

Table-1: Chromosome number reports in *Croton*

Taxon	n	2n	Authority
<i>C. alabamensis</i>	16		Farmer & Thomas (1970)
	32		
<i>C. argentius</i> Muell.-Arg.	10		Di Fulvio (1973)
<i>C. aromaticus</i> L.	10		Kothari <i>et al.</i> (1980)
<i>C. bonplandianus</i> Baill.	8		Baquar (1967-68), Sanjappa (1979)
	10	20	Gill <i>et al.</i> (1973)
	10		Thatchar (1953), Patil (1958), Gajapathy (1962), Pal (1964), Miller & Webster (1966), Datta (1967), Choda & Mehra (1972), Hans (1973),
		20, 40	
		50	Kothari <i>et al.</i> (1980)
<i>C. californicus</i> Muell.-Arg.	14	-	Urbatsch <i>et al.</i> (1975)
<i>C. californicus</i> var. <i>tenuis</i> (Wats.) Ferg.	14	-	Szweykowsky (1965)
<i>C. capitatus</i> Michaux	10		Urbatsch <i>et al.</i> (1975)
<i>C. capitatus</i> var. <i>lindheimeri</i> (Engelm. & Garay) Muell.-Arg.		20	Lewis <i>et al.</i> (1962)
<i>C. caudatus</i> Geisel.	10		Mehra & Hans (1969)
<i>C. ciliato-glanduliferus</i> Ortega	10		Seavey (1975)
<i>C. cortesianus</i> H.B.K.	10		Miller & Webster (1966)
<i>C. dioicus</i> Cav.	14		Urbatsch <i>et al.</i> (1975)
<i>C. fruticulosus</i> Torr.	ca 24		Urbatsch <i>et al.</i> (1975)
<i>C. glandulosus</i> L.		16	Urbatsch <i>et al.</i> (1975)
<i>C. humilis</i> L.	10		Urbatsch <i>et al.</i> (1975)
<i>C. joufra</i> Roxb.	10		Mehra & Hans (1969)
<i>C. klotzschianus</i> (Wight) Thw.	10		Datta (1967)
		20	Kothari <i>et al.</i> (1980)
<i>C. lobatus</i> L.	9		Miller & Webster (1966)
<i>C. megdalenae</i> Millsp.	10		Urbatsch <i>et al.</i> (1975)
<i>C. monanthogynus</i> Michaux		16	Perry (1943)
	10		Urbatsch <i>et al.</i> (1975)
<i>C. palmeri</i> S. Wats.		16	Perry (1943)
<i>C. pottsii</i> (Kl.) Muell.-Arg.	9		Urbatsch <i>et al.</i> (1975)
<i>C. punctatus</i> Jacq.	14		Bell (1965)

Table-1: Continued

Taxon	n	2n	Authority
<i>C. roxburghii</i> Balakr.	10		Mehra & Hans (1969)
<i>C. ruizianus</i> vel aff.	32	64,	
	64	ca 128	Diers (1961)
<i>C. texensis</i> (Kl.) Muell.-Arg.	14		
	28		Urbatsch <i>et al.</i> (1975)
<i>C. tiglium</i> L.	10		Mehra & Hans (1969)
<i>C. torreyanus</i> Muell.-Arg.	10		Urbatsch <i>et al.</i> (1975)
<i>C. xalapensis</i> H.B.K.	ca 60		Miller & Webster (1966)

suggested by Hans (1973) and Urbatsch *et al.* (1975). The numbers $n = 14$ and 28 could have been derived by polyploidy from $x = 7$ (a number not yet reported in the genus) while $n = 16$ and 32 from $x = 8$. The prevalence of various chromosome numbers which are multiples of 7, 8 and 10 indicates that polyploidy has played an important role in speciation in the genus. Polyploidy perhaps also accounts for the exceeding variability within a species. The reason for the occurrence of numerous closely related species showing sympatric distribution must also be sought in the cytology of the genus.

It may be noticed that species with different circles of affinity often possess identical basic number, $x = 8$ in *C. bonplandianus*, *C. glandulosus*, *C. monanthogynus* and *C. ruizianus*, $x = 10$ in *C. aromaticus*, *C. bonplandianus*, *C. capitatus*, *C. joufra*, *C. monanthogynus* etc. On the other hand, even two basic numbers are known in a single species, e.g. $x = 8$ and 10 in *C. bonplandianus*; $n = 10$ and $2n = 16$ in *C. monanthogynus*.

In view of the unsatisfactory state of the infrageneric classification of the genus (by Mueller, 1865, 1866), Miller & Webster (1966) and Webster (1967) remarked that further

cytotaxonomic studies may prove valuable in arriving at a more natural grouping of the species in *Croton*. Urbatsch *et al.* (1975) also commented that a cytogenetic study might well give valuable insight into the evolution of the genus.

14. Chemical characters :

The Euphorbiaceae contain extraordinary diversity of organic compounds, possibly more than in any other plant family (Webster, 1967). Naturally, the genus *Croton* displays notable chemical importance. Webster (1967) remarked that there is an exceedingly bright future to chemotaxonomic studies on the Crotonoideae. Farnsworth *et al.* (1969) published a valuable review article providing information relative to folklore, phytochemical screening results, biological screening results, toxicity and chemical compounds isolated from or detected in 80 species of *Croton*.

Species of *Croton* contain a great diversity of chemical compounds, viz. several kinds of alkaloids, saponins, tannins and flavonoids. A number of non-alkaloidal substances have also been reported in various species. The species which have been screened for alkaloids, saponins, tannins and flavonoids are listed in Table 2.

Table-2: Croton species screened for alkalioids, saponins, tannins and flavonoids (after Farnsworth *et al.* 1969)

Species	Alkaloids	Saponins	Tannins	Flavonoids
<i>C. acronychioides</i> F. Muell.	+			
<i>C. argyranthemus</i> Michaux	-		-	-
<i>C. argyratus</i> Bl.	-			
<i>C. arnhemicus</i> Muell. - Arg.	+			
<i>C. balsamifera</i> Jacq. (= <i>C. flavens</i> L.)	+a			
<i>C. californicus</i> Muell. - Arg.	-	-	-	-
<i>C. capitatus</i> Michaux	±	-	-	-
<i>C. caudatus</i> Geisel.	-	-		
<i>C. celtidifolius</i> Baill.	+	+		
<i>C. ciliato-glandulosus</i> Ortega	+		+	
<i>C. cortesianus</i> H.B.K.	+	-	-	
<i>C. corymbulosus</i> Rothr.	-	-		-
<i>C. crassifolius</i> Geisel.	-			
<i>C. cumingii</i> Muell. - Arg.	+a			
<i>C. discolor</i> Willd.	+a			
<i>C. echinocarpus</i> Muell.-Arg.			+	
<i>C. eluteria</i> Benn.			+	
<i>C. flavens</i> L.	+a			
<i>C. floribundus</i> Spreng.	-	+	+	
<i>C. fragilis</i> Schlecht.	-		-	
<i>C. glabellus</i> L.	-			
<i>C. glandulosus</i> L.	-	-	-	-
<i>C. gossypifolius</i> Vahl		-	+	
<i>C. griffithii</i> Hook. f.	-	-		
<i>C. gubouga</i> S. Moore	-			
<i>C. humilis</i> L.	+			
<i>C. insularis</i> Baill.	±			
<i>C. joufra</i> Roxb.	+		+	
<i>C. klotzschotii</i> Muell. - Arg.	-			
<i>C. leucophyllus</i> Muell. - Arg.	-	-		-
<i>C. linearis</i> Jacq.	+a	-		-
<i>C. lobatus</i> L.	+	+		
<i>C. lundianus</i> Muell.-Arg.	-	+		

"+" = positive; "-" = negative ; "a" = crystalline entities isolated; "±" = both positive & negative results reported.

Table-2: continued

Species	Alkaloids	Saponins	Tannins	Flavonoids
<i>C. macrobothrys</i> Hochst.	+	-		
<i>C. matourensis</i> Aubl.	-	-		
<i>C. menthodor</i> Benth.		+		+a
<i>C. monanthogynus</i> Michaux	±	-	-	-
<i>C. neo-mexicanus</i> Muell.-Arg.	-	-		-
<i>C. nivens</i> Jacq. (?)	+			+a
<i>C. phebaloides</i> Muell.-Arg.	+			
<i>C. potsii</i> Muell. - Arg.	+			
<i>C. punctatus</i> Lour.	-	-	-	+
<i>C. rhamnifolius</i> H.B.K.	+			
<i>C. ruizianus</i> R. & P.	+			
<i>C. salutaris</i> Casar.	+a	+		
<i>C. sparsiflorus</i> Morong	+a			
<i>C. speciosus</i> Muell. - Arg.	+			
<i>C. sphaerogynus</i> Muell. - Arg.	+	+		
<i>C. subgratissimus</i> Prain			+	
<i>C. texensis</i> Muell. - Arg.	-	-	-	+
<i>C. tiglium</i> L.	±	±	-	-
<i>C. turmiquirensis</i> Steyerm.	+a			
<i>C. urticaefolius</i> Lam.	+	+		
<i>C. verraeuxii</i> Baill.	+			
<i>C. wilsonii</i> Griseb.	+a			
<i>C. xanthochlorus</i> Croiz.		+		

It may be noted that out of 50 species screened for alkaloids, 27 species gave positive results. Some investigators reported positive results in another 4 species while others reported negative results in these plants. So far, 23 alkaloids have been isolated from 8 species of which the structures for 21 have been elucidated (*vide* Farnsworth *et al.* 1969- for further details relating to structure and other physical data of the alkaloids). The alkaloids of known structure may be classified as aporphine, proaporphine or morphin-andienone bases, or reduced forms of these.

Of the 13 species which were tested for the detection of quaternary alkaloids, 7 were reported to be positive. The only quaternary base isolated from *Croton* is magnoflorine and the ill-defined thrumiquirensine.

As regards the saponins, 26 species were investigated of which 9 species gave positive results. No purified saponins have yet been isolated from *Croton*. Tannins have been detected (or isolated) in 7 species out of 16. The occurrence of flavonoids were detected in 4 species out of 14 species investigated. Only

one flavonoid, quercetin has been isolated. The occurrence of triterpenes has so far not been detected. A number of non-alkaloidal substances have been reported or isolated from different species. These include : cascarillin (a neutral principle), isoeugenol, eugenol, p-cymol, angelic acid, citral, vanillin, catechin, 4-hydroxyhygric acid, betanine, oblongifoliol, β -sitosterol, phorbol, crotonoside, sucrose, palmitic, stearic, oleic, formic, acetic, butyric, valeric, linoleic, tiglic, caprylic, lauric, myristic and azelaic acids, several common amino acids and isoguanine.

It may be mentioned that *C. cumingii* as well as *C. punctatus* are now known to be synonymous to *C. cascarilloides* Raeusch. It is surprising that while the alkaloid magnoflorine has been isolated from samples of *C. cumingii*, the samples of *C. punctatus* gave negative result for alkaloids but positive for flavonoids. It is most likely that at least one of these plant samples were wrongly identified. There are more similar examples *vide* Table 2. *C. argyratus* is a species closely allied to *C. cascarilloides* but no alkaloid could be detected in it.

There are several species of *Croton* which have been shown to be of biological interest (*vide* Farnsworth *et al.* 1969) as they exhibited antimicrobial, antimalarial, antiatherogenic, androgenic, insecticidal and antitumor activities. Some species are shown to be potent anaesthetics. *C. tiglium* is an ancient plant of medicine. *Croton* oil, a powerful purgative drug is expressed from the seeds of this plant. Several tumor promoters (phorbol esters) have been isolated from *Croton* oil.

AFFINITY

According to Mueller (1865, 1866, 1873), the genera *Julocroton* Mart, *Crotonopsis* Michaux and *Eremocarpus* Benth. are allied to *Croton*. Webster (1975) recognized two genera, *Crotonopsis* and *Eremocarpus* in the *Croton* alliance, i.e. under the tribe *Crotonae* Dumort. of subfamily *Crotonoideae* Pax and maintained this treatment in the revised Conspectus presented at the International Conference of the Euphorbiaceae held in 1989. He had reduced *Julocroton* to a section of *Croton* in 1967. Recently he also reduced *Crotonopsis* and *Eremocarpus* to sections of *Croton* (Webster, 1992). Thus, according to the circumscription established by Mueller (1865, 1866, 1873) and almost universally accepted by later workers, *Croton* (including *Julocroton*, *Crotonopsis* and *Eremocarpus*) is a polymorphic and somewhat isolated genus, well characterized by the inflorescences being racemiform cymes or thyrses with the female flowers at base and the stamens in male flowers being inflexed in the bud. In addition, the genus can be readily distinguished from many other genera of *Crotonoideae* by its stellate or lepidote indumentum.

INFRAGENERIC CLASSIFICATION

Mueller (1865, 1866) divided the genus into 10 sections based on floral characters. Of these, the section *Croton* (= sect. *Eucroton*) forms the largest infrageneric group with more than two-thirds of the species, characterized by the smooth seeds, the lanate male receptacle, the pentamerous regular calyces and the rudimentary female petals. Mueller divided this section into 4 subsections

employing the features of the bracts and inflorescences. Eventually several workers criticized the Muellierian classification to be highly artificial and unnatural. As a result, most of the later workers did not use any infrageneric designations in their publications on *Croton*.

As regards the species occurring in the Indian subcontinent, they all are referable to sect. *Croton* except for the introduced species, *C. bonplandianus* and *C. glandulosus* var. *hirtus*. The former is referable to sect. *Astraea*, characterized by the glabrous male receptacle (Croizat, 1940 a) and the latter to sect. *Decarinium* having distinctly unequal female sepals.

Webster (1992) mentions that in the course of an unpublished review of the sections of *Croton*, he recognizes altogether 38 sections in the genus.

SYSTEMATIC TREATMENT

***Croton* L., Sp. Pl.: 1004. 1753 & Gen. Pl. ed. 5: 436. 1754; Geisel, *Croton*. Mongr. : 1 - 83. 1807; Baill, Et. Gen. Euphorb. 349. 1858; Muell. - Arg. in DC., Prodr. 15 (2): 512. 1866; Benth. in Benth. & Hook. f., Gen. Pl. 3: 293. 1880; Hook. f., Fl. Brit. India 5: 385. 1887; Pax & Hoffm. in Engl. & Prantl, Pflanzenfam. ed. 2, 19c: 83. 1931. *Lectotype*: *C. aromaticus* L.**

Tridesmis Lour, Fl. Cochinch.: 576. 1790. *Type*: *T. tomentosa* Lour. (= *Croton crassifolius* Geisel.).

Tigilium Klotzsch in Nov. Acta Neop. Carol. 19 (Suppl. 1): 418. 1843 & in Hayne, Arzneykunde 14(1): t. 3. 1843. *Type*: *T. officinale* Klotzsch (= *Croton tigilium* L.).

Trees or shrubs (rarely scandent or climbing), rarely herbs, monoecious or rarely dioecious, densely or sparsely clothed with stellate hairs or lepidote scales, occasionally glabrous; stems often with coloured or rarely milky (*C. bonplandianus*) sap. *Leaves* simple, alternate, often crowded towards apices of branchlets or subopposite, rarely pseudo - verticillate (*C. zeylanicus*), petiolate (petioles usually sulcate or sometimes channelled above), lamina variously shaped, entire or crenate or dentate or serrate, penninerved or palminerved at base; glands 2(-10) at the junction of petiole and lamina, sessile or stipitate, sometimes also scattered along margins; stipules deciduous. *Inflorescences* terminal, sometimes axillary, racemiform cymes or thyrses, androgynoeceous or occasionally unisexual, female flowers solitary at lower nodes, male flowers in fascicles at upper nodes (occasionally at same nodes with female); bracts linear or lanceolate or shortly subulate or triangular. *Male Flowers*: Sepals (4-)5(-6), of various shapes, often subequal, free or shortly connate at base, valvate, often penicillate at apex and ciliate along margins; petals isomerous with sepals, mostly about as long, free, mostly lanate at apex and along margins; disk-glands small, opposite the sepals; stamens 8-40, free, arranged in whorls; filaments mostly lanate towards base, inflexed at the apex in bud, basifixed; anthers mostly oblong or often ellipsoid or ovoid or obovoid, 2-loculed, the locules usually parallel or slightly diverging, adnate to a broad connective, longitudinally dehiscent; pistillode 0; receptacle densely lanate or rarely glabrous (*C. bonplandianus*). *Female Flowers*: Sepals (4-)5(-10), of various shapes, rarely unequal (*C. glandulosus* var. *hirtus*), shortly connate

at base, valvate or subimbricate, rarely accrescent (*C. chlorocalyx*, *C. lawianus*); petals 0-5(-6), smaller than the sepals or vestigial; disk-glands small; staminodes 0 or very rarely 1-5; ovary (2-)3(-5)-locular; styles free or shortly connate at base into a column, once or repeatedly bifid above into linear or thickened branches, often notched at the tip; nucellus ovule 1 per locule, anatropous; nucellus elongated into a slender beak. *Fruits* capsular, more or less globose, oblong, ellipsoid, ovoid or obovoid, unlobed or lobed, smooth or often muriculate, usually 3-seeded; columella persistent. Seeds oblong or ellipsoid or often ovoid or squarish, usually 3-angled with a broad convex back, smooth, rarely sparsely stellate-pubescent (*C. caudatus*), carunculate; testa dry, more or less thin; endosperm copious; embryo straight; cotyledons broad.

Note : Small (1913) selected *C. tiglium* L. as the lectotype species of *Croton*. Webster (1967)

pointed out that *C. tiglium* was removed by Klotzsch (1843 a, b) as the type of a segregated genus *Tigium*, and Baillon (1858) preserved Klotzsch's group as a section, while restricting sect. *Eucroton* to species with a valvate male calyx. Thus, *C. aromaticus* L. and *C. laccifer* L. are the only species originally included in *Croton* by Linnaeus (1753) which have not been removed and therefore one of these species must be designated as the lectotype. Since Geiseler (1807) combined *C. laccifer* with *C. aromaticus* under the latter binomial, the same was chosen by Webster (1967) as the lectotype species.

The gender of *Croton* was originally treated to be neuter by Linnaeus (1753) but Mueller (1865, 1866) treated it as masculine, which was followed by most of the later workers (*vide* Croizat, 1940 a) and in the present treatment as well.

KEY TO THE SPECIES

- | | | |
|-----|---|--|
| 1a | Herbs introduced, weedy | 2 |
| b. | Trees, shrubs (rarely scandent) or undershrubs | 3 |
| 2a. | Plants ± densely ochraceous stellate - hirsute to scabrid; trichomes harsh with pronounced erect central ray; leaves strongly trinerved at base; glands at the base of lamina shortly stipitate; female sepals distinctly unequal | .. 13 <i>C. glandulosus</i> var. <i>hirtus</i> |
| b. | Plants sparsely whitish stellate - pubescent to glabrescent; trichomes soft, without erect central ray; leaves penninerved; glands at base of lamina sessile; female sepals more or less equal | .. 4. <i>C. bonplandianus</i> |
| 3a. | Leaves densely or sparsely lepidote beneath | .. 4 |
| b. | Leaves variously stellate-pubescent or glabrous beneath | 9 |
| 4a. | Leaves sparsely lepidote beneath, entire or shallowly serrate, coriaceous, often turning blackish-green above on drying; inflorescences often unisexual | .. 23. <i>C. robustus</i> |
| b. | Leaves densely lepidote beneath | .. 5 |

- 5a. Leaves strongly trinerved at base, $\pm$ densely lepidote above, stiffly coriaceous .. 25. *C. scabiosus*
- b. Leaves penninerved, sparsely lepidote or glabrous above, membranous to thinly coriaceous .. 6
- 6a. Leaves sparsely silvery/coppery lepidote above; scales subentire with almost complete webbing in between the radiating rays; capsules smaller (5 - 7 mm in diam.) .. 17. *C. kongensis*
- b. Leaves glabrous above; scales lacerate - stellate with incomplete webbing in between the radiating rays; capsules larger (9 - 15 mm in diam.) .. 7
- 7a. Foliar glands stipitate; young leaves with fine, deterrent stellate hairs on upper surface; trichome - base mostly colourless; style - branches twice or thrice bifid; leaves often subopposite or pseudo-verticillate and separated by long internodes 30. *C. zeylanicus*
- b. Foliar glands sessile; young leaves with deterrent lepidote scales on upper surface; trichome - base mostly coloured; style - branches once bifid; leaves never separated by long internodes .. 8
- 8a. Capsules obovoid, larger (18 - 25 mm long, ca 15 mm in diam.), shortly stipitate .. 19. *C. malabaricus*
- b. Capsules subglobose, smaller (9 - 15 mm in diam.), without a basal stripe .. 1. *C. argyratus*
- 9a. Indumentum of young shoots, petioles, rachis and flowers lepidote .. 10
- b. Indumentum of young shoots, petioles, rachis and flowers stellate - pubescent or lacking .. 11
- 10a. Leaves very coarsely dentate - serrate - crenate; webbing of scales at least 80%, free portion of rays radiating in one plane; ovary intruded at apex; capsules smaller (8 - 12 mm in diam., up to 10 mm long), subglobose, prominently lobed .. 24. *C. roxburghii*
- b. Leaves shallowly and evenly serrate - dentate to subentire; webbing of scales 50% or less, free portion of rays radiating in all directions; ovary obtuse or rounded at apex; capsules larger (2 - 2.5 cm in diam., 2.5 - 3.5 cm long), ovoid - ellipsoid or oblong or obovoid, obscurely lobed .. 15. *C. joufra*
- 11a. Leaves strongly trinerved at base .. 12
- b. Leaves penninerved .. 22
- 12a. Scandent shrubs or sometimes climbers .. 13
- b. Erect shrubs or low undershrubs or trees .. 14
- 13a. Capsules larger (1.5 - 3 cm long, 1.5 - 2.5 cm in diam.), globose or oblong or obovoid, thick-walled, bluntly 3 - or 6 - angled; seeds with scattered stellate hairs; leaves often coarsely toothed, brittle when dry .. 7. *C. caudatus*

- b. Capsules smaller (8 - 10 mm in diam.), subglobose, thin-walled, prominently 3-lobed; seeds glabrous; leaves serrulate - denticulate to subentire .. 6. *C. calococcus*
- 14a. Undershrubs (up to 50 cm high); floral bracts and often female sepals fringed with conspicuous stipitate glands .. 10. *C. crassifolius*
- b. Tall shrubs or trees; floral bracts and female sepals without glands .. 15
- 15a. Female sepals accrescent, 1.5 - 2 cm long; ovary glabrous; petioles 4 - 8 mm long .. 18. *C. lawianus*
- b. Female sepal not accrescent, 1.8 - 4 mm long; ovary pubescent; petioles usually longer (5 - 80 mm long) .. 16
- 16a. Leaves glabrous above .. 17
- b. Leaves hispid or scabrid-pubescent or pilose or sparsely pubescent above .. 20
- 17a. Undersurface of leaves with soft, whitish or fulvous interwoven tomentum suddenly becoming glabrous in fruits; female sepals dark crimson; capsule up to 8 mm in diameter .. 29. *C. yunnanensis*
- b. Undersurface of leaves scattered ochraceous pubescent or glabrous; female sepals not dark crimson; capsules 8 - 20 mm in diameter .. 18
- 18a. Leaves coriaceous .. 22. *C. nigro-viridis*
- b. Leaves membranous .. 19
- 19a. Capsules smaller (12 - 14 mm long, ca 15 mm in diam.), subglobose; sepals ochraceous - tomentellous; leaves with stipitate basal and marginal glands .. 3. *C. birmanicus*
- b. Capsules larger (1.6 - 2.5 cm long, 1.3 - 2 cm in diam.), obovoid or $\pm$ oblong; sepals glabrous; leaves with sessile or subsessile basal glands but without marginal glands .. 27 *C. tiglium*
- 20a. Leaves sparsely pubescent above; hairs quickly evanescent .. 3. *C. birmanicus*
- b. Leaves $\pm$ densely pubescent above; hairs persistent .. 21
- 21a. Dried material turning ochraceous; leaves with sessile to subsessile glands, hispid or scabrid-pubescent beneath; stamens 11 - 16; style-branches bifid; capsules prominently lobed .. 6. *C. calococcus*
- b. Dried material not ochraceous; leaves with stipitate glands, often whitish - tomentellous beneath; stamens 15 - 30; style-branches usually quadrifid; capsules scarcely lobed .. 2. *C. aromaticus*
- 22a. Plants entirely glabrous except very young shoots; petioles black at the proximal end; female sepals accrescent (8 - 15 mm long), with glandular teeth; ovary campanulate with apically bilobulate lobes; stylar column 2 - 3 mm long .. 9. *C. chlorocalyx*
- b. Plants not as above .. 23

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23a.	Leaves hispid or hirsute or scabrid-pubescent	24
b.	Leaves neither hispid nor hirsute nor scabrid-pubescent	25
24a.	Leaves membranous to chartaceous, brown above when dry, with stipitate glands	11. <i>C. erythrostachys</i> var. <i>muriculatus</i>
b.	Leaves $\pm$ coriaceous, blackish above when dry, with sessile or subsessile glands	21. <i>C. moonii</i>
25a.	Ovary and capsule bilocular; leaves thin, drying green or brown above; basal glands slenderly stipitate	14. <i>C. hookeri</i>
b.	Ovary and capsule trilocular	26
26a.	Ovary glabrous or almost so	5. <i>C. calderi</i>
b.	Ovary densely pubescent	27
27a.	Ovary obovoid, unlobed; style - branches twice bifid	8. <i>C. chittagongensis</i>
b.	Ovary or subglobose, lobed; style - branches once bifid	28
28a.	Petioles distinctly channelled above; rachis glabrous or almost so (S. India, Sri Lanka)	29
b.	Petioles sulcate above; rachis tomentellous (Andaman Islands, Myanmar)	30
29a.	Capsules larger (10 - 14 mm in diam.); basal glands of leaves stipitate; inflorescences usually elongate (12 - 30 cm long)	12. <i>C. gibsonianus</i>
b.	Capsules smaller (6 - 10 mm in diam.); basal glands of leaves subsessile; inflorescences mostly shorter 3 - 10(-18) cm long	16. <i>C. klotzschianus</i>
30a.	Stellate hairs without an erect central ray; male and female pedicels shorter (up to 2 mm long)	20. <i>C. meeboldianus</i>
b.	Stellate hairs with an erect central ray; male and female, pedicels longer than 2 mm	31
31a.	Capsules very deeply lobed, deeply intruded at apex; female pedicels shorter (2.5 - 9 mm); rays of hairs relatively greater (7-) 29 (-60); plants flowering precociously	26. <i>C. sublyratus</i>
b.	Capsules shallowly lobed, not or slightly intruded at apex; female pedicels elongate (5-)8 - 16 mm; rays of hairs fewer on the average (5-)14(-32) ; plants not flowering precociously	28. <i>C. wallichii</i> .

1. **Croton argyrateus** Bl., Bijdr.: 602. 1826; Muell.-Arg. in DC., Prodr. 15(2): 526. 1866; Kurz, For. Fl. Brit. Burma 2: 372. 1877; Hook. f., Fl. Brit. India 5: 385. 1887; Brandis, Ind. Trees: 577. 1906; Parkins., For. Fl. Andaman Is.: 240. 1923; Ridley, Fl. Malay Penins. 3: 260. 1924; Gagnep. in Lecomte, Fl. Gen. Indoch. 5(4): 277. 1925; Backer & Bakh. f., Fl. Java 1: 476. 1963; Airy Shaw in Kew Bull. 26: 243. 1972 & 35: 616. 1980 & 36: 248. 1981 & in Kew Bull. Add. Ser. IV: 90. 1975; Whitmore, Tree Fl. Malaya 2: 58. 1973. *Type*: Java ('In sylvis montium calcareorum Provinciarum occidentaliu Javae'), Blume 1339 & 1499 (L).

C. bicolor Roxb., [Hort. Beng.: 69. 1814, *nomen*] Fl. Ind. 3: 680. 1832; Miq., Fl. Ind. Bat. 1(2): 381. 1859 & *ibid.*, Suppl. 1: 180. 1861; Muell.-Arg., *l.c.* 572. 1866. *Iconotype*: "A native of Sumatra", Roxburgh, Fl. Ind. Icon. No. 2558 (CAL). [Fig. 1, Map 1.]

Evergreen shrub or tree, 2-10 (-20) m high; all parts (except old stem and upper surface of leaves) densely clothed with adpressed silvery-coppery lepidote scales; bark brown or greyish or whitish. *Leaves* narrowly to broadly elliptic, ovate, oblong or sometimes obovate, 8-30 x 2.5-12 cm, acute, obtuse to rounded or cuneate at base and mostly narrowly cordate at extreme base, entire to serrulate (-denticulate) along margins, acuminate (acumen 5-25 mm long, acute or obtuse) to subacuminate or sometimes acute at apex, membranous to thinly coriaceous, dark reddish-brown or blackish-brown or greenish above when dry, penninerved (sometimes weakly trinerved at base); lateral nerves 5-12 pairs, faint above, prominent beneath; tertiary nerves obscure

to faint above, faint to prominent beneath, scalariform; basal glands 2, sessile, occasionally obsolete; petioles 0.5-12 cm x 1-3 mm; stipules linear, 5-12 mm long. *Inflorescences* 6-20 cm long; bracts triangular, 0.8-2.5 mm long. *Male flowers*: pedicels 2.5-4 x 0.3-0.5 mm, sepals 5, oblong, elliptic to obovate or ovate, 1.8-2.5 x 0.8-2 mm; petals 5, spathulate, oblanceolate or oblong, 1.5 - 2.5 x 0.5 - 1.5 mm; stamens 10 - 12, 3 - 4.5 mm long; anthers oblong or often ovoid, 0.8 - 1 mm long. *Female flowers*: pedicels 1-10 (-35) x 1 - 2 mm; sepals 5, oblong to oblanceolate, 2.5 - 7 x 1 - 3 mm; petals 0 - 5, narrowly oblong to filiform, 0.5 - 3 mm long; ovary subglobose, 2.5 - 4 mm diam.; styles 4.5 - 7 mm long, shortly connate below into a column (0.5 - 1 mm long), bifid above. *Capsules* subglobose, 9 - 15 mm in diam., with 6 longitudinal furrows, brown when dry, unlobed or shallowly 3-lobed; pedicels 5 - 10 (-35) mm long; seeds ellipsoid or ovoid or obovoid, 6-8 x 4.5 - 6 mm, brownish.

Flowering & Fruiting: Jan. - Dec.

Uses: Wood used as firewood and trunk for house posts and beams.

Local names: Andamans: *Talibda*; Burmese: *Chonoo*.

