fig. 10) is collected from vertical earth cuttings in tea estates having long (9 - 30 cm long) pendulous branches. Except the size difference, no other characteristic differences are noticed. From my field experience, this small form of *C. humifusa* is the smallest species under this genus in South India. However, *C. pusilla* is treated as the smallest by Gamble (1918).

Specimens examined: KARNATAKA: Mysore Dt.: Mercara, *Maesen* 3050 (CAL). KERALA: Idukki Dt.: Kattappana - Elappara wayside, *Sibichen & Nampy* 669 (SJC); Kumili, *Meebold* 978 (CAL). Palakkad Dt.: Silent Valley, *Prasanna Kumar* 11000 (CALI), *Nair* 69562 (CAL). TAMIL NADU: Nilgiri Dt.: Gudalloor, Needle point, *Sibichen & Nampy* 168 (SJC); *s. l.*, *Gamble* 15528 (CAL).

12. *C. multiflora* (Arn.) Benth. In: Hook., Lond. J. Bot. 2: 478. 1843; Thw., Enum. Pl. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook.f.,

Fl. Brit. India 2: 69. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 11. 1894; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 196. 1991; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 98. 1983; Vajrav., Fl. Palghat 151. 1990; Ansari In: Rao (ed.), Adv. Leg. Res. 162. 2002.

Type: Ceylon, *Walker* (K).

C. bifaria L. f. var. *multiflora* Arn., Nov. Actorum Acad. Caes. Leop. Carol. Nat. Cur. 8: 329.1836.

(Fig. 12)

Suffrutescent, low shrub with straggling branches, 0.5 - 1.5 m tall. Stems and branches terete, thinly strigose. Leaves simple, obliquely ascending, appressed to stem, subcoriaceous; stipule 5 - 11 x 1.5 - 2.5 mm, lanceolate, slightly oblique; petiole 3 - 4 mm long; lamina 3.5 - 5.5 x 2.5 - 3.2 cm, elliptic - lanceolate, base rounded, apex obtuse, mucronate, sparsely strigose on both surfaces. Racemes lateral, leaf opposed, 8 - 15 cm long, 2 - 8 flowered. Flowers 2 cm long and 2.2 cm across, large and showy; bracts 5 x 2 mm, ovate; bracteoles 1 - 2 x 0.5 - 1 mm, lanceolate, inserted little below the middle of the pedicel, densely pubescent; pedicel 1.2 - 1.5 cm long, appressed pubescent. Calyx sparsely strigose, green with purple veins and margins; calyx tube 5 mm long; lobes 1.5 x 0.5 cm, ovate - lanceolate, foliaceous. Corolla yellow, well exerted; standard petal 2.5 x 2 cm, obovate, apex slightly retuse, yellow with deep purple veins, densely pubescent along the mid-vein on the back; wing petals 1.8 x 1 cm, broadly oblong, yellow without purple striations; keel petals 1.6 x 1.3 cm, angular at the base, pale yellow with purple veins, inner and outer margins hirsute, beak twisted to 180°. Staminal tube 5 mm long, glabrous; filaments 9 mm and 8 mm long alternately with ovoid (0.5 mm) and oblong (3 mm) anthers respectively. Ovary 5 x 3 mm, sessile, silky pubescent laterally and densely strigose along the inner margin; style 1.5 cm long, not geniculate, hairy along the inner



Fig. 12. *C. multiflora* (Arn.) Benth.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeccium; I. Pod; J. Seed (From Sibichen & Nampy 711).

24

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margin; stigma spherical and hairy. Pod 3.5 - 4.2 x 1.5 - 1.7 cm, ellipsoid, much inflated, brown thinly sericeous, 6 - 8 seeded. Seeds 4 mm diam., obliquely cordate, dark brown, smooth with a prominent aril.

Distribution and ecology: Rudd (1991) described *C. multiflora* as apparently endemic to Sri Lanka. However, I have collected this species from a few localities in southern Kerala. It usually grows among grasses at mountain slopes of medium elevations *ca.* 800 m.

Notes: *C. multiflora* and *C. kurisumalayanum* are closely allied. But, *C. multiflora* is a semi erect low shrub with straggling branches and variable leaves of sub coriaceous texture while *C. kurisumalayanum* is a prostrate shrubby herb with wiry stem and consistently orbicular, glabrous leaves of chartaceous texture. Similarly, the calyx is puberulous and pods are small in the latter while the calyx is thinly strigose and pods are large in the former.

Specimens examined: KERALA: Idukki Dt.: Elaveezhaponchira, *Sibichen* & *Joby* 711, Moolamattom, *Sibichen* 760, *Sibichen* & *Joby* 759 (SJC).

13. *C. prostrata* Rottl. ex Willd., Enum. Hort. Berol. 747. 1809; DC., Prodr. 130.1825 (repr. 1989); Wight & Arn., Prodr. 1: 189. 1834 (repr. ed. 1976); Matthew, Fl. Tamilnadu Carnatic 1: 361. 1981; Mani. & Sivar., Fl. Calicut 78. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Saldan., Fl. Karanataka 1: 439. 1984; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 139. 1988; Ramach. & Nair, Fl. Cannanore 133. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 204. 1991; Sanjappa, Leg. India 127. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 142. 1994; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 261. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 187. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 162. 2002.

Type: India, *Rottler* (Willd. Herb.)

C. prostrata Roxb., Hort. Beng. 54. 1814, *nom. nud.*

C. prostrata Roxb. ex Don, Prod. Fl. Nepal. 241. 1825; Benth. In: Hook., Lond. J. Bot. 2: 475. 1843; Thw., Enum. Plant. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 67. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 9. 1894; Gamble, Fl. Pres. Madras 1: 282. 1918 (repr. ed. 1995).

Vernacular name: Serigally gista (Tel.), Vishnukarni (Ori.).

(Fig. 13, Pl. 3 D)

Erect, annual herb, up to 50 cm tall. Stems and branches terete, silky sericeous. Leaves simple, estipulate, subsessile; lamina 1.2 - 3.5 x 0.5 - 1.2 cm, elliptic - lanceolate to oblong, asymmetric, obliquely rounded at the base; apex obtuse - subacute, chartaceous, sparsely appressed sericeous above and densely beneath. Racemes terminal become leaf opposed, 4 - 6 cm long, 2 - 4 flowered, arranged laxly on peduncle. Flower 6 mm long and 3 mm across; bracts 1 - 2 mm long, minute, subulate; bracteoles 1.5 mm long, lanceolate, inserted on calyx at the cleft; pedicel 1.5 - 2 mm long, sericeous. Calyx bilipped, gray sericeous; calyx tube 1.5 mm long; lobes subequal, upper two lobes 4 x 1 mm, lanceolate, connate $\frac{1}{2}$ their length at the base; lower three lobes 3.5 x 0.5 mm, narrow, acuminate. Corolla yellow, hardly exerted; standard petal 4 x 2 mm, broadly oblong, apex deeply emarginate, glabrous; wing petals 3 x 1 mm, oblong, apex obtuse; keel petals 4 x 1 mm, ovate, curved at the middle, beak twisted to 180°. Staminal sheath 1 mm long; filaments 1 mm and 2 mm long alternately with oblong (0.5 mm) and ovoid (0.1 mm) anthers respectively. Ovary 1.5 mm long, sessile, glabrous; style 2 mm long, geniculate, sparsely puberulous along the margins; stigma capitate. Pods 2 x 0.5 cm, sessile, oblong, glabrous, exceeding the calyx, 15 - 20 seeded. Seeds 1.5 mm diam., obliquely cordiform, brownish black.

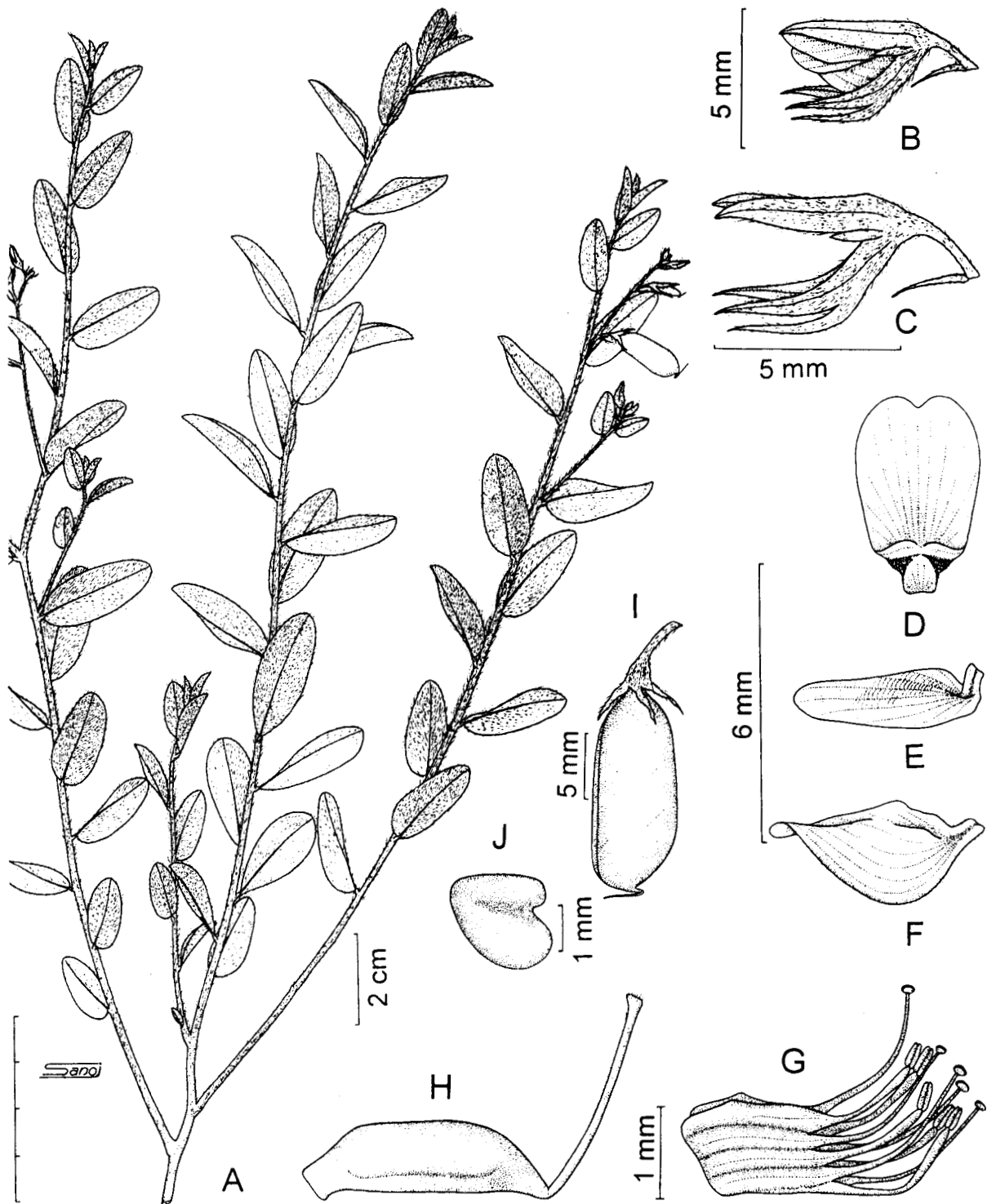


Fig. 13. *C. prostrata* Rottl. ex Willd.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen & Nampy 726).

Distribution and ecology: *C. prostrata* is distributed in India, Indonesia, Malesia, Myanmar, Nepal, Pakistan and Sri Lanka (Rudd, 1991). It is fairly common both in Western and Eastern Ghats. It grows as an undergrowth in moist deciduous forests and also occurs in open waste lands and waysides up to an altitude of 750 m. It flowers and fruits from October to March.

Notes: At higher elevations *C. prostrata* is seen in association with *C. umbellata*. The leaves clasp to stem during evening.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Talakona R.F., *Subba Rao* 46966 (CAL). Kurnool Dt.: Nallamalais, *Ellis* 32406 (CAL); Rudrakad, *Sunitha* 20196 (SKU). Medak Dt.: Madikonakutta, *Sebastine* 6731 (CAL). Nizamabad Dt.: Annaram R.F., *Raviprasad Rao & Raju* 7167 (SKU). Prakasam Dt.: Rollapenta, *Mohanan* 863 (CAL), *Vijayakumar* 18320 (SKU). Sambalpur Dt.: Badrama Ushakothi R.F., *Sri Ramamurthy* 16086 (SKU). GOA: North Goa.: Goa University Campus, *Sibichen & Nampy* 716 (SJC). KERALA : Kannur Dt.: Baveli R.F., *Ramachandran* 65384, *Ansari* 70043 (CAL). Kasaragod Dt.: *s.l.*, *Ansari* 74415 (CAL). Kollam Dt.: *Chandrabose* 49052 (CAL). Kozhikode Dt.: Chelavoor, IISR Campus, *Sibichen* 745 (SJC). Malappuram Dt.: Narukara, *Nisha Mary Mathew* 1163, *Sreepriya* 12 (SJC). TAMIL NADU: Madurai Dt.: Combai, *Sebastine* 12927 (CAL). Nilgiri Dt.: Gudalloor, Needle point, *Sibichen & Nampy* 726 (CAL). Ramanathapuram Dt.: Mudalairuthu, *Nair* 60946; Sethur Hills, *Srinivasan* 68075 (CAL). South Arcot Dt.: Cuddallore, *Venugopal* 21449 (CAL). Tinnavelly Dt.: Kalakkadu R.F., *Joseph* 15161; Naterikal, *Hooper & Ramaswami* 38389 (CAL).

14. *C. triquetra* Dalz. In: Hook., Lond. J. Bot. Kew Gard. Misc. 2: 34. 1850; Baker In: Hook. f., Fl. Brit. India 2: 71. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 12. 1894; Cooke, Fl. Pres. Bombay 1: 314. 1902 (repr. ed. 1958); Rama Rao, Fl. Plants Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 286. 1918 (repr. ed. 1995); Malathi

In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Saldan., Fl. Karnataka 1: 442. 1984; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 201. 1991; Sanjappa, Leg. India 131. 1992; Sasi. & Sivar., Fl. Thrissur 135. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 265. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 180. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: India, Maharashtra, *Dalzell & Gibson s.n.* (K).

(Fig. 14)

Suffrutescent annual herb with several decumbent or trailing branches from the base, 40 - 75 cm tall. Stems and branches slender, acutely tetragonous, glabrous – sparsely strigose. Leaves simple, subsessile; stipules 2 - 4 x 1 - 2.5 mm, ovate - acute, foliaceous, reflexed, ciliate along the margins; petiole less than 2 mm long; lamina 3 - 4.5 x 1 - 2 cm, lanceolate - oblong, base subcordate, margin ciliate, apex obtuse, glabrous except mid - vein underneath, chartaceous. Racemes 9 - 12 cm long, leaf opposed, lax, 2 or 3 flowered. Flowers 1.2 cm long and 0.4 cm across; bracts 2 x 1.5 cm long, lanceolate; bracteoles minute, setaceous, inserted on the base of the calyx tube; pedicel 3 mm long. Calyx bilipped, sparsely sericeous out and glabrous in; calyx tube 1.5 mm long; upper two lobes 4 x 1.5 mm, triangular, acuminate, connate 1/3 their length; lower three 3 x 1 mm, narrow acuminate. Corolla pale yellow without striations; standard petal 1.2 x 0.8 cm, ovate, with a tuft of hairs at the distal end; wing petals 8 x 3 mm, oblong; keel petals 10 x 3 mm, more or less white, ovate, inner margin hirsute, angular at the base, beak twisted to 90°. Staminal sheath 2.5 mm long, filaments 8 mm and 4 mm long alternately with ovoid (0.5 mm) and oblong (2 mm) anthers respectively. Ovary 5 x 1.5 mm, subsessile, silky pubescent; style 8.5 mm long, geniculate; stigma slightly expanded, hairy. Pods 1.5 - 2 x 0.6 - 0.8 cm,

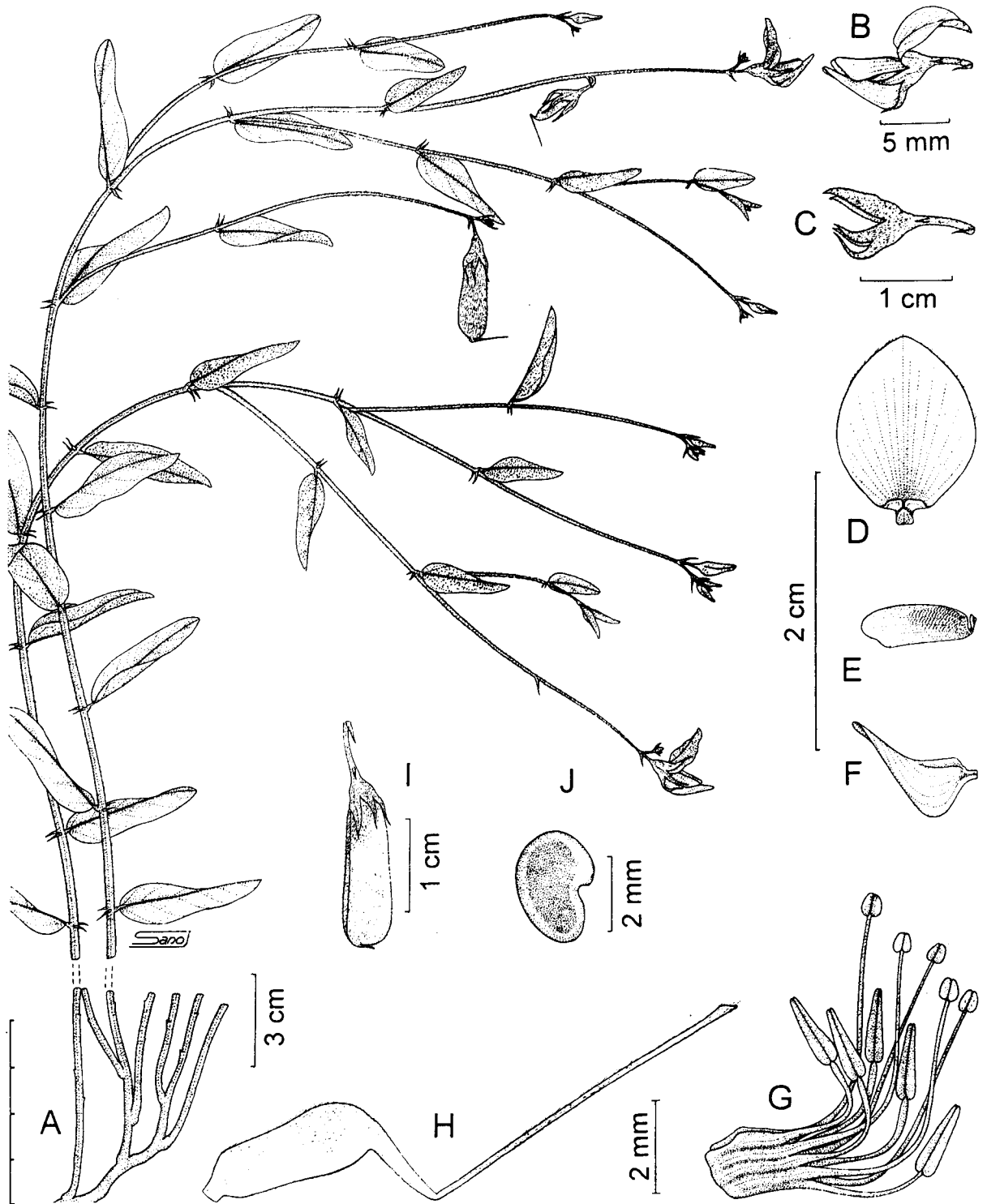


Fig. 14. *C. triquetra* Dalz.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen & Nampy 721).

oblong, appressed silky tomentose, 15 – 20 seeded; stalk 1 mm long. Seeds 2 x 1.5 mm diam., obliquely cordate, smooth, brown.

Distribution and ecology: *C. triquetra* is known only from India and Sri Lanka (Sanjappa, 1992). It occurs in grasslands or on lateritic slopes up to an altitude of 1000 m. It flowers and fruits from December to March.

Notes: *C. triquetra* is a slender suffruticose herb with pale yellow flowers, closely resembling *C. clarkei*. But it can be easily separated from the latter in having glabrescent stem and small silky tomentose pod against the diffuse sericeous stem and large ferruginous hirsute pod of *C. clarkei*. Dalzell (1850) treated *C. triquetra* under the sect. Diffusae. However, later authors like Baker (1876) and Anasri (2002) placed it under the sect. Calycinae, while Gamble (1918) placed it under the sect. Eriocarpae. My detailed study lead me to the conclusion that *C. triquetra* fits best under the sect. Diffusae owing to its diffuse habit, leaf opposed lateral racemes and appressed hairy pod.

Specimens examined: GOA: Murgoa, *Talbot* 2595 (CAL). North Goa: Goa University Campus, *Rajkumar* 429 (GU), *Sibichen & Nampy* 721 (SJC). KARNATAKA: North Kanara Dt.: s.l., *Jupa* 2135; s. l., *Talbot* 2595 (CAL). Shimoga Dt.: Theerthahalli, *Sibichen & Joby* 5208 (SJC). KERALA: Idukki Dt.: Way to Periyar, *Pandurangan* 78037 (CAL, MH). Palakkad Dt.: Shola below Poochipara, *Nair & Bhargavan* 69510 (CAL, MH). TAMIL NADU: Nilgiris Dt.: Gudalloor, *Gamble* 15437 (CAL).

15. *C. kurisumalayanum* Sibi *sp. nov.*

(Fig. 15)

Suffruticose, prostrate, short lived perennial low shrub with a few branches, reaching 15 - 50 cm long. Stems and branches terete, thinly puberulous. Leaves simple, subsessile; petiole 1 - 2 mm long; lamina 2.2 - 2.5

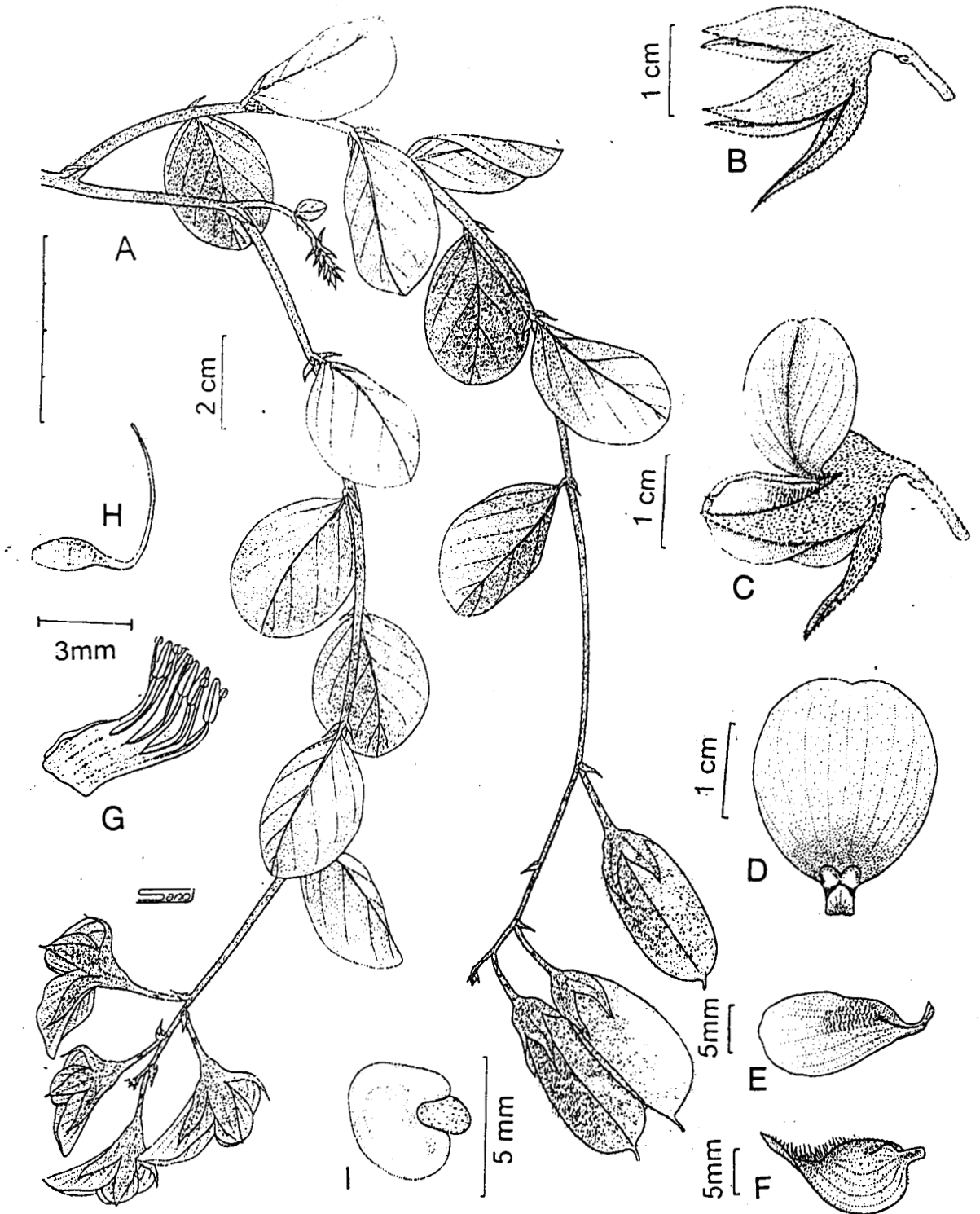


Fig. 15. *C. kurisumalayanum* sp. nova: A. Habit; B. Calyx; C. Flower; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Seed (from Sibichen & Nampy 671).

x 2 - 2.2 cm, orbicular or slightly ovate, base and apex rounded, glabrous above and thinly puberulous beneath. Racemes leaf opposed at age, 2 - 4 flowered. Flower 2.2 cm long and 2.5 cm across, showy. Bracts 4 x 2 mm, ovate, ascending; bracteoles 2 x 1 mm, subulate, inserted on midpedicel. Calyx 5 lobed; tube 5 mm long; lobes 15 x 7 mm, lanceolate, puberulous out and glabrous in, purple streaks along the margin. corolla yellow without purple striations; standard petal 2.5 x 2 cm orbicular to obovate with two basal appendages at the base, apex slightly retuse; wing petals 2 x 1 cm, obovate, base attenuate, apex rounded; keel petals 1.7 x 8 mm, rounded about the middle, hirsute along the inner margin, beak twisted to 180°. Staminal sheath 5 mm long, glabrous, filaments 9 mm and 6 mm long with ovoid (3 mm long) and oblong (1 mm long) anthers respectively. Ovary 6 mm x 3 mm, thinly puberulous, style 1.2 cm long, stigma not expanded. Pods 3.5 x 0.8 cm, ovoid, much inflated, thinly sericeous 10 - 12 seeded. Seeds 4 x 3 mm obliquely cordate, arillate.

Distribution and ecology: It is endemic to South India and occurs in lateritic slopes above 700 m. The suffrutescent perennial roots are tuberous. It flowers from January and fruits in March.

Notes: *C. kurisumalayanum* is closely allied to *C. multiflora* and *C. bifaria* in having large showy flowers and much inflated ovoid pod. But it differs from *C. multiflora* in having prostrate branches with orbicular to slightly ovate leaves; lanceolate sepals and keel petals with hirsute inner margin unlike straggling branches with elliptic to lanceolate, obliquely ascending leaves; ovate sepals and keel petals hirsute along both margins as in *C. multiflora*. It also differs from *C. bifaria* in its thinly sericeous pods, subulate bracts and 2 - 8 flowered racemes against sparsely puberulous pods, deltate bracts and 1 or 2 flowered racemes as in *C. bifaria*.

Specimens examined: KERALA: Idukki Dt.: Elappara – Kattappana way side, *Sibichen & Nampy* 671 (SJC). Kottayam Dt.: Vagamon, Kurisumala, *Antony* 923 (MH), *Abdul Jabbar* 43921 (TBGRI).

Sect. **Glaucæ** Benth. In: Hook., Lond. J. Bot. 2: 479. 1843; Baker In: Hook. f., Fl. Brit. India 1: 74. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 283. 1918 (repr. ed. 1995); Ansari In: Rao (ed.), Adv. Leg. Res. 164. 2002.

Type species: *C. glauca* Willd.

Erect herbs or shrubby herbs with ascending branches; tender stems and branchlets sulcate or obscurely angled, whole plant glabrescent. Leaves narrow, linear - lanceolate - elliptic; stipules absent. Racemes terminal, lax, many flowered. Bracts deltate, acuminate. Pod oblong, glabrous, stalked, many seeded.

Notes: Sect. *Glaucæ* was established by Bentham (1843) and he included 3 species viz., *C. genistifolia*, *C. glauca* and *C. peduncularis*. Among these species, the first two belong to tropical Africa while, the latter is a native of South India. In the mean time, Dalzell (1850) described another species *C. lutescens* from South India. Subsequently, Baker (1876) included it under the sect. *Glaucæ* along with *C. peduncularis*.

Bisby and Polhill (1973) treated *Glaucæ* as a subsection of sect. *Chrysocalycinae* and they designated *C. glauca* as the type. Moreover, this sub section has been further divided in to 5 groups. *C. glauca* Willd. belongs to the 3rd group characterized by unifoliolate leaves. Sub sect. *Glaucæ* (Benth.) Bisby & Polhill (*l.c.*) should not be treated as a synonym of sect. *Glaucæ* Benth. in the present context because, it is a heterogeneous assemblage with 1 - 3 - 7 foliolate leaves. Sect. *Glaucæ* is the smallest section of the tribe *Crotalariaeae* in South India, represented by two species viz.

C. lutescens and *C. peduncularis*. They are glabrescent herbs with more or less grassy leaves. Nayar and Sastry (1987, 1988) described them as rare and endemic.

Key to the Species

- 1a. Herbs with a few axillary branches; leaves narrow linear, grassy, apex acuminate; bract deltate *2.C. peduncularis*
- 1b. Shrubby herbs with many axillary branches; leaves lanceolate to elliptic, apex obtuse or retuse; bract ovate *1.C. lutescens*

1. ***C. lutescens*** Dalz. In: Hook., J. Bot. Kew Gard. Misc. 2: 34. 1850; Baker In: Hook. f., Fl. Brit. Ind. 1: 74. 1876 (repr. ed. 1879); Cooke, Fl. Pres. Bombay 1: 318. 1902 (repr. ed. 1958); Gamble, Fl. Pres. Madras 1: 283. 1918 (repr. ed. 1995); Saldan., Fl. Karnataka 1: 436. 1984; Sanjappa, Leg. India. 123. 1992; Nayar & Sastry (eds.), Red Data Book. 2: 113. 1988.

Type: India, Maharashtra, *Dalzell s.n.* (holotype: K)

(Fig. 16)

Erect, annual shrubby herb with many ascending branches, 0.5 - 1.25 m high. Stems and branches terete at the base and obscurely angled or sulcate towards the apex, glabrescent. Leaves simple; stipules absent; petiole 1 mm long, puberulous; lamina variable, one form reaching 10 - 12 x 1.6 - 3 cm, narrow, lanceolate, apex acuminate or apiculate and in another form lamina reaching 4 - 7 x 2 - 4 cm, elliptic, apex retuse or obtuse, chartaceous, glabrous above and glabrescent beneath. Racemes terminal 15 - 30 cm long, lax, 6 - 10 flowered. Flowers 2.3 cm long and 1 cm across; bracts 2.5 x 1 mm, ovate, acuminate; pedicel 1.3 cm, glabrous; bracteoles 1 mm long, ovate, inserted alternately on the pedicel near the calyx. Calyx bilipped; upper two lobes 12 x

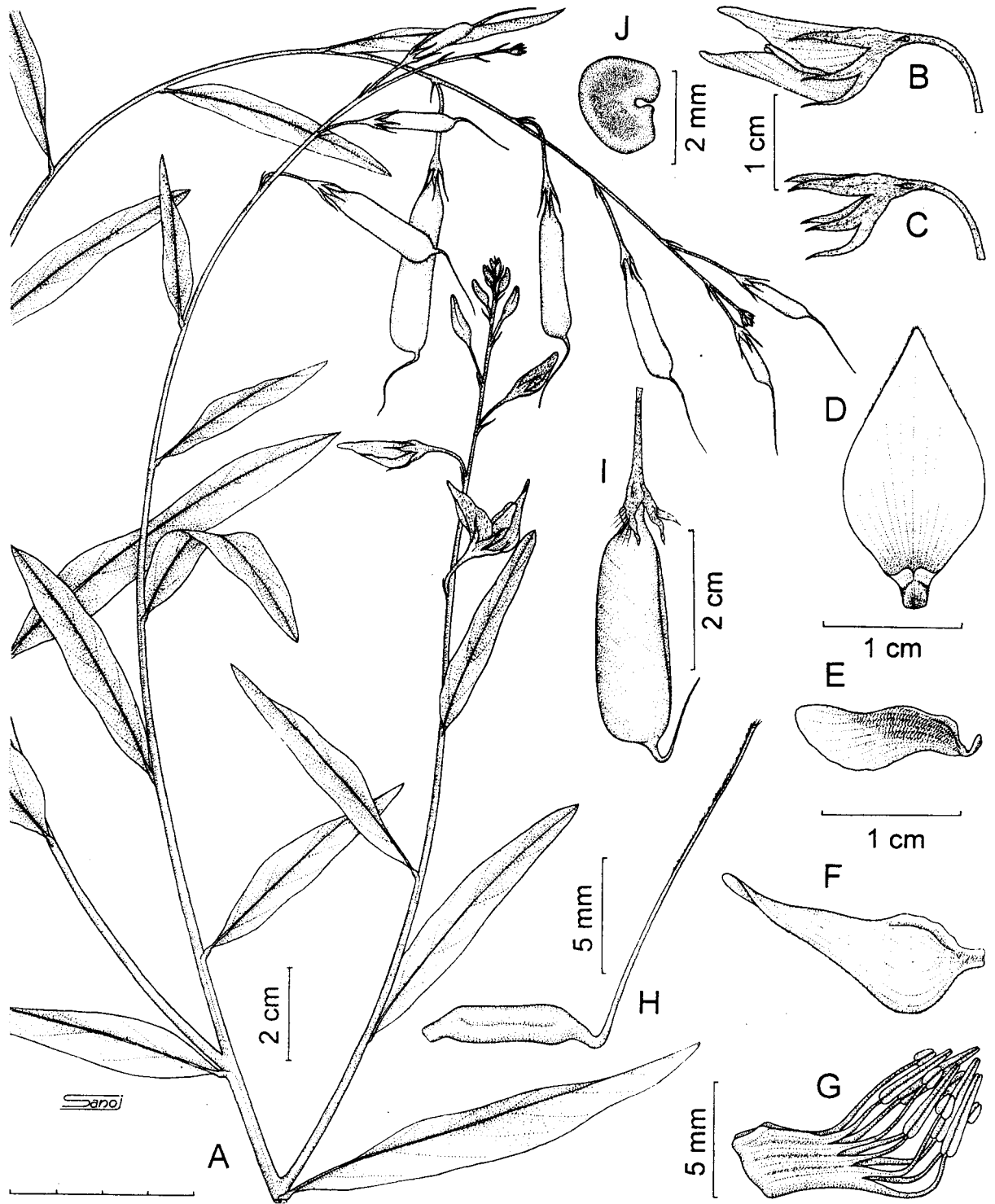


Fig. 16. *C. lutescens* Dalz.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Nampy 719).

2 mm, narrow acuminate; lower three lobes 8 x 2 mm, subulate. Corolla yellow with reddish brown striations; standard petal 2.3 x 1.6 cm, ovate, apex silky pubescent; wing petals 1.5 x 0.7 cm, ovate with a basal claw; keel petals 2 x 0.8 cm, ovate, rounded at the base, ciliate along the inner margin, beak twisted to 180°. Staminal sheath 3 mm long, glabrous; filaments 12 mm and 8 mm long alternately with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 6 mm, sessile; style 1.3 cm, exceeding the anther, hairy towards apex; stigma slightly expanded, hairy. Pods 3.8 x 0.8 cm, oblong, glabrous, 30 - 32 seeded. Seeds 3 mm diam., obliquely cordiform.

Distribution and ecology: *C. lutescens* is rare and endemic to India. It is distributed in North and South Kanara and Karwar in Karnataka, Malwan in Maharashtra (Nayar & Sastry, 1988) and Panjim in Goa. It is occasional in coastal plains and low hills among grasses. The species flowers and fruits from August to January.

Notes: Cooke (1902) described two forms of *C. lutescens* based on leaf morphology: one having linear leaves and other having elliptic lanceolate leaves. We also have collected specimens of similar nature from Goa University Campus, but in other respects they are hardly separable. *C. lutescens* is poorly represented in South Indian herbaria.

Specimens examined: GOA: North Goa, Panjim, Goa University Campus, *Sibichen & Nampy* 719 (SJC); Mapusa, *Janardhanam & Rajkumar* 899 (GU).

2. *C. peduncularis* Grah. ex Wight & Arn., Prodr. 1: 186. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 480. 1843; Baker In: Hook. f., Fl. Brit. India. 2: 74. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 283. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Nayar & Sastry (eds.), Red Data Book. 1: 153. 1987; Sanjappa, Leg. India 127. 1992.

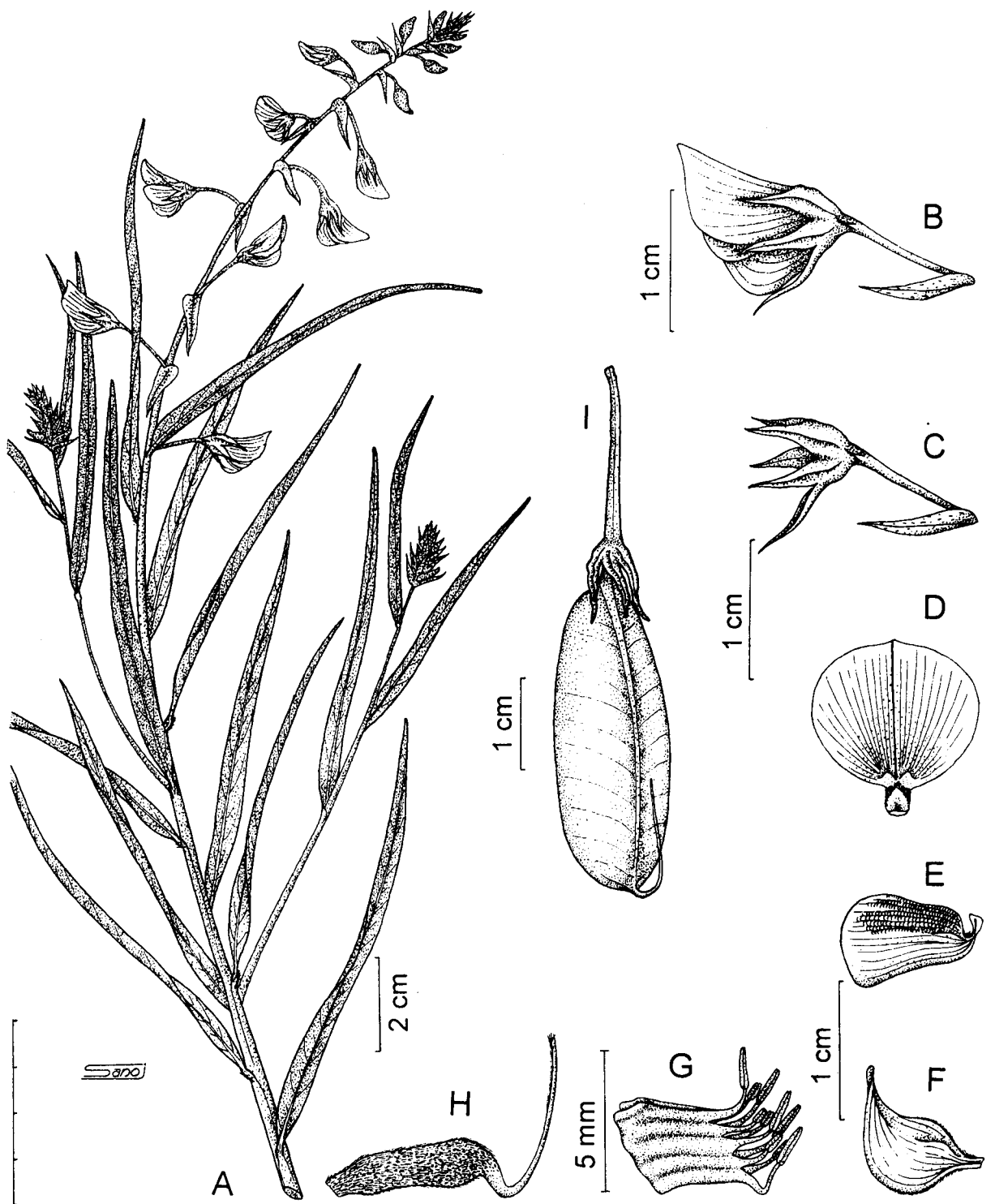


Fig. 17. *C. peduncularis* Garh. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod, (From Sibichen & Nampy 643).

Type: Indian Peninsula, *Wall.* Cat. no. 5369 (K)

C. elegans Bedd., *Madr. J. Litt. Sci.* 19: 178. 1858.

(Fig. 17, Pl. 3 B)

Erect annual herb with a few axillary branches, 0.4 - 0.6 m tall. Tender stems and branches sulcate, glabrescent. Leaves simple; stipule absent; petiole 1 mm long; lamina 4.5 - 7.5 x 0.5 - 0.6 cm, narrow - linear, grassy, base obtuse, apex acuminate, chartaceous, glabrescent. Racemes 6 - 15 cm long, terminal, lax, 6 - 12 flowered. Flower 1.5 cm long and 1 cm across; bracts 10 x 5 mm, deltate, adnate to the peduncle when young; pedicel 1.3 cm long, glabrous; bracteoles minute, subulate, inserted on pedicel close to calyx. Calyx glabrous; upper two lobes 6 x 2 mm, acuminate; lower three 5 x 1 mm linear. Corolla yellow with purple striations; standard petal 1.5 x 1.4 cm, orbicular with two small appendages at the base; wing petals 10 x 5 mm, obovate with purple striations and few characteristic spots at the distal end; keel petals 10 x 8 mm, ovate, rounded about the middle, inner and outer margins hairy at the base, beak twisted to 90°. Staminal sheath 2 mm long, glabrous; filaments 3 mm and 2 mm long alternately with oblong (1.5 mm long) and ovoid (0.5 mm long) anthers respectively. Ovary 7 x 1.5 mm, white pubescent, sessile; style 6 mm long, hairy along the inner margin; stigma narrow, hairy. Pods 3.5 x 1.2 cm, glabrous when mature; stalk 1.5 mm long, not exceeding the calyx tube, 12 - 16 seeded. Seeds 1.5 mm diam., obliquely cordiform.

Distribution and ecology: *C. peduncularis* is rare and endemic to South India (Nayar & Sastry, 1987). The plant occurs in grasslands on exposed hill slopes up to 1500 m. It flowers and fruits from October to December.

Notes: Wight and Arnott (1834) placed this species under the sect. *Erectae* and left a note along with the description that they had seen only a single specimen of *C. peduncularis* that too was very imperfect. Further, they



Plate 3. A. *C. pulchra*; B. *C. peduncularis*; C. *C. alata*; D. *C. prostrata*; E. *C. walkeri*; F. *C. obtecta*.

commented that the species is very distinct from all other species they had studied and not liable to be confused with any other species. Later authors like Bentham (1843), Baker (1876), Gamble (1918) and Ansari (2002) treated this taxon under sect. Glaucae. Our studies also justifies the position of this species under Glaucae.

Specimens examined: KERALA: Idukki Dt.: Idukki - Moolamattom road side, *Sibichen* 765 (SJC). TAMIL NADU: Coimbatore Dt.: Anamalais, *Beddome s.n.* (MH). Nilgiri Dt.: Gudalloor, Needle point, *Sibichen & Nampy* 643 (SJC); Nilgiris, *Beddome s.n.* (MH). Periyar Dt.: Karalappara, *Jomy* 14550 (CALI).

Sect. *Eriocarpae* Wight & Arn., Prodr. 1: 185. 1834 (repr.ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 559. 1843; Baker In: Hook. f., Fl. Brit. India 1: 83. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 286.1918 (repr. ed. 1995); Polhill, Kew Bull. 22. 301.1968 p.p., *Crotalaria* in Africa and Madagascar 248. 1982 p.p; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type species: *C. juncea* L. (Lectotype designated by Polhill, 1968).

Sect. *Fluvae* Wight & Arn., Prodr. 1: 182. 1834.

Sect. *Bractealae* Wight & Arn., Prodr. 1: 183. 1834.

Erect, annual herbs or perennial shrubs with ascending branches. Leaves simple, narrow, linear - oblanceolate or ovate - obovate, more or less hairy on both surfaces particularly when young; stipules small and linear to large and semilunar, or wanting, not decurrent. Flowers in terminal racemes or in panicles. Bracts and bracteoles vary in size and shape, sometimes viscid. Calyx scarcely as long as the corolla, rusty tomentose, margins flat. Pods oblong or ovoid, brown pubescent, exserted or included.

Notes: Sect. *Eriocarpae* was established by Wight and Arnott (1834). Bentham (1843) adopted this section after emending the circumscription and placed it under the series 'Simplicifoliae'. He has included 23 species in this section by merging the closely allied sections of Wight and Arnott (*l.c*) viz., *Fulvae* and *Bracteatae*. However, he subdivided this section into four categories based on the type of inflorescence and indumentum pattern of legumes. Baker (1876) adopted this section and included 14 species under two subdivisions viz., 'flowers racemed' and 'flowers panicled'. Gamble (1918) also followed the same concept and enumerated 21 species from South India. Ansari (2002) created two subsections viz., *Racemae* and *Paniculatae* under *Eriocarpae* and recognized 19 species. But the subsectional name *Racemae* is incorrect as it is contrary to Art. 11.6 of ICBN (Greuter *et al.*, 1993). In the present work we have included 12 species from South India under two subsections viz. *Eriocarpae* and *Paniculatae*. Species like *C. clarkei*, previously treated under this section by earlier authors has been transferred to section *Diffusae*. Similarly, species such as *C. shevaroyensis* and *C. madurensis* are reduced to the synonyms of *C. candicans* while *C. pulcherrima* and *C. lanata* are reduced to *C. pulchra* and *C. beddomeana* respectively

Key to the Subsections

- 1a. Flowers racemed *Eriocarpae*
 1b. Flowers panicled *Paniculatae*

Subsect. *Eriocarpae*

Subsect. Racemae Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Sect. Fulvae Wight & Arn., Prodr. 1: 182 . 1834 (repr. ed. 1976) p.p.

Key to the Species

- 1a. Stipules large, semi lunar, transverse 2
- 1b. Stipules small, linear - subulate, not transverse 5
- 2a. Corolla pale violet to white; branchlets angular 3
- 2b. Corolla yellow with reddish brown striations;
branchlets not angular 4
- 3a. Leaves rhomboid, margin undulate; 10 - 15 seeds
per pod; annual shrubby herb *5.C. verrucosa*
- 3b. Leaves ovate - elliptic, margin entire; 6 - 8 seeds per
pod; perennial shrubs *1.C. heyneana*
- 4a. Branches straggling; leaves coriaceous with
prominent nervules beneath; standard petal silky
pubescent out *4.C. semperflorens*
- 4b. Branches erect; leaves chartaceous without
prominent nervules beneath; standard petal glabrous
out *6.C. walkeri*
- 5a. Stem sulcate; pods white silky tomentose; style
geniculate; beak of the keel petal twisted to 180°
..... *2.C. juncea*
- 5b. Stem terete; pods dark brown velvety; style not
geniculate; beak of the keel twisted to
360° *3.C. obtecta*

1. C. heyneana Grah. ex Wight & Arn., Prodr. 1: 187. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 78. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 106. 1914; Gamble, Fl. Pres. Madras 1: 287. 1918 (repr. ed. 1995); Saldan. & Nicolson, Fl. Hassan 242.1976; Malathi In: Nair

& Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Saldan., Fl. Karnataka 1: 434. 1984; Ramach. & Nair, Fl. Cannanore 131. 1988; Vajrav., Fl. Palghat 150. 1990; Sanjappa, Leg. India 121. 1992; Sasi. & Sivar., Fl. Thrissur 134. 1996; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: *Wight* Cat. no. 701 (K).

(Fig. 18, Pl. 4 A)

Erect, suffruticose perennial shrubs with many ascending branches, 1 - 2.5 m high. Stems and branches terete, angular at tender portions, slightly puberulous. Leaves simple; stipules 2 x 1 mm, semi - lunar, transverse; petioles 5 mm long, pubescent; lamina 5.5 - 12 x 3 - 5.7 cm, ovate - elliptic, glabrous above and puberulous beneath, base cuneate, apex acuminate. Racemes 8 - 15 cm long, terminal but become leaf opposed at maturity, subax, 10 - 20 flowered. Flowers 1.7 cm long and 1cm across; bracts 3 mm long, subulate; bracteoles 1 mm long, inserted near the middle of the pedicel; pedicel 4 - 7 mm long, pubescent. Calyx 5 cleft, pubescent; tube 3 mm long; lobes 10 x 3 mm, more or less equal, acuminate. Corolla pale violet - white; standard petal 1.6 - 2 x 1 - 1.3 cm, obovate, pale violet with deep purple striations, glabrous except along the mid - vein on the back; wing petals obovate, 1.3 x 0.7 cm, violet; keel petals 1.8 x 0.8 cm, rounded about the middle, inner and outer margins hairy, beak twisted to 90⁰. Staminal sheath 6 mm long, glabrous; filaments 6 mm and 3 mm long alternately with ovoid (1 mm long) and oblong (3 mm long) anthers respectively. Ovary 7 x 1.5 mm, pubescent; stipe 1 mm long; style 1.1 cm long, not geniculate, exceeding the anthers, hairy along the margin; stigma slightly expanded, hairy. Pods 3 x 1 cm, oblong, thinly strigose, 6 - 8 seeded; stalk 3 mm long. Seeds 5 x 4 mm, obliquely cordate, dark brown, smooth.

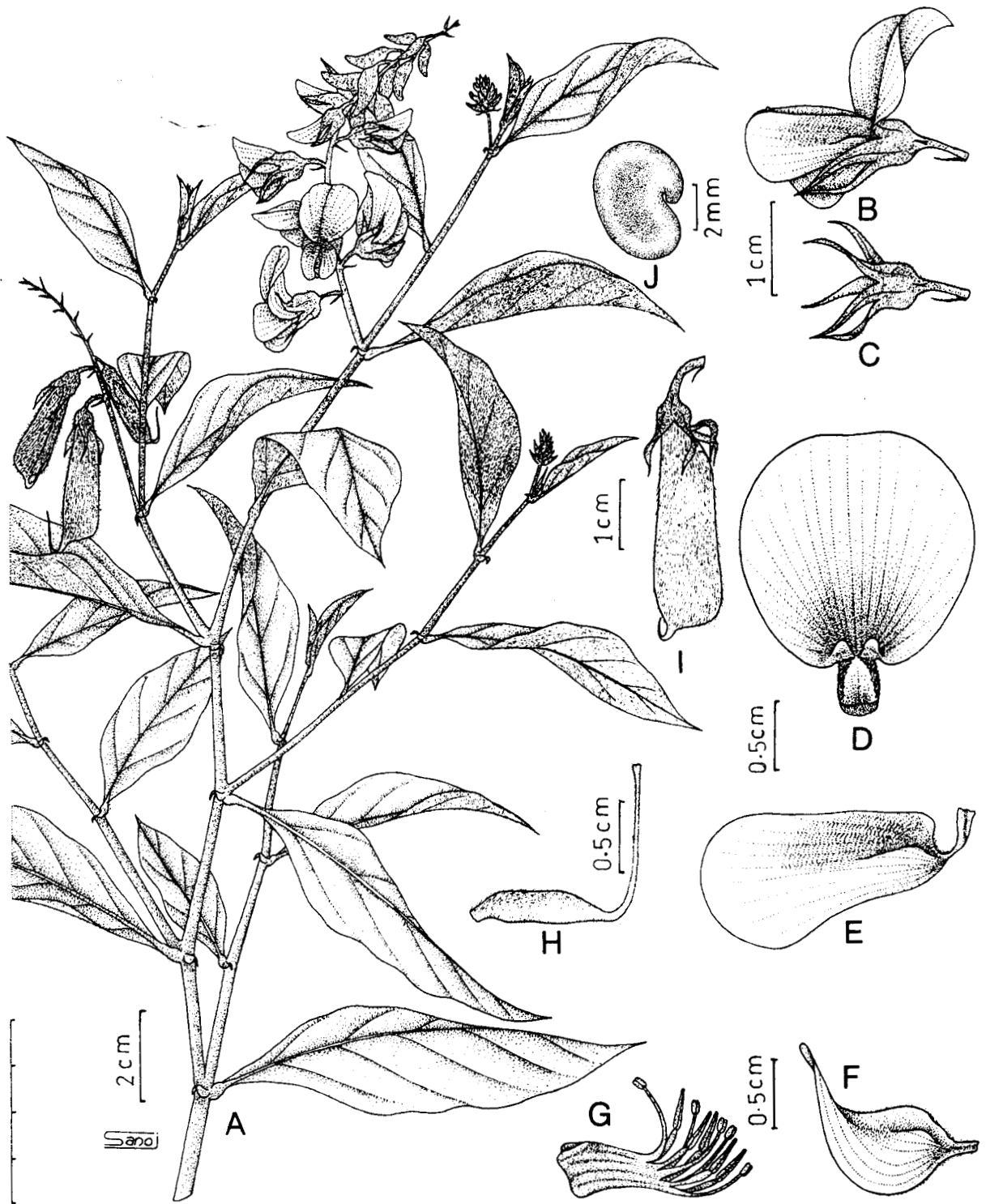


Fig. 18. *C. heyneana* Grah. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen & Joby* 757).

