PHARMACOGNOSY OF AYURVEDIC DRUGS

KERALA

BY

Prof. K. NARAYANA AIYAR M. A.

and

M. KOLAMMAL M. Sc.

PUBLISHED BY

DEPARTMENT OF PHARMACOGNOSY

UNIVERSITY OF KERALA

TRIVANDRUM

1962

Series I.

Number 5.

PRINTED AT
THE ALLIANCE PRINTING WORKS,
THYCAUD, TRIVANDRUM.

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS

bf.	bast fibre
bt.	bast
cam.	cambium
c. c. c. cl.c̄.cc	cell with coloured contents
cl. c̄. ra.	cell with raphide bundle
ch. pl.	chloroplast
ck.	cork
co.	cortex
crl. crls.	crystal – crystals
crm.	ceratenchyma
c.s.	crystal sand
cy.	cavity
en. end.	endodermis
ex.d.	exodermis
gl.t.	glandular hair or trichome
in. sp.	intercellular space
lx. t.	latex tube
lt. lt. x.	latex
ly. cy.	lysigenous cavity
mr. mdr.	medullary ray
mu. cy.	mucilage cavity
obl. ph.	obliterated phloem
ogl. ol.	oil globule
ph.	phloem
ph. i	primary phloem
phd.	phelloderm
ph.f.	phloem fibre
pi.	pith
pn.	phellogen
rhy.	rhytidome
rn.	rind
rs. crl.	rosette crystal
rsn.	resin
s.	starch
sp.	space
scl.	sclerenchyma
scld.	sclereid
scr. cl.	secretory cell or secretory reservoir or cavity
st. cl.	stone cell
stl.	stele
sto.	stomata
sv.t.	sieve tube
th. cl.	thick walled cell
v.	vessel
v. b.	vascular bundle
v. c̄. ty.	vessel with tyloses
wd.	wood
w. f.	wood fibre
xp. xy. par.	xylem parenchyma
xy.	xylem

TABLE OF TRANSLITERATION

Sans.	Eng.	Sans.	Eng.
अ	A a	ट	Ṭ ṭ
आ	Ā ā	ठ	Ṭh ṭh
इ	I i	ड	Ḍ ḍ
ई	Ī ī	ढ	Ḍh ḍh
उ	U u	ण	Ṇ ṇ
ऊ	Ū ū	त	T t
ऋ	Ṛ ṛ	थ	Th th
ए	E e	द	D d
ओ	O o	ध	Dh dh
ऐ	AI ai	न	N n
औ	AU au	प	P p
०	Ṁ ṁ	फ	Ph ph
:	Ḥ ḥ	ब	B b
क	K k	भ	Bh bh
ख	Kh kh	म	M m
ग	G g	य	Y y
घ	Gh gh	र	R r
ङ	Ṅ ṅ	ल	L l
च	C c	व	V v
छ	Ch ch	श	Ś ś
ज	J j	ष	Ṣ ṣ
झ	Jh jh	स	S s
ञ	Ñ ñ	ह	H h

DRAVIDIAN SPECIALS

ഉ	U	u	ഠ	T′	t′
ഏ	E′	e′	റ	R′	r′
ഒ	Ō	ō	ന	N′	n′
			ഴ	Z	z

ACKNOWLEDGEMENTS

The Ayurvedic notes were prepared by Sri. Konniyur N. Kesava Pillai, Ayurvedic Vydian and Retd. Lecturer, Ayurveda College under the supervision of Sri. M. N. Kesava Pillai, Director of Indigenous System of Medicine. The illustrations were prepared by Artists Sri. T. K. Padmanabha Iyer and Sri. K. Kunhirama Varier.

Mucuna prurita Hook.

1. Twig with inflorescence
2. Twig with fruits
3. Seeds
4. Hairs enlarged
5. A single hair magnified

KAPIKACCHU

Source Plant : **Mucuna prurita** Hook.

Family : Leguminosae – Papilionatae

Sanskrit Text *Descriptive synonyms*

कपिकच्छूरात्मगुप्ता स्वयंगुप्ता महर्षिभीः ।
पाङ्गुली (लाङ्गुली) क्रण्डरा (कण्डुला) चण्डा मर्कटी दुरभिग्रहा ॥
(धन्वन्तरि निघण्टुः)

Kapikacchūrātmaguptā Svayamguptā Maharṣibhiḥ |
Pāṅgulī (Lāṅgulī) Kaṇḍara (Kaṇḍulā) Caṇḍa Markaṭī Durabhigrahā ||
(Dhanvantari Nighaṇṭu)

कपिरोमफलागुप्ता दुःस्पर्शा कच्छुरा जया ।
प्रावृषेण्या शूकशिम्बी बदरी गुरुरार्षभी ॥
शिम्बी वराहिका तीक्ष्णा रोमालुर्वनसूरिका ।
कीशरोमा रोमवल्ली स्यात् षड्विंशतिनामका ॥
(राजनिघण्टुः)

Kapiromaphalā Guptā Duspars'ā Kacchurā Jayā |
Prāvṛṣeṇyā Sūkasimbī Badarī Gururārṣabhī ||
S'imbī Varāhikā Tīkṣṇā Romālurvanasūrikā |
Kīs'aromā Romavallī Syāt Ṣaḍvims'atināmakā ||
(Rājanighaṇṭu)

आत्मगुप्ता स्वयंगुप्ता कपिकच्छुर्दुरालभा ।
आर्षभी ऋषभी वृष्या सैव कण्डूकरी स्मृता ॥
(अभिधानमञ्जरी)

Ātmaguptā Svayaṁguptā Kapikacchurdurālabhā
Ārṣabhī Ṛṣabhī Vṛṣyā Saiva kaṇḍūkarī Smṛtā ||
(Abhidhānamañjarī)

कपिकच्छूरात्मगुप्ता वृष्या प्रोक्ता च मर्कटी ।
अजहा (अजद) कण्डुरा व्यङ्गा दुःस्पर्शा प्रावृषायणी ॥
लाङ्गूली शूकशिम्बी च सैव प्रोक्ता महर्षिभि ।
(भावप्रकाशः)

Kapikacchūrātmaguptā Vṛṣyā Proktā ca Markaṭī
Ajaḥā (Ajada) Kaṇḍurā Vyaṅgā Duspars'ā Prāvṛṣāyāṇī ||
Lāṅgūlī Sūkas'imbī ca Saiva Proktā Maharṣibhiḥ |
(Bhāvaprakās'a)

Meanings of Terms.

Romālu – densely hairy; *S'ūkas'imbi* – covered with awns or awn–like hairs; *Kapiromaphala* and *Kīsaroma* – having hairs similar to those of monkeys; *Sukavati* – (fruits) covered with awn or awn – like hairs; *Romavallī* – hairy vine; *Kaṇḍukarī, Kandura, Kandala (Kandara)* – causing itching; *Kapikacchu* – causing severe itching (even to monkeys). *Markatī* exhibiting all sorts of antics like a female monkey; *Candā* – hurtful; *Duspars'a* – that which cannot be handled or touched; *Durālabhā Durahbigraha* – difficult to obtain (because of the difficulty in collecting); *Bṛmhani, Jada* and *Sadyasodha* - causing thickening or swelling of the skin on account of the severe itching; *Jaha* - left alone or undisturbed by others on account of its itching. *Gupta* - self protected; *Ātmagupta* and *Swayamgupta* – capable of self protection (on account of its hairs); *Jayā* – able to win or succeed or defeat others because of these hairs; – *Prāvṛṣeṇya* or *Prāvṛṣayani* - growing abundantly in the *varṣa ṛtu* or rainy season; *Avyanga (Avyanda)* – perennial; *Guru* – difficult to digest; *Vṛṣya* – Aphrodisian. The terms *Maharṣibhih, Arṣabhi* and *Rṣyaprokta*– indicate that the ṛsis or ascetics are reluctant even to utter its name on account of its powerful aphrodisian properties.

The descriptive synonyms indicate certain important and characteristic features of the fruits and seeds. Most of the terms such as *Kapikacchu, Kandura*, or *Kandala, Duspars'a, Sūkasimbi, Romālu Kīsaroma, Romavalli, Kandukarī, Bṛmhani*, and *Kapiromaphala*, point out the hairy nature, especially of the fruits, that the hairs resemble (in colour) those of monkeys and that they cause such severe itching resulting in thickening of skin. The irritation caused by the hairs is so severe that even the animals of the forests flee away from its neighbourhood and human beings contacting the hairs subject themselves to all sorts of antics.

There is not any serious controversy over the identity of the botanical source. All the features attributed definitely point out to

only one source plant viz. *Mucuna prurita* Hook. Though the fruits of other species of *Mucuna* also are hairy they are not at all so troublesome and fearful. There are a few varieties differing mainly in the size of the seed and colour of the seed-coat. The seeds are *Vṛṣya* or powerfully aphrodisian.

Ayurvedic Properties and uses.

कपिकच्छू रसे स्वादुस्तिक्ता शीतानिलापहा ।
वृष्या पित्तास्रहन्त्री च दुष्टव्रणविनाशिनी ॥
(धन्वन्तरिनिघण्टुः)

Kapikacchū rase svādustiktā s'ītān'ilāpahā |
Vṛṣyā pittāsrahantrī ca duṣṭavraṇavinās'in'ī ||
(Dhanvantari Nighaṇṭu)

कपिकच्छू स्वादुरसा वृष्या वातक्षयापहा ।
शीतपित्तास्रहन्त्री च विकृतव्रणनाशिनी ॥ (राजनिघण्टुः)

Kapikacchū svādurasā vṛṣyā vātakṣayāpahā |
S'ītapittāsrahantrī ca vikṛtavraṇanās'in'ī ||
(Rāja Nighaṇṭu)

कपिकच्छूर्भृशं वृष्या मधुरा बृंहणी गुरुः ।
तिक्ता वातहरी बल्या कफपित्तास्रनाशिनी ॥
तद्बीजं वातशमनं स्मृतं वाजीकरं परम् ।
(भावप्रकाशः)

Kapikacchūrbhṛs'am vṛṣyā madhura bṛmhaṇī guruḥ |
Tiktā vātaharī balyā kaphapittāsranās'inī ||
Tadbījam vātas'aman'am smṛtam vājīkaram param
(Bhāvaprakās'a)

According to Dhanvantari Nighaṇṭu, *Kapikacchu* is sweet bitter, overcomes *Vāta*; is aphrodisiac and ends *Pittarakta* and malignant ulcers. Other authors mention that it cures consumption; is heavy and promotes strength.

The most important use of *Kapikacchu* is in improving semen and sexual vigour.

MUCUNA PRURITA Hook.

Syn. *Mucuna pruriens* DC., *Mucuna utilis* Wall. *Carpopogon pruriens* Roxb.

Family: Leguminosae – Papilionatae.

Sanskrit – Kapikacchu, Ātmagupta, Murkuti, or Markati Vānari.

Malayāḷam Naikorṇa, Nayakkuruṇa, Corivalli

Tamil – Pūnakāli, Poonaykāli, Poonaikkālie, Pūnakanjori

Hindi – Kawacha, Kiwach, Concha, Kavachh.

English – Cowhage, Cowhitch, Cowitch.

Distribution and habitat.

Found wild throughout India from the Himalayas to Cape Comorin in the plains districts and up to 3000 feet elevation in the hills. It is common in Bengal, Assam, Khasi hills and Deccan as well as the east and west coast regions. Occasionally cultivated.

Habit and general features

Mucuna prurita Hook. is a semi woody annual or more often a perennial twiner producing from its perennating root system, annual shoots with slender terete branches-that when young are usually clothed with short adpressed deflexed whitish hairs but become glabrescent or only slightly hairy when mature, – bearing alternate pinnately trifoliate fairly large leaves that are densely grey silky pubescent on the lower side, and axillary elongate one to two feet long pendulous or drooping racemes of large dark or lurid purple flowers two to three inches long followed by slightly longitudinally ridged blunt two to three inches long pods, falcately curved at both ends and covered with dense mass of ferruginous yellowish brown stiff sharp irritant hairs. Flowering time: October – November or earlier. Fruits – March - April.

External morphology.

Leaves: fairly large, pinnately trifoliate, alternate, stipulate. *Stipules* – deciduous, about 1/5th inch long. *Stipels* – minute, subulate. Rachises – three to five inches long. *Leaflets* – three to four

inches long, by two to three inches wide, on short, thick, sparingly deflexed hairy stalks, ovate-rhomboid acute or subacute, mucronate, membraneous, glabrous or glabrescent above and densely covered with fine lustrous or silvery grey adpressed hairs beneath. The terminal leaflets are smaller and rhomboid oval, while the lateral ones are very unequal sided with their lower halves much broader.

Flowers: short stalked, large, dark or lurid purple, turning dark when dry, with bracts and bracteoles. *Pedicels* – short, usually shorter than the calyx, 1/8th to 1/4th inch and densely clothed with sharp hairs. The flowers are usually fascicled in groups of two or three at short or close intervals on short peduncled slender drooping pubescent racemes, half to one foot or more long. Each peduncle has its axis finely grey silky and bears six to thirty or more flowers. *Calyx* – gamosepalous, about three quarters of an inch long, covered outside with whitish silky hairs intermixed with a few irritant bristles; its tube is widely campanulate, two lipped, and five-lobed and the segments broad lanceolate with the lowest about as long as the tube or longer, the laterals shorter, and the upper two connate to form a broad triangular upper lip about as long as the calyx-tube. *Corolla* - papilionaceous, much exserted, purplish, one and a quarter to one and a half inches long; *standard* - cordate, incumbent on the wings and only about half the length of the wings and keel; *wings* 1/4″ broad, oblong, ovate or linear–oblong, folded or incurved, semi-sagittate or auricled at the base, connivent or slightly cohering together by their spurs, unexpanding, and shorter than the keels; *keelpetals* - unexpanding, rostrate incurved, straight below slightly falcate above, each terminating in a smooth, sharp beak. *Stamens* - di-adelphous, alternately longer; *anthers* - dimorphous, alternately oblong and ovate and round and sagitate, the longer ones basifixed, the shorter bearded. *Pistil* - monocarpellary; *ovary* - sessile, villous, many ovuled, with a filiform incurved style hairy below and ending in a capitate stigma.

Fruit: a turgid explosively dehiscing pod, two to three or four inches long, and about half an inch broad, slightly falcately curved at both ends shaped like the letter ∽ blunt at either end and slightly longitudinally ridged. It is densely covered with numerous pointed rather weak and readily detached, short stiff or rigid persistent hairs or bristles that at first are of a pale yellowish brown

to light rusty brown colour but turn steel-grey later. The hairs if handled or on coming in contact with the skin cause much irritation and scratching. The fruit contains four to six or more seeds with septa or partitions between the seeds. The fruit valves are not keeled, but polished within. *Seeds* – ovoid or transversely oblong, slightly laterally compressed with a polished dark brownish or black or occasionally mottled testa. They measure a quarter to 0.4 inch in length and 0.2 to 0.3 inch in breadth and have a prominent hilum about half the length of the seed.

Officinal parts: Roots, seeds and the hairs covering the pods.

Description of the root.

The root system consists of many long, but softly woody, somewhat flexible roots, having a diameter of 7 mm. or more. The outer surface is dark brown to black in colour and slightly rough due to the presence of many oblong slightly protruding prominent lenticels and a few rootlets. A freshly cut transverse section shows a central soft woody region wherein could be made out even with the naked eye many small pores which appear in irregular concentric rings surrounded by the bark. The fresh cut surface after a few minutes exposure turns dark pink in colour. Water in which fresh cut roots are immersed for a few hours takes a colour intermediate between dark brown and black.

Histology of the root.

A transverse section of the root shows a central porous woody region which forms the major part of the root and an outer thin bark portion. The outermost tissue of the root is the cork which is narrow and light black in colour. It consists of 4 to 6 rows of tangentially elongated cells with thin dark brown walls and devoid of contents. The cells measure 18 to 42μ by 6 to 15μ. Exfoliating strips of crumpled cork tissue are present outer to this layer at certain regions. On treating with ferric chloride solution the cork layer turns intensely dark brown. Inner to the cork is a very narrow cortex of two or more rows of fairly large, tangentially elongated thinwalled cells. Several of these cells contain rhomboidal or rectangular crystals of calcium oxalate measuring 16 $\times$ 16 μ to 21 $\times$ 9 μ. A few other cells have brownish contents. At wounded or injured regions of the root almost all the cortical cells contain rectangular crystals. The phloem which forms the bulk part of the bark appears

in the transverse section in the form of long radial conical strips separated by the broadened funnel shaped ends of the medullary rays. The older phloem elements situated at the periphery appear as tangential strips of crushed tissue mingled or surrounded by small groups of fibrous cells. Each group consists of 2 to 9 or more narrow very thickwalled fairly long cells appearing rounded or oblique in transverse section and 9 to 18 μ in diameter. Occasional solitary fibre cells are also present. Some of the phloem parenchyma cells of this region also have the brownish-black contents. The newly formed phloem towards the inner part of the bark is composed of the regular phloem elements, namely the phloem parenchyma whose cells are polygonal, thinwalled and of varying sizes as seen in T. S. and distinctly made out sieve tubes and companion cells intermingled with fibre cells which occur singly as well as in few celled groups. Some of the phloem parenchyma cells contain small rhomboidal crystals of calcium oxalate. A distinct cambium consisting of one or two rows of thinwalled, narrow rectangular or slightly tangentially elongated cells is present immediately within the phloem. The medullary rays are many. They are long, mostly uni- or biseriate almost straight and radiating from the centre extend to very near the periphery. The ray cells are all thinwalled and slightly larger than the neighbouring cells. Those towards the inside near the centre are radially elongated. They gradually widen towards the periphery. Those in the outermost part of the phloem region appear tangentially elongated. Some of the ray cells in the inner part contain a few small starch grains. These measure 3 to 9 μ in diameter. The *wood* which forms the central part occupies about 2/3rd the diameter of the root. It is comprised of several large as well as small vessels surrounded by xylem parenchyma and nearly concentric rings of fibre groups. A characteristic feature is the presence of interxylary phloem which alternates with the fibre groups. These phloem groups are quite conspicuous. They occupy nearly the entire area between the fibre groups and are composed of prominent sieve tubes and companion cells and thinwalled parenchyma some of which contain small rhomboid crystals of calcium oxalate. The *vessels* most of which are very wide, measuring 112 to 355 μ in diameter occur either singly or in association with one or two smaller vessels which measure from 21 to 48 μ in diameter. In addition very narrow vessels which measure 15 to 21μ in diameter not in association with the

larger groups are also present. The xylem parenchyma cells which are found only in association with the vessels have slightly thickened walls and contain a few small starch grains. The fibre cells are very thickwalled and elongated and occur mostly in large groups of 9 to 40 or more arranged in the form of incomplete concentric rings the strips being separated radially by the medullary rays. The medullary rays of the wood are mostly uniseriate, long, somewhat wavy and arranged very close together. The ray cells here are radially elongated and thinwalled. They vary from 20 to 40 μ in length and 9 to 15 μ in width. Most of them contain small rounded starch grains while a few cells contain crystals of calcium oxalate.

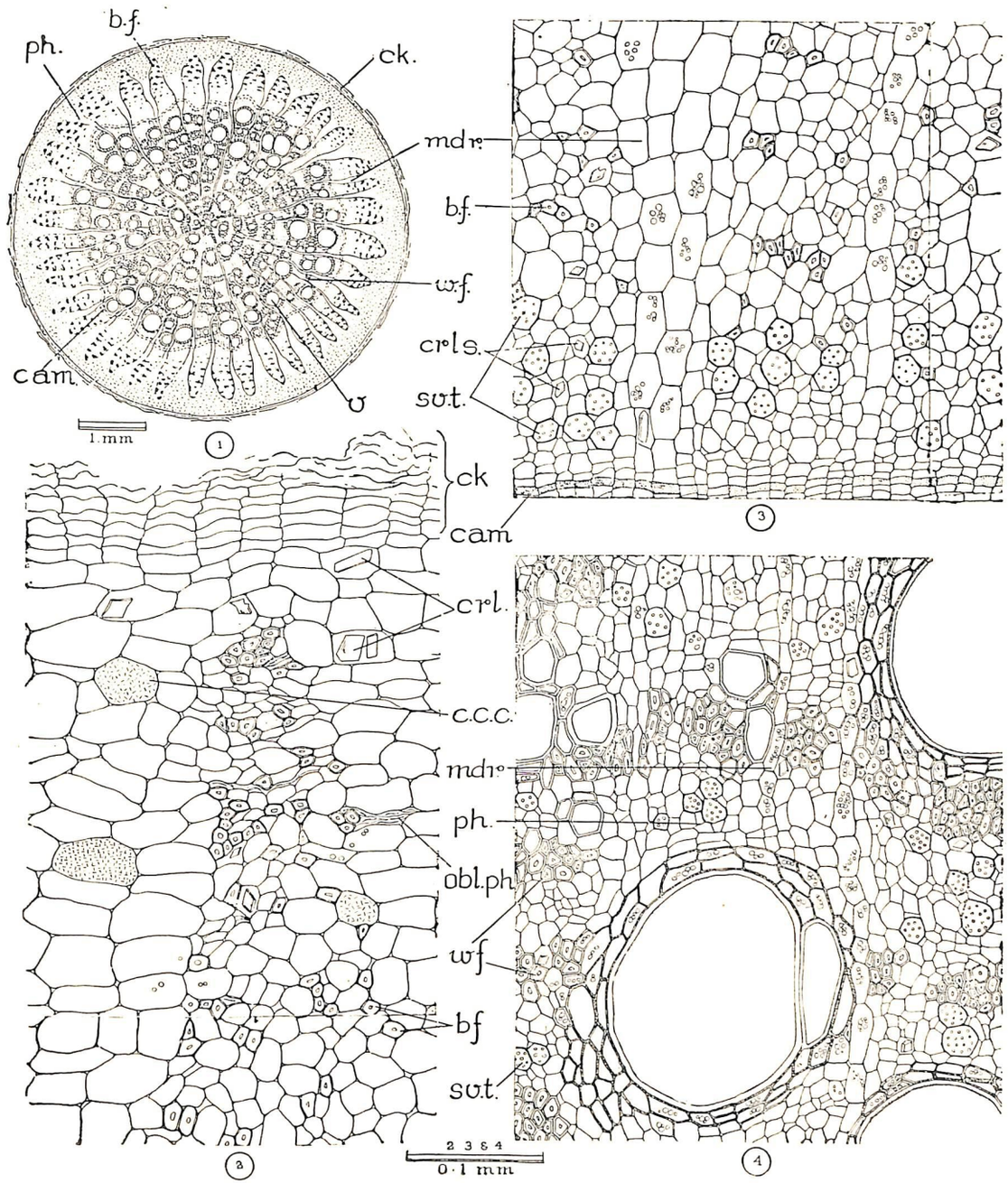
Description of fruits and seeds.

The pods are slightly curved at the base as well as at the tip, 3-4″ long and contain from 4 to 6 seeds. The valves are covered with rigid brown coloured hairs about 1/10 of an inch long which give rise to severe irritation of the skin on contact.

Description and microscopic structure of the hairs

The detached hairs as met with in the bazar occur as loose yellowish brown felted masses intermingled with black coloured fragments of the pericarp. They measure 0·6 to 2·3 mm. in length and from 50 to 65 μ in width. They are nearly uniformly cylindrical with a slight constriction above the base and with a conical or acute sharply pointed and barbed tip. The walls are yellowish or yellowish brown, thick and lignified and beset with numerous minute mostly retrorsed prominences. Those towards the top are quite sharp and act like barbs.

Plate II



Histology of root of *Mucuna prurita* Hook.

1. Diagrammatic sketch of the T. S. of the root
2. Cork with a part of old bast.
3. Young bast with the cambium.
4. Wood.

PUNARNAVA

Source plants

1. **Boerhaavia diffusa** Linn.; and **B. repanda** Willd. belonging to Nyctaginaceae.
2. **Trianthema portulacastrum** Linn.; and **T. decandra** Linn. belonging to Aizoaceae.

Sanskrit text

Descriptive synonyms

पुनर्नवा विशाखश्च कठिल्लः शशिवाटिका ।
वृश्चीकः क्षुद्रवर्षाभूर्दीर्घपत्रः कठिल्लकः ॥
पुनर्नवोऽपरः क्रूरः सद्यो मण्डलपत्रकः ।
श्वेतमूलो वर्षकेतुर्महावर्षाभुरुच्यते ॥

(धन्वन्तरिनिघण्टुः)

Pun'arnavā vis'ākhas'ca kaṭhillaḥ s'as'ivāṭikā ।
Vṛs'cīkaḥ kṣudravarṣābhūrdīrgha patraḥ kaṭhillakaḥ ॥
Pun'arnavosparaḥ krūraḥ sadyo maṇḍalapatrakaḥ ।
S'vethamūlo varṣaketurmahā varṣābhurucyate ॥

(Dhanvantari nighaṇṭu)

पुनर्नवा विशाखश्च कठिल्लः शशिवाटिका ।
पृथ्वी च सितवर्षाभूर्दीर्घपत्रः कठिल्लकः ॥
पुनर्नवान्या रक्ताख्या क्रूरा मण्डलपत्रिका ।
रक्तकाण्डा वर्षकेतुर्लोहिता रक्तपत्रिका ॥
वैशाखी रक्तवर्षाभूः शोफघ्नी रक्तपुष्पिका ।
विकस्वरा विषघ्नी च प्रावृषेण्या च सारिणी ॥
वर्षाभवः शोणपत्रो भौमः सम्मीलितद्रुमः ।
पुनर्नवो नवो नव्यः स्याच्च विंशति संज्ञया ॥
नीला पुनर्नवा नीला श्यामा नीलपुनर्नवा ।
कृष्णाख्या नीलवर्षाभूर्नीलादिस्वाभिधान्विता ॥

(राजनिघण्टुः)

Pun'rnava vis'ākhas'ca kaṭhillaḥ s'as'ivāṭikā |
Pṛthvī ca sitavarṣābhūrdīrghapatraḥ kaṭhillakaḥ
Punarnavānyā raktākhyā krūrā maṇḍalapatrikā |
Rakta kāṇḍā varṣaketurlohitā raktapatrikā ||
Vais'ākhī raktavarṣābhū; s'ophaghn'ī raktapuṣpikā
Vikasvarā viṣaghn'ī ca pravṛṣeṇyā ca sāriṇī ||
Varṣābhavaḥ s'oṇapatro bhaumaḥ sammīlita drumaḥ |
Pun'arnavo navo navyaḥ syācca vims'ati samñjayā
Nīlā pun'arnavā nīlā s'yamā nīlapun'arnavā |
Kṛṣṇākhyā nīlavarṣābhūrnīlādi svābhidhānvitā ||

(Rājanighaṇṭu)

पुनर्नवा श्वेतमूला शोथघ्नी दीर्घपत्रिका ।
पुनर्नवापरा रक्ता रक्तपुष्पा शिलाटीका ॥
शोथघ्नी क्षुद्रवर्षाभूर्वर्षकेतुः कठिल्लका । (भावप्रकाशः)

Pun'arnavā s'vetamūlā s'othagn'ī dīrghapatrikā |
Pun'arnavāparā raktā raktapuṣpā s'ilā ṭīkā ||
S'othaghn'ī kṣudravarṣābhūrvarṣa ketuḥ kaṭhillakaḥ |

(Bhāvaprakās'a)

वृश्चीवो दीर्घदलः पुनर्नवो रक्तवृन्तश्च ।
जटिलः कठिल्लकः स्यात्सुनाडिका क्षुद्रवर्षाभूः ॥
वृश्चीवोऽन्यः श्वेतमूलः सद्यो मण्डलपत्रकः ।
श्वेतपत्रश्चाम्लशाको वैशाखश्च विरेचनी ॥
कठिल्लो महावर्षाभूर्वर्षकेतुर्निगद्यते (अभिधानमञ्जरी)

Vṛs'cīvo dīrghadaḷaḥ pun'arnavo raktavṛntas'ca
Jaṭilaḥ kaṭhillakaḥ syātsunāḍikā kṣudravarṣābhūḥ
Vṛs'cīvosn'yaḥ s'vetamūlaḥ sadyo maṇḍalapatrakaḥ |
S'vetapatras'cāmḷas'āko vais'ākhas'ca virecan'ī ||
Kaṭhillo mahāvarsābhūrvarṣaketurnigadyate

(Abhidhān'amañjarī)

The term *Punarnava* (*Punah* – again and *nava* – fresh) means that which becomes fresh again, that is, sprouts up or revives again every year. The plant exhibits renewal of growth after apparent

destruction indicating that it is a herbaceous perennial. The synonyms *Kaṭhillaḥ Kaṭhillakaḥ* and *S'as'ivāṭika* also refer to the same feature namely that it is eternal or a perennial. *Vis'ākha* is a name given to the red variety.

Vṛs'cīkah means that which spreads upon the ground (likeness to a scorpion?); *Kṣudravarṣābhāt* means that it takes birth after a shower of rain. The terms *Vais'akhi* and *Prāvṛṣeni* and *Varṣabhavaḥ* mean that which grows in the rainy season; and *Bhaumaḥ* meaning growing close to the ground, and *Ammīlitadrumah* meaning growing in clusters or with many branches may refer to the habit of the plants. A few varieties are mentioned namely:—

One variety referred to as *Raktākyā Krūra, Raktakaṇda* and *Raktapatrika* has a general reddish tint with reddish stem and leaves. Its leaves are roundish (*mandala patrika*) and the roots are whitish (*svetamūla*). The terms *Raktavarṣābhu, Vikasvara, Sarini* and *S'onapatra* also denote the red colour of the aerial part or of the shoot. It is *Varṣaki* and *Mahāvarṣabhu* – growing soon after the beginning of or during the monsoon rains. *Varṣaketu* – "the banner of rain" signifying that the sprouting up of the plants synchronises with the starting of the rainy season, obviously indicates the same feature. *S'othaghni, S'ophaghni* (*sotha*, or *sopha*, *soja* – general swelling and *ghni* – to kill or destroy) meaning that which destroys swellings and *Vis'aghni* meaning that which destroys poison indicate the attributes or qualities of the plant.

Two other varieties namely *Kṛṣnākhya*, a bluish and S'yamā a greenish, are mentioned in the texts. The first variety has *sve'amūla* whitish roots and *dīrghapatrika* long leaves. It is *s'othagni* ie. removes or cures general swelling or dropsy. The other variety is *rakta* – reddish and has *raktapuṣpa* reddish flowers. It grows during the rainy season and in clusters. Other varieties have *svetamula* whitish roots, and *svetapatra* whitish leaves. They are sour in taste (*amlasako*).

It may be seen from the above that the descriptive synonyms do not give any pointed indication to the identity of the plant except certain general features. Three main varieties are mentioned based on general colour of the plant and its flowers, namely greenish white, red and blue.

Properties and uses.

पुलर्नवा भवेदुष्णा तिक्ता रूक्षा कफापहा ।
सशोफपाण्डुहृद्रोगकासोरःक्षतशूलनुत् ॥
रक्ता पुनर्नवा तिक्ता सारिणी शोफनाशिनी ।
रक्तप्रदरदोषघ्नी पाण्डुपित्तप्रमर्दनी ॥

(धन्वन्तरिनिघण्टुः)

Pun'arnavā bhaveduṣṇā tiktā rūkṣā kaphāpahā,
Sas'ophapāṇḍū hṛdrogakāsoraḥkṣata sūlan'ut |
Raktā pun'arnavā tiktā sāriṇī s'ophanāś'in'ī |
Raktapradara doṣaghn'ī pāṇḍū pittapramardan'ī

(Dhanvantari nighaṇṭu)

श्वेता पुनर्नवा सोष्णा तिक्ता कफविषापहा ।
कासहृद्रोगशूलास्रपाण्डुशोफानिलार्तिनुत् ॥
रक्ता पुनर्नवा तिक्ता सारिणी शोफनाशिनी ।
रक्तप्रदरदोषघ्नी पाण्डुपित्तप्रमर्दिनी ॥
नीला पुनर्नवा तिक्ता कटूष्णा च रसायनी ।
हृद्रोगपाण्डुश्वयथुश्वासवातकफापहा ॥ (राजनिघण्टुः)

S'vetā punarnavā soṣṇā tiktā kaphaviṣāpahā
Kāsahṛdrogasūlāsra pāṇḍū s'ophāṇ'ilārtin'ut ||
Rakā pun'arnavā tiktā sāriṇī s'ophanāś'inī |
Rakta pradaradoṣaghn'ı pāṇḍūpittapramardin'ī ||
Nīlā punarnavā tiktā kaṭūṣnā ca rasāyan'ī |
Hṛdrogapāṇḍus'vayathu s'vāsavāta kaphāpahā ||

(Rāja nighaṇṭu)

कटुः कषायानुरसा पाण्डुघ्नी दीपनी परा ।
शोफानिलगरश्लेष्महरी ब्रध्नोदरप्रणुत् ॥
पुनर्नवारुणा तिक्ता कटुपाका हिमा लघुः ।
वातला ग्राहिणी श्लेष्मपित्तरक्तविनाशिनी ॥

(भावप्रकाशः)

Kaṭuḥ kaṣāyān'urasā paṇḍughn'īdīpanī parā |
S'ophān'ilagaras'leṣmaharī bradhn'odara praṇut ||
Punarnavāruṇā tiktā kaṭupākā himā laghuḥ |
Vātaḷā grāhiṇī s'leṣmapittarakta vin'ās'in'ī ||

(Bhāvaprakās'a)

वर्षाभूःकफवातघ्नी हिता शोफोदरार्शसाम् ॥

(सुश्रुतः)

Varṣābhū kaphavātaghn'ī hitā s'ophodarārs'asām ||

(Sus'rutaḥ)

I. **श्वेतपुनर्नवा** – White Variety

कटुः कषायानुरसा पाण्डुघ्नी सरा ।
शोफानिलगरश्लेष्महरी व्रण्योदरप्रणुत् ॥

(भावप्रकाशः)

Katu kaṣāyānurasā pāṇḍughni sarā
Sophānila gara sleṣmaharī vṛaṇyodarapraṇut ||

(Bhāva prakās'a)

पुनर्नवा भवेदुष्णा तिक्ता रूक्षा कफापहा ।
सशोफपाण्डुहृद्रोग कासोरःक्षतशूलनुत् ॥ (धन्वन्तरिनिघण्टुः)

Punarnavā bhavēduṣnā tiktā rūkṣā kaphāpahā
Sas'ophapaṇḍuhṛdroga kāsōraḥkṣatasūlanut ||

(Dhanvantari nighaṇṭu)

पुनर्नवा तु वीर्योष्णा भेदिनी च रसायनी
कफानिलामदुर्नाम ब्रध्नशोथोदरापहा ॥ (राजवल्लभनिघण्टुः)

Punarnavā tu vīryoṣnā bhedinī ca rasāyanī
Kaphānilā madurnāmā bradhna s'o'thodarāpahā

(Rājavallabha nighaṇṭu)

श्वेता पुनर्नवा सोष्णा तिक्ता विषकफापहा ।
कासहृद्रोगशूलास्र पाण्डु शोफानिलार्तिहृत् ॥ (राजनिघण्टुः)

S'veta punarnavā soṣṇā tiktā viṣakaphāpahā
Kāsa hṛdroga sūlāsra pāṇḍu s'ophānilārti hṛt ||

(Rāja nighaṇṭu)

II. Properties of Rakta Punarnava :—

पुनर्नवारुणा तिक्ता कटुपाका हिमा लघु ।
वातला ग्राहिणी श्लेष्मपित्तरक्तविनाशिनी ॥ (भावप्रकाशः)

Punarnavāruṇa tiktā katupākā himā laghu
Vātalā grāhinī sleṣma pittarakta vinas'inī ॥
(Bhāvaprakās'a)

III. Properties of Nīla punarnava :—

नीला पुनर्नवा तिक्ता कटूष्णा च रसायनी ।
हृद्रोगपाण्डु श्वयथु श्वासवात कफापहा ॥ (राजनिघण्टुः)

Nīla punarnavā tiktā kaṭūṣnā ca rasāyanī
Hṛdroga pāṇḍu s'vayathu s'vāsa vāta kaphāpahā ॥
(Rāja nighaṇṭu)

Properties and uses according to Āyurveda

According to Dhanvantari nighaṇṭu the *Sveta punarnava* is *uṣṇavīryam* (heat producing, or hot) bitter, *rukṣam* (dry) and *kaphaharam* (destroying kapha). It is useful in *s'opha* (oedema or swelling) *pāndu* (anaemia) *hṛdrogam* (heart diseases), *kāsam* (cough or bronchitis) *urakṣatham* (thoracic haemorrhage) and *s'ulam* (colic or abdominal pain). The white variety of *punarnava* according to Bhāvaprakās'a is pungent with slight astringency and bitter in secondary taste. (अनुरसम् *ānurasa*). It is *kapha-vāta-haram* (destroyer of kapha and vāta) and laxative. It increases digestive power and is useful in *garam* (concocted food poison) *s'ophan* (swelling), *udaram* (ascitis or abdominal enlargement) *vṛna* (ulcers); and inguinal hernia.

Rājavallabhanighaṇṭu says that *punarnava* is *uṣnavīryam* purgative and rejuvenator. It subsides *kapham*, *vātam* and *āmadoṣam*, is good in piles, scrotal swelling, anasarca and ascites. Rājanighaṇṭu mentions the same attributes and adds that it is indicated also in bronchitis, heart disease, abdominal pain, dropsy and certain nervous diseases.

The leaves of *punarnava* are used in loss of digestive power, *gulman* (ball-like movements in the intestines) as well as in enlargement of the spleen and abdominal pain. The white variety of punarnava is considered a specific for *muṣika viṣam* (ratbite poison) and *alarkaviṣam* (rabbies). It is also a specific for various kinds of eye diseases.

The red variety of *punarnava* is bitter but pungent in reaction with digestive fire. It is *s'ītavīryam* and *laghu* (easily digestible); increases *vāyu*, reduces *kapham*, *pittam* and *raktam*, and is constipating.

The *nīla* (blue) *punarnava* has the same properties as the white variety and the indications are also more or less similar.

According to *Susruta*, *Punarnava* is beneficial in piles.

Caraka has included this in the group of drugs which cure cough and give longevity.

The principal officinal part is the root. The leaves are also used.

BOERHAAVIA DIFFUSA Linn.*

Syns. *Boerhaavia procumbens* Roxb.; *B. repens* Linn.

Family: Nyctaginaceae.

Sanskrit	–	Punarnava, Punarbhava, Sotagni, Sitagni.
Malayāḷam	–	Tazhutāma, Tamizhāma.
Tamil	–	Tamizhāmai, Tazhutāmai, Taludāma, Mookaretti. Mukkurattai. keerai, Mukukrattai, Mookrattikirai-
Hindi	–	Tikri
Telugu	–	Atka-mamidu Atikaināmidi.

Distribution and Habitat.

The plant is found all over India from Punjab to Assam in the north ascending to about 7,000 feet in the Himalayan valleys, and southwards to the Coromandel and Kerala as far as Cape Comorin. It is a very common, abundant and most troublesome weed of sandy tracts, waste lands and roadsides of the plains districts as well as of the hills to some height. It is especially abundant during the rainy season.