Distribution: India: Andaman & Nicobar Islands, AND Myanmar-Indo-China, Thailand, throughout W. Malesia to Moluccas, Bali & N. Australia.

Habitat: Andaman & Nicobar Is.: Fairly common in mixed forests or hill forests or edges of evergreen forests on rocks, rocky loam, sandy soil or clayey loam (once noted on limestone) up to about 100 m altitude. Myanmar: Frequent in tropical forests up to about 500 m altitude.

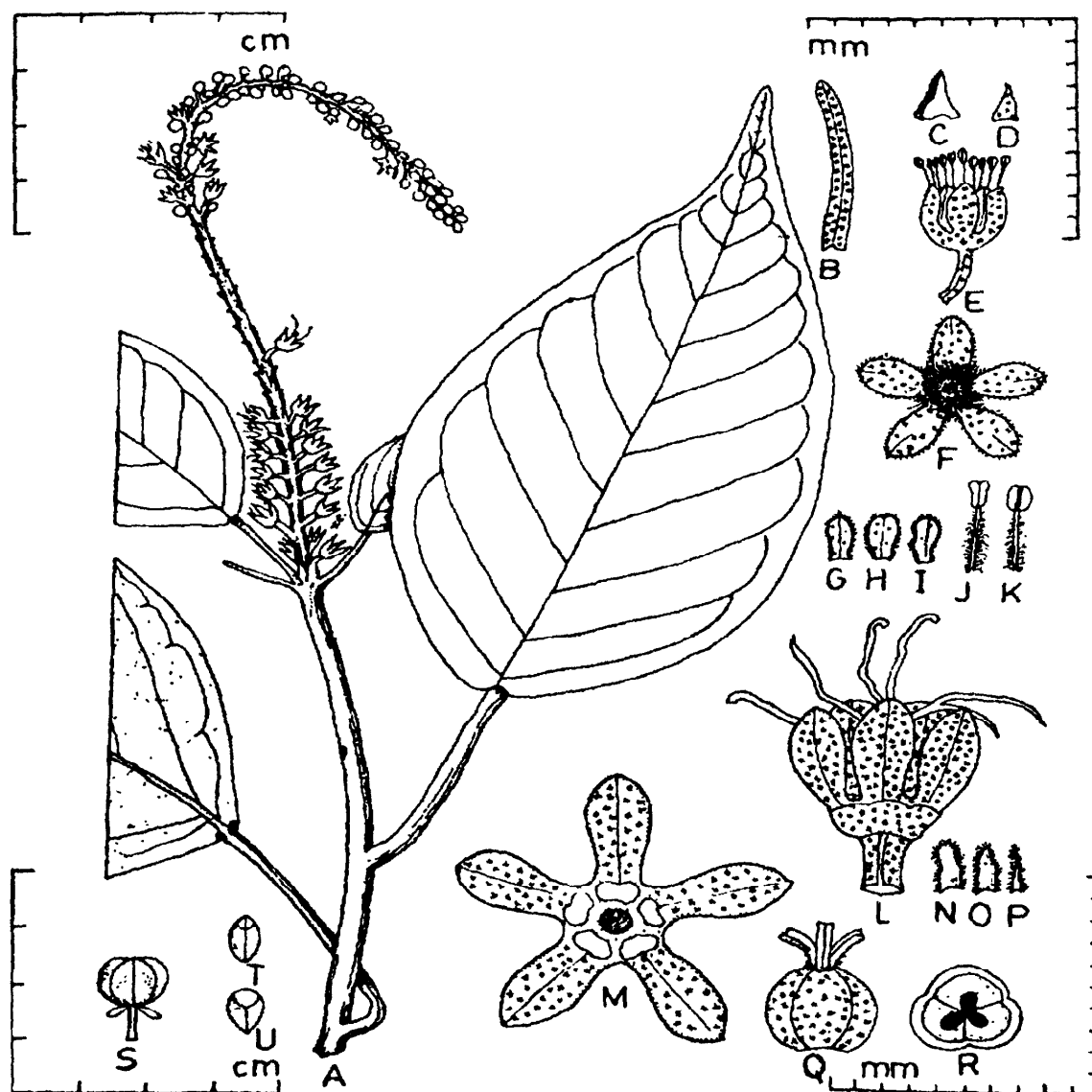
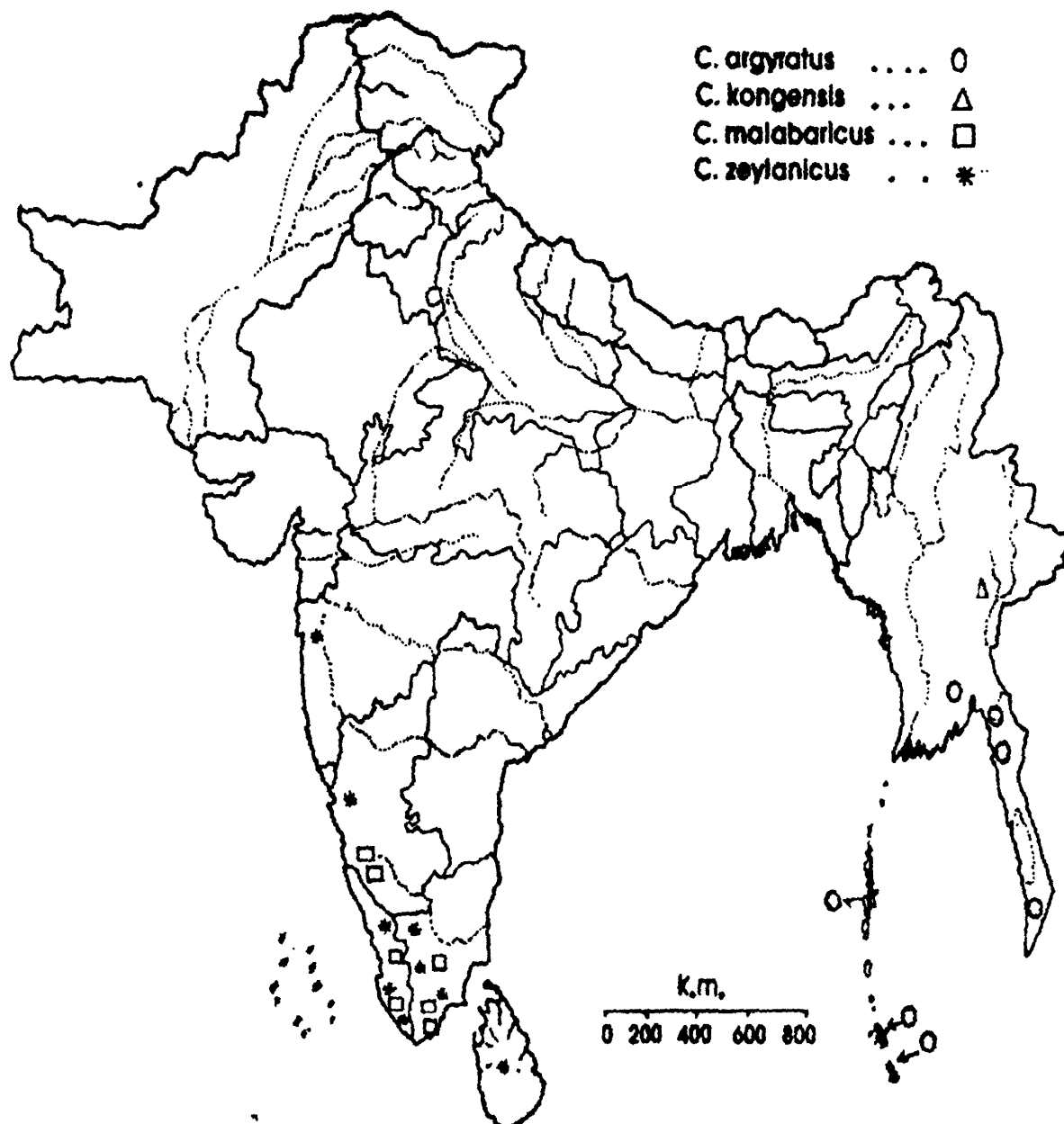


Fig. 1. *Croton argyratus* Bl. A. Flowering branchlet. B. Stipule. C-D. Bracts. E-K. Male: E. Flower. F. Calyx viewed from above. G-I. Petals. J-K. Stamens. L-R. Female: L. Flower. M. Calyx viewed from above. N-P.

Petals. Q. Ovary. R. T. S. of ovary. S. Fruit. T-U. Seeds. (A, C-H, J-M, Q-R: Balakrishnan 4050; BU : Balakrishnan 753; I, K, N-P: Russell 2067; S-T: Balakrishnan 5736).



Map-1. Distribution of *Croton argyratus*, *C. kongensis*, *C. malabaricus* and *C. zeylanicus*.

Specimens examined : MYANMAR. Martaban, n.d., Kurz 1611 A Mergui, Victoria point, 10.3.1928, coll. uncertain 7688, herb. reg. no. 46121 (DD). Pegu, Toukyeqhat, n.d., Kurz 1611 B. Tavoy dist. : Heinze No.1 camp, 9.2.1921, Russell 1959; *ibid.* 27.2.1921, Russell 2067. India. Andaman & Nicobar Is., : South Andaman Is. Goplakabang hill jungle, 16.9.1895, King's coll. s.n., Acc. nos. 410535-6; Wright Myo to Wyssen skyline, 9.1.1974, Balakrishnan 753 (PBL); Wimberlygunj, 1.1.1916, Parkinson 904 (CAL, DD); Way to Chiriatapu, 21.10.1984, T.Chakrabarty 10358 (PBL). Rutland Is. : *sine loc.*, 22.1.1982, M.K.V. Rao 8642 (PBL). Kamorta Is. : *sine loc.*, n.d., Kurz s.n., acc. nos. 410537 8. Katchal Is : Jansin, 21.2.1977, P. Chakraborty 5285 (PBL). Great Nicobar Is. : Forest behind marine quarters, 7.5.1984, T.Chakrabarty 10302 (PBL); 38 km on north-south road, 4.5.1984, T.Chakrabarty 10255 (PBL); 34-35 km on east-west road, 12.6.1977, Balakrishnan 5736 (PBL); 33 km on north-south road, 5.3.1980, Dwivedi 7914 (PBL).

C. argyratus and its allies are readily recognizable by the dense coppery-silvery lepidote scales on the branches, undersurface of leaves, petioles, rachis and flowers.

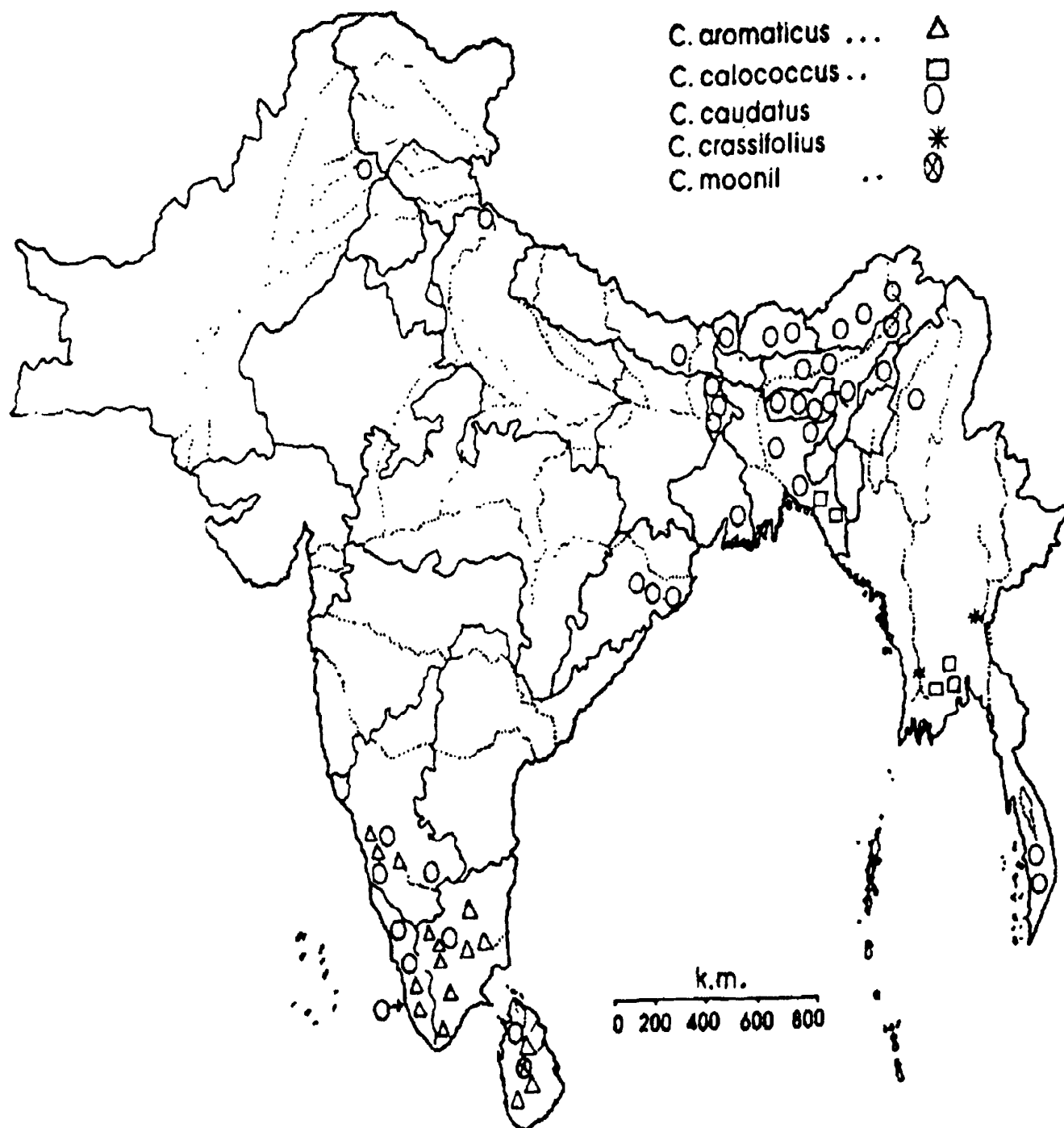
Airy Shaw (1980) mentioned that the type of *C. argyratus* is located in BO but consequent to our request for loan, the Keeper of Bogor Herbarium informed that it is not available there but may be at Leiden instead. The Director of Leiden herbarium has kindly sent two sheets on loan, Blume 1339 & 1499, collected from Java. But these specimens do not agree well with the protologue, though probably Blume had studied them before describing the species.

One collector (M.K.V. Rao 8642) notes that gum-like juice is present in the stem. The flowers were once noted to be fragrant (Dwivedi 7914).

2. *Croton aromaticus* L. [Fl. Zeyl.: 164, No. 345. 1747] Sp. Pl.: 1005. 1753; Geisel., *Croton*. Monogr.: 21. 1807; Thw., Enum. Pl. Zeyl. 4: 275. 1861; Muell.-Arg. in DC., Prodr. 15(2): 588. 1866; Bedd., Fl. Sylv. S. India : t. 283 A. 1872 & For. Man.: CCIV: 1873; Hook. f., Fl. Brit. India 5: 388. 1887; Trimen, Handb. Fl. Ceylon 4: 48. 1898; Brandis, Ind. Trees: 577. 1906; Bourd., For. Trees Travancore: 501. 1908; Rama Rao, Fl. Pl. Travancore: 366. 1914; Fyson, Fl. Nilgiri Pulney Hill Tops 3: 107, t. 500. 1920; Fischer in Rec. Bot. Surv. India 9: 164. 1921; Gamble, Fl. Pres. Madras: 1315. 1925; Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 264. 1931; T.Chakrab. & Balakr. in Bull. Bot. Surv. India 26: 200. 1986. *Ricinoides aromatica* Burm. [Thes. Zeyl.: 201, t. 91. 1737]. Type : Sri Lanka, Hermann 1 : 63, No. 345 et 4 : 21, No. 345 (BM : photo!).

Croton laccifer L. [Fl. Zeyl.: 163, No. 344. 1747] Sp. Pl.: 1005. 1753 '*lacciferum*'; Wight, Icon. Pl. Ind. Or.: t. 1915. 1852; Thw., l.c. 275. 1861; Muell.-Arg., l.c. 588. 1866; Gamble, l.c. 1315. 1925; Alston, l.c. 264. 1931; Fyson, Fl. S. Indian Hill Stations : 534, t. 467. 1932; Airy Shaw in Kew Bull. 26 : 248. 1972. Type : Sri Lanka, Hermann 2 : 54, No. 344 et 3: 54, No. 344 et 4 : 38, No. 344 (BM : photo!).

C. tiliifolius Lam. ('*tiliafolium*') var. *aromaticus* (L.) Lam., Encycl. 2: 206. 1786, excl. quoad syn. Rumph.



Map-2. Distribution of *Croton aromaticus*, *C. calococcus*, *C. caudatus*, *C. crassifolius* and *C. moonii*.

Aleurites laccifer (L.) Willd., Sp. Pl. 4: 590. 1805.

Croton aromaticus var. *laccifer* (L.) Trimen, l.c. 48. 1898. [Map. 2.].

Shrub or tree, 3-15(-20) m high; bark greyish, smooth; all parts (except older branches) fulvous to grey tomentose or scabrid-pubescent (upper surface of leaves, petioles) and shortly hirsute or pilose from erect central rays. *Leaves* narrowly to broadly ovate, elliptic to orbicular or obovate or oblong to lanceolate, 4-19 x 1.5-10 cm, rounded or cordate or sometimes subcuneate or subtruncate at base, subentire to denticulate-serrulate-crenulate along margins, acute to acuminate or caudate (acumen or cauda 0.5-3 cm long) or sometimes obtuse at apex, membranous to thinly coriaceous, remaining green or turning yellow, yellow-brown or dark reddish above when dry, paler beneath, strongly trinerved at base; lateral primary veins basal or slightly suprabasal, ascending 45-70% way up the lamina; lateral nerves 2-9 pairs, faint to prominent above, conspicuous beneath; tertiary nerves obscure to somewhat prominent, scalariform; basal glands 2-4 (-10), shortly stipitate or occasionally sessile, marginal glands present; petioles 0.5-5 cm long, 1-3 mm diam; stipules linear to filiform, 3-15 mm long. *Inflorescences* 6-15 cm long, sometimes only male or female; bracts subulate or linear to filiform, 0.5-3.5 mm long, petaline. *Male flowers* : pedicels 3.5-7 x ca 0.5 mm; sepals (4-)5, ovate, elliptic to oblong, 2-3.5 x 1-2.5 mm; petals (4-)5, narrowly oblong to spathulate-oblongate, 2-3 x 0.8-2 mm; stamens 15-30, 2.5-4 mm long; anthers oblong to orbicular, 0.7-1 mm long. *Female flowers*: pedicels 1-4 x 1-2 mm; sepals 5, elliptic, oblong to ovate, 1.8-4 x 1-3 mm; petals 5,

subulate to filiform, 0.5-2.5 mm long; ovary subglobose, 2.5-4 mm in diam.; styles 3-5.5 mm long, free, usually twice bifid. *Capsules* subglobose, 8-14 mm in diam., shallowly 3-lobed, muriculate, sparsely pubescent; pedicels 3-8 mm long; seeds oblong to orbicular, 5-8 x 4-6 mm, brown or greyish-brown.

Flowering & Fruiting : Jan. Dec.

Uses : Reported to be used in local medicine (unspecified) in South India. Bark yields a lac which is used in varnish making.

Local names : Sinhalese: *Gas-keppetiya*, *Keppetiya*, *Wel keppetiya*; Tamil : *Teppaddi*, *Vid pune*.

Distribution : S.India, Sri Lanka - Thailand. *Habitat* : S.India : Common (rare in some localities) in evergreen forests and deciduous forests, frequently along streams or river banks up to about 900 m altitude. Sri Lanka : Very common in dry or moist regions ascending to 900 m. Once found among open rocks.

Specimens examined : INDIA. Karnataka : Chikmagalur dist.: Kemmangundi-Tarikere road, 27.6.1978, *Saldanha & Ramesh* 1744 (CAL, JCB); Bababoodan hills, Santaveri, Oct.1908, *Meebold* 8712. N.Kanara dist.: Way to Sadashivagad, 26.5.1978, *Ahamed* 1112 (CAL, JCB). Kerala : Kottayam dist.: Devicolam, Dec. 1910, *Meebold*, 13360; Pamba, 27.6.1968, *Deb* 30443 (MH). Palghat dist.: Anavai, 28.4.1977, *Vajravelu* 49814 (CAL, MH). Maharashtra : Bombay, n.d., *Kurz s.n.*, acc. no. 410867. Tamil Nadu: Coimbatore dist.: Udumanparai, 29.4.1903, *Barber* 5498 (MH). Kanyakumari dist.: Muthukuzhivayal, 27.8.1976, *Henry* 47563 (CAL, MH). Namakkal dist.: Kolli hills, Mettukadushola, 20.4.1978,

Mohanan 13185 (CAL, MH). Nilgiri dist.: Nedduvattum, June 1885, *Gamble* 16268 (BSI, CAL, MH). Tirunelveli dist.: Kannikatti, 6.6.1901, *Barber* 3118 (CAL, MH); Manjanamparai, 30.5.1963, *Henry* 16376 (MH). Sri Lanka. Central Prov.: n.d., Thwaites CP 2117 (BM, CAL, G-DC : microfiche ! K: photo!). N. Central Prov.: Polonnaruwa dist., 5.5 mile NE of Habrana along road to Trincomalee, 13.10.1974, *Davidse* 7499. W. Prov.: Colombo, March 1905, *Meebold* 2417.

A variable species, differing from *C. caudatus* in its arborescent habit, usually softer tomentum and much smaller thin-walled fruits. The leaves are also subentire or less coarsely crenate-serrate but forms with much similar leaves also occur in *C. caudatus*. *C. aromaticus* is even nearer to *C. moonii*, apparently differing in its trinerved leaves not turning black on drying, relatively larger stellate hairs with greater number of radiating rays, greater number of stamens and in its quadrifid style-branches.

The inflorescences are sometimes unisexual. Sometimes a terminal entirely male inflorescence may be noticed subtended by 1-2 lateral, shorter and few-flowered entirely female inflorescences. The leaves are aromatic. Several collectors noted that the flowers are scented.

The material *Hermann* 1: 63, No. 345 (BM) is marked to be the lectotype of *C. aromaticus* but without the name of the person who chose it. The other type material (*Hermann* 4: 21, No. 345) is labelled as syntype.

3. ***Croton birmanicus*** Muell.-Arg. in *Linnaea* 34: 112. 1865 & in DC., *Prodr.* 15(2): 601. 1866; Hook. f., *Fl. Brit. India* 5: 389. 1887; Brandis, *Ind. Trees*: 577. 1906;

Airy Shaw in *Kew Bull.* 23: 72. 1969 & 26: 244. 1972; T. Chakrab. & Gang. in *J. Econ. Tax. Bot.* 12(2): 493. 1988. *Type*: Myanmar. ('In regno birmanico Indiae Orientalis secus flumen Irawaddy') : Taong-dong on Irrawaddy, 1826, *Wallich* 7744 (G-DC: microfiche!; K-WALL: microfiche!; *sine loc.* (!), *Wallich* 7773 A (K-WALL: photo!).

C. aromaticus sec. Wall., *Cat.* No. 7773 A. 1847 (*non* L., 1753). [Fig 2, Map 3].

Shrub or small tree; young shoots softly or often coarsely ochraceous tomentose; branchlets glabrous. *Leaves* elliptic, oblong, ovate to orbicular, 5-13 x 2.5-7 cm, rounded or cordate or truncate at base, shallowly dentate-serrate along margins, apiculate to acuminate at apex (acumen 5-10 mm long, acute to obtuse), membranous, glabrous or almost so above, scattered ochraceous pubescent beneath (scaberulous from central rays), yellow or brown or dark brown above when dry, strongly trinerved at base; lateral primary veins basal or slightly suprabasal, ascending 50-70% way up the lamina; lateral nerves slender, 3-6 pairs, faint above, conspicuous beneath; tertiary nerves obscure above, more or less prominent beneath, scalariform; basal glands 2, stipitate, marginal glands present; petioles 0.7-4 cm long, 1-2 mm in diam, coarsely tomentellous to scabrid-pubescent; stipules subulate-filiform, 3-5 mm long. *Inflorescences* ca 10 cm long, sometimes unisexual; rachis more or less tomentellous; bracts linear, 3-4 mm long, lacerate towards base. *Male flowers*: pedicels 3-4 x ca 0.3 mm, tomentellous; sepals 5, ovate 2 - 3.5 x 1 - 2 mm ochraceous tomentellous outside (at least towards base); petals 5, elliptic to oblong-ob lanceolate, 2-2.5 x 1 - 1.3 mm; stamens 14-18, 3.5-4 mm long; filaments glabrous; anthers

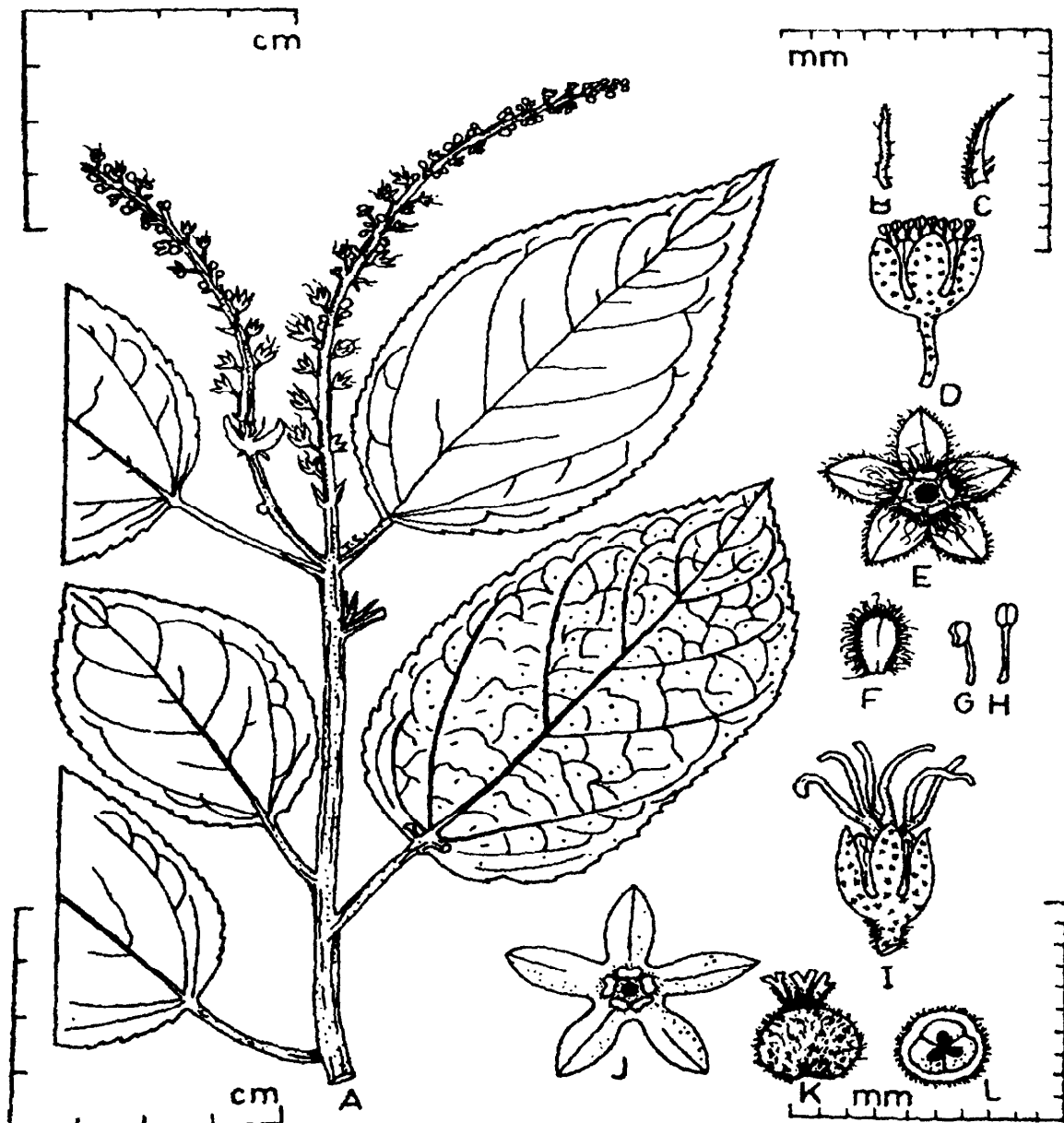
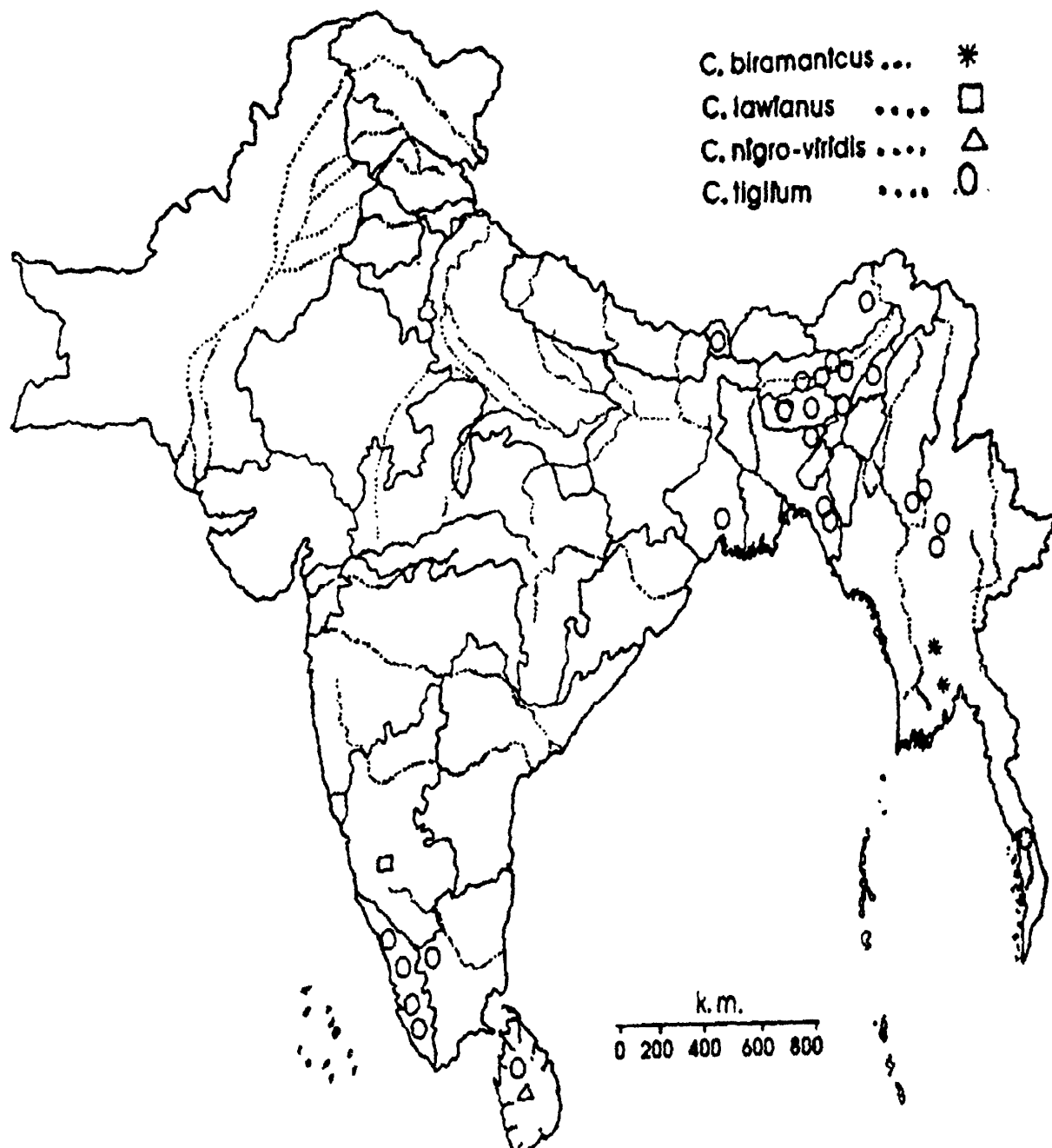


Fig-2. *Croton birmanicus* Muell.-Arg. A. Flowering branchlet. B. Stipule. C. Bract. D-H. Male: D. Flower. E. Calyx viewed from above. F. Petal. G-H. Stamens. I-L. Female : I. Flower. J. Calyx viewed from above. K. Ovary. L.T.S. of ovary (all from Kurz 1607 C).