Distribution and ecology: *C. heyneana* is endemic to South India (Sanjappa, 1992). It grows commonly in moist, deciduous and evergreen forests up to 800 m. It flowers and fruits from October to January.

Notes: Among the various species of this genus, *C. verrucosa* and *C. heyneana* have pale violet to white flowers while others have yellow flowers. However, Cooke (1902) reported pale yellow flowers in *C. heyneana*. The specimens I collected from plains and hills invariably have pale violet corolla with deep purple striations. However, the specimens collected from Wayanad and the seedlings raised in St. Joseph's College, Botanic garden differs slightly from the typical in having copious axillary branches with short internodes and sessile pods.

Specimens examined: KARNATAKA: Mysore Dt.: Masanahalli, *Meebold* 8531; Someswar, *Sundara Raghavan* 83228 (CAL). North Canara Dt.: s.l., *Talbot* 3509 (CAL). South Canara Dt.: Jattukattumalai, *Srinivasan* 72332; Ujire, *Saldanha* 4123 (CAL). KERALA: Idukki Dt.: Munnar, *Deb* 30774 (MH); Peerumedu, *Meebold* 12897 (CAL). Kannur Dt.: Kannothe R.F., *Ramachandran* 54008 (CAL, MH), *Parappa, Ansari* 70080 (MH); Payyannur, *Ansari* 69940 (CAL, MH); Tolpetty, *Ramachandran* 52345 (MH). Kollam Dt.: Plappalli to Muzhiyar, *Ramachandran* 74675 (CAL). Kozhikkode Dt.: Kodencherry, *Sibichen & Peter* 622 (SJC). Malappuram Dt.: Nedunkayam, *Mathew* 32274 (CALI), *Sibichen & Joby* 757 (SJC); Poolakkapara, *Ellis* 33577 (CAL, MH). Palakkad Dt.: Cherunelly, *Sibichen & Joby* 752 (SJC), *Vajravelu* 48734; Karivara, *Joseph* 51409; Mukkali Slopes, *Bhargavan* 65741; Panthenthode, *Vajravelu* 33156 (CAL); Silent Valley, *Sabu* 10875 (CALI). Thrissur Dt.: Vazhani, *Sasidharan* 3325 (CALI). Wayanad Dt.: Wayanad pass, *Sibichen* 623 (SJC). TAMIL NADU: Coimbatore Dt.: Koochimalai, *Sree Madhavan* 876; Mount Stouert, *Joseph* 13397; Shiruvani,

Subramanyam 1548, *Joseph* 11738 (MH). Nilgiri Dt.: Naduvattom, *Balakrishnan* 9698 (MH).

2. **C. juncea** L., Sp. Pl. 714. 1753; Burm., Fl. Indica 155. 1768 (repr. ed. 1984); DC., Prodr. 2: 125. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 185. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 562. 1843; Thw., Enum. Pl. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 79. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 16. 1894; Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Polhill In: Gillet, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 2: 950. 1971; Niyomdham, Thai For. Bull. 11. 135. 1978; Mani. & Sivar., Fl. Calicut 77. 1982; Polhill, *Crotalaria* in Africa and Madagascar 372. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 363. 1983; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Saldan., Fl. Karnataka 1: 435. 1984; Chandrabose & Nair, Fl. Coimbatore 89. 1987; Matthew, Illus. Fl. Tamilnadu Carnatic 4: t. 127. 1988; Ramach. & Nair, Fl. Cannanore 131. 1988; Vajrav., Fl. Palghat 150. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 194. 1991; Sanjappa, Leg. India 123. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 140. 1994; Matthew, Illus. Fl. Palni Hills t. 163. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 257. 1997; Matthew, Fl. Palni Hills 1: 301. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 172. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: Herb. Linn. No. 895. 11 (LINN).

C. benghalensis Lam., Encycl. 2: 196. 1786.

C. tenuifolia Roxb. ex DC., Prodr. 2: 126. 1825.

-Tandale-cotti Rheede, Hort. Malab. 9. p. 47. t. 26. 1689.

Vernacular names: Chanom (Mal.); Janupu (Tam.); Shanama (Tel.); Sanabu (Kan.); Sunn hemp (Eng.); Sunn (Hin.).

(Fig. 19, Pl. 5 D)

Erect, annual herb with a few ascending branches, 0.5 - 2 m tall; stems and branches sulcate, silky pubescent. Leaves simple; stipule 1 - 2 mm long, subulate, setaceous, caducous; petioles 4 - 5 mm long, pulvinate, densely pubescent; lamina 7 - 12 x 1.8 - 3 cm, oblong to narrow elliptic, base cuneate, apex acute, sparsely silky pubescent above and densely beneath, subcoriaceous. Racemes 20 - 30 cm long, terminal and often leaf opposed, lax, 8 - 10 flowered. Flowers 3 cm long and 2 cm across; bracts 3 x 2 mm, ovate - acuminate, silky sericeous out and glabrous in; bracteoles 1.5 mm long, minute, subulate, setaceous, inserted on calyx tube; pedicel 8 - 10 mm long, pubescent. Calyx deeply 5 cleft, slightly bilipped, tube 4 mm long, silky tomentose, lobes 15 x 4 mm, more or less equal, upper two straight, acuminate, lower three falcate. Corolla bright yellow without purple striations; standard petal 2.5 x 2.2 cm, ovate, sparsely silky on the back; wing petals 2 x 0.8 cm, obovate with a basal claw; keel petals 2 x 1 cm, ovate, angular at the base, beak twisted to 180°. Staminal sheath 2 - 3 mm long, glabrous; filaments 1.4 cm and 1 cm long alternately with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 7 x 2 mm, subsessile, silky tomentose; style 1.5 cm long, geniculate, hairy on the inner margin; stigma expanded, hairy. Pods 3 - 3.5 x 0.8 - 1 cm, sessile, straight, oblong, narrow towards base, silky tomentose, 10 - 15 seeded. Seeds 5 x 3 mm, obliquely cordiform, dark brown, smooth.

Distribution and ecology: *C. juncea* is a native of India, widely cultivated as green manure and fibre crop and readily naturalized. Now it is common throughout the tropics such as tropical Africa, Australia, Burma, Malesia, Sri

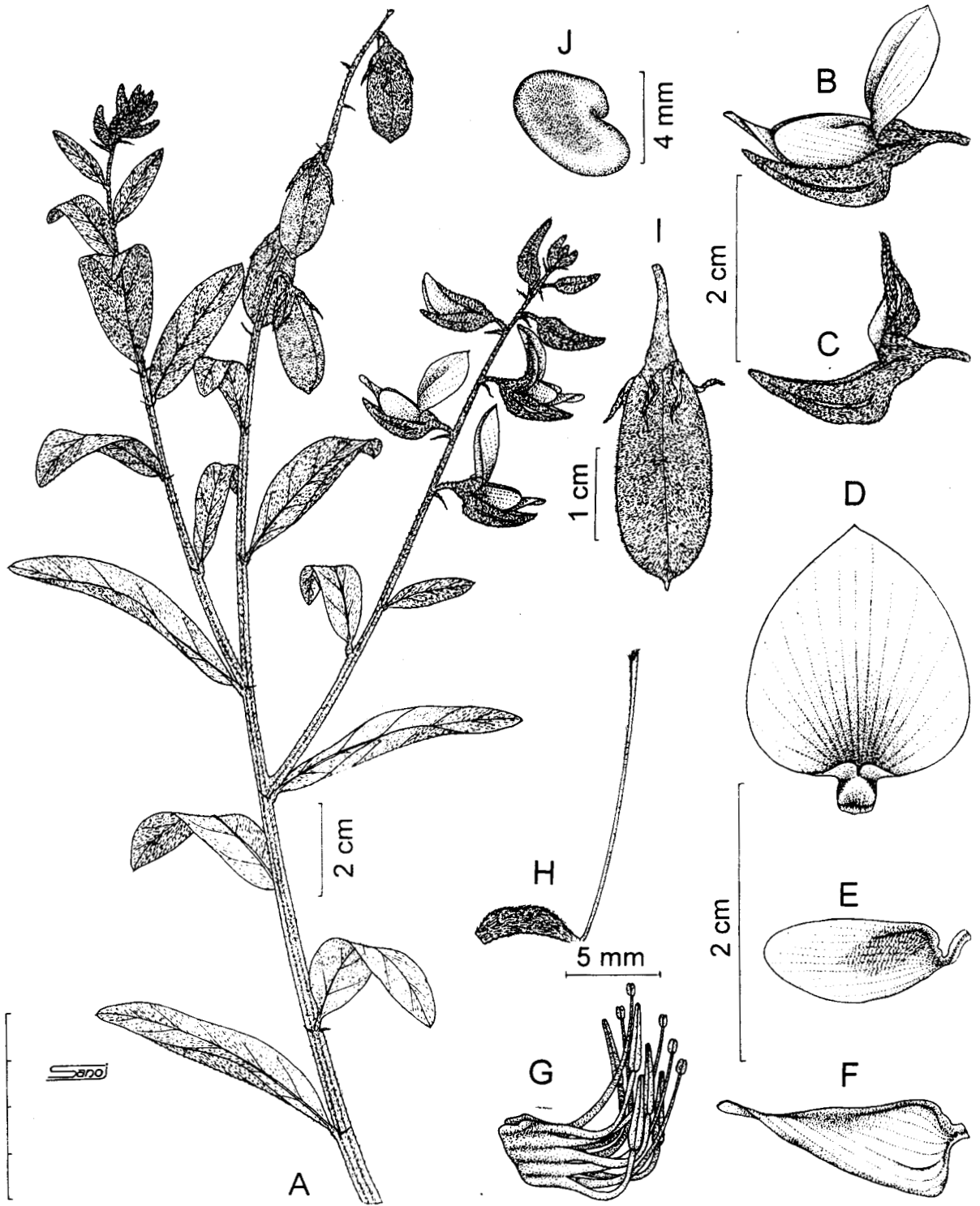


Fig. 19. *C. juncea* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Joby 701).

Lanka and USSR (Sanjappa, 1992). It occurs in plains and often cultivated in moist places. It flowers and fruits from September to May.

Notes: Nitrogen fixing ability and other economic aspects of *C. juncea* attracted the attention of scientists of various disciplines. Various aspects of this species such as root nodulation, karyotype, B-chromosomes, Nitrogen fixing ability, fibre yield etc., have been extensively studied. Specimens collected from various localities show considerable variations in quantitative features like size of the plant, pod, and indumentum pattern.

Uses: This is one of the most economically important species under the genus *Crotalaria*. The plant is extensively cultivated for its fibre. Sunn hemp is essentially a cordage fibre and is used in the manufacture of ropes, twines, and sail clothes. Being resistant to deterioration in water, it is used for making fishing nets and marine cordage (Sambamurthy & Subramanyam, 1989). It is an excellent green manure as it produces plenty of root nodules and fertilizing the soil with Nitrogen and humus. The seed proteins yield adhesives, which is used in plywood industry. Leaves are abortif, given as an antifertile agent. Seeds are used to purify blood and to cure scabies and impetigo (Agarwal, 1997).

Specimens examined: ANDHRA PRADESH: Gundur Dt.: Nidadevade, *Raju* 293 (CAL). Srikakulam Dt.: Salur, *Balakrishnan* 1022 (CAL). KERALA: Kannur Dt.: Tolpetty, *Ramachandran* 52264 (CAL, MH). Kasaragod Dt.: Nileswar, *Ansari* 74318 (CAL). Palakkad Dt.: Mukkali, *Bhargavan* 65722 (CAL). Thrissur Dt.: Thrissur town limit, *Sibichen* 680 (SJC). TAMIL NADU: Coimbatore Dt.: Muthumalai, *Viswanathan* 430 (MH); way to Shiruvani, *Subramanyam* 1410 (CAL, MH); Thekkumalai, *Sebastine* 1725 (MH); TNAU Campus, *Chandrabose* 29007 (CAL); *Sibichen & Joby* 701 (SJC). Ramnadu Dt.: Cumbummedu, *Vajravelu* 33747 (MH). Nilgiri Dt.: Mudanadu R.F., *Vajravelu* 39600; Singara R.F., *Rathakrishnan* 38976 (MH).

Periyar Dt.: Near Dhambam village, *Vajravelu* 82222 (CAL). South Arcot Dt.: Vandipalayam, *Narayanaswami* 5066 (MH). Thanjavoor Dt.: Orathanadu, *Ragupathy* 978 (CAL).

3. *C. obtecta* Grah. ex Wight & Arn., Prodr. 1: 185. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 563. 1843; Wight, Ic. t. 383. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 79. 1876 (repr. ed. 1879); Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 150. 1932; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Sanjappa, Leg. India 125. 1992; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: *Wight* Cat. no. 685 (K).

C. glabrescens Benth. In: Hook., Lond. J. Bot. 2: 563. 1843.

C. obtecta var. *glabrescens* (Benth.) Baker In: Hook. f., Fl. Brit. India 2: 79. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 297. 1918 (repr. ed. 1995); Mohanan & Henry, Fl. Thiruvananthapuram 141. 1994.

(Fig. 20, Pl. 3 F)

Suffruticose, short lived perennial shrub with straggling branches, 0.5 - 2.5 m tall; stems and branches terete, slightly sulcate at distal ends, rusty tomentose. Leaves simple; stipules 2 x 1 mm, subulate, setaceous; petiole 3 - 4 mm long, tomentose; lamina 3.5 - 12 cm x 2 - 5.5 cm, elliptic - lanceolate or oblong; base obtuse; apex obtuse - acute, sparsely strigose above and densely beneath, subcoriaceous. Racemes 10 - 15 cm long, terminal and lateral, lax, 5 - 8 flowered. Flowers 2 cm long and 1.5 cm across; bracts 3 x 1 mm, ovate, puberulous out and glabrous in; bracteoles 2 mm long, subulate, inserted on mid pedicel, setaceous. Calyx deeply 5 cleft, brown velvety, upper two (1.6 x 0.4 cm) smaller than the lower three (2 x 0.4 cm), falcate, connate at the apex. Corolla much exserted, yellow with purple striations; standard petal 2.2 x 2.3

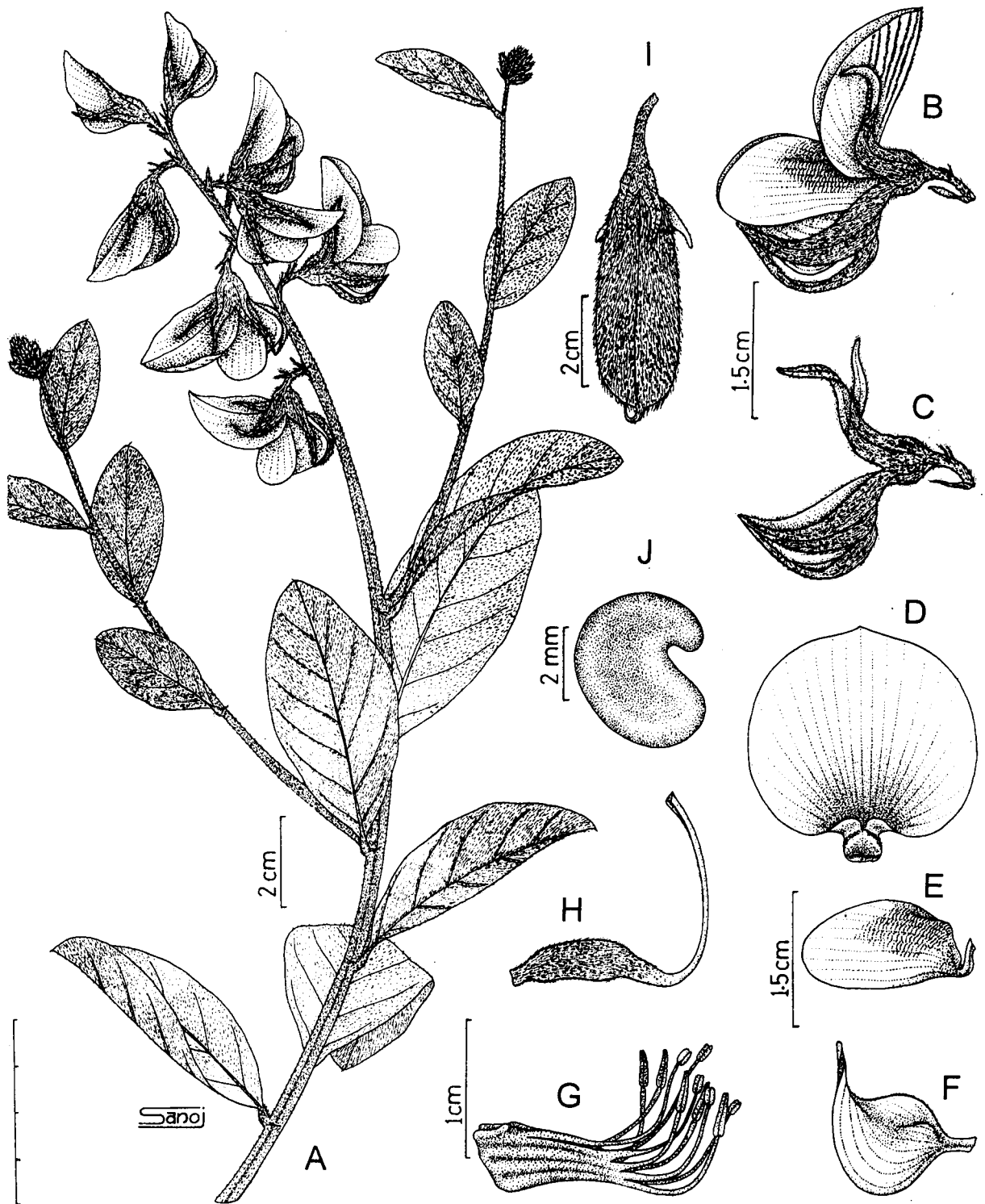


Fig. 20. *C. obtecta* Grah. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen 677).

cm, orbicular with deep purple striations, veins pubescent on the back; wing petals 1.8 x 1 cm, ovate, exceeding the keel; keel petals 1.8 x 1 cm, outer margin white and inner margin hairy, ovate, rounded about the middle, beak twisted to 360°. Staminal sheath 8 mm long, filaments 8 mm and 6 mm long alternately with ovoid (1 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 1 x 0.3 cm, silky tomentose; stipe 1 mm long; style 1.5 cm long, curved, not geniculate; stigma slightly expanded, pubescent. Pods 4.4 – 5.5 x 1.4 - 1.6 cm, sessile, oblong, broadens upwards, dark brown, velvety, 12 - 16 seeded. Seeds 4 mm diam., obliquely cordate, laterally compressed, dark brown, smooth.

Distribution and ecology: *C. oblecta* is endemic to South India (Sanjappa, 1992), and is known only from the Western Ghats of Kerala and Tamil Nadu. It is common along waysides and exposed hilltops above 1500 m. The plant produces flowers and pods from October to March.

Notes: *C. oblecta* is an attractive ornamental shrub with large racemes of yellow flowers artistically painted with deep purple striations and dark green foliage.

Specimens examined: KERALA: Idukki Dt.: Devikolam, *Sebastine* 18500 (MH); *Sibichen & Joby* 771 (SJC); *Shetty* 26591 (CAL); Kumarikulam, *Jomy* 12779 (CALI); Munnar town, *Sibichen* 677, *Sibichen & Nampy* 615, *Sibichen & Joby* 678 (SJC); Pachhakkanam, *Jomy* 12665 (CALI). Kozhikkode Dt.: Vellarimala, *Pradeep* 5496 (CALI). Palakkad Dt.: Bhimanadi, *Bhargavan* 87349; Silent valley, Walakkad, *Sabu* 11417 (CALI). Thiruvananthapuram Dt.: Agastyamala, Pongalappara, *Mohanan* 9412 (CALI); Agastyarkoodam, *Mohanan* 66034 (CAL); Poonkulam, *Mohanan* 66034 (MH). TAMIL NADU: Coimbatore Dt.: Akkamalai, *Ansari* 1164 (CAL); Vellingiri Hilltop, *Karthikeyan* 31817 (MH). Nilgiri Dt.: Conoor, *Deb* 31722 (CAL, MH); Dodaikombai, *Shetty* 37699 (MH); Edappalli, *Sebastine* 1001 (CAL, MH);

Kodanadu estate, *Vajravelu* 43637; Kunnakkombai shola, *Vajravelu* 43637 (MH); Murapalam, *Sebastine* 2092 (CAL).

4. **C. semperflorens** Vent., Descr. Nouv. Jard. Cels t. 17. 1800; Willd. Sp. Pl. 3: 978. 1802; DC., Prodr. 2: 125. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 187. 1834 (repr. ed. 1974); Thw., Enum. Plant. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 78. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 287. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 149 & 2: t. 114. 1932 (repr. ed. 1977); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 376. 1983; Sanjappa, Leg. India 129. 1992; Matthew, Illus. Fl. Palni Hills t. 168. 1996; Sasi. & Sivar., Fl. Thrissur 135. 1996; Matthew, Fl. Palni Hills 1: 306. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 195. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: *Wight*, Cat. no. 694 (K).

C. wallichiana Wight & Arn., Prodr. 1: 187. 1834; Wight, Ic. t. 982. 1845 (repr. ed. 1988).

C. arnottiana Benth. In: Hook., Lond. J. Bot. 2: 560. 1843.

(Fig. 21)

Erect, perennial shrub with many straggling branches, 1.5 - 3.5 m tall; stems and branches terete or slightly sulcate at tender portions, appressed, brown pubescent. Leaves simple; stipules 0.5 - 1 x 0.3 - 0.7 cm, foliaceous, semilunar, transverse; petioles 5 - 7 mm long, tomentose; lamina 4.5 - 8 x 3 - 5 cm, ovate to broadly elliptic, with prominent transverse nervules, coriaceous, base ovate, apex obtuse, upper puberulous and sparsely villous beneath. Racemes 10 - 20 cm long, terminal or leaf opposed, lax, 10 - 15 flowered. Flower 2 cm long and 1.2 cm across; bracts 6 - 7 mm long, subulate; bracteoles 2 mm long, subulate, inserted on pedicel close to calyx.

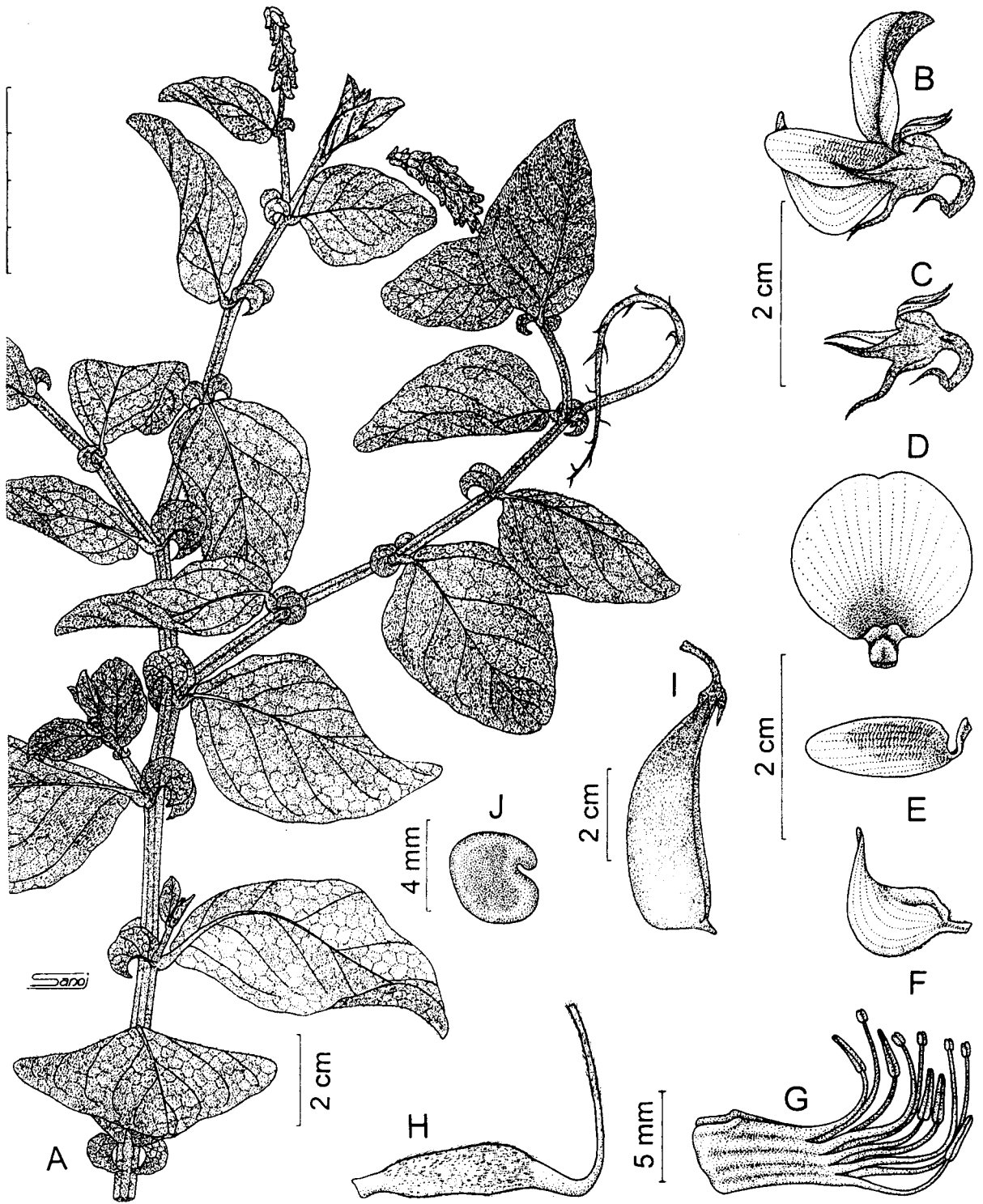


Fig. 21. *C. semperflorens* Vent.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Nampy 641).

Calyx 5 lobed, lobes 6 mm long, equal, triangular, acuminate, tube 5 mm long, puberulous out and glabrous in. Corolla twice as long as the calyx, yellow; standard petal 2 x 2 cm, orbicular with reddish pink striations, silky pubescent out and glabrous beneath; wing petals 1.5 x 0.6 cm, oblong, with pink striations. Keel petals 1.6 x 0.8 cm, ovate, rounded about the middle, beak twisted to 90° with a reddish tip. Staminal sheath 5 mm long, filaments 9 mm and 5 mm long with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 8 x 3 mm, white pubescent; stipe 1 mm long; style 1.2 cm long, curved, not geniculate; stigma simple, pubescent. Pods 4.5 x 1.2 cm, clavate, curved, rusty tomentose, 10 – 12 seeded; stalk 1 cm long, flat. Seed 4 mm diam., obliquely cordate, dark brown, smooth.

Distribution and ecology: *C. semperflorens* is a native of South India but introduced to Indonesia and Malesia (Matthew, 1983). It usually grows along borders of sholas and roadsides at an altitude of 1600 – 2400 m. The species flowers and fruits from December to March.

Notes: It is a conspicuous shrub with straggling branches. The large, semilunar stipules, ovate leaves with prominent transverse nervules, showy racemes and clavate pods can easily distinguish this species in the field.

Specimens examined: KERALA: Idukki Dt.: Peerumedu, *Pradeep* 634 (CAL). TAMILNADU: Nilgiri Dt.: Conoor, *Meebold* 11907; Kotagiri, *Subramanyam* 1053; Nilgiris, *Fischer* 2464 (CAL); Ooty - Kotagiri way side, *Sibichen & Nampy* 641 (SJC). Madurai Dt.: Bear Shola, *Sibichen & Nampy* 694; *Sajish Chacko* 24; Kodaikanal, *Suraj* 5 (SJC); Perumal Malai, *Chandrabose* 51664; Shembaganur, *Anonymous* 588; Tiger shola, *Ansari* 1093 (CAL).

5. *C. verrucosa* L., Sp. Pl. 715. 1753; Burm., Fl. Indica 158. 1768 (repr. ed. 1984); DC., Prodr. 2: 125. 1825 (repr. ed. 1989); Wight & Arn.,

Prodr. 1. 187. 1834 (repr. ed. 1976); Wight, Ic. t. 200. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 77. 1876 (repr. ed. 1879); Trimmen, Handb. Fl. Ceylon. 2: 15. 1894; Cooke, Fl. Bombay 1: 319. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 106. 1914; Gamble, Fl. Pres. Madras 1: 287. 1918 (repr. ed. 1995); Polhill In: Gillet, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 2: 959. 1971; Niyomdham, Thai For. Bull. 11. 163. 1978; Mani. & Sivar., Fl. Calicut 77. 1982; Polhill, *Crotalaria* in Africa and Madagascar 373.1982; Matthew, Fl. Tamilnadu Carnatic 3: 374. 1983; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Saldan., Fl. Karnataka 1: 429. 1984; Chandrabose & Nair, Fl. Coimbatore 89. 1987; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 146. 1988; Ramach. & Nair, Fl. Cannanore 134. 1988; Vajrav., Fl. Palghat 153. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 188. 1991; Sanjappa, Leg. India 131. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 143. 1994; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 265. 1997; Matthew, Fl. Palni Hills 1: 295. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 199. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: Herb. Herm. Vol. 3. fol. 4. Linn. no. 277 (BM).

-Pee-tandale-cotti Rheede, Hort. Malab. 9. p. 53. t. 29.1689.

Vernacular name: Pekankalakotti (Mal.); Salangai Chedi (Tam.); Gilli Gicha Tel.).

(Fig. 22, Pl. 4 B)

Erect, annual shrubby herb with profuse branches, 0.3 - 1.25 m tall; stems and branches tetragonous, puberulous. Leaves simple; stipules 0.5 - 2 x 0.2 - 1.5 cm, semi-lunar, transverse, mucronate; petioles 3 - 9 mm long, pubescent; lamina 4 - 9 x 3 - 6 cm, ovate - rhomboid, base attenuate, margin slightly undulate, apex obtuse, slightly mucronate, sparsely puberulous above

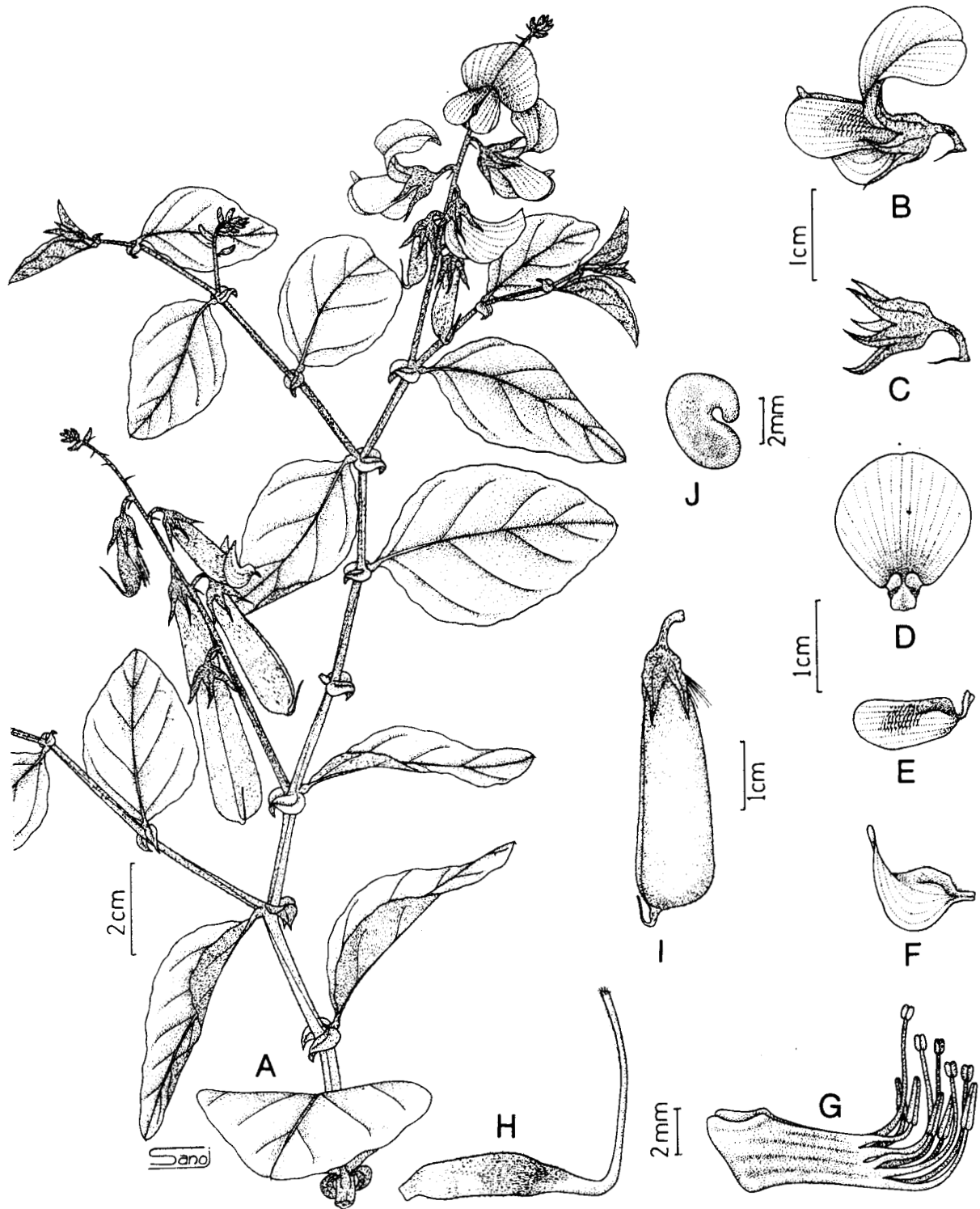


Fig. 22. *C. verrucosa* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeccium; I. Pod; J. Seed (From *Sibichen & Nampy* 634).

and pubescent beneath, chartaceous, veins prominent underneath. Racemes 10 - 20 cm long, terminal, subax, become leaf opposed at age, 5 - 20 flowered. Flower 2 cm long and 1 cm across; bracts 4 mm long, subulate, puberulous; bracteoles 2 mm long, acuminate, inserted alternately about mid pedicel; pedicels 4 - 6 mm long, pubescent. Calyx sinuses all at the same depth and lobes subequal pale green, pubescent out and glabrous in; tube 4 mm long, upper four shorter than the lower one. Corolla twice as long as calyx, pale violet to white; standard petal 2 x 1.8 cm, broadly ovate, glabrous, with two small appendages at the base; wing petals 1.5 x 0.8 cm, oblong, violet, with a basal claw; keel petals 1.8 x 0.8 cm, ovate, rounded at the middle, white; beak twisted to 90⁰, blue. Staminal sheath 4 - 5 mm long, glabrous; filaments 8 mm and 4 mm long alternately with ovoid (1 mm long) and oblong (3 mm long) anthers respectively. Ovary 7 x 2.5 mm, subsessile, silky tomentose; style 1 cm long, curved, not geniculate, hairy on the inner margin; stigma simple, hairy. Pods 3.5 - 3.8 x 0.8 - 1 cm, straight, oblong, narrow towards base, appressed puberulous, 10 - 15 seeded. Seeds 3 mm diam., obliquely cordiform, dark brown, smooth.

Distribution and ecology: *C. verrucosa* is a native of tropical Asia, widely cultivated as green manure and readily naturalized, now quite common as a weed throughout the tropics (Polhill, 1982). It grows from the coast to 600 m, particularly abundant along riverbanks and wastelands.

Notes: The flower colour seems to vary. Gamble (1918) described the flowers as blue or sometimes white, where as Cooke (1902) described as bluish - purple and white, rarely entirely white, while Ramachandran and Nair (1988) as yellow. The specimens collected by me invariably have pale violet to white flowers. Large, crescent shaped stipules and tetragonous stems are characteristic to *C. verrucosa*. The plant produces flowers and pods throughout the year.

Uses: Juice of the plant is used to treat scabies and impetigo, given internally and applied externally in swellings, found effective in reducing salivation. Extract is used as diuretic, contains tropane, an alkaloid, having some germicidal properties. Juice of leaves, with salt given as vermifuge and decoction of roots given to children for cough (Agarwal, 1997).

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Penulkonda R.F., *Yesoda* 1094 (MH). Chinglepet Dt.: Vedanthangal Birds Sanctuary, *Henry* 47009 (MH). Chittoor Dt.: Way to Kottacheruva, *Subba Rao* 45920; Thirupathy, *Rangacharyalu* 174 (MH). Kurnool Dt.: Modugamamisala, *Ellis* 4221; Nallamalais, *Ellis* 32405 (MH). GOA: Panajim, Donappal beach, *Sibichen & Nampy* 723 (SJC). KERALA: Kannur Dt.: Mangad, *Ansari* 69907 (MH); Payyannur, *Sibichen & Nampy* 620 (SJC); Thalasserry, *Ramachandran* 63996 (MH). Kozhikode Dt.: St. Joseph's College Botanic Garden, *Sibichen & Nampy* 634; Thikkody, *Sibichen & Joby* 705 (SJC). Palakkad Dt.: Dhony R.F., *Joseph* 17167 (MH). Pathanamthitta Dt.: Moozhiyar forest, *Chandrashekharan* 89308 (MH). Thiruvananthapuram Dt.: Kovalam, *Mohanan* 59411; Veli, *Mohanan* 63313 (MH). Thrissur Dt.: Koratti, *Ramamurthy* 80425 (MH); Kunnankulam, *Sibichen* 613 (SJC). TAMIL NADU: Coimbatore Dt.: Distillery Road, *Chandraboze* 28441; Maruthuamalai, *Sebastine* 128; Navamalai, *Joseph* 14178; Palamalai, *Viswanathan* 218 (MH). North Arkot Dt.: Way to Kampukudi, *Subramanyan* 7422 (MH). South Arkot Dt.: Chidambaram, *Ramamurthy* 53566 (MH).

6. **C. walkeri** Arn., Nov. Actorum Acad. Caes. Leop. Carol. Nat. Cur. 18: 328. 1840; Gamble, Fl. Pres. Madras 1: 287. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 150. 1932; Saldan. & Nicolson, Fl. Hassan 241. 1976; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Saldan., Fl. Karnataka 1: 443. 1984; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 195. 1991;

Sanjappa, Leg. India 131. 1992; Sasi. & Sivar., Fl. Thrissur 136. 1996; Matthew, Illus. Fl. Palni Hills t. 171. 1996; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: Ceylon, *Walker* 115 (isotype: K).

C. semperflorens Vent. var. *walkeri* (Arn.) Baker In: Hook. f., Fl. Brit. India 2: 78. 1876.

(Fig. 23, Pl. 3 E)

Erect, short lived perennial shrub with copious ascending branches, 0.5 - 2.5 m tall; stems and branches terete or slightly sulcate at tender portions, tomentose. Leaves simple; stipules 4 - 8 x 1.5 - 4 mm, foliaceous, semi-lunar, transverse; petioles 3 - 5 mm long, puberulous; lamina 4.5 - 12 x 2 - 5.5 cm, elliptic - lanceolate without prominent transverse nervules, chartaceous, base obtuse, apex acute, mucronate, upper glabrous and sparsely puberulous beneath. Racemes 10 - 15 cm long, terminal or leaf opposed, lax, 5 - 8 flowered. Flowers 1.8 cm long and 1 cm across; bracts 3 mm long, subulate; bracteoles 1 mm long, subulate, inserted on pedicel near the calyx. Calyx 5 lobed, lobes 4 mm long, equal, triangular, acuminate, tube 3 mm long, puberulous out and glabrous in. Corolla twice as much as the calyx, yellow with purple striations; standard petal 2.2 x 1.8 cm, orbicular with reddish pink striations, glabrous; wing petals 1.7 x 0.8 cm, oblong, exceeding the keel; keel petals 1.2 x 0.7 cm, ovate, rounded about the middle, beak twisted to 180°. Staminal sheath 7 mm long, filaments 10 mm and 5 mm long alternately with ovoid (0.5 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 6 x 1.5 mm, white pubescent; stipe 1 mm long; style 1.2 cm long, curved, not geniculate; stigma simple, pubescent. Pods 3.3 - 3.6 x 1.1 - 1.3 cm, clavate, straight, sparsely appressed pubescent, 8 - 10 seeded; stalk 1 cm long, flat. Seeds 4 mm diam., obliquely cordate, laterally compressed, dark brown, smooth.



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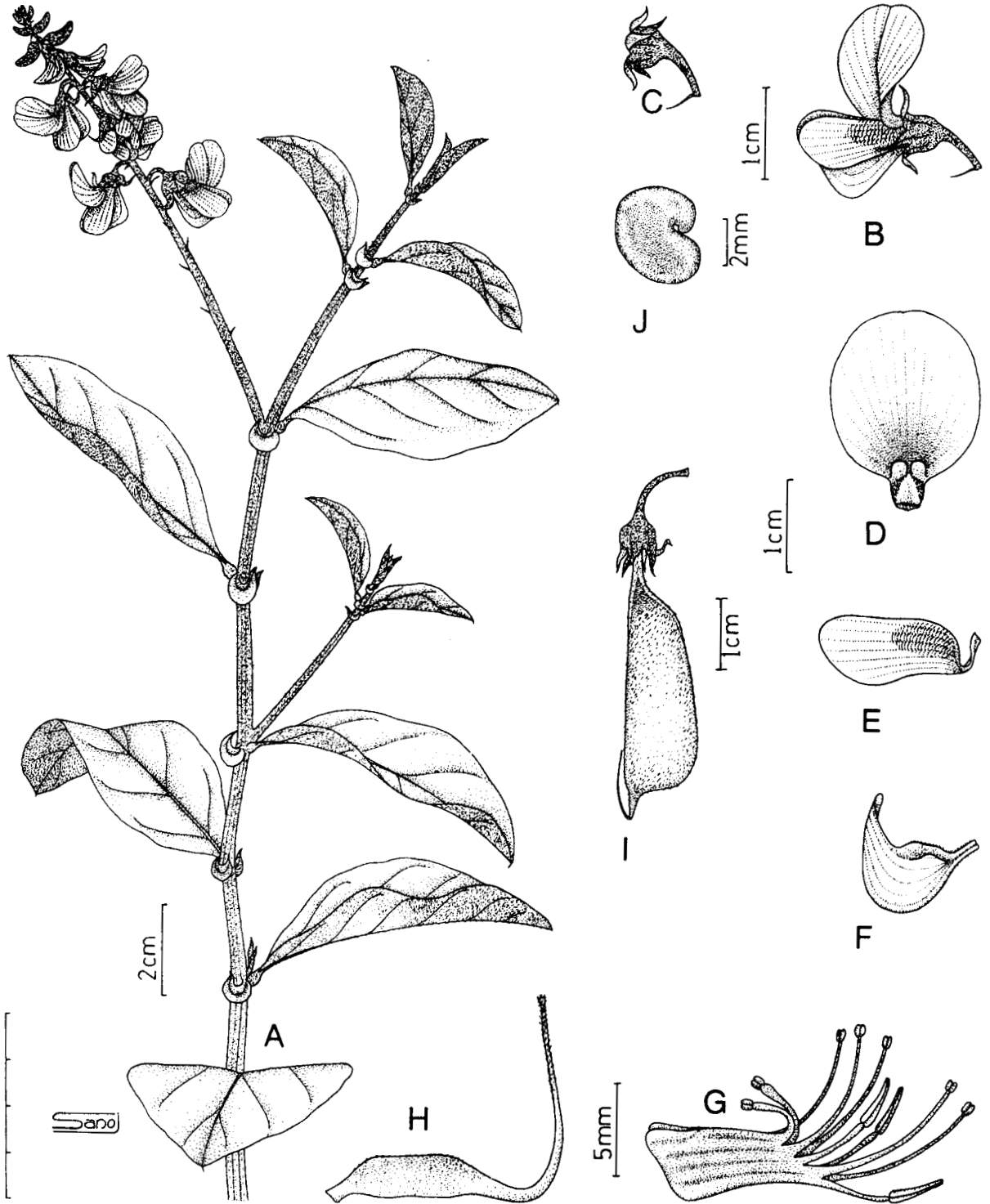


Fig. 23. *C. walkeri* Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynocodium; I. Pod; J. Seed (From *Sibichen & Smitha* 604).

Distribution and ecology: *C. walkeri* is distributed in South India and Sri Lanka. It is common along roadsides, below 1200 m. It produces flowers and fruits from June to December.

Notes: Baker (1876) treated *C. walkeri* as a variety of *C. semperflorens*. However, our critical studies based on live materials have shown that they are distinct. *C. walkeri* is an erect shrub with ascending branches and occurs below 1200 m while, *C. semperflorens* is a woody shrub with straggling branches and occurs above 1800 m. Further, *C. walkeri* can be distinguished by their elliptic – lanceolate, chartaceous leaves with mucronate apex; glabrescent vexillum and small, straight pod as against ovate, coriaceous and rugose leaves with obtuse apex; pubescent vexillum and large, curved pod of *C. semperflorens*.

Specimens examined: KARNATAKA: Shimoga Dt.: Near Theerthahalli, *Ramesh & Prakash* 5274 (CAL). KERALA: Idukki Dt.: Tholnada to Pooyamkutty, *Bhargavan* 87498 (MH); Udumpanchola, *Sibichen & Joby* 675 (SJC). Kollam Dt.: Moozhiyar, *Anilkumar* 332 (MH). Kottayam Dt.: Vellimukku - Vagamon road, *Sibichen & Nampy* 664 (SJC). Palakkad Dt.: Pothumalai, *Nair* 69631 (CAL, MH). Pathanamthitta Dt.: Pampa, *Vivekanandan* 48378 (CAL); Pampa Dam to Anathode, *Vivekanandan* 45286 (MH). Wayanad Dt.: Elephant Camp, *Ellis* 25727 (CAL); Kalpetta, *Sibichen & Smitha* 604 (SJC); Sulthan Battery, *Ellis* 18637 (MH). Thiruvananthapuram Dt.: Bonnaccord, *Shetty* 11932 (MH). TAMIL NADU: Kanyakumari Dt.: way to Muthukuzhivayal, *Henry* 68829 (MH); Nilgiri Dt.: Kottabettu, *Sebastine* 919 (CAL). Thirunelvely Dt.: Naterikal forest, *Vajravelu* 80649 (CAL).

Subsect. **Paniculatae** Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Sect. **Bracteatae** Wight & Arn., Prodr. 1: 183 . 1834 (repr. ed. 1976) p.p.

Key to the Species

- 1a. Pods large, well exerted 2.*C. candicans*
- 1b. Pods small, included or slightly exerted 2
- 2a. Lamina linear oblong, gray tomentose; branches
diffuse, sticky 6.*C. ramosissima*
- 2b. Lamina broadly ovate, golden tomentose; branches
ascending, not sticky 3
- 3a. Bracts and bracteoles ovate, foliaceous 4
- 3b. Bracts and bracteoles not as above 5
- 4a. Pods included, 2 seeded; bracts and bracteoles
ascending, not viscid 1. *C. berteriana*
- 4b. Pods slightly exerted, many (6 - 8) seeded;
bracts and bracteoles reflexed, viscid above 5.*C. pulchra*
- 5a. Stipules semi lunar; bracts and bracteoles cordate,
amplexicaul, not viscid 3.*C. lunulata*
- 6a. Stipules linear - subulate; bracts and bracteoles
copious, subulate, viscid 4.*C. paniculata*

1. *C. berteriana* DC., Prodr. 2: 127. 1825 (repr. ed.1989); Saldan. & Nicolson, 241.1976; Polhill, *Crotalaria* in Africa and Madagascar 374. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 380. 1983; Saldan., Fl. Karnataka 1: 431. 1984; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 197. 1991; Sanjappa, Leg. India 117. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 253. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 160. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: Guadelope (cultivated), Bertero (G-DC).

C. fulva Roxb., Fl. Ind. 3: 266. 1832; Wight & Arn., Prodr. 1: 183. 1834 (repr. ed. 1976); Benth. in Hook., Lond. J. Bot. 2: 563. 1843; Baker In: Hook. f., Fl. Brit. India 2: 80. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 301. 1902 (repr. ed. 1958); Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995).

Vernacular name: Kadugodavi (Kan.).

(Fig. 24)

Erect, short lived perennial with several ascending branches, 1 - 2 m tall. Stems and branches terete, sulcate towards tender portions, silky tomentose. Leaves simple, crowded, ascending; stipules absent; petioles 2 mm long, silky tomentose; lamina 5.5 - 7 x 2 - 2.7 cm, obovate, base cuneate, apex slightly mucronate, appressed silky tomentose on both surfaces, chartaceous. Racemes 3 - 8 cm long, paniced, on short terminal and axillary branches, 5 - 6 flowered. Flowers 2 cm long and 3 cm across; bracts 5 x 3 mm, ovate, ascending, not viscid, foliaceous, silky tomentose above and glabrous beneath; bracteoles 3.5 x 2 mm smaller than bracts, foliaceous, inserted on pedicel, appressed to calyx. Calyx bilipped, silky tomentose; tube 3 mm long; upper lobes 10 x 0.4 mm, oblong, appressed to corolla, enclosing 3/4th of corolla; lower three lobes 10 x 3 mm, falcate. Corolla slightly exceeding the calyx, yellow turns black when dry; standard petal 2.2 x 2.2 cm, broadly ovate, apex notched, tomentose out and glabrous in; wing petals 1.5 x 0.8 cm, oblong, glabrous; keel petals 1.7 x 0.7 cm, ovate - acuminate, rounded at the base; beak not twisted. Staminal sheath 1.2 x 0.8 cm, glabrous; filaments 10 mm and 5 mm long alternately with ovoid (1 mm long) and oblong anther (3 mm long) respectively. Ovary subsessile, silky pubescent; style 2 cm long, geniculate, hairy; stigma expanded, hairy. Pods 10 x 6 mm, oblong, sessile, included, silky tomentose, 2 seeded. Seeds 2 mm diam., obliquely cordiform, dark brown.

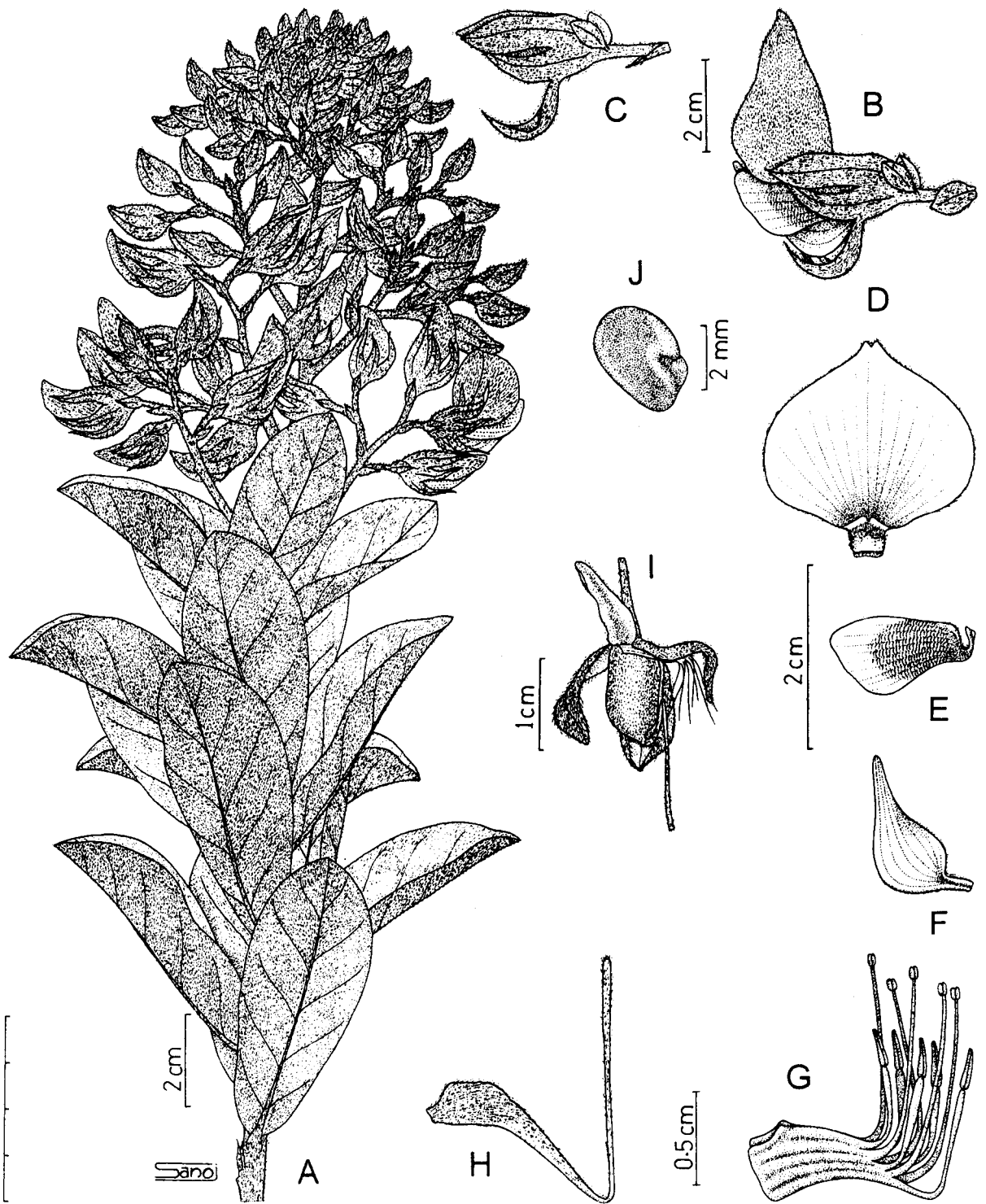


Fig. 24. *C. berteriana* DC.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From *Sibichen & Nampy* 650).