Habit and general features

Boerhaavia diffusa Linn. is a variable diffusely branched low spreading or creeping herbaceous perennial with an elongate fusiform or tapering somewhat tuberous but not very stout sparsely branched tap root one to three feet or more long growing vertically downwards and striking deep into the soil from the base of which arise numerous slender round, nodose, jointed often reddish or purplish tinted minutely pubescent to nearly glabrous divaricate branches spreading close over the ground but not rooting at the nodes, reaching 2–3 feet in length and covering a large area, bearing at each node, pairs of opposite but unequal, cordate to suborbicular leaves smooth and bright green above and covered with a silvery pellicle underneath

* This plant has been in use in Āyurveda from very ancient times. Āyurvedic texts mention three varieties (i) a white variety *Svethapunarnava* with whitish flowers and (ii) a red variety *raktapunarnava* with red flowers, the former being less common. A third variety with blue flowers is mentioned by other authorities, most probably a different plant.

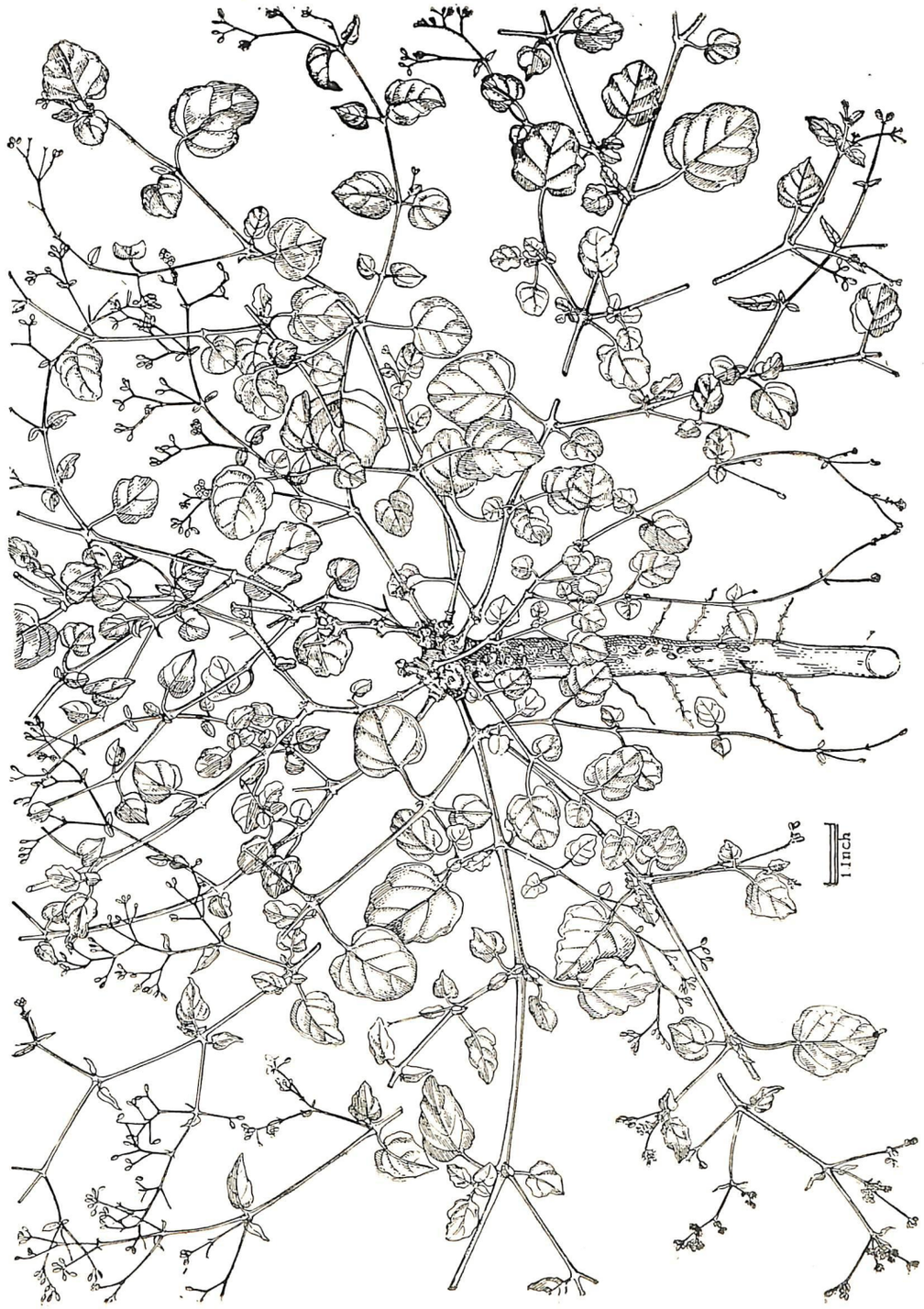


Plate III

Boerhaavia diffusa Linn.

and small rose coloured or rarely white almost sessile flowers in clusters of 4 – 10 at the ends of single or panicled, slender, long stalked, extra-axillary or terminal peduncles. The plant is in flower nearly through out the year.

The size and appearance of the plant varies considerably according to the soil, locality, situation, and climate.

Its leaves after boiling well are occasionally used as a pot herb (leaf vegetable) by poor people.

External morphology

Taproot – perennial, elongate, narrowly fusiform or tapering slightly tuberous but not very stout. It grows vertically downwards and strikes so deep into the soil as to make it a very difficult job to get its entire length dug up. It is cream or light brownish yellow externally and has a soft skin. The surface of old roots is often marked with knotty scars of fallen rootlets.

Stem : very short, practically absent. *Branches*- many either subscandent or more often creeping or trailing close to the ground, but not generally rooting at the nodes. These branches are often very long, cylindrical, light reddish brown above and pale greenish below, nodose and jointed with the internodes considerably long. These may radiate outwards to a distance of three to five feet or more according to the locality and soil conditions.

Leaves ; simple, opposite, exstipulate and short-petioled - the *petioles* are six to sixteen mm. long and grooved above. The two leaves at a node are of unequal size with the position of the large and small leaves alternating at adjacent nodes. *Blade* - slightly thick and succulent, ovate or oblong to variously cordate or even nearly sub-orbicular; green and glossy above and with a silvery white shine underneath due to minute whitish scales; margin entire pinkish, the edges often slightly curly or subundulate or occasionally somewhat scalloped, acute or obtuse at apex and with 3 – 4 pairs of secondary nerves. The size of the leaf varies according to nature of the environment, the large one measuring 2 5 cms. to 3 9 cms. or more and the smaller six mm to eighteen mm. in length.

Flowers – small, regular, monochlamydeous, short-stalked or very nearly sessile, pale rose coloured or occasionally white, in irregular glomerules or clusters of 4-10 in small bracteate umbels at the ends of single very slender elongate extra-axillary peduncles 2·5 to 7·5 cms. long or on long branching rachises forming extended terminal panicles at the ends of branches. *Bracteoles* – small, lanceolate, acute. The *peduncles* are extra-axillary solitary and arise from the naked swollen nodes between the leaves but nearer to the smaller leaf Towards the tip of the branches due to the nearness of the nodes the inflorescences may appear as numerous and paniculate. *Perianth* – short, about three mm. long, persistent, urceolate, gibbous and deeply constricted about the middle. Its lower tubular part which is persistent is cylindric or ob-conical dark and covered with glutinous glandular hairs. Its upper or limb part which is deciduous is light rose coloured or white, funnel-shaped or companulate, plaited, and five-lobed near the rim with five narrow vertical bands outside. A small fleshy three-lobed or toothed nectariferous cup (the basal connate part of the filaments) is present at base of and surrounding the ovary. *Stamens* · 2 or 3 slightly exserted arising from the base and connate around the ovary ; *anthers* - minute, round di-dynamous and two-celled. *Ovary* - small, stipitate, nearly completely enclosed by the basal half of the perianth. It is oblique, acute and unilocular with one erect basal ovule ; *style* - slender, equalling the stamens and ending in an obtuse peltate stigma.

The persistent basal half of the perianth gets hardened in fruit and is mistaken easily for the real fruit which is inside. It is about three mm. long, shortly clavate or turbinate (barrel shaped), often five sided or rounded, five ribbed, and covered outside with clammy pedicelled glands especially over the five broad blunt sides (but not at the truncated top or crown). It is articulated to the peduncle enabling the fruit to be easily detatched and adhere to the clothes or to the fur of passing animals.

Fruit: one-seeded and indehiscent with a thin pericarp. *Seed* - endospermic brownish oblong striated with a very rough adherent testa; *embryo* - hooked, with thin broad *cotyledons* of which the outer which is the larger encloses the soft floury albumin

Part used in medicine. The somewhat tuberous main or tap root.

Description of root - The tap or main root is fairly long, somewhat tuberous, cylindrical to narrowly fusiform to conical or tapering, slightly succulent and turgid. It is normally without similar prominent lateral roots but may be occasionally branched near its distal end. It has a light yellow brown to brownish grey colour and the surface skin is soft and smooth though appearing minutely transversely striated or pitted. In the case of the older roots towards the top or basal end can be made out the knotty scars of fallen rootlets and a few but very prominent elliptical transversely elongate raised lenticel openings. In the specimen or material brought for sale, attached to the thickened basal part of the root the cut ends of a large number of fairly stout branches are present. The fresh root is turgid but on drying gets longitudinally wrinkled. The surface skin is extremely thin corky cream yellow or light brown or rarely darker in tint and easily scraped when fresh. Just within this is a thin yellowish brown layer which can also be scraped easily. Inside these layers is a bright silvery or chalk white region which in tangential section appears to be made up of a very large number of minute narrowly elliptical silvery white spots that give this region its characteristic lustre. Next within and occupying the centre of the root is a fairly wide woody core.

The officinal, that is, the living part of the bark has a slightly aromatic, sweetish and starchy taste without bitterness but it is somewhat acrid or irritating to throat probably on account of the presence in abundance of bundles of calcium oxalate crystals or needles. Fracture splintery inside. The dried material may be slightly bitter.

In the fresh cut transverse section of the root the outer bark or cork appears as a very thin brownish strip or layer less than 1 mm. in thickness. Just inner to it is a region about 1 mm. thick having a silvery white lustre and in the centre the zone of wood. The wood in transverse section appears concentrically striated, the striations being due to alternating zones of rings of wood and discontinuous circles of silvery translucent patches. There are no prominent medullary rays or a well defined pith.

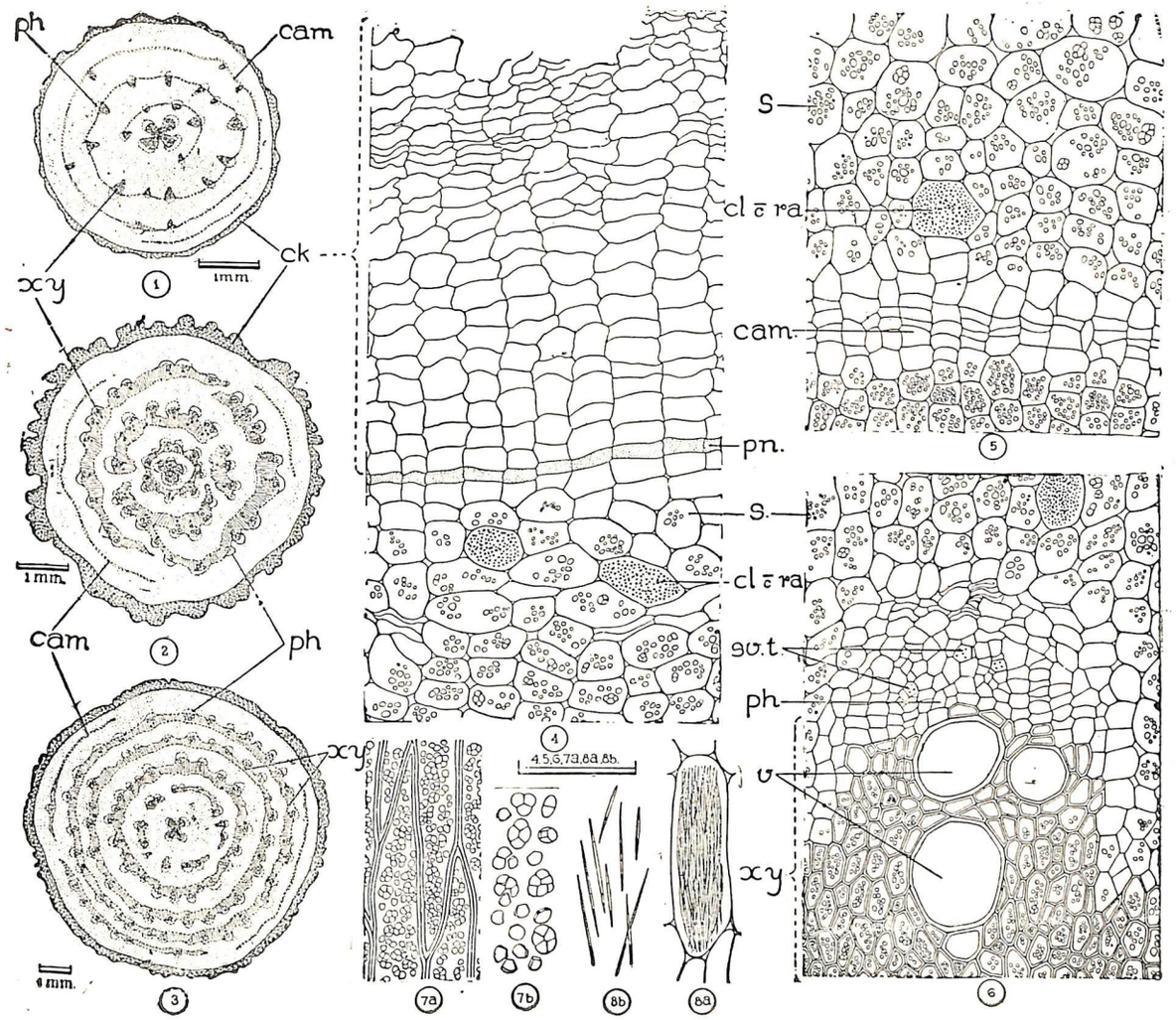
Histology of the root.

General Features.

A transverse section of a very young root having a diameter of less than half a mm. shows a central wood region with very thin patches of phloem outside forming a broken or incomplete ring. The central wood region may be irregularly circular or in the form of a maltese cross and consists mostly of sclerenchyma and a few vessels. Outer to the phloem is the cortex nearly as wide as the wood and at the periphery two or three rows of cork cells. In slightly older roots having a diameter of about 1 mm. seconday thickening has begun. In these, outside the primary central vascular strand the presence of a complete or incomplete ring of cambium can be made out which by its activity has formed five or six groups of xylem vessels towards the inside and an equal number of phloem groups towards the outside the two together suggesting the presence of five collateral bundles separated by thinwalled parenchyma. The latter may later on undergo cell wall thickness and appear sclerenchymatous.

In still older roots having a diameter of about 4 mm. one complete ring of wood is found surrounding the central vascular strand or core. The xylem vessels are confined to five or six radial groups with the xylem parenchyma occupying the rest of the ring. The phloem does not completely surround the xylem, but occurs in the form of crescent shaped patches just outside the groups of xylem vessels in the ring of wood. In addition, another incomplete concentric ring of cambium is found to be developing in the cortex outer to this vascular ring and separated from it by a zone of parenchyma. The formation of successive secondary cambial strips may slightly vary in different specimens. For example in certain other roots of the same diameter it is found that outer to the central vascular strand and separated from it by parenchyma an incomplete or broken cambium ring has developed, from which five groups of radial vascular strands have formed, with parenchyma cells in between, and just outer to this is a cambium which has produced twelve groups of varying sizes of xylem vessels with phloem outside arranged in a circle. At the periphery of the cortex may be made out yet another strip of cambium ring beginning to cut off vascular elements. All these secondary concentric zones of wood-tissue, are

Plate IV



Histology of root of *Boerhaavia diffusa* Linn.

1 & 2. Diagrammatic sketches of the T. S. of young roots.
3. Diagrammatic sketch of the T S. of an old root.
4. Cork and cortex.
5. The outermost cabium with the adjoining cells.
6. A vascular bundle.
7*a*. L. S. of the thickwalled elements of the wood.
7*b*. Starch grains.
8*a*. L. S. of a cell with the raphide bundle.
8*b*. Crystals from different raphide bundles.

composed of a limited number of radial groups of vessels separated by parenchyma, the latter forming the bulk of the woodring. (see plate)

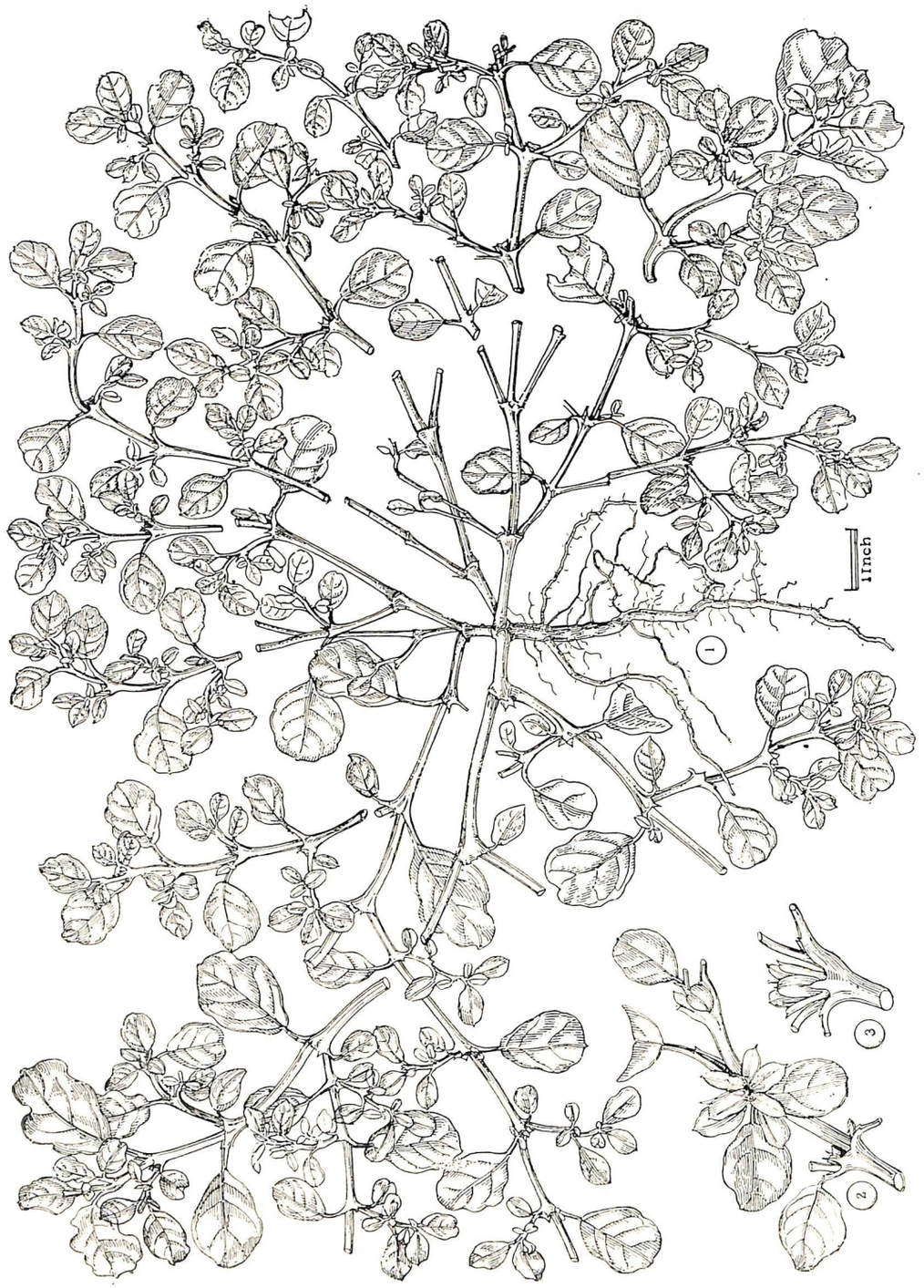
A transverse section of the root with a diameter of 6 mm. shows a comparatively broad zone of cork at the periphery and three or more concentric rings of wood outside the central primary vascular strand. Alternating with these rings of wood are broad zones of parenchyma. Phloem occurs associated with each ring of wood but only outside the groups of xylem vessels in the form of crescent shaped patches and not as a complete ring. The presence of a developing ring of cambium outside all the zones of wood in addition to the above can be made out in the cortex in some cases.

In still older roots five or more complete concentric rings of wood as well as two or three incomplete or broken rings may be made out surrounding the central core of vascular tissue, each ring alternating with a broad zone of parenchymatous tissue. Broad bands of thick walled elements separate the groups of xylem vessels in each such ring.

Details of structure of an old and fairly thick root.

The transverse section is circular in outline but the margin is not entire or even, being interrupted by short fissures or clefts in the cork. The cork layer has a thickness of about 1 mm. but the thickeness is not uniform throughout due to the unevenness of the outer layers. It is composed of 15 to 20 or occasionally up to 25 rows of almost rectangular, thinwalled cells, the walls of which are light brown or yellowish brown in colour. The cells of outermost rows are tangentially elongated and appear compressed with some of them exfoliating. A *phellogen* composed of a single row of thinwalled, slightly tangentially elongated narrow cells is present, within which can be made out a narrow *phelloderm* consisting of 2 or 3 rows of cells. The peripheral part of the cortex outside the concentric zones or bands of wood tissue is composed of 15 or more rows of cells. The cells are all thinwalled, rounded or polygonal or occasionally rectangular with rounded ends and with intercellular spaces. Most of these cells contain starch grains. The grains are mostly small, hemispherical or rounded with a diameter of 5 to 9 μ. A few compound grains are also present. A few cells

contain bundles of calcium oxalate crystals. These completely fill the cell and the cells have a characteristic appearance. They appear elliptic or oblong in L. S. and are larger than the neighbouring cells. The individual crystals or needles of the raphide bundles have a length of 60 to 66μ. These crystals are arranged lengthwise in 2 or 3 tiers in each so that in a T. S. of the root cut ends of many of these crystals may be made out. Several concentric bands of wood tissue alternating with fairly wide zones of parenchyma with the primary strand of vascular tissue occupying the centre of the root can be made out in the section. There may also be present in the cortex outside all these rings the most recently formed and currently active ring of cambium consisting of one or two rows of narrow tangentially elongate thinwalled cells. Each annular band of wood tissue is composed mostly of closely arranged thickwalled elements alternating with groups of xylem vessels. These cells appear polygonal and slightly radially elongate in T. S. and in L. S. from 12 to about 25 times as long as broad with the sides parallel and ends tapering or occasionally forked and the radial walls with simple pits. All the cells are fully packed with starch grains which are mostly compound each one composed of two to five or six components. The compound grains vary from 8 to 15 μ in width according to the number of components. The components get easily separated into simple units with one convex and two to five plane faces. The xylem vessels occur in widely separated radial groups or rows each group consisting of four to eight or more vessels of varying sizes. The narrower vessels are about 40 to 50 μ wide and 150–170 μ in length and the broader 100–130μ in diameter and 80-100 μ in length. The phloem occurs as hemispherical or crescentic patches outside the groups of xylem vessels. A continously active cambium is not evident in any of these vascular zones. The broad zone of parenchymatous ground tissue in between two successive rings of wood is composed of large thinwalled more or less rectangular cells arranged in regular radial rows with small intercellular spaces. Almost all these cells are densely packed with starch grains while a few contain raphide bundles. The medullary rays are not very clear and there is no distinct pith, the centre of the root being occupied by the primary xylem which appears irregularly circular or in the form of a cross with the free distal ends of the arms broadest.



Trianthema portulacastrum Linn.

1. The plant. 2. A portion with an open flower. 3. Side view of the flower at the axil.

Plate V

TRIANTHEMA PORTULACASTRUM Linn.*

Syn. *Trianthema monogyna* Linn.; *Trianthema obcordata* Roxb.

Family: Aizoaceae.

Sanskrit	–	Upotakai, Punarnāvī
Malayāḷam	–	Pas'alikīra (variety)
Tamil	–	S'arunai, Carunai, Kodivayalakīrai
Hindi	–	Swetsabuni, Lalsabumi, Nasarjanghi, Bishkhapa.

Distribution and habitat

Throughout India in most of the plains districts. The plant is a common weed of roadsides, waste lands fallow rice fields, old gardens, rubbish heaps etc. It is very abundant during the rainy season.

Habit and general features

Trianthema portulacastrum Linn. is a much branched, diffuse, somewhat succulent, more or less glabrous perennial herb with a slightly tuberous root and a very short thick stem with many prostrate or trailing rounded or angular jointed sometimes more or less reddish tinted dichotomous branches slightly downy or hairy on the upper side bearing opposite unequal short petioled, subfleshy, entire, leaves. The larger and smaller leaves alternate at each node and the stipuliform winged or dilated bases of their petioles together form a cuplike structure clasping or encircling the stem at the forks of the branches, enclosing small solitary sessile flowers or few seeded circumscissal capsules. The plant is in flower and fruit nearly throughout the year,

The leaves well boiled are used as a leaf vegetable.

External morphology:

Leaves: short petioled obliquely opposite, unequal, one large and one small, the larger and smaller alternating at successive nodes exstipulate but the bases of the petioles dilated into membraneous

---

* *Trianthema portulacastrum* as well as *T. pentatndra* and *T. decandra* are often substituted for *Boerhaavia diffusa*. *Trianthema portulacastrum* is often called Sveta punarnava on account of the resemblance of its foliage when young to that of *Boerhaavia*.

stipuliform margins that clasp the stem; *blade* – obovate to obcordate somewhat fleshy entire and wavy with a reddish border the larger obovate or obcordate and usually more than 2·5 cms. each way (from 18 to 36 mm. (by 18 to 36 mm.) the smaller ones narrow, oblong and tapering to the base rounded and often apiculate at apex, generally less than 2·5 cms. in length 9 mm. to 12 mm. by 6 mm. to 9 mm. *Petiole:* –about 6 mm. (4 to 8 mm.) long. slightly hairy, concave and winged. The basal stipuliform membranous margins of the leaves are stem clasping and those of each pair at a node together form a cuplike structure inside which the solitary flower is located.

Flowers: small, solitary, sessile situated within the cuplike structure formed by the sheathing bases of the petioles and therefore nearly concealed in the forks of the branches. Each flower has a membraneous bract and bracteoles. *Calyx tube* - scarious thin closely sheathed by the base of the petioles with ovate acute or obtuse cuspidate lobes that are pinkish coloured within. *Corolla* - absent. *Stamens* - ten to fifteen inserted near the top of the calyx-tube. *Ovary* - superior, sessile free turbinate truncate at apex one-chambered or occasionally two locular and enclosing a few ovules attached to a basal placenta; *style* – single subulate papillose, and shorter than the stamens.

The fruit is a coriaceous circumscissal somewhat four pointed more or less beaked capsule about five mm. long. Its upper dehiscent part is beak-like or mitriform and during dehiscence carries away one or two seeds attached in it; the lower part is scarious cuplike and encloses two to five or more seeds. *Seeds* – usually about half a dozen reniform the testa somewhat black scarcely shining, but somewhat rough with concentric broken muriculate undulating raised lines. Embryo – annular.

Officinal part : The root.

Description of the root.

The root system of *Trianthema* is poorly developed when compared to that of *Boerhaavia*. It consists of a tap root attaining a length of 8 to 10 cms. and a diameter of less than half a centimeter with several very narrow branching lateral roots. The outer surface of the root is light yellow and the cut surface has a cream white colour.

Histology of the root.

Roots less than a millimeter in diameter show a simple structure. The transverse section is circular and the outline regular. The centre of the root is occupied by a strand of secondary xylem which in transverse section appears like a dumb bell with two primary xylem groups at the narrow middle part in the plane of its longer axis showing that the root is diarch. Two groups of primary phloem are found one on either side and in contact with the narrow central part at right angles to the plane of primary xylem but separated by secondary xylem. Narrow strips of secondary phloem occur outside the broader ends of this central xylem strand. In addition, there are also present two other smaller xylem strands located laterally in the concavities of the central dumb bell shaped strand one on either side but separated from the latter by a zone of parenchyma. Strips of phloem also occur in contact with and outside these two xylem groups. A fairly broad cortex surrounds the vascular strands. The cortex is lacunar at the periphery. Its cells are fairly large and some of them contain aggregates of rhomboidal crystals. A single row of epidermis is present at the periphery.

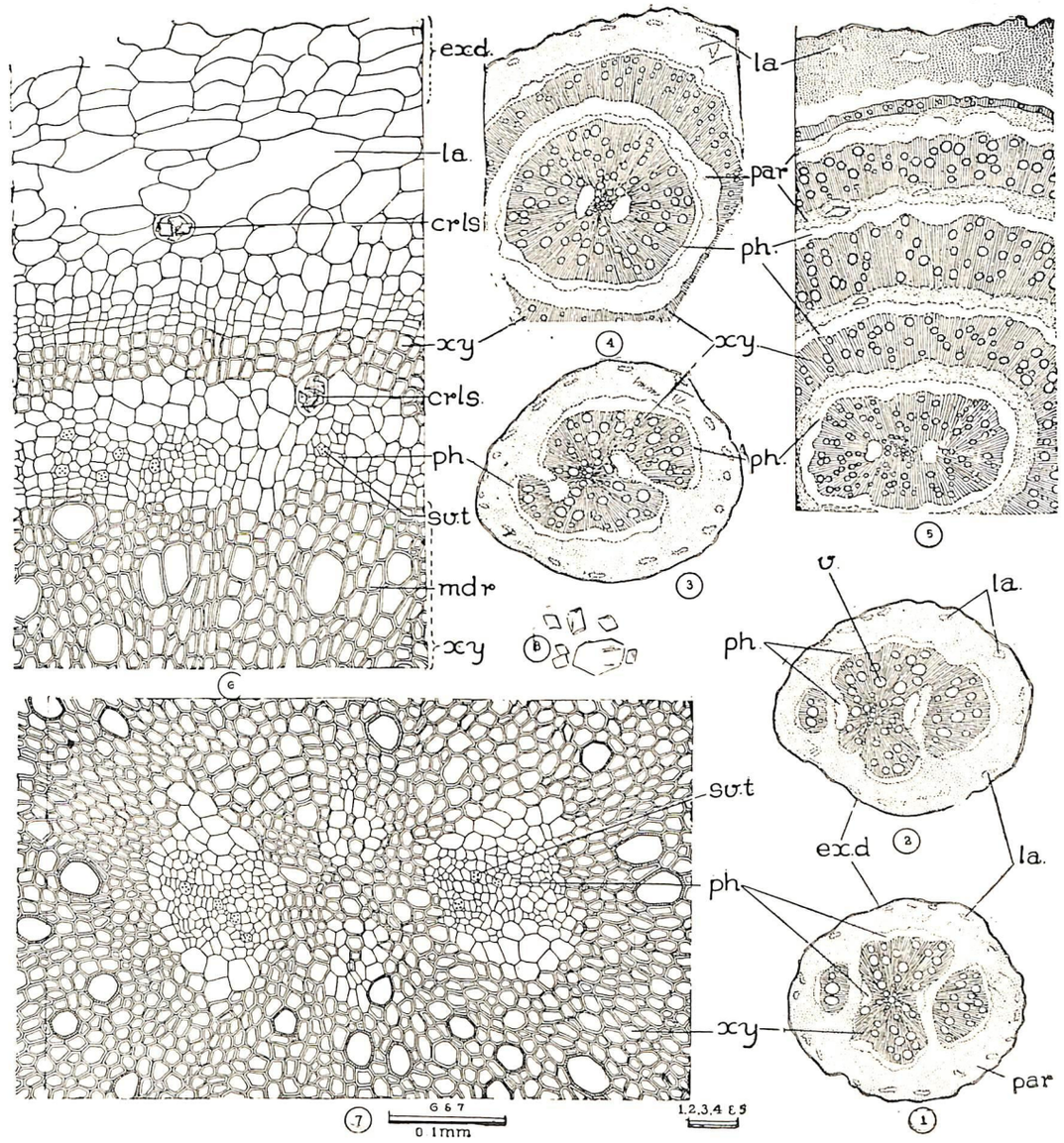
In roots which are slightly older with a diameter of one millimeter or more, the cortex is narrower, but similar in all other respects. On account of the further development of xylem elements between each of the smaller lateral xylem strands and the nearest or adjacent distal end of the central dumb bell shaped strand, the xylem as a whole appears like the letter "S" in T. S. The two phloem groups nearest the centre appear more or less completely surrounded by the xylem, except for a narrow radial zone of parenchyma. This too becomes soon closed by continuous formation of secondary xylem resulting in two islands of phloem near the centre in the midst of secondary xylem which now appears as an irregular circle. Phloem also occurs as a narrow zone surrounding the entire central xylem strand. In transverse sections of still older roots on account of the activity of one or more secondarily developed annular strips of cambium in the cortex, one or more concentric zones of vascular tissue can be made out separated by narrow bands of ground tissue or parenchyma, the cells of which are larger than those of phloem. The peripheral part of the cortex outside the vascular zones appears

lacunar and at the periphery two or more rows of slightly thinwalled cells are present forming an exodermis.

In the more mature roots that are taken up for officinal use, and which may have a diameter of four to six millimeters or more, in addition to and surrounding the central vascular strand with the two islands of phloem, three or more concentric bands of vascular tissue each composed of a broader zone of xylem and a narrow zone of phloem can be made out. The xylem vessels are of varying sizes and appear scattered amidst the thick walled xylem sclerenchyma and not in radial groups as in *Boerhaavia*. Alternating with the successive zones of vascular tissue a few rows of parenchymatous cells forming narrow rings occur. The cells of the parenchyma as seen in T. S. are polygonal, larger than those of the phloem, thinwalled and have intercellular spaces. Some of these cells contain aggregates of rhomboidal crystals similar to those of the cortical cells. A narrow zone of cortex is present outside the vascular strands. It appears lacunar at the periphery and is composed of fairly large, oblong or polygonal or tangentially elongate thinwalled cells. Aggregates of rhomboidal crystals occur in some of the cortical cells. The size of the crystals varies in the different cells. Three or four rows of closely arranged thinwalled cubical to tangentially elongate rectangular cells are found at the periphery. No distinct zone of cork is evident. Well defined medullary rays are not found but here and there a few short uniseriate rays composed of large radially elongated cells occur. These cells appear thickwalled in the xylem and thinwalled in the phloem and ground parenchyma.

The complete absence of starch grains either in the ground tissue or in xylem parenchyma is a noteworthy feature of difference between this and the root of *Boerhaavia*. The phloem occurs here as a narrow strip completely surrounding the xylem bands. In *Boerhaavia* it occurs in semicircular or crescentic patches and only just outside the groups of xylem vessels. Here calcium oxalate is present in the form of aggregates of rhomboidal crystals whereas in *Boerhaavia* it is present as bundles of acicular crystals and to a much greater extent.

Plate VI



Histology of root of Trianthema portulacastrum Linn.

1 to 4. Diagrammatic sketches of the T. S. of young roots.
5. Diagrammatic sketch of a sector of the T. S. of an old root.
6. Cortex along with the outermost two rings of vascular tissue.
7. Central part of the root showing the islands of phloem and the primary xylem groups.
8. Crystals of calcium oxalate.

ĀKHUKARNĪ*

Source plant in Kerala :

– **Merremia emarginata** Hallier f.

Family : Convolvulaceae.

Sanskrit Text

Descriptive synonyms

आखुकर्णी त्वाखुपर्णी पर्णिका भूदरीभवा ।

(भावप्रकाशः)

Ākhukarṇi tvākhuparṇī parṇikā bhūdarī bhavā |

(Bhāvaprakās')

चित्रा द्रवन्त्याखुकर्णी विषकर्ण्याखुकर्णिका ।
प्रत्यक्पुष्पी वृषैरण्डा प्रत्यक्श्रेणी च शम्बरी ॥

(अभिधानमञ्जरी)

Citrā dravantyā khukarṇī viṣakarṇyā khukarṇikā |
Pratyakpuṣpī vṛṣairaṇḍā pratyak s'reṇī ca s'ambarī

(Abhidhānamanjarī)

स्यादाखुकर्णी कृषिका द्रवन्ती चित्रा सुकर्ण्युन्दुरुकर्णिका च ।
न्यग्रोधिका मूषकनामकर्णी स्याद्वृश्चिकर्णी बहुकर्णिका च ॥
माता भूमिचरी चण्डा शम्बरी बहुपादिका ।
प्रत्यक्श्रेणी वृषा चैव पुत्रश्रेण्यद्रिभूह्वया ॥

(राजनिघण्टुः)

Syādā khukarṇī kṛṣikā dravantī
Citrā sukarṇyundurukarṇikā ca |
N'yagrodhikā mūṣakanāma karṇī
Syādvṛs'cikarṇī bahukarṇikā ca ||

---

*Three plants known in Malayalam as *Eliccevi*, *Valia eliccevi* and *Ceria eliccevi* are used. *Merremia emarginata* Hallier f. is one of the three. A species of *Salvinia* (a floating fern) is also equated as Ākhukarni.

Mātā bhūmicarī caṇḍā s'ambarī bahupādikā |
Pratyak s'reṇī vṛṣā caiva putrasreṇyadribhūhvayā ||

(Rājanighaṇṭu)

Of the descriptive synonyms *Ākhuparṇī*, *Ākhukarṇī*, *Mūṣakarṇī*, *Musakanamakarṇī* – meaning like a mouse's ear may indicate the resemblance of the form of leaves of this plant to the ears of a rat or mouse. *Parṇikā*, *Pratyakpuṣpī*, *Pratyakasreṇī*, *Sutasreṇī*, *Bahukarṇika* and *Bahupādika* may indicate the occurrence at regular intervals of the leaves and flowers and the presence of numerous roots that arise from the nodes or joints of the creeping stem. *Ākhukarṇī* and *Bhudaribhavā* and *Kṛṣika* may mean the close contact with the ground of the plant. *Dravantya*, meaning spreading to a long distance may indicate the extensive growth over the ground of its branches. The plant with its numerous branches that root at the nodes covers a large surface area of the soil. *Vṛṣairaṇḍa* indicates a quality of the plant namely that it is aphrodisian.

Ayurvedic properties and uses.