Map-3. Distribution of *Croton birmanicus*, *C. lawianus*, *C. nigro-viridis* and *C. tiglium*.

oblong, ca 0.8 mm long. *Female flowers* : pedicels 1-2 mm long, 0.5-0.8 mm thick, tomentellous ; sepals 5, narrowly oblong to elliptic, 2.5-3.5 x 0.8-1.5 mm, ochraceous tomentellous outside; petals absent; ovary globose, 2-3 mm diam., ochraceous-tomentose (hirsute from central rays); styles 4-5 mm long, slender, free, bifid nearly to base. *Capsules* not seen intact (reported to be subglobose, ca 1.5 cm in diam.); cocci ca 15 mm long, crustaceous, scattered pubescent, muriculate or verruculose.

Flowering & Fruiting : Period not known.

Distribution : Myanmar-Malaysia, Thailand (cultivated).

Specimens examined : MYANMAR. Pegu river, n.d., Kurz 1607 C; Toungoo, n.d., Coll. uncertain s.n., Acc.No. 410885.

Airy Shaw (1972) pointed out the close alliance of the rare *C. birmahicus* to *C. tigilium* and emphasized the need for further material in order to ascertain whether this is more than a well marked form of the widely cultivated *C. tigilium*. From the additional material (as cited above), it is evident that *C. birmahicus* is certainly specifically distinct from *C. tigilium* by its stipitate foliar glands which are also scattered along the margins, the tomentellous sepals and by its smaller subglobose capsules. The following specimens from Myanmar are also doubtfully referred to *C. birmahicus* : Pegu, Kurz 1608 and Toungoo, Jan. 1859, Brandis 520.

4. ***Croton bonplandianus*** Baill. in *Adansonia* 4: 339. 1864; Croizat in *J. Bombay Nat. Hist. Soc.* 41 : 573. 1940; A.R. Smith in *Kew Bull.* 30 : 678. 1976; Amaratunga in *Ceylon J.Sci. (Biol.-Sci.)*

12: 189. 1977; Short & Vickery in *Enum. Fl. Pl. Nepal*: 195. 1982; T. Chakrab. in *J. Econ. Tax. Bot.* 4(2): 621-626. 1983, *in obs.*; Long in *Fl. Bhutan* 1(3): 792. 1987. *Syntypes* : Argentina, Corrientes Prov., *Bonpland s.n.* (P, n.v.). Paraguay, Apr.-May 1845, Weddell 3207 (P, n.v.).

C. sparsiflorus Morong in *Ann. New York Acad. Sci.* 7: 221. 1893; Prain in *Rec. Bot. Surv. India* 3(2): 276. 1905; Haines, *Bot. Bihar & Orissa* 2: 105. 1921; Gamble, *Fl. Pres. Madras*: 1316. 1925, *in obs.*; Kanjilal *et al.*, *Fl. Assam* 4: 196. 1940; Datta & Mitra in *Bull. Bot. Soc. Bengal* 7: 28. 1955; Hurusawa & Tanaka in *Fl. E. Himalaya*: 177. 1966 (*err. typogr. "spiciflorus Thunb."*). *Syntypes* : Paraguay: Asuncion, 1888-90, Morong 43 (K, NY - n.v.); Pilcomayo river, Morong 940 (NY - n.v.).

Erect herb, up to 50(-100) cm high, perennating by rootstock; young shoots densely whitish tomentose; branches glabrous. *Leaves* narrowly to broadly ovate, oblong, elliptic to suborbicular or triangular-ovate, lanceolate to linear, 1.5-9(-11) x 0.2-4.5(-5.5) cm, acute, obtuse to rounded or cuneate or truncate at base, shallowly serrate dentate (-crenate) or subserrulate along margins, mucronate or acute or obtuse or often rounded at apex, membranous to thinly chartaceous, glabrous above, sparsely pubescent to glabrous beneath, green or brown or yellow when dry, penninerved; lateral nerves 3-14 pairs, obscure to prominent above, faint to distinct beneath; tertiary nerves obscure to faint. *admedial* remidied; basal glands 2, sessile petioles 0.1-2 cm long, sparsely pubescent to glabrous; stipules subulate to linear, 2-3 mm long. *Inflorescences* 3-15(-20) cm long, rarely

unisexual; rachis glabrous to sparsely pubescent; bracts triangular or deltoid or shortly subulate, 0.5 - 1 mm long. *Male flowers* : pedicels 1 - 3 mm long, glabrous; sepals 5, elliptic, oblong to ovate or spatulate, 1 - 2.5 x 0.5 - 1.5 mm, glabrous; petals 5, narrowly oblong to spatulate, 1.5 - 2.5 x 0.5 - 1 mm; receptacle glabrous; stamens (11-)14 - 16(-20), 1.5 - 2.5 mm long. *Female flowers*: pedicels 0.5-1.5 mm long, almost glabrous, with 1-2 sessile glands at base; sepals 5, triangular, oblong, ovate to lanceolate, 1-2 x 0.4-1 mm, almost glabrous; petals obsolete; ovary oblong, 1-2 x 1 - 1.5 mm, 3(-5)-loculed, whitish tomentose; styles 2-3 mm long, free, bifid. *Capsules* oblong to ellipsoid, 4-8 x 3-6 mm, shallowly lobed, scattered puberulous to glabrous; seeds oblong, 3-5.7 x 1.8-3 mm, blackish-brown.

Flowering & Fruiting : Jan. - Dec.

Uses : The plant is used as an antiseptic and styptic. Chemical studies revealed that the oil obtained from seeds contain palmitic, stearic, oleic, linoleic and decadienic acids. The seeds, leaves and stem contain alkaloids, viz. sparsiflorine, pronuciferine and crotsparine. In addition, β -sitosterol has also been isolated. Sparsiflorine has been reported to be inhibitory (*in vitro*) to heavy inocula of *Vibrio coma*, *Escherichia coli* and *Salmonella typhosa*. The plant is rich in potash and nitrogen and therefore is suitable for composing (Anantakrishnan *et al.* 1941; Anonymous, 1950, Saha, 1959; Acharya *et al.* 1964; Chatterjee *et al.* 1965; Bhakuni & Dhar, 1968; Farnsworth *et al.* 1969; Anonymous, 1976).

Local names : Burmese : *Taw-ngayok*, *Wet-keyin*; Oriya : *Gandha tulashi*; Tamil : *Eliamanakku*; Telugu : *Kukka mirapa*.

Distribution: Sri Lanka, India (including Nicobar Islands),? Pakistan, Nepal, Bhutan, Bangladesh, Myanmar Malay Peninsula, Africa (Kenya); native to S. America (S. Bolivia, Paraguay, SW. Brazil & N. Argentina).

Habitat : Very common weed in diversified habitats up to 1000 m altitude.

Specimens examined : BANGLADESH. Chittagong, 3.10.1905, *Hooper* 26029. Comilla dist., Gobindapur cemetery, 25.1.1943, *Sinclair* 6. INDIA. Andaman & Nicobar Is.: Car Nicobar Is., Kakana, 25.9.1976, *N.G. Nair* 4518 (PBL). Arunachal Pradesh: Kameng dist., Abor hills, Makum, 22.11.1911, *Burkill* 35760. Andhra Pradesh : Cuddapah dist., Near Dongalacheruvu lake, 20.8.1958, *Subramanyam* 6314 (CAL, MH). Kurnool dist., Nandyal, 27.2.1957, *Wagh* 5279 (BLAT). Assam: Cachar dist., Near Badarpur, 12.8.1903, *Gage s.n.*, acc. no. 411163. Kamrup dist., Guahati, 12.8.1909, *Burkill* 32458 (BSIS). Bihar: Nalanda dist., Rajgir hills, 12.3.1956, *Saran* 25673 (LWG). Champaran dist., Motihari, 18.8.1964, *Banerjee* 248. Delhi : Nizamuddin, 27.7.1955, *Srivastava* 22630 (LWG). Gujrat : Dahpur plantation, 24.3.1936, *Parker* 3322 (DD). Goa: Maigao town, 17.4.1963, *Kanodia* 88103. Haryana : Panipat, 7.5.1963, *N.C. Nair* 26503 (BSD). Jammu & Kashmir : *sine loc.*, June 1956, *Saran s.n.*, acc. no. 47399 (LWG). Karnataka : Bangalore dist., Sangam, 19.7.1978, *Ravindra* 1579 (CAL, JCB). N. Kanara dist., Aluvavar, 24.12.1955, *Bole* 1402 (BLAT). Kerala : Calicut dist., Kutiyadi, 27.6.1965, *Naithani* 24665 (MH). Palghat dist., Walayar dam side, 11.7.1963, *Joseph* 17087 (MH). Madhya Pradesh: Bilaspur dist., Bilaspur to Champa, 27.7.1973, *Murti* 19360 (BSA). Durg dist.,

Rajnandangaon, 14.9.1976, *Pant* 25392 (BSA). Maharashtra : Nagpur dist., Sakardara, 16.11.1957, *Subramanyam* 4643 (CAL, MH). Pune dist., Yerwada bridge, 16.7.1960, *Wadhwa* 64307. Nagaland: Naga hills, July 1936, *Bor* 21062 (ASSAM). Orissa: Cuttack dist., Paradeep, 21.5.1966, *Ghosh* 179. Koraput dist., Ghatgumar, 28.11.1963, *Raju* 1533. Pondicherry : Karikkal, 25.4.1972, *Sastry* 9151. Punjab: Bhatinda dist., Bhatinda, 21.2.1963, *N. C. Nair* 26268 (BSD). Rajasthan: Ganganagar dist., Sadhuwali, 26.10.1973, *Sohal* 265 (DD). Tonk dist., Malpura, 21.5.1977, *Pandey* 4843 (BSJO, CAL). Tamil Nadu : Coimbatore dist., Enumanur, 11.1.1951, *Jain & Bharadwaj* 22493 (DD). Kanyakumari dist., Cape Susindrum, 1.8.1977, *Henry* 49572 (MH). Tripura: Agartala, 27.9.1914, *Deb Burman* 85. Uttar Pradesh: Garhwal dist., Kotdwar, 19.5.1956, *Kapoor & Jhamman* 27411 (LWG). Sitapur dist., 15.3.1955, *Naziruddin* 19939 (LWG). West Bengal : Birbhum dist., Santiniketan 7.9.1949, *Biswas* 4250. Darjeeling dist., Kamala tea estate, 18.6.1955, *Mukherjee* 22477 (LWG). Howrah dist., Sibpur, 12.7.1904, *Prain s.n.*, acc. nos. 411154-56. MYANMAR. Kyiukse dist., Belin, 24.5.1951, *Po Khant* 2099 (DD). Minbu dist., Bogon Qr., 24.9.1951, *Tha Hla* 2171 (DD). Pakokku dist., Chauk, Apr. 1939, *Dickason* 8643. SRI LANKA. North Central Prov.: Anuradhapura, Basawakkulama tank, 31.10.1974, *Davidse & Sumithraarachchi* 8167.

5. *Croton calderi* T. Chakrab. & Balakr. in Proc. Indian Acad. Sci. (Plant Sci.) 92(4):363, 1983. *Holotype*: Myanmar, Mergui, Cinchona camp, 22.3.1929, *Calder s.n.*, acc. no. 411169 (CAL). [Map 4]

Tall tree (exact height unknown); young shoots ochraceous tomentose (hirsute from erect central rays); branchlets glabrous. *Leaves* (somewhat immature) narrowly obovate-oblong to elliptic, the largest ca 7 x 2.5 cm, subcordate or rounded at base, serrulate along margins, acute-mucronate or rounded at apex, firmly membranous, glabrous, penninerved; lateral nerves 5-10 pairs, faint above, prominent beneath; tertiary nerves obscure above, faint beneath, scalariform; basal glands 2, sessile; longest petiole ca 6 mm long, almost glabrous; stipules subulate, 1-1.5 mm long. *Inflorescences* 3-5 cm long, arising precociously; rachis sparsely pubescent; bracts triangular, 1-2 mm long. *Male flowers* : pedicels 3-4 mm long, tomentellous; sepals 5, ovate to elliptic, 2-2.5 x 1-1.5 mm, tomentellous outside (at least towards base); petals 5, oblong to elliptic-oblong, 2-2.5 x ca 1 mm; stamens 10-11, 3-3.5 mm long; anthers oblong. *Female flowers* : pedicels 2-5 mm long, tomentellous, with a sessile gland at the base; sepals 5, triangular, 2-3 x 1-1.8 mm, greyish tomentellous outside; petals 5, subulate or spathulate, 0.5-1 mm long; ovary subglobose, 2-2.5 mm in diam., unlobed, glabrous or almost so; styles 3.5-5 mm long, free, bifid. *Capsules* unknown.

Flowering : Mar.

Distribution : Myanmar - Endemic.

Specimens examined: Known by type collection only.

This species was described on the basis of incomplete material, devoid of fruits and having somewhat immature leaves. The precocious flowering condition of the plant indicates its close alliance to *C. sublyratus* but

the inflorescences are shorter and the ovary unlobed, glabrous or almost so and rounded at the apex. Since the specific distinctions in *Croton* are usually narrow, these differences appear to be sufficient in recognizing this poorly known plant as a distinct species.

6. ***Croton calococcus*** Kurz in J. Asiat. Soc. Bengal 42: 242. 1873 & For. Fl. Brit. Burma 2: 376. 1877; Hook.f., Fl. Brit. India 5: 389. 1887, '*coelococcus*'; Airy Shaw in Kew Bull. 23: 73. 1969 & 26: 245. 1972. *Type*: Myanmar (Burma): Rangoon, Kurz 1607 A (CAL-Acc. No. 410910- half of a sheet-Lectotype, here designated & K- other half of the sheet-Isolectotype); Pegu, Kurz 1607 B, Acc. No. 410912 (CAL). [Fig. 3, Map. 2].

Shrub, 1-2 m high; sometimes climbing; all parts (except older stems) shortly ochraceous hispid or scabrid-pubescent. *Leaves* elliptic, ovate-elliptic, obovate-elliptic to orbicular, 2.5-11x1-6 cm, rounded to obtuse at base, serrulate-denticulate to subentire along margins, acute to shortly cuspidate-acuminate (acumen 5-15 mm long) at apex; membranous to chartaceous, ochraceous when dry, strongly trinerved at base; lateral primary veins basal or suprabasal, ascending 60-75% way up the lamina; lateral nerves 1-4 pairs, faint above, prominent beneath; tertiary nerves obscure above, faint beneath, scalariform; basal glands 2-4(6), sessile to subsessile, marginal glands present; petioles (0.2-) 0.5-2 cm long; stipules linear-lanceolate, ca 2 mm long. *Inflorescences* up to 12 cm long, sometimes unisexual; bracts linear, 1-3 mm long. *Male flowers*: pedicels 4-6 mm long, 0.2-0.5 mm thick; sepals 5, ovate or ovate-oblong, 1.5-3 x 0.8-2 mm; petals 5, narrowly oblong, 2-3 x ca 1 mm; stamens 11-16, 2.5-4 mm long; anthers oblong or often ovoid, 0.7-1 mm long. *Female flowers*: pedicels

3-7x0.8-1.3 mm; sepals 5, narrowly oblong to elliptic-oblong, 3-5 x 1-2 mm; petals obsolete; ovary subglobose, 2.5-3.5 mm in diam.; styles slender, 3.5-5 mm long, free, bifid. *Capsules* subglobose, 8-10 mm diam., prominently 3-lobed, muriculate, ochraceous when dry; seeds ovoid to suborbicular, 4.5-5 x 3-4 mm, brown.

Flowering & Fruiting : Feb. - Aug.

Use: Cultivated for fencing in Myanmar.

Distribution : Bangladesh, Myanmar, Indochina, Thailand.

Habitat : In hill forests at low altitudes.

Specimens examined: BANGLADESH. Chittagong dist.: Chittagong, n.d., Wallich s.n. (K: photo!); Puicherri, 9.3.1906, Heinig 26372 (BSIS); Kodala hills, Apr. 1887, King's coll. 326; Voriphoon, 21.3.1876, Lister 261. MYANMAR. *sine loc.*, Aug. 1871, Barrington 3. Insein dist., Myankhlaing reserve, 17.3.1948, Po Khant 204 (DD). Rangoon, May 1911, Meebold 15567, North of mental hospital, 15.3.1932, Parkinson 14110 (DD); Balau, 26.5.1917, A. Rodger 759.

A collector (Po Khant) notes that the plant is a climber with white flowers while others found it to be a shrub. From Thailand it is known to be a scandent shrub (Airy Shaw, 1972). The scandent or climbing habit occurs regularly in *C. caudatus*, a species somewhat resembling *C. calococcus* in venation of leaves and indumentum but differing principally in its much larger fruits (Airy Shaw, 1969).

The type of *C. calococcus* is represented in CAL by two herbarium sheets and in K by a single sheet. Both the sheets in CAL bear field number 1607, of Kurz obtained from 'Pegu' (as

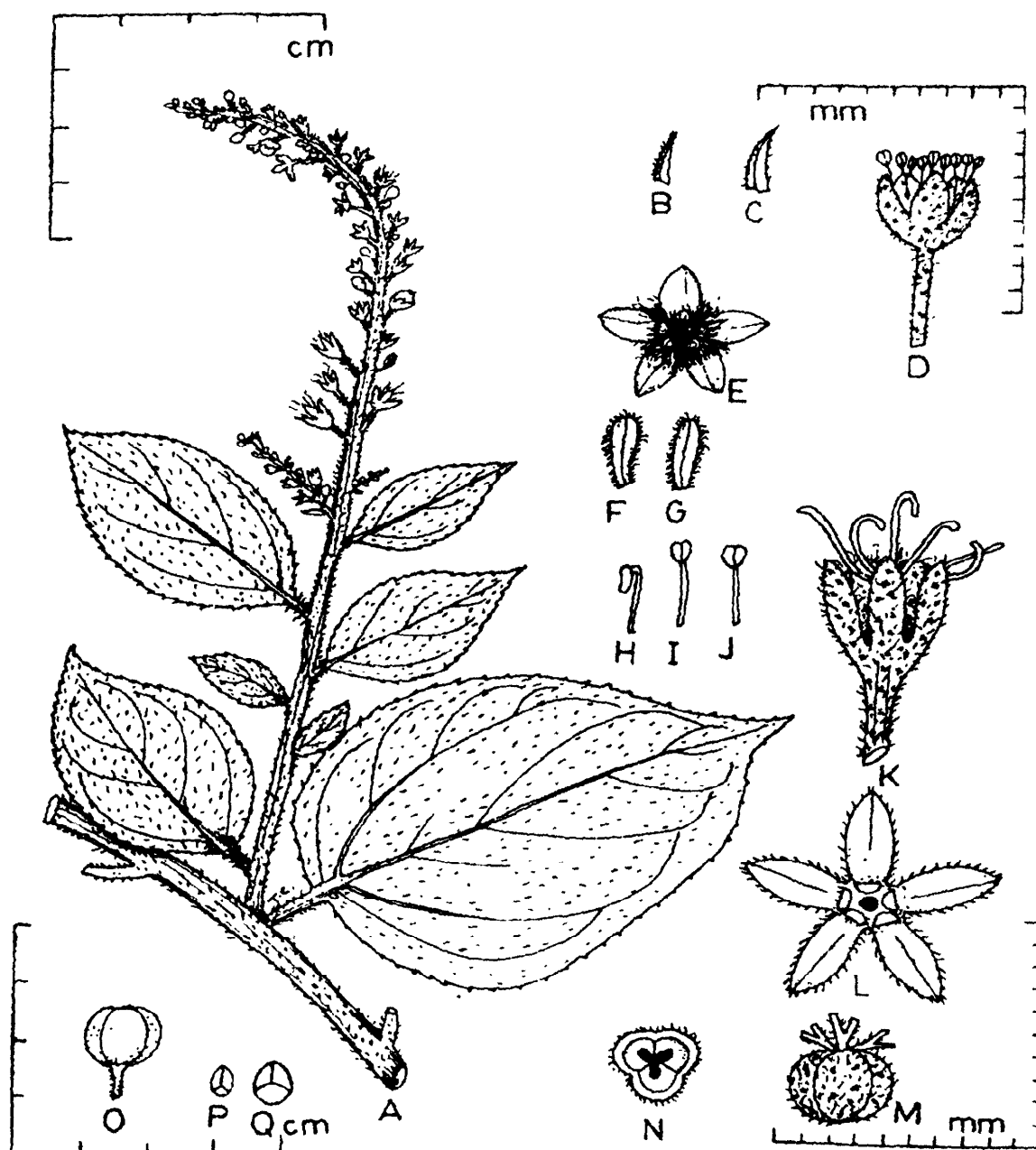
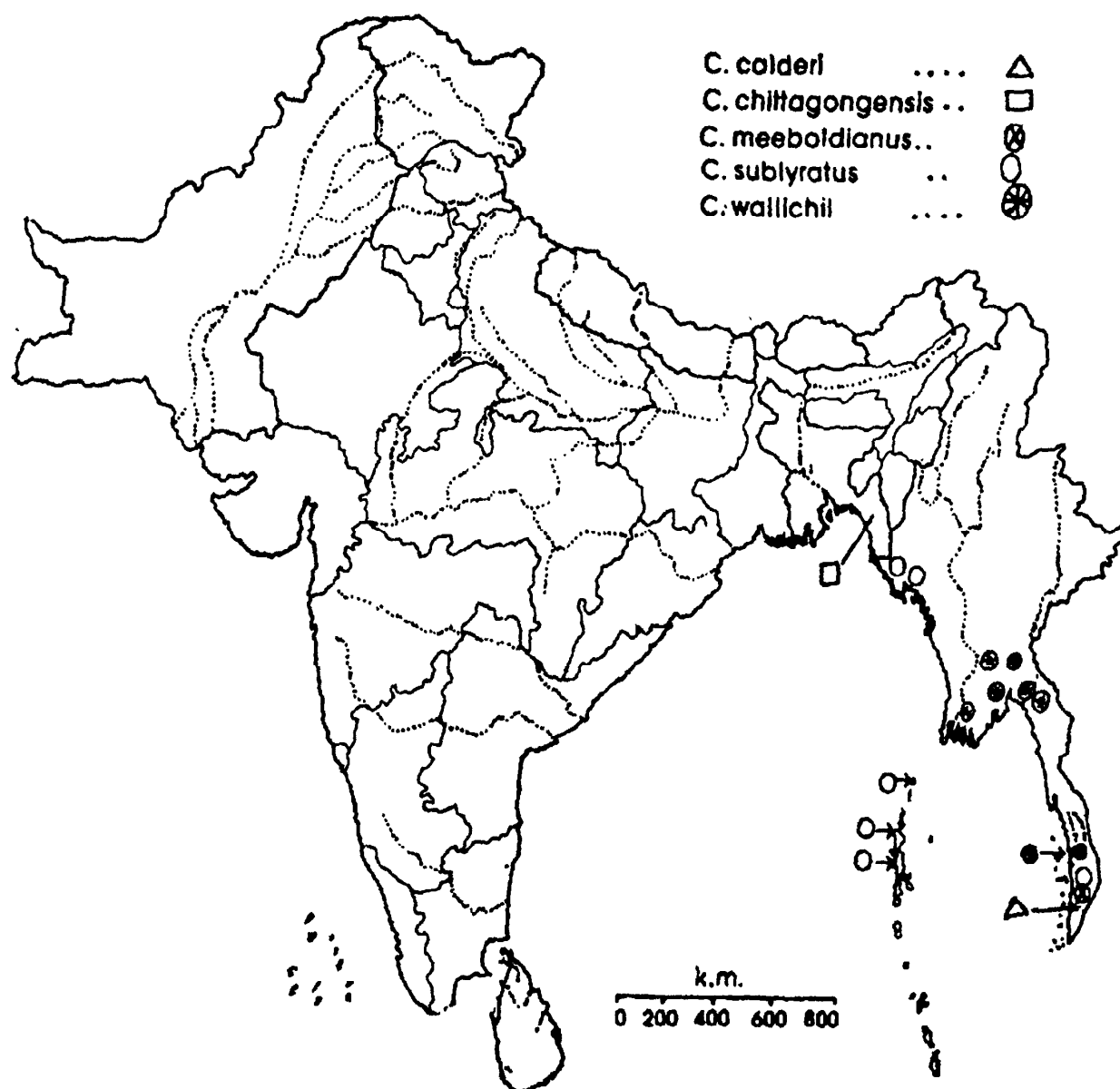


Fig-3. *Croton calococcus* Kurz. A. Flowering branchlet. B. Stipule. C. Bract. D-J. Male: D. Flower. E. Calyx viewed from above. F-G. Petals. H-J. Stamens. K-N. Female: K. Flower. L. Calyx viewed from above. M. Ovary. N. T.S. of ovary. O. Fruit. P-Q. Seeds (A, K-N, Q: King's coll. 326; B: Heinig 26372; C-J: Lister 261; O-P: Kurz 1607 A).



Map-4. Distribution of *Croton calderi*, *C. chittagongensis*, *C. meeboldianus*, *C. sublyratus* and *C. wallichii*.

printed on the label). But one specimen (indicated here as 1607 A, Acc. No. 410910 and chosen as the lectotype) is further localized as 'Rangoon' (in pen) and identified (in Kurz's own handwriting in pen) to be '*Croton calocarpus* Kz.' The other material (No. 1607 B, Acc. No. 410912) is determined to be '*Croton calococcus* Kz.' (in pen). The date of collection is not indicated but it is possible that these two specimens were collected separately, since there is one more specimen of Kurz in CAP bearing the same field number, 1607 but representing another species, *C. birmanicus*. It appears that Kurz collected No. 1607 A first and wrote the name '*C. calocarpus*' on the sheet but changed the name to '*C. calococcus*' while describing the species, without correcting the name on the sheet. No. 1607 B is apparently a later collection, bearing the published name, *C. calococcus*. It is also to be noted that the specimen, Kurz 1607 A in CAL bears a single twig mounted on a half cut sheet (now mounted on a separate board). The other half of this collection is deposited in K bearing an annotation (in pencil) as follows: '*Croton calocarpus* Kurz; half of the other specimen at Calcutta'. The name '*calocarpus*' has been crossed out and '*calococcus*' is written above it.

Airy Shaw (1969) remarked that the nativity of *C. calococcus* requires investigation. The curious circumstances that the specimens are all localized as from towns Rangoon, Chittagong, Bangkok together with the mention of shrubberies and gardens, inevitably raises doubts as to whether the species is truly a native of South-East Asia and it is therefore very desirable that this mysterious garden plant should be traced to a truly native habitat. From the several additional gatherings which

could be culled out, particularly those by Heinig, King's collector, Lister and Po Khant, it is clearly evident that *C. calococcus* is certainly a native of SE. Asia, since the plant was found growing in wild conditions on the Chittagong hill tracts in Bangladesh as well as in the forests of Myaukhlaing reserve, Insein district, Myanmar.

Airy Shaw (1969) also pointed out the unusual feature observed in the arrangement of inflorescences. He wrote : "it appears that each fertile lateral shoot bears about 4-8 leaves, from the upper axils of which, or from the axils of suppressed leaves above which, there arises short (up to 8-flowered) purely female inflorescences, followed by a single, more numerous flowered, purely male inflorescence, terminating the shoot." During the course of the present revision, further deviations in the arrangement of inflorescences were noticed, in the specimen of Lister (261) each axillary fertile shoot terminates in a 2-5 cm long purely male inflorescence and from the upper axils (of normal or suppressed leaves) of the shoot (beneath the terminal inflorescence), there arise 2-3 inflorescences, each being 1-1.5 cm in length (up to 12-flowered). Of these, at least one is bisexual while the remaining one or two being purely female. In the King's collector's specimen (326), the terminal inflorescence is bisexual, up to 11 cm long, subtended by ca 2-3 lateral 10-20-flowered (up to 2 cm long) bisexual as well as entirely female inflorescences.

7. *Croton caudatus* Geisel., *Croton*. Monogr: 73. 1807; Muell. Arg. in DC., Prodr. 15(2):599. 1866, excl. var. *klotzschianus*; Kurz, For. Fl. Brit. Burma 2: 375. 1877; Hook. f., Fl. Brit. India 5: 388. 1887; Trimen,

glandular tips, 4-15 mm long. *Inflorescences* 8-35 cm long, sometimes unisexual; bracts subulate or lanceolate or linear, 1-10 mm long, often fringed with stipitate glands. *Male flowers*: pedicels 3-9(-16) mm long; sepals 5(-6), ovate, oblong to elliptic or triangular, 2-4.5 x 1-3.5 mm; petals 5(-6), narrowly oblong-elliptic to spatulate, 2-4 x 1-3 mm; stamens 18-40, 3.5-6 mm long; anthers oblong or obovoid, 0.8-1.3 mm ; long. *Female flowers*: pedicels 1-5 x 1-1.8 mm; sepals 5, oblong, elliptic to ovate, 2-6 x 1-4 mm, often fringed with subsessile glands; petals 0-5, filiform or subulate, 0.5-2.5 mm long; ovary globose or oblong or obovoid, 2-4 x 2-4 mm, densely ochraceous hirsute or hispid (from central rays); styles 5-13 mm long, free, bifid (rarely quadrifid) almost to the base. *Capsules* globose or oblong or obovoid, 1.5-3 x 1.5-2.5 cm, bluntly 3-or 6-angled, often muricate or verruculose, scattered pubescent; seeds oblong or ellipsoid or ovoid or suborbicular, 8-20 x 5-15 mm, brown, scattered pubescent.