Distribution and ecology: *C. berteriana* is a native of Peninsular India and occurs as an undergrowth in moist deciduous forests, at an altitude of *ca.* 800 m. It is cultivated as a green manure in the plateau regions of Madagascar and became naturalized (Polhill, 1982). It flowers and fruits from December to May.

Notes: Wight and Arnott (1834) treated this species under the sect. Fulvae because of its fulvous (golden tomentose) habit. Later, Bentham (1843) placed this and other species of this section under Eriocarpae because of its hairy pods and paniculate inflorescence. The present taxonomic judgement is in favour of treating this species under section Eriocarpae subsect Paniculatae. *C. berteriana* is a beautiful shrub with golden silky hairs and yellow flowers in large panicle. It resembles *C. pulchra* in habit, indumentum and inflorescence but can be distinguished by its ascending, nonviscous bracts and included pods against the reflexed, viscous bract and exserted pods of *C. pulchra*.

Specimens examined: GOA: Nadquem, *John* 109063 (CAL). KARNATAKA: Bangalore Dt.: Nandi Hills, *Janakiammal* 7059 (MH). Mysore Dt.: Bandipur, Gopalaswami hill, *Naithani* 23216 (MH). KERALA: Wayanad Dt.: Muthanga forest, *Fischer* 4504 (CAL), *Sibichen, Joby & Dinesh Raj* 744 (SJC); Sultan Battery, *Ellis* 25770 (CAL). TAMIL NADU: Nilgiri Dt.: Gudallore Ghat, *Ansari* 1064 (CAL); Kariar Shola, *Shetty* 11989; Nadugani, *Vajravelu* 42848 (MH); Naduvattom, *Balakrishnan* 9696 (CAL, MH); Needle point, *Sibichen & Nampy* 650 (SJC).

2. ***C. candicans*** Wight & Arn., Prodr. 1: 184. 1834 (repr. ed. 1976); Trimen, Handb. Fl. Ceylon 2: 13. 1894 (excl. syn.); Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Sanjappa, Leg. India 118. 1992; Matthew, Kew Bull. 48: 759. 1993; Pullaiah & Chennaiah, Fl. Andhra

Pradesh 1: 254. 1997; Matthew, Fl. Palni Hills 1: 303. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 165. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: *Wight* Cat no. 661 (K).

C. madurensis Wight & Arn., Prodr. 1: 184. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 563. 1843; Baker In: Hook. f., Fl. Brit. 2: 71. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 144 & 2: t. 108. 1932 (repr. ed. 1977); Matthew, Fl. Tamilnadu Carnatic 3: 373. 1983 & Illus. Fl. Tamilnadu Carnaic 4: 130. 1988; Sanjappa, Leg. India 123. 1992.

Erect, perennial, woody shrub. Stems and branches fulvous. Leaves simple; stipules absent; lamina ovate, strongly nerved beneath, silky pubescent on both surfaces. Racemes in panicles. Bracts and bracteoles cordate, reflexed. Calyx bilipped, silky pubescent, margins revolute. ovary silky pubescent throughout. Pods oblong, pubescent and many seeded.

Distribution and ecology: *C. candicans* is endemic to South India. It is distributed in Andhra Pradesh and Tamil Nadu. It occurs along slopes and open forests up to 2000 m altitude. *C. candicans* is a pretty ornamental when in full bloom. It flowers from August to November and fruits from January to March.

Notes: Critical studies of the materials including types led us to the conclusion that *C. candicans* and *C. madurensis* are conspecific. This conclusion is in corroboration with Matthew (1993), Pullaiah and Chennaiah (1997) and Pullaiah & Ramamurthy (2000). In the mean time, Ellis and Swaminathan (1969) described a new variety viz. *C. madurensis* var. *kurnoolica* from Nallamalais in Kurnool District of Andhra Pradesh. This variety is distinct in having large bract, bracteoles and uniform sepals with

revolute margin. Since *C. madurensis* is conspecific to *C. candicans*, the variety has to be treated under *C. candicans* as *C. candicans* var. *kurnoolica*.

Key to the varieties

- 1a. Bracts 6 x 3 mm; sepals subequal, margin slightly revolute var. *candicans*
- 1b. Bracts 10 x 16 mm; sepals equal, margin prominently revolute var. *kurnoolica*

2a. *C. candicans* var. *candicans* Wight & Arn.

Type: *Wight* Cat. no. 661 (K).

Erect perennial woody shrub with many ascending branches, 1.5 – 2.5 m tall. Stems and branches terete, shining fulvous. Leaves simple, estipulate; petiole *ca.* 5 mm long, villous; lamina 4.5 - 9 x 2.5 - 4.5 cm, ovate, obtuse at both ends, mucronate, silky pubescent on both surfaces, chartaceous, veins prominent underneath. Racemes 4 - 8 cm long, paniced, on terminal and axillary leafy branches; 2 - 5 flowered. Flower 2 cm long and 2.8 cm across; bract 6 x 3 mm, ovate - acuminate, foliaceous, reflexed, not viscous; bracteoles 5 x 2 mm long, ovate - acuminate, silky tomentose out and glabrous in, close to calyx; pedicel 5 mm long. Calyx bilipped, silky tomentose; tube 3 mm long; lobes unequal; upper two large, 1 x 0.3 cm, triangular acuminate; lower three 0.6 x 0.2 mm, narrow, acuminate, margin slightly revolute. Corolla bright yellow; standard petal 2.3 x 2 cm, ovate with two small basal appendages, silky pubescent on both surfaces, spreading backwards; wing petals 1.8 x 0.8 cm, obovate, keel petals 2 x 1 cm, ovate, rounded about the middle, outer and inner margin fulvous basally, beak not twisted. Staminal sheath 6 mm long; filaments 10 mm and 5 mm long alternately with ovoid (1 mm long) and oblong (3 mm long) anthers alternately. Ovary 3.5 x 1.5 mm, silky pubescent throughout; not stipitate;

style 2 cm long, geniculate, pubescent along the margin; stigma expanded, hairy. Pods 3.2 - 3.5 x 1 - 1.2 cm, well exerted, oblong, obtuse at both ends, sparsely puberulous, 8 - 10 seeded. Seeds 4 x 3 mm diam., obliquely cordiform, smooth, dark brown.

Specimens examined: ANDHRA PRADESH: Kurnool Dt.: Srisailam, *Maesen* 3979 (CAL). TAMIL NADU: Coimbatore Dt.: Anamalais, *Joseph* 13744 (CAL). Madurai Dt.: Kodaikanal, *Abdul Jabbar* 45531 (TBGRI). Nilgiri Dt.: Gudallore, way to Needle point, *Sibichen* 728 (SJC); Nilgiris, *Meebold* 11586; Gudalloor - Naduvattom road, *Sebastine* 7311 (CAL). Salem Dt.: Yercaud, Shevaroyes, *Matthew, Venugopal & Jayaseelan* 18883 (CAL).

2b. *C. candicans* var. *kurnoolica* Sibi. *comb. nova*

C. madurensis Wight var. *kurnoolica* Ellis & Swamin., J. Bombay Nat. Hist. Soc. 66 (1): 227 - 228. 1969.

Type: Andhra Pradesh, Kurnool Dt., Nallamalais, *Ellis* 22144 A (holotype: CAL).

Erect perennial shrub with many ascending branches, 1.5 - 3 m tall. Stems and branches terete, silky pubescent. Leaves simple, estipulate; petiole ca. 4 mm long, villous; lamina 7.5 x 3.5 cm, ovate, rarely obovate, apiculate narrowed at the base, silky pubescent on both surfaces, veins prominent underneath. Racemes paniced, terminal. Flower 1.8 cm long and 2.1 cm across; bract 10 x 16 mm, broadly ovate, acuminate, deeply cordate, revolute, amplexicaul; bracteoles 5 x 3 mm, ovate - acuminate, deeply cordate, reflexed, silky tomentose out and glabrous in; pedicel 5 mm long. Calyx bilipped, silky tomentose, lobes equal, 9 x 4 mm, elliptic, margin prominently revolute. Corolla bright yellow; standard petal 2 x 2 cm, ovate with two small basal appendages, silky pubescent out and glabrous in, spreading backwards; wing petals 10 x 4 mm, obovate, keel petals 9 x 6 mm, ovate, rounded about the middle, beak not twisted. Staminal sheath 4 mm long; filaments 6 mm and

4 mm long alternately with ovoid (0.5 mm long) and oblong (1.5 mm long) anthers alternately. Ovary 2 x 1 mm, silky pubescent throughout, sessile; style 1.3 cm long, geniculate, pubescent along the margin; stigma expanded, hairy. Pods not seen.

Specimen examined: ANDHRA PRADESH: Kurnool Dt.: Nallamalais, *Ellis* 22144 A (CAL).

3. *C. lunulata* Heyne ex Wight & Arn., Prodr. 1: 183. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 564. 1843; Wight, Ic. t. 480. 1845 (repr. ed. 1988); Thw., Enum. Plant. Zeyl. 81. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 80. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 17. 1894; Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamilnadu Analysis 1: 98. 1983; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 198. 1991; Sanjappa, Leg. India 123. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 258. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 175. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 166. 2002.

Type: India, Thanjavoor, *Heyne* in *Wall.* Cat. no. 5378 (K).

(Fig. 25)

Erect, suffrutescent, low shrub with several ascending, glutinous branches from above, 30 – 60 cm tall. Stems and branches terete, white tomentose, becoming brown when dried. Leaves simple, closely placed; stipules 3 x 2 mm, semi - lunar, reflexed, glabrous and viscid above; petioles less than 1 mm long; lamina 3 - 4.5 x 1 - 1.5 cm, elliptic - oblanceolate, base cuneate, apex obtuse - mucronate, sparsely pubescent on both surface, chartaceous. Panicles 8 - 12 cm long, 3 - 4 flowered. Flower 1.8 cm long and 2.2 cm across; bracts 4 x 2 mm, cordate, cuspidate, amplexicaul, glabrous above and pubescent beneath; bracteoles 2 x 1 mm, semi - lunar, not viscid,

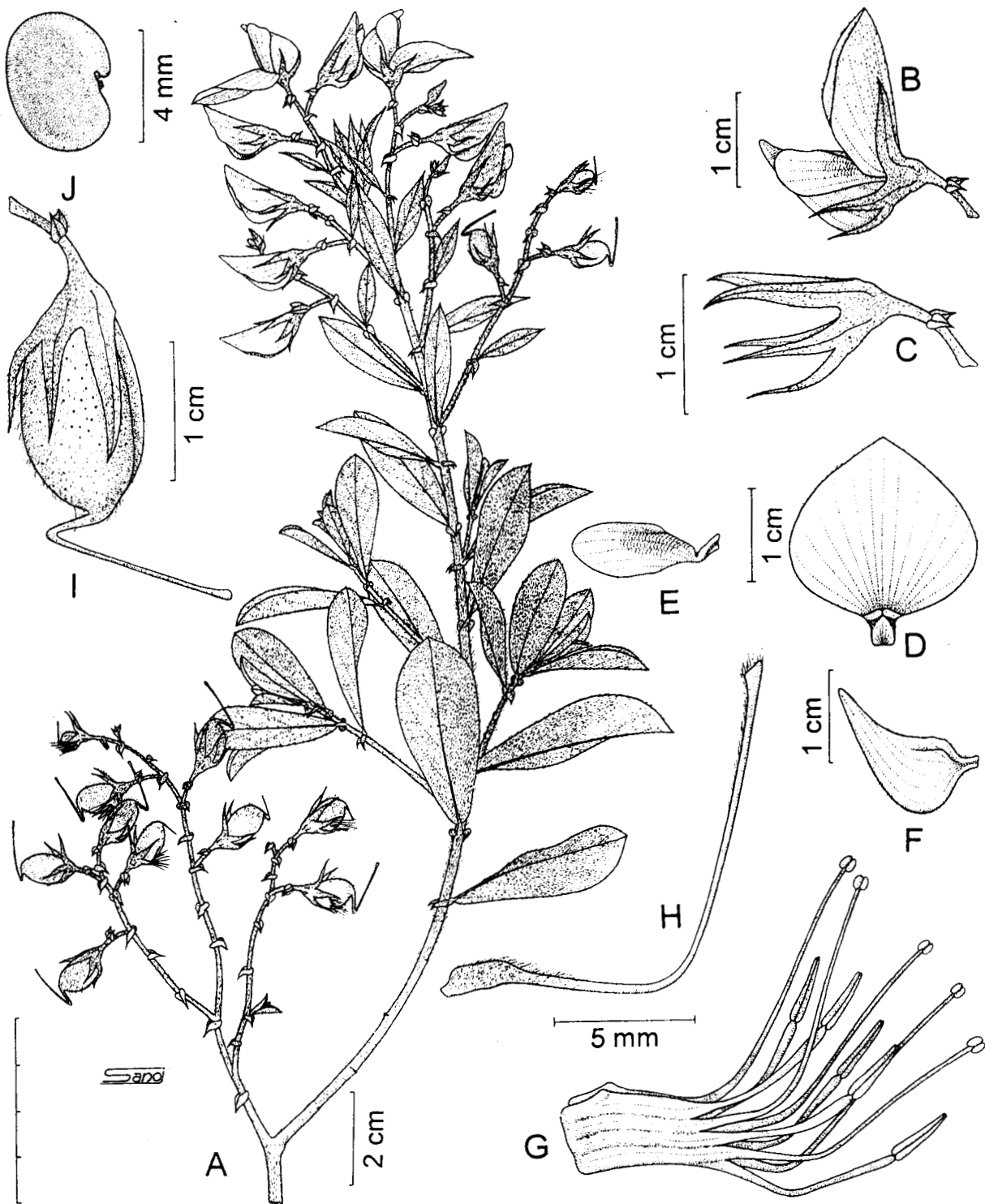


Fig. 25. *C. lunulata* Heyne ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Ramamurthy 17661).

109 A

amplexicaul, inserted on midpedicel. Calyx deeply 5 cleft, densely sericeous; upper two 8 x 2.5 mm, triangular acuminate; lower three 7 x 1.5 mm, narrow acuminate. Corolla yellow, exserted; standard petal 2 x 1.8 cm, ovate, pubescent out and glabrous in; wing petals 1.4 x 0.4 cm, oblong with a basal claw; keel petals 1.7 x 1 cm, ovate, rounded at the base, beak twisted to 90°. Staminal sheath 7 mm long, filaments 12 mm and 8 mm long alternately with ovoid (0.75 mm) and oblong (2 mm) anthers respectively. Ovary 2.5 x 1 mm, glabrous, villous throughout; style 1.8 mm long, not geniculate; stigma slightly expanded and hairy. Pods 10 x 8 mm, sessile, ovoid, sparsely hirsute, 1 seeded. Seeds 5 x 3 mm diam., reniform, smooth, dark brown.

Distribution and ecology: *C. lunulata* is distributed in India and Sri Lanka (Rudd, 1991) and is introduced to Indonesia. In India, it occurs in Andhra Pradesh, Maharashtra, Karnataka and Tamil Nadu. It is seen occasionally among grasses on hill slopes and also on waysides. The plant flowers and fruits from August to February.

Notes: The species is specially noted for its glutinous body and fetidity. The specific epithet, 'lunulata' comes from the semilunar shaped stipules and bracteoles. *C. lunulata* and *C. paniculata* resembles each other in having paniculate inflorescence and usually one seeded pod. But it can be easily distinguished by its semilunar stipules and bracteoles as against linear, subulate stipules and bracteoles of *C. paniculata*.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Thiruppathi, way to Sadasivakona from Vadamarpetta, *Anonymous* 1299 (MH). Eastern Ghats, *Ramamurthy* 17661 (SKU). TAMIL NADU: Nellur Dt.: *s.l.*, *Gamble* 20382 (CAL).

4. *C. paniculata* Willd., Sp. Pl. 3: 980. 1802; DC., Prodr. 2: 126.1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 183. 1834 (repr. ed.

1976); Benth. In: Hook., Lond. J. Bot. 2: 564. 1843; Baker In: Hook. f., Fl. Brit. India 2: 81. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 379. 1983; Saldan., Fl. Karnataka 1: 439. 1984; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 137. 1988; Sanjappa, Leg. India 126. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 261. 1997; Matthew, Fl. Palni Hills 1: 304. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 185. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Erect shrubby herbs, 0.5 - 1 m tall, with many, stiff ascending branches. Leaves oblong, silky tomentose; stipules linear, reflexed. Flowers in panicles; bracts and bracteoles copious. Pods ellipsoid, pubescent, 1 - 2 seeded.

Key to the varieties

- 1a. Leaves small, 2 - 3 x 0.5 - 1.5 cm, oblong - oblanceolate; stipules linear, 1 cm long; bracts subulate..... var. *paniculata*
- 1b. Leaves large, 3.5 - 7 x 1.5 - 3 cm, ovate - elliptic; stipules absent; bracts cordate var. *nagarjunakondensis*

4a. C. paniculata var. paniculata Willd., Sp. Pl. 3: 980. 1802; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 261. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 185. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 166. 2002.

Type: 13258 (WILLD - B).

Erect, suffruticose, shrubby herb with many stiff ascending branches, 0.6 - 1.5 m tall. Stems and branches terete, sparsely brown hirsute, viscid. Leaves simple, subsessile; stipules 1 cm long, linear - subulate; lamina 2 - 3 x

0.5 - 1.5 cm, oblong – oblanceolate, base cuneate, apex obtuse - acute, sparsely hirsute above and densely beneath, chartaceous. Panicle upto 20 cm long; racemes 4 - 8 cm long, 4 - 7 flowered. Flowers 1.5 cm long and 1.8 cm across; bracts 7 mm long, subulate; bracteoles 5 mm long, inserted on pedicel close to calyx tube subulate, viscid, curled back, and those of abortive racemes fascicled; pedicel 3 - 5 mm long. Calyx deeply 5 cleft; lobes (9 x 2 mm) more or less equal, triangular, acuminate, margin slightly revolute, brown tomentose out and glabrous in. Corolla yellow, exserted; standard petal 1.5 x 1.2 cm, obovate, apex acute with minute basal appendages, sparsely strigose out and glabrous in; wing petals 1 x 0.3 cm, oblong; keel petals 1.5 x 0.6 cm, ovate, angular at the base, beak not twisted. Staminal sheath 3 mm long; filaments 10 mm and 5 mm long alternately with oblong (3 mm long) and ovoid (0.5 mm long) anthers respectively. Ovary 3.5 x 1.5 mm, ovoid, hirsute; stipe 1 mm long; style 1.2 cm long, not geniculate, hairy along the margin; stigma slightly expanded, hairy. Pods 10 x 6 mm, ovoid, sparsely pubescent, exceeding the calyx, 1 seeded. Seeds 4 x 3 mm, black, obliquely cordiform, smooth.

Distribution and ecology: *C. paniculata* is distributed in Peninsular India and Indonesia (Sanjappa, 1992). In India, it is known to occur in Andhra Pradesh, Karnataka and Tamil Nadu. It is occasional in moist deciduous and dry deciduous forests especially along stream banks. The plant produces flowers and fruits throughout the year (Pullaiah & Ramamurthy, 2000).

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Brahmagundam, *Subba Rao* 46937 (CAL, MH). Cuddappah Dt.: Sahebmorabare, *Reddy* 8744 (SKU). Gundur Dt.: Satrasala, *Ramakrishnaiah* 6781 (SKU). Nalconda Dt.: Bottichalmi, *Sebastine* 9783 (CAL). Nellore Dt.: Raipur, *Ramamurthy* 17644 (SKU). KARNATAKA: Hassan Dt.: *s.l. Meebold* 9129 (CAL). Mandya Dt.: Near Solur, *Saldanha & Prakash* 6973 (CAL). Mysore Dt.: Gopaldaswamy

Hills, *Naiithani* 23251 (CAL, MH). TAMIL NADU: Anna Dt.: Vardhamandhi MHEP, *Ramamurthy* 8640 D (CAL). Coimbatore Dt.: Chinnathadakam, *Sebastine* 476 (CAL). Madurai Dt.: Palni, Perumthalai Dam, *Chandrabose* 54211 (MH). Salem Dt.: Hogainkkal River bank, *Vajravelu* 20670 (CAL). South Arcot Dt.: Gingee R.F., *Sebastine* 12337 (CAL). Thirunelvely Dt.: Kodumady, *Shetty* 27902 (MH).

4b. *C. paniculata* var. *nagarjunakondensis* Thoth., Bull. Bot. Surv. India 6: 67 - 68. 1964; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 261. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 186. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 166. 2002.

Type: India, A.P., Nagarjunakonda valley, *Thothathri* 9764 A (holotype: CAL).

Erect shrubby herb, up to 1.5 m tall. Stems and branches terete, villous and viscid. Leaves simple, estipulate; petiole 3 mm long, brown hirsute; lamina 3.5 - 7 x 1.5 - 3 cm, ovate - elliptic, base cuneate, apex acute - mucronate, golden tomentose on both sides, chartaceous. Panicles 12 - 20 cm long; racemes 4 - 8 flowered. Flowers 2.2 cm long and 1.2 cm across; bracts 5 - 6 x 3 - 6 mm, cordate, cuspidate, recurved; bracteoles smaller than bracts (3 - 5 x 2 - 4 mm), cordate and recurved, produced on the base of calyx tube; pedicel 0.7 - 1.2 cm long. Calyx densely brown silky, deeply 5 cleft, lobes oblong. Corolla yellow, exserted; standard petal 1.3 x 1.7 cm, ovate to orbicular, silky pubescent out and glabrous in; wing petals 1.5 x 0.5 cm, oblong; keel petals 2 x 1 cm, ovate, rounded about the middle, beak not twisted. Staminal sheath 4 mm long; filaments 14 mm and 8 mm long alternately with oblong (3 mm long) and ovoid (0.5 mm long) anthers respectively. Ovary 3.5 x 1.5 mm, ovoid, brown sericeous; stipe 1 mm long; style 1.2 cm long, not geniculate, hairy along the margin; stigma slightly

expanded, hairy. Pods 10 x 6 mm, sub - globose, sparsely brown sericeous, exserted, 1 or 2 seeded. Seeds 4 x 3 mm, black, obliquely cordiform, smooth.

Distribution and ecology: It is endemic to Nagarjunakonda valley in Andhra Pradesh.

Specimen examined: ANDHRA PRADESH: Nagarjunakonda valley, *Raghavaswamy s. n.* (SKU).

5. *C. pulchra* Andr., Bot. Rep. 9: t. 601. 1810; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 375. 1983; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 140. 1988; Sanjappa, Leg. India 127. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 262. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 190. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: the plate of a plant grown in England from seed obtained in Mysore.

C. pulcherrima DC., Prodr. 2: 126. 1825 (repr. ed. 1989); Roxb., Fl. Indica 2: 267. 1832; Wight & Arn., Prodr. 1: 184. 1834 (repr. ed. 1974); Wight, Ic. t. 481. 1841; Benth. In: Hook., Lond. J. Bot. 2: 563. 1843; Baker In: Hook. f., Fl. Brit. India 2: 80. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Saldan., Fl. Karnataka 1: 437. 1984.

(Fig. 26, Pl. 3 A)

Erect, perennial, woody shrub with many ascending branches from the base, 1.5 – 3.5 m tall. Stems and branches terete, silky tomentose. Leaves simple; stipules absent; petiole 1.5 - 3 mm long, hirsute; lamina 4 - 9 x 2 - 4 cm, obovate - oblanceolate, base cuneate, apex obtuse or slightly mucronate, appressed silky pubescent on both surfaces, subcoriaceous. Panicles 15 - 25

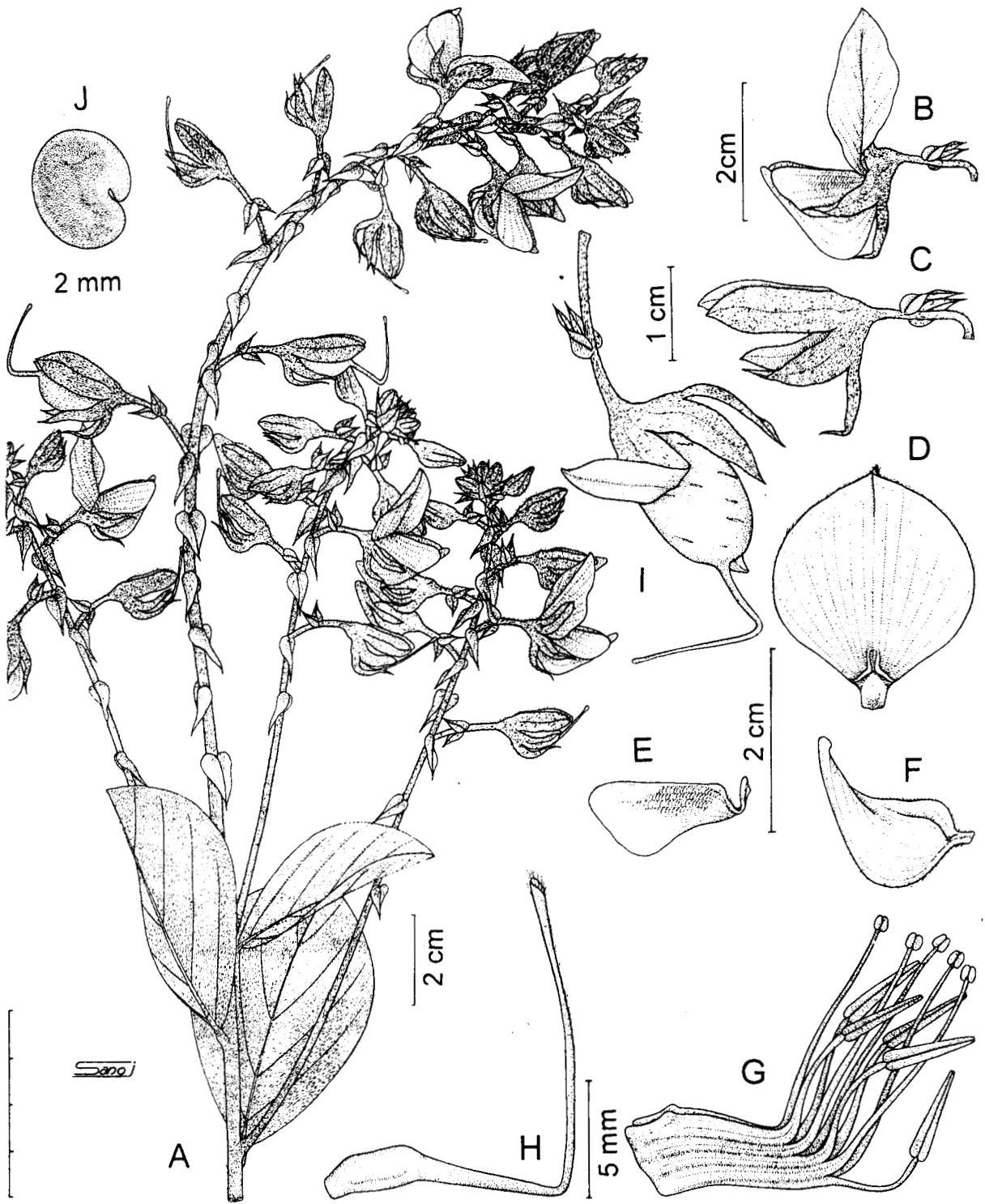


Fig. 26. *C. pulchra* Andr.: A. Habit: B. Flower: C. Calyx: D. Standard petal: E. Wing petal: F. Keel petal: G. Staminal sheath: H. Gynoeceum: I. Pod: J. Seed (From *Sibichen* 784).

39 11/18

cm long; racemes 5 - 8 flowered. Flowers 2.2 cm long and 3.1 cm across, basal ones abortive; bracts 8 x 8 mm, many, sterile except few, cordate, apex apiculate, foliaceous, viscous above and pubescent beneath, reflexed; bracteoles 8 x 4 mm, ovate, base obtuse, apex apiculate, glabrous above and pubescent beneath, inserted on midpedicel; pedicel 8 mm long. Calyx bilipped, silky tomentose; tube 3 mm long, hirsute; lobes subequal, upper two lobes 8 x 6 mm, large, oblong; lower three lobes 6 x 3 mm, narrow, acuminate. Corolla bright yellow, without striations; standard petal 2.5 x 2.2 cm, obovate, silky pubescent out and glabrous beneath; wing petals 1.8 x 0.9 cm, obovate, exceeding the keel; keel petals 2 x 1 cm, ovate, angular at base; outer and inner margin fulvous basally, beak not twisted. Staminal sheath 9 x 3 mm; filaments 10 mm and 7 mm long alternately with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 2 x 1 mm, silky pubescent, sessile; style 2.6 cm long, pubescent along the margin; stigma expanded, hairy. Pods 2.4 - 2.6 x 0.6 - 0.8 cm, scarcely exserted, oblong, obtuse at both ends, sparsely puberulous, 6 - 8 seeded. Seeds 4 x 3 mm diam., obliquely cordiform, laterally compressed, smooth, black.

Distribution and ecology: *C. pulchra* is endemic to Peninsular India (Sanjappa, 1992). The plant is occasional in moist deciduous forests at an altitude ca. 500 m. It flowers from September to November and fruits from December to March.

Notes: *C. pulchra* is allied to *C. berteriana* in habit, indumentum and inflorescence. However, It can be distinguished by the elongate racemes with persistent, sterile, reflexed and viscous bracts and bracteoles and exserted pods as against short racemes with caducous, erect, non viscous bracts and bracteoles and included pod of *C. berteriana*. The pretty, golden yellow flowers in large panicles against silky tomentose stems and leaves gives the

plant an exquisite appearance and hence the specific name "pulchra" (= beautiful) for this species.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: way to Jabalathartham, *Subba Rao* 46861 (CAL), Thirumalai, *Sibichen* 784 (SJC), *Subramanyam* 7848 (MH). Cuddupah Dt.: Chittavel R.F., *Ramamurthy* 17643, East Pancholingalu, *Reddy* 14630 (SKU). Guntur Dt.: Botlaka Bavi, *Muralidhara Rao* 21101 (SKU). Prakasam Dt.: Pullalacheruvu, *Vijayakumar* 18305 (SKU); Eastern Ghats, Gundla Brameswaram, *Ramamurthy* 14300 (CAL).

5. *C. ramosissima* Roxb., Fl. Indica 3: 268. 1832; Wight & Arn., Prodr. 1: 183. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 80. 1876 (repr. ed. 1879); Cooke, Fl. Pres. Bombay 1: 302. 1902 (repr. ed. 1958); Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Saldan., Fl. Karnataka 1: 437. 1984; Sanjappa, Leg. India 128. 1992; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 180. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: Bengal, *Carey s.n.*

Vernacular name: Thonasi thoppalu (Kan.), Unifoliate rattle wort (Eng.).

(Fig. 27)

Erect, suffruticose, annual herb with several sticky diffuse branches from the base, 10 - 20 cm tall. Stems and branches terete, short, silky tomentose. Leaves simple, subsessile, crowded; stipule 2 mm long, ferruginous; lamina 1.25 - 2 x 0.4 - 0.6 cm, linear - oblong, base cuneate, apex obtuse, sparsely hirsute above and densely beneath, subcoriaceous. Panicle 10 - 20 cm long; racemes 3 - 6 cm long, 2 - 5 flowered. Flowers 10 mm long and 5 mm across; bracts and bracteoles 5 x 2 mm, ovate -

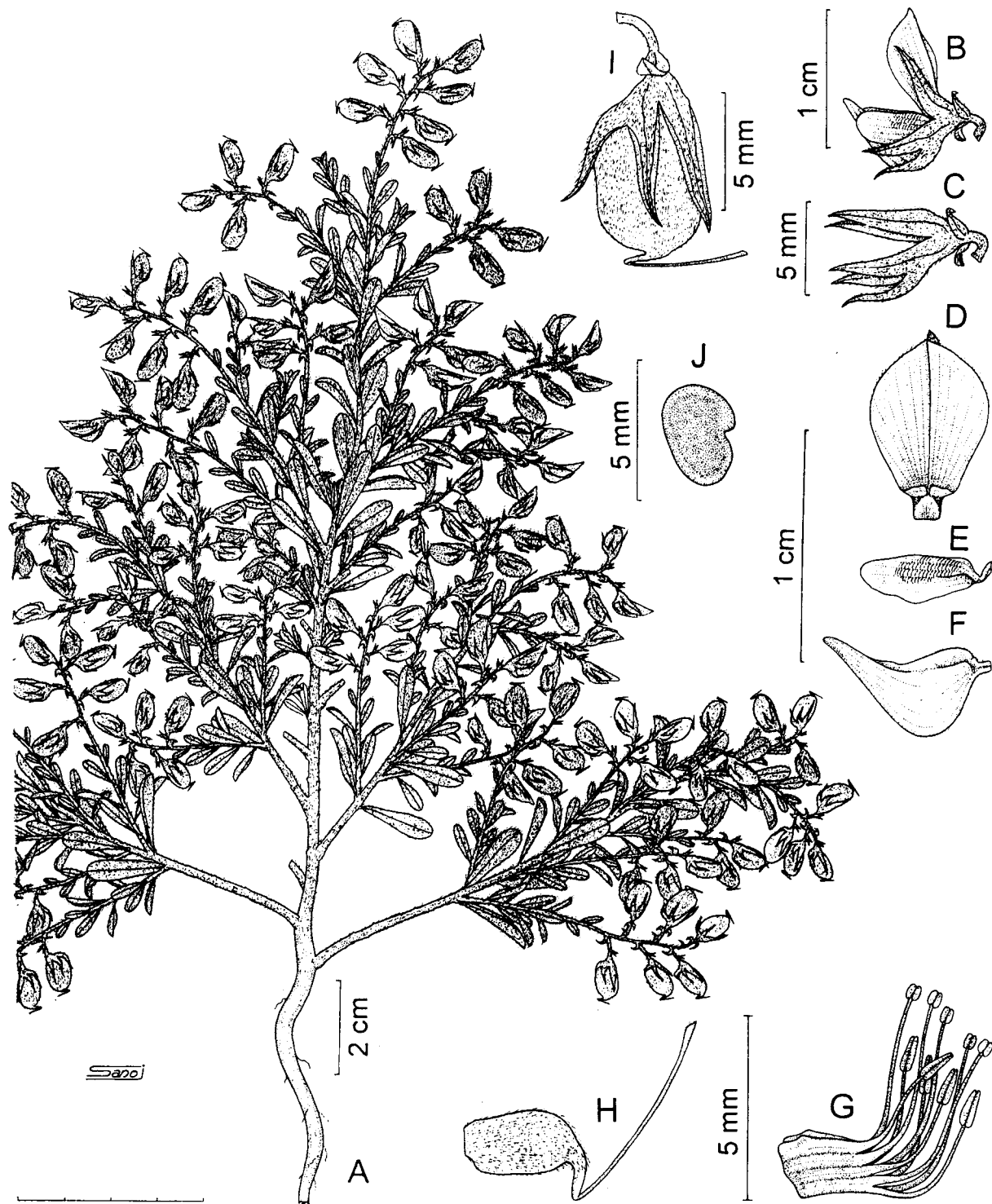


Fig. 27. *C. ramosissima* Roxb.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen* 782).

acuminate, margin revolute, curled back, silky pubescent out, black, glabrous and viscid in; bracteoles produced on the base of the calyx tube; pedicels 2 - 4 mm long. Calyx deeply 5 cleft, lobes (6 x 2 mm) more or less equal, narrow, acuminate, margin revolute, silky pubescent out and black glabrous in. Corolla exserted, reddish pink out and yellow in, turns black when dry; standard petal 8 x 5 mm, ovate, apex acute with minute basal appendages, sparsely strigose out and glabrous in; wing petals 5 x 1.5 mm, oblong; keel petals 7 x 3 mm, ovate, angular at the middle, inner margin fulvous with a beak twisted to 180°. Staminal sheath 2 mm long; filaments 6 mm and 4 mm long alternately with ovoid (0.3 mm long) and oblong (1.5 mm long) anthers respectively. Ovary 2.5 x 1.5 mm, ovoid, sessile, hirsute; style 7 mm long, geniculate, hairy along the margin; stigma slightly expanded, hairy. Pods 8 x 6 mm, globose, silky tomentose, sessile, exceeding the calyx, 1 seeded. Seeds 4 x 3 mm, black, obliquely cordiform, smooth.

Distribution and ecology: *C. ramosissima* is endemic to South West India (Sanjappa, 1992). It is common along wastelands and dry deciduous forests. The plant flowers from September and fruits from January to April.

Notes: *C. ramosissima* is a much branched, woody herb with a sticky nature due to its viscid bracts, bracteoles and sepals. The exudate imparts a characteristic yellow colour.

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Sree Krishnadevaraya Uty. Campus, *Sibichen* 782 (SJC), *Yesoda* 1143 (SKU). Chittoor Dt.: Madyagirippalli, *Fischer* 4417 (CAL). Cuddappah Dt.: Palkonda, *Fisher* 4695 (CAL). Godavari Dt.: Bodoguriau, *Gamble* 15834; Golagupa, *Gamble* 15833 (CAL). Kurnool Dt.: Bhogedwaram, *Sunitha* 22565; Devanipenta, *Sri Ramamurthy* 14286 (SKU). Nalconda Dt.: Nagarjuna sagar, *Sebastine* 9734 (CAL). Prakasam Dt.: Dasri, *Mohan* 334 (CAL). Visakapatnam Dt.: Arakku valley, *Thothatri* 9741 (CAL); Warangal Dt.: Near

T.B., *Sebastine* 11693 (CAL). TAMIL NADU: North Arcot Dt.: way to Vaniampadi, *Subramanyam* 7486 (CAL).

Sect. **Calycinae** Wight & Arn., Prodr.1: 181. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 564. 1843; Baker In: Hook. f., Fl. Brit. India 2: 70. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Polhill, Kew. Bull. 22: 301. 1968 p.p., *Crotalaria* in Africa and Madagascar 248. 1982 p.p.; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type species: *C. calycina* Schrank (Lectotype designated by Polhill, 1968).

Erect herbs with slender ascending or diffuse branches. Leaves simple, stipules absent or if present small, not decurrent. Inflorescence terminal or lateral racemes, umbels or heads. Bracts and bracteoles covered with light to dark brown hairs. Calyx large or equal to corolla, densely shaggy, cleft nearly to the base. Standard petal glabrous or with a line of hairs on the back. Pods oblong to subglobose, glabrous, exserted or included, many seeded.

Notes: Wight and Arnott (1834) described this section and included 6 species under it. Among them *C. barbata* and *C. salicifolia* were later transferred to sect. Erectae by the subsequent authors (Baker, 1876; Gamble, 1918). Bentham (1843) subdivided this section in to two major categories based on the nature of sepals viz. “upper calyx lobes connate except at the tip” and “upper calyx lobes not connate or only connate below”. He enumerated 13 species of which 9 belongs to the 1st category and the remaining 4 belongs to the 2nd category. Among them, seven species are from South India. Baker (1876) recorded 16 species under this section and treated them under two heads viz. “Pod decidedly exserted” and “Pod included or very slightly exserted”. Gamble (1918) recognized 13 species from Madras Presidency alone and treated them under the two groups as proposed by Bentham (*l.c.*).

Ansari (2002) created two new subsections *viz.* Nanae and Exsertae. But the subsectional name Nanae is illegitimate as it is contrary to 11.6 of ICBN (Greuter *et al.*, 1994). In the present treatment, I have included 12 species under two subsections *viz.* Calycinae and Exsertae. Moreover, species such as *C. clarkei* and *C. triquetra* have been shifted to sect. Diffusae after studying their affinities.

Key to the Subsections

- 1a. Pods included or very slightly exserted from the calyx Calycinae
- 1b. Pods much exserted from the calyx.....Exsertae

Subsect. Calycinae

Subsect. Nanae Ansari In: Rao (ed.), Adv. Leg. Res. 165. (2002).

Key to the Species

- 1a. Inflorescence umbels or heads 2
- 1b. Inflorescence lax racemes 5
- 2a. Flowers in umbels 3
- 2b. Flowers in heads 4
- 3a. Umbels less than 5 flowered; terminal and leaf opposed, pod sub cylindrical, 10 - 15 seeded 4.*C. nana*
- 3b. Umbels more than 10 flowered; terminal, pod globose, 5 - 8 seeded 7.*C. umbellata*
- 4a. Head rounded, 4 - 8 flowered 5.*C. speciosa*
- 4b. Head oblong, 10 - 40 flowered2.*C. dubia*
- 5a. Calyx densely shaggy, upper lobes connate $\frac{1}{2}$ their length; leaves polymorphic..... 1.*C. calycina*

- 5b. Calyx appressed hairy, upper lobes connate
except at the apex; leaves monomorphic 6
- 6a. Leaves obovate, apex emarginate;
pods oblong 6.C. *tecta*
- 6b. Leaves oblanceolate - oblong, apex obtuse;
pods subglobose..... 3.C. *linifolia*

1. *C. calycina* Schrank, Pl. Rar. Monac. 1817; DC., Prodr. 2: 129. 1825 (repr. ed. 1989); Benth. In: Hook., Lond. J. Bot. 2: 574. 1843; Thw., Enum. Plant. Zeyl. 82. 1859 (repr.ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 71. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 14. 1894; Cooke, Fl. Bombay 1: 317. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 286. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 146 & 2: t 110. 1932 (repr. ed. 1977); Saldan., Fl. Hassan 241. 1976; Matthew, Illus. Fl. Tamilnadu Carnatic 4: t. 124. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 191. 1991; Sanjappa, Leg. India 18. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 139. 1994; Matthew, Illus. Fl. Palni Hills t. 155. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 254. 1997; Matthew, Fl. Palni Hills 1: 298. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 163. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: Plate 12 in Schrank, Pl. Rar. Hort. Monac. (M).

C. anthylloides sensu Don, Prodr. Fl. Nepal. 241. 1825; Wight & Arn., Prodr. 1: 181. 1834, non Lam., 1786.

(Fig. 28 & 29, Pl. 4 F)

Erect annual herb with a few branches, 10 - 60 cm tall. Stems and branches terete, appressed silky sericeous. Leaves simple, very variable;

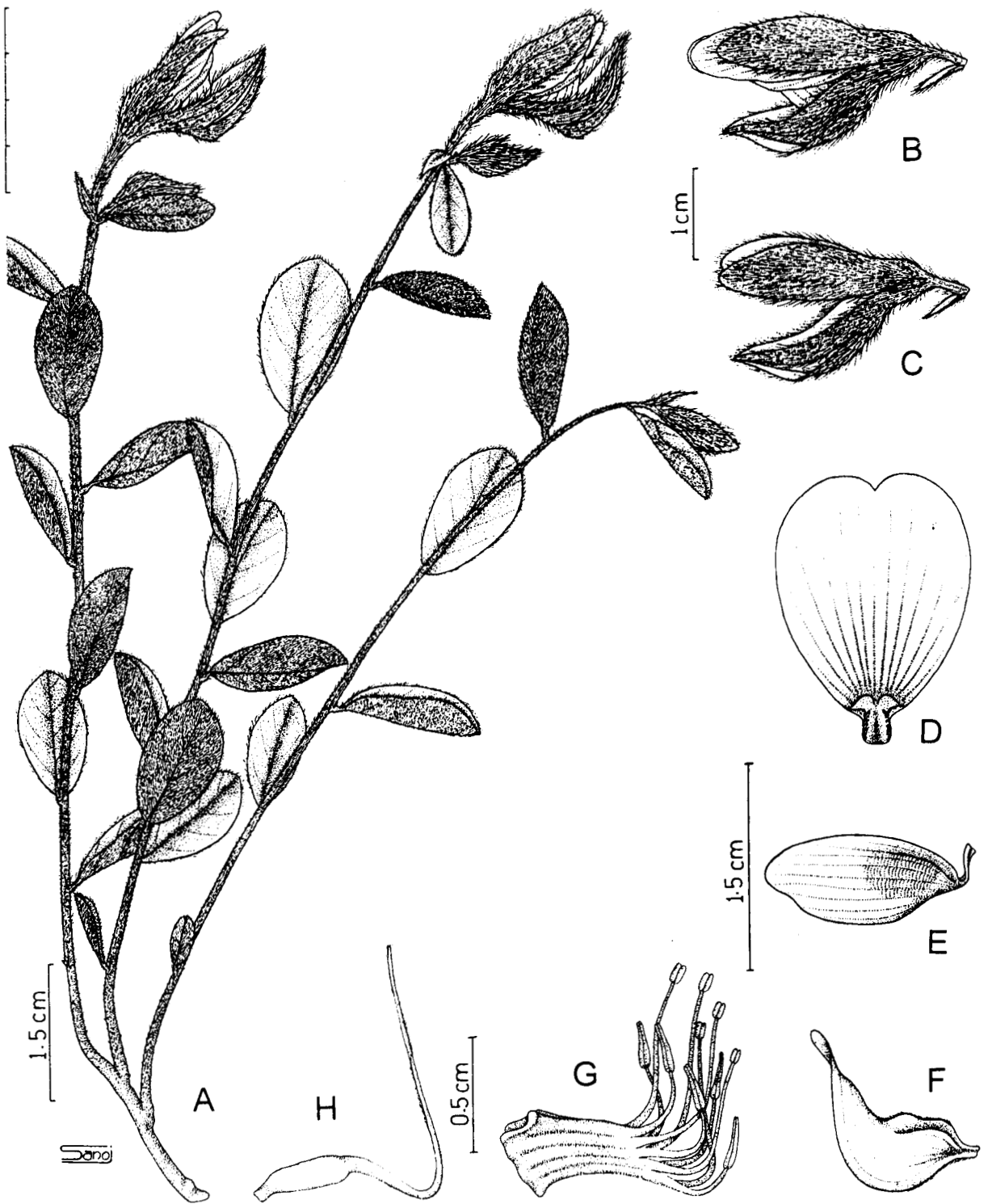


Fig. 28. *C. calycina* Schrank: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium, (From Sibichen, Joby & Dinesh Raj 748).

71

120P



Fig. 29. *C. calycina* Schrank: - Narrow leaved morphoform (From *Sibichen* 638).

42

120B



Plate 4. A. *C. heyneana*; B. *C. verrucosa*; C. *C. salicifolia*; D. *C. mysorensis*; E. *C. retusa* var. *retusa*; F. *C. calycina*.

H3
PC

stipule 2 mm long, subulate, tomentose, deciduous; lamina 3 - 13 x 0.4 - 1 cm, elliptic, ovate, oblong to linear, subcoriaceous, glabrous above and silky sericeous beneath, base obtuse, apex acute - acuminate. Racemes 5 - 15 cm long, terminal, lax, 2 - 6 flowered, other flowers in the upper axils. Flowers 2 cm long and 1 cm across, densely hirsute; bracts 8 - 15 x 2 - 4 mm, ovate - lanceolate, glabrous above and wooly beneath; bracteoles 4 - 15 x 2 - 4 mm, acuminate, woolly, inserted on the calyx tube. Calyx bilipped, densely sericeous; upper lobes 2.5 x 1 cm, obtuse, connate nearly $\frac{1}{2}$ their length; lower lobes 2 x 0.5 cm, lanceolate. Corolla yellow turning black when dry, hardly exerted; standard petal 10 x 7.5 mm, obovate, with two small appendages at the base, glabrous except along the midvein near the apex on the back; wing petals 7.5 x 5 mm, elliptic; keel petals 13 x 4 mm, ovate, rounded at the middle, beak twisted to 180° . Staminal sheath 3 mm long, filaments 7 mm and 4 mm long alternately with ovoid (1 mm long) and oblong (2 mm long) anthers respectively. Ovary 5 x 1 mm, glabrous; style 1 cm long, not geniculate, pubescent along the inner margin; stigma simple. Pods 1.8 x 0.8 cm, oblong, black when ripe, sessile, glabrous, included, 30 - 40 seeded. Seeds obliquely cordiform, pale brown.

Distribution and ecology: *C. calycina* is distributed in India, Australia, Tropical Africa, Bhutan, China, and Malesia (Sanjappa, 1992). It is seen occasionally as an undergrowth of moist deciduous forests and on exposed hill slopes up to 1500 m altitude. It flowers and fruits from September to March.

Notes: *C. calycina* is polymorphic. It assumes distinct morphological forms at different altitudes (Fig. 28 & 29). Gamble (1918) and Matthew (1999) treated these morphoforms under four well - marked groups. During my field trips I came across three distinct morphological forms viz. (a) tall plants (more than 50 cm) occurring at an altitudinal range of 700 - 1200 m with narrow linear

leaves (10 - 15 x 0.5 cm) (Fig. 29), (b) plants of medium size (20 - 35 cm) occurring below 700 m altitude with ovate - oblong leaves (3 - 5 x 0.3 - 0.5 cm), and (c) small plants (less than 20 cm) growing above 1200 m. with elliptic leaves (2 - 3 x 1 - 1.5 cm) (Fig. 28). Irrespective of the variation in height and leaf shape, all these forms have included corolla and pod.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Eethakayala - mandapam, *Subba Rao* 46900 (MH). Kurnool Dt.: Ramanapenta, Nallamalais, *Ellis* 32629 (MH). Visakapattanam Dt.: Ananthagiri, *Balakrishnan* 42640; Cherukonda, *Subba Rao* 28189; Gudugedda, *Subba Rao* 42640 (MH). KERALA: Idukki Dt.: Idukki Reservoir, *Pandurangan* 66469 (MH); Mangaladevi, *Jomy* 14191 (CALI). Palakkad Dt.: Nelliampathy, *Sibichen & Joby* 688 (SJC). Thiruvananthapuram Dt.: Agastyamala, *Mohanan* 7656 (CALI); Way to Bonnacord, *Mohanan* 58528; Kottur R.F., *Joseph* 44438 (MH). Wayanad Dt.: Kalpetta, Manikunnu, *Sibichen* 638; Muthanga forest, Ponkuzhy, *Sibichen, Joby & Dinesh Raj* 748 (SJC). TAMIL NADU: Coimbatore Dt.: Anamalais, *Joseph* 13407; Maruthamala, *Deb* 31373, *Viswanathan* 434 (MH). North Arcot Dt.: Pavathumalai R.F., *Viswanathan* 1324 (MH). Ramanathapuram Dt.: Mudaliaruth to Virusadi, *Srinivasan* 60963 (MH). Thirunelveli Dt.: Panchayat Canal, *Ansari* 80656; Thulukamparai, *Karthikeyan* 40150 (MH).

2. C. dubia Grah. ex Benth., In: Hook., Lond. J. Bot. 2: 568. 1843; Baker In: Hook. f., Fl. Brit. India 2: 73. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 316. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 286. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Saldan., Fl. Karnataka 1: 432. 1984; Ramach. & Nair, Fl. Cannanore 129. 1988; Sanjappa, Leg. India 119. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 138. 1994; Sivar. &

Mathew, Fl. Nilambur 178. 1997; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: India, Wall. Cat. no. 5404 (K).

Erect annual herb with several ascending branches, 15 - 30 cm tall. Stems and branches terete, rusty pubescent. Leaves simple, subsessile; stipules 3 - 5 mm long, setaceous, caducous; lamina 5 - 8 x 2 - 4 cm, obovate; base cuneate; apex obtuse, slightly mucronate, chartaceous, silky above and densely so beneath. Heads 2 - 5 cm long, terminal and lateral, oblong, 12 - 30 flowered, often subtended on a foliaceous bract. Flower 7 mm long and 6 mm across, subsessile; pedicel less than 2 mm long; bract and bracteoles similar, ovate - lanceolate, 4 x 3 mm, persistent, hairy on both surfaces; bracteoles inserted on calyx tube. Calyx densely silky hirsute outside, glabrous within, bilipped; lobes all 6 mm long, acuminate; upper two slightly broader and connate $\frac{1}{2}$ their length and the lower three narrow and deeply divided. Corolla hardly exerted, pale yellow; standard petal 5 x 3 mm, elliptic with emarginated apex, glabrous, except along the mid vein on the back side; wing petals 4.5 x 1.5 mm, ovate - oblong; keel petals 5 x 2 mm, ovate, angular at the base, beak twisted to 180°. Staminal sheath 1.5 mm long; filaments 2 mm and 1 mm long alternately with ovoid (0.5 mm long) and oblong (1 mm long) anthers respectively. Ovary 2.5 x 1.5 mm, ellipsoid, sessile, glabrous; style 2.5 mm long, geniculate. Pods as long as calyx, oblong, black when mature, glabrous, 6 - 8 seeded. Seeds 1.5 mm diam., cordiform, smooth, yellowish brown.

Distribution and ecology: *C. dubia* is distributed in India, Myanmar (Sanjappa, 1992) and Thailand (Niyomdham, 1978). It occurs as an undergrowth of moist deciduous forests of Western Ghats at an altitude of 100 m.

Notes: Of the various species of the genus *Crotalaria* in South India, *C. dubia* and *C. speciosa* are quite distinct in having flowers produced in heads. However, the head is rounded and few flowered (4 - 8 nos.) in *C. speciosa* while it is oblong and many flowered (10 - 40 nos.) in *C. dubia*.