आखुकर्णी कटुस्तिक्ता कषाया शीतला लघुः ।
विपाके कटुका मूत्रकफामयकृमिप्रणुत् ॥

(भावप्रकाशः)

Ākhukarṇī kaṭustiktā kaṣāyā s'itaḷā laghuh:
Vipāke kaṭukā mūtrakaphāmayakṛmipraṇut ||

(Bhāvaprakās'a)

कृमिघ्ना बद्धविण्मूत्रा कषायमधुरा हिमा ।
आखुकर्णी वलासघ्नी वातला कटुपाकिनी ॥

(भोजे)

Kṛmighn'ā baddhaviṇmūtrā kaṣāyamadhurā himā |
Ākhukarṇī valāsaghn'ī vātaḷā kaṭupākin'ī ||

(Bhoje)

शशश्रुतिर्ज्वरहरा वातवैगुण्यनाशिनी ।

(हृदयप्रियम्)

S'as'as'rutirjvaraharā vātavaiguṇyanās'in'ī

(Hṛdayapriyam)

आखुकर्णी कटूष्णा च कफपित्तहरा सदा ।
आनाहज्वरशूलार्त्तिनाशिनी पाचनी परा ॥

(राजनिघण्टुः)

Ākhukarṇī kaṭūṣṇā ca kaphapittaharā sadā |
Ān'āhajvaras'ūlārttinās'in'ī pacan'ī parā ||

(Rājanighaṇṭu)

According to Bhāvaprakās'a *Ākhukarṇī* is pungent, bitter, astringent, cool, light, and pungent on digestion. It is useful in or overcomes urinary diseases and diseases owing to *Kapha* as also worms. Other properties and uses mentioned elsewhere are: Arrests faeces and urine, is sweet, causes *Vāta*; cures fever, distension of the abdomen due to gas; and promotes digestion. The leaf juice is given for rat bites and snake bites- *Caraka* has included this among remedies against worms.

Officinal part: The whole plant.

MERREMIA EMARGINATA Hallier f.

Synonyms: *Ipomaea reniformis* Choisy.

Ipomaea cymbalaria Fenzl.; *Convolvulus reniformia* Roxb.

Convolvulus gangeticus Linn.

Evolvulus emarginatus Burm.; *Evolvulus gangeticus* Linn.

Family: Convolvulaceae

Sanskrit	–	Ākhukarṇī
Malayāḷam	–	Eliccevi
Tamil	–	Peretay keerai or Paerattae keerai
Hindi	–	Mūsakāri
Bombay	–	Undirkāni

Distribution and habitat.

The plant is found in most parts of tropical India extending southwards from Rajaputana, Bihar and Bengal to Konkan, the Deccans, N. Circars, and Carnatic, growing in the plains as well as in the hills up to an elevation of about 3000 feet. It is commonly found in slightly moist areas or places where water has stagnated and dried. Flowers during the cool season.

Habit and general features.

Merremia emarginata Hallier f. is a glabrous or sparingly pubescent ramous or many branched closely creeping perennial herb with numerous stems and slender pack-thread like branches profusely rooting at the joints or nodes and bearing simple, alternate, long stalked reniform or ovate cordate entire, wavy or slightly scallop-toothed, dark, ferruginous green leaves of varying sizes, and small subsessile, axillary bright yellow flowers followed by subglobose capsular fruits containing four brownish seeds.

External morphology.

Leaves: simple, alternate, exstipulate, comparatively long stalked; *petioles* - smooth, often longer than the leaves, from 0.25 to 0·75 inches long; *blade* - varying in size, generally broader than long, half to one and a half inches or more broad, reniform, ovate-cordate

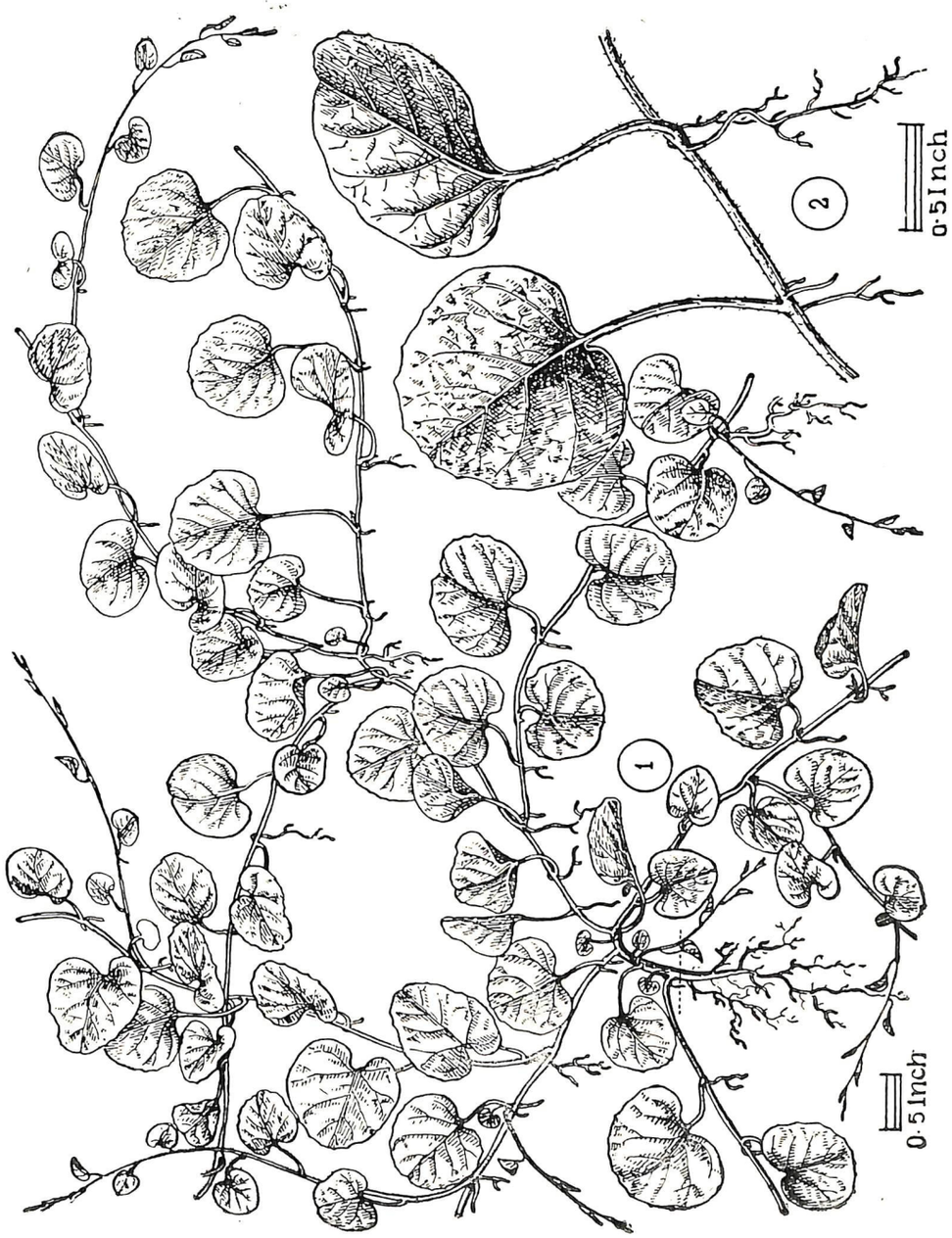


Plate VII

Merremia emarginata Hallier f.

1. The plant.
2. A. part enlarged.

or occasionally ovate, wavy or slightly scallop-toothed, emarginate, or very rarely obtuse and of a dark ferruginous green colour

Flowers: small to very small, bright yellow, subsessile with inconspicuous bracts solitary or on few (1-3) flowered very short axillary peduncles that are much shorter than the petioles. The flowers generally open in the forenoon and close early in the evening. *Sepals* – five, free, persistent, the outer two smaller oblong or ovate, obtuse, apiculate or pointed, glabrescent, and long, ciliate, the inner three larger, broadly wedge-shaped and deeply emarginate nearly 0.25 inch long. *Corolla* – gamopetalous, small 0·25 inch in diameter deeply divided into five lobes. *Stamens* – five, epipetalous, filaments filiform unequal often villous at base, (smooth according to Roxb.) anthers twisted, pollen not spinulose but with longitudinal folds. *Pistil* – bicarpellary; ovary two to four locular, with four ovules; *style* – filiform ending in a biglobose stigma.

Fruit: a subglobose or rounded capsule, the size of a small pea, (0.2″ in diameter) slightly longer than the calyx with two or four glabrous minutely dotted light brown or chestnut coloured seeds.

Officinal parts: The entire plant.

KṢĪRAVIDĀRĪ

Source plant:

Ipomaea paniculata R. Br.

Family: Convolvulaccae.

Sanskrit Text

Descriptive synonyms

(क्षीरविदारी गेडी इति लोके)

वाराही कन्दसंज्ञस्तु पश्चिमे गृष्टिसंज्ञकः ।
वाराही कन्द एवान्यैश्चर्मकारा लुको मतः ॥
आनूपसंभवे देशे वराह इव लोमवान् ।
विदारी स्वादुकन्दा च सा तु क्रोष्टी सिता स्मृता ॥
इक्षुगन्धा क्षीरवल्ली क्षीरशुक्ला पयस्विनी ।
वाराहवदना गृष्टिर्वैरदेत्यपि कथ्यते ॥

(भावप्रकाशः)

(Kṣīravidārī geṭhī iti loke)

Vārāhī kandasamjñastu pas'cime gṛṣṭhisamjn'ikaḥ
Vārāhī kanda evān'yais'carmakārāluko mataḥ ॥
Ān·ūpasambhave des'e varāha iva lomavān' |
Vidārī svādukandā ca sātu kroṣṭrī sītā smṛtā ॥
Ikṣugandhā kṣīravallī kṣīras'ukḷā payasvin'ī
Vārāhavadan'a gṛṣṭhirvara detyapi kathyate ॥

(Bhāvaprakās'a)

अन्या क्षीरविदारी स्यादिक्षुगन्धेक्षुवल्लरी ।
इक्षुवल्ली क्षीरकन्दा क्षीरवल्ली पयस्विनी ॥
क्षीरशुक्ला क्षीरलता पयःकन्दा पयोलता ।
पयोविदारिका चेति विज्ञेया द्वादशाह्वया ॥

(राजनिघण्टुः)

**Adenia palmata* Engl. (Modecca palmata Lamk. belonging to Passifloraceae whose tubers are poisonous is sometimes referred to as Modakku and has to be differentiated from *Ipomaea paniculata* which is also occasionally called Modakku.

An'ya kṣīravidārī syādikṣu gandhekṣuvallarī |
Ikṣuvallī kṣīrakandā kṣīravallī payasvin'ī ॥
Kṣīras'ukḷā kṣīralatā payaḥ kandā payolatā
Payo vidārikā ceti vijñeyā dvādas'āhvayā ॥

(Rājanighaṇṭu)

निर्दिश्यते विदारी शुक्ला वृष्या च वृष्यकन्दा च ।
वृष्यलता स्वादुमती सृगालिका स्वादुकन्देति ॥
अन्या क्षीरविदारी पयस्विनी क्षीरकन्दा च ।
आदरीक्षुविदारी कन्दपलाशी तथा नन्दी ॥
क्षीरवल्ली क्षीरशुक्ला वल्याह्वा दारिका तथा ।
इक्षुवल्ली चेक्षुकन्दा गजाश्वेष्टा निगद्यते ॥

(अभिधानमञ्जरी)

Nirdis'yate vidārī s'uklā vṛṣyā ca vṛṣyakandā ca |
Vṛṣyalatā svādumatī sṛgālikā svādukandeti ॥
An'yā kṣīravidārī payasvin'ī kṣīrakandā ca |
Ādārīkṣuvidārī kandapalās'ī tathā nāndī ॥
Kṣīravallī kṣīrasukḷā valyāhvā dārikā tathā
Ikṣuvallī cekṣukandā gajā s'veṣṭhā nigadyate ॥

(Abhidhān'amañjarī)

क्षीरकन्दो द्विधा प्रोक्तो विनालस्तु सनालकः ।
विनालो रोगहर्ता स्याद्वयस्तम्भी सनालकः ॥

(राजनिघण्टुः)

Kṣīrakando dvidhā prokto viṅāḷstu saṅāḷakaḥ |
Vināḷo rogahartā syādvayastambhī sanaḷakaḥ ॥

(Rajanighaṇṭu)

The terms *Vārāhi, Gṛsti* meaning-like the tusk of a boar *Kanda* and *Vidāri* denoting growing underneath or piercing the earth and the terms *Vārāhīkanda Vidārikanda* indicate the underground nature

of the officinal part. *Carmakārāluko* may refer to the shape of the tuber, conical and curved like that of a pitcher. *Bhumikuṣmaṇḍa* means earth gourd - from the fancied resemblance of the tuber to the fruit (gourd) of *Benincasa cerifera.*

Vārāhi iva *loman* – hairy (?) at places. *Kṣīravallī*, *Kṣīrasukla Kṣīrakanda* and *Payasvini* point out to the presence of abundant milky juice in the underground tuber as well as the aerial part. *Svādakanda* means agreeable or sweet in taste and *Ikṣugandha* having the smell of sugarcane. *Vrksavalli* – Tree-keeper or growing over trees.

The slokas refer to two varieties namely (i) *Kṣīravidāri* (Mahasveta. Ṛkṣagandhika) a white variety with milky juice in the root which is greenish red (कन्दपलाशी) and (ii) *Vidāri* (Kṣīrasukla, Ikṣugandha, Kṛōṣtri which is white and sweet, with long roots and leaves and intoxicating in its effect.

Ksiravidari is preferred over *Vidari.*

In Kerala, two varieties are distinguished. They are known locally as Pālmutukku (white) and Karimutukku (dark). It is not possible to state whether these correspond to the varieties mentioned in the texts.

Ayurvedic properties and uses.

विदारी मधुरा स्निग्धा बृंहणी स्तन्यशुक्रदा ।
शीता स्वर्या मूत्रला च जीवनी बलवर्णदा ॥
गुरुः पित्तास्रपवनदाहान् हन्ति रसायनी ।

(भावप्रकाशः)

Vidārī madhurā sn'igdhā bṛmhaṇī stanyā s'ukladā |
S'ītā svaryā mūtraḷā ca jīvan'ī balavarṇadā ||
Guruḥ pittāsrapavanadāhān hanti rasāyan'ī |

(Bhāvaprakās'a)

विदारिकन्दो बलयश्च वातपित्तहरश्च सः ।
मधुरो बृंहणो वृष्यः शीतस्पर्शोऽतिमूत्रलः ॥
स्तनदोषस्य हरणी गूढवृष्यविषूदनी ।

(धन्वन्तरिनिघण्टुः)

Vidārikando balyas'ca vāta pittaharas'ca saḥ |
Madhuro bṛmhaṇo vṛṣyaḥ sītaspars'ostimūtraḷaḥ ||
Standoṣasya haraṇī gūḍhavṛṣyaviṣūdan'ī |

(Dhanvantari Nighaṇṭu)

ज्ञेया क्षीरविदारि च मधुराम्ला कषायका ।
तिक्ता च पित्तशूलघ्नी मूत्रमेहामयापहा ॥

(राजनिघण्टुः)

Jñeya kṣīravidārī ca madhurāmḷā kaṣāyakā |
Tiktā ca pittas'ūlaghnī mūtramehāmayāpahā ||

(Rājanighaṇṭu)

विदारी वातपित्तघ्नी कण्ठ्या बल्या च मूत्रला ।

(हृदयप्रियम्)

Vidārī vātapittaghn'ī kaṇṭhyā balyā ca mūtraḷā |

(Hṛdayapriyam)

According to *Bhava prakasa Vidari* is sweet, demulcent; causing corpulence; promoting breast milk and semen; cool, improving voice; diuretic, vitalising; promoting strength and complexion; heavy; overcomes vitiated *Pitta*, *Rakta*, *Vata* and also burning sensation and is an alterative tonic.

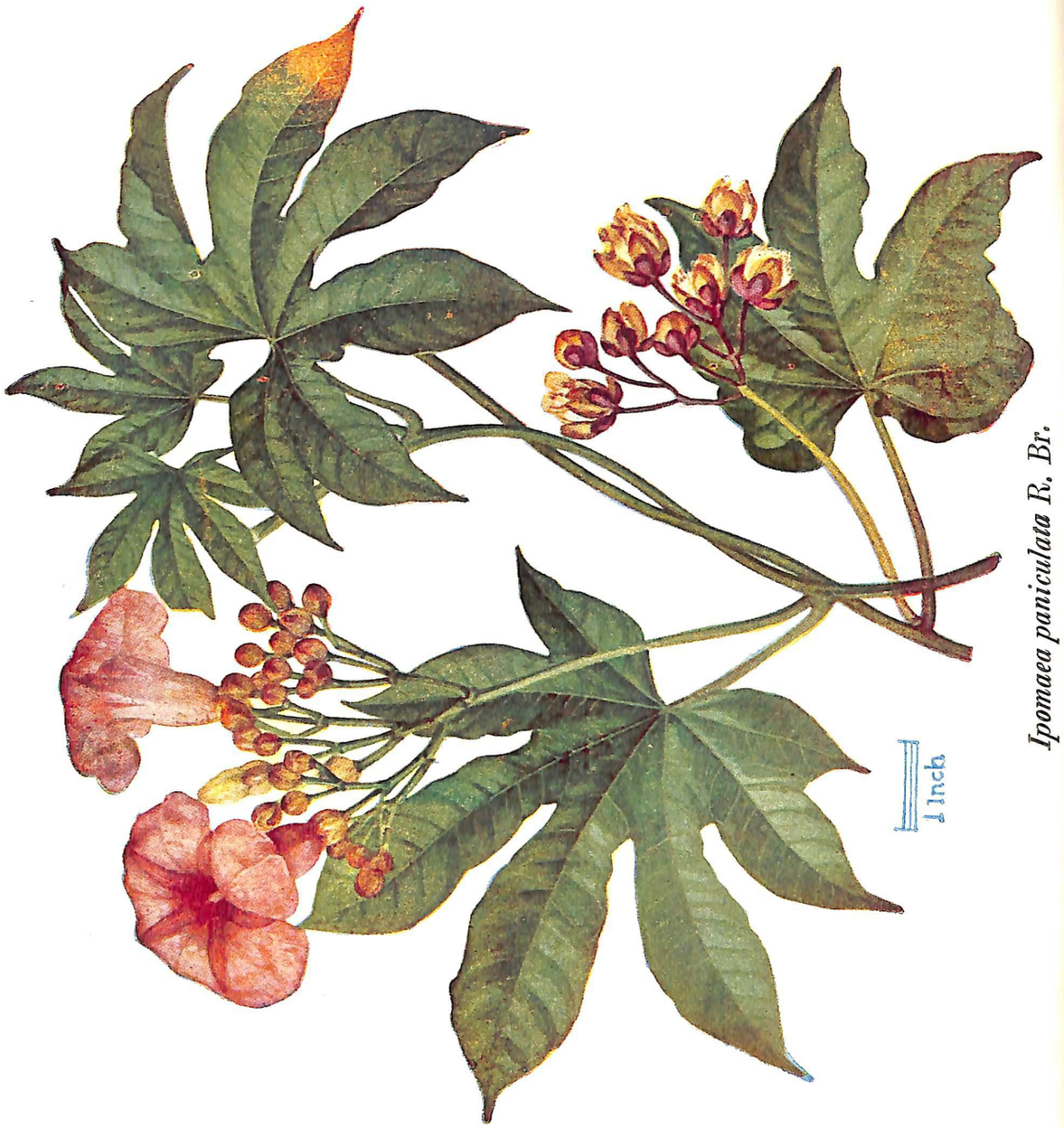
Rajanighantu attributes sour, astringent and bitter tastes also. These may be considered as *anurasas* i.e. tastes subordinate to the dominant one i.e sweet. According to this authority it is useful in urinary disorders also.

The variety *vinala* is capable of curing diseases and the variety *Sanala* of restoring youthfulness and vigour.

Caraka has included this in *Balya*, *Kanthya* and *Brmhaniya* groups. Officinal part of the plant is its underground stem.

According to Dymock the large tuberous root is considered to be tonic, alterative, aphrodisian, demulcent and lactogogue.

For Vajikaranartham and sthanyavardhanartham, both varieties of this drug are freely used by vaidyans with much benefit.



Ipomaea paniculata R. Br.

Plate VIII

IPOMAEA PANICULATA R. Br.*

Syn: *Ipomaea digitata* Linn., *Ipomaea tuberosa* G. F. W. Merr.; *Convolvulus paniculata* Linn., *Batatas paniculata* Chois.; *Batatas edulis* Chois.; *Ipomaea mauritiana* Jacq.; *Ipomaea gossypifolia* Willd.; *Convolvulus roseus* Kunth

Family :	Convolvulaceae.
Sanskrit	Kṣīravidārī, Ikṣugandha, Bhūmikuṣmānda, Payasvinī. Vṛkṣavalli, Ikṣuvalli.
Malayāḷam	Pālmutakku, or Pālmodakku, Karimodakku
Tamil	Phalmodika, Añjilatāli (അഞ്ചിലതാളി)
Hindi	Bidārikānd, Bilāikand

Distribution and habitat.

Found throughout India except the drier regions of the North-West. Fairly common from Bengal to Assam, Deccan, Bombay, the Konkans, Coromandel and along the West Coast from South Canara to Cape Comorin. It grows along river banks, margins of tanks and lakes as well as along the coastal regions preferring moist areas, climbing or twining over hedges, thickets and small trees.

Habit and general features:

Ipomaea paniculata R.Br. is a large, extensively spreading scandent handsome glabrous twining shrub with a large sized perennial tuberous root and somewhat thick, round, light reddish, rose coloured, or light purplish green, smooth stem and branches, bearing long-petioled deeply palmately five to seven lobed glossy green leaves and axillary long peduncled corymbiform cymose panicles of ten to

---

* In Kerala, two varieties, a white or lighter coloured and a dark variety known as *Pālmotakku* and *Karimotakku* respectively, are recognised by the Vaidyans who attribute slightly different virtues to them. The difference is in the colouration of the tuberous roots, their general form or appearance, and relative size as well as the colour of the stem and leaves. The white variety is always preferred.

twenty or more large showy pink or purplish-red flowers. The plant is in flower usually during the wet season.

External morphology :

Leaves : simple, alternate, exstipulate, long-petioled, fairly large, from 7.5 to 18 cms. in diameter, broadly ovate in outline but palmately five to seven lobed more than half way down or nearly to the base with the lobes lanceolate or elliptic or occasionally spathulate, acuminate, entire, glossy green above, and slightly lighter coloured below. *Petiole :* five to seven and half cms. long.

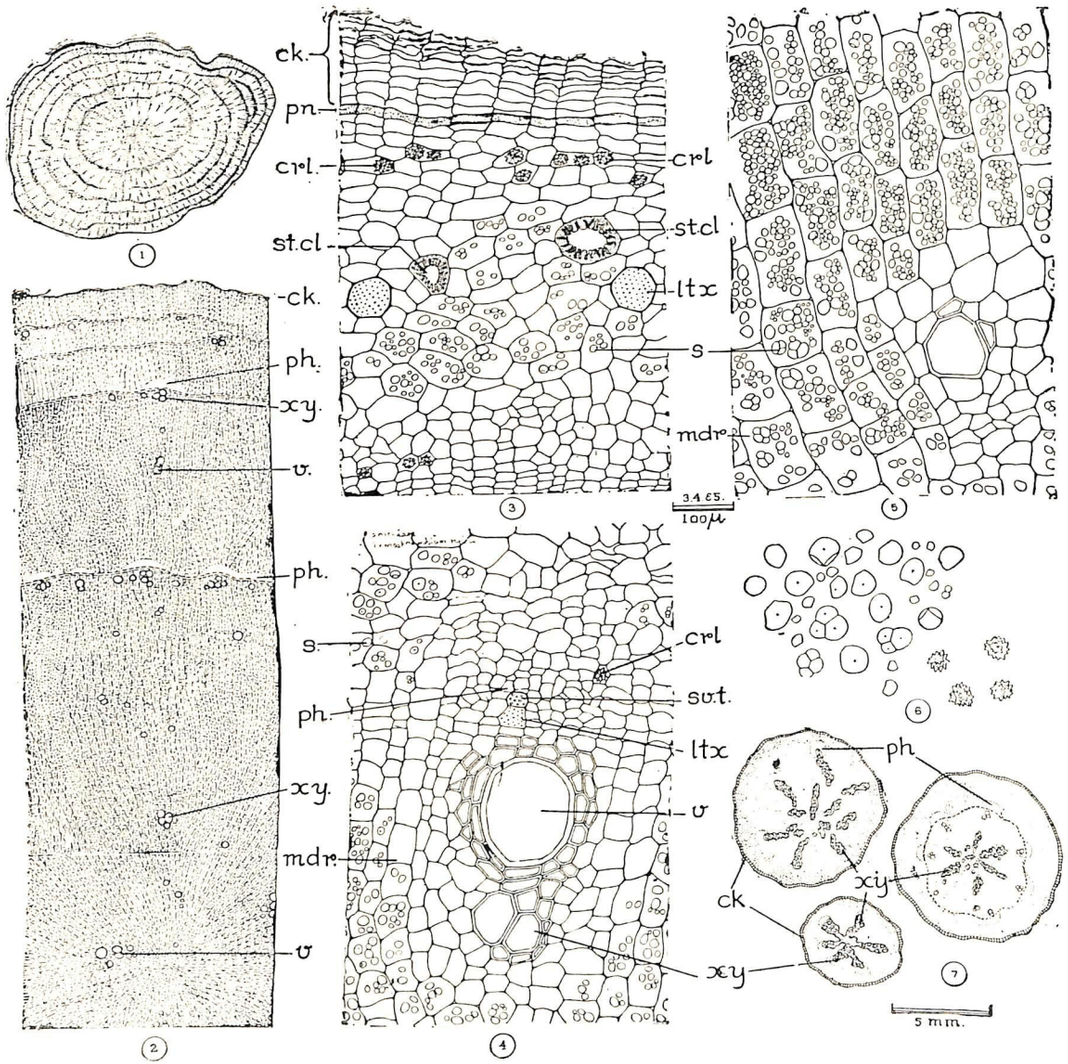
Flowers : many, bracteate, in axillary erect, long pedunculate corymbiform cymose panicles. The peduncles much exceed the petioles often reaching 15 to 25 cms. or more in length and bear ten to twenty or more large broad bell shaped, beautiful, pink to reddish-purple flowers. *Sepals* – five, free, nearly equal, ovate or elliptic rotund to orbicular, concave, obtuse or shortly acute, 7.5 to 10 mm. long and slightly enlarging in fruit. *Corolla* – gamopetalous showy, pink to purple, widely campanulate narrowed at base, glabrous 5 to 7.5 cms. long. *Stamens* – five, included, epipetalous ; *filaments* - free ; *anthers* - straight never twisted. *Ovary* - almost completely four celled except at the top with one ovule in each locule ; *style* simple with a capitate or two lobed stigma.

Fruit : An ovoid four valved capsule about eight mm. in length completely four celled to the apex and enclosing four seeds. *Seeds* - about 6 mm. in length, covered all over with many long tawny cottony or wooly hairs.

Officinal part : The tuberous root.

Description of the root : The root is a large simple or occasionally branched tuber, at times weighing up to thirty kilograms, of a brown colour externally and with a somewhat warty and scabrous surface. The transverse section of the tuber has a dirty white colour and is marked with the concentric rings of vascular bundles and laticiferous vessels from which milky latex exudes in the fresh condition. The vascular bundles are most numerous towards the periphery. The bulk of the tuber consists of starchy parenchyma which has an astringent and slightly acrid taste.

Plate IX



Histology of the tuber of *Ipomaea paniculata* R. Br.

1. Diagrammatic sketch of T. S. of the tuber (reduced).
2. Diagrammatic sketch of a sector of the T. S. of the tuber.
3. Cork and cortex.
4. A vascular bundle at the outer most cambial zone.
5. The ground tissue.
6. Starch grains.
7. Diagrammatic sketches of T. S. of very young tubers.

White variety *(Pālmotakku)*:—The main tuberous root of the 'white' variety of *Ipomaea paniculata*. is very bulky and usually napi- form attaining a diameter of about 40 cms. and weighing 12 to 20 kgs. or more. The size of the tuber varies with the age of the plant. The distal end of the tuberous root tapers off abruptly and continues as a simple or branched elongate narrowly cylindrical or conical root with a few lateral roots (see figure). The tuberous portion bears only small wiry rootlets which are a few cms. in length. The outer surface is light brown and somewhat scabrous. The corky outer layer exfoliates as small very thin narrow strips, leaving small shallow rounded depressions.

Black variety *(Karimotakku)* :—The tuberous part of the main root of the 'black' variety is bulky, mostly oblong cylindrical and one and half to two times as long as broad. It attains a diameter of 30 to 40 cms. and possesses a few lateral roots which may also occasionally get thickened at intervals forming narrow cylindrical tubers five to ten cms. in diameter, the thickness varying with the age of the plant. Long rootlets are present on these tubers. The surface colour is darker than in the white variety. The outer corky layer can be easily peeled off. On scraping this a white starchy region is exposed. In fresh tubers a milky white latex exudes when this white region is scraped or wounded. The latex exuded from the fresh cut surface turns pale brown on drying, or exposure.

Macroscopical characters.

A transverse section of a well developed tuber is 30 to 40 cms. in diameter and circular in outline. The cut surface when fresh is whitish with a thin brown border at the periphery. The sections exhibit a varying number – four to six or more according to age – of irregular concentric rings of vascular and laticiferous tissues formed in succession by the activity of separate cambium strips. These strips of secondary cambia give rise to a considerable amount of parenchymatous tissues outside. The extent of this tissue development is not uniform in the successive zones. The amount formed gradually decreases towards the periphery of the root as a result of which the cambia here are located closer together. Bounding the entire tuber at its outer border there is a well developed cork or *phellem* and immediately within a narrow zone of *phelloderm*. From the younger

peripheral regions of the tuber milky latex exudes in plenty. When the sections get dried up the colour of the cut surface turns grey and exhibits 4 to 6 irregular concentric dark narrow bands alternating with wider paler zones. The exuded latex becomes pale brown in colour and appears along the concentric rings as small dark spots, and at the phelloderm region as small bubbles.

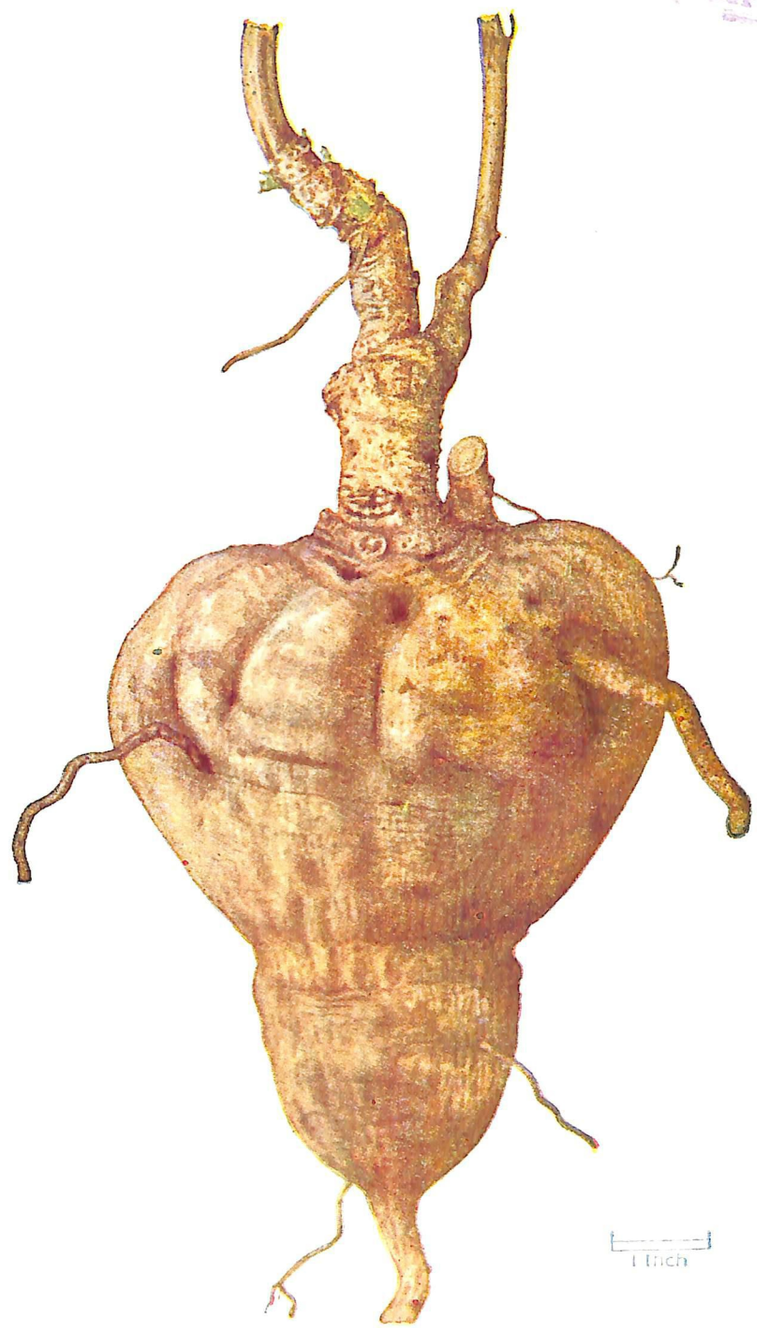
Histology.

The *phellem* or cork which forms the outer-most tissue can in many specimens be differentiated into two regions or zones. A recently formed inner zone of five to eight rows of thinwalled colourless tangentially elongated cells and an outer region of three to six rows of mature brown coloured somewhat compressed cells. In transverse section the cork cells measure 36 to 54 μ in length by 15 to 18 μ in width. Inner to the cork is the *phellogen* consisting of one row of thinwalled rectangular slightly tangentially elongated cells. Inner to the phellogen is a narrow zone of *phelloderm*. The outer two or three rows of cells of phelloderm are regularly arranged, rectangular or slightly tangentially elongated and thinwalled, while those of the inner rows appear somewhat polygonal or irregularly shaped, thinwalled and with intercellular spaces. Some of the cells of the outermost rows contain small cluster crystals of calcium oxalate varying from 15 to 36 μ in diameter while most of the other cells are packed with numerous starch grains. The starch grains are mostly simple, rounded or subspherical and vary from 5 to 30 μ in diameter. The starch grains also occur in groups of 3 or 4. as compound grains. A few compound grains measure up to 40 μ in diameter. The striations are not easily visible but the grains exhibit a well defined maltese cross in the centre.

In some samples of tubers stone cells occur singly or in groups of two amidst the parenchyma. They are mostly rounded or rectangular measuring from 60 μ by 84 μ in breadth. These cells are very thick-walled and show well marked pits. Scattered in the cortical region are the cut ends of latex cells. These appear rounded in section, are larger than the neighbouring parenchyma cells and some of these contain light brown granules. Longitudinal sections show that these latex cells occur in single series or files of four to six or more cells.

Within the cortex can be made out several concentric rings of cambium that have developed in continuous succession, the youngest

Plate X



Ipomaea Paniculata R. Br. (Tuber)

being nearest the periphery. Each strip of cambium as seen in transverse section consists of one or two rows of thinwalled narrow slightly tangentially elongated cells. Each cambium gives rise to an appreciably large amount of parenchymatous tissue, and only a small quantity of regular xylem or phloem elements. The latter appear therefore as somewhat isolated groups of few cells located amidst the parenchyma in nearly concentric circles. The phloem parenchyma cells are smaller than the adjacent parenchyma cells, and some of them contain crystals of calcium oxalate. Sieve tubes and companion cells can be distinctly made out. Crushed elements of phloem can be made out in most of the phloem groups situated within the inner rings.

The xylem vessels in each group are limited (three to five or six) in number and are surrounded by a few fibres. The vessels are of the scalariform and reticulate types and measure 30 to 120 μ in diameter. The medullary ray cells and the cells of parenchymatous tissue found in between the successive rings of secondary cambium are large thinwalled, slightly radially elongated and fully packed with large simple and compound starch grains. These cells occur in regular radial rows and the cells towards the centre of the tuber have larger radial and tangential measurements.

KADAMBAH

Source plant : **Anthocephalus indicus** A. Rich.

Family : Rubiaceae.

Sanskrit Text

Descriptive synonyms

कदम्बः प्रियको नीपो वृत्तपुष्पो हलिप्रियः । (भावप्रकाशः)

Kadambaḥ priyako nīpo vṛttapuṣpo halipriyaḥ |
(Bhāvaprakāśaḥ)

कदम्बो वृत्तपुष्पश्च नीपस्तु ललनाप्रियः ।
कादम्बर्यः सिन्धुपुष्पो मदाढ्यः कर्णपूरकः ॥
धाराकदम्बः प्रावृष्यः कादम्बर्यो हलिप्रियः ।
नीपो धूलिकदम्बोऽन्यः सुवासो वृत्तपुष्पकः ॥ (धन्वन्तरि निघण्टुः)

Kadambo vṛttapuṣpaśca nīpastu lalanāpriyaḥ |
Kādambaryaḥ sindhupuṣpo madādhyaḥ karṇapūrakaḥ ॥
Dhārākadambaḥ prāvṛṣyaḥ kādambaryo halipriyaḥ |
Nīpo dhūḷikadambosn'yaḥ suvāsoˆvṛttapuṣpakaḥ ॥
(Dhanvantari nighaṇṭu)

कुत्सिताङ्गः कदम्बश्च नीपो भ्रमरबान्धवः ।
कादम्बर्यो वृत्तपुष्पः प्रावृष्यः षट्पदप्रियः ॥
हेमपुष्पी पीतपुष्पी कथ्यते काञ्चनारकः ।
नीपो महाकदम्बस्त्वजीर्णशमनोऽतिदीपनो भृङ्गी ॥
दार्वी सूकरसंज्ञः कदम्बपर्यायकोऽप्युक्तः ।
धाराकदम्ब अन्यः सितसारो रुद्रपुष्पी च ॥
सुरभिर्महाद्रुम इति प्रोक्तः पर्यायवाचकैः शब्दैः ॥ (अभिधानमञ्जरी)

Kutsitāṅgah kadambaśca nīpo bhramarabāndhavaḥ |
Kādambaryo vṛttapuṣpaḥ prāvṛṣyaḥ ṣaṭpadapriyaḥ ॥

Hemapuṣpī pītapuṣpī kathyate kāñcanārakaḥ |
Nīpo mahākadambastvajīrṇaśamanostidīpano bhṛṅgī ||
Dārvī sūkarasamñjaḥ kadambaparyāyakospyuktaḥ |
Dhārākadamba anyaḥ sitasāro rudrapuṣpī ca ||
Surabhirmahādruma iti proktaḥ paryāyavācakaiḥ śabdaiḥ ||
(Abhidhānamañjarī)

Most of the synonyms refer to particular qualities of the drug: for instance *Kadambah, Sūkarasamñjaḥ* – meaning destroying gastric troubles and rheumatic complaints; *Priyaka*, doing good to the *body, nīpa*; giving succour to those who are ill; *Sisupāla* protecting children; *Kādambarya*, and *Madādhya* causing intoxication, or other qualitative factors such as *Halipriya* - dear to agriculturists : *Lalanapriya etc* - The terms *Pravṛṣya* - growing in the rainy season. *Bhṛamarabandhava, Ṣaṭpadapriya*, and *Bhṛngi* - meaning dear to insects (bees) etc. are too general and are not of much use in the correct identification of the botanical source. There are a few descriptive terms such as *Vṛttapuṣpa* meaning round flowers - probably referring to the spherical shape of the inflorescence; *Suvāsa, Surabhi* - meaning scented flowers, and *Hemapuṣpi Pītapuṣpi, Sindhupuṣpa Karnapūraka* indicating the golden yellow colour of the flowers. *Sitasara* perhaps refers to the white colour of the core of the stem; *Kramūkaprasuna* = like arecanut buds; and *Vasantapuṣpa* - blossoming in Spring. These terms are also too general.