Flowering & Fruiting : Jan. Dec.

Uses : The plant is used for several purposes throughout its range. The branches serve as rope. The leaves are applied as a poultice to sprains. The root is employed as a purgative (NE.India). The young shoots are used to cure cholera and also ground with leaves of *Caesalpinia sappan* for use in treatment of liver diseases. The Mikirs of NE India blacken their teeth with *C. caudatus*.

Local names : Assamese: *Ghahe lewa*, *Lota mahudi*; Bengali: *Nan bhantur*; Garo: *Dumi shak*; Khasi: *Soh lam brang*; Lepcha: *Tak chabrik*, *Talikkorik*; Lushai: *Mataun*; Malayalam: *Umithinni kodi*; Mikir: *Kumkum arong*; Nepali: *Halonge*, *Khali*, *Supera*; Oriya:

Phalancokriti, *Sanaushonta*, *Wusta*.

Distribution : Sri Lanka, India, Pakistan, Nepal, Bhutan, Bangladesh, Myanmar, S.China, Thailand, W. Malesia.

Habitat: Sri Lanka: Rare in dry regions. S.India: Scattered in evergreen forests especially on edges up to 900 m altitude. *E & NE.India* : Common in evergreen forests or mixed forests or deciduous forests or 'Khair & Sissu' forests or scrub and thickets, often along streams, up to 1500 m altitude. E. Himalaya: Common on subhimalayan tracts up to 1200 m altitude. Myanmar: Common in mixed forests.

Specimens examined : BANGLADESH, Dacca dist., Dacca, 27.5.1872, *Clarke* 17112. Sylhet dist., Rangamatty hills, 1905, *Hussain* 46; Sylhet, May 1830, *Wallich* 7720 C (K, photo!, B.M.- right hand side specimen); *ibid.*, n.d., *Wallich* 7826 E (K, photo !), BHUTAN, Birti, 23.4.1964, *Sen Gupta* 1306. Gaylegphug, 24.4.1964, *Sen Gupta* 1361. INDIA. Arunachal Pradesh: Lohit dist., Lohitpur, 19.9.1969, *A.S. Rao* 47954. Tirap dist., Waka, 29.8.1958, *Panigrahi* 14965 (ASSAM, CAL). Assam: Kamrup dist., Kamakhya hills, 12.6.1964, *A.S. Rao* 38775. Lakhimpur dist., Near Dibrugarh, 23.4.1915, *Carter* 305 (BSIS). Karnataka: Chikmagalur dist., Near Sangameshwarpet, 26.6.1980, *Saldanha* 11687 (JCB). S.Kanara dist., Karakala-Guruvarkere road, 19.4.1979, *Saldanha & Prakash* 7054 (CAL, JCB). Kerala : Cannanore dist., Trisselari, 5.5.1979, *Ramachandran* 62280. Idikki dist, Triveny, 11.10.1972, *Shrama* 42473 (MH). Kottayam dist., Peruvanthanam to Pulluparai, 22.5.1965, *Vivekananthan* 23946 (MH). Trichur dist., Orukombankutty to Parambikulam, 18.4.1977, *Ramamurthy*

49359 (CAL, MH). Meghalaya: Khasi hills, Umling river, 16.6.1911, *Das* 34972. Jowai dist., Haflong, 8.8.1908, *Craib* 173. Garo hills, Tura ridge, 27.5.1958, *B. K. Nayar* 50797 (LWG). Nagaland : Dimapur, 22.4.1962, *Srivastava* 91647 (LWG). Orissa: Ganjam dist., Gumpahar, 13.8.1913, *Hooper* 39660 (BSIS). Mayurbhanj dist., n.d., *Biswas* 235. Sikkim: Ryang, 13.6.1876, *Kings.n.*, acc.no.410853. Tista roadside, 1.6.1959, *Mukherjee* 5066. Tamil Nadu: Coimbatore dist., Karianshola Guaimalai, 30.8.1913, *Fischer* 3638. West Bengal: Darjeeling dist., Bagrakota forest, 17.5.1966, *Das* 56 (CAL). Jalpaiguri dist., Suknapara, 14.3.1973, *Krishna* 212 (BSIS). MYANMAR. Moulmein, 1827, *Wallich* 7726 (K-WALL : photo!). Tenasserim: *sinc loc.*, n.d., *Biswas* 410; Duncan, Mar. 1911, *Meebold* 14665; Let panthawng, Mar. 1911, *Meebold* 14666; Mooltan valley, 25.4.1877, *Gallatly* 905. NEPAL. Between Bakro & Shabru, 25.6.1921, *Agharkar s.n.* (CUH). PAKISTAN. Lahore, 12.8.1924, *Parker s.n.*, reg. no. 38846 (DD).

The numerous variants of this species require further study and much critical field observations. The infraspecific taxa that have been proposed from time to time appear to be linked to one another through innumerable transitions and at present it seems impossible to maintain these varieties or to propose other formal varieties. *C. caudatus* differs from its immediate allies in the scandent habit, the larger fruits and the pubescent seeds.

The inflorescences are often unisexual. Sometimes a terminal purely male inflorescence may be observed subtended by one or two shorter, few-flowered purely female inflorescence.

8. ***Croton chittagongensis*** T. Chakrab. & Balakr. in Proc. Indian Acad. Sci.(Plant Sci.) 92 (4):365, fig. 2.1983. *Holotype*: Bangladesh, Chittagong dist., Hill tracts, Mainamukh, 9.5.1939, *Dent* 72 (DD). [Map.4].

Small tree (exact height unknown); young shoots softly greyish or brownish tomentose; branchlets glabrous. *Leaves* (immature) oblong or obovate to oblanceolate, the largest *ca* 9 x 2.7 cm, acute or rounded at base, serrulate along margins, acute or obtuse at apex, membranous, glabrous, penninerved; lateral nerves 8-16 pairs, faint; tertiary nerves obscure; basal glands 2, sessile; the longest petiole *ca* 8 mm long, glabrous. *Inflorescences* up to 12 cm long; rachis sparsely pubescent; bracts subulate, 0.8-2.5 mm long. *Male flowers*: pedicels 6-10 mm long, tomentellous; sepals 5, triangular or ovate-oblong, 2-2.5 x *ca* 1 mm, sparsely pubescent outside (at least towards base), lanate inside; petals 5, oblong-elliptic to subspathulate, 2-3 x *ca* 1 mm; stamens 10-12, 3-4 mm long; anthers oblong. *Female flowers*: pedicels 6-10 mm long, whitish tomentellous; sepals 5 or 10, ovate to elliptic, 2-5 x 1-3 mm, sparsely whitish pubescent outside (at least towards base), lanate towards base inside; petals 5, filiform or spathulate, *ca* 1 mm long; ovary obovoid, 4-5 mm in diam., unlobed, greyish or brownish tomentellous; styles 5-6.5 mm long, connate below into a column (*ca* 1 mm long), twice bifid above. *Capsules* unknown.

Flowering: May.

Distribution: Bangladesh - Endemic.

Specimens examined: So far known by the type collection only.

Like *C. calderi*, this species was also described on the basis of incomplete material. Like *C. sublyratus*, this species exhibits precocious flowering condition but differs in the longer male pedicels, obovoid ovary, rounded (rather than intruded) at the apex and longer quadrifid styles. The elongated pedicels of this species resemble *C. wallichii* which differs in having relatively fewer number of radiating rays of the stellate hairs on different parts and strongly lobed subglobose ovary with shorter bifid styles.

9. *Croton chlorocalyx* Muell.-Arg. in Linnaea 34:109.1865 & in DC., Prodr. 15(2):590.1866; Hook. f., Fl. Brit. India 5: 394. 1887, *p.p.*; Brandis, Ind. Trees: 578. 1906; Kanjilal *et al.* Fl. Assam 4: 195. 1940; Airy Shaw in Kew Bull. 37: 121. 1982, *in obs.* *Lectotype*: Bangladesh, Sylhet, Wallich 8001 (10) (G-DC)-here designated; *Isolectotypes* in BM (2 sheets), CAL, G-DC (2 sheets) K-W (excluding right hand specimen belonging to *Trigonostemon*). [Fig 4, Map 5].

Small tree (!); all parts (except very young shoots) glabrous. *Leaves* elliptic to oblong-elliptic, 9.5-23x2-6 cm, cuneate or acute at base and adaxially decurrent into petioles, serrulate along margins, caudate at apex (cauda 12-30 mm long, acute), membranous to thinly chartaceous, ochraceous or light brown above when dry, paler beneath, penninerved; lateral nerves slender, 6-14 pairs, faint to prominent; tertiary nerves obscure to prominent above, distinct beneath, reticulate; basal glands 2, stipitate; petioles 0.3-2 cm x 1-3 mm, shallowly channelled above, thickened and black towards basal end. *Inflorescences* 3-8 cm long; bracts deltoid, ca 0.5 mm long. *Male flowers*: pedicels 4-5 x 0.3-0.8 mm; sepals 5,

ovate, 2-4 x 1-3 mm; petals 5, oblong-elliptic to spatulate, 2-3 x 1-1.5 mm; stamens 15-16, 3-3.5 mm long; anthers oblong, ca 0.8 mm long. *Female flowers*: pedicels 1.5-2 x 0.5-1 mm; sepals 5, elliptic to obovate, 8-15 x 4-7 mm, accrescent, glandular-serrulate along margins; petals 5, filiform; ovary campanulate, ca 3 mm long, strongly 3-lobed with the lobes apically bilobulate, hollow towards apex, shortly stipitate; styls 5-6.5 mm long, connate at base into a column (2-3 mm long), twice bifid above. *Capsules* unknown.

Distribution: Bangladesh (Sylhet) Endemic.

Specimens examined: Known by type collection only.

This very distinct and extremely localized species is probably somewhat isolated taxonomically, readily recognizable and distinguishable from most other species in the area by its almost complete glabrescence (except for very young shoots), the black petiole-base, the accrescent female sepals with minute glandular teeth, the shortly stipitate campanulate ovary with apically bilobulate lobes and the long stylar column (the fruits are still unknown). The structure of ovary is very unusual in *Croton*.

The duplicate of the type in K is a mixed assemblage. The right hand side specimen on the sheet with diffusely cymose inflorescence represents a *Trigonostemon*.

10. *Croton crassifolius* Geisel., *Croton*. Monogr. 19. 1807; Hance in J. Linn. Soc. Bot. 13: 121. 1872; Airy Shaw in Kew Bull. 26: 245. 1972. *Holotype*: China ('Habitat in Insula Harnam Chinae'), Vahl *s.n.* (C).

Holotype: Myanmar, Tavoy dist., Huingyr

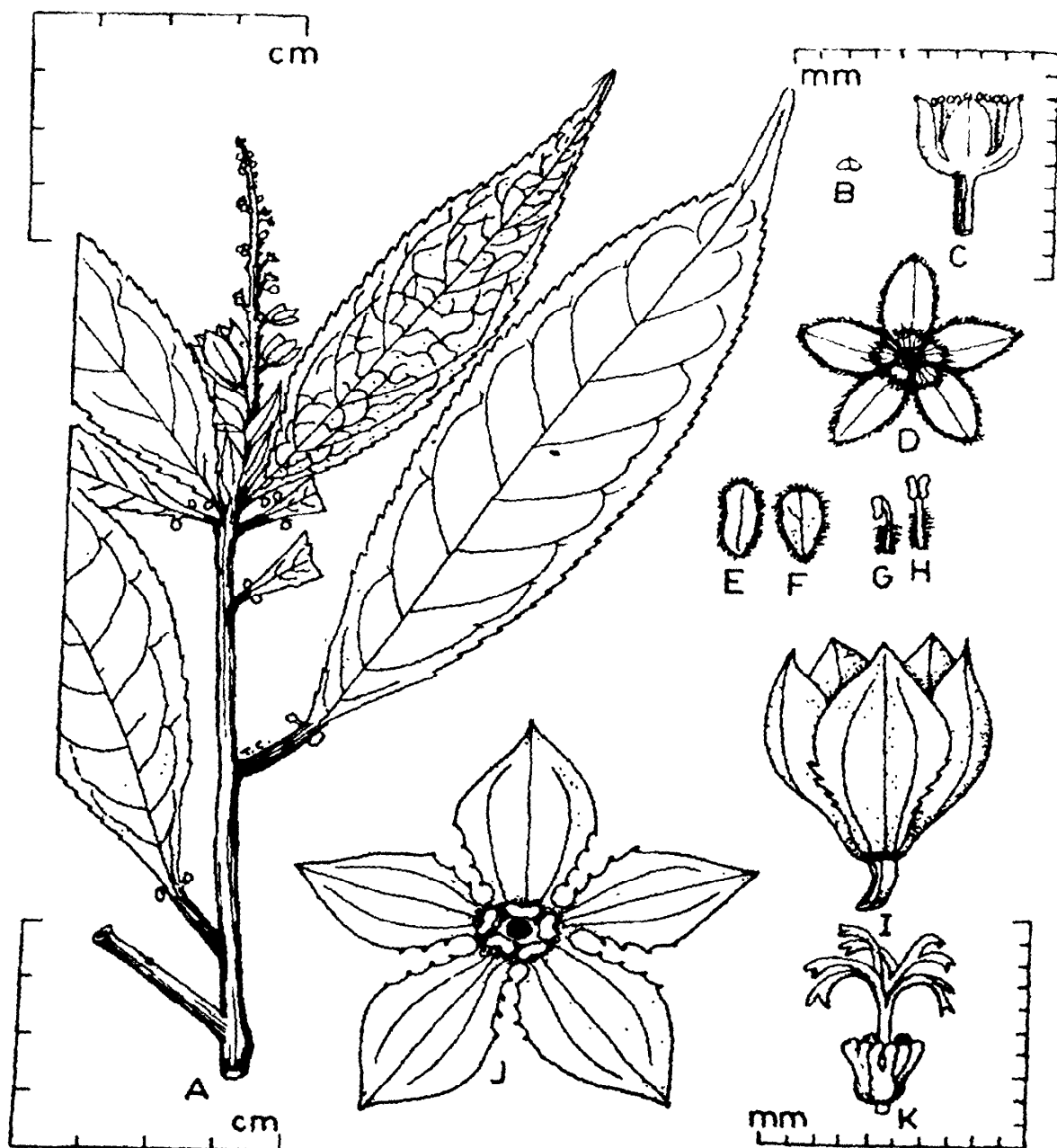
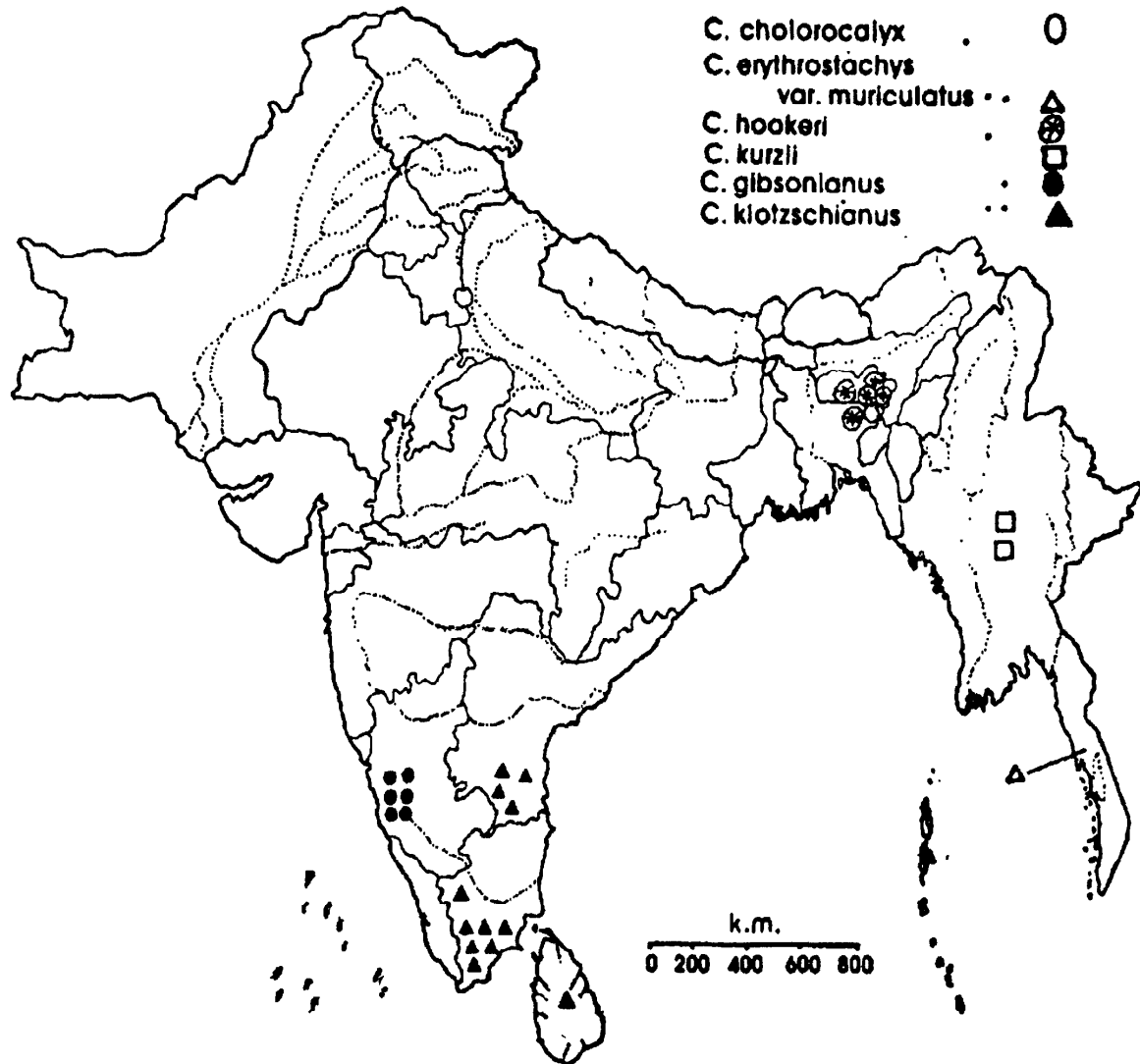


Fig-4. *Croton chlorocalyx* Muell.-Arg. A. Flowering branchlet. B. Bract. C-H. Male : C. Flower. D. Calyx viewed from above. E-F. Petals. G-H. Stamens. I-K. Female: I. Flower. J. Calyx viewed from above. K. Ovary (all from Wallich 8001).



Map-5. Distribution of *Croton chlorocalyx*, *C. erythrostachys* var. *muriculatus*, *C. hookeri*, *C. yunnanensis* (= *C. kurzii*), *C. gibsonianus* and *C. klotzschianus*.

Tridesmis tomentosa Lour., Fl. Cochinch. : 576. 1790 (*non Croton tomentosus* Link, 1822). *Type* : China ('Habitat argestis circa Cantonem Sinarum'), Canton, *Loureiro* s.n. (P. microfiche!).

T. hispida Lour. l.c. 576. 1790 (*non Croton hispidus* Kunth, 1817). *Type* : China ('Habitat in dumetis circa Cantonem Sinarum'), Canton, *Loureiro* (P? n.v.)

Croton chinensis Benth., Fl. Hongkong: 309. 1861 (*e descr.*). *Syntypes* : Hongkong, *Hance* s.n. (? 1132) n.v.; On slopes of hills at Aberdeen, *Wilford* s.n. n.v.; Putoy Island, *Wright* s.n. n.v.; Amoy, *Hance* s.n. n.v.

C. tomentosus (Lour.) Muell.-Arg. in Linnaea 34:107. 1865 & in DC., Prodr. 15(2): 588. 1866 (*non* Link, 1822); Hook. f., Fl. Brit. India 5: 389. 1887; Brandis, Ind. Trees: 577. 1906; Gagnep. in Lecomte, Fl. Gen. Indoch. 5: 262. 1925.

C. crozophoroides Kurz in J. Asiat. Soc. Bengal 42: 243. 1873 & For. Fl. Brit. Burma 2: 371. 1877, *in clavi*. *Syntypes* : Myanmar, Pegu, Irrawaddy and Sittang valley, 6/7 March 1871, Kurz 2485 (CAL 3 sheets, K: photo ! 2 sheets). [Fig. 5, Map 2.]

Undershrub, up to 50 cm high; all parts except older stems more or less densely ochraceous tomentose (hirsute or pilose from central rays) or scabrid-pubescent. *Leaves* narrowly to broadly ovate, elliptic to oblong or obovate, 2.5 - 12 x 1 - 6 cm, rounded or shortly cordate or acute at base, irregularly denticulate to entire along margins, acute to obtuse at apex, coriaceous, strongly trinerved at base; lateral primary veins suprabasal, ascending 50-70% way up the lamina; lateral

neves (above the basal) 2-5 pairs, faint above, prominent beneath; tertiary nerves obscure to faint above, prominent beneath, scalariform; basal glands 2, stipitate; marginal glands present; petioles 0.5-4.5 cm long, 1-2 mm in diam; stipules subulate or linear, 5-9 mm long, often lacerate, fringed with stipitate glands. *Inflorescences* 4-14 cm long; bracts subulate or linear, 2-7 mm long, often lacinate, fringed with conspicuous black stipitate glands. *Male flowers* : pedicels 3-6 x 0.5-1 mm; sepals 5-6, ovate to oblong or narrowly so, 2-3.5 x 1-2.5 mm; petals 5 - 6 spathulate to oblanceolate, 2 - 3 x 0.8 - 1.5 mm; stamens 19-28(-34), 3-4 mm long; anthers oblong, 1-1.2 mm long. *Female flowers*: pedicels 1.5-3 mm long, ca 1 mm thick; sepals 5-6, oblong to oblong-lanceolate or ovate to elliptic, 3.5-5.5 x 1-3 mm, often fringed with stipitate glands; petals absent; staminodes rarely present; ovary globose, 3-3.8 mm in diam.; styles 4-5 mm long, free or shortly connate at base into a column (ca 0.5 mm long), twice bifid above. *Capsules* globose, 8-9 mm in diam., shallowly 3-lobed; seeds oblong, ca 5 x 3.5 mm, brown.

Flowering & Fruiting: Feb.-Mar.

Distribution : Myanmar - Indo-China, S. China, Thailand.

Habitat: Apparently a rare plant, once collected at about 900 m altitude.

Specimens examined: MYANMAR. S. Shan States, Loi Kaw plain, n.d., *Phillmore* 2.

11. *Croton erythrostachys* Hook. f., Fl. Brit. India 5: 391. 1887 var. *muriculatus* T. Chakrab. & Balakr. in Proc. Indian Acad. Sci. (Plant Sci.) 92(4): 366, fig. 3. 1983.

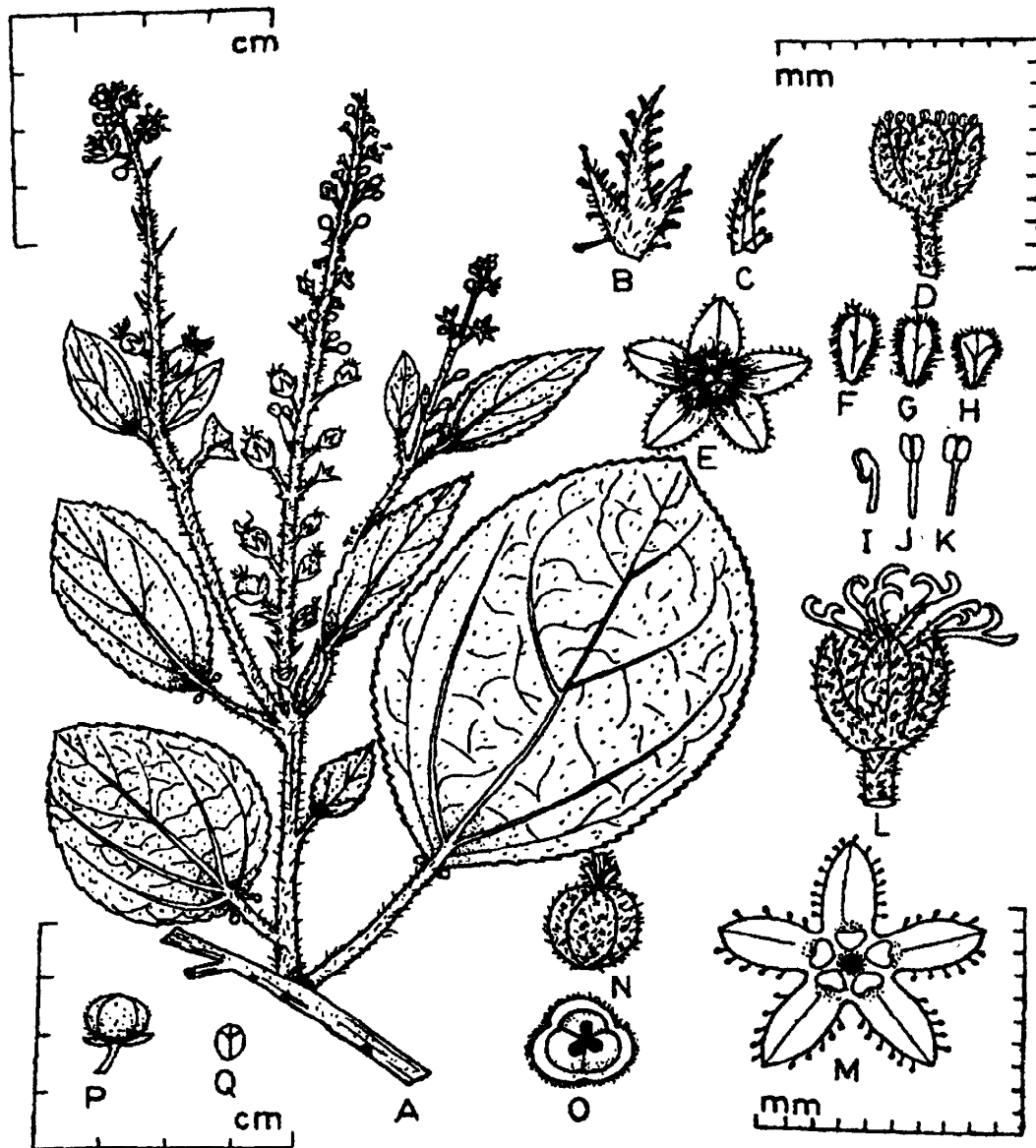


Fig-5. *Croton crassifolius* Geisel. A. Flowering and fruiting branchlets. B. Stipule. C. Bract. D-K. Male: D. Flower. E. Calyx viewed from above. F-H. Petals, I-K. Stamens. L-O. Female: L. Flower. M. Calyx viewed from above. N. Ovary. O. T.S. of ovary. P. Fruit: Q. Seed (A-O: Kurz 2458; P-Q. Hance 1132).

Holotype : Myanmar Tavoy dist., Huingyr Taung Amphitheatre, 26.2.1921, *Gage* 14A (CAL); Isotypes in CAL; Tavoy dist., Head waters of Sedi bhaung, 16.5.1920, *Russell* 1811 (CAL); Heinze No.1 camp, 18.4.1921, *Russell* 2037 (CAL) [Map 5].

Small shrub; all parts fulvous or brownish hispid or scabrid-pubescent. *Leaves* oblong to oblong-lanceolate or elliptic to elliptic-oblong or oblong-obovate to oblanceolate, 8-19 x 2.5-6.5 cm, rounded or often acute at base, irregularly dentate, denticulate-serrulate to subentire along margins, acuminate to subacuminate (acumen up to 10 mm long) at apex, chartaceous or membranous, brown when dry, penninerved; lateral nerves 5-13 pairs, faint to prominent above, conspicuous beneath; tertiary nerves obscure to faint above, more or less prominent beneath, scalariform and sometimes reticulate in some portions; basal glands 2, stipitate, marginal glands present; petioles 2-11 mm long, 1-2 mm in diam.; stipules subulate or linear, 2-5 mm long. *Inflorescences* 4-13 cm long; bracts subulate or linear-lanceolate, 1-2.5 mm long. *Male flowers*: pedicels 2.5-4 mm long; sepals 5, obovate to elliptic, 1.5-3 x 0.7-2 mm; petals 5, spathulate or oblong-oblanceolate, 1.8-3 x 0.5-1 mm; stamens 10-12, 2.5-3.5 mm long; anthers oblong or ellipsoid, ca 1 mm long. *Female flowers*: pedicels 1.5-4 mm long; sepals 5, oblong, 2-3 x 0.5-1.5 mm; petals 5, filiform, 0.5-1.3 mm long; ovary subglobose, 2.5-3.5 mm in diam.; styles 3-5 mm long, free or shortly connate at base into a column (ca 1 mm long), bifid above. *Capsules* subglobose, 8-9 mm in diam., 3-lobed, muriculate, scattered scabrid - pubescent; seeds ellipsoid, ca 6 x 5 mm, brown.

Flowering & Fruiting : Feb.-May.

Distribution : Myanmar - Endemic.

Habitat: Growing between 500-1000 m altitudes.

Specimens examined : Known by type collections only.

Distinguished from var. *erythrostachys* of Malaya, Borneo and Sumatra by its relatively more persistent stellate hairs on the upper surface of leaves and the muriculate fruits.

12. ***Croton gibsonianus*** Nimmo in Graham, Cat. P1. Bombay : 251. 1839; Dalz. & Gibs., Bombay Fl: 231. 1861; Muell.-Arg. in DC., Prodr. 15(2): 692. 1866; Hook. f., Fl. Brit. India 5: 392. 1887; Nairne, Fl. Pl. W. India: 295. 1894; Brandis, Ind. Trees: 578. 1906; Talbot, For. Fl. Bombay Pres. & Sind 2: 472. 1911; Cooke, Fl. Pres. Bombay 2: 600. 1906; Rama Rao, Fl. Pl. Travancore: 366. 1914; Vajravelu & Ramachandran in J. Econ. Tax. Bot. 7: 614. 1986. *Holotype* : India, Concan ('At Hurreechunderghur'), *Gibson s.n.* (K, photo !) [Fig 6. Map 5].