Specimens examined: KERALA: Idukki Dt.: Parambikkulam, *Meebold* 12360 (CAL). Kannur Dt.: Tolpetty, *Ramachandran* 58735 (CAL). Thiruvananthapuram Dt.: Braemore, *Mohanan* 61782 (CAL). TAMIL NADU: Coimbatore Dt.: Anamalais, *Fischer* 3510, 3916 (CAL). Nilgiri Dt.: Benne forest, *Shetty* 11957, *Gamble* 15529 (CAL).

3. *C. linifolia* L.f., Suppl. 322. 1781; DC., Prodr. 2: 128. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 190. 1834 (repr. ed. 1976); Thw., Enum. Pl. Zeyl. 82. 1859 (repr. ed. 1864); Trimen, Handb. Fl. Ceylon 2: 12. 1894; Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 285. 1918 (repr. ed. 1995); Niyomdham, Thai. For. Bull. 11: 146. 1978; Saldan., Fl. Karnataka 1: 436. 1984; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 206. 1991; Sanjappa, Leg. India 123. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 258. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 152. 2000; Ansari In: Rao Adv. Leg. Res. (ed.) 159. 2002, non Baker 1876; Cooke, 1903.

Type: Herb. *Linn. no. 895. 26* (LINN).

Erect annual shrubby herb, 20 - 40 cm tall, caespitose. Stems and branches terete, appressed pubescent. Leaves simple, estipulate, subsessile; lamina 1.5 - 2.25 x 0.3 - 0.5 cm, oblanceolate - oblong; base cuneate; apex obtuse, slightly mucronate, glabrous above and sericeous beneath, chartaceous. Racemes 10 - 15 cm long, terminal, lax, 6 - 15 flowered. Flower 1.2 cm long and 0.8 cm across; bracts and bracteoles 2 mm long, subulate, tomentose; bracteoles inserted on the calyx tube between the lips; pedicel

3 - 5 mm long, tomentose. Calyx appressed hairy, bilipped; upper two lobes 8 x 4 mm, lanceolate, connate except at the apex, forming a broad ovate upper lip, lower three lobes 9 x 1.5 mm, triangular, acuminate, often connate at the apex. Corolla yellow, slightly exserted; standard petal 10 x 8 mm, broadly oblong, apex emarginate; wing petals 7 x 2 mm, oblong; keel petals 8 x 4 mm, angled in lower part, exceeding the wing petals, beak twisted to 180°. Staminal sheath 4 mm long; filaments 2 mm and 1.5 mm long alternately with ovoid (0.5 mm long) and oblong (3 mm long) anthers respectively. Ovary 3 mm long, sessile; style 10 mm long, geniculate, hairy along the margin; stigma swollen and hairy. Pods 7 x 5 mm, sub - globose, included, glabrous, 8 - 10 seeded. Seeds obliquely cordate, black.

Distribution and ecology: *C. linifolia* is distributed in India, Sri Lanka, China, Myanmar, Malesia and Australia (Sanjappa, 1992). In South India it is reported only from Tamil Nadu. *C. linifolia* is found occasionally in open moist places. It flowers and fruits from August to November.

Notes: *C. linifolia* is closely allied to *C. montana* Heyne ex Roth in its general habit, leaf shape, indumentum etc. Because of the close similarity, several specimens of *C. montana* available either at MH or CAL were wrongly labelled as *C. linifolia*. However, *C. linifolia* can be distinguished in having larger flowers and extra large keel unlike the smaller flowers and uniform petals of *C. montana*. Niyomdham (1978) also agrees with this view and opinioned that *C. montana* has long been known as *C. linifolia*.

Specimens examined: TAMIL NADU: Kanyakumari Dt.: Pothayadi, Henry 53277 (MH). Periyar Dt.: Dhimbam, Bazalatti forest, Vajravelu 80697 (MH). South Arcot Dt.: Chidambaram, Sebastine 5267, Gomuki Dam, Ramamurthy 52850 (MH). Thanjavur Dt.: Nannilam to Aduthurai, Ramamurthy 53640 (CAL).

4. **C. nana** Burm., Fl. Indica 158. 1768; DC., Prodr. 2: 127. 1825; Wight & Arn., Prodr. 1: 191. 1834 p.p excl. syn; Benth. In: Hook., Lond. J. Bot. 2: 570. 1843; Trimen, Handb. Fl. Ceylon 2: 13. 1894; Cooke, Fl. Pres. Bombay 1: 311. 1902; Baker In: Hook. f., Fl. Brit. India 2: 71. 1914 p.p. excl. syn; Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Niyomdham, Thai For. Bull. 11: 147. 1978; Mani. & Sivar., Fl. Calicut 77. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 366. t. 240. 1983; Saldan., Fl. Karnataka 1: 430. 1984; Ramach. & Nair, Fl. Cannanore 129. 1988; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 135. 1988; Vajrav., Fl. Palghat 149. 1990; Rudd In: Dassanayake and Fosberg (eds.), Rev. Handb. Fl. Ceylon 207. 1991; Sanjappa, Leg. India 125. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 138. 1994; Sasi. & Sivar., Fl. Thrissur 133. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 250. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 180. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: India, Malabar, Garcin Herb.

(Fig. 30)

Erect or caespitose annual herb with several diffuse branches ascending from the base, up to 0.3 m tall. Stems and branches terete, slender, sparsely pilose. Leaves simple, estipulate, subsessile; lamina 0.5 - 2.2 x 0.3 - 0.8 cm, oblong - obovate, base cuneate, apex obtuse - acute, sparsely sericeous above and densely beneath, chartaceous. Racemes upto 2 cm long, terminal and occasionally leaf opposed, assumes an umbel of 3 - 4 flowers. Flowers 5 mm long and 3 mm across; bracts 1 mm long, triangular, acuminate; bracteole 1.5 mm long, acuminate, appressed to calyx; pedicel 2 mm long. Calyx exceeding the corolla, bilipped, densely sericeous, calyx tube 1.5 mm long; upper two connate except at the tip, lower three free, narrow, acuminate. Corolla yellow with reddish brown striations, turns black when dry, hardly exserted; standard petal 4 x 2.5 mm, ovate, apex acute with minute

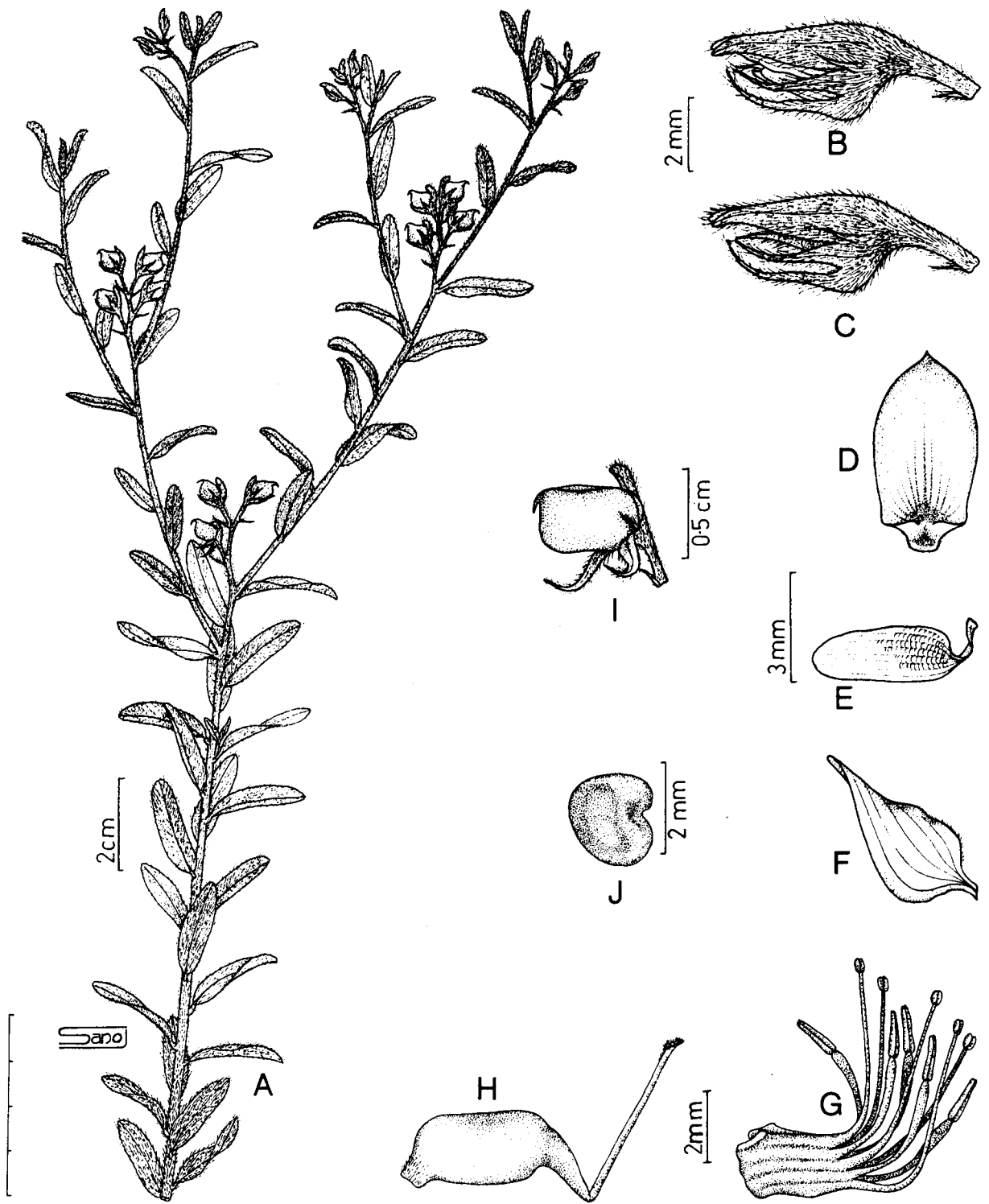


Fig. 30. *C. nana* Burm. A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen & Nampy* 655).

44 126A

basal appendages, glabrous except along the midvein on the back; wing petal 4 x 1.5 mm, oblong with a basal claw; keel petals 4 x 2 mm, ovate angular at the base, with a twisted beak. Staminal sheath 1.5 mm long, filaments 4 mm and 2 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 2 x 1 mm, sessile, glabrous, puberulous towards the base; style 4.5 mm long, geniculate; stigma slightly swollen, hairy. Pods 4.5 x 4 mm, sessile, subcylindrical, glabrous, mucronate, hardly exceeding the calyx, 10 - 15 seeded. Seeds 1.5 mm diam., obliquely cordiform, shining and brown.

Distribution and ecology: *C. nana* is distributed in India, Sri Lanka and South East Asia (Niyomdham, 1978). It is seen occasionally among grasses on lateritic slopes and also on sandy sea coast. Plants found in sandy soil grow luxuriantly and assume caespitose habit whereas those on open lateritic soil appear smaller and less branched. *C. nana* flowers and fruits from August to November.

Notes: Wight and Arnott (1834) treated *C. nana* along with *C. umbellata* under the sect. *Microcarpae* because of its small, few seeded pod. But later authors like Hooker (1876), Bentham (1843) and Gamble (1918) included them under the sect. *Calycinae* while Ansari (2002) included them under the sub sect. *Nanae*. However, in the present treatment, *C. nana* has been placed under the nominate subsect. *Calycinae* under the sect. *Calycinae*.

Specimens examined: KERALA: Kannur Dt.: Muzhuppilangadi, Ramachandran 64088, Way to Govt. Fish Farm, Thalasserry, Ramachandaran 52190 (CAL). Kollam Dt.: Vivekananthan 48353 (CAL). Kozhikode Dt.: Medical College Campus, Sibichen, Joby & Dinesh Raj 703, Thikkody, Sibichen & Nampy 655 (SJC). Palakkad Dt.: Panthanhode, Joseph 51435 (CAL). TAMIL NADU: Ramanathapuram Dt.: Mudaliaruthu, Srinivasan

60996 (CAL). South Arcot Dt.: Chidambaram, *Venugopal* 21357 (CAL).
Thanjavoor Dt.: Muthupet, *Ragupathy* 346 (CAL).

5. *C. speciosa* Heyne ex Roth., Nov. Pl. Sp. 335. 1821; DC., Prodr. 129. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 182. 1834 (repr. ed. 1976); Wight, Ic. t. 29. 1839 (repr. ed. 1988); Benth. In: Hook., Lond. J. Bot. 2: 564. 1843; Baker In: Hook. f., Fl. Brit. India 2: 73. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 286. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Matthew, Fl. Tamilnadu Carnatic 1: 372. 1983; Saldan., Fl. Karnataka 1: 441. 1984; Sanjappa, Leg. India 130. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 264. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 197. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: India, Mysore, *Heyne* 1801 (K).

(Fig. 31)

Erect, short lived perennial herb, with rigid spreading - erect branches, 30 - 60 cm tall. Stems and branches terete, brown silky pubescent. Leaves simple; stipule 1 - 1.5 mm long, subulate, densely silky on both surfaces; petiole hardly 1 mm long, sericeous; lamina 2.5 - 3 x 1.3 - 1.5 cm, elliptic to lanceolate, base ovate, apex obtuse, mucronate, coriaceous, densely sericeous on both sides. Raceme highly condensed, assuming a head; 5 - 10 flowered. Flowers 1.5 cm long and 2 cm across; bracts 1.5 x 0.8 cm, lanceolate, brown hirsute; bracteoles 6 mm long, attached to the base of the calyx tube; calyx bilipped; lobes subequal, brown sericeous; upper two lobes 1.5 x 0.4 cm, connate $\frac{1}{2}$ their length; lower three lobes 1.5 x 0.2, narrow, hirsute. Corolla yellow, included; standard petal 1.8 x 1 cm, obovate, glabrous in and silky tomentose out, margin ciliate, with two prominent basal appendages at the base; wing petals 1.3 x 0.5 cm, obovate, glabrous; keel petals 1.3 x 0.6 cm,

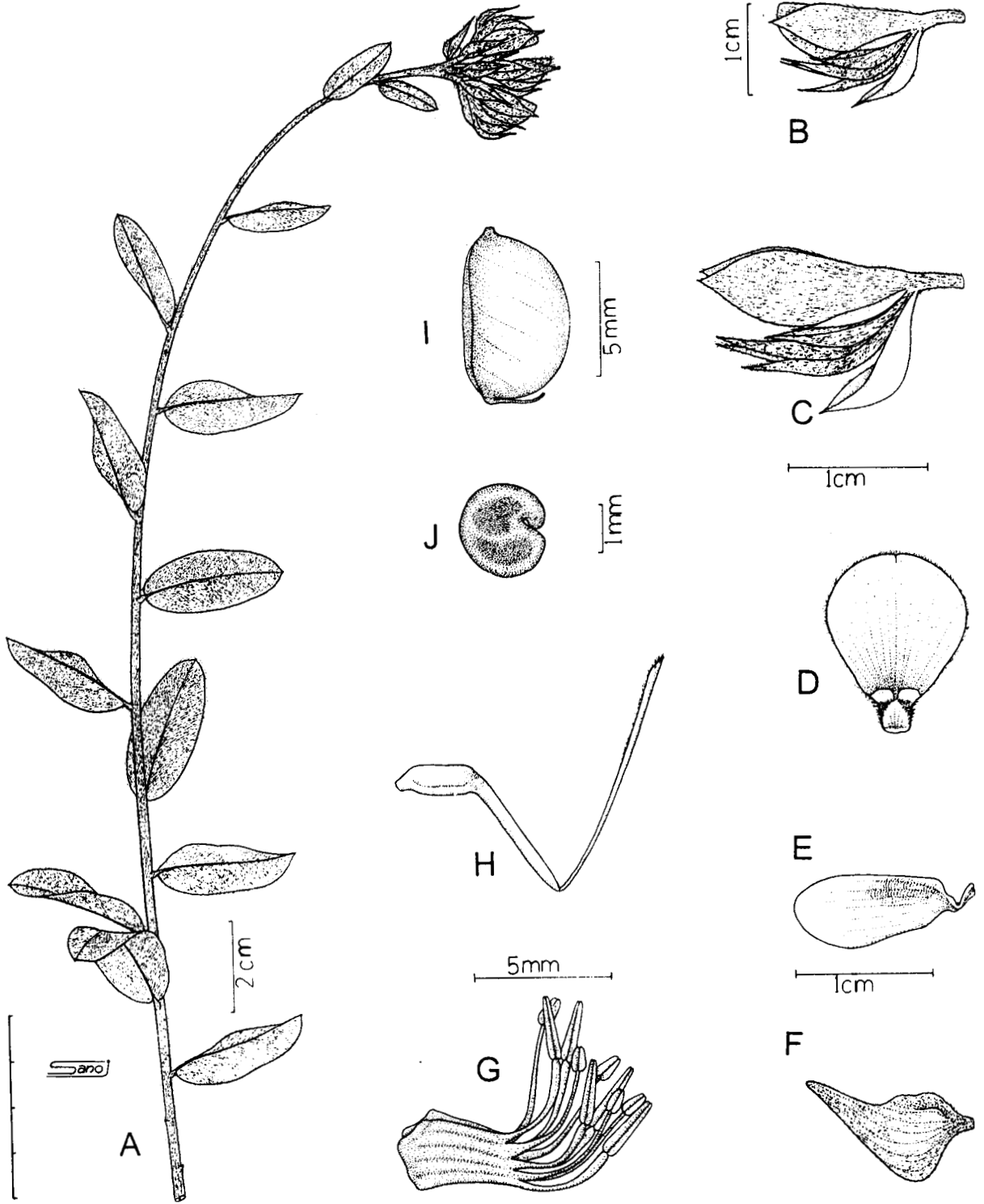


Fig. 31. *C. speciosa* Heyne ex Roth.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen, Joby & Dinesh Raj 749).

45

128 P

angular at the base, beak partially twisted, yellow, sericeous along the outer and inner margin. Staminal sheath 5 mm long, filaments 5 mm and 3 mm long alternately with ovoid (0.5 mm) and oblong (0.2 mm) anthers respectively. Ovary 6 x 4 mm, subglobose, glabrous; style 1.2 cm long, hairy along the margin; stigma slightly expanded, tomentose. Pods 8 x 5 mm, sessile, sub globose, included, glabrous, 6 - 12 seeded. Seeds 1 mm diam., reniform, brown, laterally compressed.

Distribution and ecology: *C. speciosa* is endemic to South India (Sanjappa, 1992). It is seen occasionally as an undergrowth of dry deciduous forests. It flowers and fruits from October to March.

Notes: *C. speciosa* is noted for its silky tomentose leaves and stem. The whole plant is velvety. The raceme is highly condensed, often imparts the form of a head or capitulum.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Kambakkam, Sri Ramamurthy 17651 (SKU); Mandapam, Subba Rao 46903 (CAL). KERALA: Wayanad Dt.: Muthanga forest, Sibichen, Joby & Dinesh Raj 749 (SJC). TAMIL NADU: Ramanathapuram Dt.: Mudaliaruthu, Nair 61033 (CAL). Thirunelvely Dt.: Kuluratti Estate, Vajravelu 76418; Sengaltheri, Vajravelu 76533 (CAL).

6. *C. tecta* Heyne ex Roth., Nov. Sp. 334. 1821; DC., Prodr. 126. 1825 (repr. ed. 1985); Benth. In: Hook., Lond. J. Bot. 2: 569. 1843; Baker In: Hook. f., Fl. Brit. India 2: 72. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 14. 1894; Gamble, Fl. Pres. Madras 1: 285. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Sanjappa, Leg. India 130. 1992; Matthew, Illus. Palni Hills t. 170. 1996, Fl. Palni Hills 1: 307. 1999.

Type: India Orientalis, Heyne (CAL).

Erect, suffruticose, perennial under shrub with many stiff - spreading erect branches, 30 - 45 cm tall. Stems and branches terete, appressed gray pubescent. Leaves simple, estipulate, subsessile; petiole less than 1 mm long; lamina 1 - 2.5 x 0.5 cm, obovate, base cuneate, apex emarginate or retuse, chartaceous, glabrous and punctate above, appressed pubescent beneath. Racemes terminal, lax, 10 - 20 cm long, 6 - 12 flowered. Flower 1.5 cm long and 1.2 cm across, bracts and bracteoles 1.5 mm long, linear, setaceous; bracteoles inserted on calyx tube at the cleft; pedicel 4 mm long, appressed tomentose. Calyx bilipped, sparsely pubescent; upper two lobes 8 x 5 mm, obtuse, connate $\frac{3}{4}$ their length; lower three lobes 8 x 2 mm, acuminate, initially fused by their apex. Corolla scarcely exceeding the calyx; standard petal 10 x 8 mm, obovate with two basal appendages, glabrous, apex emarginate; wing petals 10 x 4 mm, oblong; keel petals 15 x 6 mm, angular at the base, beak twisted to 180°. Staminal sheath 2.5 mm long; filaments 6 mm and 11 mm long alternately with oblong (3 mm) and ovoid (1 mm) anthers respectively. Ovary 2.5 x 1.5 mm, sessile; style 1.5 mm long, geniculate, exceeding anther; stigma swollen, oblique. Pods 1.2 - 1.5 cm long, sessile, oblong, glabrous, 9 - 12 seeded.

Distribution and ecology: *C. tecta* is endemic to India (Sanjappa, 1992) and is very rare. The plant flowers and fruits from October to March.

Notes: *C. tecta* is closely allied to *C. linifolia*. Rudd (1991) treated it as conspecific to *C. linifolia*. But *C. tecta* can easily be distinguished from *C. linifolia* in having obovate leaves with retuse or emarginate apex, geniculate style and oblong pod as against oblong - oblanceolate leaves with obtuse or slightly mucronate apex, non-geniculate style and subglobose pod as in *C. linifolia*.

Specimen examined: TAMIL NADU: Thirunelvely Dt.: Thenkasi, Abdul Jabbar 45503 (TBGRI).

7. *C. umbellata* Wight ex Wight & Arn., Prodr. 1: 191. 1834 (repr. ed. 1976); Thw., Enum. Plant. Zeyl. 82. 1859 (repr. ed. 1864); Gamble, Fl. Pres. Madras 1: 285. 1918 (repr. ed. 1995); Saldan. & Nicolson, 244. 1976; Niyomdham, Thai. For. Bull. 11: 1978; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 368. t. 379. 1983; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 115. 1988; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 265. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 198. 2000.

Type: India, Dindigul Hills, *Wight* 700 (K).

C. nana var. *umbellata* Trimen, Handb. Fl. Ceylon 2: 13. 1894; Ansari, J. Econ. Tax. 15 (2): 455. 1991, In: Rao (ed.), Adv. Leg. Res. 163. 2002.

(Fig. 32)

Erect short lived perennial herb with a few to many ascending branches, 5 – 30 cm long. Stems and branches terete, brown tomentose. Leaves simple, estipulate, sub sessile; lamina 2 - 4.5 x 0.5 - 0.6 cm, narrow, elliptic - oblong, base obtuse, apex acute, sub - coriaceous, sparsely tomentose above, densely beneath. Umbels terminal, 10 – 12 flowered. Flowers 7 mm long and 3 mm across; bracts 3 - 4 mm long, linear, tomentose; bracteoles 2 mm long, linear, inserted on the calyx at the cleft; pedicel 3 mm long, densely tomentose. Calyx bilipped, densely tomentose, exceeding the corolla; upper two lobes 5 mm long, connate except at the apex; lower three lobes 3 mm long, connate only at the base. Corolla yellow with purple striations, scarcely exserted; standard petal 5 mm x 3 mm, ovate, emarginate at apex; wing petals 2 mm x 1.5 mm, oblong; keel petals angled, 5 mm x 3 mm, beak twisted to 180°. Staminal sheath 1 mm long; filaments 3 mm and 1.5 mm long alternately with ovoid and oblong anthers respectively. Ovary 1 mm x 0.5 mm, glabrous; style 1 mm long, geniculate; stigma

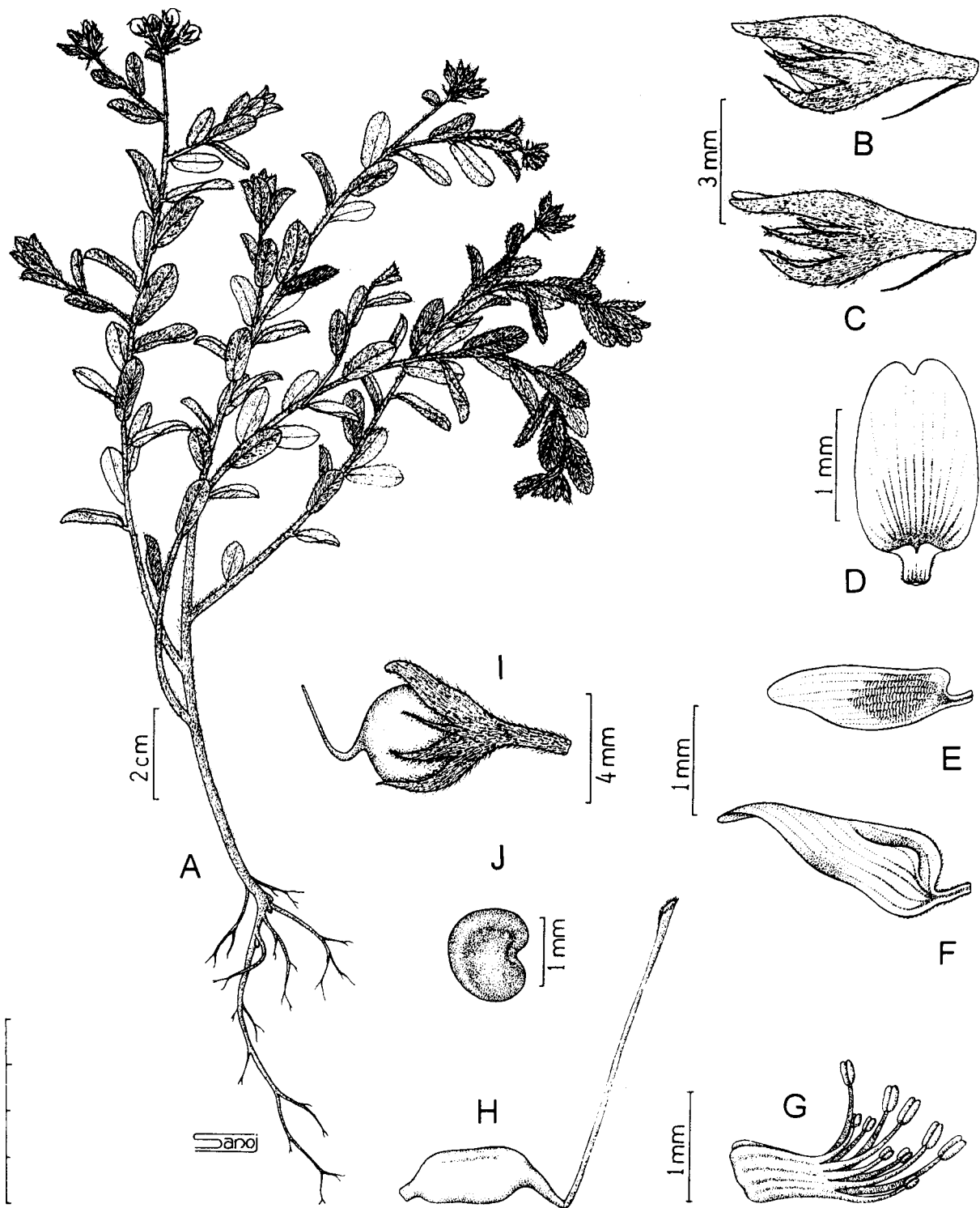


Fig. 32. *C. umbellata* Wight ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From *Sibichen & Joby* 657).

46
118

expanded, hairy. Pods 3 mm diam., globose, glabrous, turns black when dry, 5 - 8 seeded. Seeds 0.5 mm diam., reniform, brown.

Distribution and ecology: *C. umbellata* is distributed in South India, Sri Lanka and South East Asia (Niyomdham, 1978). It occurs in hills up to an altitude of 2000 m. The plant flowers and fruits from January to March.

Notes: *C. umbellata* has been considered conspecific to *C. nana* by Bentham (1843) and Rudd (1991) while, Trimen (1894) and Ansari (1991) treated it as a variety of *C. nana*. However, many authors like Wight and Arnott (1834), Thwaites (1859), Gamble (1918), Saldanha and Nicolson (1976), Niyomdham (1978), Matthew (1983), Pullaiah and Chennaiah (1997) recognized it as a distinct species. Gamble (*l.c.*) even commented that “*C. nana* is a prostrate, annual herb, with often erect branches, occurs in coastal areas while *C. umbellata* is an erect, bushy short lived perennial, seen in the hills, up to 1800 m. altitude.” The studies based on both live and herbarium specimens also confirm Gamble’s (*l.c.*) view. *C. nana* is a low altitude caespitose herb with diffuse branches having 2 - 3, rarely 5 flowered umbels; standard petal acute at apex and subcylindrical pod. But *C. umbellata* is a high altitude perennial herb with ascending branches having 5 - 10 or up to 20 flowered umbels; standard petal emarginate at apex and globose pod.

Specimens examined: ANDHRA PRADESH: Krishna Dt.: Carginini, Venkanna 5667 (CAL). Visakapattanam Dt.: Arakku valley, Balakrishnan 576 (CAL). KARNATAKA: North Canara Dt.: *s.l.*, Talbot 684 (CAL). KERALA: Idukki Dt.: Kulamavu, Mohanan 74578 (CAL); Mattupatty Dam area, Sibichen & Joby 774 (SJC); Pachakkanam, Vivekananthan 46669 (CAL); Micro wave station, Raju 71214 (MH); Painavu, Ramachandran 74531 (CAL). Kannur Dt.: Chandanathode, Ramachandran 58607, Meenmutty, Ramachandran 79985 (CAL). Pathanamthitta Dt.: Pampa, Coodrical R.F., Anil Kumar 1325 (MH). Palakkad Dt.: Nelliampathy,

Sibichen & Joby 657 (SJC). Thrissur Dt.: Karimala Hills, *Sasidharan* 5734 (CALI). Wayanad Dt.: Brahmagiri, *Abdul Jabbar* 43882 (TBGRI). Kalpetta, Manikunnu, *Sibichen* 631 (SJC). TAMIL NADU: Coimbatore Dt.: Anamalais, *Vajravelu* 48774, *Chandrabose* 57759 (CAL). Kanyakumari Dt.: way to Muthukuzhivayal, *Henry* 47545 (CAL). Nilgiri Dt.: Gudalloor, Needle point, *Sibichen & Nampy* 169, *Sibichen* 725 (SJC); Nadugani, *Ellis* 43256 (MH). Ramnad Dt.: Mudaluaruthu, *Vajravelu* 39384 (MH). Salem Dt.: Shevaroys, Sanyasimalai, *Rao* 23082; Yercaud, *Venugopal* 19123 (CAL).

Subsect. *Exsertae* Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Key to the Species

- 1a. Leaves stipulate 2
 - 1b. Leaves estipulate 3
 - 2a. Stipules large, foliaceous, reflexed; bracts three,
two lateral and one median 4. *C. mysorensis*
 - 2b. Stipules minute, subulate, not reflexed, sometimes
at the forks of the branches; bracts two, lateral 3. *C. hirta*
 - 3a. Style not geniculate 1. *C. albida*
 - 3b. Style geniculate 4
 - 4a. Pods oblong, glabrous 2. *C. epunctata*
 - 4b. Pods elliptic, golden tomentose 5. *C. pusilla*
1. **C. albida** Heyne ex Roth., Nov. Pl. Sp. 333. 1821; DC., Prodr. 2: 126. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 189. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 563. 1843; Thw., Enum. Pl. Zeyl. 82. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 71. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 12. 1894; Cooke, Fl. Pres. Bombay 1: 315. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 295. 1918 (repr.

ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 145 & 2: t. 109. 1932 (repr. ed. 1977); Saldan. & Nicolson, Fl. Hassan 241. 1976; Niyomdham, Thai For. Bull. 11: 120. 1978; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 369. 1983; Saldan., Fl. Karnataka 1: 431. 1984; Ansari, J. Econ. Tax. Bot. 15(2): 455. 1991; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 205. 1991; Sanjappa, Leg. India 116. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 252. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 152. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 159. 2002.

Type: India Orientalis, *Heyne* (K).

Vernacular names: Hill rattle wort (Eng.); Kondagiligichha (Tel.).

Caespitose short lived perennial herb, 15 - 30 cm tall. Stems and branches slender, wiry, more or less silky pubescent. Leaves simple, estipulate, subsessile; lamina 1.5 - 2.5 x 0.2 - 0.6 cm, oblanceolate - oblong; base cuneate; apex rounded or obtuse, mucronate, glabrous above and appressed pubescent beneath, pellucid punctate below. Racemes terminal, 3 - 10 cm long, 6 - 10 flowered. Flower 1 cm long and 0.6 cm across; bracts 1 mm long; bracteoles 3 mm long, linear, setaceous, inserted on the pedicel close to calyx tube; pedicel 3.5 mm long, silky pubescent. Calyx as long as corolla, silky pubescent, bilipped; upper lobes 7 x 2.5 mm, obtuse, connate 1/3rd at the base; lower lobes 6 x 1 mm, narrow, acuminate, connate at the base and apex. Corolla yellow, without purple striations; standard petal 7 x 5 mm, ovate, pubescent along the midvein on the back; wing petals 7 x 2.5 mm, oblong; keel petal 7 x 3 mm, abruptly rounded in lower part, inner margin hirsute, beak twisted to 180°. Staminal sheath 1.5 mm long; filaments 5 mm and 3 mm long alternately with ovoid (0.25 mm long) and oblong (1 mm long) anthers respectively. Ovary 2 x 1 mm, sessile; style 7 mm long, not geniculate, minutely puberulant along the inner margin; stigma not expanded.

Pods 1.5 x 0.6 cm, oblong, sessile, glabrous, 6 - 12 seeded. Seeds 1 mm diam., black, cordiform, smooth, shining.

Distribution and ecology: *C. albida* is distributed mainly in the tropical regions of India, Ceylon, China, Pakistan, Nepal, Bhutan and Malesia (Sanjappa, 1992). Matthew (1999), reported that it is very common in exposed grassy slopes, from 800 m to 1800 m. However, the species could be collected from dry stony soil of forest tracks below 200 m. The seedlings collected from Konkan coast (Goa) established in our Botanical Garden, it did not set pods and seeds.

Notes: Majority of the specimens available at CAL are from West Bengal, Madhya Pradesh, Himachal Pradesh and Maharashtra. South Indian specimens are mostly from Deccan Plateau and they have short shrubby stature against the typical caespitose form. Bentham (1843) also noticed this feature and suspects the occurrence of intermediate forms.

Specimens examined: ANDHRA PRADESH: Adilabad Dt.: Bellampalli, *Venkateswara Prasanna* 9461; Jaipur R.F., *Venkateswara Prasanna* 9432; Sarraipet, *Venkateswara Prasanna* 4817; Tiryani R.F., *Venkateswara Prasanna* 9813; Wankidi R.F., *Venkateswara Prasanna* 9480 (SKU). Chittoor Dt.: Husleykonda, *Fischer* 4379 (CAL). East Godavari Dt.: Kakavada, *Sri Ramamurthy* 14240 (SKU). Guntur Dt.: Vinukonda R.F., *Ramakrishnaiah* 6939 (SKU). Kurnool Dt.: Bairlutu R.F., *Pullaiah & Sri Ramamurthy* 14227; Rudrakad, *Sunitha* 20201 (SKU). GOA: North Goa, Bondla Sanctuary, *Sibichen & Sunil* 795 (SJC). TAMIL NADU: Coimbatore Dt.: Maruthamalai, *Deb* 31372 (CAL). Kanyakumari Dt.: Way to Muthukuzhivayal, *Henry* 48159 (CAL). South Arcot Dt.: Near Chidhambaram, *Ramamurthy* 53565 (CAL). Thirunelvely Dt.: Kuthiaivetti, *Henry* 16407; Naterikal road, *Hooper & Ramaswamy* 38478; Sengaltheri, *Joseph* 15880 (CAL).

2. *C. epunctata* Dalz., Kew J. 3: 210. 1851; Gamble, Fl. Pres. Madras 1: 295. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Saldan., Fl. Karnataka 1: 433. 1984; Ansari, J. Econ. Tax. Bot. 15 (2): 455. 1991; Sanjappa, Leg. India 119. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 252. 1997, Pullaiah & Ramamurthy, Fl. East. Ghats 2: 152. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 159. 2002.

Type: India, *Dalzel* 1878 (CAL).

C. albida Heyne ex Roth var. *epunctata* (Dalz.) Baker In: Hook. f., Fl. Brit. India 2: 71. 1876.

Erect herb, up to 50 cm high, stems and branches terete, appressed gray pubescent. Leaves simple, subsessile, estipulate; lamina 3.5 - 6.5 x 0.7 - 1.4 cm, oblanceolate - oblong; base cuneate, apex obtuse, mucronate, upper surface punctate, sparsely pubescent and densely pubescent beneath, chartaceous. Racemes 6 - 20 cm long, terminal and axillary, 3 - 7 flowered. Flower 10 mm long and 7 mm across; bracts 1 mm long, minute, subulate; bracteoles 3 mm long, setaceous, inserted on the calyx tube; pedicel 2 - 3 mm long, sericeous. Calyx as long as corolla, brown sericeous, bilipped; upper two lobes 8 x 3 mm, obtuse, basally connate; lower three lobes 7 x 1.5 mm, narrow acuminate. Corolla yellow, scarcely exerted; standard petal 8 x 8 mm, orbicular with two small appendages at the base, hairy at apex on the back; wing petals 8 x 3 mm, obovate; keel petals 8 x 3 mm, ovate, rounded at the base, hirsute at inner margin; beak twisted to 180°. Staminal sheath 2 mm long; filaments 3 mm and 2 mm long alternately with ovoid (0.5 mm long) and oblong (1.5 mm long) anthers respectively. Ovary 2 x 0.5 mm, sessile; style 7.5 mm long, geniculate, minutely puberulent along one margin, stigma not expanded. Pods 10 - 12 x 4 - 5 mm, oblong, glabrous, 6 - 12 seeded.

Distribution and ecology: A native of India, *C. epunctata* has also been reported from Indo-malesia and China (Saldanha, 1984). It is occasional in moist and dry deciduous forests.

Notes: *C. epunctata* is allied to *C. albida* Heyne ex Roth. and some times considered conspecific. Baker (1886) treated it as a variety of *C. albida*. But many authors (Saldanha, 1984; Ansari, 1991; Pullaiah & Ramamurthy, 2000) treated it as a distinct species. The present study in consultation with type and protologue corroborate the distinctiveness of the species. *C. epunctata* is distinct from *C. albida* in having erect habit, pubescent leaves and geniculate style against the caespitose habit, glabrous adaxial surface and non geniculate style in *C. albida*.

Specimens examined: ANDHRA PRADESH: Adilabad Dt.: Bijjur, *Obulesu & Prasanna* 4975; Vempalli R.F., *Pullaiah & Obulesu* 5501 (SKU). East Godavari Dt.: Bodhulure R.F., *Sri Ramamurthy* 14255 (SKU).

3. *C. hirta* Willd. in Ges., Naturf. Freunde Berlin Neue Schriften 4: 217. 1803; DC., Prodr. 2: 130. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 182. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 70. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 295. 1918 (repr. ed. 1995); Saldan. & Nicolson, Fl. Hassan. 242. 1976; Polhill, *Crotalaria* in Africa and Madagascar 371. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Saldan., Fl. Karnataka 1: 440. 1984; Matthew, Fl. Tamilnadu Carnatic 3: 368. 1981, Illus. Fl. Tamilnadu Carnatic 4: t. 126. 1988; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 256. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 173. 2000.

Type: Peninsular India, *Klein* 13254 (WILLD - B).

C. mysorensis sensu Peltier 30. t. 2. M, N. 1959 a, non Roth., 1821.

(Fig. 33)

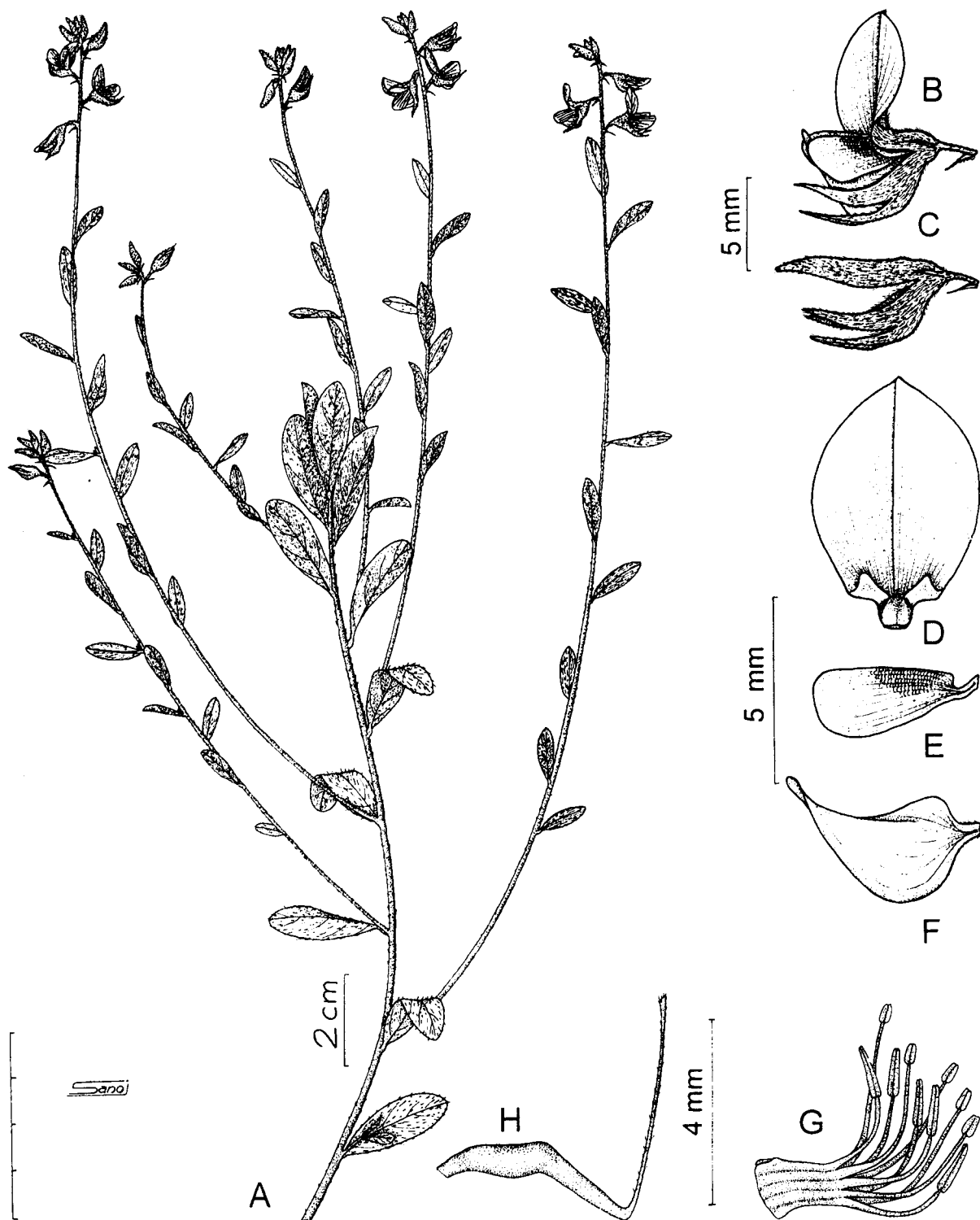


Fig. 33. *C. hirta* Willd.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoceum, (From Sibichen & Nampy 687).

47
157A

Diffuse annual or perennial short lived herb, up to 75 cm tall. Stems and branches terete, brown, densely hispid. Leaves simple, subsessile; petiole *ca* 1 mm long; stipule 5 x 1 mm, subulate, sometimes at the forks of the branches. Lamina 1.5 - 4.5 x 0.5 - 1.5 cm, linear to oblong, base obtuse, sometimes cuneate, apex obtuse or slightly mucronate, pilose on both surfaces, chartaceous. Racemes 5 - 8 cm long, terminal, subcapitate, 3 - 8 flowered. Flower 1.4 cm long and 0.8 cm across; bracts 3 mm long, lanceolate; bracteoles 8 mm long, lanceolate, inserted on the base of the calyx. Pedicel 3 mm long, densely pilose. Calyx bilipped, densely pilose, tube 2.5 mm long; upper two lobes 9 x 2 mm, triangular - lanceolate, connate 1/3rd at the base; lower three lobes triangular - subulate, connate only at the base. Corolla yellow, scarcely exceeding the calyx; standard petal 1.2 x 0.8 cm, obovate, apex pubescent on the back; wing petals 10 x 3 mm, narrow, oblong, shorter than keel; keel petals 1.2 x 0.5 cm, ovate - acute, angled at the base, beak twisted to 180°. Staminal sheath 2 mm long, filaments 6 mm and 2 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 4 x 2 mm; stipe 1 mm long; style 1.2 cm long, geniculate, minutely puberulent; stigma not expanded. Pods 1 - 1.5 x 0.6 - 0.8 cm, oblong - ellipsoid, slightly exserted, glabrous, 15 - 20 seeded. Seeds 2 - 2.5 mm diam., obliquely cordiform, smooth, reddish brown.

Distribution and ecology: *C. hirta* is endemic to India. It is seen in moist and dry deciduous forests, up to an altitude of 750 m. It flowers and fruits from January to March.

Notes: Though *C. hirta* is closely allied to *C. chinensis*, but it differs from the latter by its small obtuse leaves and much shorter calyx.

Specimens examined: ANDHRA PRADESH: Karimnagar Dt.: Aklaspur, *Subba Rao* 22522 (CAL). Nizamabad Dt.: Gandhari R.F., *Raviprasad Rao & Babu* 7228 (SKU). KERAL: Idukki Dt.: Adimaly - Munnar Road, *Sibichen &*

Nampy 687 (SJC). TAMIL NADU: Godawari Dt.: Lakkonda, *Gamble* 21772 (CAL).

4. *C. mysorensis* Roth., Nov. Pl. Sp. 338. 1821; DC., Prodr. 126. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 182. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 70. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 321. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 285. 1918 (repr. ed. 1995); Matthew, Fl. Tamilnadu Carnatic 1: 370. 1981; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 98. 1983; Saldan., Fl. Karnataka 1: 437. 1984; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 134. 1988; Vajrav., Fl. Palghat 149. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 206. 1991; Sanjappa, Leg. India 125. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 138. 1994; Sasi. & Sivar., Fl. Thrissur 437. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 259. 1997; Matthew, Fl. Palni Hills 1: 303. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 180. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 158. 2002.

Type: India, Mysore, *Heyne* (K).

C. stipulacea Roxb., Fl. Ind. 3: 264. 1832.

C. decasperma Naik, *Indian For.* 92 (12): 760. 1966.

Vernacular names: Karibijada buddegida (Kan.).

(Fig. 34, Pl. 4 D)

Erect, short lived perennial herb or shrubby herb with copious branches, 30 - 75 cm tall. Stems and branches terete, covered with ferruginous long hairs. Leaves simple; stipule 0.4 - 2 cm long, foliaceous, lanceolate, reflexed; petiole 1 - 2 cm long; lamina 2.7 - 5 x 1 - 1.4 cm, elliptic lanceolate to narrowly oblong, chartaceous, sparsely hirsute above and densely hirsute beneath. Racemes 10 - 20 cm long, terminal and lateral, 3 - 8 flowered.

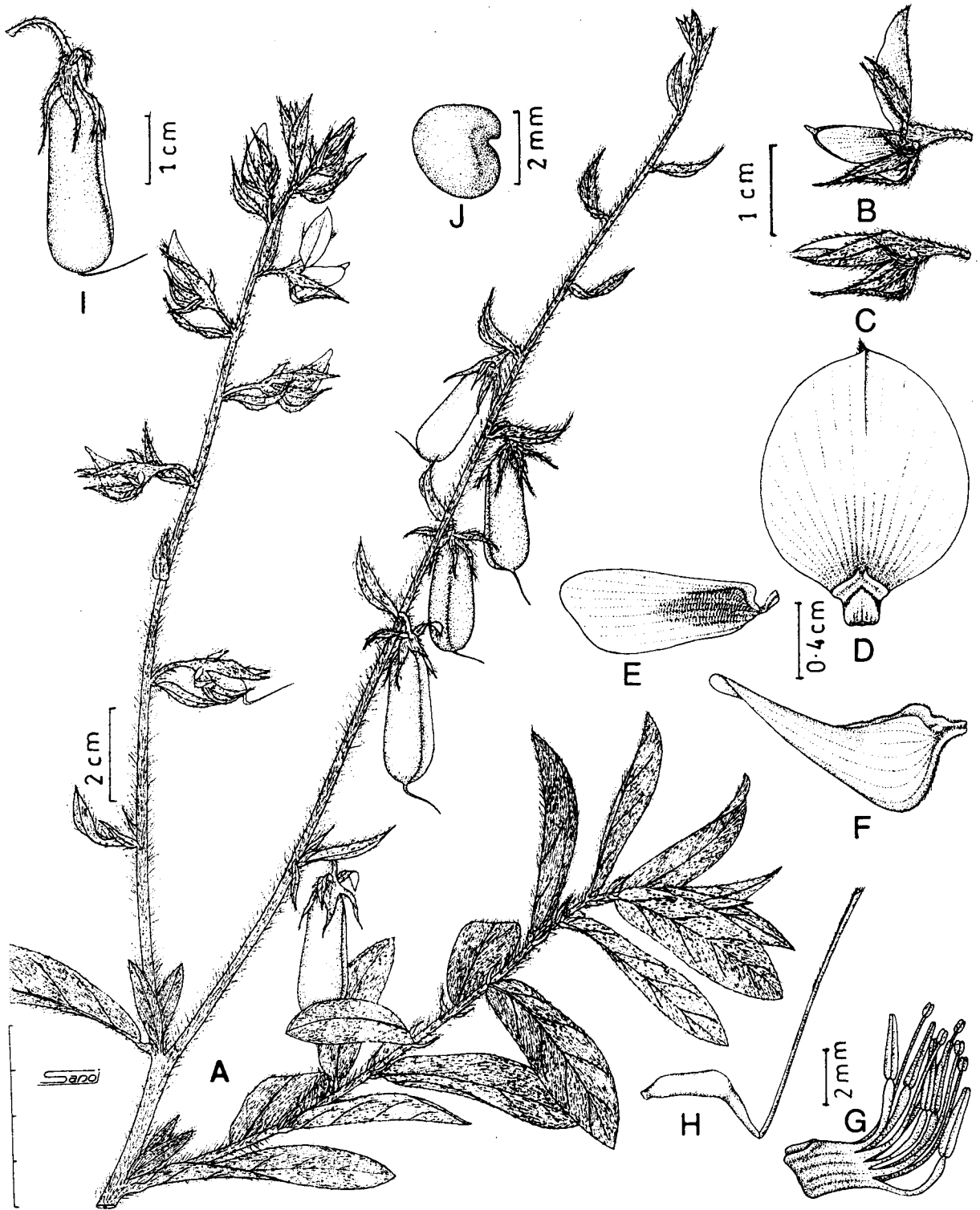


Fig. 34. *C. mysorensis* Roth: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen & Sanoj 712).

Flowers 2 cm long and 1 cm across, arranged laxly on peduncle; bracts 3, one large median (2.1 x 0.6 cm), and two small lateral (7 x 1.5 mm) lanceolate, foliaceous, glabrous above and sparsely hirsute beneath; bracteoles 1.2 x 0.2 cm, lanceolate, on the calyx tube. Pedicel 1 cm long, brown tomentose. Calyx hirsute, about or equal to corolla; calyx tube 3 mm long, lobes 5, upper two lobes broad, acuminate, lower 3, narrow, falcate, deeply five cleft. Corolla yellow, turns brownish - black when dry, hardly exerted; standard petal 1.6 x 1.2 cm, ovate to orbicular with two appendages at the base; glabrous except along the mid-vein and apex on the back; wing petals 1.8 x 1 cm, oblong with a basal claw; keel petals 1.5 x 0.5 cm, angular at the base, outer margin fulvous, beak twisted to 180°. Staminal sheath 2 mm long, glabrous; filaments 10 mm and 4 mm long alternately with ovoid (0.5 mm) and oblong (2 mm) anthers respectively. Ovary 1 x 0.2 cm, glabrous; stipe 0.5 mm long; style 2.2 cm long, geniculate; stigma hairy. Pods 3.2 x 1.2 cm, oblong, glabrous, slightly broadened towards the base, 35 - 40 seeded. Seeds 1.5 mm diam., obliquely cordate, black, shining.

Distribution and ecology: *C. mysorensis* is distributed in India, Malesia, Nepal, Pakistan (Sanjappa, 1992) and Sri Lanka (Rudd, 1991). It occurs commonly in deciduous forests and hills at an altitude of 650 - 1100 m. The plant flowers from October to December and fruits from January to March.

Notes: Critical studies in consultation with types and protologues of *C. stipulcea* and *C. decasperma* lead to the conclusion that they are conspecific with *C. mysorensis*. This is in corroboration with Ansari (2002).