Three varieties are mentioned in books namely *Dharakadamba*, (large type) *Dhulikadamba* (smaller type) and *Mahākadambah.*

Properties and uses.

कदम्बो मधुरः शीतः कषायो लवणो गुरुः ।
सरो विष्टंभकृद्रूक्षः कफस्तन्यानिलप्रदः ॥ (भावप्रकाशः)

Kadambo madhurah sītah kasāyo lavaṇo guruḥ |
Saro viṣtambhakṛdrūkṣaḥ kaphastan'yān'ilapradaḥ ||
(Bhāvāpr'akāśaḥ)

कदम्बस्तु कषायः स्याद्रसे शीतो गुणेऽपि च ।
व्रणसंरोहणश्चापि कासदाहविषापहः ॥ (धन्वन्तरिनिघण्टुः)

Kadambastu kaṣāyaḥ syādrase sīto guṇespi ca |
Vraṇasamrohaṇās'cāpi kāsadāhaviṣāpahaḥ ||
(Dhanvantari nighaṇṭu)

कदम्बस्तिक्तकटुकः कषायो वातनाशनः ।
शीतलः कफपित्तार्तिनाशनः शुक्रवर्धनः ॥
त्रिकदम्बाः कटुर्वर्ण्या विषशोफहरा हिमाः ।
कषायास्तिक्तपित्तघ्ना वीर्यवृद्धिकराः पराः ॥ (राजनिघण्टुः)

Kadambastiktakaṭukaḥ kaṣāyo vātānās'an'aḥ |
S'ītaḷaḥ kaphapittārtinās'n'aḥ s'ukḷavardhan'aḥ ||
Trikadambāḥ kaṭurvarṇyā viṣas'ophaharā himāḥ |
Kaṣāyāstiktapittaghn'ā viryavṛddhikarāḥ parāḥ ||
(Rājanighaṇṭu)

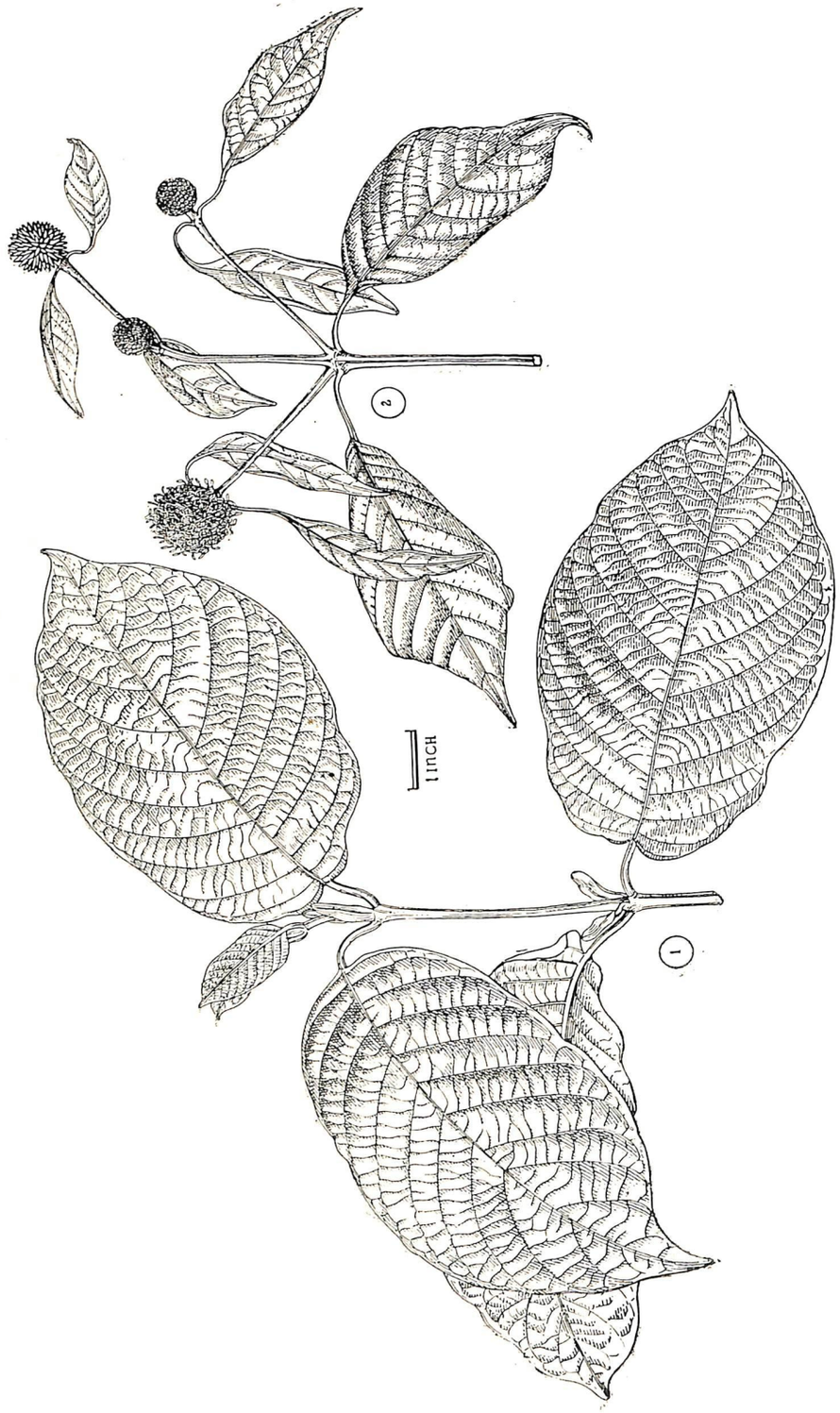
According to Bhāvaprakās'a: *Kadamba* is sweet, cool, astringent, saltish, heavy, laxative, causes gas trouble, is rough, and produces *Kapha, Vāta* and breastmilk. According to Dhanvantari Nighaṇṭu it is also capable of healing ulcers, curing cough, burning sensation and poison.

Other properties mentioned in Rājanighaṇṭu are: it is pungent, increases semen, improves complexion, cures oedema and overcomes *Pitta*.

The bark is considered to be tonic and febrifuge.

The fruit is considered to be cooling and a destroyer of phlegm and impurities of the blood.

Caraka has included Kadambah in the *S'ukḷas'odhana* and *Vedan'āsthapana* groups.



Anthocephalus indicus A. Rich.

2. A. twig with inflorescences.

1. A twig with tender leaves.

Plate XI

ANTHOCEPHALUS INDICUS A Rich.

Syns. *A. Cadamba Miq.*, *A. Morindaefolia* Korth.,
Nauclea Cadamba Roxb., *Sarcocephalus Cadamba* Kurz.

Family Rubiaceae.

Sanskrit – Kadambah, or Kalamba, Asokari, Lalanāpriya, Haripriya, Neepa.

Malayāḷam – Kadampu, Āttutēkku, Kodavara, Chaka, Katutjaka, Nīpam, Āttuvanji.

Tamil – Vellakadambu, Kolaayla or Kolaayila.

Hindi – Kadam, Kaddam.

Telugu – Kadamba, Rudraka-shamba.

Distribution and habitat.

Throughout India on the slopes of evergreen forests upto 1,500 feet elevation, along river banks, swamps. and other wet places. It has been recorded as growing in the sub-Himalayan tract from Nepal eastwards, Darjeeling, Terai and lower hills, Assam, East Bengal, Nothern–Circars, Konkan, Kurnool, Cudappa, Canara, Malabar, the Western ghats etc. It is occasionally planted in parks as an ornamental tree being considered a "very fine" tree, as an avenue tree for the extensive close shade it gives, and also near villages and temples since it is held sacred to Parvati the consort of Siva.

Habit and general features.

Anthocephalus indicus A.Rich. is a tall, large, glabrous deciduous tree of rapid growth attaining a height of twenty meters or more. It has a perfectly straight erect clean trunk or bole—that may attain a diameter of half a meter or a girth of one and a half meters in sixteen years—with a rounded head or crown supported by a system of spreading or horizontal branches that are slightly enlarged at their junction with the main stem and terminate in thick terete drooping branch lets. These bear fairly large, simple, ovate, or ovate-cordate long-stalked stipulate leaves and large globular showy or handsome peduncled heads 2.5 to 5 cms. in diameter, of sessile fragrant lemon or orange coloured flowers with white protruding stigmas followed by

greenish yellow spherical clusters that simulate simple fruits—of many seeded somewhat fleshy, pyrenaceous capsules. The tree blossoms at the end of the hot season (during May to July) and the fruits mature in August and September.

Bark—dark grey, from about 8 mm. to 2·5 cms. thick, fibrous, the outer bark peeling off in small thin woody irregularly circular or rectangular flakes or scales leaving the surface fairly smooth. *Blaze* very fibrous, at first pale yellow but on exposure rapidly turning into a dirty greenish brown colour.

Wood—white or yellowish white soft and even-grained and without a distinct heartwood. Pores scanty but large sometimes in short radial lines. Rays: fine, numerous and close grained.

External morphology :

Leaves: simple, opposite, spreading, petioled; *petioles* - terete, smooth, 2·5 to 3·8 or 5 cms. long, stipulate;–*stipules*–inter–foliaceous, triangular-lanceolate to linear, 1·2 to 1·8 cms. long and fall off early. *Blade*-ovate, ovate-cordate, or elliptic-oblong, 18 to 36 cms. long and proportionately (7·5 cms. or more) broad, entire, coriaceous; the base usually rounded or subcordate and abruptly cuneate or decurent on the petiole, apex acute or shortly acuminate; surface dark green and shining above, paler and often pubescent beneath with 10 – 14 pairs of upwardly curved secondary nerves that are quite prominent on the lower side.

Flowers—, many, fragrant at night, yellow or orange coloured, small, about 12 mm. long, sessile, arranged compactly or crowded, in large solitary globular peduncled heads 2·5 to 5 cms. in diameter: *peduncles* – terminal, stout. 2·5 to 3·8 cms. long, each with two stipular bracts at the base. The flowers are epigynous, regular, five merous and have conspicuously long exserted white stigmas. *Calyx* – tubular, five lobed: the tubular portions of the calyx of flowers being very closely pressed together, but not fusing; the calyx segments or lobes linear oblong; and persistent or deciduous. *Corolla* – gamopetalous, regular, yellow or orange with a long erect funnel shaped tube, a glabrous throat and the limb cut up or divided into five imbricate lobes. *Stamens* – five, inserted on the throat of the corolla near its mouth: they have short filaments and ovate-sagittate, apiculate anthers. *Ovary* – inferior, two celled below

and four celled above, with very many ovules arranged horizontally on two bifid placentae that ascend from the septum below its middle and send an arm into each of the four upper loculi: *style* - filiform, elongate, much exserted ending in a white fusiform or spindle-shaped stigma.

Fruit: The common receptacle bearing the entire head of flowers after pollination enlarges and develops into a globose, fleshy, orange or lemon-yellow coloured pseudocarp about the size of a small orange, 5 to 6·3 cms. in diameter, on whose surface are inserted the numerous small, closely packed individually free or separate fruits. Each such fruit-let is obconical and four ribbed, with a thin or membraneous outer envelope and encloses two or four capsular segments. These enclose a limited number of seeds and have a hard turbinate crustaceous or coriaceous upper half that easily separates as a lid from the membraneous fragile lower or basal half. *Seeds* - usually limited in number or occasionally many, minute, rather thin and angular, with a thin brownish muriculate testa: endospermic. Embryo minute clavate with rounded cotyledons and a superior cylindrical radicle, embedded in the fleshy endosperm

Officinal parts : Flower, leaf, bark and fruit.

Stem bark. Those from the stems and older branches vary from 6 to 12 mm. in thickness. In well–developed trees the thickness of the bark may be 2·5 cms. or more. The surface is fairly smooth and dull green in barks from young stems or branches while those from medium sized stems are greenish grey, unevenly smooth and in still older cases they are greyish to dark grey, unevenly smooth on account of number of shallow depressions of various sizes due to the exfoliation of the outer bark here and there in thin woody irregularly rounded flakes and the presence of a few irregularly scattered, corky lenticel eruptions. Lichen patches very few or nil. Even in the older barks the outer bark or rind remains comparatively thin on account of the development of several abscission layers and the consequent exfoliation of portions of the bark in small sized thin woody irregular flakes leaving shallow depressions covered with fresh light to rosy-brown cork tissue with the margin greenish grey. Finally the colour becomes dark merging with that of the rest of the bark. On account of this exfoliation the surface in many places, is smooth and in other areas somewhat rough, being studded irregularly

with small prominent corky lenticels, but the bark as a whole appears free from prominent cracks or fissures of any size. Because of this constant exfoliation of thin layers of the outer rind encrustations of Lichen patches are also very few. The outer part of the exfoliating rind is very thin and has the characteristic greyish or greenish-grey colour. Inner to this and constituting the bulk of the rind is a distinctly corky zone which in the case of fairly old barks may be somewhat woody and composed of very compact and somewhat friable cork tissue. The thickness of this cork tissue varies in barks of different ages. It is almost absent in young barks where the rind is very thin, membraneous and closely adherent to the rest of the bark. Its thickness increases as the bark gets older, but when exfoliation begins this layer is not present as a distinct continuous tissue being replaced by a freshly formed closely adherent skin. The corky tissue has a feebly bitter taste. The rest of the bark forming the bulk portion and constituting the officinal part is slightly reddish to reddish-brown and appears lamellated. The lamellations are of two types that alternate with each other, namely, a large number of somewhat indistinct layers interspaced with more prominent layers at frequent intervals. The bark easily splits tangentially along the latter. The tissue thus separated has a distinctly fibrous texture. The entire bark has a predominantly fibrous fracture and bitter astringent taste. In transverse sections of old barks the rind appears as a thin greenish-grey layer about 0·5 mm. in thickness with or without an inner greyish-white compact corky zone.

The inner bark next within is brownish or reddish brown, varies in thickness and appears distinctly lamellated. It has a distinctly bitter taste with slight astringency and feeble sweetness.

Young barks :

Clean cut transverse sections of fresh young barks less than 3 mm. in thickness appear whitish at first but the surface colour very rapidly—often within a minute—turns brown. The peripheral part or outermost region is greenish and appears as a greenish line. The rest of the bark is whitish at the periphery, gradually turning brown towards the interior. The part that changes colour quickly is the inner region, the outer part of the living bark doing so only rather slowly or less rapidly. The bark has a fibrous texture but the lamellations are not quite distinct or prominent. The initial taste is somewhat sweeter than in older barks, but soon it becomes as bitter as in the latter.

Distinguishing features of the stem bark (external).

The somewhat smooth greyish-green surface with the rind exfoliating in small thin patches of irregular size and shape, the general light reddish to reddish-brown colour of the officinal part of the bark, its fibrous texture with the distinct lamellation and easy separation of the inner bark into tangential strips along certain well marked areas, as well as its bitter taste are important diagnostic features.

Histology of the stem bark.

In a transverse section of the stem bark, the outermost tissue is the *phellem* which is comparatively thin or very narrow due to constant exfoliation of the outer layers. It usually consists of 3–5 or more rows of cubical to nearly rectangular thinwalled colourless cells. The cells of the outermost row appear somewhat compressed or narrowly rectangular and they have brown or brownish-green contents. Within the phellem is the *phellogen* composed of a single row of narrow tangentially elongated cells.

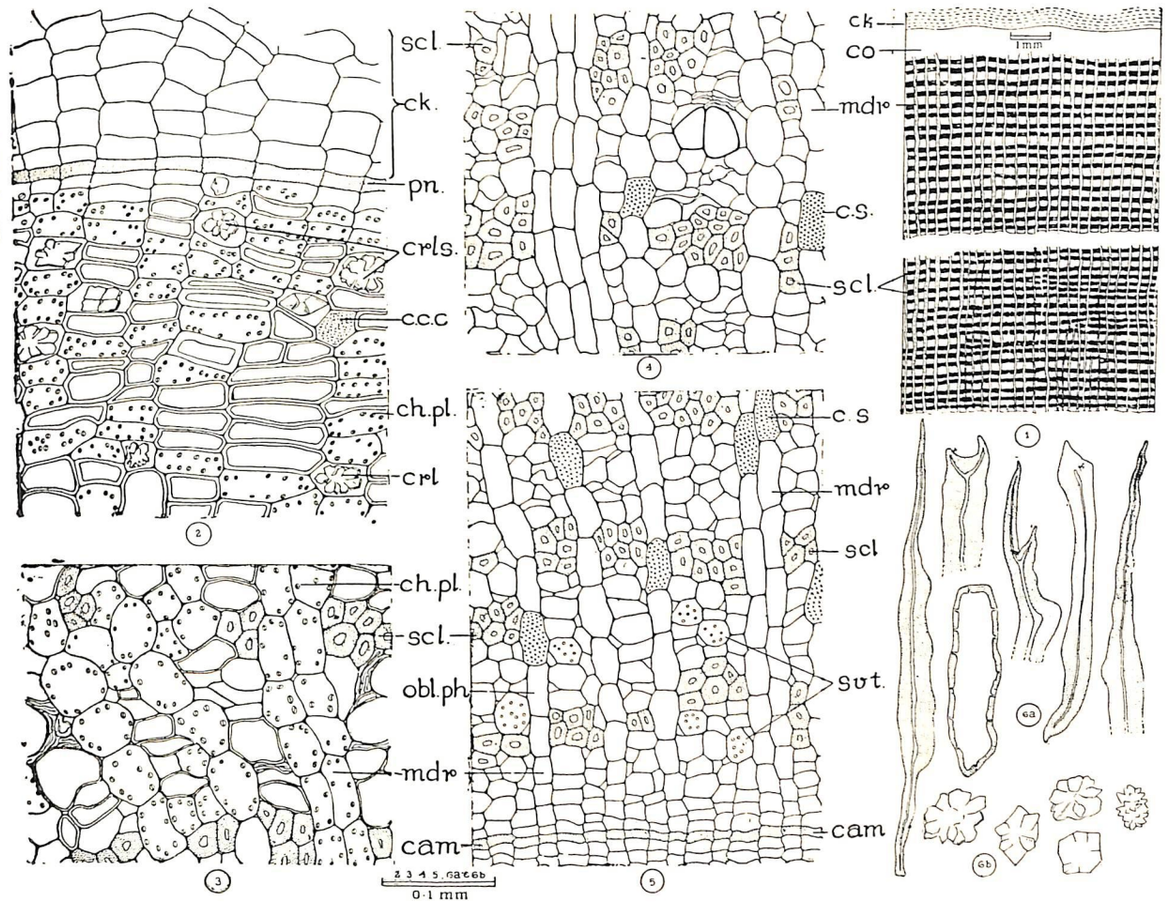
The middle bark is also not very thick and consists of about 15 to 20 rows of cells which are rectangular or more often tangentially elongated. More than half the cells of this tissue have highly thickened cell walls. These appear rectangular in L. S. The rest of the cells are thinwalled and contain either chloroplasts or crystals of calcium oxalate in the form of druses measuring 30 to 36μ in length. There are a few cells which are filled with a brown substance possibly tannin, which turns black on treating with a solution of ferric chloride. An aqueous extract of the bark when treated with ferric chloride solution produces a dark green precipitate showing the presence of tannin. The inner bark forms the major part and consists of a very large number—about 50 to 60 or more —of tangential bands of fibre groups alternating with thinwalled phloem elements, both being radially intercepted by a large number of uni—to three seriate medullary rays. The fibre groups within the inner bark are composed of two to fourteen cells. These fibres on maceration are found to be very long and thickwalled with blunt or forked endings

(see figure). The phloem tissue found in between the fibre groups at the outer region of the inner bark consists of regular thinwalled fairly large rounded to polygonal cells mingled with compressed or collapsed cells. Certain other cells in this region have slightly thickened walls but are not sclerenchymatous. The recently formed phloem elements situated towards the inner most part appear quite distinct. The phloem parenchyma cells are polygonal and thinwalled. Sieve tubes and companion cells are very distinct. Inner to this tissue the cambium is present which separates the bark from the wood.

Medullary rays. A large number of long uniseriate rays are present which are arranged very close to one another. Biseriate and occasional triseriate rays also occur. The rays extend up to the middle bark. The rays cells are generally slightly radially elongated and thinwalled. Some of the ray cells situated within the inner bark are filled with a colourless amorphous substance (crystal sand) which on treating with sulphuric acid forms acicular crystals. The ray cells towards the periphery of the inner bark appear oblong or even almost rounded and they contain chloroplasts.

The presence of certain special types of druses inside the cortex, the predominence of sclerenchymatous groups in numerous tangential rows, each group composed of highly thickwalled elements, as well as the complete absence of starch grains in any tissue are noteworthy features of the stem bark. Calcium oxalate occurs as crystal sand as well as druses.

Plate XII



Histology of stem bark of *Anthocephalus indicus* A. Rich.

1. Diagrammatic sketch of T. S. of stem bark.
2. Cork and cortex.
3. Innermost region of the middle bark.
4. A portion of the inner bark.
5. Young bast with the cambium.

6*a*. Bast fibres.

6*b* Crystals.

JAMBU

Source plant in Kerala:

Syzygium jambolanum DC ,
and a few other species of **Syzygium**

Family: Myrtaceae.

Sanskrit Text:

Descriptive synonyms

फलेन्द्रा कथिता नन्दो राजजम्बूर्महाफला ।
तथा सुरभिपत्रा च महाजम्बूरपि स्मृता ॥
क्षुद्रजम्बू: सूक्ष्मपत्रा नादेयी जलजम्बुका ।

(भावप्रकाश:)

Phalendrā kathitha nando rājajambūrmahā phalā ।
Tathā surabhipatrā ca mahā jambūrapi smṛtā ॥
Kṣudrajambū sūkṣmapatrā nādeyī jalajambukā ।

(Bhāvaprakāśa)

जम्बू: सुरभिपत्रा च राजजम्बूर्महाफला ।
सुरभि स्यान्महाजम्बू र्महास्कन्धा प्रकीर्तिता ॥
वेतसी काकजम्बूश्च नादेयी शीतवल्लभा ।
भ्रमरेष्टा नीलवर्णा द्वितीया जम्बू जम्बुरुच्यते ॥ ((धन्वन्तरि निघण्टु:)

Jambūḥ surabhi patrā ca rājajambūrmahā phalā
Surabhī syānmahā jambūrmahā skandhā prakīrtitā
Vetasī kākajambūśca nādeyī sītavallabh ।
Bhramreṣṭā nīlavarṇā dvitīyā jamburucyate ।

(Dhanvantari nighaṇṭu)

जम्बूस्तु सुरभिपत्रा नीलफला श्यामला महास्कन्धा ।
राजार्हा राजफला शुकप्रिया मेंघमोदिनी नवाह्वा ॥
महाजम्बूं राजजम्बू: स्वर्णमाता महाफला ।
शुकप्रिया कोकिलेष्टा महानीला बृहत्फला ॥

काकजम्बूः काकफला नादेयी काकवल्लभा ।
भृङ्गेष्टा काकनीला च ध्वाङ्क्षजम्बूर्घनाप्रिया ॥
भूमिजम्बू र्ह्रस्वफला भृङ्गवल्लभा ह्रस्वा ।
भूजम्बूर्भ्रमरेष्टा पिकभक्षा काष्ठजम्बूश्च ॥ (राजनिघण्टु)

Jambūstu surabhi patrā nīlaphalā s'yāmaḷā mahāskandhā |
Rājārhā rājaphalā s'ukapriyā meghamodin'ī navāhvā ||
Mahājambū rājajambūḥ svarṇamātā mahāphalā |
S'ukapriyā kokileṣṭā mahānīlā bṛhatphaḷā ||
Kāka jambūḥ kāka phalā nādeyī kākavallabhā |
Bṛṅgeṣṭā kākanīlāca dhvāṅkṣajambūrghan'a priya |
Bhūmijambūrhrasva phalā bhṛngavallabhā hrasvā ||
Bhū jamburbhramareṣṭā pika bhakṣā kāṣṭhajambūs'ca |
(Rāja nighaṇṭu)

जम्बूस्तु काकजम्बूः कृष्णाफला सुरभिपत्रा स्यात् ।
अन्या ह्रस्वफला स्यात् घनपर्णा वैदिशश्च नादेयी ॥
(अभिधानमञ्जरी)

Jambūstu kākajambūḥ kṛṣṇaphalā surabhipatrā syāt |
An'yā hrasvaphalā syāt ghan'aparṇī vaidis'as'ca nādeyī ||
(Abhidhan'amañjarī)

Meanings of terms

Surabhipatra = with sweet smelling leaves, *Mahāskanda* = with long (stout) stem and branches; *Vetasi* = growing along river-banks; *Jalajambuka* = growing near water; *meghamodini* and *ghanapriya* = luxuriating or thriving well during the rainy season; *bhṛmareṣta*, *bhṛgavallabha* and *bṛngeṣta* = attracting bees; *bhrameṣta* = attracting cuckoos; *dhavanikṣa jambu* = attracting crows of cuckoos; *pikabhakṣya* fruits eaten by cuckoos; *kākaphala* may refer either to the dark or blackish colour of the fruits or that they are eaten by crows; *krṣnaphala*, *kaṣtajambū*, *kākanīla*, *nīlaphala* and *nīlavarṇi* indicate the dark or blue black colour of the fruits and *mahāphala* and *bṛhatphala* the comparatively large size of the fruits; *sītavalībha* = cool; *rajajambu* and *phalendra* signifiy that its fruits are the best and they are *nanda* or tasty. Of these varieties kṣudra-jambu has *sukṣmapatra*

(smaller leaves and it is jalajambū a plant growing near water. *Bhumijambū* or *bhūjambu* grows low; it is *hṛsva* or short in stature and, its fruits are small (*hṛsvaphala*), bluish, and (*kaṣtajambū*), attracts bees (*bhṛgavallabha*) and flies (*Bhṛameṣta*). *Kākajambū* is a wild variety (*vanajambu*). Its fruits are *nādeyī* giving tone to voice and music, is the favourite of crows (*kākavallabha*), and *bhṛingeṣta* liked by large black bees. Another type has *ghanaparṇi* broad and thick leaves and the plants grow closely (*vaidiśaśca*).

The Āyurvedic texts mention three varieties namely – Mahājambū or Rājajambū, Kākajambū and Bhumijambū. A fourth Kṣudrajambū is also mentioned by some authorities. From the descriptive terms which are rather general it is not possible to precisely indicate the identity of the botanical sources of these nor is it possible to state whether the varieties referred to in the texts are different varieties of *Syzygium jambolanum* DC. or different species or genera.

Properties and uses.

राजजम्बूफलं स्वादु विष्टम्भि गुरुरोचनम् ।
जम्बूः संग्राहिणी रूक्षा कफपित्तास्रदाहजित् ॥
(भावप्रकाशः)

Rājajambū phalam svādu viṣṭambhigururocan'am
Jambūḥ samgrāhiṇī rūkṣā kaphapittāsradāhajit ||
(Bhāvaprakās'a)

जाम्बवं वातलं ग्राहि स्वाद्वम्लं कफवातजित् ।
हृत्कण्ठघर्षणं चान्यत्कषायं क्षुद्रजाम्बवम् ॥
(धन्वन्तरि निघण्टुः)

Jāmbavam vātaḷam grāhi svādvamḷam kaphavātajit
Hṛtkaṇṭhagharṣaṇam cān'yatkaṣāyam kṣudrajāmbavam ||
(Dhanvantari nighaṇṭu)

जम्बूः कषायमधुरा श्रमपित्तदाह -
कण्ठार्तिशोषशमनी कृमिदोषहन्त्री ।
श्वासातिसारकफकास विनाशिनी च
विष्टम्भिनी भवति रोचनपाचनी च ॥

महाजम्बूरुष्णा समधुरकषया श्रमहरा ।
निरस्यत्यास्यस्थं झटिति जडिमानं स्वरकरी ॥
विधत्ते विष्टम्भं शमयति च शोषं वितनुते ।
श्रमातीसारार्त्तिश्वसितकफकासप्रशमनम् ॥
काकजम्बूः कषायाम्ला पाके तु मधुरा गुरुः ।
दाहश्रमातिसारघ्नी वीर्यपुष्टिबलप्रदा ॥
भूमिजम्बूः कषाया च मधुरा श्लेष्मपित्तत् ।
हृद्या संग्राहिहृत्कण्ठदोषघ्नी वीर्यपुष्टिदा ॥

(राजनिघण्टुः)

Jambūḥ kaṣāyamadhurā s'ramapittadāha-
Kaṇṭhārtīs'oṣa s'aman'ī kṛmidoṣahantrī ।
S'vāsā tisārakapha kāsa vin'ās'inī ca
Viṣṭambhin'ī bhavati rocan'a pācan'ī ca ॥
Mahā jambū rūṣṇā samadhura kaṣāyā s'ramaharā ।
Nirasyatyā syastham jhaṭiti jaḍimān'am svarakarī ॥
Vidhatte viṣṭambham s'amayati ca s'oṣam vitanute
S'ramātīsārārti svasita kapha kāsa pras'aman'am ॥
Kāka jambūḥ kaṣāyāmlā pāke tu madhurāguruḥ ।
Dāha s'ramātisāraghn'ī vīryapuṣṭi balapradā ॥
Bhūmi jambūḥ kaṣāyā ca madhurā s'leṣmapittan'ut ।
Hṛdyā saṃgrīhi hṛtkaṇṭhadoṣaghnī vīryapuṣṭidā ॥

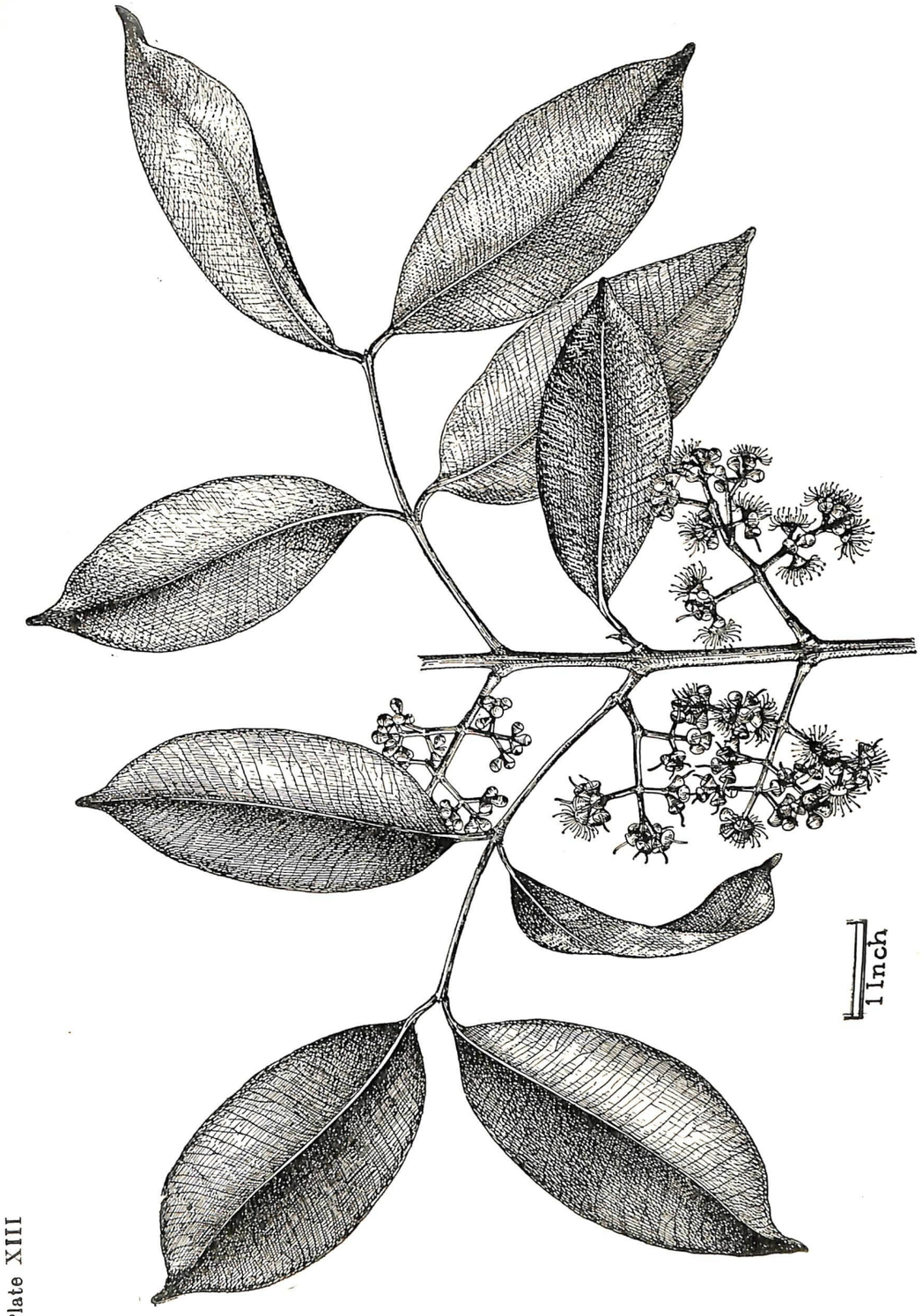
(Rājanighaṇṭu)

According to Bhāvaprakās'a the fruit is sweet, anticarminative, heavy and promoting taste. Jambū is arresting, dry, overcomes *kapha*, *raktapitta* and burning sensation. Another property mentioned in Dhanvantari nighaṇṭu is that Jambū is expectorant.

Worms, difficult breathing, diarrhoea, cough, diseases of the throat and exhaustion are other conditions mentioned in Rājanighaṇṭu as indications. Jambū also improves voice and is useful in diabetes and *pradaram*.

"The bark is considered a specific for dysentery"

Parts used in medicine:- Bark and ripe fruits.



Syzigium jambolanum DC.

Plate XIII

SYZYGIUM JAMBOLANUM DC.

Syns. *Eugenia jambolana* Lamk.
E. jambolana Lamk. var. *Caryophyllifolia ;*
E. caryophyllifolia Lamk. *E. frondosa* Wall.,
E. obtusifolia Roxb. *Syzygium caryophyllifolium* DC.,
Calyptranthes jambolana Willd.; *Calyptranthes capitellate* Ham.

Family: Myrtaceae.

Sanskrit	–	Jambū, Meghavarṇa, Rājaphala, Nīlaphala, Bṛhaspati
Malayāḷam	–	Perīñjāra, Njāra, Nāga, Ñāra,
Tamil	–	Ñaval or Nawel, Arugadam, Kottain'āgam Kottaināval
Hindi	–	Jàman, Jamun, Jamuna, or Jamoon, Phalinda or Phalanda, Jambhal, Jamni, Phalāni, Pharendra, Phaunda.
Telugu	–	Naredu, Nasedoo, Nasedu, Nairuri, Nareyr.
English	–	Black plum.

Distribution and habitat.

This tree is found in almost all forest districts over the greater part of India from the sub Himalayan tract and lower Himalayas on the north ascending in Kumaon to 1500 metres to the extreme south; the principal regions being Konkan, Deccan, Gujarat, Canara. Madras and Kerala. It is common both in the wild and cultivated state. Its natural habitat is along river banks and similar moist localities. Yet it is commonly found everywhere both in the plains and up to 1800 metres elevation in the hills, in the wild as well as cultivated state, every soil and situation suiting it equally well. It is found for example growing luxuriously even in the sandy coastal tracts on one side and the humid sholas of the Western ghats on the other. It is often cultivated as an avenue tree for shade as well as for its fruits. Flowering time - the beginning of the hot season ; fruits from June to August.

Habi and general features.

Syzygium jambolanum DC. is a moderate to large sized dense foliaged, glabrous shady tree often of considerable size with a trunk seldom straight or long, 3 to 3·6 meters or more in girth, covered with light grey or ash coloured (cracked or smooth) exfoliating bark and having numerous spreading irregular branches terminating in pendulous twigs, the whole forming a beautiful shady crown. These twigs or branchlets bear small, simple opposite petioled shiny oblong lanceolate nodding leaves and small cymose panicles of white flowers that arise mostly from the leafless portions of the branchlets just below the leaves followed by oblong dark purplish edible fleshy one or two seeded fruits, 18 mm. to 25 mm. long.

Bark about 6 to 8 mm. thick, smooth, but with shallow depressions caused by exfoliation, light grey or ash coloured and often blotched with large patches of darker colour. It affords a brown dye and a kind of gum kino and has been used in dyeing and tanning.

The *wood* is hard, close grained, and reddish grey or whitish. It is durable, and used for building and agricultural purposes.

External m orphology.

Leaves: simple, opposite, exstipulate, short petioled, nodding, extremely variable in size and shape 7 to 15 cms long and 2·5 to 5 cms. broad, ovate, oblong, broadly ovate-elliptic, elliptic, lanceolate or elliptic-lanceolate, acute, sub-obtuse or more or less shortly acuminate or sometimes abruptly pointed, the base usually tapering but sometimes rounded, firm and coriaceous in texture, wavy, very smooth and shining on both sides and featherveined. The lateral veins are numerous most slender or very fine, closely parallel inconspicuous above but more prominent underneath and unite into a distinct intramarginal vein just within the margin. *Petiole* 12 to 25 mm. long, channelled. When crushed the leaves emit an agreeable terebinthinate odour and on distillation yield a bright green oil.

Flowers: numerous, small, but larger than in most other species, 4.5 to 7.5 mm. across, sessile or shortly pedicelled, sweet scented, dull white, crowded in heads at the ends of small but rigid lax axillary trichotomous cymose panicles or more often arranged

Plate XIV

Syzygium jambolanum DC.

in diverging cross armed pairs opposite each other that arise from the scars of fallen leaves on the older naked portions of the branchlets just below the leaves. *Calyx* - persistent cupshaped or shortly turbinate. 4 to 6 mm. long, rugulose externally, tube short, cylindrical, its mouth about 5 mm. in diameter, limb obscurely four lobed to nearly truncate. *Petals*–four, free, nearly orbicular, concave, almost sessile or with very short claws, arising from the mouth of the calyx, and united in a calyptra that seldom or never expands but falls off as a whole when the bud opens. *Stamens* – numerous, free, as long as the calyx-tube; anthers small. *Ovary* - inferior, with a short declining style comparatively shorter than the stamens and acute stigma.

Fruit : an oblong ellipsoid or globose, one or two-seeded, juicy edible berry, crowned with the truncate calyx limb, pink while ripening and dark purple to purplish-black when ripe, varying in size from a large pea to that of a pigeon's egg. The cultivated fruit which is often as large as a pigeon's egg is astringent and has a sub-acid flavour. *Seed* – usually one, roundish, smooth.

Officinal parts – Bark, fruit, dried seed and leaves.

Description of stem bark

General eatures

Bark light grey or ash coloured, often blotched with large patches of darker colour, smooth on young branches; older barks often with shallow depressions left by exfoliation, and shallowly to deeply fissured. Internally it is red and fibrous. Its minute structure is remarkable in having several rows of very large pitted oblong oval cells which can be easily seen with the naked eye. The odour is like that of oak bark and the taste very astringent.