Shrub, 1-5 m high; young shoots white or yellow tomentose; branchlets slender, terete, smooth, glabrous. *Leaves* narrowly oblong to elliptic or often obovate to oblanceolate, (5.5-) 7-25 x (1-) 2-7(-10) cm, rounded, cuneate, acute or narrowly cordate at base, shallowly crenate-serrate to subentire along margins, acute or acuminate or caudate (acumen 5-25 mm long) at apex, membranous to chartaceous, glabrous, sometimes glossy, brown or green or ochraceous above when dry, penninerved; lateral nerves 4-14 pairs, prominent, tertiary nerves faint to prominent above, conspicuous beneath, scalariform; basal glands 2, stipitate; petioles 0.2-4.5 cm long, 0.8-2 mm in diam.;

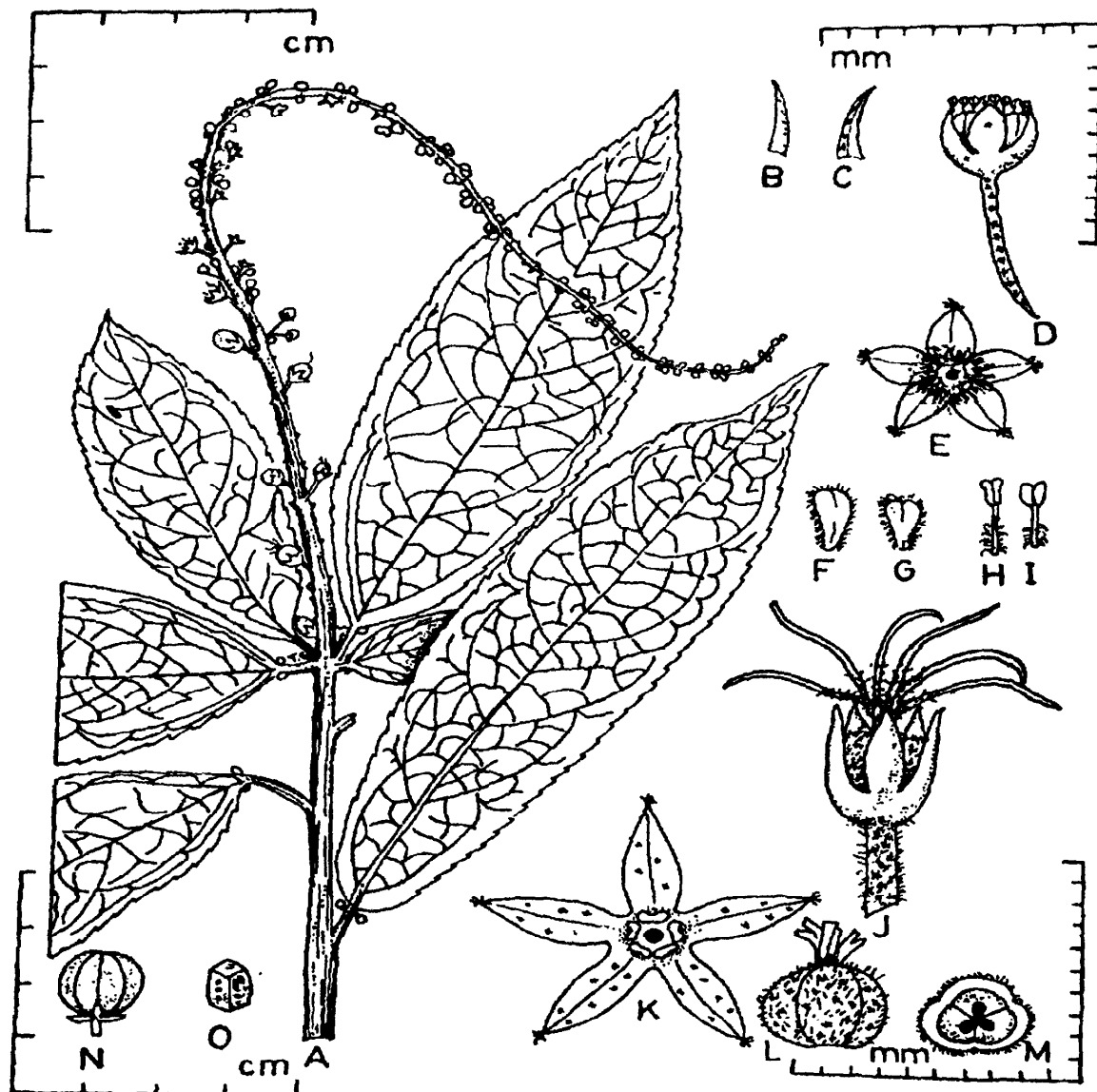


Fig-6. *Croton gibsonianus* Nimmo. A. Flowering branchlet. B. Stipule. C. Bract. D-I. Male: D. Flower. E. Calyx viewed from above. F-G. Petals. H-I. Stamens. J-M. Female: J. Flower. K. Calyx viewed from above. L. Ovary. M. T.S. of ovary. N. Fruit. O. Seed (A, D-I: Raghavan 68131; B-C, J-M: BSI acc. No. 5427; N-O: Talbot 1095).

glabrous, channelled above; stipules subulate, 2-2.5 mm long. *Inflorescences* 12-30 cm long; rachis glabrous or almost so; bracts subulate, 1-2.5 mm long. *Male flowers*: pedicels 3-8 mm long, sparsely pubescent; sepals 5, ovate, elliptic to oblong, 1.5-3 x 1-1.5 mm, sparsely pubescent to glabrous outside; petals 5, spathulate or oblanceolate, 1.5-2.5 x 0.8-1.5 mm; stamens 10-11, 2.5-3.5 mm long; anthers oblong, ca 1 mm long. *Female flowers*: pedicels 2-5 mm long, pilose-tomentose to sparsely pubescent; sepals 5, ovate-lanceolate or narrowly oblong-elliptic, 2.5-5 x 1-2 mm, sparsely pubescent outside towards base; petals 0-5, filiform, 0.5-1 mm long; ovary globose, 2-3.5 mm in diam., white or yellow tomentose, hirsute from central rays; styles 4.5 - 8 mm long, free or shortly connate below into a column, bifid above. *Capsules* globose, 10-14 mm in diam., 3-lobed, sparsely puberulous to glabrous; seeds squarish, 8-9 x 6.5-7.5 mm, marbled.

Flowering & Fruiting: Jan. - Dec.

Uses: Reported to be used in native medicine for rheumatism.

Distribution: W. Peninsular India (Karnataka) Endemic.

Habitat: Locally common in evergreen forests or rain forests as undergrowth or outskirts of forests up to 500 m altitude.

Specimens examined: INDIA. Karnataka: Chikmagalur dist., Koppa, 13.12.1978, *Ramesh & Prakash* 5329 (JCB); Gangamula, 10.3.1979, *Ramesh & Prakash* 6605 (CAL, JCB). N. Kanara dist.: *sine loc.*, n.d., *Arora* 3002; Gairsoppa falls, 15.11.1883, *Talbot* 254 (DD K: photo!); *ibid.*, 27.11.1883, *Talbot* 827; *ibid.*, 17.11.1884, *Talbot* 1095 (CAL, DD); *ibid.*, Oct.

1908, *Meebold* 9255; Kumta-Sirsi road, Kasunge, 28.9.1978, *Murty & Sreenath* 3035 (CAL, JCB); Sampakhand, Oct. 1919, *Sedgwick & Bell*, 6989; *ibid.*, Oct. 1919, *Hall & Mc Cann* 35140 & 35149 (BLAT); Nilkund ghat, 2.3. 1898, *Talbot s.n.* (DD). Shimoga dist., Agumbe, 5.2.1961, *Raghavan* 69351; *ibid.*, 12.12.1978, *Ramesh & Prakash* 5232 (JCB); Galingudda, 13.5.1962, *Raghavan* 80521; Barkana falls, 4.11.1960, *Raghavan* 68131 A (BSI); *ibid.*, 27.12.1978, *Murthy et al.* 5119 (JCB); Hosur near Nedur, 5.10.1962, *Raghavan* 82994; Yedur, 4.10.1962, *Raghavan* 82950.

The leaves were once noted to be aromatic. Sometimes it may not be easy to separate the materials of *C. gibsonianus* from those of *C. klotzschianus*, except by their larger fruits. However, the leaves of the former are usually much larger with stipitate basal glands and the inflorescences are generally much longer. The hairs tend to be more persistent.

13. *Croton glandulosus* L., Syst. Nat. ed. 10, 2:1275. 1795 var. *hirtus* (L'Herit.) Muell.-Arg. in DC., Prodr. 15(2): 684. 1866.

C. hirtus L'Herit., Stirp. Nov. 1:17, t. 9. 1785; Amaratunga in Ceylon J.Sci. (Biol.-Sci.) 12:189. 1977; Ramachandran *et al.* in Ind. J. For. 15(2):183. 1992. *Type*: Not seen.

Erect, annual herb, up to 50 cm high; stem woody, terete, up to 6 mm thick, scattered whitish to yellowish hirsute; branches striate, yellowish white, densely hirsute. *Leaves* triangular ovate, rhombate-ovate to suborbicular, 2-9 x 1-4.5 cm, rounded, obtuse to subtruncate at base, irregularly denticulate-serrulate along margins, acute at apex, thinly chartaceous, scattered strigose (hirtellous

from central rays), densely pubescent when young, remaining green on drying, strongly trinerved at base; lateral primary veins basal, ascending 50-70% way up the lamina; lateral nerves 3-5 pairs, slender, faint; tertiary nerves obscure; basal glands 2, slenderly long-stipitate; petioles 0.4-2.8 cm long, hirtellous; stipules filiform, 3-5 mm long. *Inflorescences* up to 4 cm long; rachis densely whitish to yellowish hirsute (from erect central rays) and with branched capitate glands towards base; bracts linear to filiform, 2-4 mm long, fringed with slender capitate (or stipitate) glands. *Male flowers*: pedicels 1-1.5 mm long, hirtellous; sepals 5, ovate-elliptic, 1.5-1.8 x ca 1 mm, hirtellous outside; petals 5, spathulate, ca 1.8 x ca 1 mm; stamens 11, ca 2 mm long; anthers oblong, ca 0.5 mm long. *Female flowers*: pedicels ca 0.5 mm long; sepals 5, distinctly unequal, narrowly oblong to oblanceolate or spathulate, the larger ones 3-4 x 0.8-1.5 mm, the smaller ones 1-2 x 0.2-0.5 mm, shallowly denticulate along margins, hirtellous outside; petals 5, filiform, ca 0.3 mm long, sometimes obsolete; ovary globose, ca 1 mm diam., densely hirsute; styles 3, slender, ca 2 mm long, bifid almost to base. *Capsules* globose, 4.5-5 mm in diam., 3-lobed, brown, thin-walled, scattered hirsute; pedicels ca 1 mm long; seeds broadly ellipsoid, ca 3 x 2.5 mm, blackish.

Flowering & Fruiting: Apr. - May.

Distribution: Sri Lanka, S. India - Native to W. Indies and C. & S. America; becoming an aggressive weed in tropical Asia and Africa.

Habitat: Locally abundant in dry deciduous forests, often near streams between 400-550m altitudes.

Specimens examined: INDIA. Tamil Nadu: Tirunelveli dist., Mundanthurai wild life sanctuary, Agasthiar Nagar, Kani Kudiyiruppu, 2.5.1990, Ravikumar 92638 (CAL, MH).

It seems convenient to treat *C. hirtus* as a variety of the variable *C. glandulosus*. Now that the plant has been introduced into S. India (obviously from Sri Lanka), there is little doubt but that like *C. bonplandianus*, it will also spread all over India in near future.

14. *Croton hookeri* Croizat in J. Arn. Arb. 21: 498. 1940; Airy Shaw in Kew Bull. 26: 246. 1972.

C. laevifolius sec. Hook. f., Fl. Brit. India 5: 391. 1887 (non Bl., 1826); Brandis, Ind. Trees: 578. 1906; Kanjilal et al. Fl. Assam 4: 195. 1940. *Syntypes*: Bangladesh, Sylhet, 1835, Wallich 7719 (CAL, K-photo!). India, Meghalaya, Khasi hills, Mwamluh, 1850, Hooker & Thomson s.n. (K: photo!).

C. khasianus Hook. f., l.c. 392. 1887, in obs., nom. event.

C. oblongus sec. Balakr., Fl. Jowai 2: 428. 1983 (non Burm.f., 1768). [Fig. 7, Map - 5]

Shrub or tree, 3-5(-16) m high; bark grey; young shoots tomentose; branchlets glabrous. *Leaves* elliptic to oblong (often narrowly so) or obovate to oblanceolate, 3-13 (-16) x 1.5-4.5(-6) cm, cuneate or acute or rounded at base, crenulate-serrulate or sometimes subentire along margins, acute to acuminate (acumen up to 10 mm long, acute) at apex, membranous to chartaceous, glabrous or sometimes sparsely puberulous beneath, green or brown above when dry, penninerved; lateral nerves slender, 4-12 pairs, faint to prominent

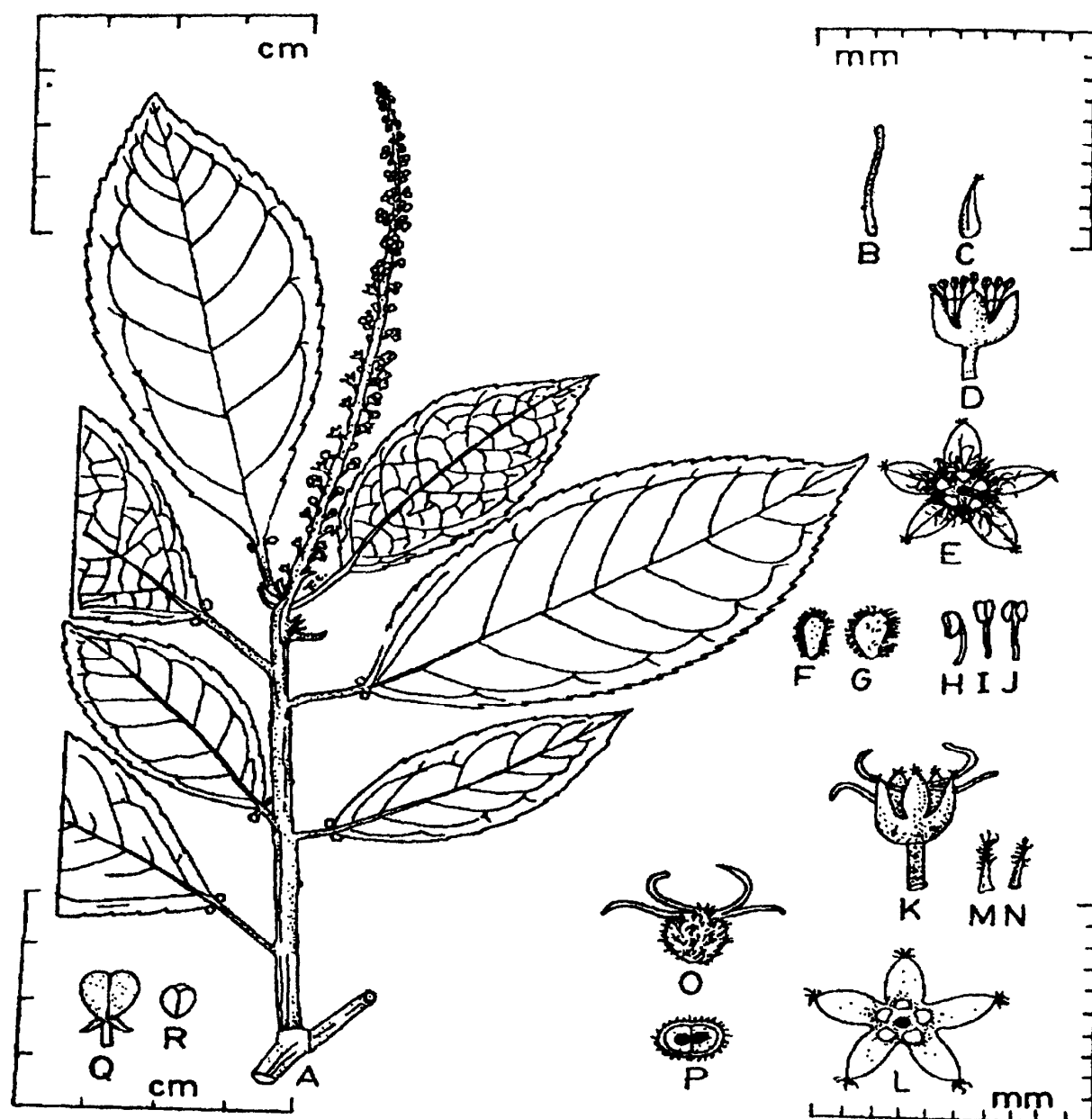


Fig-7. *Croton hookeri* Croiz. A. Flowering branchlet. B. Stipule. C. Bract. D-J. Male : D. Flower. E. Calyx viewed from above. F-G. Petals. H-J. Stamens. K-P. Female : K. Flower. L. Calyx viewed from above. M-N. Petals. O. Ovary. P. T.S. of Ovary. Q. Fruit. R. Seed (A-P: Gallatly 234; Q-R. Clarke 45194).

above, distinct beneath, tertiary nerves inconspicuous above, faint to prominent beneath, scalariform; basal glands 2, slenderly long-stipitate; petioles 2-25 (-30) mm long, 0.5-1.5 mm in diam, glabrous or almost so; stipules filiform, 2-8 mm long. *Inflorescences* 4-12 cm long; rachis subglabrous; bracts lanceolate, 0.5-2.5 mm long. *Male flowers* : pedicels 1.5-3 x ca 0.3 mm, glabrous; sepals 5, oblong, elliptic to ovate, 1.5-3 x 0.5-2 mm, subglabrous outside; petals 5, oblanceolate, 1.5-2.5 x 0.5-1 mm; stamens 10-11, 2.5-3 mm long; anthers oblong, 0.5-0.8 mm long. *Female flowers* : pedicels 1.5-4 x 0.5-1 mm, sparsely pubescent to glabrous; sepals 5, oblong to elliptic, 1.5-3 x 0.5-2 mm, sparsely puberulous towards base to glabrous outside; petals 0-5, filiform or subulate, 0.5-1.3 mm long; ovary obovoid, 1.3-2 x 1-1.5 mm, 2(-3)-locular, ochraceous tomentose (hirsute from central rays), styles 2.5-4.5 mm long, slender, free, bifid almost to base. *Capsules* more or less obovoid or subglobose, 6-10 mm diam., 2(-3)-lobed, intruded at apex, almost glabrous; seeds obovoid, 4.5-5 x 3.5-4 mm, brown.

Flowering & Fruiting : Apr. Nov.

Local names : Khasi : *Dieng-kharang*, *Dieng-soh-rin*.

Distribution : NE. India, Bangladesh, SW China, (Yunnan), Thailand.

Habitat : NE. India : Common in primary forests between 100-1700 m altitudes.

Specimens examined : BANGLADESH. Sylhet dist., 1849, *Wallich s.n.* INDIA. Meghalaya : Khasi hills dist., Cherrapunji, 10.5.1960, *Sitholey s.n.*, acc. no. 43510 (LWG) ; Khasi hills, n.d., *Kurz s.n.*, acc. nos. 411188/90/91; *ibid.*, n.d., *Kurz* 140; *ibid.*, n.d., *Griffith* KD

4784; Mwamluh village, 3.5.1956, *R.S. Rao* 2683; Mawsmmai, 9.5.1886, *Clarke* 43727; Pynursla, 7.5.1958, *B.K. Nayar* 49969 (LWG); Serrareiu, 11.10.1914, *Kanjilal* 4537 (DD); Suvareen, 6.10.1886, *Clarke* 45194. Jowai dist., Chennap valley, June 1878, *Gallatly* 234 (BSIS, CAL); Jowai, 10.6.1911, *Burkill & Banerjee* 246.

The bilocular fruits of the species are distinctive. The female flowers occur up to about halfway along the rachis and are solitary as well as at the same nodes with the male flowers. The species is allied to *C. griffithii* Hook. f. of Malaya but the leaves are short-petioled, usually drying green or brown, with conspicuous long-stipitate glands (*Airy Shaw l.c.*)

15. *Croton joufra* Roxb. [Hort. Beng.: 104. 1914, nomen '*jouffiah*'] Fl. Ind. 3: 685. 1832; Voigt., Hort. Sub. Calcutt.: 156. 1845; Muell.-Arg. in DC., Prodr. 15(2): 519. 1866; Kurz, For. Fl. Brit. Burma 2: 373. 1877; Hook. f., Fl. Brit. India 5: 387. 1887; Prain, Bengal Pl. 2: 943. 1903; Brandis, Ind. Trees: 577. 1906; Gagnep. in Lecomte, Fl. Gen. Indoch. 5: 280. 1925; *Kanjila et al.* Fl. Assam 4: 139. 1940; *Airy Shaw* in Kew Bull. 26: 247. 1972; Deb, Fl. Tripura 1: 328. 1981, p.p.; *Balakr.*, Fl., Jowai 2: 429. 1983; Long in Fl. Bhutan 1(3): 792. 1987. *Type* : Sylhet, *Roxburgh s.n* (K? - n.v.) *Roxburgh*, Fl. Ind Icon. No. 2812 (CAL).

C. persimilis Muell. Arg. in Linnaea 34: 116. 1865 & in DC., Prodr. 15(2): 618. 1866 var. *genuinus* Muell. Arg., l.c. 619. 1866, p.p. *Syntypes* : India, Meghalaya, Dhupdura & Birjura, *F. Hamilton in Wallich* Cat. No. 7718 43170. D (K-W, microfiche!). Bangladesh, Sylhet, *Wallich* 7735 (K-W, microfiche! G-DC:

microfiche!); East Bengal, *Griffith* KD 4776 A (DD). Birma & Malay Peninsula', *Griffith* KD 4776 A (CAL).

C. oblongifolius sec. Buch.-Ham. in Wall. Cat. No. 7718 D. 1847 (non Delile, 1814; nec Siebr. ex Spreng., 1826; nec Roxb., 1832).

C. roxburghii sec. Mukherjee & Malick in Rec. Bot. Surv. India 20(2): 191. 1973 (non Balakr., 1961). [Fig. 8, Map - 6].

Deciduous shrub or tree, 3-15 m high; bark greyish or greyish-brown or pale yellowish; all parts except older branchlets and leaves densely silvery or yellowish or fulvous lepidote. Leaves crowded towards tips of branches, elliptic to oblong or obovate to oblanceolate, (2.5-)5-30(-35) x (1.5-)2-9 cm, cuneate or acute or sometimes rounded at base, shallowly dentate-serrate to subentire along margins, acuminate (acumen 5-35 mm long, obtuse or acute) to acute or sometimes obtuse to rounded at apex, thinly coriaceous to chartaceous, glabrous, light to dark brown or greenish above when dry, penninerved; lateral nerves 6-19 pairs, prominent; tertiary nerves faint above, somewhat prominent beneath, scalariform or reticulate; basal glands 2, sessile; petioles 0.5-5 cm long, 1-2.5 mm in diam, densely lepidote to glabrous; stipules linear, 4-5 mm long. *Inflorescences* up to 35 cm long, occasionally unisexual; bracts triangular or deltoid, 0.7-2 mm long. *Male flowers* : pedicels 2.5-6 x 0.5-0.8 mm, sepals 5, ovate to oblong, 1.5-3.5 x 1-2.5 mm, petals 5, oblong-elliptic to oblanceolate, 2-3 x 0.8-1.5 mm; stamens 10-13, 3-4.5 mm long; anthers oblong or ovoid, 1-1.5 mm long. *Female flowers* : pedicels 1.5-6 x 0.8-2 mm; sepals 5, triangular-acuminate to ovate, 1.5-3 x 1-2.5 mm; petals 5, filiform or narrowly oblong-elliptic, 0.5-3 mm

long; staminodes rarely present; ovary ovoid or oblong-ellipsoid to obovoid, 2.5-4 x 2.5-3.5 mm, with irregular longitudinal ridges, usually obtuse at apex; styles 4-7 mm long, shortly connate at base into a column (0.5-1.5 mm long), bifid at apex. *Capsules* ovoid-ellipsoid or oblong or obovoid, 2.5-4 x 2-3 cm, very shallowly 3-lobed; seeds broadly oblong or ellipsoid, 1.7-2.5 x 1-1.8 cm, brown.

Flowering & Fruiting : Jan. Dec.

Uses : Plant contains alkaloids and tannins. In N.E. India, the leaves, seeds and roots are used in tribal medicine (unspecified) and the bark employed in veterinary medicine. Bark and leaves are also used for fermenting liquor.

Local names : Assamese : *Mahudi*; Bengali : *Joufra*; Khasi : *Dieng-lamosuh*; Manipuri : *Thaunang*; Mikir : *Martu-arong*; Naga : *Inthap-ching*.

Distribution : Bhutan, N.E. India, Bangladesh, Myanmar, Yunnan, Indo-China.

Habitat : *Bhutan* : Frequent in subtropical forests up to about 1300 m altitude. *NE India* : Common in mixed forests, deciduous forests, edges of forests or scrub (once noted to be growing on red soil) up to 1300 m altitude. *Bangladesh* : In hill forests. *Myanmar* : Frequent in low mixed forests on clayey or sandy loam up to about 1000 m altitude.

Specimens examined : BANGLADESH : Chittagong dist. : Hill tracts, Demagiri, 18.3.1876, *Lister* 229; Sitapahar reserve, 25.11.1934, *Parkinson* 4288 (DD). BHUTAN, Birti, 23.4.1964, *Sen Gupta* 1305. Tama, 14.4.1964, *Sen Gupta* 1148. INDIA. Arunachal Pradesh : Kocharigaon reserve, Chudwar, 23.3.1957, *Panigrahi* 5898. Assam : Cachar dist., Rukin I.R. Res., 9.12.1914, *Kanjilal* 4843 (DD). Goalpara dist. 4.3.1886,

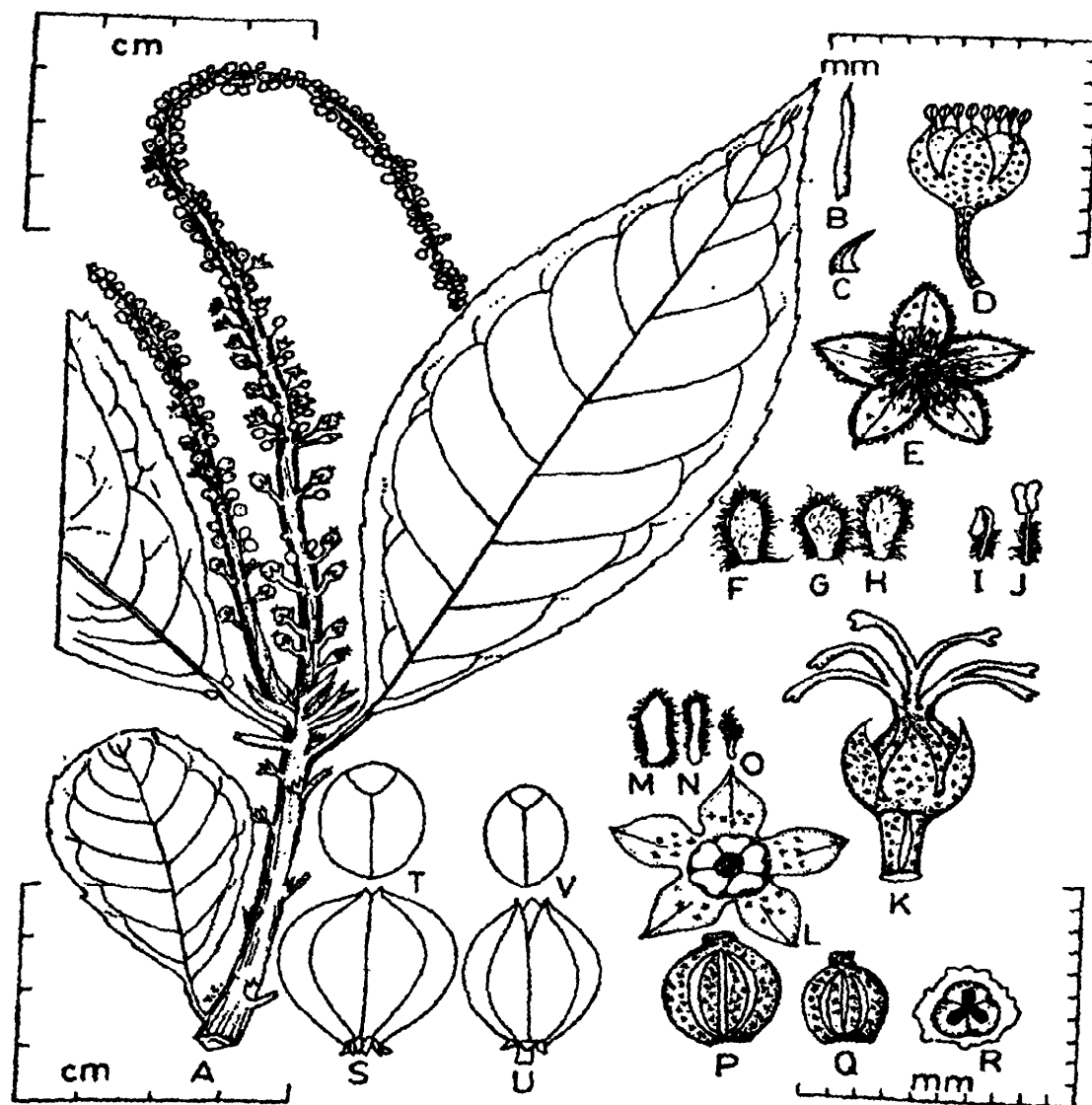
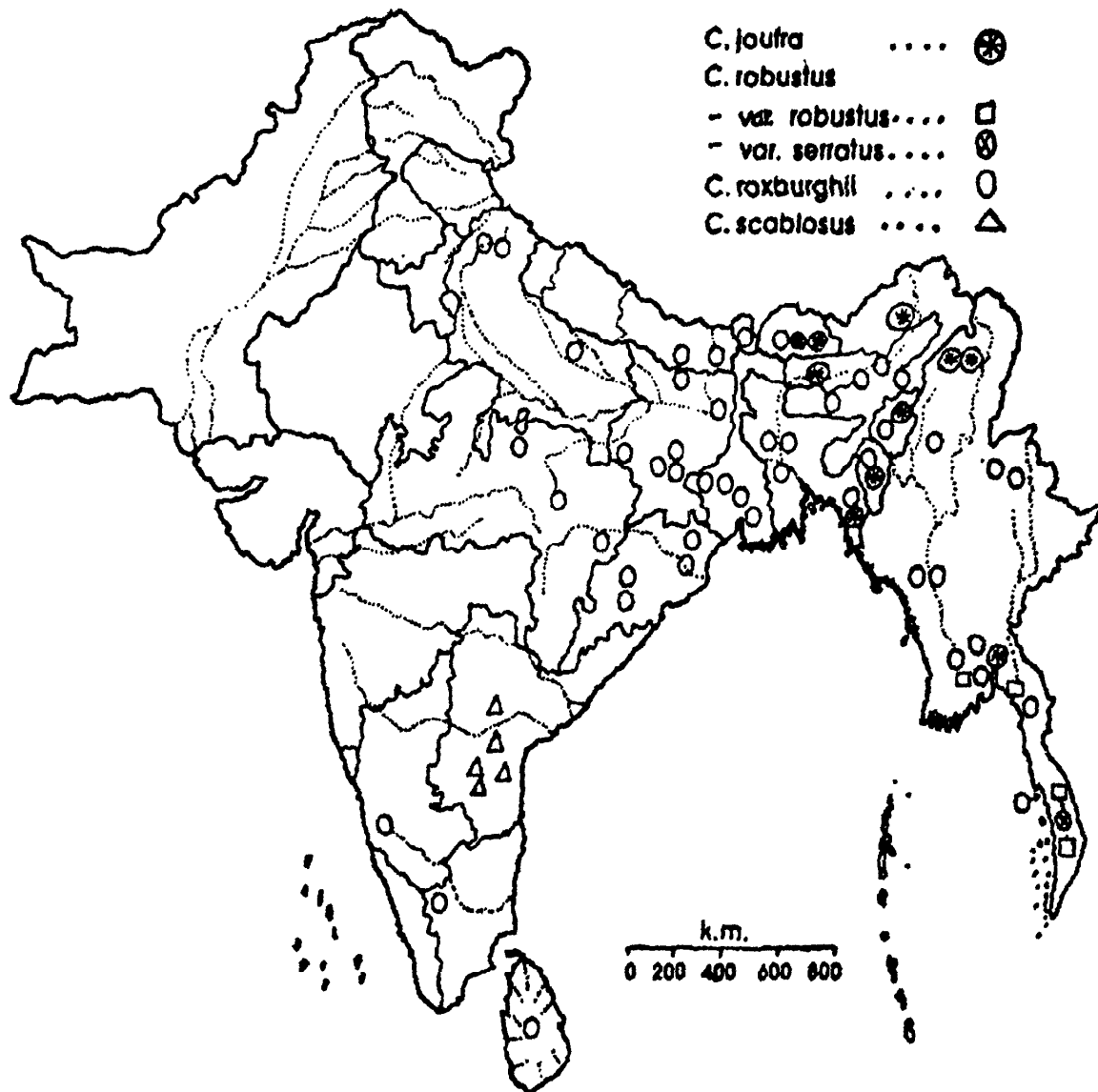


Fig-8. *Croton joufra* Roxb. A. Flowering branchlet. B. Stipule. C. Bract. D-J. Male : D. Flower. E. Calyx viewed from above. F-H. Petals. I-J. Stamens. K-R. Female : K. Flower. L. Calyx viewed from above. M-O Petals. P-Q. Ovary. R. T.S. of ovary; S&U. Fruits. T & V. Seeds (A, C-F, H-L, O-P: *Deka* 4676; B, G, M-N, Q-R: *Simon s.n.*; S-T. *Chatterjee s.n.*; U-V: *Griffith* 4776).