Specimens examined: ANDHRA PRADESH: Karimnagar Dt.: Rechapalli, *Subba Rao* 25694 (MH). Kurnool Dt.: Chellama, *Ellis* 22054 (MH). KARNATAKA: Mysore Dt.: Bandipur, *Neaithani* 21275 (MH). KERALA: Idukki Dt.: Thekkady, *Jomy* 16962 (CALI). Palakkad Dt.: Panthanthode, *Vajravelu* 33149 (CAL); Parambikulam, *Abdul Jabbar* 45555 (TBGRI);

Valayar, *Joseph* 17081 (CAL), *Sibichen & Sanoj* 712 (SJC). Thrissur Dt.: Vellayanimala, *Sasidharan* 5147 (CALI). Wayanad Dt.: Muthanga forest, *Sibichen, Joby & Dinesh Raj* 741 (SJC). TAMIL NADU: Coimbatore Dt.: Thekkumalai, *Sebastine* 1739 (CAL). Madurai Dt.: Courtallum, *Rama Rao* 2040; Koodallore, Kumali Road, *Subramanyam* 8091; Kuridimalai, *Subramanyam* 1772; Poolathur, *Chandrabose* 51695 (MH); Varahamanadhi MHEP area, *Ramamurthy* 85989; Vilpatti Valley R.F., *Chandrabose* 5136 (CAL). Salem Dt.: Namakkal, *Mohan* 13133 (CAL).

5. *C. pusilla* Heyne ex Roth., Nov. Pl. Sp. 335. 1821; DC., Prodr. 2: 128. 1825; Wight & Arn., Prodr. 1: 189. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 563. 1843; Baker In: Hook. f., Fl. Brit. India 2: 70. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 315. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 105. 1914; Gamble, Fl. Pres. Madras 1: 286. 1918 (repr. ed. 1995); Saldan. & Nicolson, Fl. Hassan 243. 1976; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Matthew, Fl. Tamilnadu Carnatic 3: 373. 1983; Saldan., Fl. Karnataka 1: 440. 1984; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 143. 1988; Vajrav., Fl. Palghat 152. 1990; Sanjappa, Leg. India 127. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 251. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 190. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 163. 2002.

Type: India Orientalis, *Heyne* (K).

Erect annual herb with copious ascending branches, 5 - 25 cm tall. Stems and branches slender, terete, appressed brown tomentose. Leaves simple, estipulate, subsessile; lamina 5 - 15 x 1.5 - 3 mm, narrow, oblong, subcoriaceous, sparsely sericeous above and densely beneath; base cuneate; apex obtuse - sub acute. Racemes 2 - 5 cm long, terminal, 3 - 10 flowered. Flowers 4 mm long and 3 mm across; bracts and bracteoles 3 - 4 mm long,

lanceolate, setaceous; pedicel 2 mm long, densely tomentose. Calyx deeply 5 cleft and very slightly bilipped, golden sericeous; lobes equal, 2 mm long, lanceolate, connate at the base. Corolla yellow, scarcely exserted; standard petal 3 x 1 mm, oblong, pubescent along the midvein on the back; wing petals 2 mm x 1 mm, oblong; keel petals 3 mm x 1.5 mm, ovate, angular at the middle, beak twisted to 180°. Staminal sheath 1 mm long; filaments 2 mm and 1.5 mm long alternately with ovoid and oblong anthers respectively. Ovary 1.5 mm x 1 mm, tomentose all over; style 2.5 mm long, geniculate; stigma expanded, hairy. Pods 7 x 2 mm, elliptic, golden tomentose, 4 - 6 seeded. Seeds 1 mm diam., pale brown, obliquely cordate.

Distribution and ecology: *C. pusilla* is endemic to India (Sanjappa, 1992). It is frequent in dry stony soil across the plains and wastelands. It flowers from June to September and fruits from October to January.

Notes: *C. pusilla* has been treated under different sections by various authors. Wight and Arnott (1834) treated it under the sect. Diffuse; Bentham (1843) under Erectae; Baker (1876) and Ansari (2002) under Calycinae and Gamble (1918) under Eriocarpae. The taxon shares certain features characteristic to section diffuse in having diffuse branches and Eriocarpae by hairy pods. It matches with Erectae due to its exserted pods but differs due to its glabrous nature. While considering the overall characters, the species fits best under section Calycinae. Baker (1876), Cooke (1902) and Gamble (1918) reported *C. pusilla* as the smallest plant among the species of *Crotalaria* in South India. However, among our collections *C. humifusa* is the smallest.

Specimens examined: ANDHRA PRADESH: Kurnool Dt.: Nallamalais, Ellis 3243; Swamyapenta Colony, Ellis 22125 (MH). Ranga Reddy Dt.: Mohammedasad, Silar Mohammed 10482 (SKU). KERALA: Palakkad Dt.: Walayar R.F., Joseph 17882 (MH). TAMIL NADU: Chinglepet Dt.:

Karikili, Henry 47090 (MH). Coimbatore Dt.: Konnamalai, Sree Madhavan 351 (MH).

Sect. *Erectae* Wight & Arn., Prodr.1: 181.1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 480. 1843; Baker In: Hook. f., Fl. Brit. India 1: 75. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 283. 1918 (repr.ed. 1995); Ansari In: Rao (ed.), Adv. Leg. Res. 164. 2002.

Sect. fulvae Wight & Arn., Prodr. 1: 182. 1834 (repr. ed. 1976) p.p.

Type species: *C. retusa* L.

Erect, annual or perennial herbs or shrubs with many ascending branches. Stems and branches glabrescent to rusty tomentose. Leaves simple, usually glabrous above and sparsely to densely sericeous beneath; stipules minute to prominent, even wanting, not decurrent. Racemes terminal or lateral, many flowered. Calyx shorter than corolla, usually pubescent or glabrous. Corolla yellow turns black when dry. Pod twice as long as calyx or more, oblong – clavate, stipitate or sessile, glabrous, many seeded.

Notes: Wight and Arnott (1834) recognized 9 species under the sect. *Erectae*. They further divided the section into 2 groups viz., ‘*Retusae*’ and ‘*Verrucosae*’ having glabrous or softly pubescent legumes respectively. Moreover, *Verrucosae* have prominent transverse, semilunar, recurved stipules. Subsequent authors like Bentham (1843), Baker (1876), Gamble (1918) and Ansari (2002) adopted this section without or with slight modification in the subsectional level. Bentham (*l.c.*) divided this section in to two groups “*folis supra glabrous*” and “*folis supra sericeous*”. Gamble (1918) also followed a similar sub sectional classification. Baker (*l.c.*) and Ansari (2002) also recognized 8 and 9 species under this section respectively, without attempting a sub sectional classification. Polhill (1982) treated this as a subsection under the sect. *Crotalariae* along with other sections such as

Bracteatae and Polyphyllae. In the present treatment, 8 species are included from South India.

Key to the species

- 1a. Leaves glabrous above 2
- 1b. Leaves sparsely pubescent to sericeous above 5
- 2a. Branchlets sulcate, puberulous 3
- 2b. Branchlets terete, rusty tomentose 4
- 3a. Stipules and bracts minute, subulate;
pods oblong, sessile *5.C. retusa*
- 3b. Stipules and bracts prominent, ovate - acuminate;
pods clavate, stalked *8.C. spectabilis*
- 4a. Racemes long (20 - 30 cm long), many (12-18)
flowered; leaves large, ovate - elliptic; stipules large,
semi - lunar; pod > 4.5 cm long; woody shrubs *2.C. beddomeana*
- 4b. Racemes short (3 - 8 cm), few (3 - 6) flowered;
leaves small, obovate; stipules minute, setaceous;
pod < 3 cm long; shrubby herbs *3.C. formosa*
- 5a. Bracts and bracteoles broadly cordate, margin revolute;
keel petal not twisted at the beak *4.C. longipes*
- 5b. Bracts and bracteoles ovate to linear, margin not
revolute; keel petal twisted at the beak 6
- 6a. Leaves dimorphic; peduncle long (20 - 30 cm);
calyx golden brown *6. C. salicifolia*
- 6b. Leaves monomorphic; peduncle short (5 - 10 cm);
calyx silky brown 7
- 7a. Style geniculate; standard petal with a tuft of hairs
at the distal end on the back; beak of keel twisted to
180°; leaves estipulate *7.C. scabra*

- 7b. Style not geniculate; standard petal glabrous on the back; beak of keel twisted to 90°;
leaves stipulate..... *1.C. barbata*

1. *C. barbata* Grah. ex Wight & Arn., Prodr. 1: 181. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 483. 1843; Wight, Ic. t. 980. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 76. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 148 & 2: t.113. 1932 (repr. ed. 1977); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Sanjappa, Leg. India 119. 1992; Sivar. & Mathew, Fl. Nilambur 178. 1997; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: *Wall.* Cat. no. 5394 (K)

(Fig. 35)

Erect, perennial shrub with several ascending branches, 2 - 3.5 m high. Stems and branches terete, dark brown velvety. Leaves simple, sessile; stipules minute, inconspicuous; lamina 3.5 - 8 x 1.4 - 3 cm, oblong - oblanceolate; base cuneate - truncate; margin slightly revolute; apex acute-mucronate, coriaceous, sparsely sericeous above and densely beneath. Racemes 5 - 10 cm long, terminal and axillary, lax, 5 - 10 flowered. Flower 2.5 - 2.8 cm long and 1.3 - 1.5 cm across; bracts 5 x 3 mm, ovate - lanceolate, brown setaceous; bracteoles 6 x 2 mm, lanceolate, flat, inserted on calyx tube, appressed to sepals; pedicel 1 - 1.25 cm, brown tomentose. Calyx silky brown sericeous out and glabrous in, bilipped; upper lobes 2 x 5 mm, broad acuminate, connate about ½ their length; lower lobes 1.5 x 0.4 mm, narrow acuminate, connate only at the base. Corolla bright yellow, exceeding the calyx; standard petal 2 x 1.8 cm, orbicular, notched centrally at the distal margin; wing petals 1.2 x 0.8 cm, oblong; keel petals 2 x 0.75 cm, rounded about the middle, inner margin lanate, beak twisted to 90°, leaving a hole at

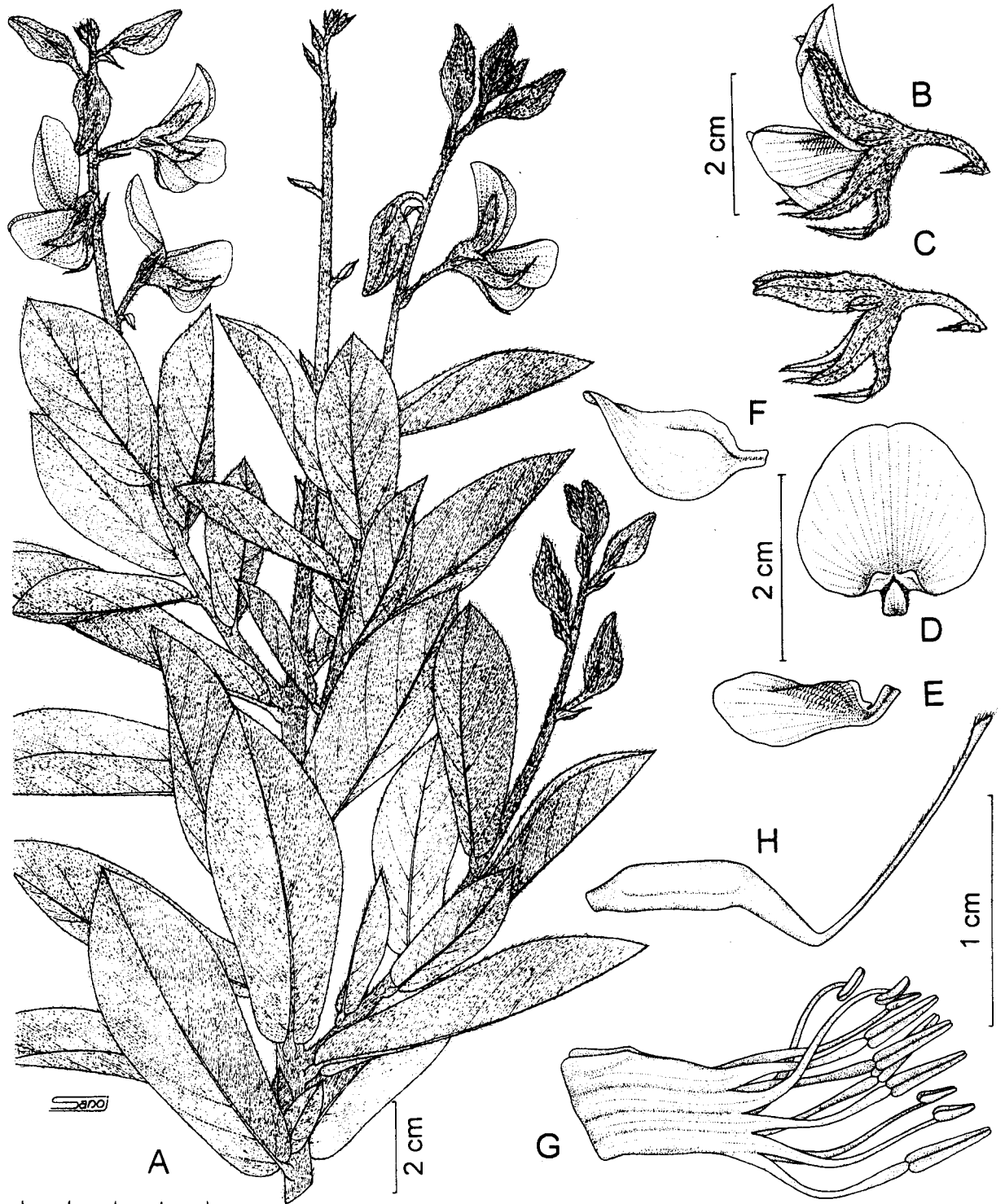


Fig. 35. *C. barbata* Garh. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen 684).

49

145A

the tip. Staminal sheath 8 mm long, filaments 10 mm and 7 mm long alternately with ovoid (0.5 mm long) and oblong (4 mm long) anthers respectively. Ovary 7 x 3 mm, glabrous; style 1.3 cm long, not geniculate, hairy along the margin; stigma expanded, hairy. Pods 3 - 3.5 x 1.2 - 1.5 cm, obovoid, widest at the distal end, glabrous; stalk 2 - 4 mm long, flat. Seeds not seen.

Distribution and ecology: *C. barbata* is endemic to Peninsular India (Sanjappa, 1992). It is distributed in higher altitudes (1500 - 2000 m), especially in shola forests of Nilgiris in Western Ghats. It flowers and fruits from December to March.

Notes: Wight and Arnott (1834) included *C. barbata* under the sect. Calycinae while later authors like Bentham (1843), Baker (1876), Gamble (1918) and Ansari (2002) treated it under the sect. Erectae. Members of the sect. Calycinae are small herbs with terminal racemes or umbels and their calyx is much prominent, more or less equaling the corolla and in many cases enclosing the pod. But, *C. barbata* is a shrubby herb with terminal and axillary racemes. Moreover, the corolla and pod well exceeding the calyx. Therefore, it is better to treat *C. barbata* under the sect. Erectae. *C. barbata* is distinct in having bright yellow flowers and dark - green, erect, rather crowded leaves. The plant has silky brown hairs throughout and turns black when dry.

Specimens examined: KERALA: Palakkad Dt.: Malabar, *Fischer* 2515 (CAL); Silent Valley, Sispara, *Philip Mathew* 33861, *Sabu* 11311 (CALI). TAMIL NADU: Nilgiri Dt.: Avalanchi, *Shetty* 37582 (MH); *Sibichen & Chandran* 684 (SJC); Conoor, *Gamble* 12709 (CAL); Kodanadu, *Vajravelu* 39702; Naduvattom, *Meebold* 11754 (CAL), *Ellis* 43326; *Rathakrishnan* 39020; Mudimunda, *Ellis* 37846 (MH).

2. *C. beddomeana* Thoth. & Ansari, Bull. Bot. Surv. India 20: 180. 1978; Sanjappa, Leg. India 117.1992; Matthew, Illus. Fl. Palni Hills t. 154. 1996, Fl. Palni Hills 1: 297. 1999; Ansari In: Rao (ed.), Adv. Leg. Res.165. 2002.

Type: India, Madras, Anamalais and Pulney Hills, *Beddome* (isotype: CAL).

C. lanata Bedd., Madras J. Lit. Sci., 19: 178. 1858; Baker In: Hook.f., Fl. Brit. India 2: 77. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; non, Thunb. 1796, *nom. illegit.*

C. lunata Bedd., Madras J. Lit. Sci. 1: 42. 1864, *nom. nud.*

C. lunata Bedd. ex Polhill, *Crotalaria* in Africa and Madagascar 373. 1982; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 194. 1991.

(Fig. 36, Pl. 5 A)

Erect, perennial woody shrub with several ascending branches, 2 – 5 m high. Stems and branches terete; branchlets striate, rusty villous. Leaves simple; stipules 1.5 x 1 cm, semi - lunar, foliaceous, transverse; petioles 1 - 1.5 cm long, tomentose; lamina 8 – 14 x 5 - 7 cm, elliptic, base rounded, apex obtuse, apiculate, glabrous above and sparsely villous beneath, subcoriaceous. Racemes 20 – 30 cm long, terminal and lateral, 12 – 18 flowered. Flowers 3 cm long and 1.5 cm across; bract 0.8 x 0.3 cm, ovate, acuminate; bracteoles 4 x 1.5 mm, acuminate, inserted on pedicel close to calyx, appressed to calyx tube; pedicel 1 - 1.2 cm long, rusty tomentose. Calyx brown, hirsute, lobes equal, 1.5 – 2 cm long, triangular; Corolla bright yellow; standard petal 2.5 x 2.5 cm, orbicular, glabrous; wing petals 2.8 x 1.8 cm, oblong, exceeding the keel; keel petals 2.2 x 1.3 cm, ovate, rounded below the middle, with a twisted beak. Staminal sheath 1.3 cm long, filaments 10 mm and 5 mm long alternately with ovoid (0.5 mm long) and oblong (1 mm long) anthers

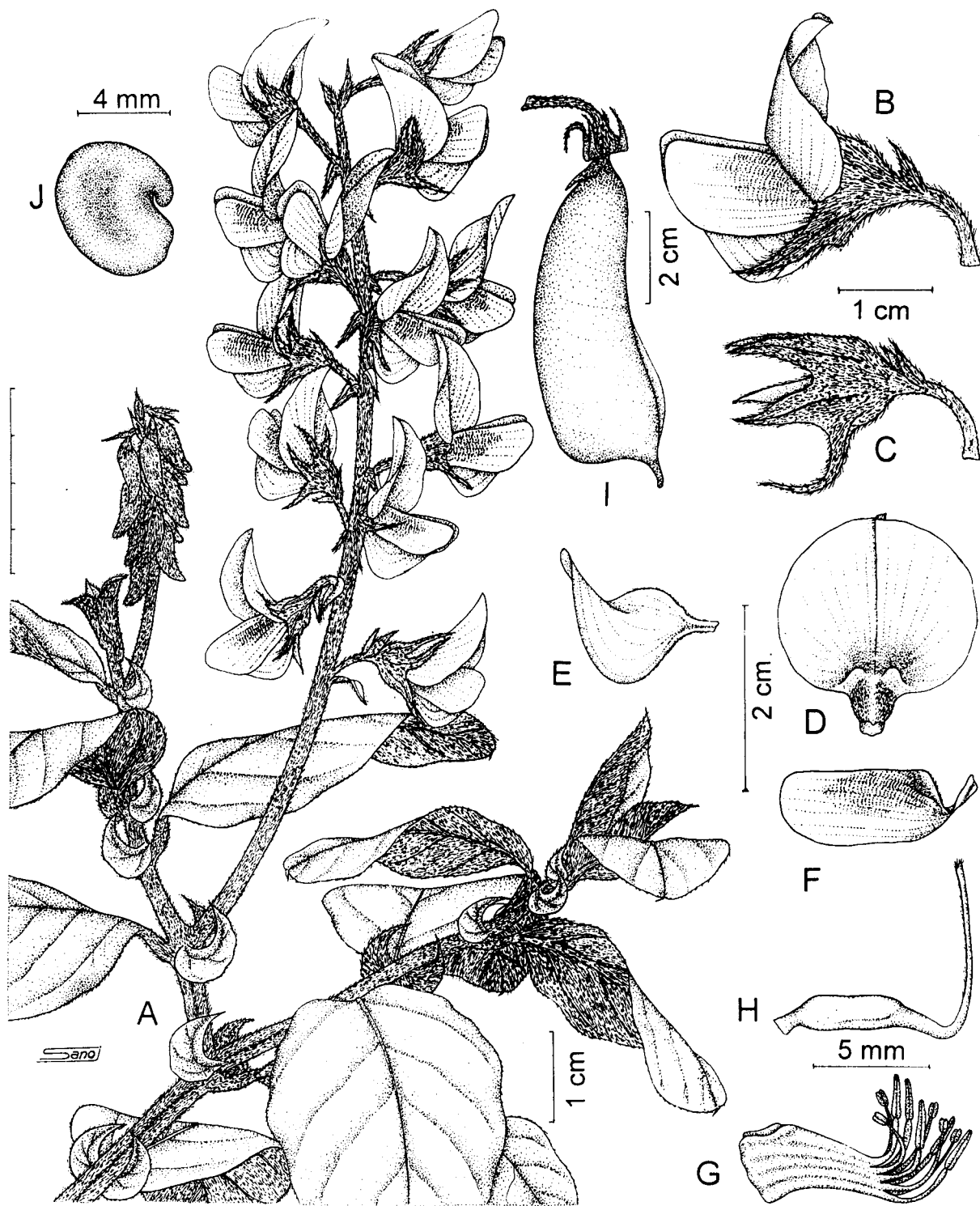


Fig. 36. *C. beddomeana* Thoth. & Ansari: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen & Nampy 612).



Plate 5. A. *C. beddomeana*; B. *C. spectabilis*; C. *C. stipitata*; D. *C. juncea*.

157 28

respectively. Ovary 9 x 3 mm, glabrous; stipe 2 mm long; style 1.5 cm long, not geniculate; stigma not expanded, hairy. Pods 4.5 - 5 x 1.5 - 1.8 cm, clavate, glabrous, 12 - 16 seeded; stalk 1 cm long, flat. Seeds 7 x 5 mm, obliquely cordiform, smooth, brown.

Distribution and ecology: *C. beddomeana* is a native of South India and is introduced to Sri Lanka, Africa, New Guinea and Australia as an ornamental and as shade in tea and coffee plantations (Rudd, 1991). It usually occurs on waysides of high altitudes ca. 1600 - 2400 m. Flowers are in peak during September to December and pods are seen throughout the year (Matthew, 1999).

Notes: *C. beddomeana* is an attractive ornamental shrub. The conspicuous stipules, copious foliage, bright yellow flowers and large clavate pods easily identify the species in the field. Many authors viz. Baker (1876) Gamble (1918) and Ansari (2002) placed it under the sect. *Eriocarpae* due to its semi-lunar stipules and large exserted pods. Since *C. beddomeana* has glabrous pods, it is better to place the species under the sect. *Erectae*.

Specimens examined: KARNATAKA: Shimoga Dt.: Theerthahalli, *Sundara Ragavan* 82808 (CAL). KERALA: Idukki Dt.: Munnar - Marayur way side, *Sibichen & Nampy* 612; Munnar - Rajamala wayside, *Sibichen & Joby* 781 (SJC). TAMIL NADU: Anna Dt.: Vardhamanadhi, *Ramamurthy* 86423 (CAL). Coimbatore Dt.: Navamalai, *Joseph* 14178; Distillery Road, *Chandrabose* 28441 (CAL). Krishna Dt.: Beguwada, *Gamble* 12589 (CAL). Lalgudi Dt.: Grand Anicut Campus, *Matthew, Manohar & Alamelu* 19150 (CAL). Madurai Dt.: Palni, *Sebastine* 25048 (CAL); Shembagannur, S.H. College Campus, *Sibichen & Sanoj* 691 (SJC). Nilgiri Dt.: Pakasura Hills, *Sebastine* 4843 (MH). Ramanathapuram Dt.: Kallayarkovil, *Nair* 57439 (CAL). Salem Dt.: Yercaud, *Matthew, Venugopal & Jayasree* 18718 (CAL). Thirunelvely Dt.: Naterikkal, *Hooper & Ramaswamy* 384 (CAL).

3. *C. formosa* Grah. ex Wight & Arn., Prodr. 1: 186. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 481. 1843; Wight, Ic. t. 981. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 76. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 148 & 2: t. 112. 1932 (repr. ed. 1977); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 96. 1983; Sanjappa, Leg. India 120. 1992; Sivar. & Mathew, Fl. Nilambur 179. 1997; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: *Wall.* Cat. no. 5393 (K).

Erect perennial low shrub with many ascending branches, 0.5 - 1.25 m tall. Stems and branches terete, rusty tomentose. Leaves simple; stipules 1 mm long, minute, setaceous, curved downward; petioles 2 - 3 mm long, tomentose; lamina 2.5 - 4.5 x 1.4 - 2 cm, obovate; base narrow - cuneate; apex obtuse or mucronate, dark green, coriaceous, glabrous above and brown silky tomentose beneath. Racemes 3 - 8 cm long, terminal, 3 - 6 flowered. Flower 2 - 2.2 long and 1.5 - 1.8 cm across; bracts 4 x 2 mm, ovate - lanceolate, reflexed; bracteoles 2 mm long, linear, inserted near the base of pedicel; pedicel 5 mm long, brown tomentose. Calyx tube extended on lower side, tomentose out and glabrous in; lobes equal, 8 x 4 mm, ovate, connate at the base; Corolla bright yellow with purple striations, slightly exserted; standard petal 2 x 2 cm, orbicular, base broadly emarginate; wing petals 1.5 x 0.8 cm, oblong; keel petals 2 x 0.8 cm, rounded about the middle, inner margin fulvous, beak twisted. Ovary glabrous; style not geniculate. Pods 2.8 - 3.2 x 1.2 - 1.5 cm, oblong, glabrous, 8 - 12 seeded; stalk 2 - 4 mm long, flat. Seeds 2 mm diam., obliquely cordiform, laterally compressed.

Distribution and ecology: *C. formosa* is endemic to South India. It occurs in sholas and exposed rocky slopes above 2000 m.

Notes: *C. formosa* is characterized by rusty tomentose stems and leaves with short, thick racemes of dense yellow flowers.

Specimens examined: KERALA: Malappuram Dt.: Nilambur, Kunda Hills, Mathew 33828 (CALI). TAMIL NADU: Nilgiri Dt.: near East Varahapallam Dam, Shetty 37542; Pykara, Rathakrishnan 39086; Avalanchi, Shetty 37626 (MH).

4. *C. longipes* Wight & Arn., Prodr. 1: 183.1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 76. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Sanjappa, Leg. India 123. 1992; Matthew, Kew Bull. 48 (4). 759. 1993; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 258. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 174. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: Kolli hills, Wight 990 (K).

C. subperfoliata Wight & Arn., Prodr. 1: 184. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 79. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 288. 1918 (repr. ed. 1995); Sanjappa, Leg. India 130. 1992.

C. shevaroyensis Gamble, Bull. Misc. Inform. Kew 28. 1914, Fl. Pres. Madras: 288.1918 (repr. ed. 1995); Fyson, Fl. S. Ind. Hill Stat. 1: 151. 1932 (repr. ed. 1977); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Sanjappa, Leg. India 129. 1992.

C. kodaiensis Debb. & Biswas, J. Indian Bot. Soc. 16: 59. 1937.

Vernacular name: Kattuthuvarai (Tam.).

(Fig. 37)

Erect, perennial woody shrub with several ascending branches, 1.5 - 3 m tall. Stems and branches terete, ferruginous villous. Leaves simple, estipulate; petiole 3 - 5 mm long, villous; lamina 4.5 - 9 x 2.5 - 4.5 cm,

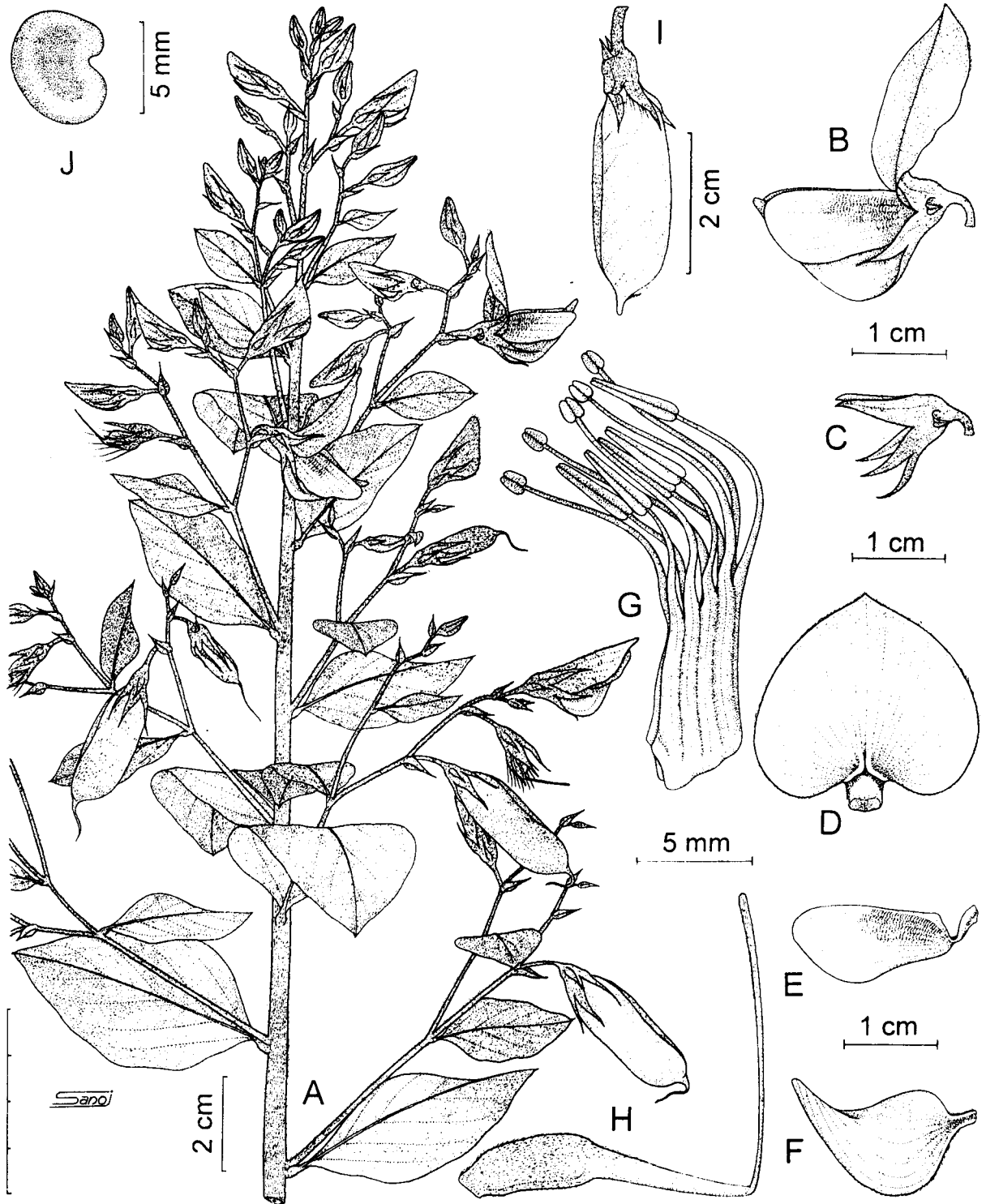


Fig. 37. *C. longipes* Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen 728).

52
150A

obovate-elliptic, base cuneate, apex acute, mucronate, silky pubescent on both surfaces, veins prominent underneath, coriaceous. Racemes 6 - 8 cm long, terminal and axillary 3 - 5 flowered. Flowers 1.5 cm long and 1 cm across; bracts 4 - 6 x 4 - 2 mm, ovate - cordate, foliaceous, margin revolute; bracteoles 3 - 5 x 1.5 - 2.5 mm long, ovate - acuminate, silky tomentose out and glabrous in, inserted on mid-pedicel; pedicel 1 cm long. Calyx bilipped, rusty tomentose; tube 4 mm long; lobes sub equal, upper two large, 10 x 3 mm, triangular, acuminate; lower three 7 x 3 mm, narrow, acuminate, margin slightly revolute. Corolla bright yellow; standard petal 2 x 1.8 cm, broadly ovate, silky pubescent out and glabrous in; wing petals 1.4 x 0.6 cm, oblong; keel petals 1.8 x 1 cm, ovate, rounded at the middle, outer and inner margin fulvous basally, beak not twisted. Staminal sheath 6 mm long; filaments 8 mm and 4 mm long alternately with ovoid (1 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 4 x 1.5 mm, silky pubescent; stipe 1 mm long; style 1.4 cm long, not geniculate, pubescent along the margin; stigma expanded, hairy. Pods 3.2 - 4 x 1- 1.2 cm, oblong; base and apex attenuate, glabrous, 10 - 12 seeded. Seeds 4 x 3 mm diam., obliquely cordiform, smooth, shining, pale brown.

Distribution and ecology: *C. longipes* is rare and endemic to South India (Ahmedullah & Nayar, 1987). It occurs in hills above 1500 m, as an undergrowth of semi evergreen forests. It flowers from August to November and fruits from November to March.

Notes: *Crotalaria*, being the most prolific genus in Pulney hills, the chance of erroneous description is high. The species, *C. longipes* can be a good example of the above phenomenon. The binomials associated with *C. longipes* viz., *C. subperfoliata*, *C. shevaroyensis*, and *C. kodaiensis* were described from the adjoining hills viz., Kolli hills (Colemala), Servarayens (Shevaroy), Palnis (Pulneys) and Sirumalai (Dindigul hills) within a radius of 150 km. Detailed

examination of live specimens and their comparisons revealed that the above species are described mainly based on indumentum and inflorescence characters which is found intergrading. Hence they are treated as synonyms of *C. longipes*. My observations is in corroboration with Matthew (1993) and Pullaiah and Ramamurthy (2000 partly).

Specimens examined: TAMIL NADU: Madurai Dt.: Dharmapuri, *Matthew & Venugopal* 20426 (MH). Namakkal Dt.: Kolli hills, Solakkadu, *Perumal & Manoharan* 21460 (MH). Nilgiri Dt.: way to Kottagiri, *Subramanyan* 1172 (CAL); Gudallore, Way to Needle point, *Sibichen* 728 (SJC); Kakkambadi, *Karthikeyan* 26858, *Elango* 75209 (MH).

5. *C. retusa* L., Sp. Pl. 715.1753; DC., Prodr. 2: 125. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 187. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2 : 480.1843; Baker In: Hook. f., Fl. Brit. India 2: 75. 1876 (repr. ed. 879); Trimen, Handb. Fl. Ceylon. 2: 15. 1894; Cooke, Fl. Bombay 1: 318. 1902 (repr. ed. 1958); Rama Rao, Fl. Plts. Travancore 106. 1914; Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Polhill In: Gillett, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 2: 958. 1971; Niyomdham, Thai For. Bull. 11. 151. 1978; Mani. & Sivar., Fl. Calicut 78. 1982; Polhill, *Crotalaria* in Africa and Madagascar 272. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 375. 1983; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Saldan., Fl. Karnataka 1: 440. 1984; Chandrabose & Nair, Fl. Coimbatore 89. 1987; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 142. 1988; Ramach. & Nair, Fl. Cannanore 133. 1988; Vajrav., Fl. Palghat 152. 1990; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 192. 1991; Sanjappa, Leg. India 128. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 143. 1994; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 263. 1997; Matthew, Fl. Palni Hills 1: 305. 1999;

Pullaiah & Ramamurthy, Fl. East. Ghats 2: 192. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 164. 2002.

Type: Herb. Herm. Vol. 2: fol. 21. Linn. No. 84. & 4: 51, 78 (syntype: BM).

--Kankalakotti-cotti Rheede, Hort. Malab. 9. p. 25. t. 29.1686.

Erect annual herbs or under-shrubs with ascending branches. Stems and branches appressed pubescent to brown sericeous. Leaves simple, obovate - oblanceolate, subsessile; lamina glabrous above and pubescent beneath, apex obtuse or retuse. Racemes terminal or leaf opposed, few to many flowered, equally distributed on the peduncle or confined towards the apex. Calyx bilipped; lobes subequal, appressed puberulous or glabrous. Corolla yellow, with or without deep purple striations. Pods 2.5 - 3.8 cm long, oblong, glabrous, many seeded, turns black when dry.

Notes: *C. retusa* is pantropical and probably Asiatic in origin. It occurs from the seashores to mountain peaks of 2200 m. The size of the plant varies considerably. I have collected mature plants of 10 cm to 1.5 m height from different localities. There are three varieties under *C. retusa*, viz., var. *indica* Nampy & Sibi., var. *retusa* L. and var. *tanguensis* (Lima) Polhill, of which the first two occur in South India whereas, the latter is known only from eastern coastal Africa.

Key to the Varieties

- 1a. Branches appressed hairy; calyx thinly puberulous;
flowers evenly distributed on the peduncle var. *retusa*
- 1b. Branches brown sericeous; calyx glabrous except at
the base; flowers restricted towards the apex
of the peduncle var. *indica*

5a. *C. retusa* var. *retusa* L., Sp. Pl. 715. 1753.

(Fig. 38, Pl. 4 E)

Erect, annual herb or lowshrub with many ascending branches, 0.1 – 1.5 m tall. Stems and branches sulcate, appressed puberulous, fistulate. Leaves simple; stipules *ca.* 2 mm long, subulate, puberulous; petiole 2 - 4 mm long; lamina 2.5-10 x 0.5 – 2.5 cm, oblanceolate, base attenuate, apex obtuse or retuse, glabrous above and appressed puberulous beneath, turns black when dry. Racemes 4 - 30 cm long, terminal, 5 – 30 flowered. Flowers 1.5 – 1.8 cm long and 1 cm across: bracts 3 – 5 mm long, acuminate, puberulous; bracteoles 1.5 mm long, filiform inserted on mid-pedicel; pedicel 5 - 8 mm long, pubescent. Calyx bilipped, appressed puberulous; upper lobes 6 x 3 mm, triangular; lower 4 x 2 mm, acuminate. Corolla well exerted, bright yellow with deep purple striations, turns black when dry. Standard petal 1.6 x 1.6 cm, orbicular, puberulous along the midvein; wing petals 1.5 x 0.9 cm, obovate, exceeding the keel; keel petals 1.5 x 0.7 cm, rounded at the middle, beak twisted to 90°. Staminal sheath 8 mm long, filaments 10 mm and 6 mm long alternately with ovoid (1 mm long) and oblong (3 mm long) anthers respectively. Ovary 8 x 2 mm, glabrous; stipe 1 mm long; style 9 mm long, not geniculate, hairy towards apex; stigma expanded. Pods 3.5 – 3.8 x 1.2- 1.5 cm, oblong, glabrous, turns black when dry, sessile. Seeds 3 - 4 mm diam., obliquely cordiform, pale brown.

Distribution and ecology: *C. retusa* var. *retusa* is common in Kerala, Tamil Nadu and Karnataka whereas, it is not so common in Andhra Pradesh. It grows in sandy to loamy soil in low altitudes and lateritic slopes in high altitudes.

Specimens examined: KERALA: Idukki Dt.: Devikolam, *Sebastine* 16526; Kallarppara, Vivekanandan 50505; Kulamavu, Mohanan 76087 (MH); Munnar Town, *Sibichen & Nampy* 617 (SJC). Kannur Dt.: Kottiyur R.F.,

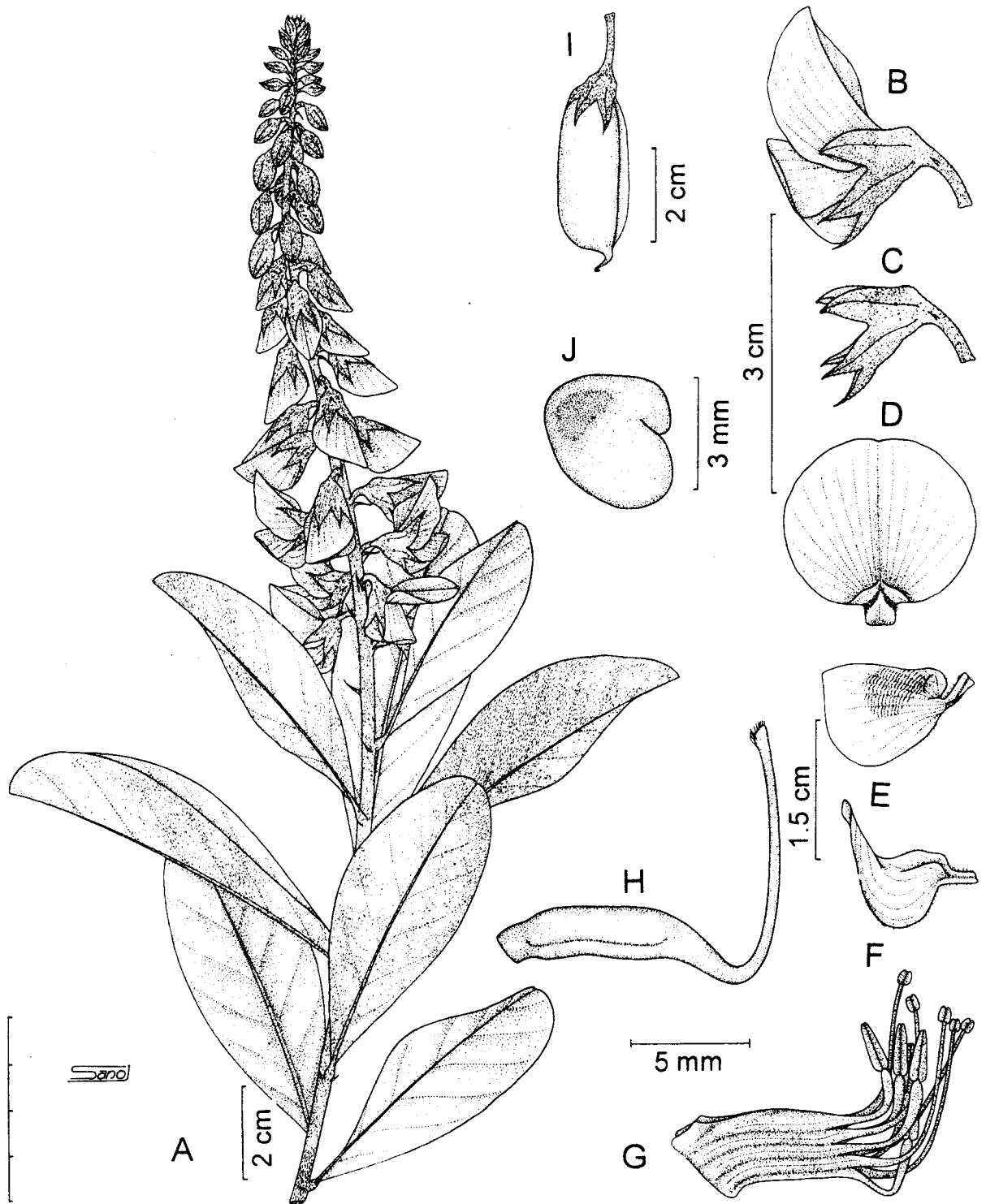


Fig. 38. *C. retusa* var. *retusa* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen* 624).

53 154A

Ramachandran 58244; Kumbala, *Nair* 59667; Manjeswar, *Ansari* 64895; Chandanathode, *Ellis* 29415 (MH). Kottayam Dt.: Ponthanpuzha, Valiyakavu, *Antony* 1066 (MH). Kozhikkode Dt.: Kakkadompoil, *Sibichen & Pradeep* 661; Kottooly, *Sibichen* 603; Palazhi, *Sibichen* 624 (SJC). Palakkad Dt.: Karasuryamalai, *Vajravelu* 48776; Pothumalai, Karappara forest, *Vajravelu* 69629; Vaniampara border, *Vajravelu* 60443 (MH). Pathanamthitta Dt.: Konni R.F., *Mohanan* 58328 (MH). TAMIL NADU: Madurai Dt.: Kodaikanal, *Sibichen & Nampy* 691 (SJC).

5b. *C. retusa* L. var. *indica* Nampy & Sibi., *Rheedea* 12 (2): 143. 2002

Type: INDIA, Tamil Nadu, Ramanathapuram Dist.: Rameswaram, *Sibichen & Nampy* 698 (holotype - K; isotype - CALI, SJC).

(Fig. 39)

Erect, annual lowshrub, usually unbranched near the base and repeatedly branched towards apex, 0.75 - 1.25 m high; stems and branches terete, fistulate, brown sericeous; hairs slightly crisped. Leaves simple, alternate; stipules 2 mm long, subulate, tomentose; petioles 2 - 4 mm long, tomentose, non articulate; lamina 6 - 7.5 x 2.1 - 3 cm, obovate-oblongate, base attenuate, apex obtuse, glabrous above and sparsely pubescent beneath. Racemes 10 - 25 cm long, 10 - 20 flowered, the flowers arranged laxly towards the base and densely at the apex. Flower 1.8 cm long and 1.1 cm in diameter; bract 3-5 mm long, subulate, tomentose externally and glabrous within, margin ciliate; bracteole 1.5 mm long, subulate, produced at the base of the calyx tube; pedicel 5 - 6 mm long, brown tomentose. Calyx tube 4 mm long, lobes subequal; upper two lobes larger (7 mm long); lower three smaller (6 mm long), glabrous except at the extreme base. Corolla yellow without striations; standard petal 1.5 x 1.2 cm, obovate, puberulous along the mid vein; wing petals 1.5 x 0.7 cm, oblong with basal claw, exceeding the keel, with transverse folds between the veins; keel 10 x 8 mm, rounded at the base

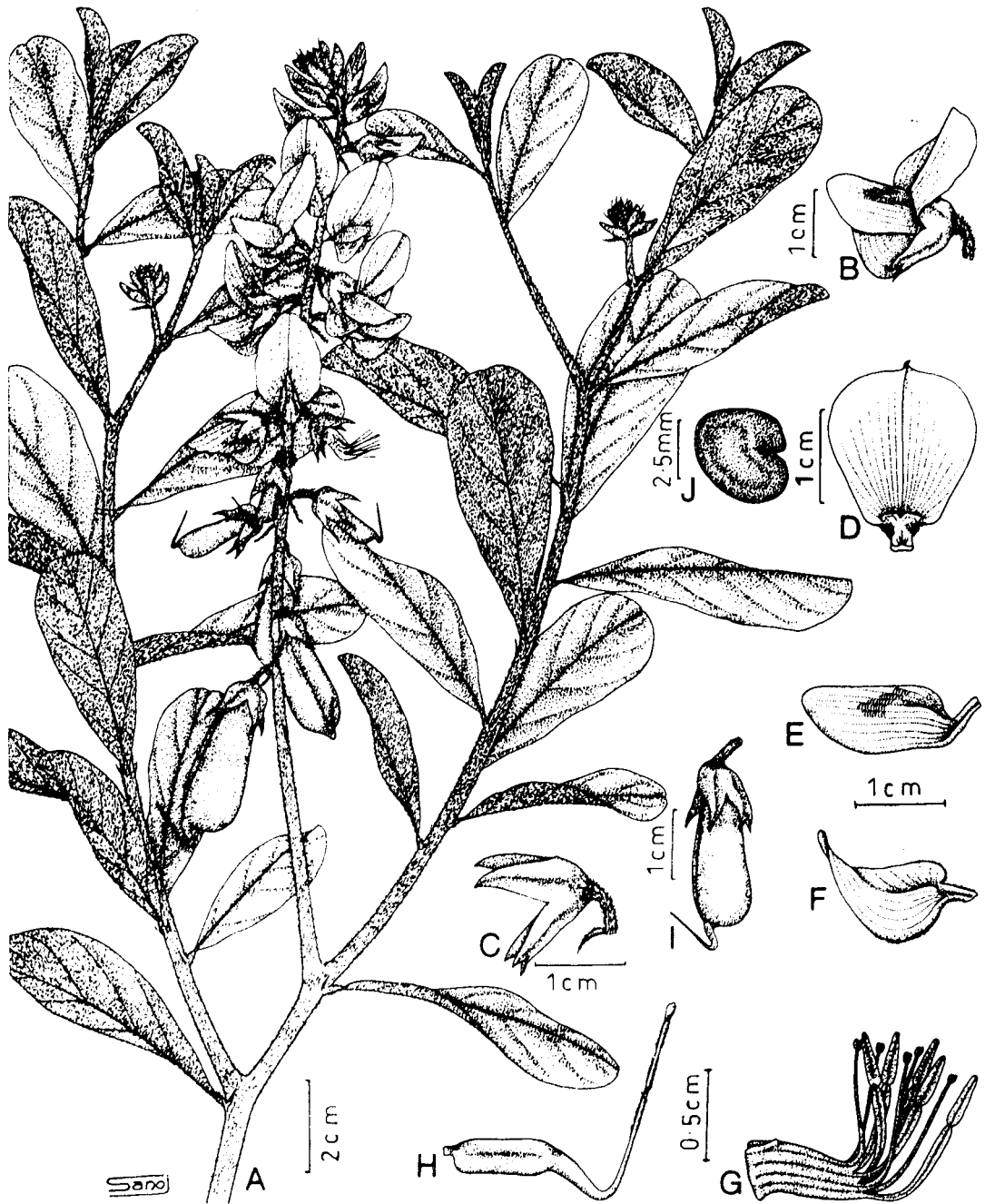


Fig. 39. *C. retusa* var. *indica* Nampy & Sibi. : A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Gynoecium; I. Immature pod; J. Seed (From Sibichen & Nampy 698).

54
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with a twisted beak. Staminal sheath 5 mm long, glabrous; filaments alternately 7 mm and 3 mm long with ovoid (0.5 mm) and oblong (3 mm) anthers respectively. Ovary 5 x 2 mm, glabrous; stipe 1mm long; style 1.3 cm long, geniculate, hairy along the margin; stigma slightly expanded. Pods 3.2 x 1.2 cm, oblong, shortly stalked, glabrous, green, turns black when dry, 12 – 18 seeded; stalk 5 - 7 mm long. Seeds 4 mm in diameter, pale brown, obliquely cordiform.

Specimens examined: KARNATAKA: Castle Rock, M.S.M. Ry, Nana in *Sedgwick & Bell* 5603 (K). TAMIL NADU: Thirunelvely Dt.: Palayamcottai, *Wight* 591 (K). Ramanathapuram Dt.: Krishnathevarthoppu, *Srinivasan* 63627 (MH); Rameswaram, CMFRI Campus, *Sibichen & Nampy* 698 (SJC).

6. *C. salicifolia* Heyne ex Wight & Arn., Prodr. 1: 182. 1834 (repr. ed. 1976); Baker In: Hook.f., Fl. Brit. India 2: 76.1876 (repr. ed. 879); Rama Rao, Fl. Plts. Travancore 106. 1914; Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Saldan. & Nicolson., Fl. Hassan 244. 1976; Malathi In : Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 100. 1983; Saldan., Fl. Karnataka 1: 441. 1984; Vajrav., Fl. Palghat 152. 1990; Sanjappa, Leg. India 128. 1992; Sasi. & Sivar., Fl. Thrissur 135. 1996; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: India, *Wall.* Cat. no. 5359 A (K).

(Fig. 40, Pl. 4 C)

Erect short lived perennial shrub with stiff ascending branches, 0.5 – 1.5 m tall. Stems and branches terete, appressed silky brown sericeous, apparently striate. Leaves simple, dimorphic and ascending; stipules absent; petioles 5 mm long, densely sericeous; lamina 7 - 9.3 x 1.5 - 3 cm (basal leaves), ovate - oblanceolate and 7.5 – 10 x 0.4 – 0.8 cm (apical leaves), lanceolate – linear, base acute, apex acute or mucronate, sparsely sericeous above and densely beneath. Racemes 20 - 30 cm long, terminal, lax, 4 - 8

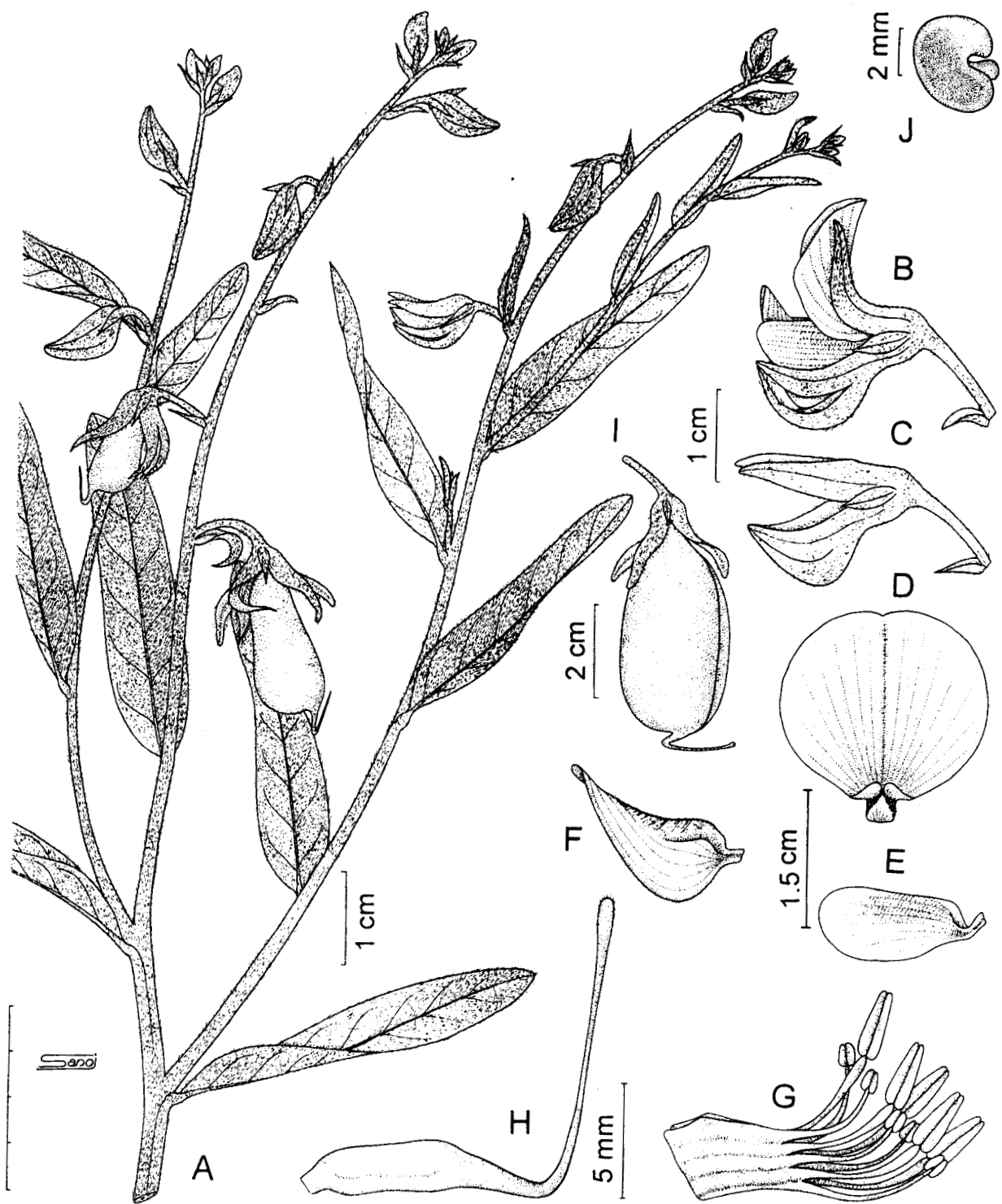


Fig. 40. *C. salicifolia* Heyne ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Johy 670).