Fresh barks from young branches about 20 cms. in diameter have a thickness of about 7 millimeters. The surface is dark green but on account of the development of variegated patches of lichen appears ash green. Numerous very short vertical fissures and slightly projecting small oval to rounded lenticels about 2 mm. long are present on the surface and hence it is not quite smooth. The outer bark exfoliates as very thin rounded little pieces exposing a thin layer

of light green tissue. Within this is a reddish-brown granular tissue. The inner surface of the bark is smooth and cream coloured with many vertical or longitudinal wavy striations. On wounding, the exposed portions turn pinkish.

A transversely cut end of this bark shows an outer brownish green border which is less than 1 mm. thick and a middle granular light reddish brown zone about 3 mm. in thickness next inside, followed by the inner bark which is cream coloured and much fibrous and about or slightly thicker than the middle bark.

Barks of medium size. In still older trunks the bark attains a thickness of 1 to 1½ cms. In these barks the outer surface is light brown in colour but the surface colour is masked by the growth of green and ash white lichen patches. Surface is not quite smooth. It shows vertical fissures as well as irregularly circular shallow depressions due to the outer skin exfoliating in small flakes. The surface as a result appears rugged and uneven. On removing or scraping the outer bark a light reddish granular region is exposed The inner surface is smooth but wavy longitudinal striations are visible. A cut section shows an outer brown rhytidome with cork which is about 1 mm. in thickness a middle granular light reddish brown region which is more than 5 mm. thick and an inner bark which is cream coloured fibrous and about 4 mm. in thickness.

Barks from very old trunks are 20 to 30 mm. thickness and grey or ash white in colour. The outer surface is very rough and uneven. Short vertical fissures are present. Large irregular shallow as well as deeper depressions are formed due to the exfoliation of the outer rind. The outer bark consists of a crustaceous thick outer part which cannot be easily peeled off but exfoliates in thick pieces (rhytidome) and a comparatively thin cork zone closely appressed to the middle bark. The middle bark which is exposed when the entire outer bark is removed is reddish yellow and highly granular. Oblique sections of this present a fibrous appearance. The fresh inner bark is very fibrous and whitish but on exposure to air it turns pink or light reddish.

A clean cut transverse section of the bark shows (1) a light brown coloured unevenly thick outer region about 5 mm. in thickness with small dark brown patches embedded within at certain regions. (2) a middle highly granular light reddish yellow region which is very thick occupying nearly 2/3 the thickness of the entire bark and which can be broken into small fragments, and (3) an inner fibrous cream coloured region about 2/3 thickness of the middle bark which on exposure turns light reddish.

Histology of the stem bark.

In the fairly thick barks that are about 4–5 cms. obtained from old stems the outer bark composed of phellem together with the adjacent rhytidome outside may have a thickness of 5 mm. or more. The cork tissue in these well matured stem barks can be differentiated into two zones: (i) an inner narrow region composed of 5–7 rows of regularly arranged nearly cubical as well as rectangular slightly radially elongated thin walled cork cells which appear empty or without contents, and (ii) an outer broader but unevenly thick stratified brownish zone. This part consists of 5 to 10 or more rows of cubical or radially elongated thinwalled cells. Most of these cells are filled with dark brown contents, that turn black when treated with ferric chloride solution. This outer zone of cork is thick at places where a rhytidome of old hard tissue is present. The dead outer tissue or rhytidome is usually very hard and brown in colour. It is composed of many groups of large stone cells each group containing two to four cells measuring from 80 x 64 μ to 600 x 200 μ, several smaller rounded stone cells, crushed up elements of phloem and strips of old medullary rays. Most of the thin walled elements namely, parenchyma and ray cells appear compressed or ruptured, and contain the brown contents. A *phellogen* composed of a single row of very narrow tangentially elongated cells is often evident, followed by a thin *phelloderm* of 2 or 3 rows of small thinwalled mostly cubical or rectangular cells. Some of these cells also contain the characteristic reddish brown contents

The middle bark comprises more than half the thickness of the well developed stem barks and is mainly composed of a very large number of scattered groups of stone cells in the midst of thinwalled parenchyma cells. The latter are very small when compared with the stone cells and most of them contain small simple rounded or oval starch grains 9 to 12 μ in diameter. A few cells have small druses of calcium oxalate and a few others have the brown contents. The stone cell groups of the middle bark are tangentially elongated

and mostly arranged in regular tangential rows in the young barks whereas they appear scattered and somewhat radially elongated in the older barks. Each stone cell group is composed of 2 to 10 large thickwalled radially elongated cells which vary in size and wall thickness. Pits and striations are very distinct on the walls of the stone cells. In addition, small rounded very thick walled stone cells either solitary or in few celled groups also occur. The medullary ray cells present in the middle bark are thinwalled radially elongated and filled with the brownish contents.

The inner bark forms about 1/3 the thickness of the entire bark and is composed of alternating tangential layers of fibrous and soft tissue intercepted by the medullary rays. Each group of stone cells of the tangential rows within the inner bark is very small being composed of 2 to 4 small, rounded or oblong thickwalled cells measuring 60 × 45 to 105 × 65 μ. Solitary stone cells also occur. A good number of sieve tubes and companion cells are distinctly seen amidst the phloem parenchyma cells of the inner bark. Some of the phloem parenchyma cells contain the brown contents and many others have druses of calcium oxalate crystals measuring 26 to 30 μ. Simple starch grains occur in some of the parenchyma cells.

Medullary rays are many, closely arranged, long wavy. Most of the rays are uni-or bi-seriate but four-seriate rays are also common. They may extend up to the outer border of the middle bark. The ray cells are thin walled radially elongated and filled with the reddish brown contents. At the innermost border of the bark a cambium consisting of one or two rows of thinwalled narrow tangentially elongated cells is present separating the bark from the wood.

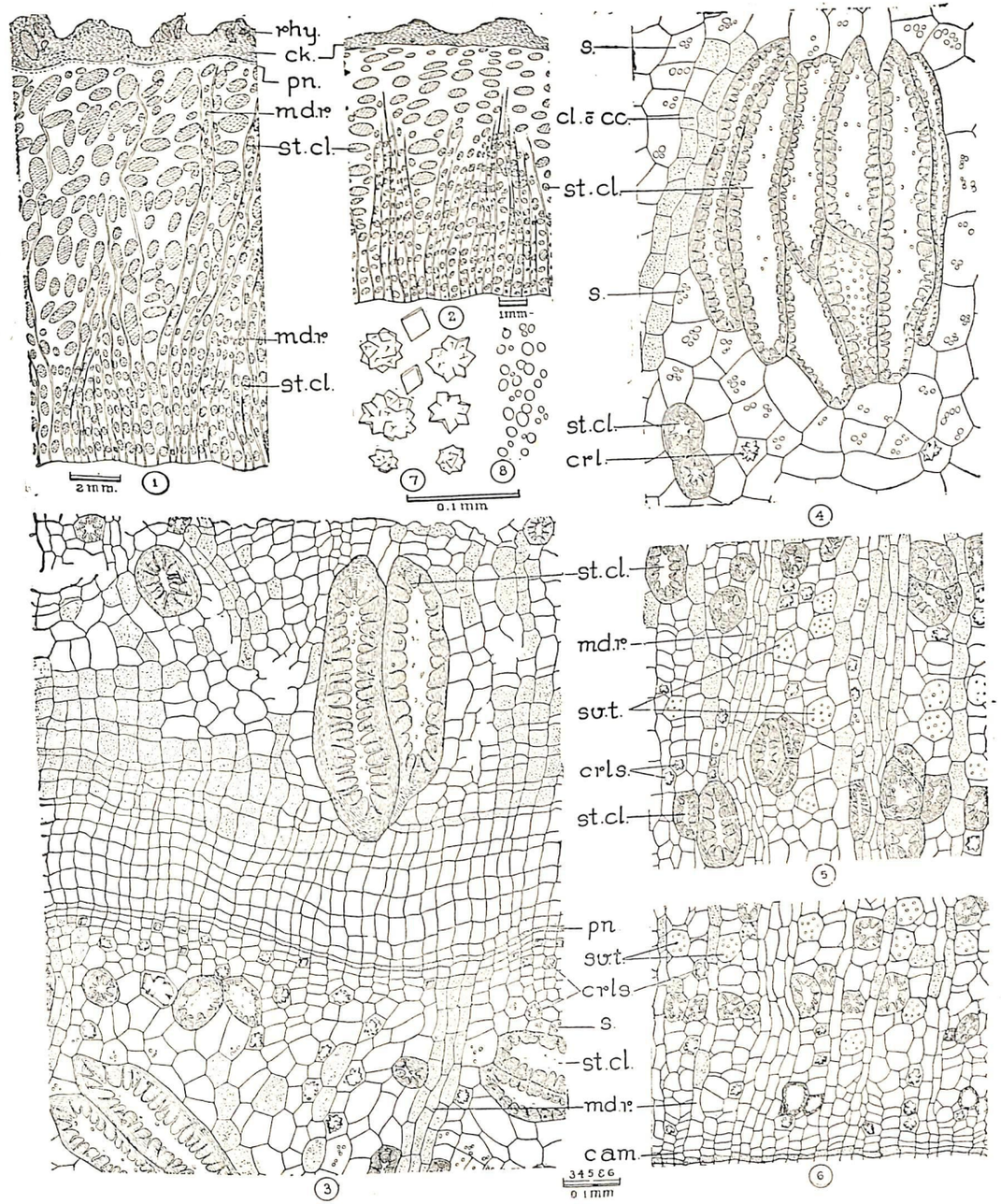
Distinguishing characters.

The presence of

1. a large number of stone cells throughout the bark.
2. many groups of very large sized elongated stone cells forming a major part of the middlebark.
3. many, long medullary rays, which are closely arranged with almost all cells filled with characteristic brownish contents.
4. small sized stone cells in tangential rows in the inner bark alternating with soft tissue.

and 5. a large number of druses (crystals) within the inner bark.

Plate XV



Histology of stem bark of *Syzigium jambolanum* DC.

1. Diagrammatic sketch of the T. S. of stem bark.
2. Diagrammatic sketch of the T. S. of young stem bark.
3. Cork and cortex.
4. A portion of middle bark.
5. A portion of innner bark.
6. Young bast with the cambium.
7. Crystals
8. Starch grains.

SYZYGIUM CARYOPHYLLAEUM Gaertn.*

Synoyms: *Eugenia caryophyllaea* Wt.; *E. corymbosa* Lamk.; *Calyptranthes caryophyllata* Pers.; *Myrtus caryophyllata* Linn.

Family: Myrtaceae.

Malayāḷam – Ceruñāra, Ñjāra

Tamil – Cherunjāra

Distribution and habitat. Chiefly in south India, from north Canara southwards, the Konkans, and Western Ghats including the West Coast of Kerala, Nilgiris etc. from sea level up to 1600 meters elevation in various habitats such as stream banks, sandy coastal areas etc.

Habit and general features

Syzygium caryophyllaeum Gaertn. is a fairly large shrub or small tree growing 6 meters or more high with terete branches having smooth grey bark bearing opposite ob-ovate or ovate shiny leaves of variable size, small white flowers in trichotomous cymes and clusters of small globose dark purplish or black berries. Flowering time – February to April; Fruits – June to July.

Wood brown, rather soft.

External morphology

Leaves: simple, opposite, exstipulate, very short-petioled, varying considerably in size-7·5 to 10 cms. long and 2·5 to 3·7 cms. broad -, entire, glabrous, obovate - ovate or spathulate, rarely ovate-lanceolate, attenuated towards the base, obtuse emarginate or with a short blunt acumen, subcoriaceous, dark green above rusty red beneath inconspicuously pellucid dotted and with many closely parallel secondary veins. *Petiole* - very short, stout.

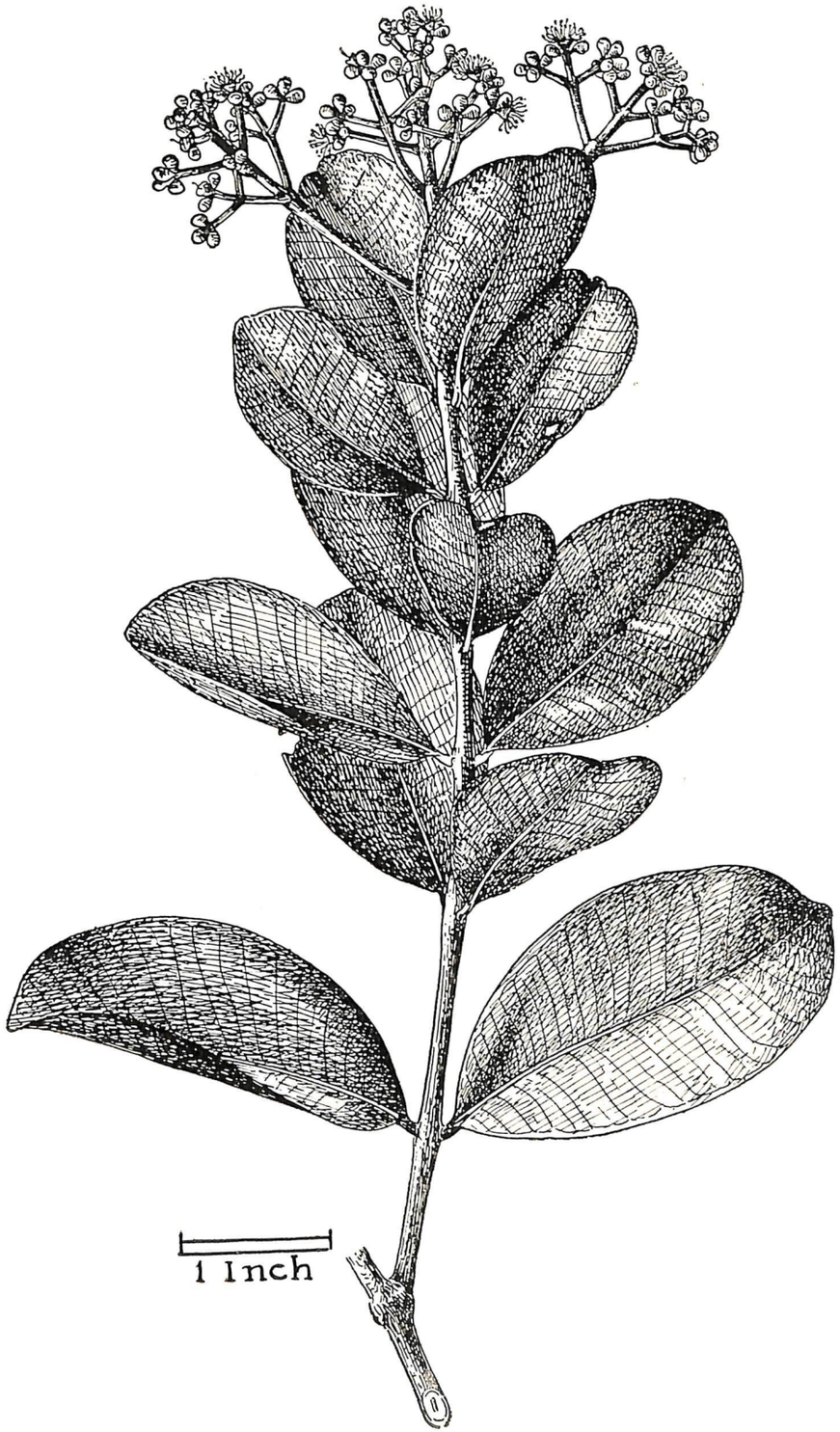
Flowers: with bract and small deciduous bracteoles, about 2·5 mm. wide whitish in lax flowered trichotomous terminal corymbose cymes, the inflorescence branches moderately thick and

* Considered by some Vaidyans of Kerala as the small (hṛsva) variety of *Jambū (Kāka jambū (?) or Bhūmi jambū (?)*

ascending. *Calyx* - shortly turbinate, shallowly four or five lobed, without a thickened staminal disc. *Corolla* - of four to five small rounded concave petals that fall off in one piece (calyptrate) *Stamens* very numerous, free, bent towards the middle when in bud; *anthers* - small. *Ovary* - inferior, two celled, with several ovules in each cell; *Style* - single with simple stigma.

Fruit: a smooth globose one celled one or few-seeded juicy edible berry slightly bigger than a pea in size (about one cm. in diameter) dark purplish or black when ripe. *Seeds*-globose. Embryo with fleshy cotyledons and a small radicle concealed between the cotyledons.

Plate XVI



Syzigium caryophyllaeum Gaertn.

KIRĀTATIKTAH

Source plants in Kerala :

Andrographis paniculata Nees. belonging to Acanthaceae and
Solanum indicum Linn.
belonging to Solanaceae.

Sanskrit Text

Descriptive synonyms

किरातितिक्तः कैरातः कटुतिक्तः किरातकः ।
काण्डतिक्तोऽनार्यतिक्तो भूनिम्बो रामसेनकः ॥
किरातकोऽन्यो नैपालः सोऽर्धतिक्तो ज्वरान्तकः ।

(भावप्रकाशः)

Kirātatiktaḥ kairātaḥ kaṭutiktaḥ kirātakaḥ
Kāṇḍatiktosnāryatikto bhū nimbo rāmasen'akaḥ ||
Kirātakosn'yo naipālaḥ sosrdhatikto jvarāntakaḥ |

(Bhāvaprakāś'a)

किराततिक्तं कैरातं भूनिम्बं रामसेनकम् ।

(मदनपालनिघण्टुः)

Kirātatiktam kairātam bhūnimbam rāmasen'akam |

(Madanapāla nighaṇṭu)

भूनिम्बोऽनार्यतिक्तः स्यात् कैरातो रामसेनकः ।
कैराततिक्तको हैमः काण्डतिक्तः किरातकः ॥

(राजनिघण्टुः)

---

* According to Kirtikar and Basu, Khory and Katrak and others the Botanical source of Kirātatikta is *Swertia chitrata* Ham. (Gentianaceae) which is most probably the original source plant. *Andrographis paniculata* is equated as *Bhunimba* as well as *Kirāta* which are synonyms of Kirātatiktah by Kirtikar and Basu and as *Bhunimba* by Khory and Katrak. Rama Rao in "Flowering plants of Travancore" equates it as *Mahatikta* which is also a synonym. In some parts of Kerala *Solanum indicum* a thorny shrub equated with *Bṛhati* and known in Malayālam as *Puttaricunda* is used as *Kiratatikta*, perhaps guided by *Śabdavguhatarangini* which says, "*Bhunimbohimakastikasciratiksasca kantati*" indicating that it is a thorny plant. This is supposed to have more or less similar properties.

Bhūnimbosn'āryatiktaḥ syāt kairāto rāmasen'akaḥ |
Kairātatiktako haimaḥ kāṇḍatiktaḥ kirātakaḥ ||

(Rāja nighaṇṭu)

नेपालः कथितश्चान्यो जातिभेदो ज्वरान्तकः ।
महातिक्तश्च तिक्तश्च निद्रारिः सन्निपातहा ॥

(धन्वन्तरि निघण्टुः)

Nepālaḥ kathitas'cān'yo jātibhedo jvarāntakaḥ |
Mahātiktas'ca tiktas'ca nidrāriḥ san'n'ipātahā ||

(Dhanvantari nighaṇṭu)

नेपालनिम्बो नैपालस्तृणनिम्बो ज्वरान्तकः ।
नाडीतिक्तोऽर्धतिक्तश्च निद्रारिः सन्निपातहा ॥

(राजनिघण्टुः)

Nepālanimbo naipalastṛṇanimbo jvarāntakaḥ |
Nāḍitiktosrdhatiktas'ca nidrāriḥ san'n'ipātahā ||

(Rājanighaṇṭu)

भूनिम्बो हि किरातः किरातितिक्तश्च काण्डतिक्तः स्यात् ।
कतृणमतितिक्ताह्वः किरातको रामसेवकोऽनार्यः ॥

(अभिधानमञ्जरी)

Bhūnimbo hi kirātaḥ kirāta tiktas'ca kāṇḍatiktaḥ syāt |
Kartṛṇamati tiktāhvaḥ kirātako rāmasevakosnāryah |

(Abhidhān'amañjarī)

The synonyms do not indicate any descriptive feature of the plant or drug. The terms *Kirāta Kirātika* and *Kirātatikta* mean that the plant grows in the forest and *Bhunimba*, that it is a small plant or herb growing low or near the ground with qualities similar to that of nimbo or Neem. Several terms as *Tikta*, *Mahatikta*, *Katutiktā Kaṇḍatikta*, *Anāryatikta*, *Atitiktahvah* specify its bitter taste, *Jvarāntaka*, and *Sannipātaka* mean that it destroys or curves fever. *Nidrāri* that it destroys sleep and charddighni that it arrests vomitting.

Properties and uses

किरातः सारको रूक्षः शीतलस्तिक्तको लघुः ।
सन्निपातज्वरश्वासकफपित्तास्रदाहनुत् ॥
कासशोथतृषाकुष्ठज्वरव्रणकृमिप्रणुत् । (भावप्रकाशः)

Kirātaḥ sārako rūkṣaḥ s'itaḷastiktako laghuḥ |
San'n'ipātajvaras'vāsa kaphapittāsradā han'ut ||
Kāsas'othatṛṣā kuṣṭhajvaravraṇakṛmipraṇut |

(Bhāvaprakās'a)

किरातको रसे तिक्तो सरः शीतो लघुस्तथा ।
श्लेष्मपित्तास्रशोफादिकासतृष्णाज्वरापहः ॥ (धन्वन्तरिनिघण्टुः)

Kirātako rase tikto saraḥ s'īto laghustathā |
Sḷeṣmapittāsra s'ophādi kāsatṛṣṇā jvarāpahaḥ ||

(Dhanvantari nighaṇṭu)

भूनिम्बो वातलस्तिक्तः कफपित्तज्वरापहः ।
व्रणसंरोपणः पथ्यः कुष्ठकण्डूतिशोफनुत् ॥ (राजनिघण्टुः)

Bhūnimbo vātalastiktaḥ kaphapitta jvarāpahaḥ |
Vraṇā samropaṇaḥ pathyah kuṣṭhakaṇḍūtis'ophan'ut ||

(Raja nighaṇṭu)

नेपालनिम्बः शीतोष्णो योगवाही लघुस्तथा ।
तिक्तोऽतिकफपित्तास्रशोफतृष्णाज्वरापहः ॥ (राजनिघण्टुः)

Nepalanimbah s'itoṣṇo yogavāhī laghustathā |
Tiktoftikapha pittāsra s'opha tṛṣṇā jvarāpahah ||

(Rāja nighaṇṭu)

Kirata is laxative, dry, cooling, bitter, light and overcomes San'n'ipāta type of fever, difficulty in breathing, *Kapha*, *Pitta* vitiation of blood, burning sensation, cough, oedema, thirst, skin diseases, fever, ulcer and worms.

According to Rājanighaṇṭu it is Vātaḷa ie. increases *Vāta*.

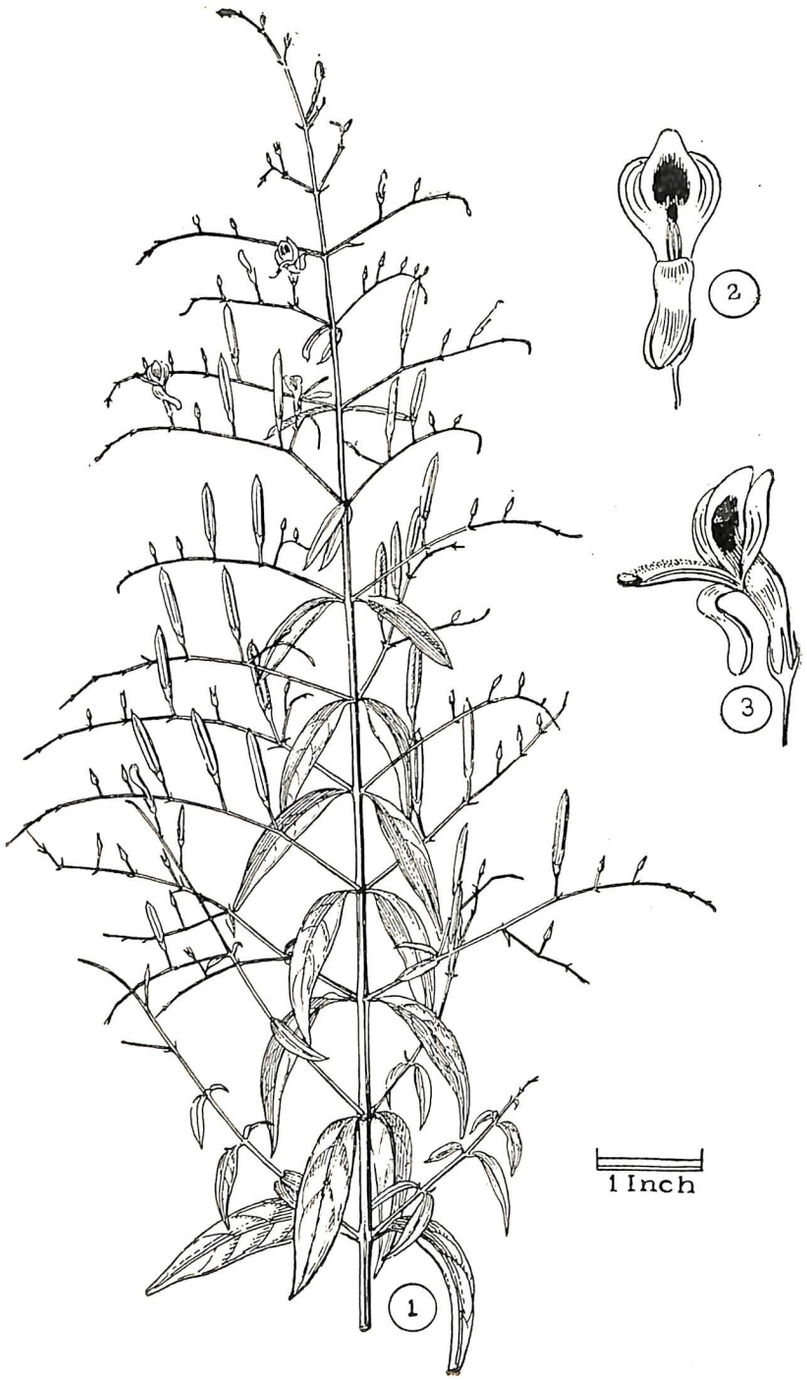
*Nepālanimba** a variety belonging to Nepal is *Śītoṣṇa*, ie, neither hot nor cool and is *Yogavāhi* ie. conveying the property of any other material (drug) with which it combines.

The plant is commonly used in *Viṣamajvara*, intermittent fever *amlapitta* or acidity and in *yakṛtrogam* (liver complaints.)

---

* This evidently is a species of *Swertia*.

Plate XVII



Andrographis paniculata Nees.

1. Shoot.
2. Front view of a flower.
3. Side view of a flower.

ANDROGRAPHIS PANICULATA Nees.

Synonyms: *Andrographis subspathulata* C. B. Clerke; *Justicia paniculata* Burm.

Family : Acanthaceae.

Sanskrit — Bhunimba, Bhunimbaha, Mahatikta, Kairata Kirata

Malayalam — Kiriyattu, Nilaveppu, Karakāñniram

Tamil — Nilavembu, Kiriāt, Shiratkuchchi

Hindi — Kiriyat, Charayetah, Mahatita, Mahatela Kalamegh, Cherota.

Distribution and habitat.

The plant is found in a wild condition or occasionally in cultivation throughout tropical India from Lucknow and Assam to the extreme south. It has been recorded from Bengal, N. Circars, Deccan, Carnatic, Kerala etc. It is quite common in most uncultivated ground and also as an undergrowth of scrubby or deciduous forests as well as in dry ground under shade of trees, bushes etc.

Habit and general features.

Andrographis paniculata Nees. is a small, erect, branched herbaceous to semi-woody annual or with the shoot portion at least dying down to the ground level, growing 30 to 75 cms. or more high with sharply four angled or almost winged jointed stem and opposite or cross armed four-sided spreading branches, bearing simple, short-petioled, opposite, lanceolate, entire, glabrous leaves narrowed at both ends, from 2·5 to 7·5 cms. long and about 12 mm. wide, and axillary horizontal simple or dichotomous racemes of small somewhat distantly spaced whitish, purplish-dotted irregular bilabiate flowers, one at each node (the opposite one being suppressed) and linear-oblong to elliptic compressed fruits 18 to 22 mm. long and 3 mm. wide, containing 6-12 ovoid rugose, glabrous, somewhat flattened seeds.

The plant is in flower for most part of the year but mostly in the wet and cold seasons. The entire plant is persistently intensely bitter.

External morphology :

Stem and *branches* acutely four-angled, nodose, jointed and nearly glabrous, branches cross-armed, four-sided, spreading or horizontal.

Leaves: simple, opposite, exstipulate, short–petioled, the petiole scarcely 6 mm. long; *blade* entire, slightly undulate, glabrous, membraneous, lanceolate, narrowed at both ends, the base attenuate to the petiole, dark green and glabrous above, paler and slightly glaucous or finely granular beneath from 2·5 cms. to 7·5 cms. long and 12 to 18 mm. wide, and with four to six pairs of slender lateral nerves.

Inflorescence : terminal as well as axillary (arising in the upper leaf axils) horizontal four–sided elongate or long secund lax flowered sub panicled, racemes 2.5 to 10 cms. long, bearing only one flower at each node, thus simulating monochosia, the flower in the axil of one of each pair of bracts as a node being suppressed, the whole inflorescence having the appearance of a large panicle.

Flowers: small, bracteate, pedicellate, all turned to one side, distantly placed one only at a node, zygomorphic or distinctly two lipped, white to pinkish most often with purplish dots, the lower lips darker; *Pedicels.* – very short, less than 4 mm. long somewhat glandular, pubescent. *Bracts* – from 1.5 mm to 2·5 mm. shorter than the calyx, linear – lanceolate; *bracteoles* – smaller or absent. *Calyx* – 9 to 12 mm. long, deeply five–parted, the segments or lobes equal, narrow, linear – lanceolate, glandular pubescent. *Corolla* – gamopetalous, 9 to 12 mm. long, hairy outside, *tube* – 5 mm. long, oblique, dilated below the limb; *limb* - prominently two lipped for at least half its length, the upper oblong and slightly twofid or two-toothed, the lower deflexed deeply three lobed, white to pinkish and spotted rose or dark purple, the segments subacute and imbricate in bud. *Stamens* – two, filaments free, broad or flattened or enlarged at base, hairy upwards; *anthers* – exerted, blackish, two-celled, the cells parallel, subequal, oblong or obovate, very flat and muticous, with their bases bearded coalesced or united firmly due to interlocking hairs. *Gynoecium* – bicarpellary, syncarpous. *Ovary* – superior, subglabrous or very thinly hairy, elongate, flat and bilocular, with 6 – 12 ovules in each cell; *style* slender, terminal ending in a minutely bifid stigma.

Fruit : a linear oblong, or elliptic, erect, somewhat cylindrical or more often a slightly flattened capsule, tapering at each end, and compressed at right angles to the septum, slightly glandular hairy when young but glabrous when mature, about 18 mm. long and 3 mm. wide, enclosing 6–12 seeds. *Seeds* – on retinacula, subquadrate or ovoid, hardly compressed, hard or osseous, rugosely pitted as in a thimble, glabrous (without scales or hairs) yellow or deep brown and with deep hilum.

Officinal part: The entire plant.

BALĀ

Balā is a very important Āyurvedic medicinal plant especially in Kerala, where it forms a chief ingredient of the famous medicine *Kṣīrabalā* used in the treatment of rheumatism etc. *Balā* enters into the composition of several other preparations also. Several species of *Sida* two or three species of *Abutilon*, two species of *Urena* and one or two species of *Pavonia* and *Grewia* are also mentioned as the botanical source of *Balā* in different parts of India. In the ancient Sanskrit medical texts under the denomination of *Pancabalā* five or more kinds of *Balā* are mentioned namely: *Balā*, *Nāgabalā*, *Mahābalā*, *Atibalā*, *Rājabalā*, and *Bhūmibalā*. In addition to these such names as *Balābalā Brihan'n'āgābalā*, *Suganthabalā*, *Pītabalā*, etc. are also mentioned. Whether these terms are mere synonyms of one drug or different kinds of the same drug or different drugs having slightly or distinctly different medical properties is not clear and has to be investigated. There is also considerable confusion in the equating of these kinds or varieties of *Balā* to their respective botanical sources*. The confusion is made worse when the vernacular names of the different plants are taken into consideration, for here either different plants go under the same name or with a prefix added or different names are applied to the same plant, sometimes even in the same region or/and the same language.

---

* Accordiug to a recent Hindi publication – *Abhinava butidarpana, Sida cordifolia* is equated as *Pitabalā* and also as *Swetabalā* and *Bhūmibalā* and its Hindi name is given *Bariar*. This Hindi name *Bariar* or Berial or Berala is found applied to *S. rhomboidea*, *S. rhombifolia*, *S. veronicaefolia*, *S. cordifolia*, and *S acuta*. Again *S. rhombifolia* is equated as *Mahābalā* and *Sahadevi*, *S. spinosa* as *Atibalā* and *Nāgabalā* and *S. veronicaefolia* as *Nāgabalā* – as well as *Bhūmibalā* probably on account of its habit of growing close to the ground with long wiry branches,

Khory and Katrak in their "Materia medica of India" equate under the general name *Balā*, *Sida cordifolia*, *S. retusa*, *S. spinosa*. *S. rhombifolia* and *S. acuta* indicating thereby that all these are used as *Balā*.

Dymock in the Pharmacographia indica considers *S. carpinifolia* (*S. acuta*) *S. rhombifolia*, *S. cordifolia* and *S. spinosa* as the source plants.

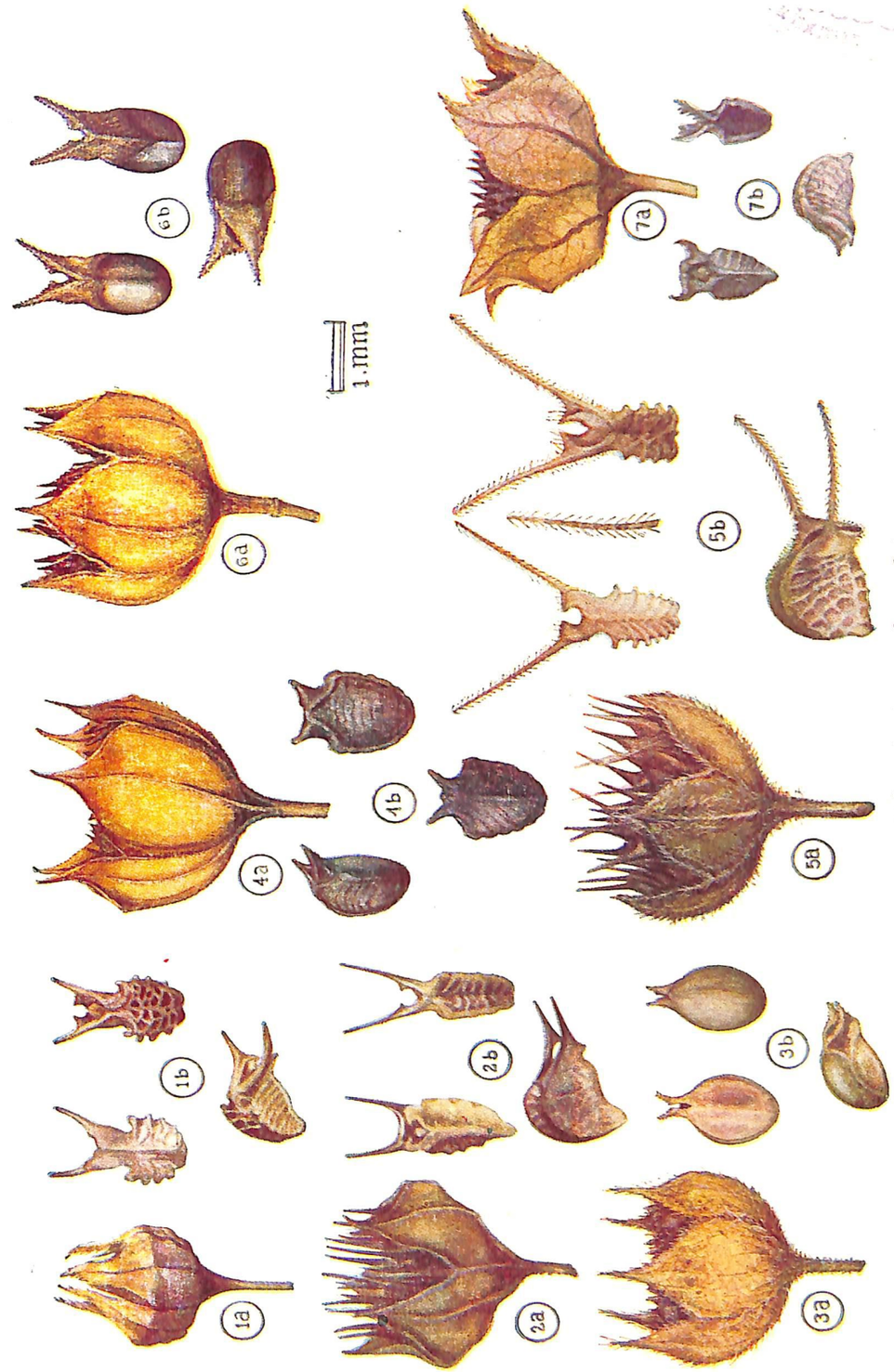


Plate XVIII

Sida (fruits and seeds)

1 a & 1 b *Sida acuta* Burm. 2 a & 2 b *Sida rhombifolia* Linn. 3 a & 3 b *Sida veronicaefolia* Lamk.
4 a & 4 b *Sida retusa* Linn. 5 a & 5 b *Sida cordifolia* Linn. 6 a & 6 b *Sida spinosa* Linn.
7 a & 7 b *Sida rhomboidea* Roxb.

*BALĀ

Source plant in Kerala : Mostly **Sida rhombifolia** Linn. var. **retusa** Linn.

Family : Malvaceae.

Sanskrit text :

Descriptive synonyms

वला वाट्यालिका वाट्या सैव वाट्यालकाऽपि च ।
महाबला पीतपुष्पा सहदेवी च सा स्मृता ॥
ततोऽन्याऽतिबला ऋश्यप्रोक्ता कङ्कतिका च सा ।
गाङ्गेरुकी नागबला ऋषा ह्रस्वगवेधुका ॥

(भावप्रकाशः)

Balā vāṭyālika vāṭyā saiva vāṭyāḷakāspi ca |
Mahābalā pītapuṣpā sahadevī ca sā smṛtā ||
Tatoṅyātibalā ṛṣ'ya proktā kaṅkatikā ca sā |
Gāṅgerukī nāgabalā ṛṣā hrasvagavedhukā ||

(Bhavaprakāś'a)

'बला भद्रौदनी वाटी समङ्गा खरयष्टिका ।
महासमङ्गौदनिका शीतपाक्योदनाह्वया ॥
महाबला वर्षपुष्पी तथा वाट्यायनी स्मृता ।
सहदेवा देवसहा पीतपुष्पा बृहत्फला ॥

---

*The plants most commonly used as the source of *Balā* belong to the genus *Sida*. The chief of these are. *Sida retusa*, or *Sida rhombifolia* var *retusa* : *S. rhombifolia* (type); *Sida rhomboidea* or S. *rhombifolia* var. *rhomboidea*; *S. spinosa*,. *S. cordifolia*; *S. acuta* or *S. carpinifolia* and occasionally also *S. humilis*. or *S. veronicaefolia* (as *Bhumibalā* and *Nāgabalā*). The plant in common use in Kerala is *S. rhombifolia* var. *retusa*.