Map-6. Distribution of *Croton joufra*, *C. robustus*, *C. roxburghii* and *C. scabiosus*.

Clarke 43170. Jorhat dist., Near Golaghat forest, 27.3.1962, *Srivastava* 81263 (LWG). Manipur : Irong, Feb. 1906, *Meebold* 5402. More, 11.4.1962, *Srivastava* 83144 (LWG). Meghalaya : Khasi hills dist., Nongpoh, 10.4.1960, *Deka* 18167; Nowgong, Sonai kusi res., 20.4.1915, *Kanjilal* 5507 (DD). Jowai dist., Dawki from Pynursla I.B., 26.11.1956, *Panigrahi* 4676. Garo hills dist., Dhima res., 30.3.1915, *Kanjilal* 5406. Mizoram : Lungleh dist., Hauruang, 27.1.1963, *Deb* 31358 (ASSAM, CAL). Nagaland: Mokokchung dist., Naga hills, n.d., *Ward* 11291. Tripura : Monpui to Vaughmun, 22.1.1962, *Deb* 27019 & 27028 (ASSAM, CAL). Myanmar. Gokteik, Jan. 1908, *Meebold* 8095. Kachin hills, May 1898, *Mokim s.n.*, acc. no. 410678; *ibid.*, Namli, 24.3.1897, *Pottinger s.n.*, acc. no. 410766. Myitkyine dist., Kaukwe valley, Apr. 1911, *Buchanan & Lace* 39 (DD). Pounplin, Jan. 1862, *Brandis* 515. S. Shan States, Taungyi, 17.4.1910, *Mac Gregor* 1139.

Closely related to *C. roxburghii*, differing in the shallowly serrate-dentate to subentire leaves, the strongly lacerate-stellate trichomes with the radiating rays free at least up to 50% of their total length (i.e. webbing or fusion of rays half of the scale length), the obtuse (rather than intruded) apex of ovary and the much larger, scarcely lobed ovoid-ellipsoid or oblong or obovoid capsules. In vegetative condition *C. joufra* is often mistaken for *C. wallichii*, particularly the forms having relatively thinner leaves; even the indument of the two species apparently looks alike but a careful study under microscope would reveal that the indument of *C. wallichii* consists of stellate hairs instead of lacerate-stellate scales.

One collector notes that the leaves are slightly aromatic.

16. *Croton klotzschianus* (Wight) Thw., Enum. Pl. Zeyl. 4: 276. 1861; Bedd., For. Man.: CCIV. 1873; Hook. f., Fl. Brit. India 5: 392. 1887; Trimen, Handb. Fl. Ceylon 4: 49. 1898; Brandis, Ind. trees: 578. 1906; Bourd., For. Trees Travancore: 502. 1908; Rama Rao, Fl. Pl. Travancore: 366. 1914; Gamble, Fl. Pres. Madras: 1315. 1925.

Tigilium klotzschianum Wight, Icon. Pl. Ind. Or.: t. 1914. 1852 ('*klotcheanum*'). Lectotype : Penins. Ind. Or., Wight 2607, acc. no. 411136 (CAL)- here designated; Isolectotypes in CAL & MH.

Croton argutus Heyne in Wall. [Cat.No. 7768 A. 1847, nomen].

C. umbellatus Heyne in Wall. [Cat.No. 7768 B. 1847, nomen].

C. thwaitesianus Muell.-Arg. in Linnaea 34: 116. 1865 & in DC., Prodr. 15(2):621. 1866. Syntypes : Sri Lanka, Central Prov., *Thwaites* CP 2113 (BM, CAL, G-DC, K; photo!).

C. caudatus Geisel. var. *klotzschianus* (Wight) Muell.-Arg., l.c. 599. 1866.

C. officinalis sec. Alston in Trimen, Handb. Fl. Ceylon VI (Suppl.): 264. 1931, p.p. excl. typo incl. syn. non (Klotzsch) Alston, 1931. [Map 5].

Shrub (often bushy) or tree, 2-7 m high; bark whitish or greyish; young shoots fulvous or whitish tomentose (pilose or hirsute from erect central rays); branchlets slender, terete, smooth, glabrous. Leaves oblong to elliptic or often ovate oblong to obovate - oblong, 2-10(-15) x 1-4(-6) cm, acute, obtuse to rounded at base, shallowly serrate to subentire along margins, acute to shortly and acutely acuminate (acumen 5-15 mm long) or

occasionally rounded at apex, membranous to chartaceous, glabrous, often glossy, green or yellow-brown or dark brown above when dry, penninerved, occasionally weakly trinerved at base, lateral nerves slender, 5-10 pairs, faint to prominent above and beneath, tertiary nerves obscure to faint above and beneath, reticulate; basal glands 2(-4), subsessile, petioles 0.3-3 cm long, 0.5-1.5 mm in diam., glabrous, channelled above; stipules linear-lanceolate or subulate, 3-7 mm long. *Inflorescences* (3-)5-10 (-18) cm long; rachis glabrous or almost so; bracts lanceolate or subulate or oblanceolate, 0.8-3.5 mm long. *Male flowers* : pedicels 2.5-5 mm long, almost glabrous; sepals 5, oblong, elliptic to ovate, 1.5-3 x 0.5-2 mm, more or less glabrous outside; petals 5, obovate to oblanceolate or spatulate, 1.8-3 x 0.5-2 mm; stamens (8-) 11-14, 2-3 mm long, anthers oblong or ellipsoid, 0.5-1 mm long. *Female flowers* : pedicels 1.5-4 x 0.5-1.3 mm, glabrous; sepals 5(-7), narrowly oblong to lanceolate, 1.5-4 x 0.5-2 mm, glabrous or often sparsely puberulous outside; petals 0-5, filiform or subulate, up to 1.5 mm long; ovary more or less globose, 1.5-2.5 mm in diam., fulvous or whitish tomentose, pilose or hirsute from central rays, styles 3.5-6 mm long, free, bifid. Capsules more or less globose, 6-10 mm diam., 3-lobed, glabrous to sparsely puberulous; seeds suborbicular, 3.5-6 x 3-5 mm, marbled.

Flowering & Fruiting : Jan. - Dec.

Local name : Malayalam : *Nanchu*.

Distribution : S. India and Sri Lanka.

Ecology : S. India: Common in evergreen forests between 200-1000 m altitudes. Sri Lanka : Common in the dry regions.

Specimens examined : INDIA. Andhra Pradesh: Chittoor dist., Towards Papanasam theertham, 30.12.1975, *Subba Rao* 46885 (CAL, MH); Tirumalai hills, 10.5.1956, *Wagh* 5663 (BLAT). Cuddapah dist., Balapalle, 20.1.1958, *Wagh* 7593 (BLAT); Sahoendra Kona, Feb. 1883, *Gamble* 10787 (DD). Tamil Nadu : Kanyakumari dist., Ponagudi, 4.2.1972, *Sharma* 39944 (MH). Madurai dist., Palni hills, Sept. 1950, *Coll. uncertain s.n.*, acc.no.3985 (RHT). Tirunelveli dist.: Courtallam, June 1901, *Barber* 3256 (CAL, MH); *ibid.*, 21.4.1957, *Subramanyam* 2825 (CAL, MH); *ibid.*, 15.9.1970, *Matthew* 12579 (RHT); Kannikatti, 7.2.1958, *Kamath* 90 (PCM); Mundanthurai, Jan. 1917, *Fisher* 135 (PCM). SRI LANKA. Central Prov., n.d. *Thwaites* CP 2113 (BM, CAL, K, photo !, G-DC).

Although *C. klotzschianus* can be distinguished with certainty from *C. gibsonianus* only by its smaller fruits, the species is not reduced here to a variety of the latter on the ground that the upper surface of leaves of *C. klotzschianus* bears stomata in the vicinity of the major veins whereas in *C. gibsonianus* the stomata are totally absent on the upper surface of leaves.

17. *Croton kongensis* Gagnep. in Bull. Soc. Bot. France 58: 555. 1921 & in Lecomte, Fl. Gen. Indoch. 5: 287. 1925; Croizat in J. Arn. Arb. 21: 500. 1940; Airy Shaw in Kew Bull. 26: 247. 1972; T. Chakrab. & Balakr. in Proc. Indian Acad. Sci. (Plant Sci.) 92: 370. 1983. *Syntypes* : China : Laos, *Thorel s.n. (n.v.)*; Annam, *P. Couderc s.n. (n.v.)*; Cochinchina, Mt. Din., *Pierre s.n. (n.v.)* [Map 1].

Habit unknown (shrub or tree to 4 m high in Thailand); all parts (except old stem and upper

surface of leaves) densely silvery or coppery lepidote. *Leaves* ovate-lanceolate to elliptic-lanceolate, 6-17 x 1.5-4.5 cm, acute to obtuse at base, entire along margins, acuminate to subacuminate (acumen 5-15 mm long) at apex, membranous, sparsely lepidote above, dark brown above when dry, penninerved, weakly trinerved at base (i.e. the first pair of secondary veins slightly stronger than subsequent pairs); lateral nerves 3-10 pairs, faint above, somewhat prominent beneath, tertiary nerves obscure; basal glands 2, sessile; petioles 1-3.5 cm long, 1-2 mm in diam; stipules subulate, 3-3.5 mm long. *Inflorescences* 3-10 cm long, female flowers at the same nodes with males occurring up to about halfway along the rachis; bracts triangular, 1-2.5 mm long. *Male flowers*: pedicels ca 1 mm long; sepals 5, ovate, elliptic to oblong, 1.5-2 x 1-1.5 mm; petals 5, narrowly oblong to lanceolate, 1.5-1.8 x 0.3-0.5 mm; stamens 11, ca 2 mm long; anthers oblong or ellipsoid. *Female flowers*: pedicels 0.5-2 mm long; sepals 5, elliptic-oblong to ovate, ca 1.2 x 1 mm; petals absent ovary subglobose, 1.3-1.8 mm in diam., deeply 3-lobed, not or slightly intruded at apex; styles up to 2.5 mm long, free, bifid nearly to base. *Capsules* not seen (reported to be globose and 5-7 mm in diameter).

Distribution: Myanmar, - S.W. China (Yunnan), Indo-China, Thailand.

Specimens examined : MYANMAR, S. Shan States, Loi Kaw, 1909, Mac Gregor 167 (CAL); *sine loc. exact.*, 1909, Mac Gregor 660 (CAL).

Airy Shaw determined the above cited specimens to be *C. kongensis* and we agree with it. This species can be readily distinguished from *C. argyratus*, *C. malabaricus* and *C. zeylanicus* by its persistent

scattered lepidote scales on the upper surface of leaves that are subentire with almost complete webbing in between the rays whereas the scales of the other three species are lacerate-stellate, i.e. webbing in between the rays being incomplete. From the limited material available, it seems that *C. kongensis* can be further distinguished from these three species by the smaller female flowers with shorter styles and the smaller fruits. The female flowers are associated with male flowers at the same nodes along the lower portion of the rachis, a feature not commonly observed in *C. argyratus*, *C. malabaricus* and *C. zeylanicus*. According to Airy Shaw (*l.c.*), the leaves of *C. kongensis* are strongly trinerved at the base in the specimens from Thailand. The Myanmar plant probably represents a slightly divergent variant with rather penninerved leaves, the basal pair of lateral nerves being only slightly stronger and longer than the subsequent super adjacent pairs. Obviously, this basal pair of veins can not be designated to be lateral primary veins (see Hickey, 1973). Such weakly trinerved leaves often also occur in *C. argyratus* as well as in *C. malabaricus*.

18. ***Croton lawianus*** Nimmo in Graham, Cat. Pl. Bombay: 251. 1839; Dalz. & Gibs., Bombay Fl.: 232. 1861; Muell. - Arg. in DC., Prodr. 15(2): 698. 1866, *in obs*; Hook. f., Fl. Brit. India 5: 394. 1887; Nairne, Fl. Pl. W. India : 295. 1894; Talbot, Syst. List Trees Bombay ed. 1: 184. 1894 & ed. 2: 311. 1902 & For. Fl. Bombay Press. Sind 2: 472. 1911, *in obs.*; Cooke, Fl. Pres. Bombay, 2: 600. 1906, *in obs.*; Brandis, Ind. Trees: 578. 1906, *in obs.*; Rama Rao, Fl. Pl. Travancore: 366. 1914; Gamble, Fl. Pres. Madras: 1315. 1925. *Lectotype* : Peninsular India, W.

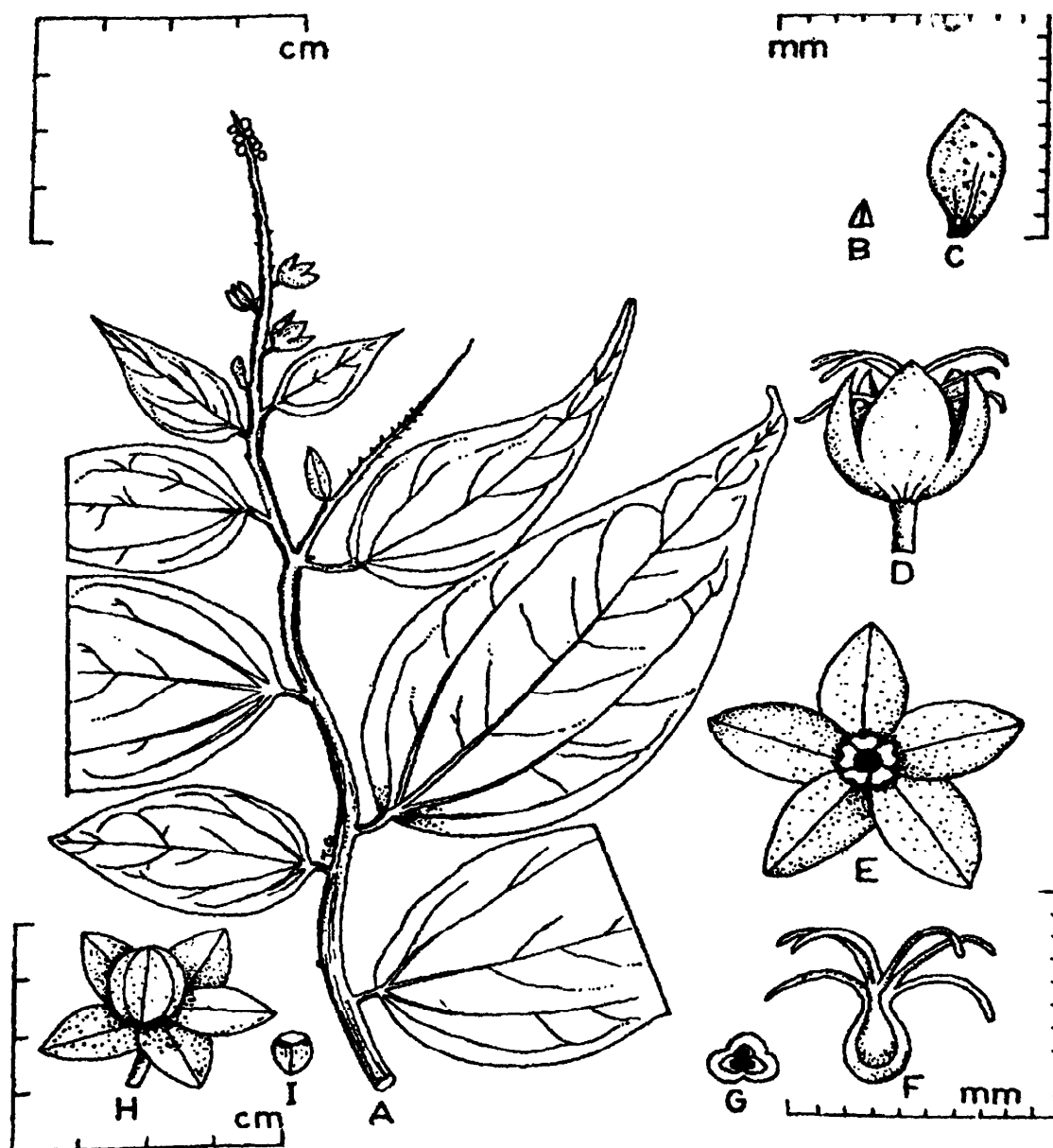


Fig-9. *Croton lawianus* Nimmo A. Flowering branchlet. B-C. Bracts. D-G- Female : D. Flower. E. Calyx viewed from above. F. Ovary. G. T.S. of ovary. H. Fruit. I. Seed (A,H-I: Dalzell s.n.; all others from Gibson s.n.).

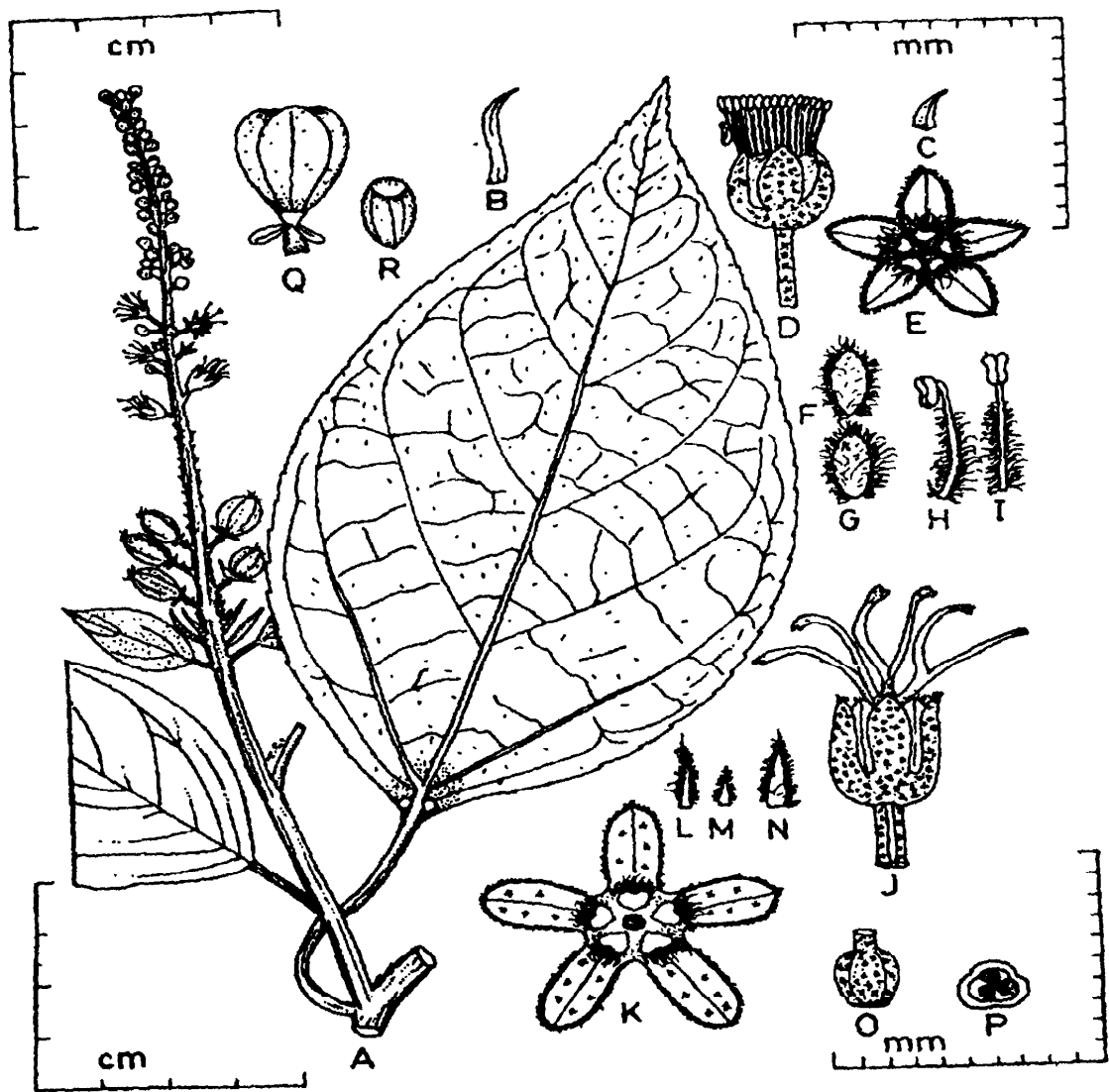


Fig-10. *Croton malabaricus* Bedd. A. Flowering & fruiting branchlet. B. Stipule. C. Bract. D-I. Male: D. Flower. E. Calyx viewed from above. F-G. Petals. H-I. Stamens. J-P. Female: J. Flower. K. Calyx viewed from above. L-N. Petals. O. Ovary. P. T.S. of ovary. Q. Fruit. R. Seed (A, J-L, N-P.: Vasavada 36185; B-I, M: Barber 5865, Q-R. Ramamurthy 48484).

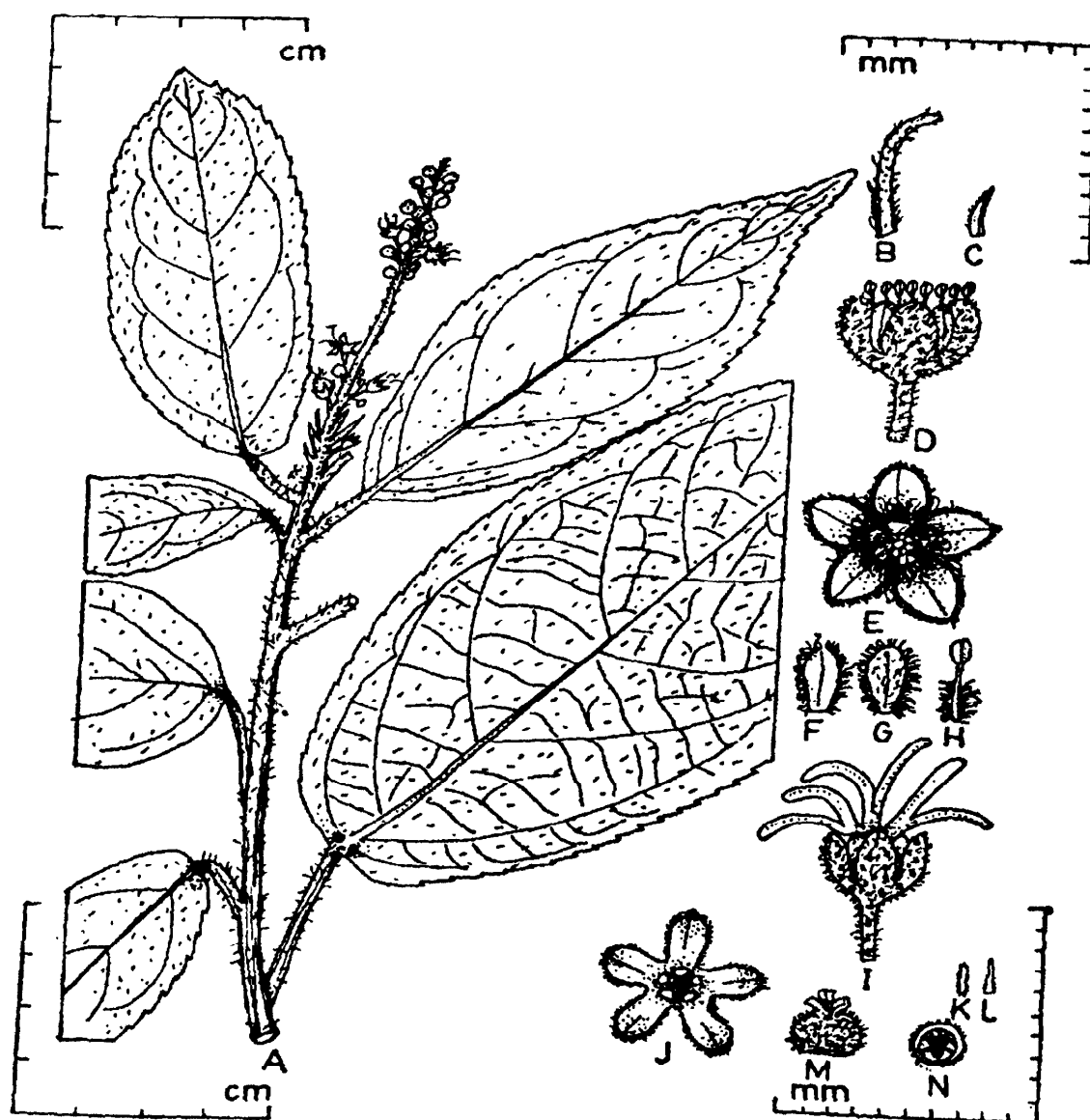


Fig-11. *Croton moonii* Thw. A. Flowering branchlet. B. Stipule. C. Bract. D-H. Male: D. Flower. E. Calyx viewed from above. F-G. Petals. H. Stamen. I-N. Female: I. Flower. J. Calyx viewed from above. K-L. Petals. M. Ovary. N. T.S. of ovary (all from type).