55

111A

flowered, restricted to the terminal $\frac{1}{2}$ of the peduncle. Flower 2 cm long and 1 cm across; bracts 8 x 2 mm, ovate - deltate, sericeous out and glabrous in; bracteoles 5 x 3 mm, ovate, inserted on calyx tube at the cleft, glabrous in and hirsute out; pedicel 6 - 8 mm long, hirsute. Calyx bilipped, golden brown velvety, enclosing $\frac{3}{4}$ of the corolla; upper lobes large (1.8 x 0.5 cm), connate at the base; lower lobes 1.7 x 0.3 cm, narrow, acuminate. Corolla pale yellow without striations, slightly exserted; standard petal 1.8 x 1.8 cm, broadly ovate or orbicular, glabrous, except along the midvein on the back; wing petals 1.5 x 0.7 cm, oblong; keel petals 1.7 x 1 cm, abruptly rounded in lower part, inner margin white fulvous, beak twisted to 90°. Staminal sheath 8 mm long; filaments 8 mm and 5 mm long alternately with ovoid (0.5 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 8 x 2.5 mm, sessile; style 1.5 cm long, geniculate, glabrous; stigma swollen, hairy. Pods 4 - 5 x 1.5 - 2 cm, clavate, glabrous; stalk 2-3 mm long, flat; 10 - 15 seeded. Seeds 2 mm diam., obliquely cordiform, laterally compressed, dark brown, smooth and arillate.

Distribution and ecology: *C. salicifolia* is endemic to Peninsular India. It is occasional in moist deciduous forests and scrub jungles at an altitudinal range of 600- 1200 m. It flowers and fruits from October to March.

Notes: Wight and Arnott (1834) included *C. salicifolia* under the sect. Calycinae. Members of sect. Calycinae are generally herbs having hardly exserted or included corolla and pod in a shaggy prominent calyx. But, *C. salicifolia* is an erect shrub with well exserted corolla. Moreover, its pod is several times longer than calyx and corolla compared to the small pods of Calycinae. Critical studies of the specimens from various localities led me to treat this species under the sect. Erectae. This is in corroboration with the earlier findings of Bentham (1843), Baker (1876), Gamble (1918) and Ansari (2002). Two interesting features noticed in this species are (1) a long leafy

“bract” subtends the lowest flower of the raceme and hence that flower appears to be axillary and (2) the seeds are arillate as in sect. *Alatae*.

Specimens examined: KERALA: Idukki Dt.: Elappara - Kattappana way side, *Sibichen & Joby* 670 (SJC); Erattayar Dam, *Mohanan* 72165 (CAL); Mangaladevi Temple, *Nair* 70233 (CAL, MH); Pachakkanam, *Vivekanandan* 45367 (MH), *Jomy* 12665 (CALI); Thekkady, Anjuruli, *Sharma* 42412; Pindimedu, *Bhargavan* 90069 (MH). Kollam Dt.: Muzhiyar Power house, *Chandrabose* 49150 (MH). Kozhikkode Dt.: Kakkadampoil, *Sibichen, Nampy & Pradeep* 662 (SJC). Palakkad Dt.: Attappady, *Fischer* 2520 (CAL); Nelliampathy, *Vajravelu* 44776 (MH). Pathanamthitta Dt.: Pampa, Coodrical R.F., *Anil Kumar* 1332 (MH). Thiruvananthapuram Dt.: Bonneccord, *Mohanan* 7816 (CALI); Kovaltherimala, *Mohanan* 9110 (CALI). Thrissur Dt.: Peringalkuthu R.F., *Sebastine* 6649 (MH); Sholayar Forest, *Rajan* 75527 (CAL). TAMIL NADU: Coimbatore Dt.: Karakkal, *Joseph* 13225 (CAL).

7. *C. scabra* Gamble, Kew Bull. 27: 28. 1917, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 284. 1983; Nayar & Sastry (eds.), Red Data Book 2: 117. 1988; Sanjappa, Leg. India 128. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 143. 1994; Ansari In: Rao (ed.), Adv. Leg. Res. 165. 2002.

Type: India, *C.A. Barber* 2931 (K).

Erect, short lived perennial shrubby herb with slightly scandent branches, 0.75 - 1.5 m tall. Stems and branches terete, reddish brown, densely sericeous. Leaves simple, estipulate; petioles less than 1 mm long, brown tomentose; lamina 2 - 3.5 x 1- 1.5 cm, elliptic, base rotundate, margin slightly revolute, apex acute or rarely sub-acute, sparsely strigose above and densely appressed beneath. Racemes 5 - 10 cm long, terminal, lax, 3 or 4 flowered. Flower 2 cm long and 1 cm across; bracts and bracteoles 5 - 7 mm

long, linear – lanceolate; bracteoles arising from the calyx tube, appressed to sepals; pedicel 5 mm long, brown tomentose. Calyx silky brown, densely sericeous out and glabrous in, bilipped; upper lobes 1.8 x 0.4 cm, lanceolate, connate at the base; lower lobes 1.8 x 0.2 mm, narrow linear. Corolla bright yellow, exceeding the calyx; standard petal 1.5 x 1.3 cm, obovate-orbicular with a tuft of hairs at the distal end on the back; wing petals 1.5 x 0.5 cm, oblong; keel petal 1.7 x 0.8 cm, ovate, rounded a little below the middle, inner margin lanate, beak twisted to 180°. Staminal sheath 4 mm long, filaments 10 mm and 8 mm long alternately with ovoid (0.5 mm long) and oblong (3 mm long) anthers respectively. Ovary 7 x 2 mm, glabrous; style 9 mm long, geniculate, hairy along one margin; stigma hairy, expanded. Pods 3 - 3.5 x 1 - 1.5 cm, cylindrical, glabrous, 10-12 seeded; stalk 2 - 4 mm long, flat. Seeds 1.5 - 2 mm diam., obliquely cordate and pale brown.

Distribution and ecology: *C. scabra* is rare and endemic to Peninsular India (Nayar & Sastry, 1988) and is poorly represented in Indian Herbaria. It occurs in rock crevices and in hilltops at an altitude ca. 1800 m. It flowers and fruits from January to March.

Specimens examined: KERALA: Thiruvananthapuram Dt.: Agastyarkoodam, *Mohanan* 66092 (MH); Agastyamala, *Barber* 2931 (CAL); *Mohanan* 44588 (MH); 9467, 10956 (CALI).

6. *C. spectabilis* Roth., Nov. Pl. Sp. 341. 1821; DC., Prodr. 2: 125. 1825 (repr. ed. 1989); Polhill In: Gillett, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 2: 959. 1971; Niyomdham, Thai For. Bull. 11: 155. 1978; Polhill, *Crotalaria* in Africa and Madagascar 372. 1982; Saldan., Fl. Karnataka 1: 442. 1984; Sanjappa, Leg. India. 130. 1992; Matthew, Illus. Fl. Palni Hills t. 169. 1996, Fl. Palni Hills 1: 306. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 1: 197. 2000.

Type: India, *Heyne* (CAL).

C. sericea Retz., Obs. Bot. 5: 26. 1788 non Burm. f., 1768, *nom. illegit.*: DC., Prodr. 126.1825; Wight & Arn., Prodr. 1: 186. 1834; Cooke, Fl. Bombay 1: 319. 1902; Gamble, Fl. Pres. Madras 1: 284.1918 (repr. ed. 1995).

C. leschenaultii DC., Prodr. 2: 125. 1825; Wight & Arn., Prodr. 1: 186. 1834 (repr. ed.1976); Baker In: Hook. f., Fl. Brit. India 2: 76. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 284. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat.1: 147 & 2. t. 111. 1932 (repr. ed. 1977).

Vernacular name: Junka, Jhunka, Haradijiling (Ori.).

(Fig. 41, Pl. 5 B)

Erect, annual shrubby herb with many ascending branches, 0.5 – 1.5 m tall. Stems and branches terete, sulcate at tender portions, glabrescent. Leaves simple; stipules 6 x 3 mm, ovate, acute at apex; petioles 5 - 7 mm long, pulvinate, densely tomentose; lamina 7.5 - 8.5 x 2.7 - 3 cm, obovate – oblanceolate, base cuneate, apex rounded-obtuse, subcoriaceous, glabrous above and silky pubescent beneath; veins prominent underneath. Racemes 20 - 50 cm long, terminal, 20-30 flowered. Flowers 3 cm long and 2.5 cm across; bracts 5 - 8 x 2 - 4 mm, ovate, foliaceous, deflexed; bracteoles minute, 1-1.5 mm long, lanceolate, inserted on pedicel near the base; petioles 1-1.2 cm long, sparsely puberulous. Calyx bilipped, glabrous; tube 4 mm long; lobes subequal, upper two large (1 x 0.5 cm), broadly ovate; lower three narrow (1 x 0.3 mm), acuminate. Corolla bright yellow; standard petal 2 x 2.2 cm, suborbicular with two basal appendages, apex slightly emarginated, spreading backwards; wing petals 2.2 x 1.3 cm, obovate, longer than keel; keel petals 2 x 1 cm, ovate, rounded about the middle with an incurved twisted beak. Staminal sheath 7 mm long; filaments 7 mm and 3 mm long alternately with ovoid (1 mm long) and oblong (3 mm long) anthers alternately. Ovary 10 x 2.5 mm, glabrous; stipe 2 mm long; style 1 cm long, geniculate, pubescent

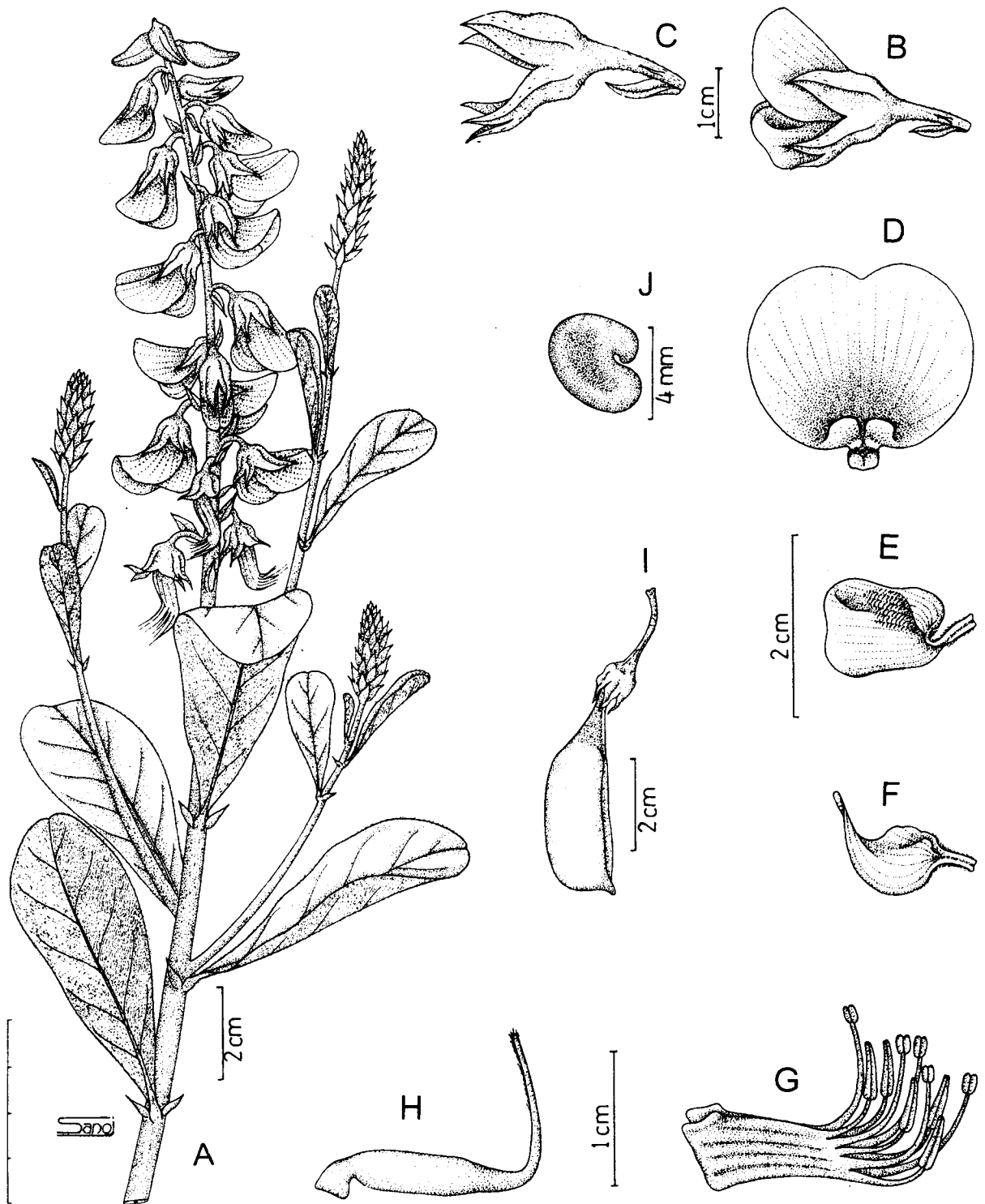


Fig. 41. *C. spectabilis* Roth: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen & Nampy 689).

along the margin, exceeding anther; stigma not expanded. Pods 4 - 5.5 x 1.5 - 2 cm, clavate, glabrous, 20 - 30 seeded; stalk (5 - 8 mm long), flat. Seeds 4 mm diam., obliquely cordiform, smooth, brown.

Distribution and ecology: *C. spectabilis* is pantropical in distribution. It is a native of Asia and is widely introduced to Africa and Madagascar as a green manure and became naturalized there (Polhill, 1982). In India it is frequent in Western Ghats, especially in open forests and wastelands at an altitude of 1100 to 2500 m. It flowers from December and fruits from April.

Notes: *C. spectabilis* is a beautiful shrub of high ranges with large, bright yellow flowers. During flowering season, all branches usually end in long racemes of numerous flowers. However, the peduncle and upper surface of the leaves turns black when dry. Among my collections, *Sibichen & Joby* 761 (SJC) is distinct in having silky tomentose stem, leaves with mucronate apex and compact raceme as against the glabrescent stem, obtuse or sub acute leaf apex and lax raceme of the typical. The taxon seems to be distinct at some level, but more detailed studies are needed to confirm its novelty.

Specimens examined: KARNATAKA: Kodagu Dt.: Mercara, *Saldanha* 5541 (CAL). KERALA: Idukki Dt.: Kattappana, Kalvari Mount, *Sibichen & Joby* 761 (SJC). Kottayam Dt.: Vagamon, *Abdul Jabbar* 43920 (TBGRI). Palakkad Dt.: Silent Valley R.F., *Vajravelu* 33400 (MH). Pathanamthitta Dt.: Konni Forest, *Anilkumar* 181 (CAL). Thrissur Dt.: Parambikulam, *Sebastine* 15313 (CAL). TAMIL NADU: Anna Dt.: Thandikudi, *Sudharsan* 303 (MH). Coimbatore Dt.: Way to Lampton's Peak, *Ellis & Sree Madhavan* 20007 (MH). Madurai Dt.: Kodaikanal, *Jojo* 682, *Sibichen & Nampy* 689 (SJC); Palni Hills, *Fischer* 2886 (CAL). Salem Dt.: Sheveroy Hills, *Mohanan* 56415 (CAL).

Sect. **Hedriocarpae** Wight & Arn. Prodr. 1: 194. 1834 (repr. ed. 1976).

Type species: *C. clavata* Wight & Arn.

Sect. *Dispermae* Wight & Arn., Prodr. 1: 191. 1834 (repr. ed. 1976).

Sect. *Podocarpae* Wight & Arn. Prodr. 1: 193. 1834 (repr. ed. 1976).

Sect. *Oliganthae* Benth. in Hook., Lond. J. Bot. 2: 573. 1843.

Sect. *Longirostres* Benth. in Hook., Lond. J. Bot. 2: 580. 1843.

Sect. *Macrostachyae* Benth. in Hook., Lond. J. Bot. 2: 583. 1843.

Sect. *Incanae* Benth. in Hook., Lond. J. Bot. 2: 587. 1843.

Sect. *Stipulaceae* Benth. in Hook., Lond. J. Bot. 2: 588. 1843.

Group *Trifoliolatae Polyspermae* Baker in Hook. f., Fl. Brit. India. 2: 82. 1876.

Sect. *Trifoliolatae* Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995);
Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Herbs, shrubby herbs, woody shrubs or very exceptionally small trees. Leaves trifoliolate; petioles long. Racemes terminal or become leaf opposed at maturity. Flowers few to many, densely or laxly arranged on the peduncle. Pods sub globose to oblong, stalked or sessile, glabrous or pubescent, 2 - many seeded.

Notes: Wight and Arnott (1834) subdivided the genus *Crotalaria* in to two groups viz., plants with 'leaves simple, sessile or shortly petioled' and 'leaves long petioled, digitately 3 - 5 foliolate'. Among the latter group, species having trifoliolate leaves were placed under three sections viz., *Dispermae*, *Podocarpae* and *Hedriocarpae* and species with 5 - 7 foliolate leaves were placed under *Polyphyllae*. Bentham (1843) treated all the trifoliolate species under the series *Foliolatae* and recognized 9 sections viz., *Oliganthae*, *Dispermae*, *Longirostres*, *Macrostachyae*, *Incanae*, *Stipulaceae*, *Farctae*, *Chrysocalycinae* and *Fruticosae*. All the South Indian species with trifoliolate leaves falls within the first six sections. Baker (1876) subdivided all the

trifoliolate species of *Crotolaria* under two groups viz., Trifoliolatae Dispermae and Trifoliolatae Polyspermae. However, Gamble (1918) in his Flora of Presidency of Madras neither adopted the sections of Wight and Arnott (*l.c.*), Bentham (*l.c.*) nor the groups of Baker (*l.c.*), instead, he treated the entire trifoliolate species under the section Tri-foliolatae. Ansari (2002) created two subsections viz., Dispermae and Polyspermae under the sect. Trifoliolatae. But the subsectional name Polyspermae Baker ex Ansari is inadmissible as it is contrary to Art. 11.6 of ICBN (Greuter *et al.*, 1994). In the present work I have included 12 species and 2 varieties under two subsections viz. Hedriocarpae and Dispermae.

Key to the Subsections

- 1a. Pods oblong, many seeded *Hedriocarpae*
 1b. Pods globose to sub globose, 1 or 2 seeded *Dispermae*

Subsect. **Hedriocarpae**

Group Trifoliolatae Polyspermae Baker in Hook. f., Fl. Brit. India. 2: 82. 1876.

Sect. Trifoliolatae Subsect. Polyspermae Baker ex Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Leaves trifoliolate. Legumes oblong, stalked, sparsely pubescent to glabrous, many seeded.

Key to the Species

- 1a. Trees; flowers > 4.5 cm long, greenish yellow *1.C.agatiflora*
 1b. Trailing herbs, shrubs or under-shrubs; flowers < 3.5 cm long, yellow, with or without reddish-pink striations 2
 2a. Pods ascending 3
 2b. Pods drooping 4

- 3a. Woody shrubs; stipules subulate; keel petals exceeding wing petals 8.*C. stipitata*
- 3b. Herbaceous under shrub; stipules falcate, up curved; keel petals not exceeding wing petals 2.*C. goreensis*
- 4a. Prostrate trailing herbs..... 6.*C. orixensis*
- 4b. Erect shrubs or under shrubs 5
- 5a. Pods glabrous, pendulous; stalk > 2.5 cm long, much exceeding the calyx tube 4.*C. laburnifolia*
- 5b. Pods pubescent or glabrescent; stalk < 0.5 cm long, not exceeding the calyx tube 6
- 6a. Flowers 20 - 60 nos., arranged closely on peduncle.....7.*C. pallida*
- 6b. Flowers 3 - 15 nos., arranged laxly on peduncle 7
- 7a. Seeds 30 - 40 nos., 2.5 mm diam., laterally compressed, black 3.*C. incana*
- 7b. Seeds 8 - 12 nos., 4 - 5 mm diam, swollen, pale brown 5.*C. micans*

1. **C. agatiflora** Schweinf. In: von Hoehnel, Zum Rudolph-See und Stephaie-See, Anh.,13. 1892; Polhill, Kew Bull. 22: 202. 1968, In: Gillett, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 2: 850. 1971, *Crotalaria* in Africa and Madagascar 72. 1982.

Type: Kenya, NE. Aberdare Mts., von Hoehnel 95 (holotype: B).

Perennial woody shrub or small tree with many branches, 1-10 m tall. Stems and branches glabrous or pubescent. Leaves trifoliolate; leaflets elliptic-lanceolate to elliptic-ovate, sparsely pubescent above and tomentose beneath; stipules linear, caducous. Racemes long, many flowered. Bracts subulate to caudate, caducous; bracteoles filiform to attenuate, inserted on pedicel. Calyx glabrous to pubescent out, upper and lateral lobes on each side connate except at the tip. Corolla lemon-yellow to greenish-yellow; standard petal ovate, sparsely pubescent out; wing petals shorter than keel petal; keel

petals rounded at the base; beak not twisted. Pods subcylindrical, gradually narrowed to long stipe, many seeded.

Distribution and ecology: *C. agatiflora* is a native of tropical East Africa (Polhill, 1982).

Notes: *C. agatiflora* is commonly known as “Giant Crotalaria” or “Bird flower”. The large greenish - yellow flowers against dark green silky pubescent foliage mimic birds and hence the name “Bird flower”. Morphological variations within the species are such that Polhill (1968) recognized four subspecies under *C. agatiflora* viz., *agatiflora*, *engleri*, *imperialis* and *vaginifera*. Indian taxon belongs to the sub sp. *engleri* and it can be distinguished by its tree habit, elliptic lanceolate leaves, large caducous bracts of ovate - caudate shape and filiform bracteoles. Being a garden plant it is usually propagated by grafting and pod does not mature under South Indian conditions.

1a. *C. agatiflora* subsp. *engleri* (Baker f.) Polhill, Kew Bull. 22: 203. 1968, In: Gillett, Polhill & Verdcourt (eds.), Fl. Trop. East. Africa 2: 851. 1971, *Crotalaria* in Africa and Madagascar 73. 1982; Matthew, Fl. Palni Hills 1: 296. 1999.

Type: Tanganyika, W. Usambara Mts., *Engler* 1277 (holotype: B; isotype: BM)

(Fig. 42, Pl 6 & 7 D)

Small tree with spreading canopy. Stems and branches diffuse, glaucescent; branchlets white tomentose. Leaves tri-foliolate; stipules 4 - 8 mm long, linear, ascending; petioles 4.5 - 6.5 cm long, silky pubescent; leaflets 5 - 8.2 x 2.3 - 3.6 cm, elliptic to lanceolate; base rounded, apex obtuse, mucronate, sparsely pubescent above and densely beneath. Racemes 10 - 20 cm long, terminal, lax, many flowered. Flower 5 cm long and 5 cm

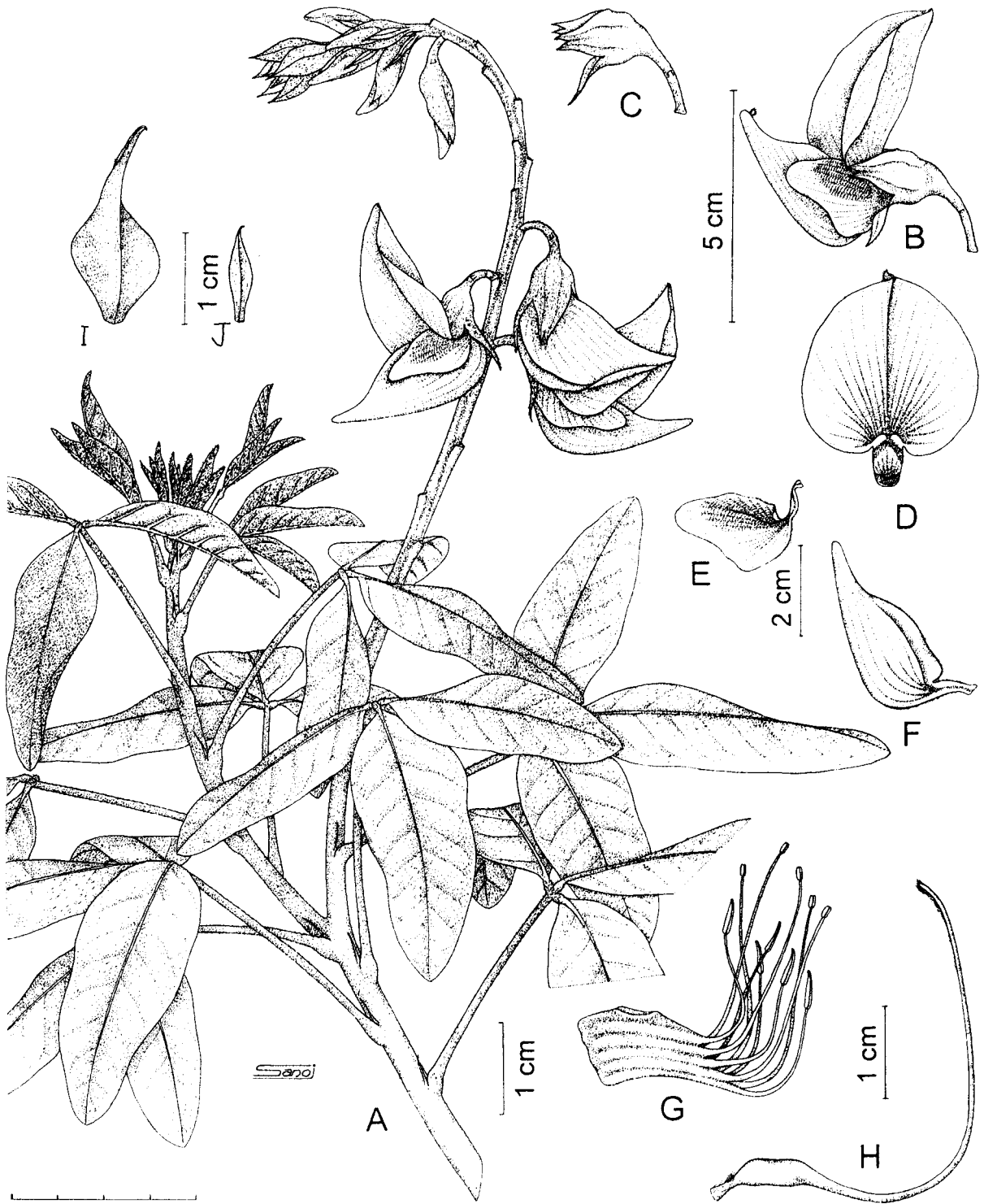


Fig. 42. *C. agatiflora* Schweinf. Sub sp. *engleri*: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Bract; J. Bracteole (From Sibichen & Nampy 697).

59
165A



Plate 6. *C. agatiflora* subsp. *engleri* Habit.

across; bracts 2.2 - 2.8 x 1.2 - 1.4 cm, broadly lanceolate-caudate, caducous; bracteoles 8 x 1.5 mm, subulate, inserted on mid-pedicel appressed to calyx, caducous; pedicel 1 - 1.5 cm long, puberulous. Calyx 3 cleft, glabrous to puberulous, tube 8 - 10 mm long; lobes three, upper and lateral lobes on each side connate except at the tip forming two large triangular sepals (1 x 1 cm) laterally, leaving the narrow lower most lobe (1 x 0.5 cm) free. Corolla greenish yellow, much exserted; standard petal 4 x 3.4 cm, ovate with puberulous mid vein on the back, apex mucronate, two prominent white appendages at the base; wing petals 3 x 1.5 cm, ovate with a lateral lobe, base clawed, much smaller than keel; keel petal 4.5 x 2 cm, rounded at the base, inner margin slightly fulvous, beak not twisted leaving an opening at the apex. Staminal tube 1.2 cm long, filaments 2 - 2.2 cm long and 1.6 - 1.8 cm long alternately with ovoid (3 mm long) and oblong (5 mm long) anthers respectively. Ovary 8 x 3 mm, glabrous, 18 - 20 ovuled; stipe 2 mm long; style 4 - 4.2 cm long; stigma simple. Pods not maturing.

Distribution and ecology: *C. agatiflora* subsp. *engleri* is a native of tropical East Africa (Polhill, 1982). It is cultivated in hill stations of South India as an ornamental plant owing to its large and attractive flowers.

Notes: This is the only tree species under the genus *Crotalaria* in South India. The pods do not mature under South Indian conditions and hence it is propagated by cuttings

Specimens examined: TAMIL NADU: Madurai Dt.: Kodaikanal, Botanical Garden (cultivated), *Sibichen & Nampy* 697 (SJC); Kodaikanal peak, *Matthew* 2082; Tiger Sholai, *Sebastine* 2086 (MH). Nilgiri Dt.: Edappalli, *Sebastine* 996; Nilgiris, Sholur, *Sharma* 35790; Kottagiri way side, *Subramanyam* 1940 (MH).

2. *C. goreensis* Guill. & Perr., Fl. Seneg. Tent. 1: 165. 1832; Benth. In: Hook., Lond. J. Bot. 2: 589. 1843; Polhill In: Gillet, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 4 (2): 875. 1971; Polhill, *Crotalaria* in Africa and Madagascar 104. 1982; Bhatt, J. Bombay Nat. Hist. Soc. 96 (1): 174. 1999.

Type: Sengal, *Perrottet s.n.* (syntype: P).

(Fig. 43)

Erect, annual or short-lived perennial with ascending branches, 0.5 – 1 m high. Stems and branches terete, pubescent. Leaves trifoliolate; stipules 8 x 2 mm, falcate, asymmetric, up curved, appressed to stem, pubescent on both surfaces; petioles 2 - 4 cm long, pubescent; median leaflets (2 - 4 x 1 - 1.8 cm) larger than lateral leaflets (1.5 - 2 x 1 - 1.4 cm), obovate; base cuneate; apex obtuse, chartaceous, glabrous above and scabrescent beneath. Racemes 2 - 3 cm long, terminal and leaf opposed, 2 - 3 flowered. Flowers 10 mm long and 4 mm across; bracts 3 - 4 mm long, caducous; bracteoles 2 mm long, linear, on the calyx; pedicels more than 1mm long. Calyx pubescent, tube 2 mm long, lobes 2 mm long, equal, triangular, acuminate. Corolla yellow; standard petal 8 x 8 mm, broadly ovate with purple striations; wing petals 10 x 3.5 mm, oblong, exceeding the keel; keel petals 8 x 4 mm, angled at the base, beak not twisted, upper margin lanate. Staminal sheath 3 mm long, glabrous; filaments 5 mm and 3 mm long alternately with ovoid (0.5 mm long) and oblong (1 mm long) anthers respectively. Ovary 4 mm long, pubescent; style 6 mm long, geniculate, hairy along the inner margin; stigma expanded, hairy. Pods 1.5 x 0.5 cm, oblong, ascending, tomentose, 10 – 12 seeded. Seeds 4 mm diam., reniform.

Distribution and ecology: *C. goreensis* is widespread in Africa and has been widely introduced into Asia and New Guinea. Bhatt (1999) reported this species for the first time from India. I have collected this species from railway

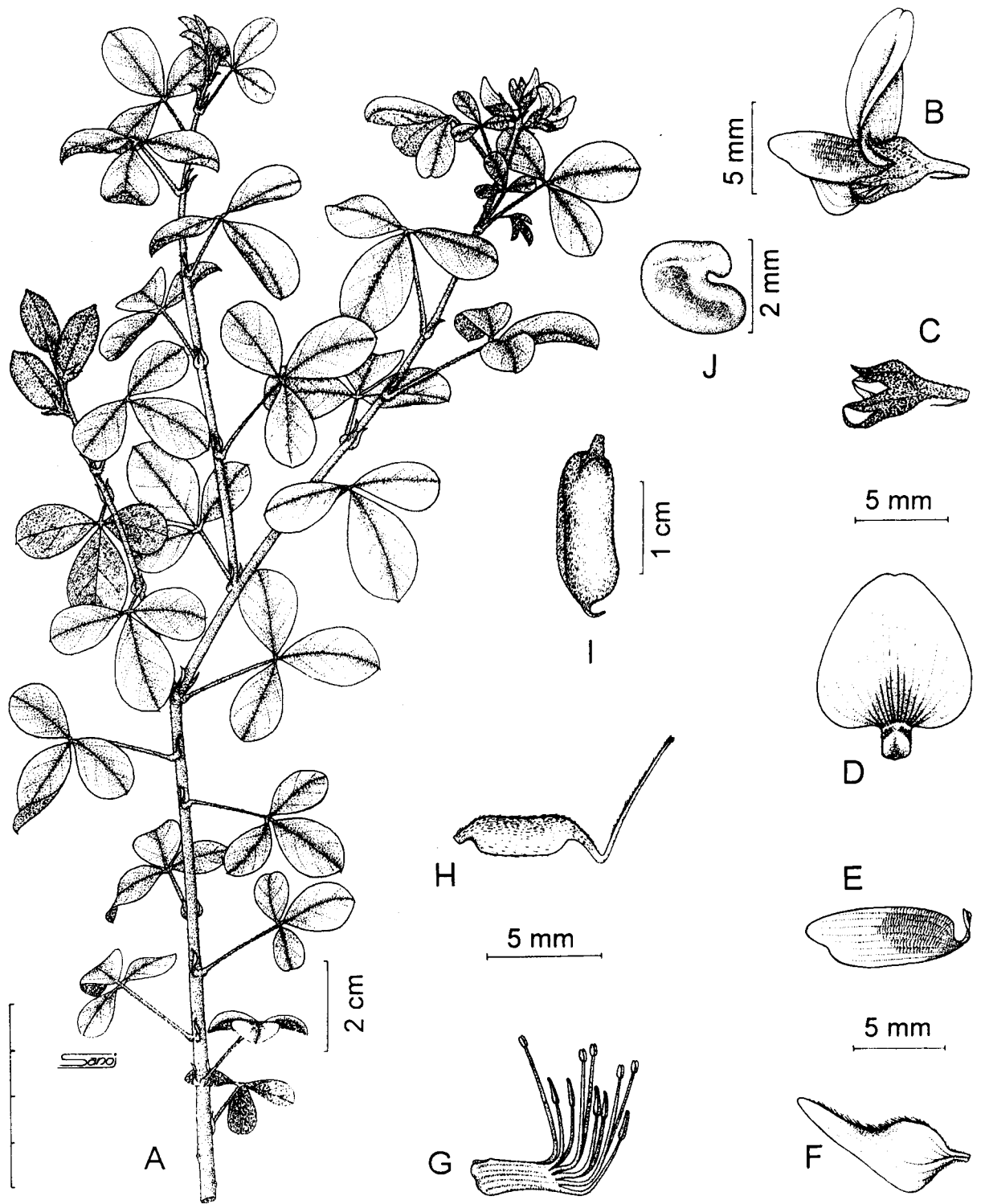


Fig. 43. *C. goreensis* Guill & Perr.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From *Sibichen & Jojo* 654).

59
167A

tracks, near CPCRI Campus in Kasaragod district in Kerala. The species is hardly represented in many Indian herbaria.

Notes: *C. goreensis* resembles *C. stipitata* in the size and shape of leaflets and in the ascending nature of pod. But, the former is an annual herb with sessile pod while the latter is a perennial woody shrub with stalked pod. It flowers and fruits from September to December.

Specimens examined: KERALA: Kasaragod Dt.: Near CPCRI Campus, *Sibichen & Jojo* 654 (SJC). Kozhikode Dt.: St. Joseph's College Botanic garden (cultivated), *Sibichen & Nampy* 685 (SJC).

3. *C. incana* L., Sp. Pl. 716. 1753; Lam., Encycl. Meth. 2: 199. 1786; DC., Prodr. 2: 132. 1825 (repr. ed. 1989); Thw., Enum. Pl. Zeyl. 82. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 83. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 19. 1894; Ravi, J. Bombay Nat. Hist. Soc. 67: 132. 1970; Polhill In: Gillet, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 4 (2): 869. 1971; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 210. 1991; Sanjappa, Leg. India 122. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 140. 1994; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: Herb. Sloane, Voy. Jamaica 2: 34, t.179, f. 1. 1725 (lectotype: BM).

C. incana f. *glabrescens* Wilczek, Bull. Jardin Botanique del' Etat, Bruxelles 23: 147. 1953.

(Fig. 44, Pl. 7 E)

Erect, annual herb with a few ascending branches, 0.5 - 1.5 m high. Stems and branches terete, white silky pubescent, axils bear a hyaline cushion at every lateral branch (when fresh). Leaves trifoliolate; stipules 4 mm long,

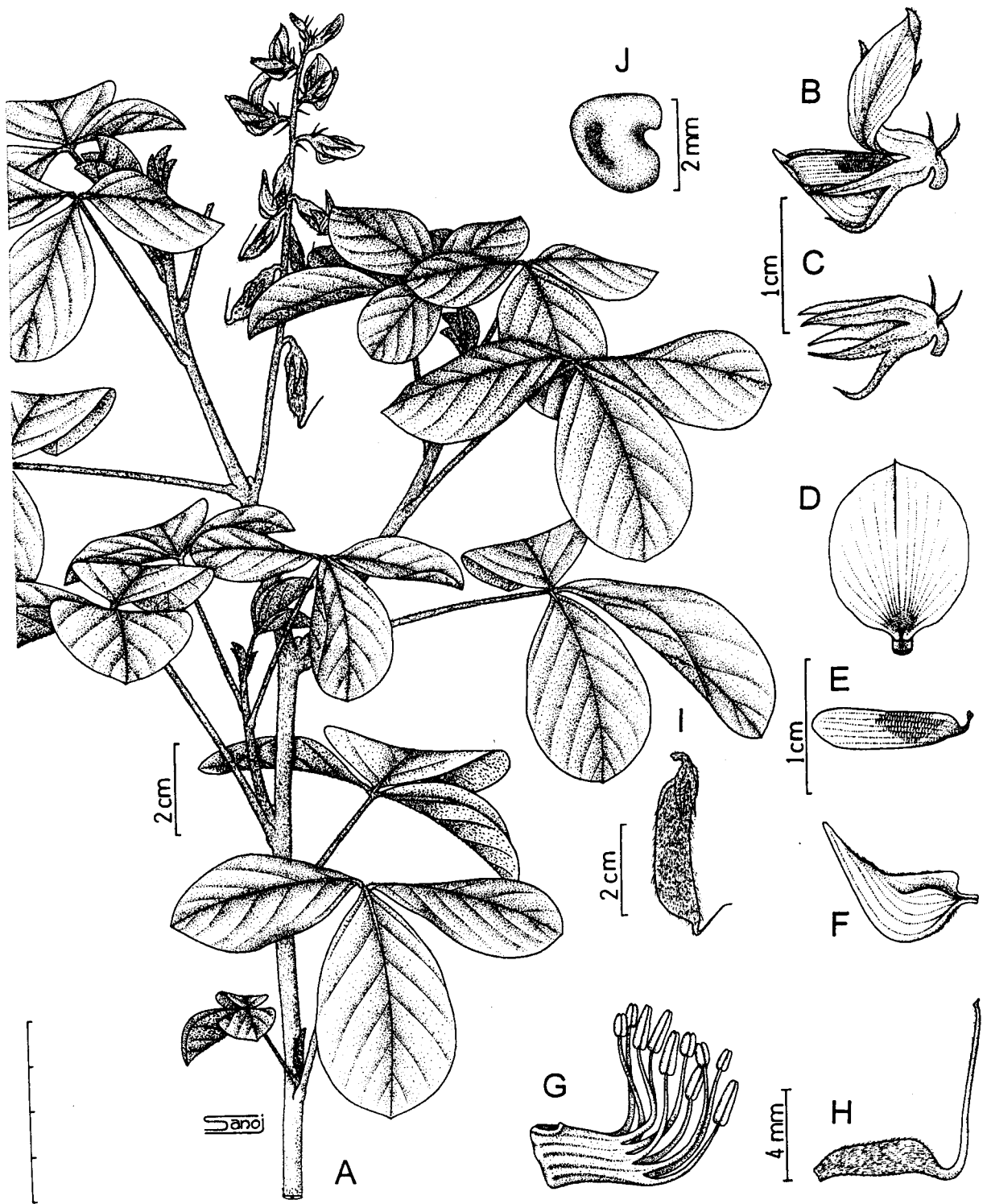


Fig. 44. *C. incana* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From *Sibichen & Sanoj* 702).

filiform, hairy, caducous often represented as a scar; petioles 5 - 6 cm long, longer than leaflets, pubescent; leaflets 2.5 - 4 x 1.5 - 2.8 cm, median one larger than laterals, elliptic - obovate, base cuneate, apex acute, mucronate, chartaceous, glabrous above and sparsely pubescent beneath. Racemes 5 - 15 cm long, lax, terminal become leaf opposed at age, 3 - 15 flowered. Flowers 1.2 cm long and 1.5 cm across; bracts 5 mm long, linear subulate, hairy, deciduous; bracteoles 6 mm long, curved, inserted on calyx base: pedicels 3 mm long, white pubescent. Calyx bilipped, sparsely puberulous, tube 2 mm long; upper 2 lobes (7 x 2 mm) larger than lower 3 lobes (6 x 1.5 mm), lanceolate, greenish yellow. Corolla pale yellow without striations, slightly exserted; standard petal 9 x 7 mm, elliptic, hairy along the midvein on the back; wing petals 7 x 3 mm, oblong; keel petals 1.3 x 0.5 mm, ovate with white hirsute inner margin. Staminal sheath 4 mm long, glabrous; filaments 6 mm and 3 mm long alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 4 x 1.7 mm, sessile, silky pubescent; style 8 mm long, curved, hairy along the inner margin; stigma not expanded. Pods 2.8 - 3 x 0.6 - 0.8 cm, oblong, densely pubescent, sessile, 30 - 40 seeded. Seeds 2.5 mm diam., obliquely cordiform, laterally compressed, black.

Distribution and ecology: *C. incana* is pantropical in distribution. It grows as a weed on roadsides, dumping grounds and wastelands. In South India, *C. incana* is very rare and is collected only from a few localities. The species is least enumerated in South Indian floras and scarcely represented in many Indian Herbaria. The plant flowers from June to August.

Notes: Redhead (1961) recognized two subspecies under *C. incana* viz., subsp. *incana* and subsp. *purpurescens*. South Indian materials belong to subsp. *incana* and they can be distinguished by their glabrescent stem, sparsely puberulous calyx and obliquely cordate, smooth, black seeds.

Specimens examined: KERALA: Thiruvananthapuram Dt.: Kanakakunnu Palace, *Ravi* 4050 (MH); Karakulam, *Abdul Jabbar* 45537 (TBGRI); Karamana, Parachira, *Sibichen & Sanoj* 702 (SJC); Museum compound, *Ravi* 2412 (SNGC). TAMIL NADU: Nilgiri Dt.: Kutrapatti, near Moyar River, *Subba Rao* 40175 (MH); Mettupalayam – Ooty Road, *Nampy* 765 (SJC).

4. ***C. laburnifolia*** L., Sp. Pl. 715. 1753; Burm., Fl. Indica 156. 1768 (repr. ed. 1984); Lam., Encycl. Meth. 2: 199. 1786; Willd., Sp. Pl. 3: 982. 1802; DC., Prodr. 2: 130. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 193. 1834 (repr. ed. 1976); Thw., Enum. Plant. Zeyl. 82. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 84. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 19. 1894; Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Cooke, Fl. Bombay 1: 324. 1902 (repr. ed. 1958); Polhill, Kew Bull. 22 (2): 209. 1968, In: Gillet, Polhill & Verdcourt (eds.), Fl. Trop. East Africa 4 (2): 856. 1971; Niyomdham, Thai For. Bull. 11: 138. 1978; Matthew, Fl. Tamilnadu Carnatic 3: 357. 1983; Polhill, *Crotalaria* in Africa and Madagascar 76. 1983; Saldan., Fl. Karnataka 1: 435. 1984; Chandrabose & Nair, Fl. Coimbatore 88. 1987; Matthew, Illus. Fl. Tamilnadu Carnatic 4: 128. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 214. 1991; Sanjappa, Leg. India 123. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 257. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 173. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: Herb. Herm. Vol. 4. fol. 1. Linn. no. 278 (lectotype: BM).

-Nella-tandale-cotti Rheede, Hort. Malab. 9: 49. t. 27. 1686.

Vernacular name: Kankalakotti (Mal.); Kilukippai (Tam.); Dedda-Giligicha (Tel.).

(Fig. 45, Pl. 7 B)

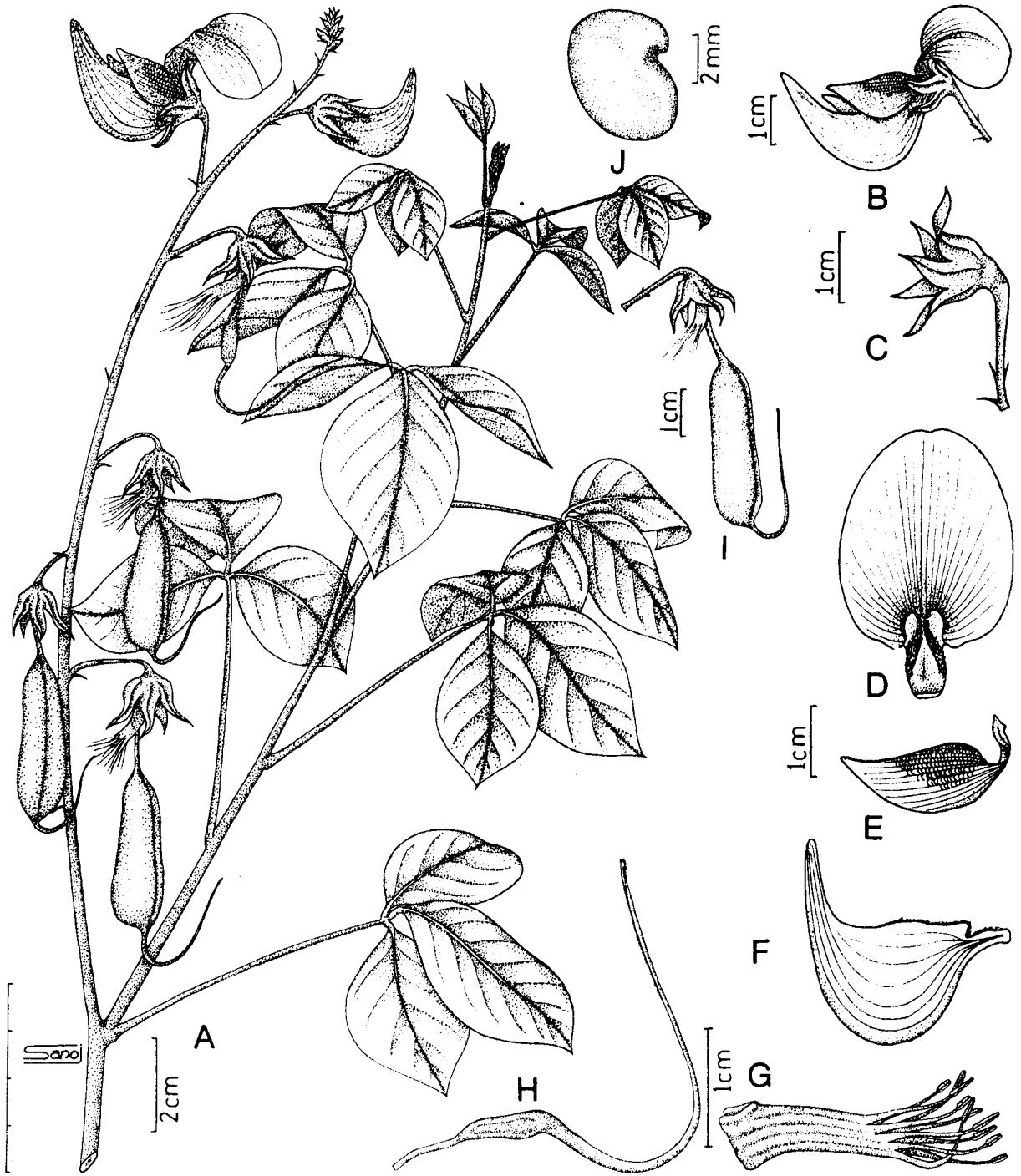


Fig. 45. *C. laburnifolia* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Sibichen 626).

Erect, perennial, woody shrub with copious branches, 0.6 - 2.5 m high; stems and branches terete, glabrescent. Leaves trifoliolate, median one larger than laterals; stipules absent; petiole 5 - 8 cm long, usually longer than the leaflets, glabrous; leaflets 2 - 3.4 x 1.2 - 2.5 cm, broadly elliptic to obovate; base cuneate; apex acute, mucronate, pale green, chartaceous, glabrous above and puberulous beneath. Racemes 10 - 30 cm long, terminal and leaf opposed, lax, 8 - 12 flowered. Flowers 3 cm long and 2 cm across, large, showy, pendulous; bracts 2 - 3 mm long, subulate; bracteoles less than 4 mm long, filiform, on mid-pedicel; pedicels 1.3 - 1.6 cm long, puberulous. Calyx 5 cleft, glabrous; tube 4 mm long; lobes 6 x 4 mm, more or less equal, triangular. Corolla much exserted, greenish-yellow without striations; standard petal 3.5 x 2 cm, ovate-elliptic, glabrous; wing petals 2 x 1 cm, oblong, apex obtuse; keel petals 3.2 x 1.5 cm, rounded at the middle, apex acuminate, beak not twisted. Staminal sheath 1 - 1.2 cm long; filaments alternately flat and filiform *ca.* 8 mm long with oblong (1 mm long) and ovoid (2 mm long) anthers respectively. Ovary 5 - 7 x 1.5 - 2 mm, glabrous; stipe 8 - 10 mm long; style 3 cm long, curved, hairy along the inner margin; stigma simple, puberulous. Pods 3.5 x 1 cm, oblong, glabrous; stalk 2 - 2.5 cm, much longer than calyx, a little shorter than pod, 12 - 14 seeded. Seeds 4 - 5 mm diam, obliquely cordiform, pale brown, granulose.

Distribution and ecology: *C. laburnifolia* is distributed in western Peninsular India, Sri Lanka, Malesia, Philippines, Bangladesh and tropical Africa (Sanjappa, 1992). In South India, it is occasional in open deciduous forests, along roadsides and in cultivated land as a weed.

Notes: Polhill (1968) recognized 5 sub-species under *C. laburnifolia* viz., *laburnifolia*, *petiolaris*, *eldomae*, *tenuicarpae* and *australis* with well-defined geographical ranges and apparently slight ecological preferences. All South Indian and Sri Lankan materials of this species belong to *C. laburnifolia*

subsp. *laburnifolia* in having large showy, greenish - yellow flowers and conspicuously long stalked, pendulous pods. Large and pendant greenish - yellow flowers on lax racemes and prominent gynophore impart the expression of Indian laburnum and hence the specific epithet "laburnifolia". It flowers and fruits from August to March.

Uses: It is often cultivated as a garden plant. Infusion of the plant is used as gargle for sore throat and mouth inflammations. An alkaloid anacrotine has been isolated, which cause depression (Agarwal, 1997).