In addition to the aforesaid species of *Sida* species of *Abutilon* such as *A. indicum*, *A. asiaticum*, *A. graveolens* etc. species of *Urena* as *Urena lobata*, and *U. sinuata* which go uuder the same or similar vernacular names as well as *Pavonia odorata* and *P. zeylanica* and one or two species of *Grewia*, are also indicated as the botanical source of *Balā* in certain books on Indian Materia Medica and these bear Sanskrit or vernacular names suggestive of this factor.

गाङ्गेरुकी नागबला खरगन्धिनिका झषा ।
विश्वदेवा तथारिष्टा खण्डा ह्रस्वगवेधुका ॥
बलिकातिबला प्रोक्ता वाट्यपुष्पी च कङ्कता ।
वृष्या प्रोक्ता वृष्यगन्धा सैव भूरिबला मता ॥
बला चातिबला चैव महाबलबलाबला ।
अन्या राजबला चेति बलायाः पञ्चकं मतम् ॥

(धन्वन्तरिनिघण्टुः)

Balā Bhadraudaṅī vāṭī samaṅgā kharayaṣṭikā |
Mahāsamaṅgaudaṅī kā sītapākyodaṅāhvayā ||
Mahābalā varṣapuṣpī tathā vāṭyāyaṅī smṛtā |
Sahadevā devasahā pītapuṣpa bṛhatphalā ||
Gāngerukī nāgabalā kharagandhiṅikā jhaṣā |
Visvadevā tathāriṣṭā khaṇḍā hrasvagavedhukā ||
Balikātibalā proktā vāṭyapuṣpī ca kaṅkatā |
Vṛṣyā proktā vṛṣyagandha saivabhūribalā matā ||
Balā catibalā caiva mahābala balābalā |
Aṅyā rajabalā ceti balāyāḥ pañcakam matam ||

(Dhanvantari nighaṇṭu)

बला समङ्गौदनिका च भद्रा भद्रौदनी स्यात् खरकाष्टिका च ।
कल्याणिनी भद्रबला च मोटा वाटी बलाह्वेति दशाह्वया स्यात् ॥
महाबला ज्येष्ठबला कटंभरा केशरुहा केसरिका मृगादनी ।
स्याद्वर्षपुष्पाऽपि च केशवर्धनी पुरासिनी देवसहा च सारिणी ॥
सहदेवी पीतपुष्पी देवार्हा गन्धवल्लरी ।
मृगा मृगरसा चेति ज्ञेया सप्तदशाह्वया ॥
भद्रौदनी नागबला खरगन्धा चतुष्पला ।
महोदया महाशाखा महापत्रा महाफला ॥
विश्वदेवा तथारिष्टा खर्वा ह्रस्वगवेधुका ।
देवदण्डा महादण्डा घण्टेत्याह्वास्तु षोडश ॥
बलिकातिबला बल्या विकङ्कता वाट्यपुष्पिका घण्टा ।
शीता च शीतपुष्पा भूरिबला वृष्यगन्धिका दशधा ॥

महासमङ्गौदनिका बलाह्वया वृक्षारुहा वृद्धिबलाक्षतण्डुला ।
भुजङ्गजिह्वापि च शीतपाकिनी शीता बला शीतवरा बलोत्तरा ॥
बल्या स्वरहटी चैव व्यालजिह्वा त्रिपञ्चधा ।

(राजनिघण्टुः)

Balā samangaudaṅikā ca bhadra
Bhadraudan'ī syāt kharakāṣṭikā ca |
Kalyāṇin'ī bhadrabalā ca moṭā
Vāṭī balāḍhyeti dasʻāhvayā syāt ||
Mahābalā jyeṣṭabalā kaṭambharā
Kesʻāruhā kesarikā mṛgādanī |
Syādvarṣapuṣpāpi ca kesʻavardhan'ī
Purāsin'ī devasahā ca sāriṇī ||
Sahadevī pīta puṣpī devārhā gandhavallarī |
Mṛgā mṛgarasā ceti jñeyā saptadasʻāhvayā ||
Bhadraudan'ī nāgabalā kharagandhā catuṣphalā |
Mahodayā mahā sʻakhā mahāpatrā mahāphalā ||
Visvadevā tathāriṣṭā kharvā hrsvagavedhukā |
Devadaṇḍā mahā daṇḍā ghanṭetyahvāstuṣoḍasʻā ||
Balikātibalā balyā vikaṇkatā vātyapuṣpikāghaṇṭā |
Sʻīta ca sʻītapuṣpā bhūribalā vṛṣyagandhikā dasʻadhā ||
Mahā samaṅgaudaṅikā balāhvayā
Vṛkṣāruhā vṛddhibalā kṣataṇḍulā |
Bhujaṅga jihvā pi ca sʻītapākin'ī
Sʻītā balū sʻītavarā balottarā ||
Balyā svarahatī caiva vyāḷajihvā tripañcadhā |

(Rājanighaṇṭu)

The synonyms are not much helpful in giving any clue to the correct identification of the plant. Two of them namely *Pītapuṣpī* (having yellow flower) and *Catuṣpha'a* (four-fruited) however give some indication of the nature of flower and fruit. Four varieties namely *Balā*, *Nāgabalā*, *Atibalā* and *Mahābalā* are mentioned in Bhāvaprakāsa. Rājanighaṇṭu mentions one more variety i.e. *Rājabalā*. Oshadhi-

nighantu, a book in Malayālam mentions a sixth variety called *Bhūmibalā*. Dalhana, commentator of Susrutasamhita says "*Balātibalā suklapītapuspe*", i.e. *Balā* and *Atibalā* have white and yellow flowers respectively.

Properties and uses

बला चतुष्टयं शीतं मधुरं बलकान्तिकृत्
स्निग्धं ग्राहि समीरास्रपित्तास्रक्षतनाशनम् ॥
बलामूलत्वचश्चूर्णं पीतं सक्षीरशर्करम् ।
मूत्रातिसारं हरति दृष्टमेतन्न संशयः ॥
हरेन्महाबला कृच्छ्रं भवेद्वातानुलोमिनी ।
हन्यादतिबला मेहं पयसा सितया समम् ॥

(भावप्रकाशः)

Balācatuṣṭayam s'ītam madhuram balakāntikṛt |
Snigdham grāhi samīrāsrapittāsrakṣatan'āś'an'am ||
Balāmūlatvaca s'cūrṇam pītam sakṣīra s'arkaram |
Mūtrātisāram harati dṛṣṭametanna sams'ayaḥ ||
Harenmahābalā kṛcchram bhavedvā tān'ulomin'ī |
Han'yādatibalā meham payasā sitayā samam ||

(Bhāvaprakās'a)

'बला स्निग्धा हिमा स्वादुर्वृष्या बल्या त्रिदोषनुत् ।
रक्तपित्तक्षयं हन्ति बलौजोवर्धयत्यपि ॥
महाबला तु हृद्रोगवातार्शः शोफनाशनी ।
शुक्रवृद्धिकरी हन्याद्विषमं च ज्वरं नृणाम् ॥
गाङ्गेरुकी मधुराम्ला कषायोष्णा गुरुस्तथा ।
कटुस्तिक्ता च वातघ्नी व्रणपित्तविकारजित् ॥

(धन्वन्तरिनिघण्टुः)

Balā snigdhī himā svadurvṛṣyā balyā tridoṣan'ut |
Raktapittakṣayam hanti balaujo vardhayatyapi ||
Mahābalā tu hṛdroga vātārs'aḥ s'ophanās'an'ī |
S'uklavṛddhikarī han'yādviṣmam ca jvaram nṛṇām ||

Gāngerukī madhurāmlā kaṣāyoṣnā gurustathā |
Kaṭustiktā ca vātaghn'ī vraṇapittavikārajit ||

(Dhanvantari nighaṇṭu)

बलातितिक्ता मधुरा पित्तातीसारनाशनी ।
बलवीर्यप्रदा पुष्टिकफरोगविशोधनी ॥
महाबला तु हृद्रोगवातार्शः शोफनाशनी ।
शुक्रवृद्धिकरी बल्या विषमज्वरहारिणी ॥
मधुराम्ला नागबला कषायोष्णा गुरुस्तथा ।
कण्डूतिकुष्ठवातघ्नी व्रणपित्तविकारजित् ॥
तिक्ता कटुश्चातिबला वातघ्नी कृमिनाशनी ।
दाहतृष्णाविषछर्दिक्लेदोपशमनी परा ॥
महासमङ्गा मधुरा अम्ला चैव त्रिदोषहा ।
युक्त्या बुधैः प्रयोक्तव्या ज्वरदाहविनाशिनी ॥

(राजनिघण्टुः)

Balātitiktā madhurā pittātīsāranās'an'ī |
Balavīryapradā puṣṭi kapharoga vis'odhan'ī ||
Mahābalā tu hṛdroga vatārs'aḥ s'ophanās'an'ī |
S'uklavṛddhikarī balyā viṣamajvarahāriṇī |
Madhurāmlā nāgabalā kaṣāyoṣṇā gurustathā |
Kaṇḍūti kuṣṭhavātaghn'ī vraṇapitta vikārajit ||
Tiktā kaṭūs'cātibalā vātaghn'ī kṛminās'an'ī |
Dāhatṛṣṇā viṣachardi kledopas'aman'ī parā ||
Mahāsamaṅgā madhurā amlā caiva tridoṣahā |
Yuktyā budhaiḥ prayoktavyā jvaradā havin'as'in'ī ||

(Rājanigha

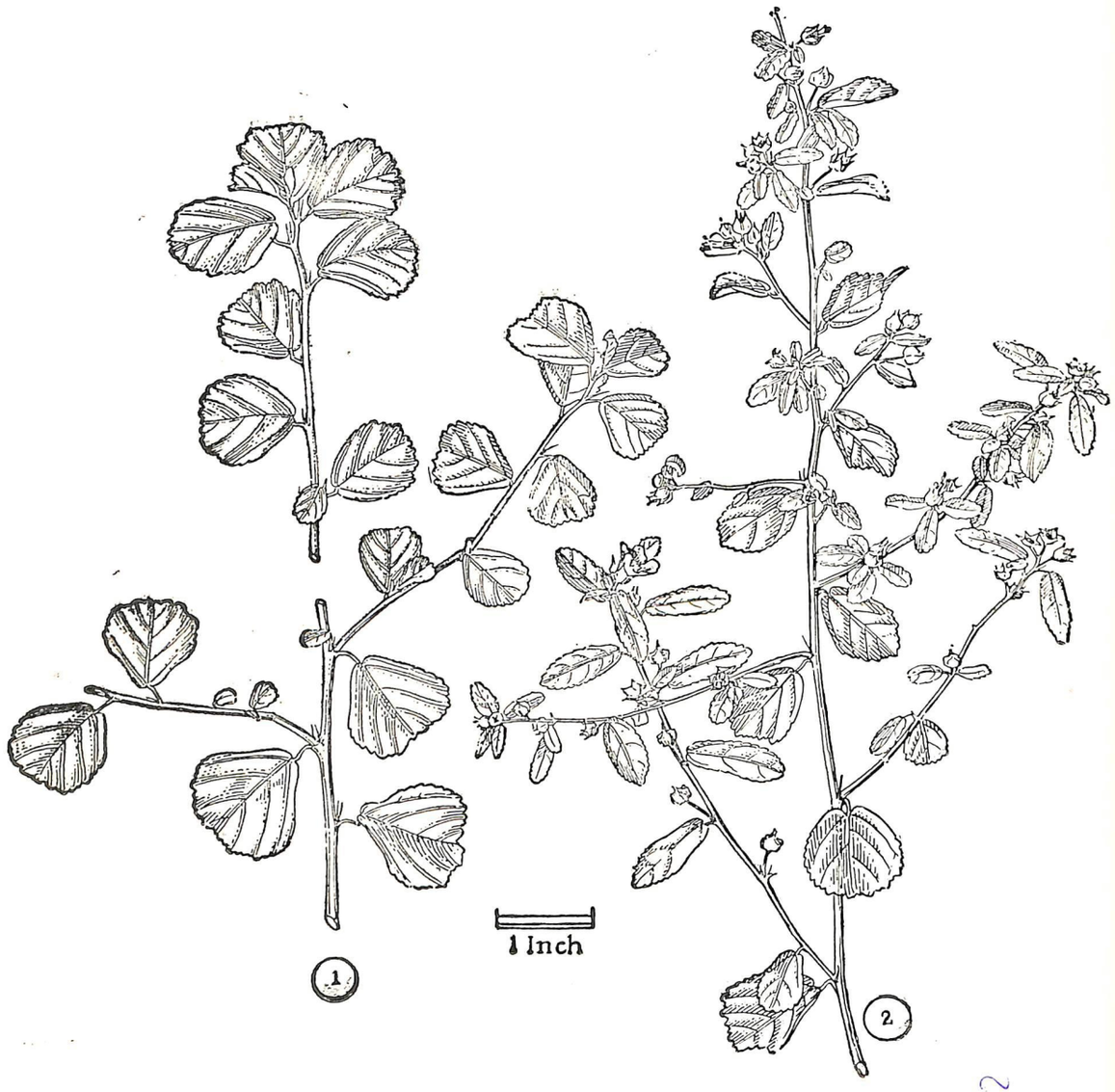
According to Bhāvaprakās'a the four varieties of Balā are cool, sweet, produce strength and beauty; are demulcent, arresting, cures *Vātarakta*, *Raktapitta* and consumption. Powder of Balā-

root-bark with milk and sugar stops polyuria Mahābalā cures difficult passing of urine and corrects *Vāta* into its normal course: Atibalā with milk and sugar cures urinary diseases with increased flow of urine like diabetes mellitus etc.

Other properties mentioned by Dhanvantari nighaṇṭu and Rāja nighantu are: Balā promotes sexual vigour and vital factor. Mahābalā cures heart diseases, *Vāta* type of piles, oedema, and irregular fevers. Nāgabalā is sweet, sour, astringent and hot, heavy, pungent and bitter; cures *Vāta* ulcers and *Pitta* diseases. Balā cures *Pitta* variety of diarrhoea. Nāgabalā cures skin diseases (leprosy) etc., Atibalā destroys worms, burning sensation, thirst, poison and vomitting. Rājabalā cures burning in fever.

Caraka has included Balā in Balya and Bṛmhaṇīya groups.

Plate XIX



Sida retusa Linn.

1. A twig of an young plant. 2. A twig with flower and fruits.

SIDA RETUSA Linn.*

Syn: *Sida rhombifolia* var. *retusa* Masters.; *Sida retusa* Willd.; *Sida chinensis* Retz.; *Sida philippica* D C.

Family	—	Malvaceae.
Sanskrit	—	Balā, Atibalā,
Malayāḷam	—	Kuruntoṭṭi, Āṉakuruntoṭṭi, Valankuruntoṭṭi
Tamil	—	Kurundoṭṭi
Hindi	—	Jungli-methi

Distribution and habitat

The plant is found throughout the warmer parts of India-chiefly in Bengal, Konkan, Bombay, Deccan, Carnatic and Kerala. It is a common weed of waste places as well as of cultivated ground and often grows gregariously.

Habit and general features

Sida retusa Linn. is an erect, minutely stellately hairy, suf frutescent herb or branched under-shrub from 30 to 90 cms. high with a firm woody stem and densely intricate branches, bearing simple, small short-petioled, variable generally obovate truncate or more often retuse, serrate leaves and small short-stalked solitary axillary yellow flowers. As in the other species of *Sida* the tissues of the plant abound in mucilage, and the bark yields a fine flaxy useful fibre. The plant usually flowers in the cool season, from November to January but may be found in flower nearly all through the year, in different localities.

External morphology

Leaves: Simple, 12 to 37 mm. long, alternate, short-petioled; the *petioles* pulvinate, about 3 mm. or less, stipulate; the *stipules* filiform, longer than the petioles; *blade* – shape and size varies according to the age of the plant. In seedlings and young plants, it is obovate, those on the middle of the stem are obovate, cuneate at

**Sida retusa* Linn. is the most commonly used source of Balā throughout Kerala.

base, truncate or retuse at tip and coarsely toothed towards the apex, while those towards the top in the flower bearing branches are much smaller and narrower. They are dark green and nearly glabrous above but hoary tomentose beneath.

Flowers: Comparatively small, without any epicalyx, yellow, fading to white, solitary axillary on peduncles about as long as the subtending leaves with an articulation or joint about the middle. *Calyx* – gamosepalous, persistent, broadly campanulate five angular, five lobed, the lobes triangular acute and valvate in bud: *corolla* – yellow, about twice as long and broad as the calyx, of five petals, twisted in bud and free except at the base where they are joined to the base of the staminal tube; *Stamens* – many, the filaments united below to form a short tube but free above, each tipped with an one celled kidney-shaped anther. *Pistil* – mostly ten-carpellary, rarely of fewer carpels (5–8), the carpels united to form a superior ten or fewer chambered ovary having a solitary ovule in each chamber and with as many stylar branches as the number of carpels.

Fruit: Smaller than and enclosed within the persistent calyx. The carpels when ripe are reticulated each having two short awns about as long as themselves. They separate from each other and from the central axis as indehiscent one seeded cocci. *Seeds* – smooth black.

Officinal parts: The roots and occasionally leaves.

Description of the root system

The root system consists of the main tap root and many branching lateral roots. The taproot attains a diameter of about 8 to 10 mm. and has a number of long wavy thin lateral roots. These have a large number of wiry rootlets. The roots have an yellowish brown colour and there are a few very small, tangentially elongated slightly prominent lenticels on the upper part of the thick roots. The outer surface of the root is not smooth on account of the presence of the many small rootlets. A transverse section of the root shows a central woody region which forms the major part of the root and a thinner outer bark which surrounds the wood. The bark can be easily peeled off from the wood in the fresh roots. In a root about a centimeter in diameter the bark is only about one mm. in thickness. In some roots there is a narrow hole at the centre of the root within the wood.

Histology

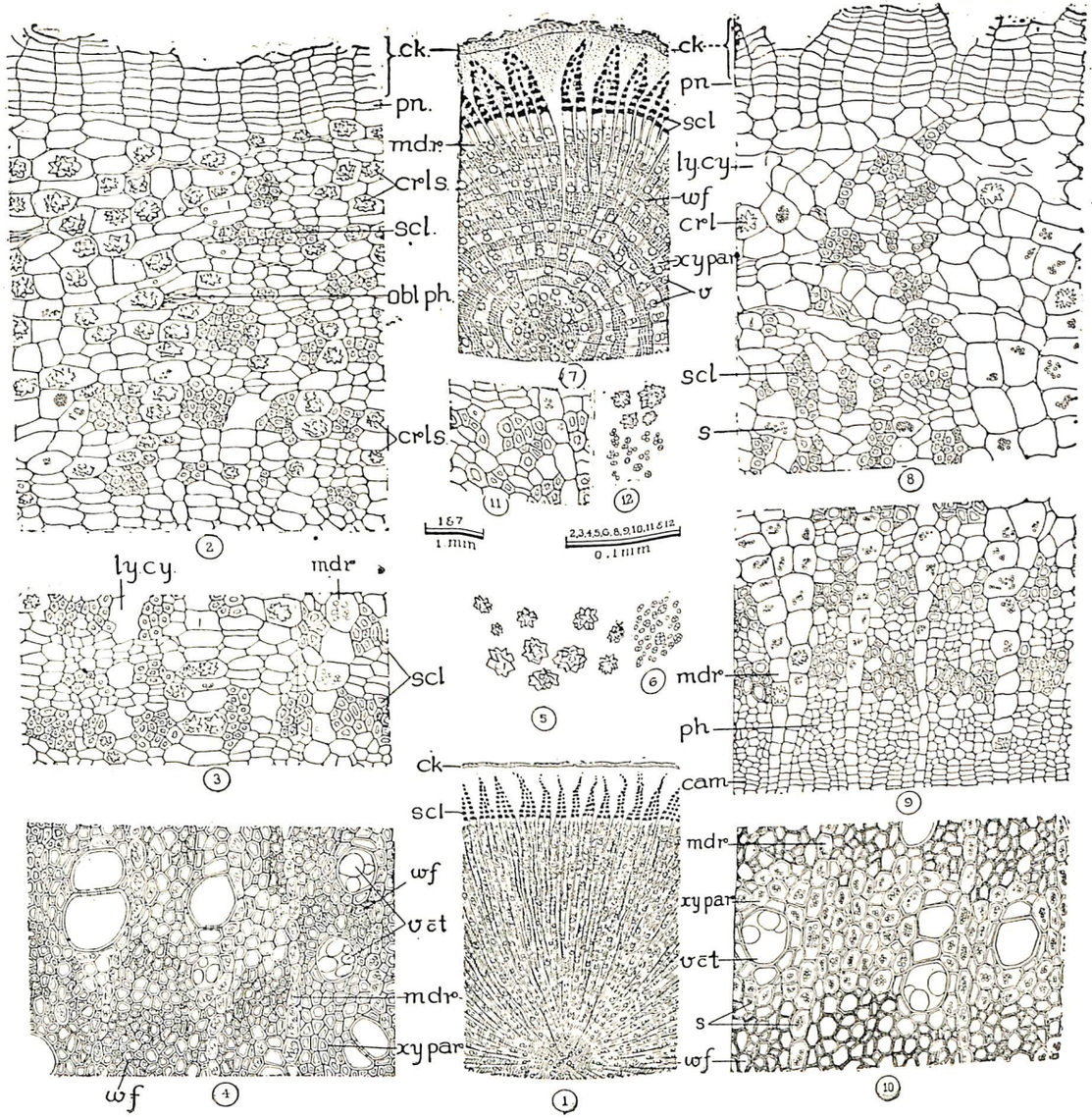
The outermost tissue namely the cork is very thin and composed of 4 to 7 rows of thinwalled, rectangular tangentially elongated cells with some of the outer cells detached and recurved. A *phellogen* composed of a single row of narrow, thinwalled, tangentially elongated cells is present. The *phelloderm* next within is very thin being only two to three rows in thickness. Its cells are large, slightly tangentially elongated and some of them contain large cluster crystals of calcium oxalate measuring 24μ in diameter. Just inner to this layer narrow strips of crushed cells of old cortical tissue are present. The bast or phloem occurs in conical strands which are more narrow and linear when compared to those of other species. These strands are separated by or alternate with the widened distal ends of the medullary rays. Each conical strand of bast is composed of 9–11 rows of tangential strips or zones of fibre groups alternating with the regular phloem elements. In each fibre group the number of cells vary from four to fifteen or more. The fibre cells are long and thickwalled. The cells of the phloem elements at the outer half of the phloem strand are thinwalled and oblong or almost rectangular with rounded corners. Some phloem parenchyma cells contain small crystals of calcium-oxalate. Very thin strips of crushed phloem elements are also present in this region. Towards the inner half of the phloem strands lysigenous cavities are found in between the two adjacent fibre groups in a tangential row. The cells of the phloem tissue in the newly formed phloem are small, thinwalled and mostly polygonal.

Inner to the phloem is the *cambium* which is formed of one or two rows of narrow, thinwalled cells. The *wood* which forms the major part of the root is composed mostly of secondary elements. The primary xylem present at the centre of the wood is tetrarch. The wood is composed of vessels, parenchyma, fibres and medullary rays. The vessels are many, pitted and vary in diameter from 30 to 50 μ. Tyloses are present in some of the vessels. Groups of wood fibres are present almost in concentric rings alternating with groups of xylem parenchyma cells. They are thickwalled and in transverse section appear slightly smaller in size than the parenchyma cells which are also thickwalled. Only a few xylem parenchyma cells contain starch grains. The starch content is less when compared with *Sida rhombifolia* (type), *Sida rhomboidea*, *Abutilon* etc.

Medullary rays. Many, long, uniseriate, as well as biseriate, and almost straight. Most of them extend from the centre to the periphery of the root. The secondary rays are mostly uniseriate. The ray cells in the wood are radially rectangular thickwalled and packed with small compound starch grains. The ray cells of the bark are thin-walled. The rays dilate gradually towards the outer region of the phloem strands and the ray cells also gradually become larger. Towards the distal end of the rays the cells are tangentially elongated and thinwalled and most of the cells contain small cluster crystals of calcium oxalate. Only a few ray cells contain starch granules. The starch grains are compound consisting of two to four components. Grains with six components are also met with. The starch grains are comparatively much smaller than those present in *S. rhomboidea*, *Abutilon* sp. etc. Almost all the cells at the distal widened ends of the primary medullary rays contain large cluster crystals of calcium oxalate varying from 15 to 24 μ in diameter.

Distinguishing characters

The presence of large numbers of cluster crystals in the expanded distal ends of the medullary rays, the presence of small lysigenous cavities towards the periphery of the bark in the bast region and the comparative scantiness of starch grains as well as the small size of the fibre groups there, are noteworthy features.



Histology of roots of *Sida retusa* Linn. & *Sida rhombifolia* Linn.

(Figs. 1 to 6) *Sida retusa* Linn.

1. Diagrammatic sketch of a sector of T. S. of the root
2. Cork and cortex.
3. Bast
4. Wood
5. Crystals
6. Starch grains.

(Figs. 1 to 12) *Sida rhombifolia* Linn.

7. Diagrammatic sketch of a sector of T. S. of the root.
8. Cork and cortex.
9. Bast with the cambium
10. Wood.
11. Portion of the bast showing the lysigenous cavity
12. Crystals and starch grains.

SIDA RHOMBIFOLIA Linn. (type)*

Synonyms: *S. Canariensis* Wild.; *S. compressa* Wall.

Family:	—	Malvaceae.
Sanskrit	—	Balā, Atibalā, Mahābalā, Pītabalā, Pitapuṣpi, Sahadevi, or Sahadeva, Prasadini.
Malayāḷam	—	Kuruntoṭṭi, Ānakuruntoṭṭi
Tamil	—	Kuruntoṭṭi, Cittamuṭṭi
Hindi	—	Barela, Lālbariala, Bariara, Kharenti, Swetberela, Sahadevi or Sahadeva.
Telugu	—	Atibala, Atibalachettu.

Distribution and habitat.

The plant is widely distributed throughout tropical India found growing as a weed of waste places in all the plains districts. It is seldom cultivated.

Habit and general features.

Sida rhombifolia Linn. is an erect woody herb or at times in places of good rainfall a branched undershrub with strong wiry flexuose branches, the surface glabrous or sparsely beset with scattered simple and stellate hairs, bearing simple, alternate, short-petioled stipulate rhomboid-lanceolate leaves serrated towards the top, and small yellow solitary axillary flowers on slender articulated peduncles. The stem and branches are slightly woody and covered with a thin tough fibrous bark. The fibres which occur abundantly are of a fine flaxy nature and very valuable. The whole plant especially the tissues of the leaves, bark and flowers abound in mucilage.

There is considerable variation in the form and size of the leaves, the relative length of the peduncle, the position of the joint or articulation on the latter and the size of the carpellary awns.

The plant is generally in flower during the cool months of the year, from November to January.

---

* Chopra (Indigenous drugs of India, p. 528) includes *S. rhombifolia* type as well as the varieties *microphylla* Cav; *obovata* Wall, *retusa* Linn; *rhomboidea* Roxb; and *scabrida* W. & A. as the botanical sources of Balā.

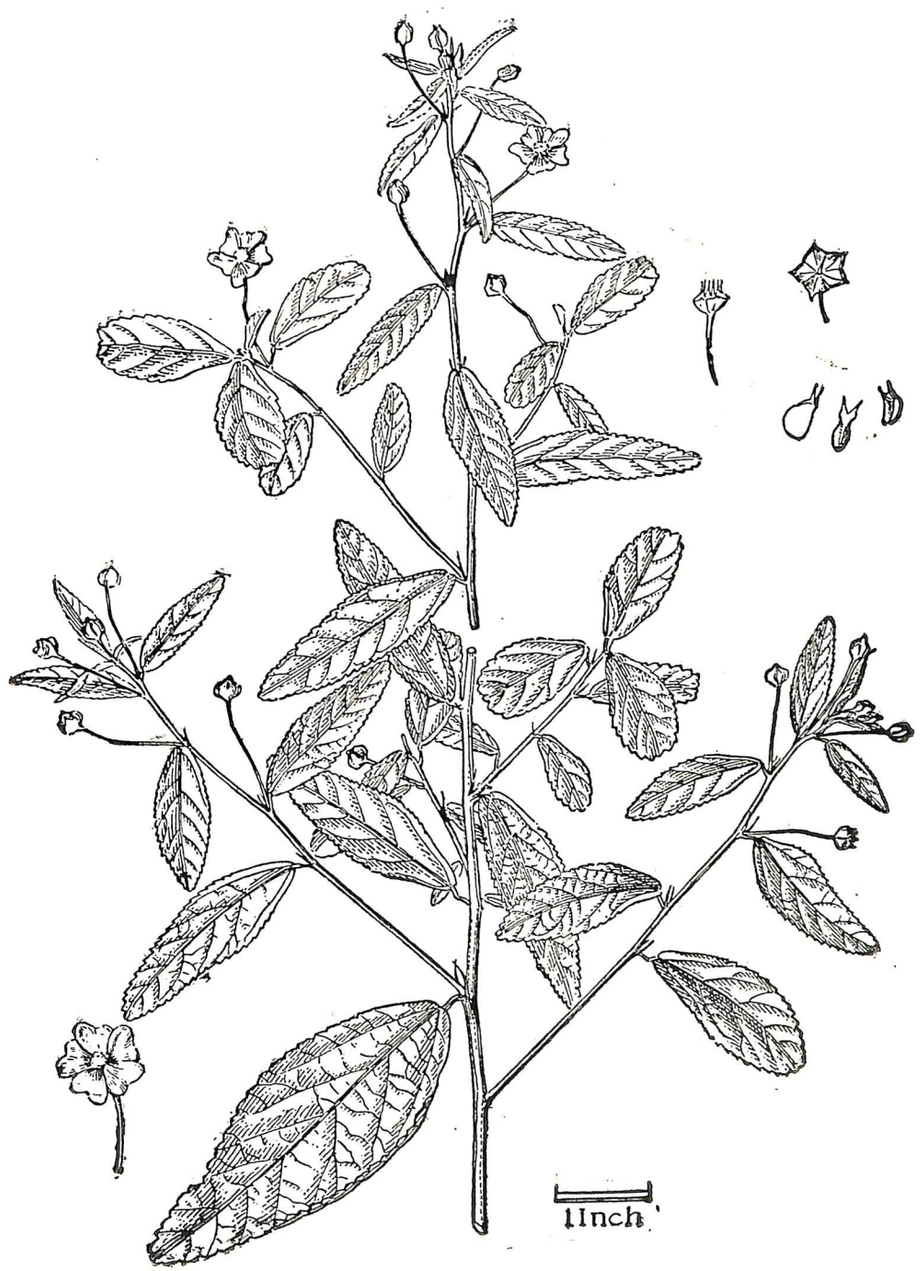
External morphology.

Leaves: simple, alternate, polymorphous, 2.5 to 6 cms. or more long. and up to about 2·5cms. broad, short-petioled; - the *petioles* pulvinate at base and apex, 6 mm. to rarely 12 mm. long stipulate; the *stipules* – longer than the petioles about 6 to 12 mm. filiform or linear, and setaceous; *blade* – variable in size and shape even in the same plant usually narrowed or tapering and three nerved at base, broadened at the top, obovate to broadly rhomboid in seedlings and young plants but become narrower in the older twigs; margin entire towards the base, serrate on the upper part, the surface glabrous or nearly so above but comparatively somewhat whitish or hoary and covered with soft silvery hairs underneath.

Flowers: without an epicalyx or involucre of bracteoles, about 1 cm. in diameter, mostly yellow rarely whitish, solitary, on slender peduncles that are axillary or appearing clustered or crowded towards the ends of the branches. The peduncles are longer than the petioles, rarely less than twice as long as the petiole. They vary from 2 cms. to over 2·5 cms. in length, the lower ones being comparatively longer than the upper and disarticulate at a joint at or above the middle, i. e. nearer the calyx *Calyx* – gamosepalous, broadly campanulate, five angled, five lobed, the lobes deltoid acute or shortly acuminate and valvate in bud. It is persistent and encloses the ripening fruit. *Corolla* – yellow or rarely whitish: when fully open nearly 15 mm. broad; of five free spreading petals which are unsymmetrical or oblique and slightly or shallowly bilobed at the tip, twisted in bud and adnate by their bases to the base of the staminal tube. *Stamens:* many, mon-adelphous to form a short staminal tube or column that surrounds the pistil and divides at the top into many anther bearing filaments; *anthers* – kidney shaped, one celled. *Pistil* – generally of eight to ten united carpels. *Ovary* – superior as many chambered as the number of carpels with one ovule in each chamber and with as many stylar branches (or free styles). Each carpel has usually two short awns or beaks at the top.

Fruit: a depressed globose, schizocarp enclosed within the calyx. The ripe carpels are about as long as the calyx and have two straight sharp long narrow horns or awns without barbs and separate as one seeded indehiscent units from a short central axis. *Seed*: solitary, pendulous or horizontal, and smooth with its radicle superior.

Plate XXI



Sida rhombifolia Linn.

Officinal parts:

The entire root system and occasionally the leaves.

Description of root:

The main or tap root attains a diameter of about 12 mm. but is comparatively short. The lateral roots are longer but thinner and possess numerous rootlets. These may be straight or more often wavy and are brownish yellow in colour. The outer surface is not smooth due to the presence of many longitudinally elongated and oval lenticels and many small rootlets.

Histology:

In a transverse section of a root of about 8 mm. in diameter the bulk part is constituted of the wood and the bark has only a thickness of about one mm. The outermost layer of the root namely the cork is composed of three to eight or ten rows of narrow rectangular, tangentially elongated thin walled cells having a light brown colour for the cell walls. Inner to the cork the *phellogen* is present composed of a single row of thin walled, narrow slightly tangentially elongated cells. *Cortex* - Secondary cortex formed by the activity of the phellogen is very thin consisting of two or three rows of thinwalled almost rectangular but larger cells. Primary cortical cells are present but large lysigenous cavities are formed in this tissue just above the medullary ray expansions. A few of the cortical cells contain cluster crystals of calcium oxalate. *Bast*- This tissue as seen in T. S. appears in the form of conical strands composed of nine to eleven or more tangential rows of fibre groups alternating with the regular phloem tissue. The primary phloem elements situated towards the outer border, are crushed and the strips of crushed tissue are seen in between the fibre groups. The fibre groups at the pheriphery are smaller than those occurring inside. Towards the mid region of the bark portion or just above the recently formed phloem many small lysigenous cavities are found in between the two adjacent fibre groups. Some of the phloem parenchyma cells of this region contain small starch granules. The fibre groups situated at the region of the newly formed phloem are composed of a larger number of cells than those at the periphery. The cells of phloem elements are thinwalled polygonal and are smaller in cross section than those at the outer region.

A *Cambium* consisting of one or two rows of thinwalled narrow tangentially elongated cells is present inner to the phloem

The wood which occupies the central part of the root consists of many vessels, alternating bands of incomplete or complete rings of wood fibres and wood parenchyma and the medullary rays. At the centre of the wood six primary xylem groups are present. The vessels are comparatively much narrower than in other species. They range in diameter from 20 to 50 μ. and are distributed in small groups of 2–4 in radial lines. Most of the vessels appear occluded with tyloses. The wood parenchyma cells are thickwalled and are packed with small mostly rounded starch grains. Compound grains of 2 to 4 components measuring about 6 μ are also very common. The wood fibre cells which are arranged in alternating layers with the parenchyma cells are also thickwalled but most of the cells are slightly smaller in T. S. than the parenchyma cells.

Medullary rays. Many, long and radiate from the centre. Most of them are uni-and biseriate, except the primary medullary rays which are four or more seriate. The ray cells within the wood are slightly radially elongated and thickwalled and are packed with starch grains. The ray cells in the phloem region are thinwalled, and slightly larger than those of the wood being rectangular or slightly radially elongated. The ray cells gradually widen and become tangentially elongated towards the distal end of the rays. Most of them contain starch grains and a few cells contain crystals of calcium oxalate measuring about 21 μ in length.

Distinguishing characters

Large cavities are found at the periphery of the root just above the ray expansions. Small lysigenous cavities occur within the conical strands of the phloem at the innermost region as in *Sida retusa*. Most of the ray cells contain starch grains. Only a small quantity of crystals is present. In the wood the xylem fibres and xylem parenchyma are present in separate bands and the xylem parenchyma cells contain starch grains. The vessels are not very wide and most of them are occluded with tyloses.

Plate XXII

Sida rhomboidea Roxb.

SIDA RHOMBOIDEA Roxb.

Synonyms : *Sida rhombifolia* Linn. var. *rhomboidea* Masters.; *Sida orientalis* Cav.

Family : Malvaceae.

Sanskrit	—	Balā Mahābalā
Malayāḷam	—	Kuruntoṭṭi
Tamil	—	Cittamuṭṭi, Arivālmunaipundu
Hindi	—	Sufet or swet bariala or Barela

Distribution and habitat.

Throughout the warmer parts of India: recorded occurring in Assam, Bengal, Bombay, Mysore, Andhra, Madras and Kerala. It is a weed of waste places; found also as an under-growth of open forest lands, but is not very common.

Habit and general features.

Sida rhomboidea Roxb. is a nearly glabrous, erect, ramous perennial undershrub growing 90 to 120 centimeters high, with a short erect stem and ascending or upwardly directed branches, the younger shoots a little mealy, bearing simple, alternate, short-petioled, rhomboid or rhomboid-lanceolate coarsely toothed leaves and fairly large solitary axillary yellow flowers that open towards noon or in the afternoon. The stem bark yields fine or delicate flaxy fibres and the tissues of the entire shoot abound in mucilage. Flowering time usually the cool season from November to January.

External morphology.

Leaves : simple, alternate, of varying sizes, short-petioled; the *petioles* – pulvinate, 3 to 6 mm. long; stipulate; the *stipules* – longer than the petioles, setaceous or bristle-shaped; *blade* – widely rhomboid-lanceolate or occasionally ovate-elliptic, those towards the base or in young plants rhomboidal, those in the upper and flowering twigs elliptic to lanceolate, rhomboid-lanceolate or narrowly rhomboidal coarsely serrate, cuneate and three nerved at base, nearly glabrous above, hoary with short tomentum beneath. The size and shape of the leaves vary even in the same plant. The length may be up to 6 cms. and breadth upto 3.5 cms.