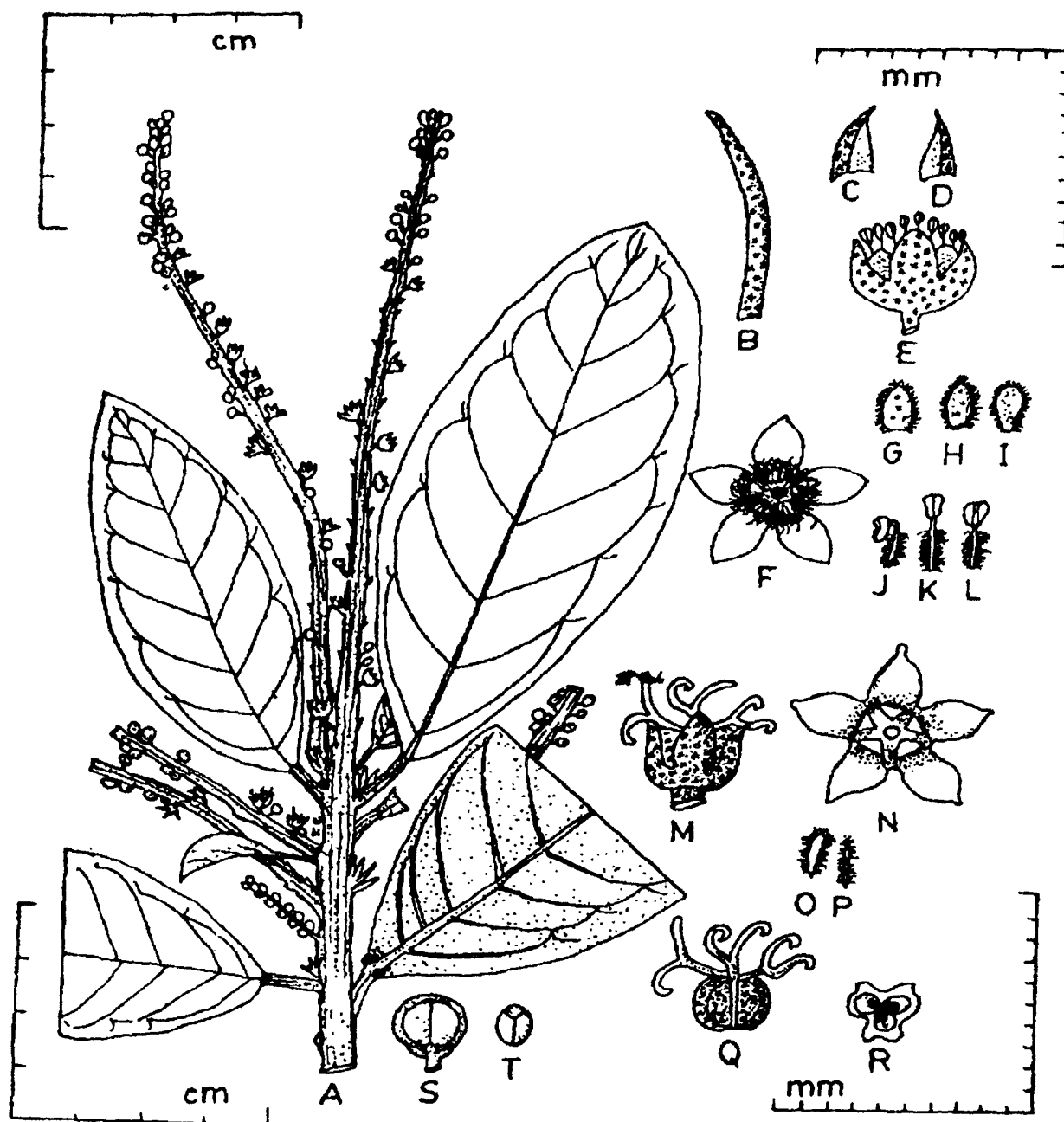


Fig-12. *Croton robustus* Kurz. A. Branchlet with male inflorescence. B. Stipule. C-D. Bracts. E-L. Male: E. Flower. F. Calyx viewed from above. G-I. Petals. J-L. Stamens. M-R. Female: M. Flower. N. Calyx viewed from above. O-P. Petals. Q. Ovary. R. T.S. of ovary. S. Fruit. T. Seed (A, D-L: Dickason 8037; B: Meebold 15508; C, M-R: Meebold 17180; S-L: Meebold 15319).

unisexual; bracts subulate, lanceolate or triangular, 0.5-5 mm long. *Male flowers*: pedicels 2-5 x 0.3-0.8 mm; sepals 5, ovate, elliptic to triangular, 2-3.5 x 1-2.5 mm; petals 5, spathulate or narrowly oblong to elliptic, 2-3.5 x 0.5-1.5 mm; stamens 10-15, 3.5-4.5 mm long, anthers oblong or ovoid, 1-1.3 mm long. *Female flowers*: pedicels 2-5 x 0.5-1.5 mm; sepals 5, ovate, triangular to elliptic, 2-3.5 x 1-2.5 mm; petals 5, spathulate to filiform, 0.3-3.5 mm long; ovary subglobose, 2-4 mm in diam., styles 4-6 mm long, free, bifid. *Capsules* subglobose, 8-12 mm in diam., usually slightly intruded at apex, 3-lobed; seeds oblong to ellipsoid, 7-7.5 x 3.5-4.5 mm, brown.

Flowering & Fruiting: Jan. Dec.

Uses: *C. roxburghii* is used for many purposes throughout its range. The bark contains a number of closely related diterpenes, particularly oblongifoliol and deoxyoblongifoliol as well as a triterpene acid, called acetyl aleuritelic acid (Aiyar & Seshadri, 1971a, 1971b, 1972). The bark is employed in reducing chronic enlargement of liver and fever. It is pounded and taken orally or applied externally to the hepatic region in chronic hepatitis. Pounded bark is also applied externally to sprains, bruises and rheumatic swellings. Pounded bark and root are taken orally as a cholagogue. The seed, root and bark are drastic purgative and poisonous in large doses. *Hastidanti*, a purgative root-drug has been identified variously to be *C. roxburghii* and *Citrullus colycynthis*. Oil from the seeds, which forms the substitute for croton oil (from *C. tiglium*) is often used as insecticide in NE. India. The plant is often cultivated for hedges or ornamental purposes. The wood is used for fencing.

Local names: Assamese: *Burmaparokupi*, *Mahunda*; Bengali: *Baragach*, *Chucka*, *Putri*; Garo: *Bol-mang-chham*; Goanese: *Gonsur*; Hindi: *Arjunna*, *Chucka*; Khasi: *Dieng-lamasu*; Malayalam: *Kote*, *Putol*; Marathi: *Ganasura*, *Gunsur*; Mikir: *Marthu-arong*; Myanmarese: *Pan-gran-pan*, *They-yin-gui*, *Theyin*; Naga: *Thing-ban-lin*; Nepali: *Akh*; Oriya: *Mahasindhu*, *Masundi*; Sanskrit: *Nagadanti*, Santali: *Gote*; Tamil: *Millakumari*, *Milgu-nari*; Telugu: *Bhutan-kusam*, *Bhutala-bhairi*.

Distribution: Sri Lanka, India, Nepal, Bhutan, Bangladesh, Myanmar-S.W. China (Yunnan), Indo-China, Thailand.

Habitat: Sri Lanka: Rare in dry regions. India: Common in sub-Himalayan tracts and warmer parts in rain or deciduous forests or scrubs (rare in S. India) up to 1300 m altitude. Myanmar: Common in mixed or semievergreen forests or riverine forests or rain forests on sandy loam or sandstone or on rocky substratum up to 1200 m altitude.

Specimens examined: BANGLADESH. Chittagong dist., Hill tracts, n.d., *King's coll.* 367; Kodala hills, Feb. 1887, *King's coll.* 286; Khulna dist., Sunderban, 9.2.1892, *Heinig s.n.*, acc. no. 410620. BHUTAN. Lamchia, 27.5.1949, *Narayanaswamy* 3045. INDIA. Assam: Cachar dist., Cachar, 9.12.1914, *Kanjilal* 4843. Goalpara dist., Near Gosaingaon, 20.2.1915, *Kanjilal* 5149. Bihar: Champaran dist., Bhikhnathoree, 16.3.1958, *Srivastava* 49008, 49032 & 49053 (LWG). Palamau dist., Talghat, 10.8.1956, *Chandra* 35120 (LWG). Karnataka: S. Kanara dist., Bennekudure (Udipi), 13.2.1952, *Kamath* 94251 (MH). Kerala: Malappuram dist., Malabar, June 1859, *Beddome* 82. Madhya

Pradesh : Bilaspur dist., Korba to Kudumwa, 21.2.1972, *Panigrahi* 16809 (BSA, CAL). Raigarh dist., Hamirpur, 6.2.1974, *Rathakrishnan* 19729 (BSA). Meghalaya : Khasi hills, Apr. 1877, *Agharkar s.n.* (CUH). Nagaland : Kala Naga hills, May 1882, *Watt* 7339. Orissa : Mayurbhanj dist., Kalapahad, Baldiha, 17.4.1940, *Coll. uncertain* 433 (DD). Sambalpur dist., Apr. 1915, *Coll. uncertain* 12763 (DD). Sikkim: Sanuebuti terai, Mar. 1876, *Coll. uncertain* 857. Tamil Nadu : Nilgiri dist., Kargudi, 12.4.1972, *Vivekananthan* 40803 (MH). Uttar Pradesh : Dehra Dun dist., Dehra Dun, 30.3.1900, *Lace* 2124. Mirzapur dist., Churk, 10.3.1961, *Srivastava* 99864 (LWG). West Bengal: Bankura dist., Bishnupur, 9.2.1965, *Sanyal* 535. 24-Parganas dist., Rudrapur, 29.6.1904, *Banerjee* 22917. MYANMAR. Amherst dist., Thingan nyi nawng to Myaswaoi, Mar. 1904, *Burkill* 24428. Insein dist., Wagyaung, 17.2.1925, *Parkinson* 44 (CAL, DD). Katha dist., *sine loc.*, 27.2.1926, *Maung Mya* 2326. Minbu dist., Kanbauk Pazu Reserve, 28.1.1939, *Parkinson* 15695 (DD). Pegu dist., Toukyeqhat, Palawa, n.d., *Kurz* 1612 A. Rangoon dist., Kamayut, 27.2.1932, *Parkinson* 14006 (DD). Shan States, Heho, 8.3.1917, *Annadale* 497. Tavoy dist., Dec. 1900, *Mokim* 112 & 225. Tenasserim, Sidaw, Thayet chaung, 20.12.1904, *Manson* 734. Toungoo dist., South of Louyan Reserve, 7.5.1914, *Rogers* 347 (CAL, DD). Yamethin dist., Yonbin Reserve, 18.1.1915, *Rodger* 576 (CAL, DD). NEPAL. Bamban Nala, 16.5.1900, *Mayut* 23588 (DD). Chatra (Koshi catchment), 11.1.1963, *C.R. Rao* 76. Off Bhikhnathoree, 15.3.1958, *Srivastava* 48896, 48932 & 48944 (LWG). Thuligad, 25.3.1929, *Bis Ram* 86 (DD). SRI LANKA. Central Prov., n.d. *Thwaites* CP 2114 (CAL, G-DC: microfiche!).

25. *Croton scabiosus* Bedd., Fl. Sylv. S. India: t. 283 B.1872 & For. Man.:CCIV. 1873; Hook. f., Fl. Brit. India 5:386. 1887; Brandis, Ind. Trees: 577. 1906; Bourd., For. Trees Travancore: 499. 1908; Rama Rao, Fl. Pl. Travancore: 365. 1914; Gamble, Fl. Pres. Madras: 1314. 1925. *Lectotype*: India, Andhra Pradesh, Kurnool dist., Nallamalay hills, *Beddome* 68 (CAL)- here designated; *Isolectotype* in BM [Map 6].

Tree, up to 8 m tall; bark dark brown; all parts more or less densely silvery or orange-brown or golden lepidote. *Leaves* ovate, cordate, oblong, elliptic to orbicular, 4-16 x 2-12 cm, cordate or rounded or subtruncate at base, crenate-serrate or shallowly so along margins, obtuse, rounded to acute at apex, thinly coriaceous, pale brown or greenish when dry, strongly trinerved at base; lateral primary veins basal or suprabasal, ascending 50-70% way up the lamina; lateral nerves 1-6 pairs, faint to prominent above and beneath; tertiary nerves obscure to somewhat prominent above and beneath, scalariform; basal glands 2, sessile; petioles 1-5 cm long, 1-2 mm in diam., sulcate above; stipules subulate or lanceolate, 2-5 mm long. *Inflorescences* 3-10 cm long; bracts ovate, subulate or linear-lanceolate, 0.5-3 mm long. *Male flowers*: pedicels 2.5-3.5 x ca 0.5 mm; sepals 5, ovate to oblong-elliptic, 1.5-3 x 1-2 mm; petals 5, oblong-elliptic to spatulate-oblong, 2-3 x 0.5-1 mm; stamens 8-16, 3-3.5 mm long; anthers oblong, ca 1 mm long. *Female flowers*: pedicels 2-5.5 x ca 1 mm; sepals 5-7, ovate, oblong to elliptic, 2-4 x 0.5-2.5 mm; petals 0-5, filiform or linear, 1-2.5 mm; long; staminodes very rarely present; ovary globose or ovoid, 1-2 mm in diam., 3-4-locular; styles 3-5 mm long, free, bifid. *Capsules* globose, 8-12 mm in diam., prominently 3-4-lobed; seeds oblong, 6-10 x 4-7 mm.

Flowering & Fruiting : Jan. - July.

Uses : The silvery or golden foliage is very attractive; should be cultivated as an ornamental.

Local names : Telugu : *Yerrichilla*, *Chilla*.

Distribution : S. India (Andhra Pradesh) -Endemic.

Habitat : Locally very common in evergreen forests between 300-1200 m altitudes.

Specimens examined : INDIA. Andhra Pradesh. Cuddapah dist., Cuddapah, Feb. 1883, *Gamble s.n.*, herb. reg.no.11149 (DD); Seshachalam hills, 12.3.1921, *Fischer* 4612; Kuli pass, July 1887, *Gamble* 15230 (MH); Sidhout, 20.3.1957, *Wagh* 5909 (BLAT); Sonepaya ghat, Feb. 1883, *Gamble* 11035; *ibid.*, *Gamble* 11143 (DD); Tauifaya ghat, Aug.1899, *Gamble* 21294 (DD). Kurnool dist., Nallamalay hills, 1881, *Beddome s.n.*, Acc. No. 410606; *ibid.*, 28.4.1881, *Beddome* 244 (K, photo!).

The strongly trinerved leaves with dense silvery or golden lepidote indumentum on both surfaces are sufficient to distinguish *C. scabiosus* from all other species in the region. The fruits are sometimes 4-locular.

26. *Croton sublyratus* Kurz in J.Asiat. Soc. Bengal 42: 243. 1873 & For. Fl. Brit. Burma 2: 374. 1877; Hook. f., Fl. Brit. India 5: 390. 1887; Brandis, Ind. Trees: 578. 1906; Parkinson, For. Fl. Andaman Is.: 240. 1923; Airy Shaw in Kew Bull. 26: 250. 1972. **Lectotype :** India, South Andaman Is., South Point, *Kurz s.n.*, Acc. No. 410943 (CAL) here designated; Isolectotypes in CAL & K. [Fig. 13, Map - 4].

Deciduous shrub or tree, up to 10 m high; bark whitish or brownish; young shoots softly coppery or brownish pilose-tomentose (often hispid from central rays); branchlets glabrous. *Leaves* lyrate, obovate, elliptic-obovate to oblanceolate or oblong-elliptic to suborbicular or ovate, 5-24 x (1.5-)3-7(-9) cm, cuneate or subcuneate at base and narrowly cordate at extreme base, shallowly serrate to subentire along margins, caudate-acuminate (acumen 5-20 mm long) or bluntly acuminate or sometimes obtuse to rounded at apex, membranous to firmly chartaceous, glabrous, dark brown or ochraceous or coppery above when dry, coppery-brown beneath, penninerved; lateral nerves 6-13 pairs, faint above, prominent beneath; tertiary nerves obscure to somewhat prominent above and beneath, scalariform; basal glands 2(-3), shortly stipitate or subsessile; petioles 0.5-7 cm long, 1-4 mm in diam, sparsely pilose or often hispid, sulcate above; stipules linear, 3-5 mm long. *Inflorescences* (6-)10-22 cm long; rachis pilose-tomentose; bracts lanceolate or triangular or subulate, 0.8-3 mm long. *Male flowers* : pedicels 3-6 mm long, *ca* 0.4 mm in diam., tomentose; sepals 5, ovate, oblong to elliptic, 2-3.5 x 1-2.5 mm, tomentose outside (pilose from central rays); petals 5, obovate or oblong, 2-3 x 1-2 mm; stamens 11(-20), 3-4 mm long, anthers oblong or ovoid, *ca* 1 mm long. *Female flowers* : pedicels 2.5-6(-9) x 0.5-1 mm, tomentose; sepals 5, oblong, elliptic to obovate, 3-5.5 x 1.5-3 mm, tomentose outside; petals 0; ovary strongly 3(-4)lobed, 2-3 x 2.5-3 mm, intruded at apex, tomentose (hirsute from central rays); styles 3-4 mm long, connate at base into a column (0.5-0.8 mm long), bifid at apex. *Capsules* deeply 3(-4)-lobed (lobes pointed or blunt at the apex),

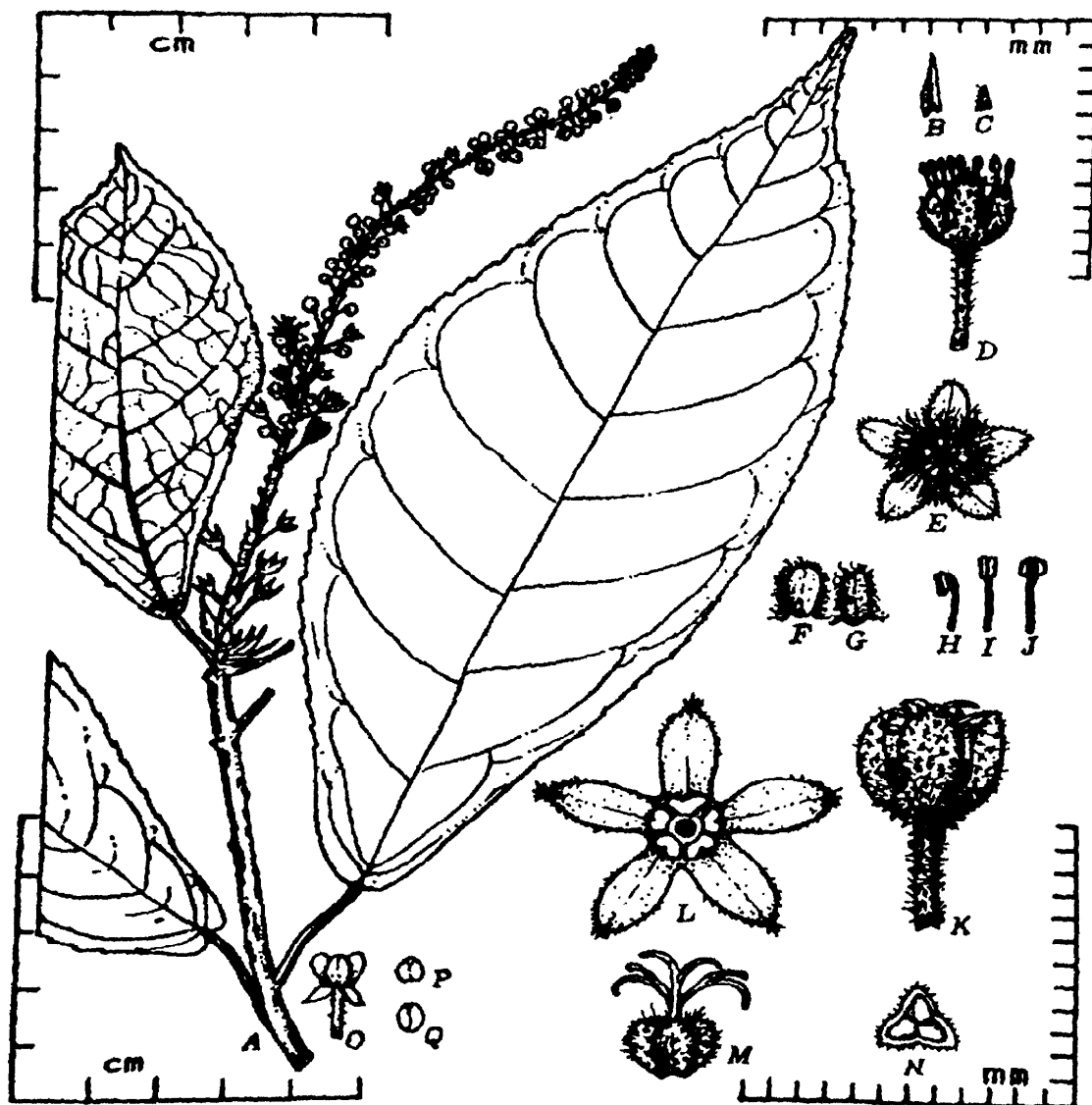


Fig. 13. *Croton sublyratus* Kurz A. Flowering branchlet. B. Stipules. C. Bract. D-J. *Male*: D. Flower. E. Calyx viewed from above. F-G. Petals. H-J. Stamens. K-N. *Female*: K. Flower. L. Calyx viewed from above. M. Ovary. N. T.S. of ovary. O. Fruit. P-Q. Seeds (A: Parkinson 483; B-E, G-N: King's coll. s.n.; F, P: King s.n.; O, Q: King's coll. s.n.).

intruded at apex, 5.5-7.5 x 7-8 mm, thinly pubescent; seeds ellipsoid to suborbicular, 3.5-5 mm in diam., marbled.

Flowering & fruiting : Jan. Dec.

Uses : The bark is pounded and applied externally as a remedy for body pains in Andamans.

Local name : Andamans : *Putri*.

Distribution : India (Andaman Islands), Myanmar, Thailand.

Habitat: Andaman Is.: Common in coastal forests, inland forests or scrub, frequent along streams on clayey soil at low altitudes.

Specimens examined : INDIA. Andaman & Nicobar Islands : Long Island, 21.7.1957, *Seth* 25252 (DD). Middle Andaman Island : Wood Mason Bay, 24.4.1916, *Parkinson* 483 (DD); Tugapur III, 24.4.1964, *Ellis & Ramamurthy* 18928 (PBL). Baratang Island, Bamboonala village, 29.1.1978, *Basu* 6859 (PBL). South Andaman Is. : *sine loc. exact.*, n.d. *Kurz s.n.*, Acc. No. 410941; *ibid.*, 15.11.1901, *Heinig* 297, 298 & 359; Manglutan, 31.3.1916, *Parkinson* 475 (DD); Wimberlygunj, 27.4.1905, *Lace* 2822; Dhanikhari, Forest behind school, 15.12.1984, *T. Chakrabarty* 10362 (PBL); *ibid.*, Behind tea stall, 10.4.1985, *T. Chakrabarty* 10376 (PBL). MYANMAR. Akyab dist., Hill near Kaladan village, 6.5.1914, *Rogers* 127 (CAL); Ran stream near Bokkaung village, 13.5.1914, *Rogers* 158 (CAL, DD); Kyanktaw, 5.1.1907, *Dass* 28232 (BSIS). Tenasserim, n.d., *Biswas* 784 (CAL). Great Coco Island., 2.12.1899, *Prain s.n.*, Acc. Nos. 410937 & 410979 (CAL).

Differs from *C. wallichii* in having more numerous radiating rays of the stellate hairs, shortly stipitate or sessile (but never

sessile) foliar glands, shorter female pedicels and very deeply lobed fruits which are much intruded at apex. In addition, the inflorescences arise precociously from the apices of defoliated branches and the fruits are almost ripe when the young leaves are still unfolding. A specimen (*Ellis & Ramamurthy* 18928) bears a short, purely female inflorescence, arising from near the base of the usual terminal bisexual inflorescence.

27. ***Croton tiglium*** L. [Fl. Zeyl.: 163, No. 343.1747] Sp. Pl.: 1004. 1753; Roxb., Hort. Beng.: 69. 1814 & Fl. Ind. 3:682. 1832; Thw., Enum. Pl. Zeyl. 4: 277. 1861, *in obs.*; Muell.-Arg. in DC., Prodr. 15(2): 600. 1866; Kurz, For. Fl. Brit. Burma 2: 374. 1877; Hook. f., Fl. Brit. India 5: 393. 1887; Trimen, Handb. Fl. Ceylon 4 : 49. 1898, *in obs.*; Prain, Bengal Pl. 2: 943. 1903; Cooke, Fl. Pres. Bombay 2: 600. 1906; Brandis, Ind. Trees: 577. 1906; Talbot, For. Fl. Bombay Sind 2: 472. 1911; Rama Rao., Fl. Pl. Travancore: 366. 1914; Duthie, Fl. Upp. Gang. Plains 3: 104. 1915; Haines, Bot. Bihar & Orissa 2: 104. 1921; Gamble, Fl. Pres. Madras: 1315. 1925, *in obs.*; Kirtikar & Basu, Indian Med. Pl. ed. 2: 2256, t. 872 B. 1935; Kanjilal *et al.*, Fl. Assam 4: 194. 1940; Hurusawa & Tanaka in Fl. E. Himalaya : 177. 1966 ('*tiglinum*'); Airy Shaw in Kew Bull. 26: 250. 1972; Long in Fl. Bhutan 1(3): 793. 1987; T. Chakrab. & Balakr. in J. Econ. Tax. Bot. 12(2): 370. 1988. *Type* : Sri Lanka, *Hermann* 2: 6, No. 343 (BM, photo!).

Codel avenacau Rheede [Hort. Mal. 2: 61, t. 33. 1679].

Ricinoides indica Burm. [Thes. Zeyl.: 200, t. 90. 1737].

Granum moluccum Rumph: [Herb. Amb. 4: 98, t. 42. 1743].

Croton jamalgota Buch.-Ham. in Trans. Linn. Soc. 14: 258. 1825. *Type*: 'Habitat ubique in Bengala', Dhupdona, *Hamilton* (in *Herb. Wallich*) 7722 B, p.p. (K-WALL, microfiche!).

C. pavana Buch.-Ham., l.c. 259. 1825; Wall., Cat No. 7722 B. 1847 '*parona*'; Muell.-Arg., l.c. 623. 1866. *Type*: India, Assam, Goalpara, *Hamilton* in *Wallich* Cat No. 7722 B, p.p. (K-WALL: microfiche!).

Tigllium officinale Kl. in Nov. Acta Neop. Carol. 19 (Suppl. 1): 418. 1843 & in Hayne, Arzenykunde 14(1): t.3. 1843. *Type*: Same as *C. tigllium*.

Croton officinalis (Klotzsch) Alston in Trimen, Handb. Fl. Ceylon 6 (Suppl.): 264. 1931, *excl. syn.*

C. himalaicus Long in Notes R.B.G. Edinburgh 44(1): 170. 1985 & in Fl. Bhutan 1(3): 792. 1987 [Map 3].

Evergreen shrub or tree up to 15 m high; bark grey or ash-coloured; young shoots ochraceous tomentose; branchlets glabrous. *Leaves* ovate, elliptic, oblong or obovate, (3-)7-20(-28) x (1-)2.5-8(-11) cm, rounded, obtuse to acute as base, serrate to distantly serrulate along margins, acuminate (acumen 5-30 mm long) or sometimes acute at apex, membranous, glabrous above, sparsely ochraceous pubescent to glabrous beneath, green or yellow to yellow-brown or sometimes dark brown when dry, strongly trinerved at base; lateral primary veins basal or suprabasal, ascending 50-70% way up the lamina; lateral nerves 1-6 pairs, prominent; tertiary nerves obscure to faint above, faint to prominent beneath, scalariform; basal glands

2, sessile or occasionally subsessile; petioles 1-8(-12) cm long, glabrous or almost so, shallowly channelled above; stipules subulate, 0.8-3 mm, long. *Inflorescences* 5-18 cm long, sometimes unisexual; rachis glabrous or occasionally sparsely pubescent; bracts triangular, subulate, lanceolate or linear, 0.7-4 mm long. *Male flowers*: pedicels 2-5 x ca 0.3 mm, glabrous; sepals 5, elliptic, oblong to ovate, 1.5-4 x 1-2.5 mm, glabrous outside; petals 5, oblong-elliptic to oblanceolate, 2-4 x 0.7-2 mm; stamens 14-20(-25), 3-4 mm long; anthers oblong or ellipsoid, 0.7-1 mm long. *Female flowers*: pedicels 2-8 mm long, 0.5-1 mm thick, ochraceous hirtellous-tomentellous to sparsely pubescent; sepals 5, oblong, triangular, ovate or lanceolate, 2-4.5 x 0.7-3 mm, sparsely pubescent to glabrous outside; petals 0-5, linear to filiform, often bifid, 0.5-1.5 mm long; ovary obovoid or oblong, 2.5-4 x 2-3.5 mm, coarsely ochraceous tomentose, hirsute from central rays; styles 3.5-7 mm long, free, bifid. *Capsules* obovoid to oblong, 1.6-2.5 x 1.3-2 cm, 3(-4)-lobed, more or less glabrous; seeds oblong or ellipsoid, 10-18 x 7-14 mm, brown or greyish.

Flowering & Fruiting: Jan. Dec.

Uses: *C. tigllium* is used throughout its area of distribution for several purposes, particularly as herbal medicine and poison. All available data emphasize the very drastic purgative action and poisonous properties of the seeds and the oil obtained from them is popularly known as croton oil. In N.E. India, the fruits and seeds are employed as fish-poison or insecticide. In E. Himalayas, the bark or leaves are used by tribals in making arrow poison. Dried leaves are pounded and used to poultice snake bites. The twigs are said to be diaphoretic in small doses and

purgative and emetic in large doses. It is also used for clearing teeth and for relieving and curing tooth-ache (N.E. India, Myanmar). The roots are used as abortifacient and diuretic.

The chemical studies carried out on the seeds and oil revealed two active principles: one purgative but with non-irritant properties, the other (resin) irritant or vesicant. In addition to the toxic croton-resin, the oil contains oleic, linolic, arachidic, myristic, stearic, palmitic, acetic and formic acids with traces of lauric, tiglic, valeric and butyric acids. The kernel also contains two toxic proteins, croton-globulin and croton-albumin as well as sucrose and a glycoside called crotonoside. The glycoside has no harmful action in small doses. Several tumor promoters, particularly the phorbol esters have also been isolated from the croton oil. The leaves contain hydrogen cyanide and a triterpinoid. An alcoholic extract of seeds of *C. tiglium* showed antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. Crotonoside has been shown to reduce blood pressure, decrease tone of isolated strips and to stimulate isolated uterine tissue. The croton oil has now been removed from various pharmacopeias since it is unsafe for use (Drury, 1873; Anonymous, 1950; Chopra *et al*, 1956; Farnsworth *et al*, 1969; Perry & Metzger, 1980).

Local names : Arabic : *Batu, Dand, Datun, Habul salatina* ; Assamese : *Jaipal, Kanibhi*; Bengali : *Jaifal*; English : *Croton oil plant*; Gujrati : *Nepal*; Hindi : *Jamalgota, Jayfala*; Kannada : *Danti, Japalabeeja, Nepala*; Khasi : *Dieng kymbat lasam*; Malayalam : *Dantibijam, Katala-vanaccu, Valam*; Marathi : *Jamalgota, Jepal*; Burmese : *Kanako*; Nepali : *Guj, Lepchabis*; Oriya : *Jaipala, Konika*; Persian : *Bedanjir e khatia, Dund, Habbe*

khatai; Sanskrit : *Danti, Jaifala, Kanakaphala, Nepala*; Sinhalese : *Jayapala*; Tamil : *Kattukkattai, Naganam, Nigumbam, Sambari, Sayabalam, Sevalangoltai, Siduram, Tendi*; Telegu : *Nepala vitua, Nepala vema, Neppalam*.

Distribution : Sri Lanka, India, Bangladesh, Myanmar - China, Taiwan, Thailand, Japan, throughout Malesia.

Habitat : Common in evergreen or mixed forests or in scrubbs, ascending to 2000 m in E. Himalaya, 1000 m in both N.E. and S. India and to 1300 m in Myanmar. Widely cultivated for hedges or medicinal purposes.