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Ananthapur town, *Yesoda* 804 (SKU). East Godavari Dt.: Bhimudupakal, *Sri Ramamurthy* 14253 (SKU). Nizamabad Dt.: Manchippa, *Raviprasada Rao & Babu* 9607 (SKU). Ranga Reddy Dt.: Nancherlegate, *Silar Muhammed* 10393 (SKU). Visakapatanm Dt.: Andhra University campus, *Pullaiah & Chennaiah* 7326 (SKU). KERALA: Kozhikode Dt.: Providence Women's College Bot. Garden (cultivated), *Sibichen* 626, St. Joseph's College Bot. Garden (cultivated), *Sibichen & Nampy* 795 (SJC). Palakkad Dt.: Palakkad town, *Sebastine* 14740 (MH). PONDICHERRY: Auroville, *Rajan* 86249 (MH). TAMIL NADU: Chinglepet Dt.: Vandulur R.F., *Henry* 47155 (CAL). Madurai Dt.: Vannathipparai, *Shetty* 10280 (CAL). Nilgiri Dt.: Anaikkatty, *Subba Rao* 36203, Arakkadupatti, *Subba Rao* 36203 (MH). North Arcot Dt.: Sathanur Forest Rest House, *Vajravelu* 52093 (CAL). Ramnad Dt.: Tiruppathur, *Ramamurthy* 20942 (MH). Ramanathapuram Dt.: Somythoppu, *Nair* 5311 (CAL); Mandapam, *Ellis* 53111 (MH). South Arcot Dt.: Tirukoilur, *Ramamurthy* 51154 (CAL). Thanjavur Dt.: Point Calimere, *Ellis* 11848 (CAL). Thiruvalluvar Dt.: Theosophical Society, Adayar, *Narasimhan* 679 (MH). Tirunelveli Dt.: Kudiramoli, *Sebastine* 13676 (CAL); Nurthamalai, *Ramamurthy* 25930 (CAL, MH); Sivagiri, *Vajravelu* 38884; Sivanaperi, *Joseph* 15115 (MH).

5. *C. micans* Link, Enum. Pl. Hort. Berol. 2: 228. 1822; Polhill, *Crotalaria* in Africa and Madagascar 371. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 360. 1983, Illus. Fl. Tamilnadu Carnatic 4: 132. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 213. 1991; Mohanan & Henry, Fl. Thiruvananthapuram 141. 1994; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 117. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: Central America, *Humbolt & Bonpland* 2172 (Willd. Herb).

C. anagyroides Kunth., Nov. Gen. Sp. 6: 404. 1824; DC., Prodr. 2: 130. 1825 (repr. ed. 1989); Niyomdham, Thai For. Bull. 11: 1978; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 95. 1983; Sanjappa, Leg. India 116. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 252. 1997.

(Fig. 46, Pl. 7 C)

Erect, annual shrub with many ascending branches, 1 - 3 m tall. Stems and branches terete, densely appressed pubescent. Leaves trifoliolate; stipules 3 - 8 mm long, linear, appressed to stem; petiole 4 - 7 cm long, pubescent; leaflets 5.5 - 9 x 2 - 3 cm, narrow, elliptic, median one usually larger than the laterals; base cuneate, apex acute or slightly mucronate, glabrous above and appressed pubescent beneath. Racemes 10 - 40 cm long, terminal, subdensely arranged, 10 - 15 flowered. Flower 2.5 cm long and 2 cm across; bracts 6 mm long, linear, caducous; bracteoles 5 - 7 mm long, linear, on mid pedicel, appressed to calyx; pedicel 1 cm long. Calyx sparsely pubescent; tube 5 mm long; upper lobes 6 mm long, triangular, acuminate; lowermost lobe 5 mm long, narrow, smaller than the rest. Corolla bright yellow with red striations; standard petal 1.8 x 2.6 cm, broadly ovate to semicircular; wing petals 2 x 1 cm, obovate, exceeding the keel; keel petals 1.5 x 0.8 cm, ovate, rounded at the middle, inner margin woolly, the hairs with slightly incurved tip, beak not twisted. Staminal sheath 10 mm long, filaments 6 mm and 3 mm long



Fig. 46. *C. micans* Link.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen & Nampy 676).

62 173A

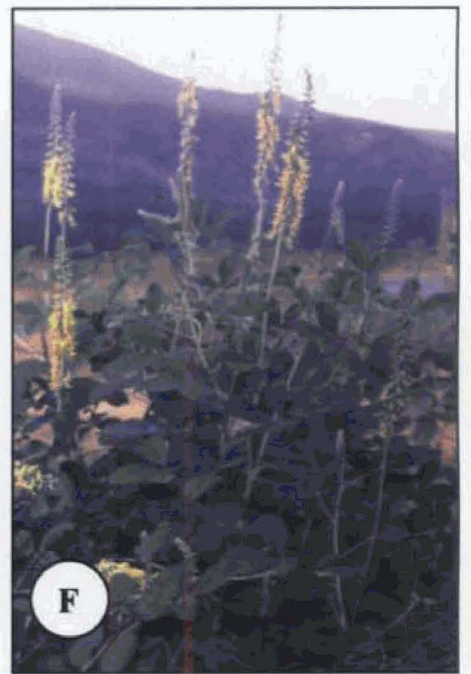
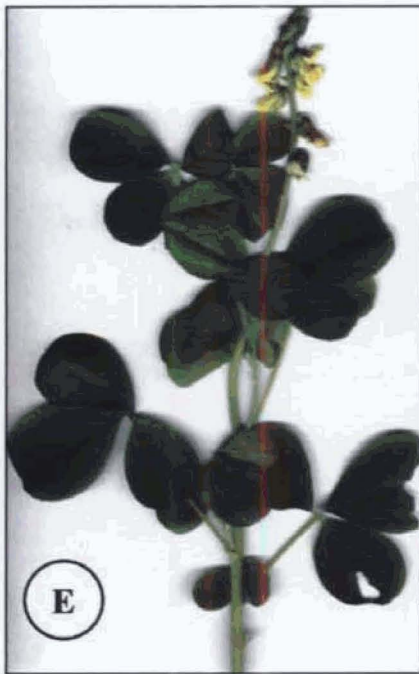


Plate 7. A. *C. quinquefolia*; B. *C. laburnifolia*; C. *C. micans*; D. *C. agatiflora* subsp. *engleri*; E. *C. incana*; F. *C. pallida* var. *obovata*.

62 13B

alternately with ovoid (0.5 mm long) and oblong (2 mm long) anthers respectively. Ovary 1 cm long, white silky pubescent; stipe 4 mm long; style 1 cm, curved, not geniculate, hairy towards the tip; stigma not expanded, hairy. Pods 4 x 1.4 cm, oblong, stalked, ascending when young and become drooping at maturity, thinly appressed pubescent, 8 - 12 seeded; stalk 10 mm long. Seeds 4 - 5 mm diam., obliquely cordiform, smooth, pale brown.

Distribution and ecology: *C. micans* is a native of tropical America and introduced to old World tropics as a green manure and ornamental. In India, it is planted in coffee and tea estates as windbreakers. It is quick growing and productive of palatable fodder or mulch, well suited to damp places. It flowers from July to October and fruits from December to March.

Notes: Niyomdham (1978) and Mohanan and Henry (1994) considered *C. micans* and *C. incana* as quite confusing. But it seems strange because they are not remotely similar. The confusion might have been derived from the misnamed materials. *C. micans* is a woody shrub with large elliptic leaves and thinly appressed pubescent erect pods which become drooping at maturity, containing 8 - 12 pale brown seeds whereas *C. incana* is a low herb having obovate - elliptic leaves with small, densely pubescent drooping pods containing 30 - 40 black seeds.

Specimens examined: ANDHRA PRADESH: Visakapatanam Dt.: Arakku valley, *Subba Rao* 44411 (MH); Galikonda, *Subba Rao* 19592 (CAL, MH). KERALA: Idukki Dt.: Pampa - Vandiperiyar roadside, *Deb* 30470 (MH); Udumpanchola, *Sibichen & Nampy* 676 (SJC); Vandiperiyar, *Vivekanandan* 24327 (MH). Palakkad Dt.: Karappara river side, *Nair* 69673 (CAL, MH). Thiruvananthapuram Dt.: Bonnaccord, *Mohanan* 61861 (MH); Ponnudi, *Sibichen* 687 (SJC). TAMIL NADU: Coimbatore Dt.: Lower Poonachi, *Joseph* 12771; Sholaiyur submergible area, *Sebastine* 16659 (MH). Kanyakumari Dt.: Balamore, *Henry* 47510; Balmadies Estate, *Ellis* 34857

(MH). Nilgiri Dt.: Conoor, *Sebastine* 2034 (MH); Kottabettu - Illithoai roadside, *Sebastine* 963 (CAL); Kotagiri, *Subba Rao* 36689 (MH); Ooty - Mettupalayam roadside, *Sibichen* 651 (SJC); Upasi Tea Experiment Station, *Subramanyam* 10592 (MH). Salem Dt.: Shevaroy hills, *Rao* 18273 (MH), *Sibichen* 788 (SJC).

6. *C. orixensis* Rottl. ex Willd., Ges. Naturf. Freunde Berlin Neue Schriften 4: 217. 1803; DC., Prodr. 2: 131. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 193. 1834 (repr. ed. 1976); Baker In: Hook. f., Fl. Brit. India 2: 83. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 323. 1902 (repr. ed. 1958); Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Polhill, *Crotalaria* in Africa and Madagascar 250. 1982; Matthew, Fl. Tamilnadu Carnatic 3: 357. 1983; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 99. 1983; Saldan., Fl. Karnataka 1: 438. 1984; Sanjappa, Leg. India 126. 1992; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 260. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 182. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: India, *Rottler* 13264 (Willd. Herb.).

Vernacular name: Kadu budde gida (Kan.).

Trailing annual herb with diffuse branches, 15 – 50 cm tall. Stems and branches terete, sparsely pubescent. Leaves trifoliolate; stipule 3 x 1 mm long, lanceolate, reflexed; petiole 1 - 1.5 cm long, pubescent; leaflets 1.2 - 4 x 0.5 - 1.5 cm, more or less equal in size, elliptic - obovate, base cuneate, apex rounded, subcoriaceous, glabrous above and appressed pubescent beneath. Racemes 5 - 10 cm long, lateral, leaf opposed, 3 - 12 flowered. Flower 6 mm long and 4 mm across; bracts 3 x 2 mm, cordate; bracteoles 2 mm long, lanceolate, inserted on calyx base: pedicel 1 - 1.2 cm long, filiform, sparsely pubescent. Calyx bilipped, sparsely pubescent, tube 1 mm long; upper lobes

(4 x 1 mm) shorter than lower lobes (5 x 1 mm), lanceolate. Corolla yellow without striations, scarcely exerted; standard petal 6 x 4 mm, orbicular-ovovate, glabrous except along the mid vein on the back; wing petals 5 x 1.5 mm, shorter than keel, oblong; keel petals 6 x 3 mm, ovate, rounded at the base, beak twisted to 180°, inner margin fulvous. Staminal sheath 2 mm long, glabrous; filaments 3 mm and 2 mm long alternately with ovoid (0.3 mm long) and oblong (1.2 mm long) anthers respectively. Ovary 3 x 1 mm, glabrous; style 5 mm long, geniculate, hairy along the inner margin; stigma simple, hairy. Pods 1.3 - 1.6 x 0.6 - 0.8 cm, oblong - ellipsoid, glabrous, 8 - 10 seeded; stipe 3 - 4 mm long. Seeds 3 x 2 mm., obliquely cordiform, smooth, yellowish - brown.

Distribution and ecology: *C. orixensis* is distributed in India and Ethiopia (Polhill, 1982). It is frequent among grasses in dry deciduous forests of western plains. It flowers from October to December and fruits from December to March.

Notes: *C. orixensis* shows affinity to sect. *Diffusae* in having trailing habit with diffuse, procumbent branches and lateral racemes.

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Samrajakonda, *Ramamurthy* 17691 (SKU). Karim Nagar Dt.: Kodimial, *Subba Rao* 21834 (CAL). Kurnool Dt.: Ramellakotta, *Raviprasad Rao* 1842 (SKU). Medak Dt.: Massjira barrge, *Raviprasad Rao & Prabhakar* 14096 (SKU). Nizamabad Dt.: Banappally, *Raviprasad Rao* 9552 (SKU). KARNATAKA: Kodagu Dt.: Manna R.F., *Ramesh & Prakash* 3137; Mercara town, *Banerjee* 11685 (CAL).

7. *C. pallida* Ait., Hort. Kew. 3: 20. 1789; Saldan. & Nicolson, Fl. Hassan 243. 1976; Mani. & Sivar., Fl. Calicut 79. 1982; Saldan., Fl. Karnataka 1: 439. 1984; Vajrav., Fl. Palghat 152. 1990; Mohanan &

Henry, Fl. Thiruvananthapuram 142. 1994; Sasi. & Sivar., Fl. Thrissur 135. 1996; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 261. 1997; Sivar. & Mathew, Fl. Nilambur 182. 1997.

C. striata DC., Prodr. 2: 131. 1825 (repr. ed. 1989); Baker In: Hook. f., Fl. Brit. India 2: 84. 1876 (repr. ed. 1879); Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Fyson, Fl. S. Indian Hill Stat. 1: 153. 1932 (repr. ed. 1977).

Erect annual shrub, 0.5 – 2.5 m tall. Stems and branches pubescent to puberulous. Leaves trifoliolate; stipules present or absent; leaflets subequal, longer than petiole, obovate or broadly elliptic, base cuneate, apex obtuse or retuse or acute, chartaceous. Racemes 20 - 60 cm long, terminal and lateral, many flowered. Flowers arranged closely on the peduncle; bracts caducous. Calyx becoming basally truncate and deflexed against the pedicel. Standard petal elliptic or ovate, yellow, with or without deep purple striations; wing petals narrowly elliptic or oblong; keel petals falcate, angular about the middle, beak not twisted. Ovary pubescent along the inner margin; style curved; stigma hairy. Pods oblong, straight or slightly curved, glabrescent. Seeds obliquely cordiform, 2 or 3 mm diam., pale brown.

Notes: Polhill (1968) recognized two varieties under *C. pallida* viz., var. *pallida* (= *C. striata* var. *acutifolia* Trimen) and var. *obovata* (= *C. falcata* Vahl ex DC. and *C. obovata* Don). The former is characterized by elliptic acute leaflets while the latter is characterized by obovate, obtuse to retuse leaflets. During our studies we have noticed that, in addition to the elliptic acute leaflets, *C. pallida* var. *pallida* consistently maintains the estipulate condition, almost straight pod and preference to high altitude; whereas *C. pallida* var. *obovata* is characterized by obovate, stipulate leaves with obtuse to retuse apex, curved (falcate) pod, and the preference to hotter and wetter situations characteristic of low altitude. The above observations are in par

with Wilczek (1953). Moreover, Chandraskhariah and Kempanna (1963) have reported that the two types as they occur in India show several small differences in chemical content, flowering time and duration etc.

Uses: Bark of the plant yields fibre. Extract is given in hypotension, and used in derangements of the stomach and in cases of infantile diarrhea. It is also having some antitumour properties (Agarwal, 1997).

Key to the Varieties

- 1a. Stipules absent; leaflets elliptic, apex acute, mucronate; occurs in hills, above 500 m var. *pallida*
- 1b. Stipules present; leaflets obovate, apex obtuse or retuse, not mucronate; occurs in plains below 200 m var. *obovata*

7a. *C. pallida* var. *pallida* Polhill, Kew Bull. 22: 262. 1968; Ramach. & Nair, Fl. Cannanore 132. 1988; Matthew, Illus. Fl. Palni Hills t. 165. 1996, Fl. Palni Hills 1: 304. 1999.

Type: Plant cultivated at Kew, from seeds collected by Bruce in Ethiopia (holotype: BM).

C. striata var. *acutifolia* Trimen, Handb. Fl. Ceylon. 2: 19. 1894; Gamble, Fl. Pres. Madras 1: 301. 1918 (repr. ed. 1995).

C. striata DC., Prodr. 2: 131. 1825; Baker In: Hook. f., Fl. Brit. India 2: 84. 1876 (repr. ed. 1879) p.p; Fyson, Fl. S. Indian Hill Stat. 1: 153. 1932 (repr. ed. 1977) p.p; Matthew, Fl. Tamilnadu Carnatic 3: 358. 1983 p.p.

(Fig. 47)

Erect, short lived perennial shrub with copious branches, 0.5 - 2.5 m tall. Stems and branches ascending, terete, pubescent to puberulous. Leaves trifoliolate; stipules absent; petiole 3 - 7 cm long, appressed puberulous;

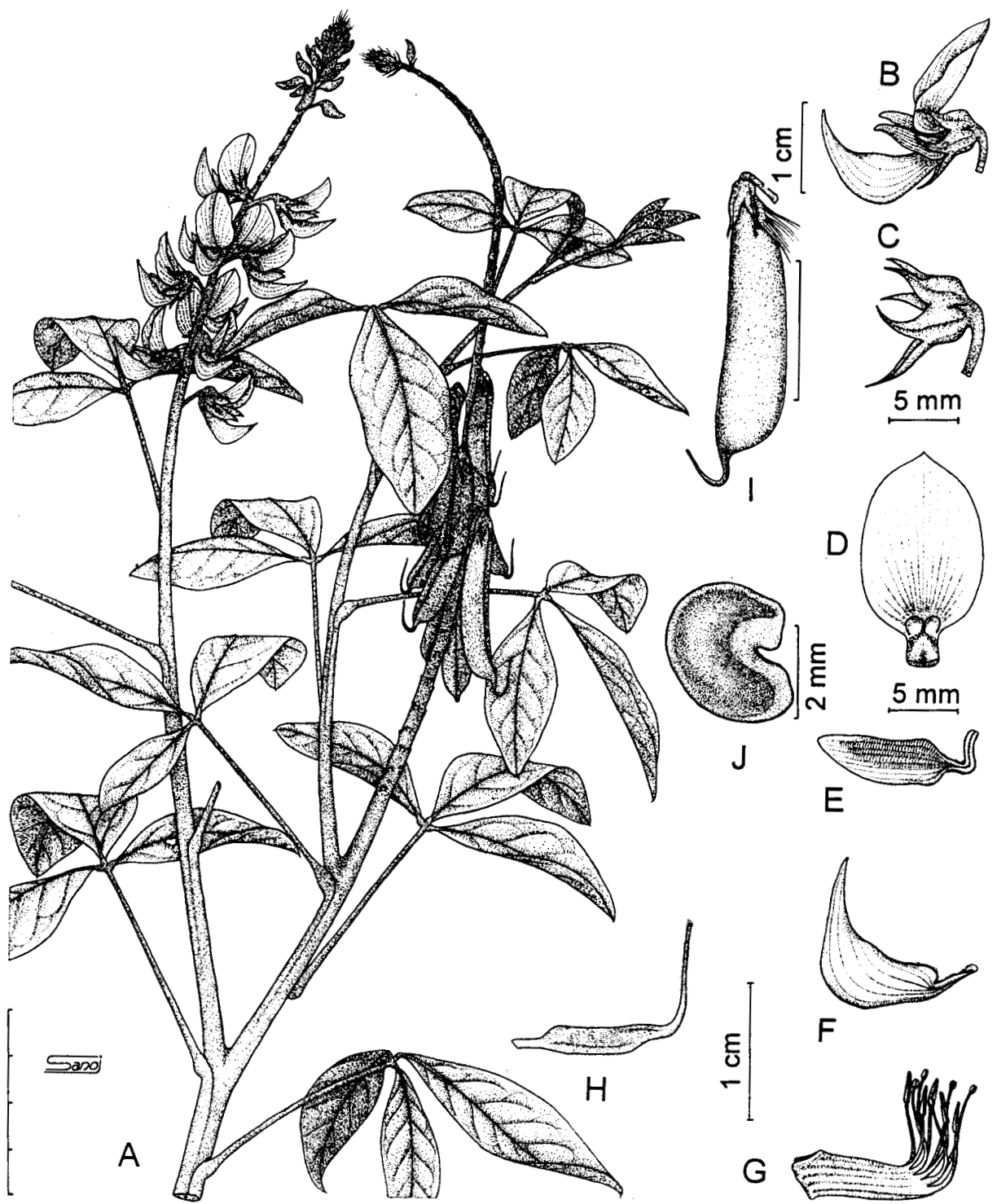


Fig. 47. *C. pallida* var. *pallida* Ait.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoecium; I. Pod; J. Seed (From Nampy 610).

64
177A

leaflets 5.5 - 8 x 3.5 - 4.5 cm, broadly elliptic, base cuneate, apex acute, mucronate, median one usually larger than the laterals, chartaceous, glabrous above and pubescent below. Racemes 15 – 25 cm long, terminal and lateral, densely 20 - 40 flowered. Flower 18 mm long and 5 mm across, arranged closely on the peduncle; bracts 4 mm long, linear, deciduous; bracteoles 2 mm long, filiform, pubescent, inserted near the base of the calyx. Calyx appressed puberulous, tube 4 mm long; lobes subequal, longer than tube, narrow, acuminate. Standard petal 1.2 x 0.7 cm, elliptic, yellow or yellow with purple striations, glabrous, apex acute; wing petals 10 x 4 mm, narrowly ovate; keel petals 15 x 5 mm, falcate, angular about the middle, beak not twisted. Staminal sheath 8 mm long; filaments 8 mm and 3 mm long alternately with ovoid (1 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 5 x 1.5 mm, inner margin silky pubescent; stipe 2 mm long, glabrous; style 8 mm long, curved, not geniculate, pubescent along the inner margin; stigma simple, hairy. Pods 4.2 x 0.8 cm, oblong, terete, almost straight with puberulous mid ventral groove, glabrescent, 30 - 40 seeded. Seeds 3 mm diam., obliquely cordiform, pale brown.

Distribution and ecology: *C. pallida* var. *pallida* is distributed throughout South India, Tropical America and Africa preferably at high altitude (above 500 m). It is a common weed on road sides, waste lands and in moist, deciduous forests. It flowers and fruits from September to March.

Notes: In var. *pallida*, the corolla is yellow, with or without purple striations. The plant is more robust and occurs gregariously. Since the pods are persistent, the peduncle together with the whole pods containing loose seeds imparts the appearance of a baby rattle.

Specimens examined: KARNATAKA: Mysore Dt.: Bandipur Forest, *Sibichen* & *Nampy* 646 (SJC); Sreerangapattanam, *Sibichen* 647 (SJC). KERALA: Idukki Dt.: Moolamattom, *Raju* 71180 (CAL); Munnar - Chinnar road,

Nampy 610 (SJC); Periyar Forest, *Jomy* 12512 (CALI). Kannur Dt.: Tolpetty, *Ramachandran* 52267 (CAL). Kottayam Dt.: Adukkam, *Antony* 1027 (MH). Palakkad Dt.: Mukkali Forest, *Vajravelu* 33291 (MH); Silent Valley, *Prasanna Kumar* 11098 (CALI). Pathanamthitta Dt.: Moozhiyar, *Anilkumar* 1175 (MH). Thiruvananthapuram Dt.: Ponmudi, *Mohanan* 69245 (MH). TAMIL NADU: Coimbatore Dt.: Poonachi, *Joseph* 15621 (MH). Kanyakumari Dt.: Thengapattanam, *Swaminathan* 68955 (CAL). Madurai Dt.: Madurai – Kumily Road, *Subramanyam* 9432 (CAL); Thandigudi, *Chandrabose* 51621 (MH). Nilgiri Dt.: Mudumalai, *Sebastine* 7333 (MH). North Arcot Dt.: Kottaiyur R.F., *Viswanathan* 573 (CAL). Periyar Dt.: Bhavani-Kaltalai, *Ramamurthy* 86421 (CAL). Salem Dt.: Yercaud, *Deb* 31395 (MH). Thanjavur Dt.: Adirampattanam, *Ramamurthy* 84608 (CAL).

7b. *C. pallida* var. *obovata* (G. Don) Polhill, Kew Bull. 22: 265. 1968, *Crotalaria* in Africa and Madagascar 186. 1982; Matthew, Fl. Tamilnadu Carnatic 4: t.136. 1988; Ramach. & Nair, Fl. Cannanore 133. 1988; Matthew, Ills. Fl. Palni Hills t. 166. 1996; Fl. Palni Hills 1: 304. 1999.

Type: Ghana, Accra, *G. Don* (holotype: BM).

C. falcata Vahl ex DC., Prodr. 2: 132.1825.

C. obovata G. Don., Gen. Syst. 2: 138.1832.

C. striata DC., Gamble, Fl. Pres. Madras 290.1935 (p.p).

C. pallida sensu Mani. & Sivar., Fl. Calicut 78. 1982 p.p; Matthew, Fl. Tamilnadu Carnatic 1: 358. 1981 p.p; Mohanan & Henry, Fl. Thiruvananthapuram 142. 1994 p.p; Sasi. & Sivar., Fl. Thrissur 135. 1996 p.p.

(Fig. 48, Pl. 7 F)

Erect, short lived perennial with a few ascending branches, 0.3 - 2 m tall. Stems and branches terete, puberulous. Leaves trifoliolate; stipule 1 mm

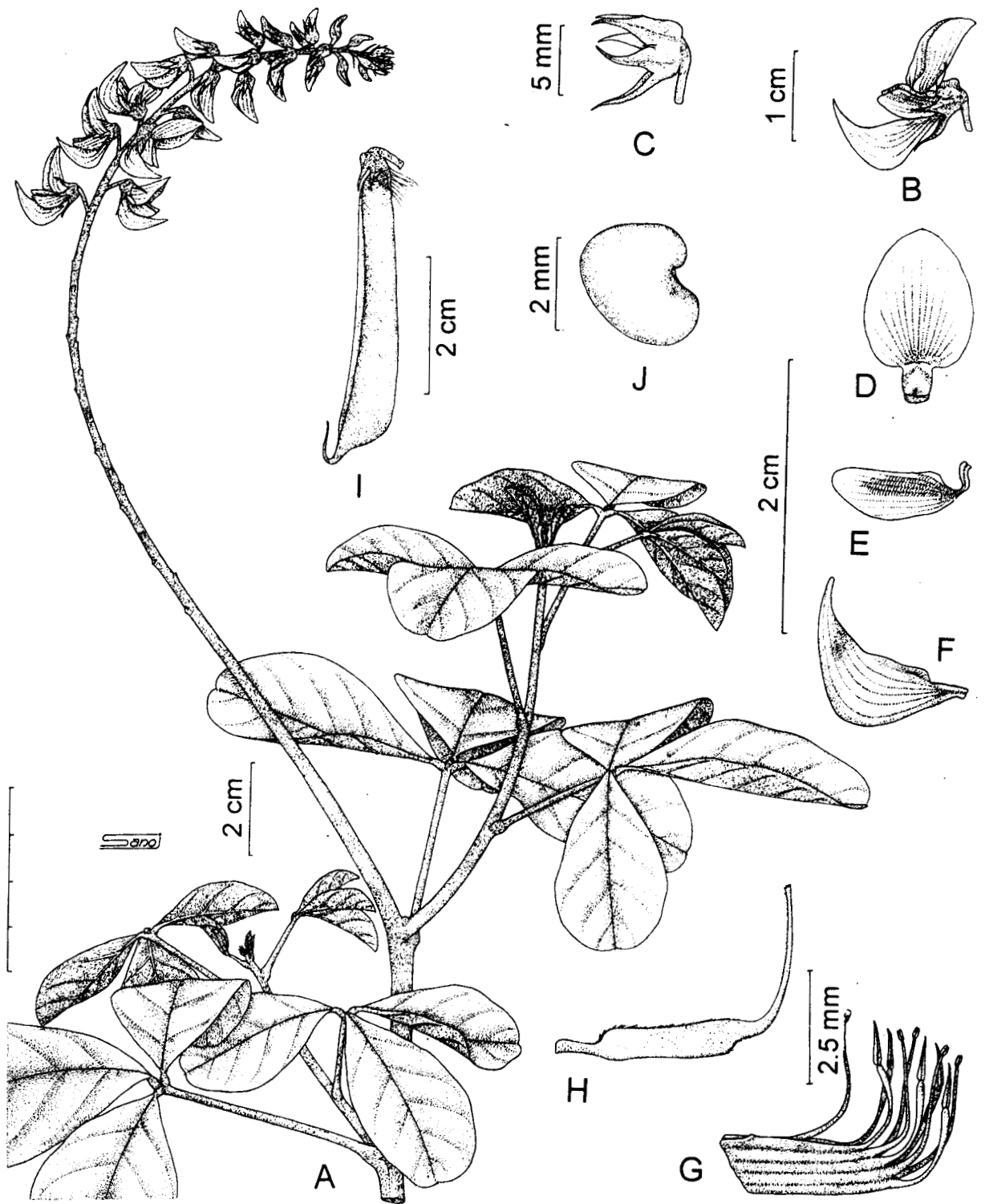


Fig. 48. *C. pallida* var. *obovata* (G. Don) Polhill: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeccium; I. Pod; J. Seed (From Sibichen & Nampy 704).

65
1961 A

long, subulate, pubescent; petiole 3 - 4.5 cm long, pubescent; leaflets 3.5 - 5.5 x 2 - 3.5 cm, median one larger than the laterals, obovate, base acute, apex retuse or obtuse, chartaceous, puberulous above and sparsely pubescent beneath. Racemes 20 - 30 cm long, terminal and lateral, densely 40 - 60 flowered. Flowers 2 cm long and 0.5 cm across, arrange closely on peduncle; bracts 2 mm long, linear, caducous; bracteoles 2 mm long, subulate, puberulous, appressed to calyx. Calyx pubescent out, tube 3 - 4 mm long; lobes 4 mm long, more or less equal, acuminate. Standard petal 1.4 x 0.8 cm, ovate with purple striations, glabrous, apex obtuse; wing petals 1 x 0.3 cm, oblong; keel petals 1.8 x 0.5 cm, falcate, angular about the middle, beak not twisted. Staminal sheath 8 mm long; filaments 4 mm and 3 mm long alternately with ovoid (1 mm long) and oblong (2 mm long) anthers respectively. Ovary 5 x 1.5 mm, inner margin densely pubescent than outer; stipe 2 mm long, glabrous; style 1.8 cm, curved, pubescent along the inner margin; stigma not expanded, hairy. Pods 4 x 0.6 cm oblong, terete, slightly curved, with a mid ventral groove, 40 - 50 seeded. Seeds 2 mm diam., obliquely cordiform, pale brown.

Distribution and ecology: *C. pallida* var. *obovata* is pantropical. It is a common weed, grows gregariously along roadsides and waste lands at low altitude (below 200 m). It flowers and fruits from July to March.

Notes: In var. *obovata* the corolla is yellow with purple striations. It is common at low altitudes. Since flowering is asynchronous in the inflorescence, the same peduncle may carry pods of different maturity.

Specimens examined: ANDHRA PRADESH: Visakapatanam Dt.: Arakku valley, *Balakrishnan* 10793 (MH). KERALA: Alappuzha Dt.: Vembanadu lake side, *Swaminathan* 88202 (CAL, MH). Kannur Dt.: Pappinisseri, *Ramachandran* 52267 (CAL). Kozhikode Dt.: Devagiri, *Sibichen* 620 (SJC). Malappuram Dt.: Thenhippalam, *Sibichan & Nampy* 704 (SJC). TAMIL

NADU: Coimbatore Dt.: Navamalai, *Joseph* 14172; Sholayar, *Sebastine* 16647 (MH). Kanyakumari Dt.: Pothayadi, *Henry* 53279 (MH). Periyar Dt.: Bhavani area, *Ramamurthy* 84608 (MH); Kottamala, *Jomy* 16298 (CALI).

8. *C. stipitata* Grah. ex Wight & Arn., Prodr. 1: 193. 1834 (repr. ed. 1976); Polhill, Kew Bull. 22: 247, 304 (1968).

C. laevigata sensu Benth. In: Hook., Lond. J. Bot. 2: 576. 1843; Baker In: Hook. f., Fl. Brit. India 2: 83. 1876 (repr. ed. 1879); Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Mani. & Sivar., Fl. Calicut 79. 1982; Polhill, *Crotalaria* in Africa & Madagascar 161. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamilnadu Analysis 97.1983; Saldan., Fl. Karnataka 1: 435. 1984; Vajrav., Fl. Palghat 151. 1990; Sanjappa, Leg. India 123. 1992; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

(Fig. 49, Pl. 5 C)

Erect woody perennial shrub with spreading erect branches, 1.5 to 2.5 m tall. Stems and branches slender, terete, white pubescent. Leaves trifoliolate; stipule 1.5 mm long, subulate; petioles 1.5 cm long; median leaflet (1.8 x 1 cm) larger than the laterals (1.5 x 0.9 cm), obovate, base cuneate, apex obtuse or retuse, slightly mucronate, chartaceous, glabrous above and appressed puberulous beneath. Racemes 2 - 3 cm long, subcorymbose at the end of copious branchlets, 2 - 4 flowered. Flowers 15 mm long and 7 mm across; bract 2 mm long, subulate; pedicel 1 - 1.4 cm long; bracteoles 1 mm long, subulate on mid pedicel. Calyx 5 cleft, tube 3 mm long, pubescent, lobes subequal, triangular, upper two lobes (4 mm long) larger than the lower three (3 mm long). Corolla yellow with purple striations, exserted; standard petal 18 x 10 mm, ovate, sparsely pubescent out with a reddish brown centre; wing petals 9 x 4 mm, oblong; keel petals angular, 15 x 5 mm, exceeding the wing petals, lanceolate, beak twisted to 180°. Staminal

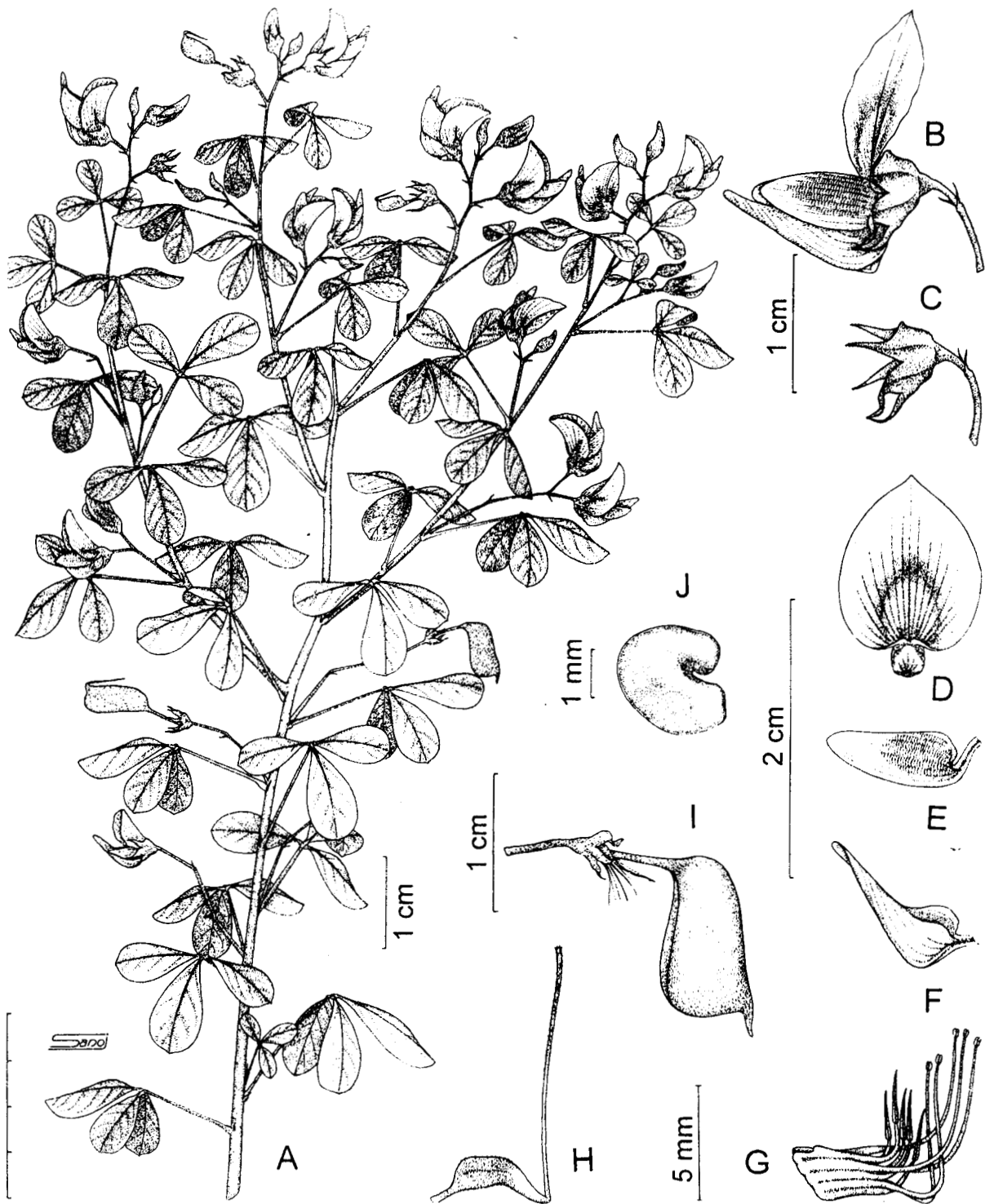


Fig. 49. *C. stipitata* Grah. ex Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From *Sibichen* 639).

66

115-A

sheath 4 mm long, filaments 9 mm and 4 mm long alternately with ovoid (0.5 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 4 x 1.5 mm, silky pubescent; stipe 2.5 mm long; style 1 cm long, geniculate, hairy towards apex; stigma simple, hairy. Pods 1.4 x 0.5 cm, oblong - obovoid, ascending, sparsely appressed, pubescent, 8 - 10 seeded; stalk 1.2 cm long. Seeds 2 mm diam., broadly oblique - cordate, smooth, brown.

Distribution and ecology: *C. stipitata* is restricted to Peninsular India. It is a common undergrowth of deciduous and semi ever green forests. It flowers and fruits from October to March.

Notes: In South Indian floras, specimens belonging to *C. stipitata* has been misnamed as *C. laevigata*, a totally dissimilar Madagascan species. It resembles *C. goreensis* in the nature of leaves. But the former can be distinguished by its perennial woody habit and stalked pod against the annual herbaceous habit and ascending, sessile pod of the latter.

Specimens examined: KARNATAKA: Mysore Dt.: Way to Bandipur, *Naithani* 21241 (MH). KERALA: Idukki Dt.: Kattappana - Elappara wayside, *Sibichen & Nampy* 668 (SJC); Painavu, Cheruthoni road, *Ramachandran* 71232; Pooyamkutty, Tholnada, *Bhargavan* 87494 (MH). Kannur Dt.: Periya, *Ramachandran* 58688 (MH). Kozhikode Dt.: Ampumala, *Sibichen & Pradeep* 659; Kakkadompoil, *Sibichen, Nampy & Pradeep* 639 (SJC); Tolpetty, *Ellis* 25728 (MH). Malappuram Dt.: Nilambur, Nedumgayam, *Philip Mathew* 33632 (CALI). Thrissur Dt.: Sholayar, *Sasidharan* 5230 (CALI). Palakkad Dt.: Anammooly slopes, *Bhargavan* 65771 (MH); Panthanthode, *Vajravelu* 33140 (CAL, MH); Silent Valley National park, *Nair* 56669 (MH). Wayanad Dt.: Elephant Camp, *Ellis* 25728 (CAL); Muthanga, *Sibichen* 639; Pulpally, Seetharmount, *Sibichen & Joby* 740 (SJC). TAMIL NADU: Coimbatore Dt.: Mount Stouert, *Joseph* 13345, Nellimalai R.F., *Ramamurthy* 16012, *Fisher* 1684 (CAL). Nilgiri Dt.: Mudumalai,

Sebastine 7359 (CAL); Nellithurai slopes, *Vajravelu* 43569, Theppakkadu, *Vivekanandan* 43050 (MH).

Subsect. **Dispermae** Baker ex Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type species: *C. medicaginea* Lam. (lectotype designated by Polhill, 1968).

Sect. Dispermae Wight & Arn., Prodr. 1: 191. 1834 (repr. ed. 1976).

Sect. Dispermae subgroup *Medicagineae* Benth. In: Hook., Lond. J. Bot. 2: 577. 1843.

Group Trifoliolatae Dispermae Baker in Hook. f., Fl. Brit. India 2: 81. 1876.

Leaves trifoliolate. Legumes small, sessile, subglobose, obliquely beaked by the hardened base of the style, pubescent, 2 seeded.

Notes: Wight and Arnott (1834) included 8 species under this section. Among them, *C. neglecta* and *C. herniariodes* are now considered conspecific to *C. medicaginea*. While species such as *C. rigida* Heyne and *C. rostrata* Wight & Arn. are excluded from the present discussion, as I was not able to collect them even after extensive survey in South India. Bentham (1843) recognized two subgroups viz., *Medicagineae* and *Sphaerocarphae* under this section and included 6 and 2 species respectively. All the South Indian species such as *C. medicaginea*, *C. willdenoviana*, *C. notonii* and *C. trifoliastrum* were treated in the former subgroup. A similar treatment can be found in Baker's (1876) Flora of British India. The members of this subsection are characterized by their bi-ovulate ovary.

Key to the Species

- 1a. Racemes terminal 2
- 1b. Racemes terminal and lateral 3
- 2a. Flowers 5 - 8, restricted at the apex of peduncle;
leaflets shorter than petiole *C. trifoliastrum*

- 2b. Flowers 12 - 40, distributed uniformly on the peduncle;
leaflets longer than petiole 2. *C. notonii*
- 3a. Leaflets obovate; calyx lobes 2 or 3 times
as long as calyx tube 1. *C. medicaginea*
- 3b. Leaflets oblong – oblanceolate; calyx lobes nearly
equal to calyx tube 4. *C. willdenowiana*

1. ***C. medicaginea*** Lam., Encycl. 2: 201. 1786; DC., Prodr. 2: 133. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 192. 1834 (repr. ed. 1976); Trimen, Handb. Fl. Ceylon. 2: 9. 1894; Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995, incl. var.); Polhill, Kew Bull. 22: 321. 1968; Niyomdham, Thai For. Bull. 11: 140. 1978 (incl. var.); Matthew, Fl. Tamilnadu Carnatic 3: 356. 1983; Saldan., Fl. Karnataka 1: 436. 1984 (incl. var.); Matthew, Illus. Fl. Tamilnadu Carnatic 4: t. 131. 1988; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 208. 1991; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 259. 1997 (incl. var.); Matthew, Fl. Palni Hills 1: 303. 1999; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 175. 2000 (incl. var.).

Type: "India Orientalis", *Sonnerat s.n.* (P).

C. herniarioides Wight & Arn., Prodr. 1: 192. 1834 (repr. ed. 1976).

C. neglecta Wight & Arn., Prodr. 1: 192. 1834 (repr. ed. 1976).

C. luxurians Benth. In: Hook., Lond. J. Bot. 2: 578. 1843.

C. medicaginea var. *neglecta* (Wight & Arn.) Baker In: Hook. f., Fl. Brit. India 2: 81. 1876 (repr. ed. 1879).

C. medicaginea var. *luxurians* (Benth.) Baker In: Hook. f., Fl. Brit. India 2: 81. 1876 (repr. ed. 1879).

C. medicaginea var. *herniarioides* (Wight & Arn.) Baker In: Hook. f., Fl. Brit. India 2: 81. 1876 (repr. ed. 1879).

(Fig. 50)

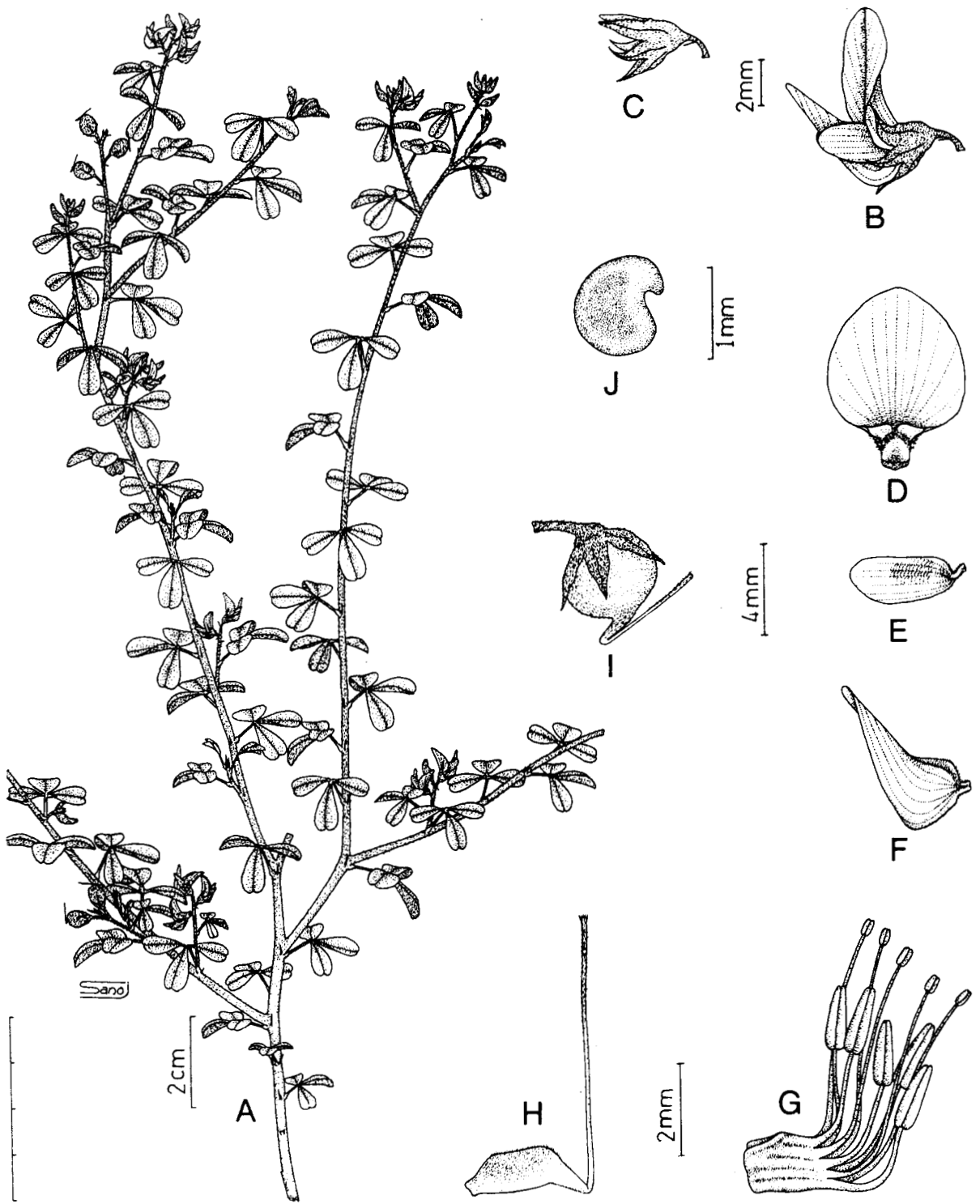


Fig. 50. *C. medicaginea* Lam.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod; J. Seed (From Sibichen & Nampy 609).

67
1074

Erect or diffuse, suffruticose, short lived perennial herb with ascending or decumbent branches, 15 - 45 cm tall. Stems and branches terete, slender to filiform, sparsely appressed pubescent. Leaves trifoliolate; stipules 1 mm long, subulate; petioles 2 - 4 mm long, sparsely pubescent; leaflets 6 - 12 x 4 - 7 mm, obovate, base cuneate, apex retuse - emarginate, slightly mucronate, glabrous above and appressed pubescent beneath, median one usually larger than the laterals, chartaceous. Racemes 2 cm long, terminal and lateral, 2 - 6 flowered. Flowers 8 mm long and 6 mm across; bracts 1 - 2 mm long, linear, setaceous; bracteoles minute, subulate, inserted on pedicel near the calyx; pedicels 2 mm long, pubescent. Calyx puberulous out and glabrous in, tube 1 mm long; lobes *ca.* 3 x 1 mm, lanceolate, subequal, upper two broader than the lower three. Corolla twice as long as calyx, yellow without striations; standard petal 6 x 5 mm, ovate to orbicular, glabrous except along the midvein on the back, wing petals 6 x 4 mm, oblong, apex obtuse; keel petals 7 x 3 mm, ovate, angular at the base, with a spirally twisted beak. Staminal sheath 1.5 mm long; filaments 6 mm and 3 mm long alternately with ovoid (0.5 mm long) and oblong (1 mm long) anthers respectively. Ovary 1.5 mm long, sessile, densely pubescent; style 6 mm long, geniculate, puberulous towards the apex; stigma simple, hairy. Pods 4 mm diam., sessile, subglobose, obliquely beaked by the hardened base of the style, appressed puberulous, 2 seeded. Seeds 0.5 mm diam., cordiform, dark brown.

Distribution and ecology: *C. medicaginea* is distributed in tropical India, Ceylon, Malaya, Afghanistan, China and Australia (Sanjappa, 1992). It occurs from the coast to an altitude of 750 m in poor soil on dry and rocky slopes and also in open forest. The habit of the plant varies with the habitat. Costal forms are prostrate while, the high altitude types are small, ascending herbs. It flowers from December to April.

Notes: *C. medicaginea* shows considerable variation in morphology. Variations in some of the quantitative traits such as height of the plant, size of leaves, number of flowers *etc.* are so strong that, the taxon has been repeatedly described under various names. Baker (1976) treated these morphoforms as varieties of *C. medicaginea*. Subsequent authors *viz.*, Gamble (1918), Saldanha (1984) and Sanjappa (1992) followed this treatment. But, lack of solid contrasting qualitative traits makes the key to varieties rather confusing. Hence it would be better to treat all these varieties as synonyms in par with Matthew (1983) and Rudd (1991).

Uses: In Punjab the plant is officinal, being sold in the name of Gulabi (Watt's Dic.). Seeds may be used as cattle feed after cooking with common salt. The seeds contain fat 6.76%; protein 23 - 31% and carbohydrate 42.04% (Agarwal, 1997).

Specimens examined: ANDHRA PRADESH: Ananthapur Dt.: Sree Krishnadevaraya University Campus, *Sibichen* 783 (SJC). Chengalpet Dt.: Vandalur R.F, *Subba Rao* 47126 (MH). Chittoor Dt.: Kailasakona Hill, *Subba Rao* 46991 (MH); way to Kammappa temple, *Rangacharryulu* 2004 (CAL); Talakona R.F., *Sibichen* 785 (SJC). East Godavari Dt.: Gollarayikonda, *Subba Rao* 67543 (CAL). Kurnool Dt.: Srisailam, *Ellis* 22092 (MH). Srikakulam Dt.: Salur, *Balakrishnan* 1061 (CAL). KERALA: Idukki Dt.: Chinnar Wild Life Sanctuary, *Sibichen & Nampy* 609 (SJC). PONDICHERRY: Auroville, *Rajan* 88050 (MH). TAMIL NADU: Dharmapuri Dt.: Cauvery river bank, *Matthew* 19767 (CAL). Kanyakumari Dt.: Vivekanandapuram, *Henry* 53309 (MH). Nilgiris Dt.: Anaikkatty, *Subba Rao* 37342 (MH). South Arcot Dt.: Pakamalai R.F., *Ramamurthy* 53518 (CAL).

2. *C. notonii* Wight & Arn., Prodr. 1: 192. 1834 (repr. ed. 1976); Wight. Ic. t. 752. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 82. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 323. 1902 (repr. ed.

1958); Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: *Wight* Cat. no. 991 (K).

Erect, perennial herb with many ascending branches, up to 30 – 90 cm tall. Stems and branches terete, pubescent. Leaves trifoliolate; stipules 2 mm long, linear; petioles 5 - 7 mm long, puberulent; leaflets 1.5 - 2 x 0.5 - 0.8 cm, obovate, base cuneate, apex rounded, slightly mucronate, glabrous above and appressed pubescent beneath. Racemes 5 - 6 cm long, terminal, 12 – 40 flowered, distributed uniformly on the peduncle, occasionally few flowered racemes in the axils of the upper leaves. Flowers 1.5 cm long and 1.2 cm across; bracts minute, setaceous; pedicel 3 mm long; bracteoles 2 mm long, setaceous, inserted on mid pedicel. Calyx 5 cleft, tube 2 mm long, lobes 4 mm long, equal, linear. Corolla exserted, yellow; standard petal 1.3 x 1 cm; wing petals 1 x 0.4 cm, oblong; keel petals 1.3 x 0.4 cm, ovate, beak long, twisted to 360°. Staminal sheath 1.5 mm long; filaments 3 mm and 2 mm long alternately with ovoid (0.5 mm long) and oblong (1 mm long) anthers respectively. Ovary 4 mm long; style 1 cm long, with line of hairs along the margins; stigma capitate. Pods 5 x 4 mm, subquadrangular, appressed pubescent, 2 seeded. Seeds 3 x 2 mm, obliquely cordate, glabrous.

Distribution and ecology: *C. notonii* is endemic to India (Sanjappa, 1992). It flowers and fruits from September to March.

Specimens examined: GOA: North Goa, Goa University Campus, *Sibichen & Nampy* 717 (SJC). KERALA: Palakkad Dt.: Silent Valley, Perumalmalai, *Sabu* 10003 (CALI).

3. *C. trifoliatrum* Willd., Sp. Pl. 3: 983. 1802; Wight & Arn., Prodr. 1: 191. 1834 (repr. ed. 1976); Wight, Ic. t. 421. 1845 (repr. ed. 1988); Baker In: Hook. f., Fl. Brit. India 2: 82. 1876 (repr. ed. 1879); Gamble,

Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 1: 101. 1983; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 264. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 197. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: 13265 (Willd.-B).