Flowers: without epicalyx, comparatively large, solitary axillary or collected into leafy corymbs at the ends of the branches yellow or pale yellow, regular, bisexual and hypogynous; *peduncles* – slender, erect, shorter than but more than half the length of the leaves – 1.8 to 2.5 cms. or more in length, with a joint or articulation at or near the base, mostly solitary or occasionally two or more arising from the same axil. In the upper branches, on account of the branches being smaller, the internodes shorter, and the smaller size of the leaves, the flowers appear somewhat crowded into leafy corymbs. *Calyx* – gamosepalous, without an involucre of bracteoles, broadly companulate, persistent, minutely hairy, five–toothed, the teeth valvate in bud. *Corolla* – pale yellow, sub-rotate, of five free twisted petals which are obliquely and deeply retuse and adnate to base of the staminal column. *Stamens* – many, mon–adelphous, the tube short breaking into several antheriferous filaments at the top; *anthers*–one celled kidney - shaped. *Pistil* – ten carpellary. *Ovary* – ten celled with one ovule in each loculus and with ten short stylar branches. The carpels when young together form a depressed somewhat umbilicated orb covered by the incurved lobes of the calyx, but when the seeds mature, they diverge or separate into one seeded cocci, each coccus or carpel, usually muticous or with rather very short inflected awns.

The chief differences from *Sida rhombifolia* are in the shape and margin of the leaves, the position of the joint or articulation on the peduncle and the size and nature of awns.

Officinal part: Root and occasionally leaves

Description of the root :

The *root-system* consists of a fairly stout taproot about one cm. in diameter with several slightly thinner lateral roots. The roots are woody and fibrous and have an yellowish brown colour. The outer surface of the root is smooth except for the presence of a number of small wiry rootlets and many dot-like lenticels towards the basal portions. The major part of the root is composed of the central woody strand which is surrounded by a thin bark that can be easily peeled off in the fresh condition.

Histology.

The outermost tissue in the transverse section of the root is the *cork* which is very thin (40 μ to 60 μ) and composed of four to eight rows of thinwalled rectangular or slightly tangentially elongated cells. In certain regions the outermost row of the cork layer is slightly detached due to exfoliation and their cell walls have a light yellow colour. The *cortex* is very thin consisting of two to three rows of fairly large tangentially elongated thin-walled cells. Some of these cells contain large cluster crystals of calcium oxalate about 15 to 20 μ in diameter. A few other cells contain small mostly subspherical starch grains of 3 μ to 6 μ in length. The bast which forms the major part of the bark appears as conical strands with the bases of the latter facing the wood and separated by the broadened distal portions of the medullary rays. Each conical strand is composed of several groups of fibre cells arranged in tangential bands alternating with thinwalled phloem elements. The number of cells in each fibre group varies from two to sixteen, the smaller groups being situated towards the periphery and the larger groups in the inner portions of the bast. The bast fibres are nearly uniform in thickness or size and their length varies from 1 to 1.5 mm. The alternating strips of phloem are composed of thinwalled parenchyma some of which contain small starch grains and others small cluster crystals of calcium oxalate. The sieve tubes and companion cells being small are not very conspicuous even in the recently formed regions.

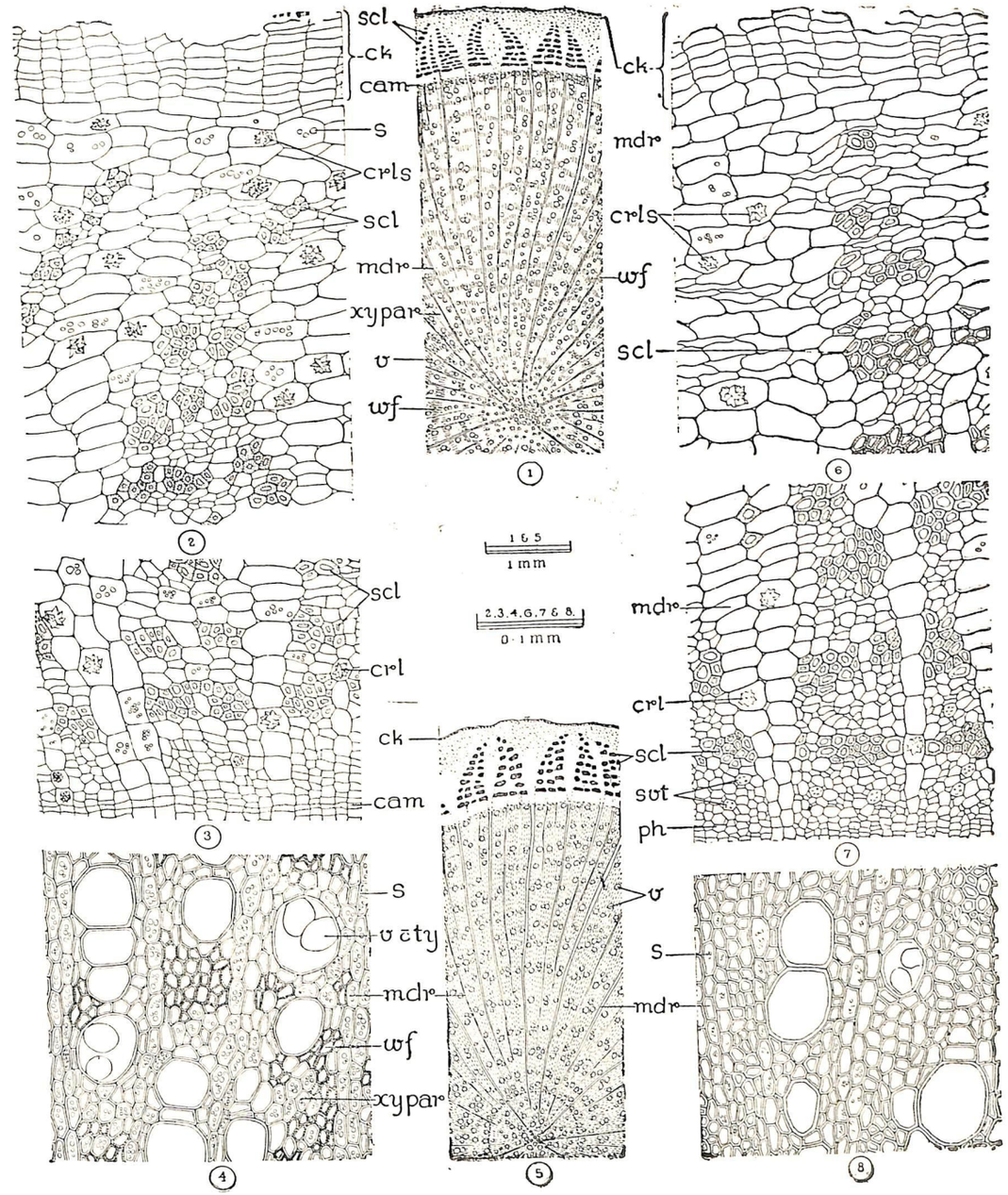
The medullary rays present in the bark are mostly uni-or biseriate or occasionally triseriate. These expand towards the periphery of the root. The medullary ray cells near the cambium are almost cubical or slightly elongated but they gradually lengthen in a tangential direction at the distal ends of the rays. Most of the ray cells either contain starch grains or cluster crystals, the crystals being very abundant in the ray cells situated at the outer region of the bast. A cambium consisting of a single row of thinwalled tangentially elongated cells is present inner to the phoem.

The *wood* forms the central major part of the root. It is composed of a large number of vessels, wood fibres, xylem parenchyma and medullary rays. The groups of xylem parenchyma are

not however so closely arranged to form well defined concentric rings alternating with rings of xylem fibres as seen in *S. rhombifolia*; *S. rhombifolia var. retusa;* or *S. veronicaefolia*. Vessels are found in small groups of two to four. They are arranged in radial rows, vary in diameter from 35 μ to 75 μ and some of them contain tyloses. The wood fibres are very thick-walled and occur in groups. The xylem parenchyma cells are also comparatively thickwalled, and arranged compactly. They are more or less of the same size as the fibre cells as seen in transverse section and contain starch grains. Most of the medullary rays present in the wood are uni-or biseriate and they start from very near the centre of the root. The ray cells are radially elongated thickwalled and almost all of them are packed with starch grains.

In the size of the conical strands of bast, the size and number of bast fibre cells in each group and the presence of cluster crystals of calcium oxalate in the cells of the distal broadened portion of the medullary rays there is close similarity between this plant and *S. rhombifolia var retusa.*

Plate XXIII



Histology of the roots of *Sida rhomboidea* Roxb. and *Sida spinosa* Linn.

(Figs. 1 to 5) *Sida rhomboidea* Roxb.

1. Diagrammatic sketch of a sector of T. S. of the root.
2. Cork and cortex.
3. Bast and cambium.
4. Wood.

(Figs. 5 to 8) *Sida spinosa* Linn.

5. Diagrammatic sketch of a sector of T. S. of the root.
6. Cork and cortex.
7. Bast and cambium.
8. Wood.

SIDA SPINOSA Linn.*

Synonyms : *Sida alba* Linn. ; *S. alnifolia* Linn. ; *S. glandulosa* Roxb. ; *S. boriaria* Wall.

Family :	–	Malvaceae
Sanskrit	–	Nāgabalā, Khāryaṣṭa or Kharyaṣṭika
Malayāḷam	–	Kāttu – venthiyam, Ānakuruntoṭṭi,
Tamil	–	Mayirmānikkam,
Hindi	–	Bariyara, Janglimethi, Gulsakari
Telugu	–	Chinamootam.

Distribution and habitat.

The plant is found throughout the hotter parts of India but is more common in the dry districts. It has been reported occurring in Bengal, Bombay, Gujerat, Sind, the Circars, Carnatic and Madras. It is a weed of waste places roadsides and lands that have lately been under cultivation, but is not very common in Kerala.

Habit and general features.

Sida spinosa Linn. is a small erect, or suberect, grey pubescent suffruticose branched herb or very rarely an undershrub with a slender erect stem "winding from branch to branch" and many small branches, the young shoots covered with soft grey mealy stellate down and bearing simple small ovate or rounded cordate, variable leaves usually with two or occasionally three, small or minute, stiff somewhat spiny projections or tubercles at the nodes adjacent to or just below the place of insertion of the leaves, and small cream yellow solitary axillary flowers on slender jointed peduncles with the joint or articulations near the flower.

The plant is in flower usually during the rainy and cold seasons mostly from October to December, but may occasionally bear flowers all through the year.

*Kirtikar and Basu, Sir R. N. Chopra and others equate *Sido spinosa* as *Nāgabalā*. According to certain others *Nāgabalā* is *Sida veronicaefolia*.

External morphology

Leaves: simple, alternate, short petioled; the *petioles* – half to three quarters the length of the leaves (blade), generally 1.2 to 2·5 cms. or more long with 2 or 3 small hard glands or projections, one on each side and one below their insertion, stipulate – the *stipules* subulate arising from the short stiff lateral projections; *blade* - variable, 12 to 18 mm. long or occasionally longer (up to 5 cms.) roundish ovate, ovate, obovate, oblong, elliptic-oblong, lanceolate or even linear-lanceolate, obtusely serrate or coarsely crenate-serrate, three nerved and rounded to subcordate or sometimes cuneate at base, rounded to narrowed at apex, ultimately glabrate above and stellately grey pubescent or hairy beneath with a scattering of silvery hairs all over.

Flowers: small, about 12 mm. across, pale yellow to cream white, axillary solitary on slender peduncles that equal or slightly exceed the petioles 12 to 18 mm. long with a joint towards the top very near the calyx. The peduncles are mostly solitary, but occasionally there may be several flowers associated together on short axillary branches with reduced leaves or without leaves. *Calyx* - without an involucre of bracteoles, gamosepalous, persistent, grey pubescent, regular cup shaped, five lobed the lobes deltoid or triangular acute and valvate in bud. *Corolla* - pale yellow, slightly exceeding the calyx of five free obliquely triangular twisted petals. *Stamens* - ten or twelve to fifteen monadelphous, the free ends bearing half anthers. *Pistil* - mostly of 5 - 6 or rarely of 3 carpels that are united to form an as many chambered ovary with one ovule in each locule. Carpels pubescent, equalling or scarcely longer than the calyx, with two short erect or slightly divergent hairy beaks or awns about half the length of the carpel arising from a conical base. *Seeds* - smooth, brownish black, one in each carpel.

Officinal part: Root.

Histology: The outermost tissue in the transverse section of the root namely the cork is narrow (20–40 μ) and composed of 4 to 6 rows of thin walled tangentially elongate cells. The cells of the outermost row have a light cream colour for the cell walls. The cortex (within the cork) consists of only three or four rows of slightly large

Plate XXIV

Sida spinosa Linn.

tangentially elongated thinwalled cells, a few of them containing cluster crystals of calcium oxalate and some others starch grains measuring 3 μ to 6 μ in length. The starch and crystal content is comparatively very meagre in this species. The bast is found in T. S. in the form of conical strands as in other species but the number of strands is fewer. Each conical strand of bast consists of 5–7 tangential strips of bast fibre groups alternating with the regular thinwalled phloem elements. Each group of bast fibre is composed of three to 20 or more cells. The smallest groups are arranged at the periphery of the root. The cells of the phloem elements alternating with the outer most groups of bast fibres are thinwalled and tangentially elongated with some of the cells very much compressed, but the cells towards the interior are more regular, polygonal and thinwalled. In the recently formed phloem, sieve tubes and companion cells are distinct. Here the cells of the phloem are slightly longer in T. S. than those of *S. acuta*, *S. cordifolia* etc. but these cells do not contain any crystals or starch grains as in the other species. They ray cells present in this region are radially elongated and they become larger and tangentially elongated towards the periphery. Some of the ray cells situated at the innermost part of phloem contain cluster crystals and a few small starch grains. At the regions of the ray expansion all the cells are tangentially elongated some of them containing starch grains and a few others crystals. Some of the ray cells are found to be much compressed so that narrow tangential strips of compressed cells are found at the distal ends of the rays.

A cambium composed of a single row of narrow thinwalled rectangular cells is present inner to the bast. *The wood* forms the major part of the root and consists of a large number of vessels xylem parenchyma fibres and medullary rays. The vessels occur in small groups of 2–4 distributed in the form of concentric rings. There is comparatively less of xylem parenchyma cells and more of fibres. The vessels are pitted and vary from 30 μ to 85 μ in diameter. A few vessels towards the centre are occluded by tyloses. The xylem parenchyma cells are thickwalled and are not arranged in wide bands as in other species being very much less in number and they too are not packed with starch grains as in other species. The xylem fibres are thickwalled and occur comparatively in a larger

proportion than the parenchyma. The medullary rays are one to three seriate. Four primary rays are clearly made out. Most of the rays start from the centre of the wood and reach up to the cortex at the periphery of the root. The ray cells within the wood are slightly radially elongated thickwalled and most of them have a small quantity of starch grains. The size of the grain is also smaller when compared with the other species.

Distinguishing characters

This can be differentiated from other allied species by the following:–

(1) the presence of only a comparatively very small quantity of crystals and starch grains.

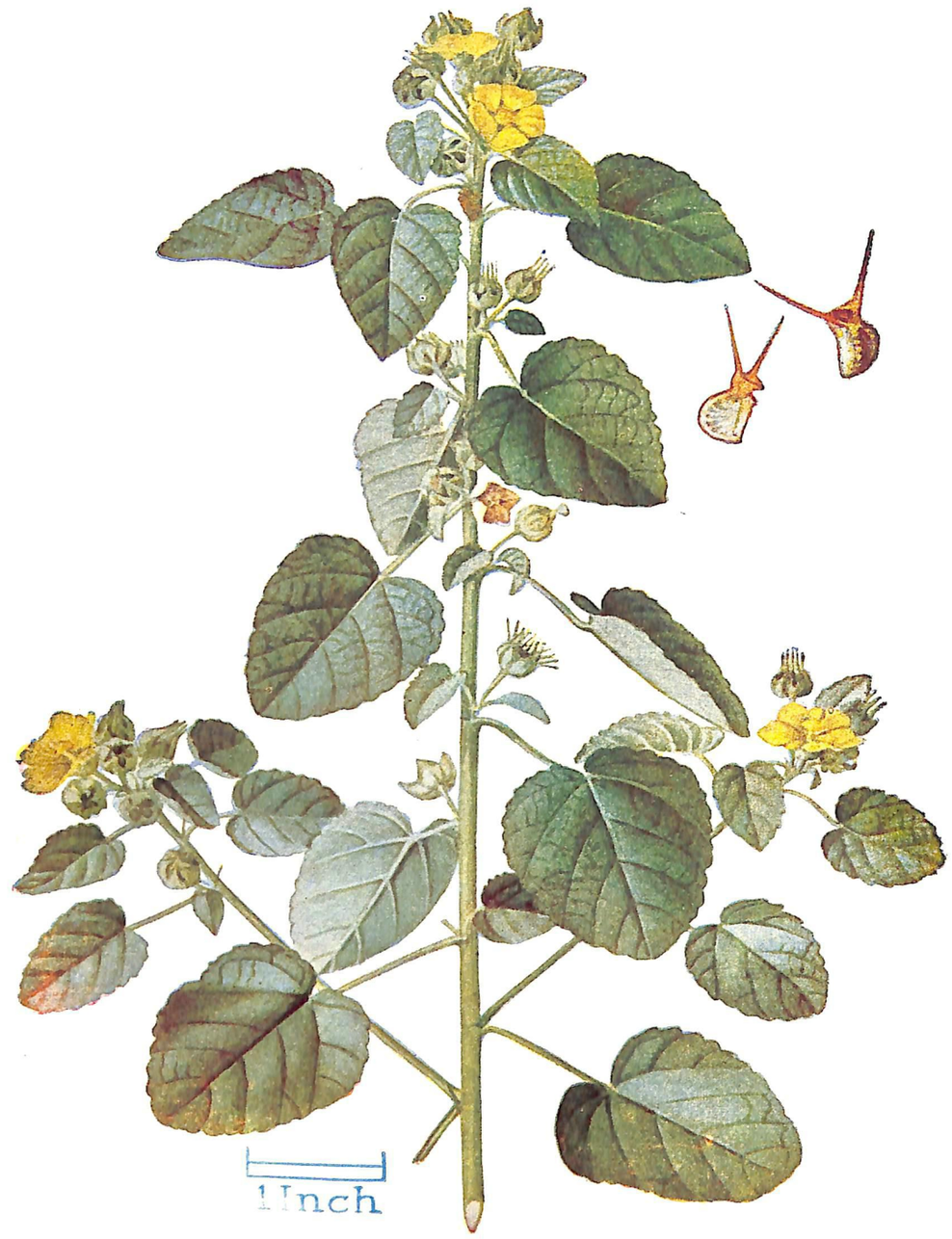
(2) the expanded distal ends of the medullary rays are wider.

(3) the meagre presence or even absence of crystals and starch grains in the ray cells.

(4) the xylem parenchyma and the wood fibres are not so distinctly differentiated to form tangential strips or bands.

(5) the tetrarch parenchyma and xylem.

Plate XXV



Sida cordifolia Linn.

SIDA CORDIFOLIA Linn.*

Synonyms: *Sida herbacea* Cav.; *Sida althaefolia* Swartz.; *Sida rotundifolia* Cav.

Family : — Malvaceae.

Sanskrit	—	Balā, Batyūlaka or Badiyālka, Badyūlaka.
Malayāḷam	—	Veḷḷūram, or Vellūran, Vellūrpam or Vellūrpan, Kāttūren or Kāttūran
Tamil	—	Malaitāngi, Pilambasi, Viṣabodi, Nilatutti, Arivālmunaipundu.†
Hindi	—	Cikana, Bariara, Bariara, Bariāla, Barela, Kharenti, Gulaskari, Kungyi, Barial,Bariar.

Distribution and habitat.

The plant is found throughout the tropical and subtropical regions of India up to an elevation of 1800 meters. Bengal, Bombay, Coromandel, Carnatic, and Kerala are the chief regions of its occurrence. It is a very common weed of roadsides and waste places in Kerala where it most often grows gregariously.

Habit and general features.

Sida cordifolia Linn. is an annual or under favourable conditions a perennial, short erect, greyish-green, softly hairy or pubescent woody herb, growing to about 60 cms. or more high with short stem and branches, bearing, orbicular, or ovate, or cordate or ovate-cordate obtuse very downy leaves and small pale yellow to whitish solitary, axillary flowers. The plant yields a fine fibre from its bark. Flowering time; mostly the rainy and cool seasons. Generally from October to January or February the plant is in flower.

External morphology.

Leaves: simple, 2·5 to 5 cms. long and 1·8 to 3 cms. wide, alternate, petioled; the *petioles* – about as long as the blade, 1 2 to 3·7 cms. long, pulvinate; stipulate, the *stipules* – linear about half the

* *Sida cordifolia* Linn. as well as *S. acuta*, *S. retusa*, *S. rhombifolia* and *S. spinosa* are equated as Balā by Khory and Khatrak. Five varities viz. *Balā*, *Mahābalā*, *Nāgabalā*, *Atibalā* and *Rājabalā* are mentioned in the Ayurvedic texts.

† Most of these vernacular names are applied to other species of *Sida* also.

length of the petiole; *blade* – orbicular, ovate, ovate-oblong, or cordate; base, cordate or occasionally cuneate apex obtuse, margin crenate, or bluntly serrated and surface very downy or velvety – tomentose on both surfaces.

Flowers: without an epicalyx, light or sulphur yellow, to creamwhite mostly axillary and solitary, but appears crowded in the upper portions and towards the tips of the branches. *Peduncles* – 12 to 18 mm. long with an articulation or joint above the middle or nearer the flower. The lower peduncles are usually distant and longer than the petioles and the upper comparatively shorter and crowded. *Calyx* – gamosepalous, persistent, without bracteoles, 6 to 8 mm. long, downy or hairy, subglobose to cupshaped, five-lobed; the lobes ovate acute and valvate in bud. *Corolla* – pale or sulphur yellow, slightly longer than the calyx of fine free petals that are twisted in bud and adnate at their bases to base of the staminal column. *Stamens* – many, monadelphous, with the filaments free towards the top where they bear small half anthers. *Pistil* – ten carpellary, syncarpous; *Ovary* – superior ten chambered with one pendulous ovule in each chamber.

Fruit: a depressed globose schizocarp, 6 to 8 mm. in diameter with the seed bearing basal part enclosed in the calyx. The ripe carpels are furrowed at the back, the sides reticulated and the two dorsal margins almost scabrous. Each carpel has two long straight linear or setaceous awns that are about as long as or more often longer than calyx. These are ciliate or covered with stiff or scabrid reflexed hairs and project above the calyx. When ripe the individual carpels separate from each other and from the central axis as one-seeded indehiscent cocci. *Seeds* – smooth.

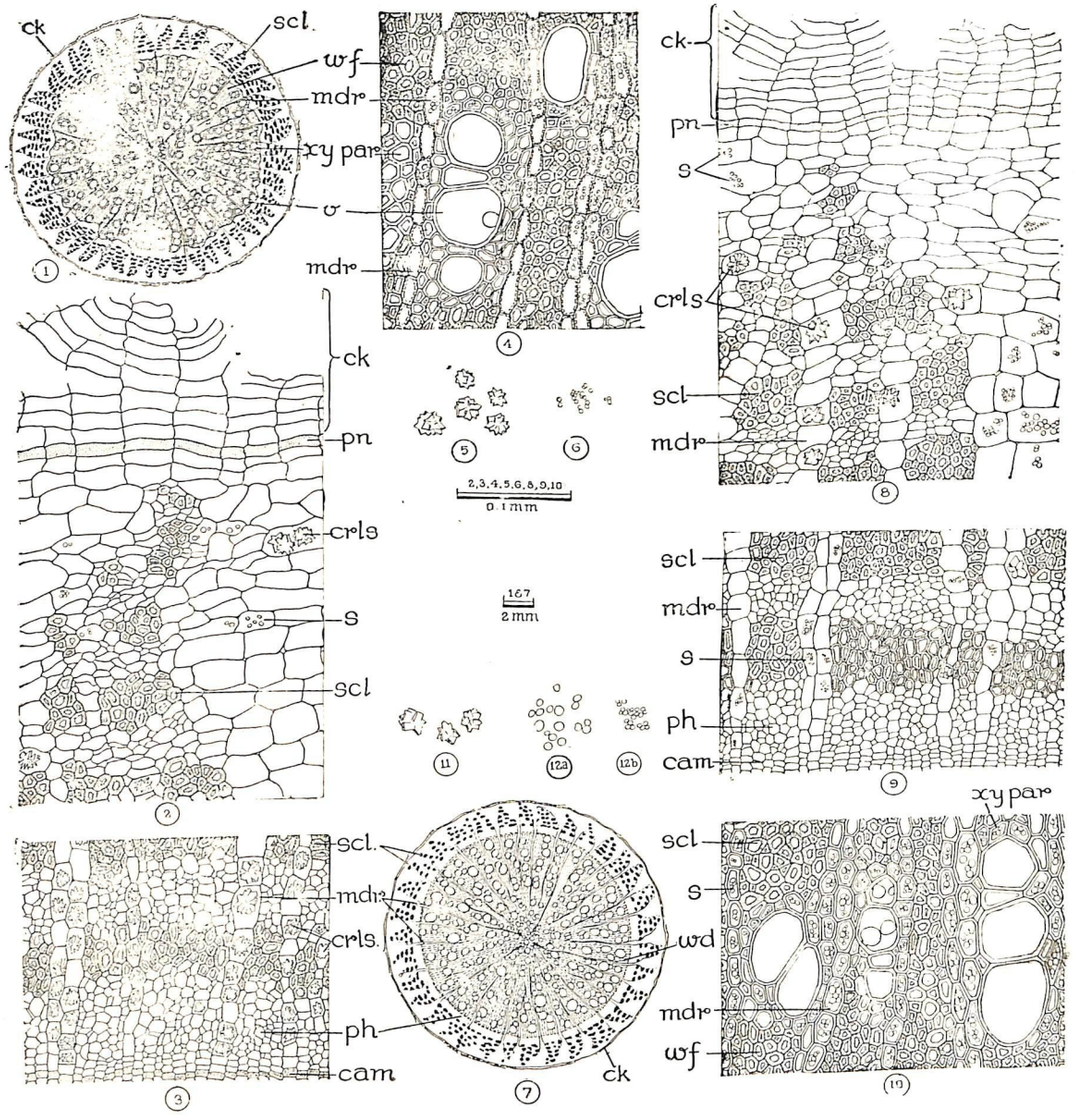
Officinal part: Roots.

Description of the root: In general appearance the roots of *S. cordifolia* resemble those of *S. acuta* but the colour is slightly paler.

Histology:

A transverse section of the root is circular in outline with a very wide central woody part and a thin outer bark. The bark is about 1 mm. in thickness in roots with a diameter of 8 mm. or more. The outermost tissue the *cork* consists of 4 to 6 rows of thin-

Plate XXVI



Histology of the roots of *Sida cordifolia* Linn. & *Sida acuta* Burm.

(Figs. 1 to 6) *Sida cordifolia* Linn.

1. Diagrammatic sketch of the T. S. of the root.
2. Cork and cortex.
3. Bast and cambium.
4. Wood.
5. Crystals.
6. Starch grains.

(Figs. 7 to 12) *Sida acuta* Burm.

7. Diagrammatic sketch of T. S. of the root.
8. Cork and cortex
9. Bast and cambium
10. Wood.
11. Crystals.
12*a* & *b*. Starch grains.

walled, tangentially elongated cells of which the outermost one or two rows of cells are slightly ruptured and light brown in colour. Inner to the cork is the *phellogen* consisting of a single row or narrow, thinwalled tangentially elongated cells. The cortex is also very narrow consisting of three or four rows of comparatively large polygonal or slightly tangentially elongated thinwalled cells. A very limited number of these cells contain calcium oxalate crystals and several others have small starch grains. The starch grain content of the cortical cells is comparatively very low in this species.

Bast is similar in structure to those of the other species and occurs in the form of conical strands as seen in T. S. each strand being composed of 5 to 6 or more tangential bands of thickwalled fibre groups alternating with thin-walled phloem elements. The fibre groups here however are not so large as in *S. acuta*. Some of the phloem parenchyma cells at the outer region of phloem contain small cluster crystals. In the recently formed phloem the parenchyma cells are slightly larger than those in *Sida acuta* and are polygonal. Sieve tubes and companion cells can be differentiated. Almost all the medullary ray cells in this region contain cluster crystals of calcium oxalate. A distinct cambium can be made out.

Wood: consists of vessels, xylem parenchyma, xylem fibres and medullary rays. Vessels are many, distributed throughout the wood and occur solitary or in groups of 3 or 4. They vary in size and shape. The xylem parenchyma are found surrounding the vessels, but do not form distinct concentric rings as in *Sida retusa*, *Sida rhombifolia*, *Sida veronicaefolia* etc. The parenchyma cells which are of the same size as the fibre cells are thickwalled and contain starch grains. The fibre cells are very thickwalled and are found in greater proportion than the xylem parenchyma. Four groups of primary xylem are present at the centre of the wood.

Medullary rays: These are many and mostly uni-or biseriate. They extend through the wood and reach up to the cortex in a straight course. The ray cells within the wood are also thickwalled, radially elongated and most of them contain small crystals of calcium oxalate, while those in the bast are thinwalled, radially elongated, fairly wide and almost all of them contain crystals of calcium oxalate. The rays expand towards the outer region and cells at the distal ends appear tangentially elongated.

SIDA ACUTA Burm.*

Synonyms: *Sida carpinifolia* Linn.; *Sida lanceolata* Willd. Retz.

Family: Malvaceae

Sanskrit	—	Balā, Rājabalā, Brihannāgabalā, Phanijivaka. Pronijivaka Vātyalika or Vatyaluka, Vatya.
Malayalam	—	Tsjeruparua, Cheruparua, Malatāngi,† Kuruntoṭṭi.
Tamil	—	Pazampāsi, Malatāngi, Arivalmukham, Malaikurundala, Ponmusattai, Mayirmanikkam, Vathatirippi, Vizhabodhi.
Hindi	—	Janglimethi, Lahanchikna, Kharenti, Khareta or Kureta, Bariara or Bariala, Paharibariara, Karela.
Telugu	—	Cittimu, Cittamutti, Visaboddi, Sahadevi.

Distribution and habitat.

The plant is found distributed throughout the hotter parts of India, chiefly Bombay, Konkan, Deccan, Bengal, Madras and Kerala. It is a fairly common weed of the waste places of the plains districts and often grows gregariously.

Habit and general features

Sida acuta Burm. is a much branched nearly smooth to sparsely and minutely hairy erect suffrutcose (woody) herb or undershrub growing 90 cm. or more high, with a short stem, slender terete flexuose branches and bifarious spreading branchlets, bearing simple, short-petioled pale green lanceolate serrated leaves 2.5 to 7.5 cms. long, and small yellow, short peduncled axillary flowers. The tissues of this plant also, as in the other species of *Sida* abound in mucilage. Flowering time–the cool season, mostly from October to January.

* considered a botanical source of Balā and referred to as such by Dymock.

† The term *malatangi* is also applied to *Cissampelos pareira.*

$ Also applied to *S. veronicaefolia.*

Plate XXVII

Sida acuta Burm.

External morphology.

Leaves: simple, alternate, short-petioled,-the *petioles* – pulvinate mostly under 6 mm. long - stipulate, *stipules* – linear-subulate, two to three times as long as the petiole, ciliate and many nerved; *blade* – 2·5 to 7·5 cms. in length and 6 to 18 mm. wide, pale or light green, lanceolate or linear-lanceolate, serrate or rarely crenate, base rounded or sometimes somewhat cuneate, apex acute, the surface glabrous or slightly sprinkled with hairs but ultimately glabrous, light green above, and minutely tomentose and paler beneath.

Flowers: small, yellow, regular, without an epicalyx, about 1.2 cms. in diameter, axillary, solitary or occasionally arranged in short axillary branchlets with reduced leaves. *Peduncles* – as long as or occasionally longer than the petiole, with a joint or articulation about the middle. *Calyx* – persistent, gamosepalous, 6 to 7 mm. long, practically glabrous – fivelobed; *tube* – subglobose, *lobes* – triangular, acute and valvate. *Corolla* – of five free twisted petals nearly twice the length of the calyx and adnate at its base to the base of the staminal column. *Stamens* – many, mon-adelphous, the staminal tube short, separating at the top into many antheriferous filaments each tipped with a small reniform anther. *Pistil* – of five or more carpels, commonly ten-carpellary; the *ovary* depressed globose, as many chambered as the number of carpels, usually with one pendulous ovule in each loculus; *styles* as many as the number of carpels, each with a terminal stigma.

Fruit: Enclosed within and shorter than the persistent calyx, 5 to 6 mm. in diameter. Ripe carpels 5 to 10 rugose, strongly reticulate towards the dorsal margin. They ultimately separate from each other and form a short central axis as one seeded indehiscent rugose birostrate or two horned segments. *Seeds* – smooth black.

Officinal part: The roots.

Description of the root.

The root sytem consists of a short stout taproot attaining a diameter of about one cm. and many long and flexuose fairly thick lateral roots. The roots have a pale yellow colour. The outer surface

is fairly smooth, except for the small filmy strips of exfoliating cork a few small rootlets and numerous dot like lenticels. The bark has a thickness of about 1 to 1½ mm. and can be easily peeled off in the fresh condition.

Histology

A transverse section of the root of *Sida acuta* shows an outer thin layer of bark of about 1½ mm. thickness and a central woody portion which forms the bulk of the root.

The outermost tissue namely the *cork* is very thin (28 to 40 μ) It consists of 4 to 9 rows of rectangular to slightly tangentially elongated thinwalled cells. The outer border of the cork is not even on account of exfoliation, and some of the outer cells appear recurved and slightly tangentially elongated. The *cortex* inner to the phellogen is a very thin zone consisting of two or three rows of tangentially elongated slightly large cells some of which contain very small starch grains and some others cluster crystals. When compared to the other species of *Sida* the number of cells having cluster crystals of calcium oxalate is very few here.

The *bast* present inner to the cortex forms the major part of the bark and appears as conical strands with their narrower ends pointed outside. Each conical strand consists of several groups of fibre cells arranged in 5-8 or more tangential rows that alternate with the regular phloem elements, both being intercepted radially by the medullary rays. The number of cells composing a fibre group varies from four to sixty. The smaller groups are arranged towards the periphery. The fibre cells are very thickwalled. The phloem elements found in between the fibre groups consist mostly of small thinwalled polygonal parenchymatous cells, the sieve tubes and companion cells being few but quite distinct.

Inner to the phloem is the *cambium* consisting of one or two rows of narrow almost rectangular thinwalled cells within which is the wood. *The wood* is composed of many vessels, xylem parenchyma, xylem fibres and the medullary rays. The vessels occur in groups of 3 to 4 and are mostly radially arranged. Several of them are found occluded with tyloses. The xylem parenchyma cells are thickwalled and mostly located surrounding the vessels but not in such *distinct tangential bands* as in *Sida retusa*. Some of the parenchyma cells contain simple starch grains. The fibre cells which occur in groups are thickwalled but in T. S. appear slightly smaller than the parenchyma cells. The ray cells are also fairly thickwalled. They are radially elongated and contain starch grains. At the centre of the root four primary xylem groups are present.

The Medullary rays. There are four prominent broad primary medullary rays in addition to the many uni-or biseriate and a few four seriate secondary rays. All of them radiate in a nearly straight manner from near the centre of the wood. The ray cells within the wood are radially elongated and thickwalled and contain small round or oblong starch grains. The ray cells at the inner part of the phloem region are also slightly radially elongated but thinwalled and some of them contain stellate crystals of calcium oxalate. The ray cells situated at the outer region of the phloem tissue where the rays broaden or expand are almost rectangular and slightly tangentially elongated. Most of the cells here contain starch grains while a few contain crystals of calcium oxalate.

Distinguishing characters.

The fibre groups in the bast region are comparatively large and several of them contain very many cells. Starch grains occur in plenty in the cells of the bark region more than in the other species, but the calcium oxalate crystals are comparatively fewer in number.

SIDA VERONICAEFOLIA Lamk.

Synonyms : *S. humilis* Cav. (Willd.); *S. pilosa* Retz.

Family :		Malvaceae
Sanskrit	–	Bhūmibalā, Nāgabalā,
Malayāḷam	–	Vallikuruntoṭṭi, Velutta ūrakam
Tamil	–	Palampasi*
Hindi	–	Bananiyar, Bhiunli, Kharenti, Kareta, Bariara, Pahari-bariara, Kureta, Kiretta, Bhui-chika, Bhoybal.
Telugu	–	Gayapuwaku.

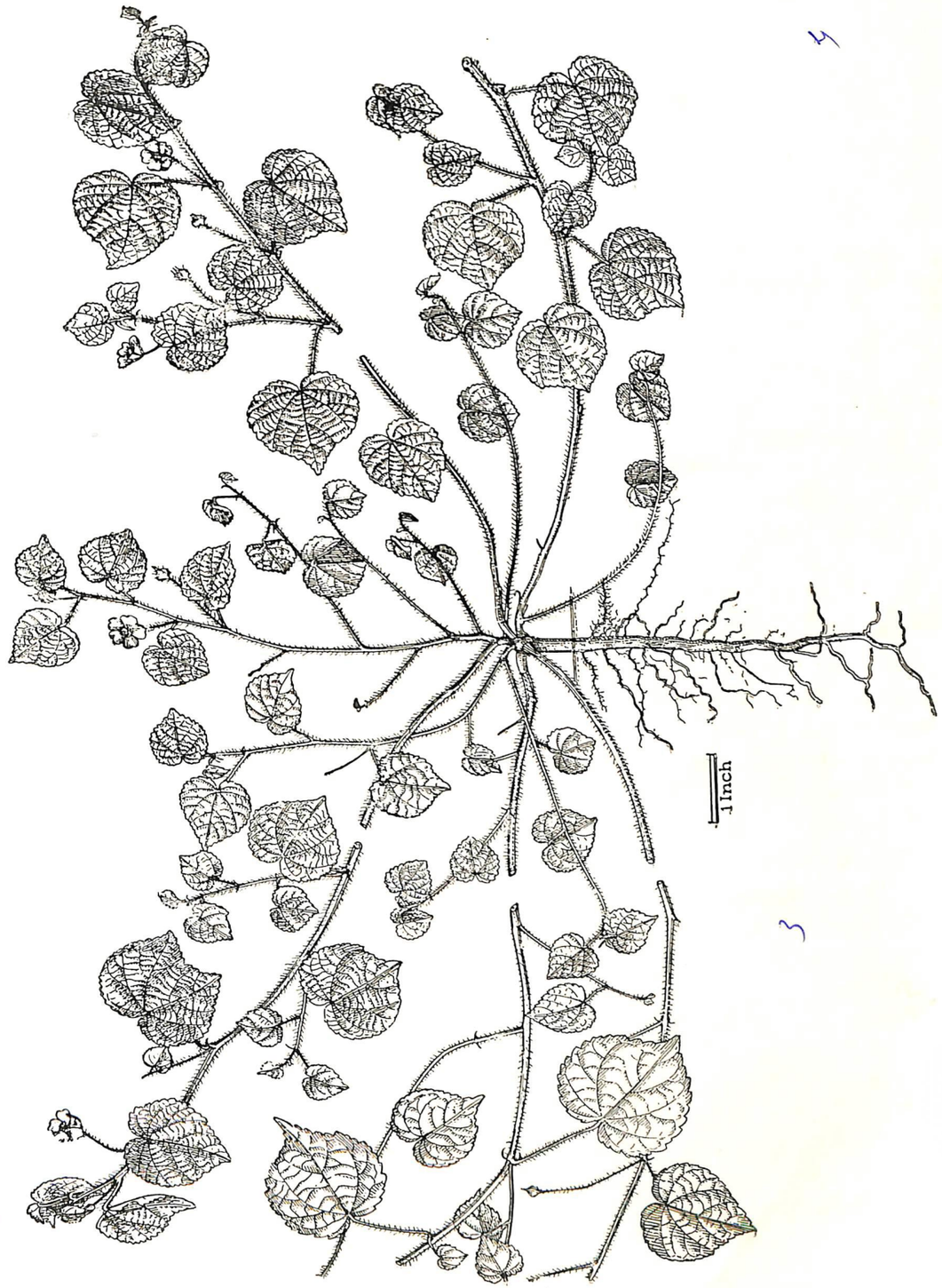
Distribution and habitat.