Specimens examined : BANGLADESH. Chittagong dist., Kodala hills, July 1887, *King's coll.* 515. Sylhet, 16.1.1886, *Clarke* 42713. INDIA. Assam : Cachar dist., Lakhimpur on the Barak river, 16.8.1903, *Gage s.n.*, Acc. No. 411107. Lakhimpur dist., N. Lakhimpur, 7.11.1915, *Carter* 389 (BSIS). Sibsagar dist., Jamnaguri, 2.9.1912, *Kanjilal* 1776 (DD). Arunachal Pradesh : Tirap dist., Zinghu to Rusa, 6.9.1958, *Panigrahi* 16796 (ASSAM, CAL). Kerala : Cannanore dist., Konnoth R.F., 18.6.1979, *Ramachandran* 62665. Kottayam dist., Mundakayam, 24.9.1964, *Vivekananthan* 21351 (MH). Quilon dist., Placherry R.F., 25.2.1979, *Mohanan* 61208. Meghalaya : Khasi hills, 16.9.1918, *Kanjilal* 7410 (ASSM). Garo hills, Dec. 1880, *Fischer s.n.*, Acc.No. 411112. Nagaland : Naga hills, 1935, *Bor* 4473 (DD). Sikkim : Ari, 23.8.1910, *Smith* 4517. Tamil Nadu : Coimbatore dist., Samiyaramalai Ayyankolli forest, 23.6.1974, *Vajravelu* 44921 (MH). Uttar Pradesh : Dehra Dun, June 1931, *Raizada s.n.*, reg. no. 56903 (DD). West Bengal : Darjeeling dist., Tista river side, Aug. 1904, *Haines* 828 (CAL-Paratype of *C.himalaicus*). MYANMAR. Ambon,

Ajoke, n.d., *de Fretes* 5758 (CAL). Kyoondo, 15.9.1868, *Henderson s.n.*, acc.nos. 411127-8. Maymyo dist., 60 miles from Mandalay, June 1888, *Khan* 26; Near Nyaungui plateau, 7.6.1925, *Ba Pe* 994 (DD). Tavoy, 1827, *Wallich* 7722 E. S. Shan States, Keng Tung, Aug. 1909, *Mac Gregor* 662. Tenasserim, Bomchaung, April 1911, *Meebold* 15249 (CAL).

28. ***Croton wallichii*** Muell.-Arg. in *Linnaea* 34: 118. 1865 & in DC., *Prodr.* 15(2): 623. 1866; Kurz, *For. Fl. Brit. Burma* 2: 373. 1877; Hook. f., *Fl. Brit. India* 5: 390. 1887; Brandis, *Ind. Trees*: 578. 1906; Airy Shaw in *Kew Bull.* 26: 251. 1972. *Lectotype* : Burma. Attran, 1827, *Wallich s.n.* (G-DC)-here designated; Moulmein, 1827, *Wallich* 7729 (G-DC); Amherst, *Wallich* 7730 (CAL, G-DC, K-WALL, microfiche!).

C. stellatopilosus H. Ohba in *J. Jap. Bot.* 55(4): 97. 1980, syn. nov. *Holotype* : S.E. Thailand, Prachin Buri, *Ogiso & Promdej* 229 (TI, Photo!); Prachup Kirikhan, *Ogiso & Promdej* 8 (TI-n.v.) [Fig. 14, Map 4].

Deciduous tree up to 12 m tall; young shoots fulvous, brown or greyish tomentose (pilose from central rays); branchlets glabrous. *Leaves* obovate to oblanceolate or subpanduriform or elliptic to oblong, 5-24 x 2-7 cm, more or less cuneate at base and shortly cordate or rounded or acute at extreme base, shallowly serrate-dentate along margin, acuminate (acumen 5-20 mm long) or often acute at apex, chartaceous to thinly coriaceous or sometimes submembranous, glabrous, greenish, yellow or light brown to dark brown above when dry, paler beneath, penninerved; lateral nerves 5-15 pairs, faint to prominent above, distinct beneath; tertiary nerves obscure above, faint to prominent beneath, scalariform or sometimes forming reticulations; basal glands

2(-3), sessile, marginal glands often present; petioles 0.5-4.5 cm long, 1-2 mm in diam., glabrous or sometimes densely pubescent, sulcate above; stipules linear or subulate, 2-4 mm long. *Inflorescences* up to 30 cm long; rachis more or less tomentellous (often hirtellous from central rays); bracts triangular, ovate or subulate, 1-2 mm long. *Male flowers*: pedicels 3-9 mm long, ca 0.5 mm thick, softly tomentose; sepals 5, ovate, triangular or oblong, 1.5-3.5 x 0.8-3 mm, tomentellous outside; petals 5, oblong, elliptic to spatulate, 2-3 x 1-1.5 mm; stamens 8-12, 3-4 mm long; anthers oblong, ca 1 mm long. *Female flowers*: pedicels (5-)8-16 mm long, 0.5-1.5 mm thick, tomentose; sepals 5(-10), triangular, 2-4 x 1-3 mm, tomentose outside (pilose from central rays); petals 0-5, filiform, ca 0.5 mm long; ovary subglobose, 2-3 mm diam., fulvous or greyish tomentose (hirsute or pilose from central rays), distinctly or obscurely keeled towards apex; styles 3.5-5 mm long, free, bifid. *Capsules* subglobose, 6-10 mm diam., prominently lobed, thinly pubescent; seeds ellipsoid, 4.5-6 x 3-4 mm, brown.

Flowering & Fruiting : Feb. Sept.

Local names : Burmese (Karen) : *Kwa kwa*, *Thetyin byu*.

Distribution: Myanmar, Thailand.

Habitat : Rare in tropical forests and dry hill slopes from sea level up to about 1500 m altitude.

Specimens Examined : MYANMAR. Amherst dist., Amherst, 1857, *Falconer* 28; Winsaw block, 14.2.1910, *Tha Myaieug* 61 (DD). Bassein dist., Mittaya Res., 29.3.1906, *Lace* 2995 (CAL, DD). Kyanktwin, Apr. 1911, *Meebold* 15192. Martaban, Along Attran river, n.d., *Wallich*

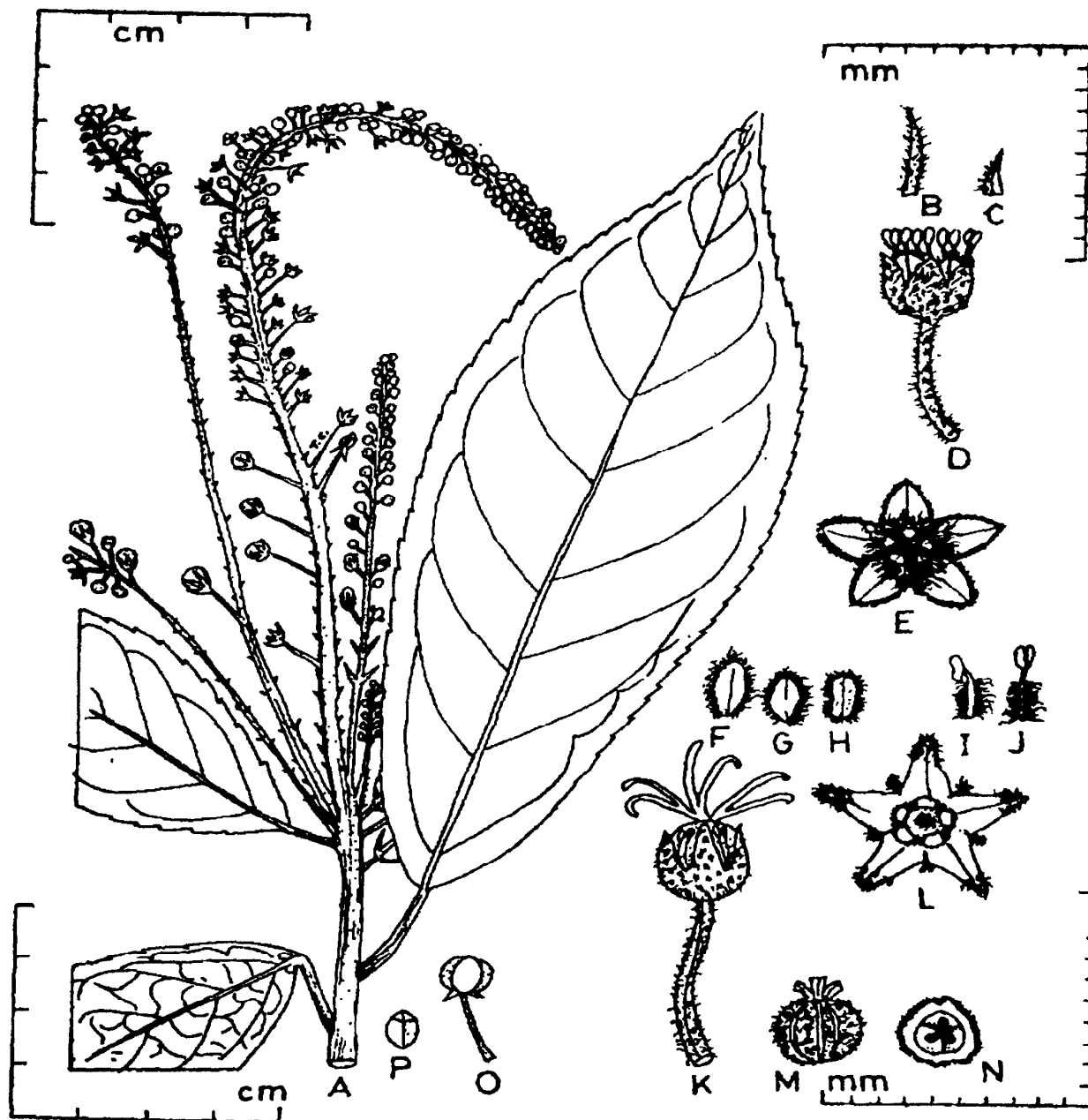


Fig. 14. *Croton wallichii* Muell.-Arg. A. Flowering branchlet. B. Stipule. C. Bract. D-J. Male: D. Flower. E. Calyx viewed from above. F-H. Petals. I-J. Stamens. K-N. Female. K. Flower. L. Calyx viewed from above. M. Ovary. N. T.S. of ovary. O. Fruit. P. Seed (A: Biswas 1117; B, D-G, I-J: Calder s.n.; C, H, K-P: Gallatly 552).

7739, *p.p.* Pegu, n.d., *Kurz* 2482. Tavoy dist., Zin Ba Chq., Kalein aung Reserve, 11.4.1928, *Ba Pe* 8204 (DD). Mergui, Cinchona camp, 24.3.1929, *Calder s.n.*, acc. no. 411171; Thamihla, 3.2.1927, *Parker* 2541 (DD). Tenasserim, *sine loc.*, *Biswas* 1117 (CAL); Dunaon, Mar. 1911, *Meebold* 14658; Taefu, 15.4.1877, *Gallatly* 552; West of Papun 22.4.1908, *Manson* 33. Thaung yin Div., Na Bu Chg, Let let, 10.1.1932, *Dickason* 7314.

29. *Croton yunnanensis* W.W. Smith in Notes R.B.G. Edinburgh 13: 159. 1921. *Syntypes* : W. China, Yunnan, *G. Forrest* 12612, 10352 & 10522 (E-n.v.)

C. flocculosus Kurz in J. Asist. Soc. Bengal 42: 242. 1873 & For. Fl. Brit. Burma 2: 375. 1877 *non* Geisel., 1807; Hook. f., Fl. Brit. India 5: 394. 1887; Brandis, Ind. Trees: 578. 1906, **syn. nov.** *Type*: Burma, Ilp Slay (!), 9.10.1868, *Henderson s.n.* (CAL, K, photo !).

C. kurzii Croiz. in J. Arn. Arb. 23: 45. 1942. [Fig. 15, Map. 5].

Tree, 5 - 8 m tall; young shoots densely and softly yellow, fulvous or whitish pilose-tomentose; branchlets glabrous. *Leaves* ovate or often cordate-ovate, elliptic to orbicular, 5 - 16 x 2.5 - 9 cm, cordate, rounded, obtuse or truncate at base, dentate-serrate or shallowly so along margins, obtuse to acute or apiculate to acuminate (acumen 5 - 25 mm long) at apex, membranous to chartaceous, glabrous above, densely and softly stellate-floccose beneath, becoming glabrous in fruits, pale greenish or dark brown above when dry, strongly trinerved at base; lateral primary veins basal or suprabasal, ascending 50 - 65% way up the lamina; lateral nerves slender, 2 - 5 pairs, faint above, conspicuous beneath; tertiary nerves obscure above, more or less

prominent beneath, scalariform; basal glands 2 - 4, stipitate or sessile, marginal glands mostly present; petioles 0.5 - 4 cm long, 1 - 2 mm in diam., tomentellous to subglabrous, shallowly sulcate above; stipules linear, 4 - 6 mm long. *Inflorescences* up to 10 cm long; rachis pilose-tomentose to subglabrous; bracts not seen. *Male flowers* : not seen (reported to be pentamerous, sepals elliptic, obtuse, tomentose outside; petals oblong or oblanceolate and as long as sepals; stamens ca 12; filaments and receptacle villous). *Female flowers* : pedicels 1.5 - 3 mm long, softly tomentellous; sepals 5(-6), oblong to oblong-lanceolate, 2.5-5 x 0.8-2.5 mm, yellow or whitish-tomentose outside towards base, lanate inside towards base, dark reddish, often penicillate at apex, acute to obtuse; petals 5(-6), filiform, 0.3 - 0.8 mm long; ovary subglobose, 3 - 3.5 mm diam., ochraceous pilose-tomentose; styles slender, 3.5 - 5 mm long, free, bifid almost to the base, recurved. *Capsules* subglobose, ca 8 mm in diam., shallowly 3-lobed, tomentose; seeds ellipsoid, 5.5 - 6.5 x ca 4 mm, pale brown smooth.

Flowering & Fruiting : July - Oct.

Local name : Myanmarese : *Taung salat*.

Distribution : Myanmar, W. China (Yunnan).

Habitat : Apparently rare in swamp forests and rocky hill forests up to about 200 m altitude.

Representative specimens : MYANMAR. Hill near Paghamew, 1826, *Wallich* 7743 (K : microfiche !). Myingyan dist., Myingyan, Aug. 1913, *English* 17 (K, photo !); Taungtha Reserve, 14.8.1914, *Rogers* 432. S. Shan States, Indine, 1883, *Khalil s.n.*, Acc. Nos. 419573, 421187. CHINA. Yunnan, Bey-ti Shan,

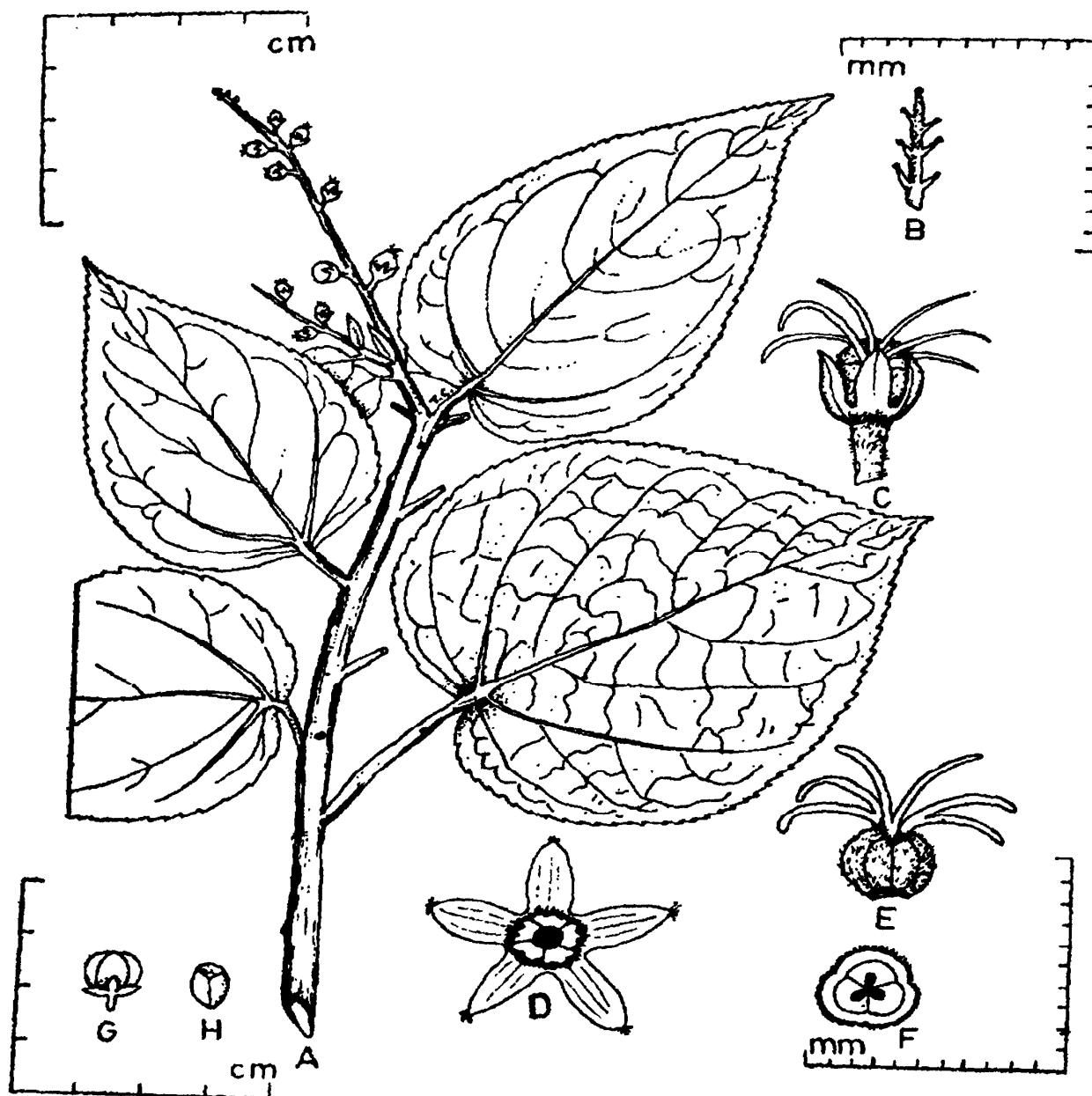


Fig-15. *Croton yunnanensis* W.W. Smith A. Flowering & fruiting branchlet. B. Stipule.
 C-F. Female : C. Flower. D. Calyx viewed from above. E. Ovary. F. T.S. of ovary. G. Fruit. H. Seed (A,C-F:
 Rogers 4321; B. G-H: Henderson s.n.).

July 1921, *G. Forrest* 20544 - shrub of 3 - 6 ft., at 7000 ft. altitude.

From the limited materials available, it is observed that the characteristic soft, interwoven tomentum on the lower surface of leaves, petioles and rachis fall down suddenly during the fruiting condition. The plant is also unmistakable by the distinct dark reddish female sepals.

30. *Croton zeylanicus* Muell.-Arg. in *Linnaea* 34: 107. 1865 & in DC., *Prodr.* 15(2): 581. 1866; Alston in *Trimen, Handb. Fl. Ceylon* 6 (Suppl.): 264. 1931; Balakr. in *Bull. Bot. Surv. India* 3: 39. 1961. *Lectotype*: Sri Lanka, *Thawites* CP 2110, Pret. No. 005295 (G-DC) here designated; *Isolectotypes* in CAL, G-DC, K.

C. reticulatus Heyne in Wall. [Cat. No. 7724 B. 1847, *nomen*] ex Muell. - Arg. in DC., *Prodr.* 15(2): 580. 1866 *non* Willd., 1805; Bedd., *For. Man.*: CCIV. 1873 & *Icon. Pl. Ind. Or.*: t, 233. 1874; Hook. f., *Fl. Brit. India* 5: 386. 1887; Nairne, *Fl. Pl. W. India*: 295. 1894; *Trimen, Handb. Fl. Ceylon* 4: 47. 1898; Cooke, *Fl. Pres. Bombay* 2: 599. 1906; Talbot, *For. Fl. Bombay Pres. Sind* 2: 469. 1911; Rama Rao, *Fl. Pl. Travancore*: 365. 1914; Fischer in *Rec. Bot. Surv. India* 9(1): 164. 1921; Gamble, *Fl. Pres. Madras*: 1314. 1925; Kirtikar & Basu, *Indian Med. Pl. ed. 2*: 2253, t. 870. 1935. *Syntypes*: S. India, Devuia (?), 21.7.1838, Heyne in *Wallich Cat. No. 7724 B* (K-WALL, photo !); Malabar & Concan, 1861, *Stocks, Law etc. s. n.* (G-DC, K, photo!).

C. hypoleucus Dalz. in Hook., *Kew J. Bot.* 3: 123. 1851, *non* Schlecht., 1847; Dalz. & Gibs. *Bombay Fl.*: 231. 1861; Thw., *Enum. Pl. Zeyl.* 4: 276. 1861. *Syntypes*: S.W. India, *Dalzell*

s.n., Acc. No. 410587 (CAL); *ibid.*, *Dalzell s.n.* (K, photo !) [Fig. 16, Map. 1].

Evergreen shrub (often bushy) up to 3 m high; bark smooth, whitish; all parts (except older branchlets and upper surface of leaves) densely silvery-coppery lepidote; branchlets slender, terete. *Leaves* alternate but often subopposite or in false whorls separated by long bare internodes, narrowly elliptic to oblong or often ovate-oblong to ovate-lanceolate, (3-)6 - 14(-20) x (0.5-)1.5 - 5(-8) cm, rounded, obtuse to acute at base, entire along margins, caudate-acuminate (acumen 0.5 - 5 cm long, mostly acute) or sometimes acute at apex, chartaceous to firmly membranous, evanescently stellate - pubescent above when young, yellow-brown, brown or green above when dry, penninerved; lateral nerves 4 - 11 pairs, obscure to prominent above, faint to conspicuous beneath; tertiary nerves inconspicuous to faint above, obscure to prominent beneath, scalariform; basal glands 2 - 4(-6), long-stipitate or rarely sessile; petioles (0.1-)0.5 - 3(-4) cm long, 1 - 1.5 mm in diam., sulcate above; stipules linear or subulate, (1.5-)3 - 8 mm long. *Inflorescences* 3-8 cm long, rarely unisexual; bracts lanceolate, linear or subulate, 1.5-4 mm long. *Male flowers*: pedicels (1.5-)3-7 x 0.3-0.5 mm; sepals 5, ovate to elliptic oblong, 1.5-3.5 x 1-2 mm; petals 5, spatulate-obovate to oblong, 1.8-3 x 1-2 mm; stamens 10-23, 2.5-3.5 mm long; anthers mostly oblong, ca 1 mm long. *Female flowers*: pedicels 2-4 x 1-2 mm sepals (4-)5, narrow, elliptic-oblong to oblanceolate or sometimes linear, 3-6.5 x 1-2 mm, often slightly accrescent; petals 0-5, linear or oblanceolate, 1-2 mm long; staminodes rarely present; ovary more or less globose, 2-3.5 mm in diam.; styles

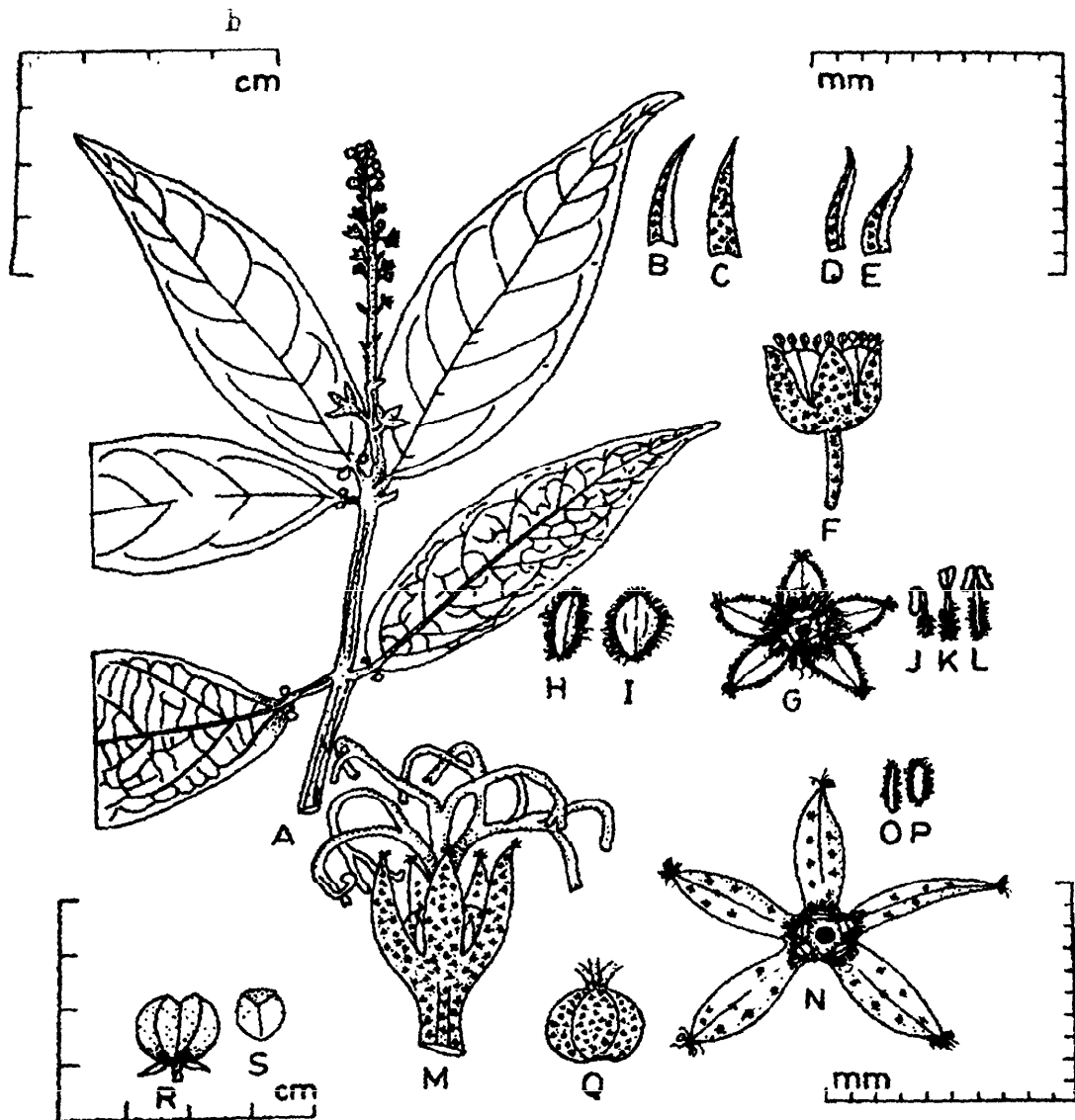


Fig.16. *Croton zeylanicus* Muell.-Arg. A. Flowering branchlet. B-C. Stipules. D-E. Bracts. F-L. Male: F. Flower. G. Calyx viewed from above. H-I. Petals. J-L. Stamens. M-Q. Female: M. Flower. N. Calyx viewed from above. O-P. Petals. Q. Ovary. R. Fruit. S. Seed (A-D: Henry & Chandrabose 19872; M-Q: Matthew 12484; R-S: Barber 3807).

up to 10 mm long, connate at base into a column (1-2 mm long), twice or thrice bifid at apex. *Capsules* globose, 10-12 mm in diam., shallowly 3-lobed; sepals 5-10 mm long; seeds squarish, 8-8.5 x 6-7 mm, marbled.

Flowering & Fruiting : Jan. Dec.

Use: Bark reported to be bitter and stomachic.

Local names : Marathi : *Panduray, Pondhari, Pandharisala*.

Distribution : W. Peninsular India & Sri Lanka.

Habitat : *S. India* : Common (scarce in some localities) in evergreen forests or moist rain forests or open areas or scrubs on clayey or red gravelly soils between 700 and 1550 m altitudes. *Sri Lanka* : Rare in moist regions between 600 and 900 m altitudes.

Specimens examined : INDIA. Kerala : Calicut dist., Wynaad, June 1859, *Beddome* 84. Devicolum dist., Peermade, Dec. 1909, *Meebold* 12902. Kottayam dist., Pamba, 27.6.1968, *Deb* 30425 (MH). Palghat dist., Silent Valley R.F. 11.10.1965, *Vajravelu* 26140 (MH). Trivandrum dist., Ponmudi, 16.10.1959, *Matthew* 1354 (RHT); *ibid.*, 13.9.1970, *Matthew* 12484 & 12487 (RHT). Maharashtra : Pune dist., Lonavla, 27.4.1964, *Reddy* 97749. Tamil Nadu : Coimbatore dist., Anaimalai hills, Iyerpadi, 25.10.1901, *Barber* 3867 (CAL, MH). Nilgiri dist., Sholayar, 23.9.1958, *Alamelu* 507 (PCM). Tirunelveli dist., Way to Agastyamalai, 22.8.1963, *Henry* 16979 (MH); Kannikatti, 6.6.1899, *Barber* 383 (MH).

The slender branches, fine deterrable stellate hairs (rather than scales) on upper

surface of young leaves, colourless trichome-base, long-stipitate foliar glands and twice or thrice bifid style-branches clearly distinguish *C. zeylanicus* from its allies in the area. The leaves are alternate but often tending to be subopposite or pseudo-verticillate and then separated by long bare internodes, a feature characteristic of *C. cascarilloides* Raeusch. of S.E. Asia and Malesia and its related species.

DOUBTFUL / IMPERFECTLY KNOWN
/ EXCLUDED TAXA

1. *Croton cascarilloides* Raeusch., Nomencl. Bot. ed. 3: 280. 1797; Airy Shaw in Kew Bull. 26: 244. 1972; Whitmore in Tree Fl. Malaya 2: 84. 1973.

Airy Shaw (*l.c.*) as well as Whitmore (*l.c.*) included 'Burma' while citing the distribution of the species but the basis of their record could not be traced out, nor any other material from Myanmar. However, this species, usually recognizable by the large (up to 20 cm) distinctly pseudo-verticillate leaves separated by long bare internodes and small capsules, is well expected in Myanmar. It is known to occur in Thailand, Indo-China, W. Malesia and Ryukyu Is.

2. *Croton rhodostachys* Muell.-Arg. in Linnaea 34: 108. 1865 & in DC., Prodr. 15(2): 590. 1866; Hook. f., Fl. Brit. India 5: 391. 1887; Brandis, Ind. Trees: 578. 1906. *Syntypes* : Myanmar. Taong Dong, 1826, *Wallich* 7731 (G-DC, K-WALL: microfiche!); Segain, 1826, *Wallich* 7739 & 7741 (G-DC, K-WALL, microfiche!).

This imperfectly known species, with glabrous elliptic-oblong or obovate, long-petioled leaves, is apparently related to *C. sublyratus* and *C. wallichii*. The

inflorescences in the type specimens are immature. Further gathering are necessary to establish its status.

Hooker (1887, p. 395) treated four taxa, viz. *C. cardiospermus* Gaertn. (= *Aporusa* sp?), *C. ramiflorus* Graham, *C. rheedei* Graham and *C. tabacifolius* Geisel. as doubtful or imperfectly known species. No material of these plants could be examined during the present revision and therefore it is not possible for us to comment on their status.

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