(Fig. 51)

Erect, suffruticose shrubby herb with many ascending branches, 0.5 – 1.5 m tall. Stems and branches terete, pale yellow puberulous. Leaves trifoliolate; stipules 4 mm long, subulate; petioles 1 - 1.5 cm long, articulate, pulvinate; leaflets 0.9 - 1.8 x 0.5 – 1.2 cm, median one larger than laterals, obovate, base cuneate, apex rounded, mucronate, chartaceous. Racemes terminal, 5 - 10 cm long, 5 - 8 flowered, restricted at the apex, umbellate. Flowers 1.5 cm long and 0.5 cm across; bracts 5 mm long, subulate, setaceous; bracteoles 4 mm long, subulate, setaceous, inserted on mid pedicel; pedicels 5 - 8 mm long. Calyx 5 cleft, tube 4 mm long; lobes equal, 8 x 4 mm, triangular, acuminate, rusty tomentose out and glabrous in. Corolla yellow with purple striations; standard petal 10 x 8 mm, ovate, pubescent out and glabrous in; wing petals 9 x 3 mm ovate; keel petals 10 x 5 mm, lanceolate, angular at the base, beak twisted to 180°. Staminal sheath 2 mm long, filaments 2 mm and 4 mm long with oblong (2.5 mm long) and ovoid (0.5 mm long) anthers respectively. Ovary 3 x 2 mm, silky puberulous; stipe 1 mm long; style 5 mm long, geniculate, hairy towards the apex; stigma slightly expanded, hairy. Pods 5 x 4 mm, obliquely subglobose, puberulous, 2 seeded. Seeds 2.2 mm diam., reniform, laterally compressed, granulose.

Distribution and ecology: *C. trifoliastrum* is distributed in Peninsular India, Assam, Rajasthan, Uttar Pradesh and Bhuttan (Sanjappa, 1992). The plant flowers and fruits from August to December.

Notes: The species is usually seen as an undergrowth in moist deciduous forests and can be distinguished by its umbellate inflorescence.

Specimens examined: ANDHRA PRADESH: Gundur Dt.: Atchempeta, *Ramakrishnaiah* 5858 (SKU). KERALA: Idukki Dt.: Munnar, *Abdul Jabbar* 43964 (TBGRI); Munnar - Rajamala wayside, *Sibichen & Joby* 780 (SJC). TAMIL NADU: Nilgiri Dt.: Conoor, *Meebold* 11956; Nilgiris, *Gamble* 16816 (CAL).

4. *C. willdenowiana* DC., Prodr. 2: 134. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1:191. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 579. 1843; Thw., Enum. Pl. Zeyl. 441. 1859 (repr. ed. 1864); Baker In: Hook. f., Fl. Brit. India 2: 81. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 18. 1894; Gamble, Fl. Pres. Madras 1: 289. 1918 (repr. ed. 1995); Matthew, Fl. Tamilnadu Carnatic 3: 356. 1983; Rudd In: Dassanayake and Fosberg (eds.), Rev. Handb. Fl. Ceylon 209. 1991.

Perennial, suffrutescent herb, with profuse ascending branches, about 50 - 75 cm high. Stems and branches gray pubescent. Leaves trifoliolate, leaflets oblong - oblanceolate, base cuneate; apex retuse, chartaceous, pubescent on both sides rarely glabrous above. Racemes terminal and lateral, up to 3 cm long, 4 - 8 flowered. Flowers 10 mm across; pedicels about 2.5 mm long. Calyx tube 1.5 mm long, pubescent; lobes lanceolate. Corolla yellow. Staminal sheath glabrous, anthers oblong and ovoid on short and long filaments respectively. Ovary pubescent; style not geniculate; stigma simple. Pods subglobose, pubescent, 1 or 2 seeded.

Notes: Ellis (1964) described the sub species *C. willdenowiana* subsp. *glabrifoliata* from South India. Nayar and Sastry (1987) treated this as rare.

Key to the Subspecies

- 1a. Leaflets pubescent on both surfaces;
root stock not yellow..... *C. willdenowiana* subsp. *willdenowiana*
- 1b. Leaflets glabrous above, pubescent beneath;
root stock deep yellow..... *C. willdenowiana* subsp. *glabrifoliolata*

4a. *C. willdenowiana* DC. subsp. *willdenowiana*; Chandrabose and Nair, Fl. Coimbatore 88. 1987; Sanjappa, Leg. India 132. 1992; Pullaiah and Ramamurthy, Fl. East. Ghats 2. 199. 2000; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: Based on *C. genistoides* Willd., non. Lam.

Erect, suffrutescent, perennial herb with copious ascending branches, up to 75 cm high. Stems and branches gray pubescent. Root stock woody, branched, not yellow. Leaves trifoliolate; petiole 6 mm long, shorter than leaflets; stipule minute, setaceous, persistent; leaflets 1 - 2 x 0.3 - 0.6 cm, oblong - oblanceolate; base cuneate; apex retuse or emarginate, pubescent on both surfaces, chartaceous. Racemes terminal and lateral, about 3 cm long, 4 - 8 flowered. Flowers 7 - 10 mm long; bracts 2 mm long, linear; bracteoles 1.5 mm long, inserted on pedicel. Calyx tube 1.5 mm long, lobes 2 mm long, equal, lanceolate, pubescent. Corolla yellow, twice as long as calyx; standard petal 10 x 8 mm, orbicular, pubescent out; wing petals 8 x 3 mm, oblong; keel petals 8 x 4 mm, angular at the base, beak not twisted. Staminal sheath 2 mm long, filaments 6 mm and 3 mm long alternately with ovoid (0.7 mm long) and oblong (1.5 mm long) anthers respectively. Ovary 3 mm long, sessile, pubescent; style 6 mm long, geniculate; stigma simple, hairy. Pods 5 mm diam., subglobose, pubescent, 1 or 2 seeded. Seeds 1 mm diam.

Distribution and ecology: *C. willdenowiana* subsp. *willdenowiana* is distributed in South India; apparently introduced in Sri Lanka (Rudd, 1991).

It is seen rarely on river banks, waste lands and on floor of scrub jungles (Matthew, 1983). Flowers and fruits in peak during November to March.

Specimen examined: TAMIL NADU: Namakkal Dt.: Kolli hills, *Perumal & Manoharan* 22375 (MH).

4b. *C. willdenowiana* DC. subsp. ***glabrifoliolata*** Ellis, Bull. Bot. Surv. India 6: 97. 1964; Chandrabose & Nair, Fl. Coimbatore 88. 1987; Sanjappa, Leg. India 132. 1992; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: India, Coimbatore, *Ellis* 13536 (holotype: MH)

Erect, perennial herb with numerous spreading branches, 20 - 30 cm tall. Stems and branches terete, appressed pubescent. Root stock woody, branched, tinged deep yellow. Leaves trifoliolate; petioles up to 4 mm long; stipules 5 mm long, minute, ovate - lanceolate; leaflets 2 x 1 cm, oblanceolate; base cuneate; apex emarginate, slightly mucronate, glabrous above and tomentose beneath. Racemes terminal and lateral, 2 - 10 flowered; peduncles and pedicels with spreading hairs. Flowers 7 mm long and 10 mm across. Calyx tube 3 mm long; lobes equal to calyx tube, tomentose out and glabrous within. Corolla yellow; standard petal 9 x 7 mm, obovate, with purple striations; wing petal 6 x 2 mm, oblong; keel petals 6 x 2 mm, ovate, angular at the base, hairy along the margin. Stamens dimorphous; long and short filaments arranged alternately, bearing ovoid and oblong anthers respectively. Ovary sessile; style 3 mm long, not geniculate; stigma simple, hairy. Pods 5 x 4 mm, obliquely subglobose, strongly beaked, tomentose, 2 seeded. Seeds 2 x 3 mm, reniform, gray, smooth.

Distribution and ecology: It is endemic to South India.

Notes: *C. willdenowiana* subsp. *glabrifoliolata* is quite distinct in having leaflets glabrous on the upper surface and root stocks being deep yellow.

Specimen examined: TAMIL NADU: Coimbatore Dt.: Gandhi Memorial Library compound, *Ellis* 28922 (MH)

Sect. *Polyphyllae* Wight & Arn., Prodr. 1: 194. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 593. 1843.

Group *Multifoliolatae* Baker In: Hook. f., Fl. Brit. India 2: 84. 1876 (repr. ed. 1879).

Sect. *Multifoliolatae* Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995).

Sect. *Multifoliolatae* Baker ex Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Herbs or lowshrubs. Stems and branches fistulate, terete or sulcate. Leaves 5 - 7 foliolate; petioles 3 - 7 cm long; lamina oblong to oblanceolate or obovate, base cuneate, apex obtuse or retuse; glabrous above and thinly pubescent or silky tomentose beneath. Racemes terminal, many flowered, arranged laxly on peduncle. Corolla yellow with deep purple striations. Pods large, clavate, much inflated, glabrous, hooked at apex and attenuated at the base into a flat short stalk, many seeded.

Notes: The sect. *Polyphyllae* was originally established by Wight and Arnott (1834) to include 3 species from South India viz., *C. quinquefolia*, *C. grahamiana* and *C. digitata* characterized by 5 - 7 foliolate leaves. Bentham (1843) included two more species under this section viz., *C. trichotoma* and *C. burkeana* belong to Madagascar and South Africa respectively. However, Baker (1876) placed the Indian species under the group *Multifoliolatae* with more or less the same circumscription. The only glaring alteration is in the number of leaflets i.e., 3 - 7 foliolate instead of 5 - 7. Possibly, this might have been to include the very rare situation in *C. quinquefolia* where the lower leaves may be tri or unifoliolate due to leaf abortion as noticed by Polhill (1997). Baker's (*l.c.*) treatment was followed by Gamble (1918). However, Ansari (2002) raised the group *Multifoliolatae* of Baker (1876) to the rank of a section. Since there is no reason to invalidate the sectional name

Polyphyllae of Wight and Arnott (*l.c.*). I have followed it in the present treatment. Even after extensive survey in different parts of South India I could not locate *C. digitata* Hook., hence it is not included in the present treatment.

Key to the Species

- 1a. Stems and branches terete, densely tomentose;
lamina obovate - oblanceolate, densely tomentose
beneath, subcoriaceous; occurs in hills 1.*C. grahamiana*
- 1b. Stems and branches sulcate, thinly puberulous;
lamina oblong - oblanceolate, glabrous above and
thinly puberulous beneath, chartaceous; occurs in
wetlands 2.*C. quinquefolia*

1. *C. grahamiana* Wight & Arn., Prodr. 1: 194. 1834 (repr. ed. 1976); Benth. In: Hook., Lond. J. Bot. 2: 593. 1843; Baker In: Hook. f., Fl. Brit. India 2: 85. 1876 (repr. ed. 1879); Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Polhill, *Crotalaria* in Africa and Madagascar 373. 1982; Malathi In: Nayar & Henry (eds.), Fl. Tamil Nadu Analysis 1: 97. 1983; Ahmedulla & Nair, End. Pl. India 96. 1987; Sanjappa, Leg. India 120. 1992; Mohanan & Henry, Fl. Thiruvananthapuram 139. 1994; Matthew, Illus. Fl. Palni Hills t. 162. 1996; Polhill, Curtis's Bot. Mag. 208. 1997; Matthew, Fl. Palni Hills 1: 301.1999; Ansari In: Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: India, Madras, Dindigul Hills, *Wight* 706 (holotype: K).

C. digitata *Wight* in Wall cat. no. 5430, non Hook.

(Fig. 52)

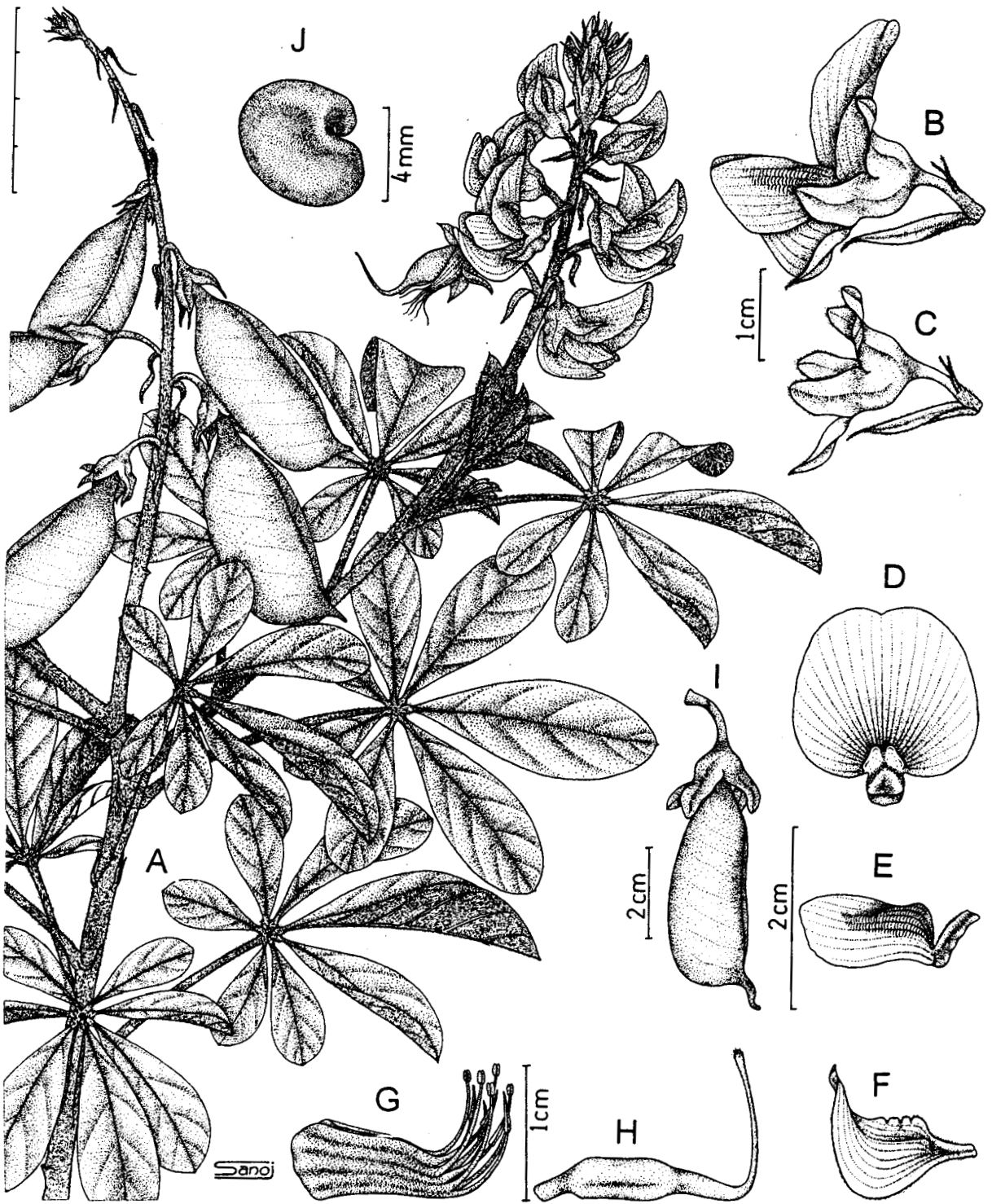


Fig. 52. *C. grahamiana* Wight & Arn.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen & Nampy 674).

63
12+P

Erect, annual shrubby herb with many ascending branches, densely tomentose throughout, 1 – 2 m tall. Stems and branches fistulate, terete. Leaves 5 - 7 foliolate; stipule 7 – 9 mm long, lanceolate, recurved up; petioles 3.5 – 7 cm long, longer than leaflet; leaflets 2.5 – 4 cm x 0.8 - 1.2 cm, obovate - oblanceolate, base cuneate, apex obtuse or slightly retuse, mucronate, glabrous above and silky appressed tomentose beneath, subcoriaceous. Racemes 8 – 30 cm long, terminal, 8 - 20 flowered, arranged laxly. Flowers 2 cm long and 1.5 cm across; bracts 13 - 15 x 2 – 3 mm, lanceolate, reflexed down; bracteoles 4 mm long, linear, inserted on mid pedicel; pedicels 8 mm long. Calyx 5 cleft, tube 5 mm long, glabrous; lobes 8 x 8 mm, equal, ovate - triangular, puberulous, margin slightly revolute. Corolla yellow with purple striations; standard petal 1.5 x 1.3 cm, suborbicular, glabrous; wing petals 1.5 x 0.5 cm, obovate; keel petals 1.5 x 0.8 cm, ovate, rounded about the middle, outer margin fulvous and inner margin undulate, beak twisted to 360°. Staminal sheath 5 – 7 mm long; filaments 9 mm and 5 mm long alternately with ovoid (0.5 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 10 x 3 mm, glabrous; style 10 mm long, hairy along the inner margin; stigma expanded, hairy. Pods 4.5 - 5.5 x 1.2 – 1.6 cm, clavate, base attenuate in to short stalk, apex obtuse, glabrous, 16 - 18 seeded; stalk 6 - 8 mm long, flat. Seeds 5 x 3 mm, obliquely cordiform, pale brown.

Distribution and ecology: *C. grahamiana* is endemic to South India (Ahmedulla & Nair, 1987) and is introduced to Madagascar as green manure (Polhill, 1982). In India, it occurs chiefly in southern western Ghats from 800 m to 1800 m altitude. It grows gregariously in thin layer of soil on rocky slopes. Flowers are in peak from January to March and pods are seen throughout the year.

Specimens examined: KERALA: Idukki Dt.: Kallarppara, near Pampadumpara, *Sibichen & Joby* 769, *Sibichen & Nampy* 674 (SJC);

Kuttikkanam, *Vivekanandan* 23002 (MH); Munnar - Marayur road side, *Sibichen & Nampy* 611 (SJC); Periyar river bank, near Thannikudi, *Nair* 70146; Vandanmedu, *Mohanan* 72068 (CAL, MH). Kottayam Dt.: Vagamon, Kurisumala, *Antony* 729 (MH). Palakkad Dt.: Nelliampathy, *Das & Sibichen* 565 (SJC). Thiruvananthapuram Dt.: Boneccord, *Mohanan* 59332 (CAL, MH). TAMIL NADU: Coimbatore Dt.: Aliyar submergible area, *Sebastine* 15362; Anamalais, *Joseph* 13309; Kurudimalai, southern slopes, *Subramanyan* 1225 (MH). Madurai Dt.: Bodimettu, Kerala border, *Ravikumar* 1841 (CAL, MH); Palni hills, *Beddome s. n.*; Pannaikadu wayside, *Deb* 30883 (MH).

2. *C. quinquefolia* Linn., Sp. Pl. 716. 1753; Burm., Fl. Indica 157. 1768 (repr. ed. 1984); DC., Prodr. 2: 135. 1825 (repr. ed. 1989); Wight & Arn., Prodr. 1: 194. 1834 (repr. ed. 1976); Benth. in Hook., Lond. J. Bot. 2: 593. 1843; Thw., Enum. Plant. Zeyl. 82. 1859 (repr. ed. 1864); Baker in Hook. f., Fl. Brit. India 2: 84. 1876 (repr. ed. 1879); Trimen, Handb. Fl. Ceylon 2: 19. 1898; Rama Rao, Fl. Plts. Travancore 107. 1914; Gamble, Fl. Pres. Madras 1: 290. 1918 (repr. ed. 1995); Cooke, Fl. Bombay 1: 324. 1902 (repr. ed. 1958); Saldan. & Nicolson, Fl. Hassan 243. 1976; Niyomdham, Thai For. Bull. 11: 150. 1978; Mani. & Sivar., Fl. Calicut 79. 1982; Malathi In: Nair & Henry (eds.), Fl. Tamil Nadu Analysis 100. 1983; Saldan., Fl. Karnataka 1: 440. 1984; Ramach. & Nair, Fl. Cannanore 133. 1988; Rudd in Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 216. 1991; Sanjappa, Leg. India 127. 1992; Polhill, Curtis's. Bot. Mag. 14: 208. 1997; Sivar. & Mathew, Fl. Nilambur 182. 1997; Pullaiah & Chennaiah, Fl. Andhra Pradesh 1: 262. 1997; Pullaiah & Ramamurthy, Fl. East. Ghats 2: 190. 2000; Ansari in Rao (ed.), Adv. Leg. Res. 168. 2002.

Type: Herb. Linn. No. 895. 38 (LINN).

-*Wellia tandele* – cotti Rheede, Hort. Malab. 9. p. t. 28. 1689.

Vernacular name: Kankalakotti (mal.).

(Fig. 53, Pl. 7 A)

Erect, annual or short-lived perennial herb with many ascending branches; 0.5 – 2.5 m tall. Stems and branches sulcate, fistulate, puberulous. Leaves 5 - 7 foliolate; stipules 2.5 mm long, subulate, reflexed; petioles 3 - 6 cm long, puberulous; leaflets 3 - 11 x 0.6 - 1.2 cm, oblong to oblanceolate, base cuneate, apex obtuse to slightly retuse, glabrous above and thinly appressed puberulous beneath, median ones usually longer than the laterals, chartaceous. Racemes 20 - 40 cm long, terminal, lax, 10 - 15 flowered. Flowers 2 cm long and 1.2 cm across; bracts 10 x 3 mm, foliaceous, lanceolate, reflexed, persistent; bracteoles 2 mm long, linear, inserted on the lower half of the pedicel; pedicels 6 - 8 mm long, glabrous. Calyx tube 7 mm long, upper four 4 x 3 mm, lower one 6 x 4 mm, glabrous; lobes triangular, subequal, upper two larger, two laterals medium sized and the basal narrow. Corolla yellow with deep purple striations; standard petals 2.4 x 2.5 cm, broadly elliptic, bright yellow with purple striations, glabrous; wing petals 1.8 x 1 cm, broadly oblong, exceeding the keel; keel petals 1.5 x 1 cm, rounded about the middle, inner margin slightly undulated and hairy at the base, beak twisted and turned upwards. Staminal sheath 1 cm long, filaments 7 mm and 5 mm long alternately with ovoid (1 mm long) and oblong (2.5 mm long) anthers respectively. Ovary 6 x 2 mm, glabrous; stipe 2 mm long; style 10 mm long, curved, hairy along the margin; stigma flattens towards apex, hairy. Pods 5.5 x 1.8 cm, clavate, glabrous, 20 - 30 seeded; stalk 7 x 2 mm. Seed 5 x 3 mm. diam., obliquely cordiform.

Distribution and ecology: *C. quinquefolia* is a native of India, and is introduced to Burma, Malaya, Philippines, Sri Lanka, Indo - Malesia, Cuba, Hispaniola, Antigua, Guadeloupe, Martinique (Polhill, 1997). The plant

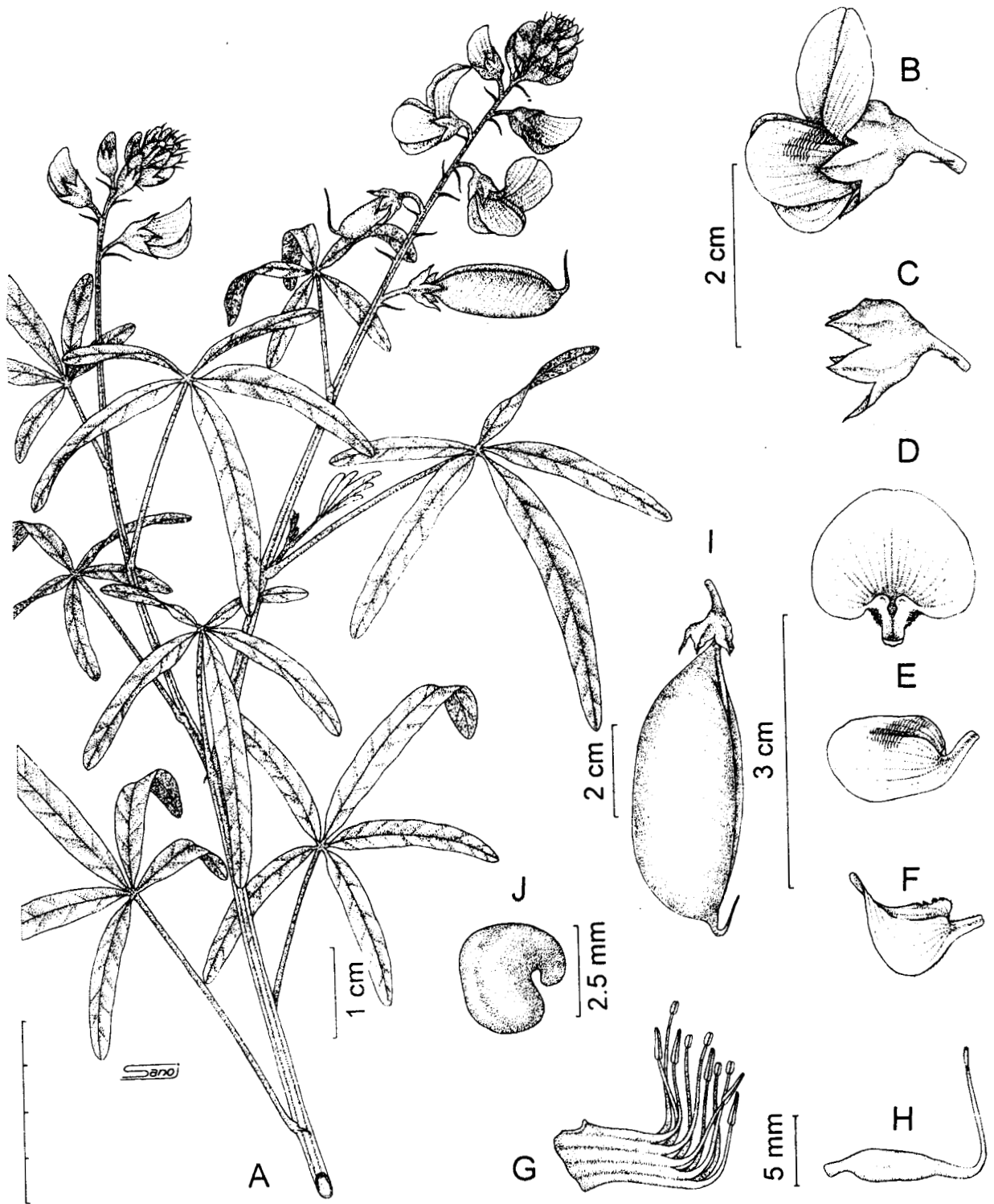


Fig. 53. *C. quenquefolia* L.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceum; I. Pod; J. Seed (From Sibichen & Nampy 601).

70
1979

usually grows in wet places, occasionally in paddy fields, so it may have been inadvertently spread with the crop. It flowers from September to February.

Notes: *C. quinquefolia* is quite distinct in its marshy habitat, hollow, ribbed stem, digitately 5 - foliolate leaves and large glabrous pods. Though South Indian specimens invariably have 5 - foliolate leaves, Polhill (1997) reported 3 - 7 foliolate leaves and very occasionally uni - foliolate condition in *C. quinquefolia*. It resembles *C. spectabilis* in the nature of bracts, stipules and pods but the leaves are simple in the latter and 5 - 7 foliolate in the former.

Specimens examined: ANDHRA PRADESH: Godavari Dt.: Palagudein, *Narayanaswami* 4466; Samalkot, *Narayana* 16830 (MH). Gundur Dt.: Nellore, *Cheriyana* 18526 (MH). Karim Nagar Dt.: Dayyam Maduga, *Ravishankar* 83688 (MH). KARNATAKA: Mysore Dt.: Heggorgudda, *Sundara Raghavan* 90083 (CAL). KERALA: Kannur Dt.: Tolpetty, *Ramachandran* 20491 (MH), *Ramachandran* 52351 (CAL). Kasaragod Dt.: Beemanadi, *Ansari* 74350 (MH). Kozhikode Dt.: Chedalet, *Ellis* 20491 (CAL, MH); Thondayadu, *Sibichen* 683 (SJC); Ummalathoor, *Sibichen & Nampy* 601 (SJC). Malappuram Dt.: Kavalanukata, *Philip* 33476 (CALI). Thrissur Dt.: Santhanathode area, *Ramamurthy* 75545; Triprayar, *Ramamurthy* 48416 (MH). TAMIL NADU: Thanjavur Dt.: Ammapetai, *Ragupathy* 962 (CAL, MH); Chettinad, *Nair* 53038 (CAL).

Rothia Pers.

Rothia Pers., Syn. Pl. 2: 302, 638. 1807, nom. cons., non Schreb., 1791; nec Borkh., 1792; nec Lam., 1792; Polhill, Bot. Syst. 1: 326. 1976.

Type species: *R. trifoliata* (Roth) Pers., based on *Dillwynia trifoliata* Roth, synonym of *R. indica* (L.) Druce.

Annual herbs. Stems prostrate or diffuse. Leaves digitately trifoliolate; stipules linear to oblong or lanceolate. Flowers small, solitary or in a few

flowered terminal or leaf opposed fascicles; bracts small, linear; bracteoles minute or wanting. Calyx campanulate with 5 subequal lobes. Corolla yellow to pink. Standard petal glabrous or nearly so; wing petals spathulate; keel petals coherent. Stamens monadelphous with the filaments of same length; sheath open on the side of the standard petal; anthers small, subequal, subspherical, dorsifixed. Ovary sessile, many ovuled; style glabrous, essentially straight; stigma terminal, minutely capitate. Pods sessile, tardily dehiscent, linear, somewhat compressed, many seeded.

Notes: The genus is represented by two species all over the world, of which one is a native of India and Australia while the other is a native of Tropical Asia. *R. indica* alone occurs in South India.

R. indica (L.) Druce, Bot. Soc. Exch. Club Brit. Isles Rep. 3: 423. 1914; Rudd In: Dassanayake & Fosberg (eds.), Rev. Handb. Fl. Ceylon 7: 184. 1991; Mani. & Sivar., Fl. Calicut 76. 1982; Matthew, Fl. Tamilnadu Carnatic 2: t. 219. 1982 & 3: 456. 1983.

Trigonella indica L., Sp. Pl. 778. 1753.

Dillwynia trifoliata Roth, Catolecta 3: 71. 1805.

R. trifoliata (Roth) Pers., Syn. Pl. 2: 302. 1807; Wight, Ic. t. 199. 1839; Baker In: Hook (ed.), Fl. Brit. India 2: 634. 1876 (repr. ed. 1879); Cooke, Fl. Bombay 1: 308. 1902; Gamble, Fl. Pres. Madras 279. 1918 (repr. ed. 1995); Matthew, Mat. Tamilnadu Carnatic 197. 1981.

(Fig. 54)

Annual herb with diffuse branches, upto 30 cm high. Stems and branches terete, appressed villous. Leaves trifoliolate; stipules 4 x 2 mm, obovate, foliaceous; petiole 6 – 10 mm long; lamina 10 – 15 x 4 – 6 mm, obovate, median one larger than the laterals, base attenuate, apex obtuse, slightly mucronate, chartaceous, sparsely sericeous on both sides. Fascicles

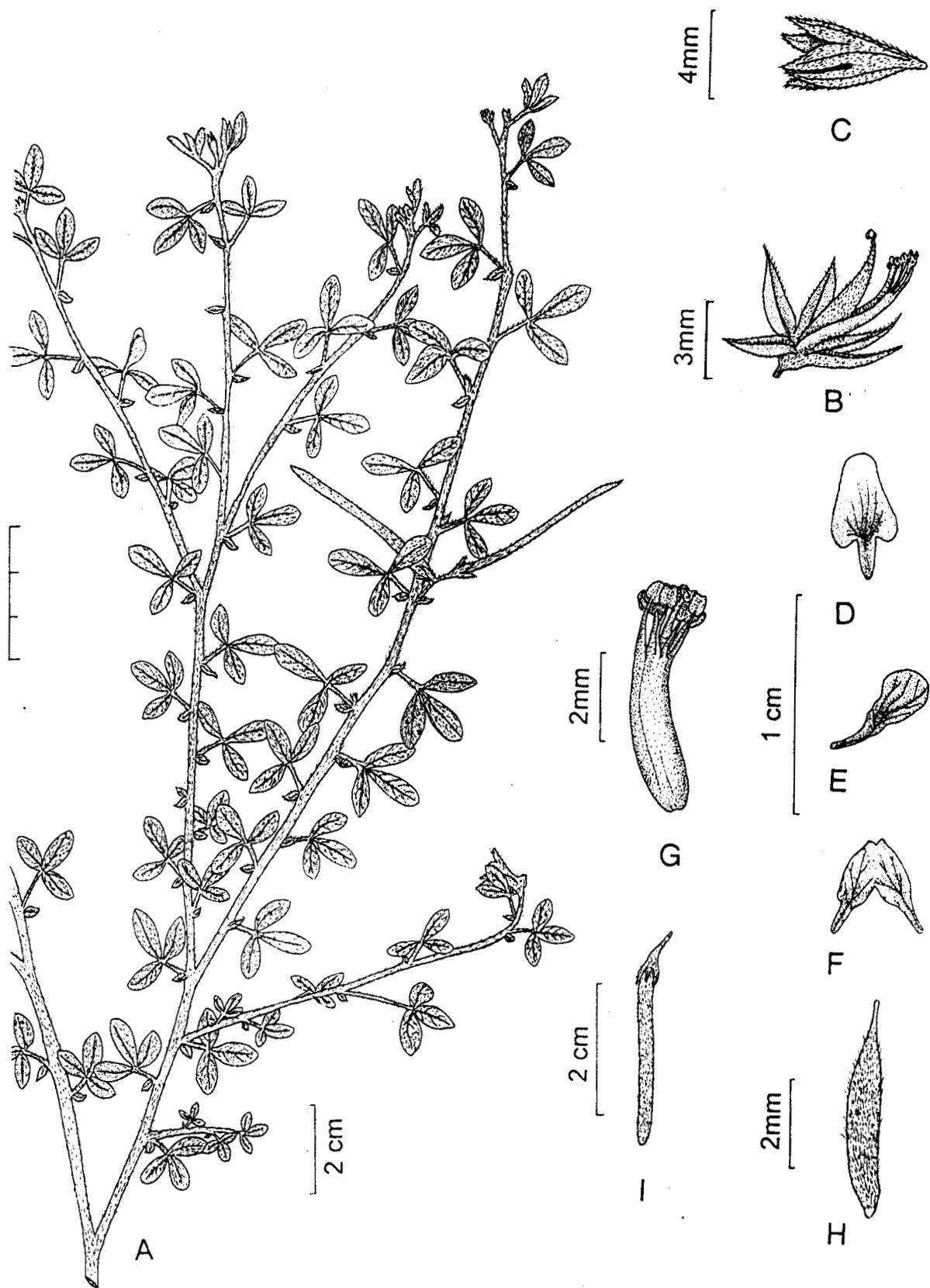


Fig. 54. *Rothia indica* Pres.: A. Habit; B. Flower; C. Calyx; D. Standard petal; E. Wing petal; F. Keel petal; G. Staminal sheath; H. Gynoeceium; I. Pod. (From Sheja 2290)

71

axillary, 1 – 3 flowered. Flowers 6 mm long and 5 mm across, pedicel 2 mm long; bracts and bracteoles small. Calyx campanulate; lobes 5, subequal, lanceolate, upper two broader, falcate. Corolla yellow; petals long clawed; standard petal 6 x 2 mm, ovate, wing petals 4 x 2 mm, obovate; keel petals 3 x 2 mm, cohering, falcate. Staminal sheath 4 mm long, glabrous; anthers uniform, ovoid. Ovary 3.5 mm long, subsessile, densely hirsute; style 1 mm long, erect, glabrous; stigma capitate. Pods 6 x 0.2 cm, linear, compressed, appressed villous, dehiscent along dorsal suture, many seeded. Seeds 1 mm diam., reniform.

Distribution and ecology: *R. indica* is distributed in India, Pakistan and Ceylon. It occurs from the coast to 500 – 800 m altitude. It is a common weed in cultivating land and grasslands during monsoon. The plant flowers in July and fruits from December.

Specimens examined: ANDHRA PRADESH: Chittoor Dt.: Digha, *Magi* 2572 (CAL). Visakapatanam Dt.: near Patel River, *Balakrishnan* 10867 (CAL). KERALA: Kozhikode Dt.: Baypore shore, *Rao* 9806 (CAL). Malappuram Dt.: Thavannur, *Babu* 37737 (CAL). Thiruvananthapuram Dt.: Vellayani, *Mohanan* 52636 (CAL); Veli, *Sibichen* 798 (SJC). Thrissur Dt.: Chavakkad Sea coast, *Ramamurthy* 52636 (CAL); Chiklai, *Ramamurthy* 74944 (CAL). TAMIL NADU: Coimbatore Dt.: Kurudi malai, *Subramanyan* 1812; Thekkumalai, *Sebastine* 1630 (CAL). Dharmapuri Dt.: Karur, *Matthew* 19035 (CAL). North Arcot Dt.: Sathanur forest, *Vajravelu* 52068 (CAL). Ramnathapuram Dt.: Devathanum, *Srinivasan* 79732 (CAL). Salem Dt.: Kuzhithurai, *Henry* 49564 (CAL); Namakkal, *Matthew* 19944 (CAL). South Arcot Dt.: Pakkamalai, *Ramamurthy* 52888 (CAL).

DISCUSSION

Sibichen M. Thomas “Morphologic and Taxonomic Studies on Fabaceae (Tribe
Crotalarieae) in South India” Thesis. Department of Botany, St. Joseph's
College Kozhikode , University of Calicut, 2004

DISCUSSION

72

10/11

Comparative Morphology

Habitat

The genus *Crotalaria* comprises mesophytes and is found to occur from sea level to higher altitude, about 2400 m in South India. Of the 65 species recognized from the study area, the majority inhabit in places of medium (400-1200 m) to high (1200-2400 m) altitude. Species viz., *C. micans*, *C. walkeri*, *C. heyneana*, *C. multiflora*, *C. calycina*, *C. speciosa*, *C. berteriana*, *C. longipes*, *C. clarkei* etc. are distributed in medium altitudes whereas *C. fysonii*, *C. spectabilis*, *C. beddomeana*, *C. obtecta*, *C. grahamiana*, *C. semperflorens*, *C. wightiana*, *C. scabrella* etc., are strictly high altitude species. *C. pallida* var. *obovata*, *C. verrucosa*, *C. quinquefolia*, *C. laburnifolia*, *C. nana* etc., are adapted to low altitude. *C. retusa* is found to occur from sea level to 2200 m altitude. Though there is apparent variation in the morphology of plants collected from varying localities, it does not show a consistent correlation with the habitat. Whereas, *C. calycina* collected from low altitude (below 700 m) invariably have ovate-oblong leaves; high altitude (above 1200 m) ones have elliptic leaves and those seen at medium elevations (700-1200) have narrow linear leaves. *C. quinquefolia* is a marshy plant found to grow on bunds in paddy fields.

Habit

Members of this genus *Crotalaria* are either herbs, under-shrubs, shrubs or very rarely small trees. The only tree member that found in South India is *C. agatiflora* subsp. *engleri*, a native of tropical East Africa. Herbaceous members are usually annuals such as *C. umbellata*, *C. nana*, *C. humifusa*, *C. filipes*, *C. fysonii* etc., while under-shrubs may be annuals or perennials. Species like *C. verrucosa*, *C. retusa*, *C. juncea*, *C. goreensis* etc. are annual under-shrubs while *C. obtecta*, *C. micans*, *C. alata*, *C. wightiana*,

C. multiflora etc. are perennial under-shrubs. Species such as *C. stipitata*, *C. beddomeana*, *C. heyneana*, *C. longipes*, *C. semperflorens*, *C. pulchra* etc. are perennial shrubs. Most species are erect plants with suffrutescent base. The smallest species that has been collected from South India is *C. humifusa*, though the earlier workers considered *C. pusilla* as the smallest.

Stems and branches

The stems and branches are usually terete or rarely angular. They are tri or tetragonal throughout in *C. clarkei*, *C. triquetra* and *C. verrucosa*; whereas, in *C. heyneana* they are angular only at extreme branchlets. The stem is sulcate in *C. juncea*, *C. retusa* and *C. quinquefolia* and is fistulate in *C. grahamiana* and *C. quinquefolia*. Copious branching is noticed in species viz. *C. verrucosa*, *C. fysonii*, *C. scabrella*, *C. stipitata*, *C. albida*, *C. globosa* etc., while, it is scanty in *C. peduncularis*, *C. speciosa* etc. The whole plant is glabrous in *C. peduncularis* and *C. lutescens* and are appropriately included under the section Glaucae. Generally the indumentum varies from glaucescent as in *C. stipitata* to densely sericeous as in *C. salicifolia* through varying degrees of pubescence as in *C. heyneana*, *C. juncea*, *C. beddomeana* etc.

Stipules

A variety of stipules are met with in the genus. The section Alatae is characterized by decurrent, persistent wing like stipules. Similarly small to large, foliaceous, semilunar, transverse stipules are seen in species viz. *C. verrucosa*, *C. beddomeana*, *C. walkeri* and *C. semperflorens* while, *C. goreensis* have falcate, foliaceous and up-curved stipules. While a majority of the species are characterized by the nature of stipules, sect. Glaucae and species such as *C. nana*, *C. albida*, *C. epunctata* and *C. pallida* are distinguished by the absence of stipules.

Leaves

Foliar character are important at subgeneric as well as species level classification. De Candolle (1825) divided the entire genus into two sub-division as 'Foliis simplicibus' and 'Foliis palmatim compositis 3-7 foliolatis' based on the nature of the leaf. The same criteria has been followed even by present day workers. In South India ca. 79 % of the total species are simple leaved and the rest are digitately compound leaved. The latter group consists of plants with tri-foliolate leaves and 5-7 foliolate leaves. *C. quinquefolia* and *C. grahamiana* are the two South Indian species having 5-7 foliolate leaves. Petioles are long, sometimes longer than lamina, in many of the compound leaved species. However, it is sessile or sub sessile in simple leaved forms.

Lamina

The lamina may be either ovate, obovate, elliptic or oblong – linear in different species. But in a few species like *C. calycina*, *C. evolvuloides*, *C. salicifolia* etc., the leaf shape is quite variable. The size also shows considerable variation in different species. For example, while *C. albida* have an average leaf size of 1.5 - 2.5 x 0.2 - 0.6 cm, *C. beddomeana* have 8 -14 x 5 - 7 cm. The texture is mostly chartaceous but rarely subcoriaceous as in *C. salicifolia* and *C. semperflorens*. Transverse nervules are very prominent in *C. semperflorens*. The base of the lamina may be attenuate or cuneate; the margin is always entire and the apex is acute or obtuse or retuse and mucronate in many species. Indumentum pattern of leaves is another important character in species delimitation. Generally the adaxial surface is less pubescent than the abaxial side. In *C. lutescens*, *C. laburnifolia*, *C. triquetra* and *C. peduncularis* both sides of the lamina are glabrous whereas, in *C. pallida*, *C. incana*, *C. mysorensis* and *C. quinquefolia* only the adaxial side is glabrous. Lamina is silky sericeous on both surfaces in *C. salicifolia*, *C. beddomeana* and *C. wightiana*.

Inflorescence

Inflorescence is mostly racemes and rarely umbels and very exceptionally head or capitulum. It is either terminal as in sections like Glaucae and Polyphyllae, lateral as in sect. Diffusae, or terminal as well as lateral as in sect. Erectae. In *C. heyneana* and *C. juncea*, terminal inflorescence become leaf opposed at age. Racemes may be as short as 2 – 3 cm as in *C. stipitata* or as long as 20 - 50 cm as in *C. spectabilis*. Number of flowers also varies from 3 - 60, and are distributed evenly as in *C. micans* and *C. spectabilis* or restricted to the apex of the peduncle as in *C. fysonii*, *C. trifoliastrum* and *C. evolvuloides*. Flowers are arranged compactly in *C. pallida*, *C. notoni* etc., whereas, they are arranged laxly in *C. quinquefolia*, *C. salicifolia*, *C. juncea* etc. 3 - 4 flowered umbels are seen in *C. nana* while, 8 - 12 flowered are found in *C. umbellata*. Capitulate heads are seen in *C. speciosa* whereas oblong heads are seen in *C. dubia*. Racemes are paniced in the sub sect. Paniculatae.

Flowers

The size of the flower may vary from 5 x 2 mm as in *C. globosa* to 50 x 50 mm as in *C. agatiflora*. The flowers are usually drooping in majority of the species but rarely erect as in *C. stipitata*, *C. goreensis*, *C. micans* and exceptionally pendulous as in *C. laburnifolia*. The flowering season starts from September and ends by March. In species such as *C. quinquefolia*, *C. retusa*, *C. verrucosa* etc., flowers and fruits are seen simultaneously on the same raceme.

Bracts and bracteoles

The bracts and bracteoles of *Crotalaria* are usually persistent, except in *C. incana*, *C. micans*, *C. pallida* var. *pallida* and *C. agatiflora*, where the bracts are caducous. Both of them have more or less the same appearance in

almost all species. Bracts are as small as 1 mm long, narrow, linear, setaceous as in *C. albida* and as large as 22-28 x 12-14 mm, broadly lanceolate as in *C. agatiflora*. Bracts are three in *C. mysorensis*, one large median and two small laterals. Bracts are ovate, foliaceous and deflexed in *C. spectabilis* and *C. peduncularis*; acuminate, viscous above and tomentose beneath in *C. pulchra*, *C. ramosissima*, *C. paniculata* and *C. lunulata*. In *C. salicifolia*, a long leafy bract subtends the lowest flower of the raceme and hence that flower appears to be axillary. A similar situation is never noticed in any other species of this genus. Bracteoles are generally smaller than bracts and are inserted either on pedicel or on calyx tube. It may be setaceous, subulate, cordate or lanceolate; glabrous in and pubescent out. In *C. paniculata* bracteoles are subulate, viscid, curled back, and those of abortive flowers are fascicled. Bracteoles are cordate, amplexicaul and inserted on mid-pedicel in *C. lunulata*.

Calyx

Calyx is an important character for species delimitation in this genus. It is usually 5 lobed, with the sepals connate into a short campanulate or bilabiate tube. In some species, the upper two lobes are connate almost to the apex as in *C. nana*, *C. linifolia* and *C. tecta*. Occasionally three lower lobes are united or coherent either from the base to apex or only at the apex as in *C. obtecta*. Sepals are usually subequal or rarely equal; normally bilipped or exceptionally trilipped as in *C. agatiflora*. The upper lip is two lobed while the lower lip is three lobed. Calyx exceeds corolla in *C. calycina*, *C. humifusa*, *C. speciosa*, *C. berteroana* etc. It is glabrous in *C. quinquefolia* and *C. peduncularis* whereas, it is densely sericeous in *C. speciosa*, *C. calycina*, *C. barbata*, *C. scabra* etc.

Corolla

The corolla is yellow, with or without purple striations in all South Indian species except *C. verrucosa* and *C. heyneana* where it is pale violet to bluish white. The corolla is composed of standard petal, wing petal and keel petal. Standard petal is ovate or orbicular or oblong in shape with two callus like appendages on the inner side at the base. They are remarkably variable in size and shape. The wings vary from oblong to obovate with distinct intercoastal cavities. The wings are usually paler than standard petal. The keel is narrow, elongate with or without a twisted beak. The corolla may be included or exerted. In the former type, it is enclosed by the calyx as in *C. calycina*, *C. hirta*, *C. mysorensis* etc., whereas, it is well exposed as in *C. laburnifolia*, *C. micans*, *C. heyneana* etc. Keel petals generally exceed wing petals and it encloses the androecium and gynoecium within.

Androecium

The stamens of *Crotalaria* are dimorphic and monadelphous and has the sheath split above. Of the ten stamens, 5 have long narrow filaments and alternating 5 have short flat filaments bear small, basifixed, ovoid anthers and large, dorsifixed, oblong anthers respectively. The length of filaments and the size of the anther vary in various species.

Gynoecium

The gynoecium is subsessile or stipitate. Prominent stipe is seen in *C. stipitata* and *C. laburnifolia*. The ovary is ovate to oblong with hairy or glabrous surface, bearing long narrow style which is either geniculate or not. In most species the style is ciliated along the upper suture but in species such as *C. spectabilis*, *C. retusa* etc. two rows of hairs are found along both sutures. Ovules vary in number from one to many. The stigma is simple or rarely expanded with a ring of hairs along the rim.

Pod

Pod characters are important in the classification of the tribe Crotalariaeae. Of the two genera recognized under this tribe in South India, *Crotalaria* have inflated pod while *Rothia* have linear and laterally compressed pod. Size, shape and indumentum of the pod are quite variable and are used in the sectional classification of the genus *Crotalaria*. Pods are glabrous in sect. *Erectae*; pubescent in *Eriocarpae*; smaller or slightly exceeding the calyx in *Calycinae*; clavate and glabrous in *Polyphyllae*. The size of the pod may be as small as 3 mm diam. as in *C. umbellata* or as large as 55 x 18 mm as in *C. quinquefolia*. Pods are globose in *C. globosa* and *C. umbellata*; subcylindrical in *C. nana*; oblong in *C. pallida*, *C. verrucosa* and *C. retusa* and clavate in *C. quinquefolia*, *C. grahamiana*, *C. semperflorens* and *C. walkeri*. The pod is distinctly stalked in *C. laburnifolia* and *C. stipitata*. Indumentum of the pod is also variable. It is thinly puberulous in *C. heyneana*, sericeous in *C. multiflora* and densely sericeous in *C. obtecta*. The number of seeds per pod is found vary from one to many in different species.

Summary

The tribe Crotalariaeae belongs to the monophyletic clade, the "core Genistoids". Presently it consists of 11 genera viz. *Pearsonia* Diimmer, *Rothia* Pers., *Robinsiophyton* Wileczek, *Spartidium* Pomel, *Rafnia* Thunb., *Aspalathus* L., *Crotalaria* L., *Bolusia* Benth., *Lotononis* (DC.) Eckl. & Zeyh. and *Wiborgia* Thunb. Most of them are confined to Africa and Madagascar. In South India, the tribe is represented by two genera viz., *Crotalaria* and *Rothia*. Among them, the former is the most prolific genus under the subfamily Faboideae while the latter is represented by a single species *R. indica*. The tribe is represented by 67 species and 4 infra-specific taxa in South India which includes two new descriptions viz., *C. kurisumalayanum* Sibi and *C.*

retusa var. *indica* Nampy & Sibi and a new report viz., *C. stipitata* from the study area. The entire species of the genus *Crotalaria* has been treated under 8 sections viz., Alatae, Diffusae, Calycinae, Glaucuae, Erectae, Eriocarpae, Hedriocarpae and Polyphyllae. The majority of Indian species is unifoliolate while multifoliolate globally.

The sect. Alatae is characterized by the persistent, decurrent, wing like stipules, racemes springing laterally from the branch a little below the node and arillate seeds. Though many of the earlier workers recognized seven species under this section, the present taxonomic judgment is in favour of treating only three species from South India, viz., *C. alata*, *C. scabrella* and *C. wightiana*, others being reduced to synonyms.

The high degree of morphological homogeneity makes species segregation rather difficult in section Diffusae. Members are mostly prostrate herbs with diffuse trailing branches and lateral racemes. This section shares affinity with Calycinae in habit as well as inflorescence. But in Calycinae, the inflorescence is terminal in the beginning and becomes lateral when the flowering considerably advanced. The resemblances mislead many authors to treat several species of the section Calycinae viz., *C. albida*, *C. pusilla* and *C. linifolia* under Diffusae. The above species are rightly treated in the present work. Similarly, species such as *C. clarkei* and *C. triquetra* treated under sect. Eriocarpae, are placed under this section. *C. evolvuloides* var. *acutifolia* and *C. fysonii* var. *glabra* are reduced to the synonyms of the respective species. Fifteen species has been recognized under this section including the new species *C. kurisumalayanum*.

Section Glaucuae consists of only two species viz. *C. lutescens* and *C. peduncularis*. As the name indicates, the members are glabrous throughout. Both these taxa are rare and endemic to India. Members of sect. Erectae are erect annual or perennial herbs or shrubs with large showy flowers and

glabrous pod. In South India, the section is represented by eight species. A few species recognized by earlier authors are reduced to synonyms. For example, *C. kodaiensis*, *C. subperfoliata* and *C. shevaroyensis* are treated as synonyms of *C. longipes*. Similarly, *C. sericea* and *C. leschenaultii* are reduced to *C. spectabilis*. These changes are in par with the findings of recent workers. A new variety of *C. retusa* var. *indica* has been described and illustrated from South India.

The sect. Calycinae comprises 12 species under two subsections viz. Calycinae and Exsertae. Pods are included in the subsect. Calycinae while it is decidedly exserted in Exsertae. The former subsection consists of seven species and the latter five. The members are small herbs with prominent and densely shaggy calyx, bracts and bracteoles. Corolla hardly exceeds the calyx and pods are glabrous invariably. The section Eriocarpae have simple or paniculate racemes and hairy pod. As there are no distinct characters to segregate the sections Bracteatae and Fulvae of Wight & Arn. they are treated as synonyms of Eriocarpae. The section Eriocarpae is divided into two subsections viz. Eriocarpae and Paniculatae. Both of these subsections consist of 6 species each. Moreover, a new combination viz. *C. candicans* var. *kurnoolica* has also been made.

The sections viz., Hedriocarpae and Polyphyllae, are characterized by digitately compound leaves. The members of the Sect. Hedriocarpae invariably have trifoliolate leaves while sect. Polyphyllae have 5-7 foliolate leaves. Based on the number of seeds per pod, two subsections are recognized under Hedriocarpae viz., subsection Hedriocarpae and Dispermae. The former subsect. consists of 8 species and the latter consists of 4 species. Among the members of Hedriocarpae, *C. agatiflora*, *C. goreensis*, *C. micans* and *C. incana* are introduced species. In South India, the sect. Polyphyllae is represented by only two species viz., *C. quinquefolia* and *C. grahamiana*. The

former is a wetland inhabitant while the latter occurs in high altitudes. The sectional name *Polyphyllae* Wight & Arn. is reinstated in the present treatment against *Multifololilatae* Baker ex Ansari.

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