The plant is distributed throughout the hotter parts of India, chiefly in Bombay, Konkan, Gujerat, Belgaum, Bengal, Carnatic, Madras, and Kerala. It is a common weed of grassy ground along roadsides and other waste places of the plains districts and occurs also as an undergrowth of scrub forests.

Habit and general features.

Sida veronicaefolia Lamk. is a very variable diffuse much branched herb or low growing undershrub with a very short main stem or axis but with long slender trailing or procum-bent branches that occasionally root at places of contact with the ground, covered all over with scattered long spreading as well as stellate hairs and bearing simple long petioled, suborbicular cordate to roundish or ovate cordate, acute membraneous sparingly hairy (hispid) leaves and comparatively long peduncled solitary axillary yellow flowers. The degree of pubescence varies in plants growing in different habitats. It is in flower the greater part of the year but mostly from September onwards.

* The name is applied also to *S. cordifolia*.



Sida veronicaefolia Lamk.

Plate XXVIII

External morphology :

Leaves : simple, alternate, long petioled; the *petioles* slender, hairy, shorter than the blade, 10 to 18 mm. or more long, stipulate, *blade* – ovate or more often cordate or suborbicular – cordate, 1·2 to 5 cms. or more long and proportionately broad, three or five–nerved and cordate at base, acute or shortly acuminate, serrate or coarsely or crenate-serrate membraneous and sparsely clothed with stellate hairs on both surfaces.

Flowers : comparatively small, pale yellow or straw coloured, axillary, solitary or rarely in pairs towards the ends of the branches arranged in longish racemes with smaller subtending leaves that are shorter than the peduncles. *Peduncles* – usually shorter than the leaves 1.2 to 3.7 cms. long, slender, with a joint or articulation at or slightly above the middle. *Calyx* – regular, gamosepalous hairy, about 12 mm. long, without an involucre of bracteoles, persistent, five angled, the *lobes* – triangular, acute or acuminate, and valvate in bud. *Corolla* – regular, light yellow or straw coloured, slightly exceeding the calyx, of five free twisted petals which are broader than long. *Stamens* many mon-adelphous, with the free ends of the filaments bearing small half anthers. *Pistil* - five carpellary, syncarpous, the ovary five chambered with one ovule in each chamber.

Fruit: A schizocarp located within the persistent calyx. Ripe carpels smooth (not reticulated) blunt or slightly muticous or shortly bicuspidate, the awns or beaks being shorter than the calyx segments. *Seeds* - brownish, glabrous.

Officinal part: Root.

Description of the root: The root system consists of a long tap root and many long, spreading lateral roots which attain a diameter of 1 to 1·5 cms. The roots are not straight and are provided with many rootlets and have a cream white to a light brown colour. The old roots are brownish. The outer surface is not very smooth. Towards the upper part of the taproot many longitudinal wavy lines and small ovate elliptic narrow lenticels are present. In fresh roots the bark can be peeled off easily but it adheres firmly on drying.

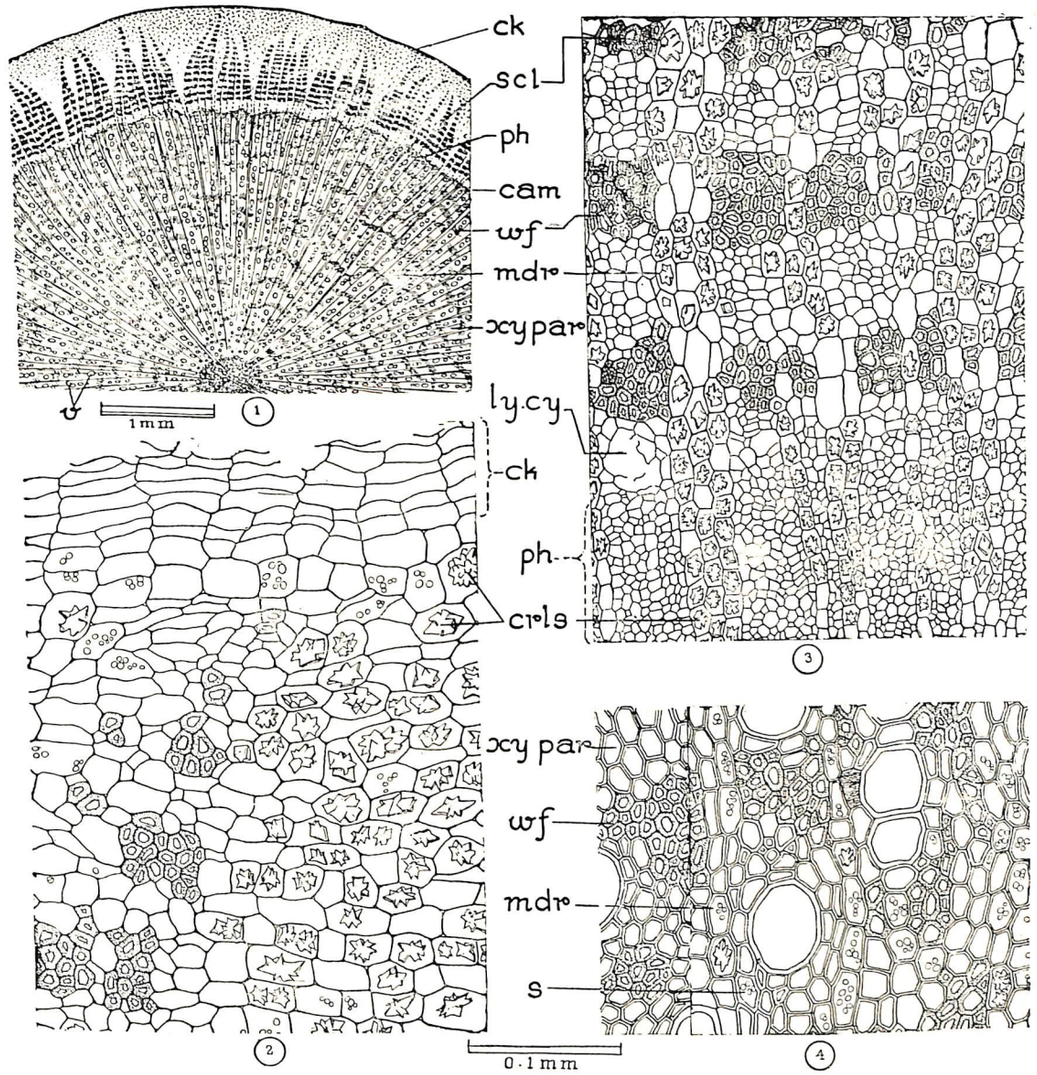
Histology

The outline of the transverse section of the root is wavy or dentate on account of the projecting sections of lenticels. The *phellem* or cork zone is very thin and consists of 4 to 6 rows of narrow tangentially elongated thinwalled cells of which the outermost one or two rows of cells have a light brown colour. The cortex inner to the cork is very narrow consisting of 2 or 3 rows of slightly large, polygonal or tangentially elongated thinwalled cells. Some of the cells contain starch grains varying in diameter from 3 μ to 6 μ and a few others contain cluster crystals of calcium oxalate. Bast is found in the form of narrowly conical strands and consists of tangential fibre groups arranged in 8 or 9 rows alternating with the regular phloem elements. In this species the fibre groups are comparatively small being composed of a lesser number of cells as is the case in *Sida retusa*, *S. rhombifolia* etc. Larger groups also occasionally occur. The parenchyma cells in between the fibre groups are small, polygonal and thinwalled and some of them contain small crystals. At the inner most region of the bast small lysigenous cavities are formed in the parenchyma region and in certain specimens a cambium is also distinct.

Wood consists of many vessels scattered throughout the wood occuring singly as well as in groups. Tangential strips of wood fibres alternate with wood parenchyma cells. The fibre cells are thickwalled their lumen being much smaller than those of the wood parenchyma cells. The xylem parenchyma cells are slightly larger in T. S. than the fibre cells and thickwalled. Most of them contain starch grains. Reticulate thickenings are found in some of the parenchyma cells. The ray cells are also thickwalled. Four primary xylem groups are present at the centre of the wood.

Medullary rays: These are many, one to three seriate and closely arranged. The larger ones radiate from the centre and reach up to the cortex. The ray cells within the wood region are thickwalled slightly radially elongated and most of them contain starch grains. Some of the ray cells contain small cluster crystals of calcium oxalate (12 μ) in diam. More than one crystal may be present in the same cell. Within the bark the ray cells are thinwalled. Just outer to the cambium in the newly formed phloem the ray cells are comparatively larger than the neighbouring cells

Plate XXIX



Histology of the root of *Sida veronicaefolia* Lamk.

1. Diagrammatic sketch of a sector of T. S. of root.
2. Cork and cortex. 3. Bast. 4. Wood.

Plate XXX

Sida (Seedlings)

1. *Sida cordifolia* Linn
2. *Sida retusa* Linn.
3. *Sida acuta* Burm.
4. *Sida rhombifolia* Linn.
5. *Sida veronicaefolia* Lamk.
6. *Sida rhomboideae* Roxb.

thinwalled, and radially elongated. Most of these cells here contain small cluster crystals of calcium oxalate. The rays gradually widen towards their distal ends and the cells appear tangentially elongated. Most of the cells contain large cluster crystals of calcium oxalate 25 μ or more in length. Two crystals may often be present in each cell. The crystals in the cells towards the outer part of the bark region are larger. Here only a few cells contain starch grains. In some specimens the crystals are more abundant than in others.

Distinguishing characters.

1. The presence of cluster crystals in abundance throughout the root especially in the distal wider ends of the medullary rays and in nearly all the ray cells of the recently formed phloem.

2. The presence of starch contents is less when compared to the amount of crystals present.

3. The size of the starch grains is larger than those of *Sida acuta* and *Sida cordifolia*.

4. The close arrangement of the medullary ray cells in the wood and the presence in them of both starch grains and crystals.

5. The occurrence of wood parenchyma cells in alternating small tangential bands but not forming distinct regular concentric rings of some species of Sida.

ABUTILON INDICUM G. Don.*

Synonyms: *Abutilon asiaticum* W. & A.; *Sida indica* Linn.; *Sida populifolia* Lamk.

Family: Malvaceae

Sanskrit	–	Atibalā, Balika, Kankalika, Kankatika, Bhuribalā.
Malayāḷam	–	Ūram, Kāttūram, Peṭṭakapuṭṭi, Belore, (Vellūram)
Tamil	–	Tutti, Paniyaratutti, Perumtutti, Nallatutti.
Hindi	–	Tepāri, Kanghi, Kangahi, Petārea, Jhampi.
Telugu	–	Noogubenda, or Nagubenda, Adavibenda. Belore, Tooteabenda, Tutturabenda, and Tuttirichettu.

Distribution and habitat.

The plant is distributed throughout the tropical parts of India. It is a fairly common weed of roadsides and other waste places of the plains districts as well as of the hills up to an elevation of about 600 meters and often grows somewhat gregariously.

Habit and general features.

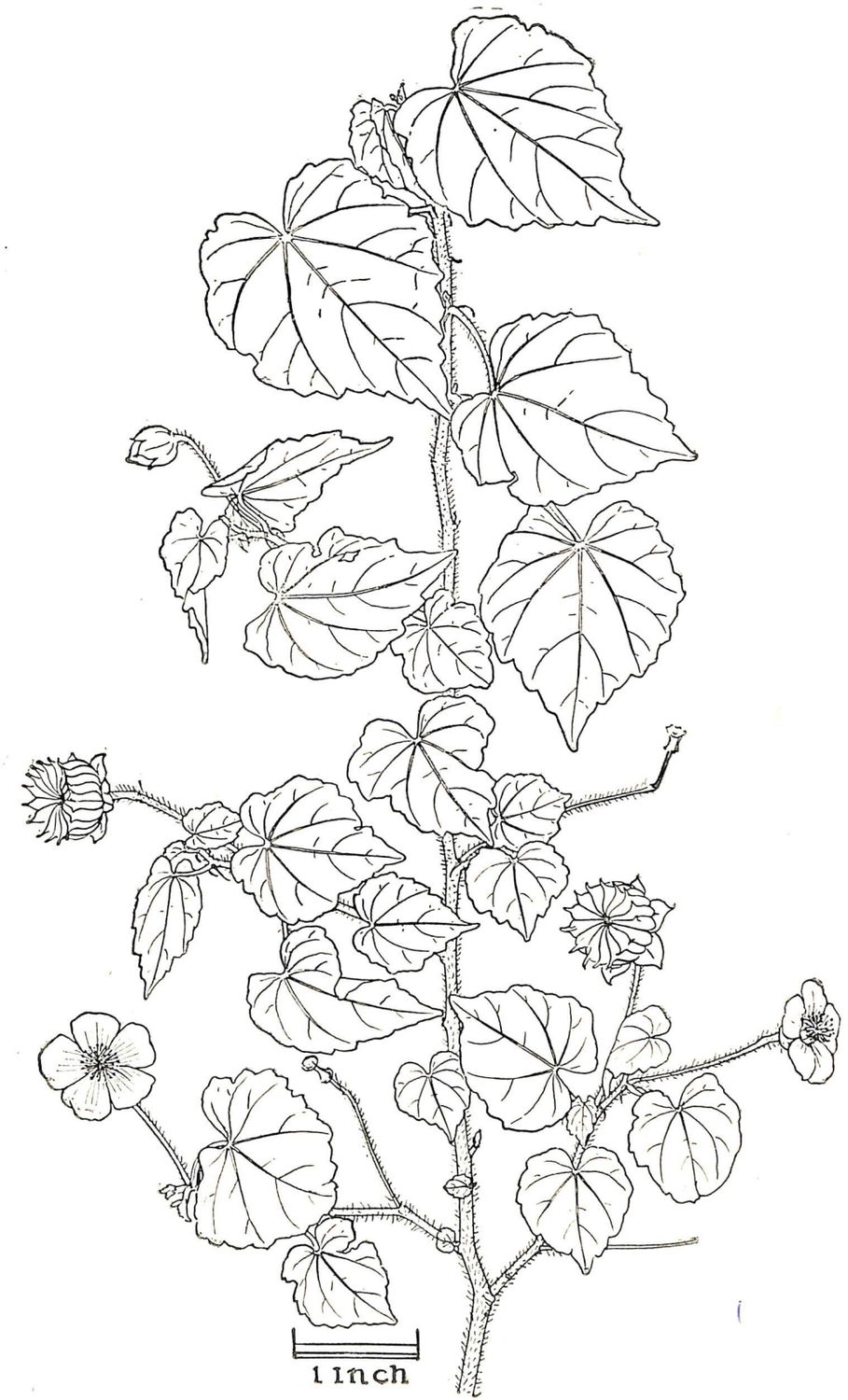
Abutilon indicum G. Don. is an annual or more often perennial erect woody, branched herb or undershrub growing about one meter or more high covered all over with close, hoary, smooth or downy, and occasionally slightly glutinose tomentum bearing long petiolate simple, alternate, cordate, entire or most often irregularly toothed leaves and fairly large beautiful yellow solitary axillary flowers on peduncles longer than the petioles. The flowers open in the afternoon. The plant is in flower mostly throughout the year, but especially from September to February.

The stem bark yields a strong fibre fit for manufacture of ropes.

---

*Considered one of the varieties of *Balā*

Plate XXXI



Abutilon indicum G. Don.

External morphology.

Leaves: simple, alternate, long petioled; the *petioles* 2·5 to 7·5 cms. long, pulvinate at base, jointed near the top, stipulate; the *stipules*—deflexed; *blade*—round or broadly ovate to cordate, sometimes angled or slightly palmately lobed, acute or shortly acuminate, nearly entire or more often unequally or irregularly dentate or toothed, three to five ribbed at base and covered on both surfaces with a closely felted greyish-white down with few or no hairs intermingled.

Flowers: without an epicalyx or involucre of bracteoles, yellow or orange-yellow, regular about 2·5 cms. in diameter, on solitary axillary slender erect peduncles that are longer than the petioles and with a joint or articulation towards the top. *Calyx*—gamosepalous, regular, fivelobed; *tube*—short, the *lobes*—ovate, acute or apiculate and valvate in bud *Corolla*—of five free spreading evenly obcordate petals, twisted in bud, with their bases adnate to base of the staminal column. *Stamens*—many, monadelphous, with a short staminal tube dividing at the top into numerous antheriferous filaments each tipped with a reniform one celled anther. *Pistil*—fifteen to twenty carpellary, syncarpous, the carpels pointed or mucronate. *Ovary*—superior, 15 to 20 chambered, its surface thinly tomentose with a few scattered tufts of stiff hairs that fall off eventually; *stylar branches* as many as the carpels, ending in small capitate stigmas. Ripe carpels 15 to 20, longer than the calyx, most often three seeded, glabrescent or sparsely roughly hairy on back and truncate or shortly awned or beaked with the awns spreading. When the seeds are fully ripe, the carpels readily separate and spread out from a short central axis, each carpel ultimately dehiscing along its ventral suture. *Seeds*—usually three in each carpel, the upper one ascending and the lower one descending, or rarely only one in each carpel; glabrous, and minutely dotted or furrowed with the eye of the seed bearded.

Officinal parts:

Roots, leaves and seeds.

Description of the root: The root system consists of a fairly long, stout taproot with many lateral branching roots. The roots attain a diameter of 1·5 to 2 cms. and have a light brown colour.

The outer surface is smooth except for the small rootlets and dotlike lenticels. A transverse section of the root shows a central, thick woody region and a narrow bark surrounding it. In roots with a dia. of 1 cm. the bark is less than 1·5 mm. thick. The bark can be easily peeled off when the root is fresh but adheres to the wood on drying.

Histology :

The outermost tissue in a transverse section of the root is the *cork* which is thin and composed of four to seven or more rows of rectangular to slightly tangentially elongated cells with the cell walls light brown in colour. The layer is not continuous on account of the openings of lenticels. Inner to the cork is the *phellogen* consisting of a single row of narrow thinwalled tangentially elongated cells. At the regions of the lenticels inner to the phellogen a thin layer of *phelloderm* of two or three rows of cells can be made out. The cells are thinwalled, almost cubical or rectangular, and most of them contain small cluster crystals of calcium-oxalate. Just inner to the phellogen is the cortex which is also very thin being only three or four rows in thickness. Some of the cortical cells appear crushed and small strips of these crushed cells are seen just above the tips of the conical strands of bast. Small starch grains are present in some of the cells. These grains have a diameter of 6–9 μ and most of them are hemispherical in shape.

Bast–forms the major part of the bark and is present in the form of linear conical strands with their bases towards the wood and with the dilated distal ends of the primary medullary rays in between them. In a conical strand of bast there are about 10–12 fibre groups arranged in tangential rows alternating with the thinwalled phloem elements. These fibre groups towards the wood are larger and each group consists of 7 to 30 or more cells. The phloem elements present in between the rows of fibre groups are formed mostly of phloem parenchyma cells which are small and polygonal. Some of these contain small cluster crystals and a few others have starch grains. Some of the cells towards the periphery of the bast appear compressed and crushed.

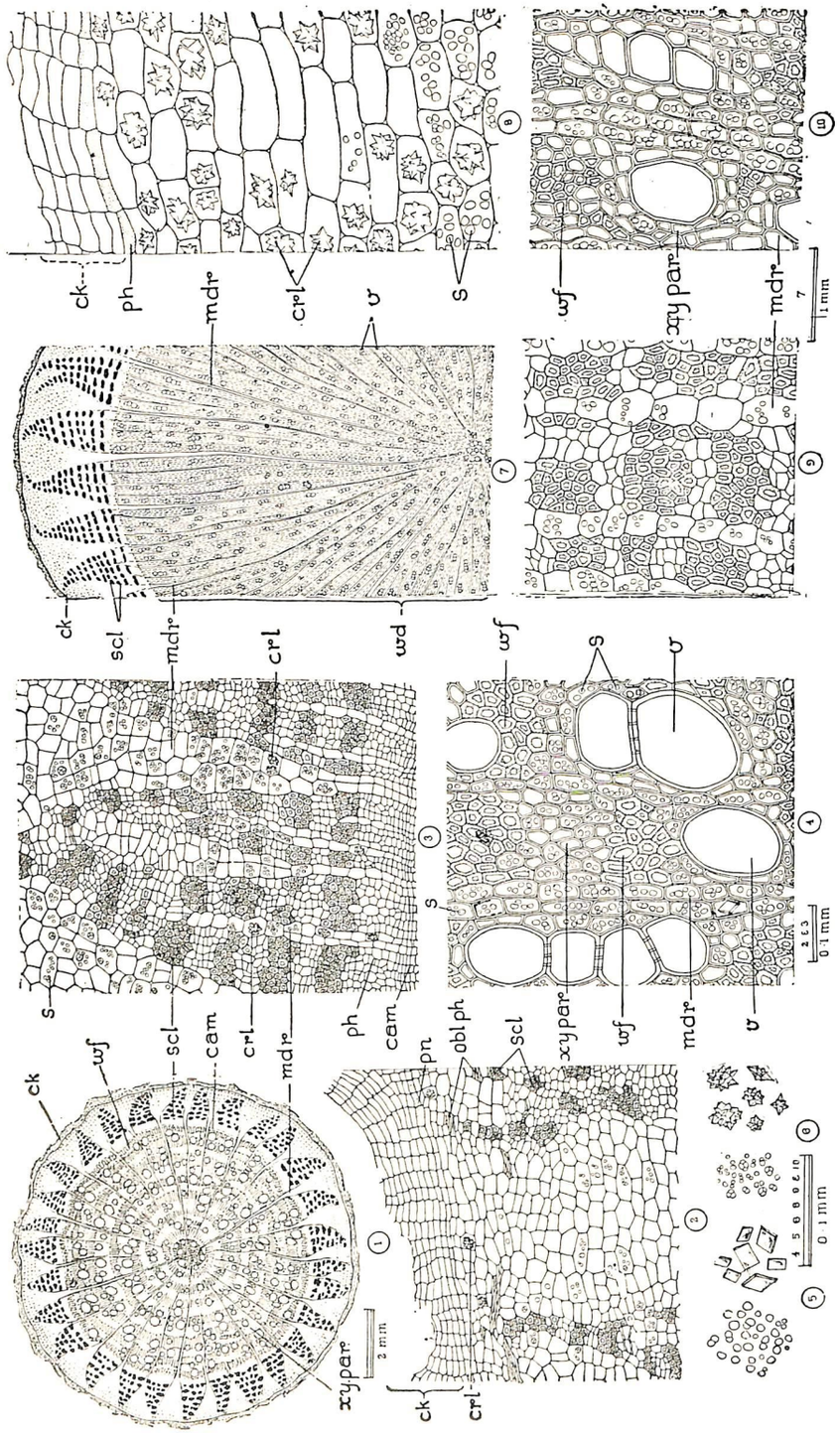
Inner to the phloem a cambium is present consisting of one or two rows of narrow, thinwalled, rectangular cells. *Wood* is com-

posed of many vessels, wood fibres, wood parenchyma and medullary rays. The vessels vary in diameter from 30 μ to 105 μ and are arranged in radial groups of 2-4. Solitary vessels also occasionally occur. Tyloses are rare when compared with species of *Sida*. The Wood parenchyma cells are thickwalled. They are slightly wider than the fibre cells but not so thickwalled and are filled with nearly spherical simple starch grains. Compound grains having 2 to 4 components are also met with in these cells. A tetrarch bundle of primary xylem is present at the centre of the wood.

Medullary rays – Many, long, uniseriate or biseriate, radiating from the centre of the wood and extending up to the cortex. The primary rays are slightly longer. All the rays widen much towards their distal ends. The ray cells in the bast are thin walled, and nearly cubical or radially elongated. The cells gradually become larger towards the periphery and at the distal ends of the rays are tangentially elongated. Most of the ray cells contain starch grains. Some of the cells contain small cluster crystals. In the wood the ray cells are slightly radially elongated thickwalled and nearly all of them are packed with starch grains. The starch grains present within the wood are larger than those in the bark region. Some of the compound grains have a length of 15 μ. A few ray cells at the centre of the root contain rhomboidal crystals.

Distinguishing characters. The presence of several lenticel openings in the cork. The number of conical or wedge shaped strands of bast which are many. The cells of the medullary rays at their distal dilated end have both starch grains and crystals. The starch grains are slightly larger than those found in *Sida* species. No lysigenous cavities are met with in the bast. Crystals are present in the ray cells. The wood fibres and wood parenchyma occur in distinct, almost concentric alternating zones. The wood parenchyma cells have thinner walls than wood fibres and are filled with starch grains. Tyloses occur only occasionally.

Plate XXXII



Histology of the roots of *Abutilon indicum* G. Don & *Urena lobata* Linn.
(Figs. 1 to 6) *Abutilon indicum* G. Don.

1. Diagrammatic sketch of T. S. of the root.
2. Cork and cortex.
3. Bast and cambium.
4. Wood.
5. Starch grains and crystals of the wood.
6. Starch grains and crystals of the bark.

(Figs. 7 to 10) *Urena lobata* Linn.

7. Diagrammatic sketch of a sector of T. S. of the root.
8. Cork and cortex.
9. Bast.
10. Wood.

URENA LOBATA Linn.*

Family : — Malvaceae.

Sanskrit	–	Vanadenda or Vanabenda:
Malayāḷam	–	Udiram, Ūram, Uran, Vatto, Uren,
Tamil	–	Oṭṭatti, Oṭṭuthuthi, Piliya mankena
Hindi	–	Lotloti, Kunjia, Kūngooya, Bachata Baehit, Bachita, Brachta.
Telugu	–	Pedda Benda.

Distribution and habitat

The plant is found in most districts of India. It is a very common undergrowth of open or deciduous forests and a weed of waste places.

Habit and general features:

Urena lobata Linn. is an erect herbaceous or semiwoody tomentose undershrub growing 60 to 100 cms. or more high, the young stem and branches covered with somewhat harsh spreading stellate hairs (tomentum), and bearing simple, alternate variable broadly ovate to round cordate, angled or lobed leaves and sessile or shortly stalked pinkish axillary flowers.

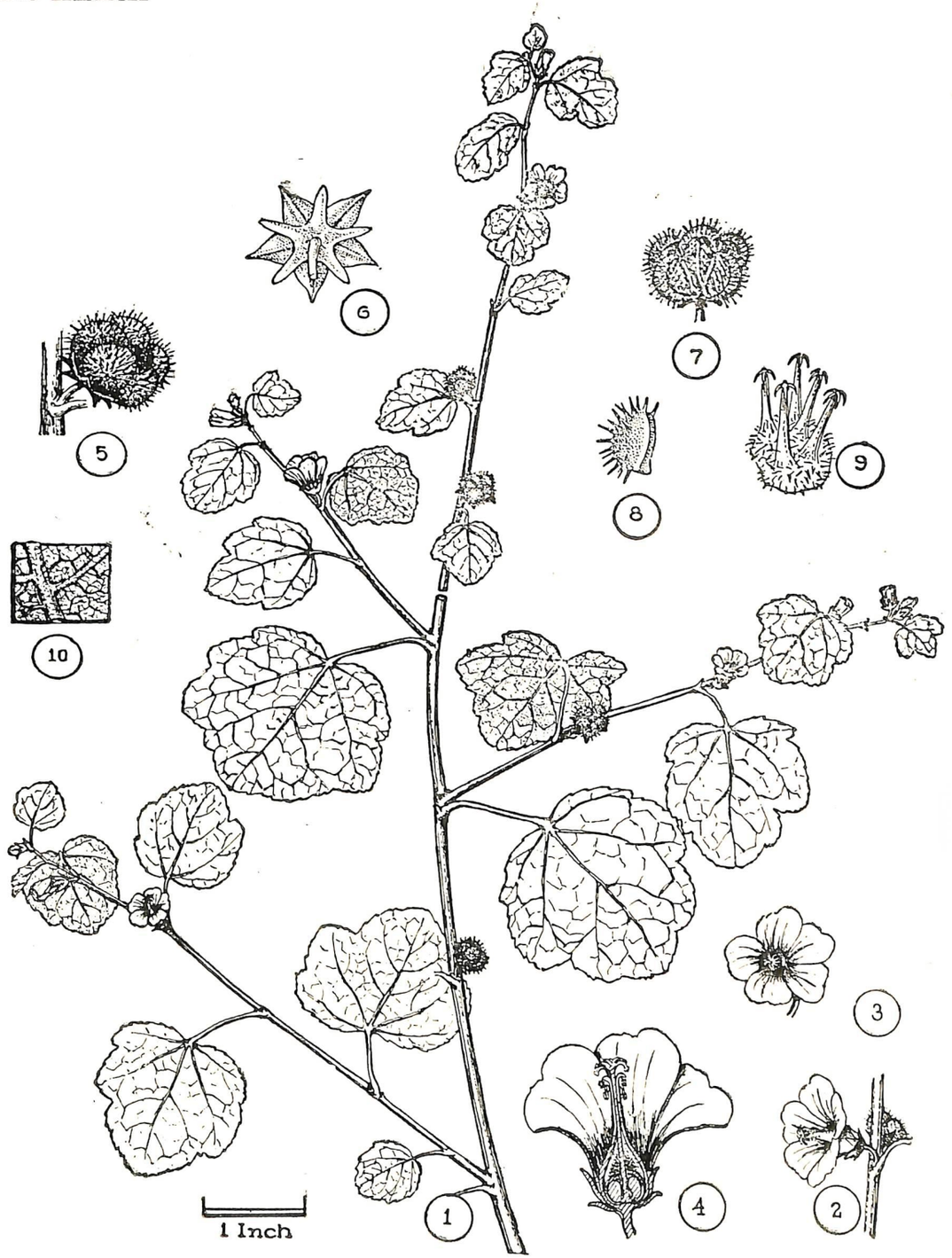
Flowering time—Generally the rainy season from July to November. The stem yield a useful fibre which may be used as a substitute for flax.

External morphology

Leaves: simple, alternate, petiolate, stipulate; the *stipules* – linear; *blade* – very variable, usually broader than long rounded or ovate, up to 10 or 15 cms long, cordate at base, angled or shallowly 5-7 lobed, the lobes not extending half way down or occasionally nearly obsolete, generally acute or acuminate, serrate, stellately tomentose on both surface but paler beneath with five to seven pairs of basal nerves which are prominent on the under surface and with a large gland below at the base of the midrib and sometimes at the base of two laterals also. *Petiole* - variable in length.

**Urena lobata* Linn. and *U. sinuata* Linn. are occasionally used as Atibalā in (some) parts of Kerala.

Plate XXXIII



Urena lobata Linn.

1. A twig
2. Lateral view of a flower.
3. A flower.
4. L. S. of a flower,
5. A fruit.
6. Bracteoles and calyx - (back view)
7. A fruit split up.
8. A single ripe carpel.
9. Spines on the fruit.
10. Veins.

Flowers: small, about 1·2 cms. long, pinkish with a dark centre, sessile or shortly pedicelled, solitary or more often in clusters, the ultimate flower-bearing branchlets sometimes more or less simulating leafless terminal racemes. *Pedicels* – very short, hairy. Each flower has an involucre or five linear oblong acute, bracteoles united at base into a cup adnate to the tube of the calyx and clothed with rigid hairs. These, which are about 8 mm. long equal or slightly exceed the calyx, alternate with the calyx lobes and ultimately become rigid. *Calyx* – gamosepalous, cupshaped, deeply divided into five lanceolate ciliate lobes about 5 mm. long *Corolla* – bright pink with a dark centre about 16 mm. long composed of five free petals united by their bases to the base of the staminal tube. *Stamens*–mon-adelphous, united to form a narrow tube bearing subsessile or very shortly stalked anthers below the truncate or five toothed apex of the staminal tube. *Pistil* – five carpellary syncarpous; *ovary* – five locular, with one ovule in each chamber; stylar branches ten ending in capitate stigmas. Ripe carpels five, muticous indehiscent densely pubescent, echinate ie. covered with blunt glochidiate spines, each spine with two straight pointed bristles or barbs, downwardly directed at an angle from the apex. The carpels ultimately separate from short central axis. *Seeds* - smooth, rounded on the back, wedge shaped on the inside.

Officinal part: Root.

Description of root:

The root system consists of the tap root and several branching lateral roots. The tap root as well as the lateral roots are fairly stout and brown in colour. These may attain a diameter of 5 to 6 mm. and a length varying from 20 to 25 cms. Very small wiry cream coloured rootlets arise from the lateral roots. Small lenticels are also present towards the base and the outer surface of the root is not therefore smooth. The entire bark of the root can be easily peeled off in the fresh condition. The inner surface of the bark is smooth and has a dull white colour. A. T. S. of the root shows a central woody region which forms the major part of the root and a narrow bark surrounding it. In a root 7 mm. in diameter the bark is only one mm. in thickness.

Histology :

A transverse section of the root reveals the following features :

The outermost tissue is the *cork* which is very thin and composed of 4 to 6 rows of rectangular to tangentially elongated, thin-walled cells. A *phellogen* composed of a single row of narrow, thin-walled, slightly tangentially elongated cells of nearly the same size as the cork cells is present. A thin *phelloderm* is present just inner to it consisting of three or four rows of cells. These cells are slightly larger in size than the phellogen cells and most of them contain large cluster crystals of calcium oxalate. Inner to this the *bast* occurs in conical strands with their apices towards the cork and separated by the widened distal ends of the meduallary rays. The cells at the ray expansion regions are thin-walled tangentially elongated and contain either crystals of calcium oxalate or starch grains. Each conical strip of bast is composed of 10 to 12 tangential bands of fibre groups alternating with regular phloem elements. The fibre groups at the outer region of the bark are smaller in size than those at the interior and in each group the number of cells vary from 4 to 30. Fibre cells are long and thick-walled with simple pits. The cells of the phloem elements are thin-walled and almost rectangular or oblong. Sieve tubes and companion cells are not distinct as in some species of Sida. Inner to the phloem a *cambium* is present composed of one or two rows of thinwalled rectangular, narrow cells. The *wood* forms the central and major part of the root and is mostly formed of secondary wood. The primary xylem present at the centre of the wood. is pentarch. Wood is composed of vessels, wood-parenchyma, wood fibres and medullary rays. There are many vessels found in small groups of 2 to 5. They are radially arranged and vary from 30 to 75 μ in diameter. Wood fibres are many and are arranged in groups but not in regular bands. They are slightly smaller in size in T. S. than the xylem parenchyma cells. Wood parenchyma cells are thick-walled and contain starch grains. *Medullary rays*: Many long uniseriate to four seriate almost straight and most of them extend from the centre to the periphery of the root. Most of the rays are uniseriate and most of the ray cells contain starch grains. The ray cells within the wood are radially elongated and thickwalled while those of the bast are thin-walled and only slightly elongated radially. The rays dilate gradually towards the outer region and the cells also gradually

enlarge and become tangentially elongated at the distal ends of the rays. The ray cells in the bast region are packed with starch grains which are mostly components of the compound grains and measure from 12 to 20 μ. The ray cells at the ray expansions with their abundant cluster crystals have a similarity to *Sida rhombifolia* var. *retusa*.

URENA SINUATA Linn.*

Family : — Malvaceae.

Malayāḷam	–	Uram
Tamil	–	Oṭṭatti, Oṭṭuttutti
Telugu	–	Nallabenda, Padanikada, Piliyamankena

Distribution and habitat.

The plant is widely distributed throughout the warmer parts of India as a weed. It is found as an undergrowth of the forests at higher elevations but does not occur in abundance.

Habit and general features:

Urena sinuata Linn. is a perennial shrub 60 to 120 cms. or more high, the young shoots and leaves stellately hairy, bearing simple, alternate irregularly lobed leaves and solitary axillary rose coloured flowers 1·8 to 2·5 cms. in diameter. Flowering time–Oct. to December.

External morphology

Leaves: simple, alternate, petioled, the petioles 9 to 37 mm. long, stipulate, *blade* – cordate or truncate at base, irregularly three to five or more lobed, the lobes dilated upwards, the sinuses rounded and extending more than halfway down, serrate or toothed, stellately hairy on both surfaces, the under surface paler with a gland below at the base of the midrib and sometimes at the bases of the two basal lateral nerves.

Flowers: solitary or clustered on short pedicels. Each flower has an involucre of linear-oblong acute, bracteoles which are as long as or slightly longer than the calyx (about 6 mm. long) and alternating with the calyx lobes. *Calyx* – gamosepalous, minutely pubescent, five lobed the lobes lanceolate. *Corolla*–rose, 1·8 to 2·5 cms. in diameter. *Stamens* and *Pistil* similar to those of *U. lobata*.

Fruit : similar to that of *Urena lobata*.

* The plant is very similar in habit to *Urena lobata*, goes under the same vernacular names and is used for the same purpose.

PAVONIA ODORATA Willd*

Family :	—	Malvaceae
Sanskrit	—	Balā, Hṛivera, or Hribera, Lalanapriya§§, Barhista, Ūdicya
Malayāḷam	—	Kuruntoṭṭi, Iruveli
Tamil	—	Perāmuṭṭi, Avibattam.
Hindi	—	Sugandhabalā

Distribution and habitat

Konkan, Maharastra, Belgaum, N. Circars, Deccan, Carnatic etc. where this is a common plant of waste places and open woods.

Habit and general features

Pavonia odorata Willd. is an erect woody branching herb or undershrub, with its stem and branches covered with viscous pubescence, and bearing simple, alternate, long stalked, cordate to roundish ovate subentire or three to five angled or lobed leaves and solitary axillary pinkish flowers about 2·5 cms. in diameter, each provided with an involucre or epicalyx of 10–12 linear persistent bracteoles. Flowering time October to January.

External morphology

Leaves: simple, alternate, long petioled, – the *petioles* longer than the blades, up to 6 cms. long, pulvinate, stipulate; *blade* 2·5 to 5 cms. long, cordate to roundish-ovate, subentire, or slightly three to five angled or lobed or pinnatifid; the lobes acute, distantly toothed and stellately hairy on both surfaces.

Flowers: slighty longer than those of *Pavonia zeylanica*, pinkish solitary or occasionally clustered, axillary, with an involucre of 10-12 distinct linear bracteoles each about 8 to 10 mm. long, covered with long hairs, and borne on peduncles 2·5 to 3·7 cms. long that have a

**Pavonia odorata* Willd. is also equated as Balā and goes under the Malayalam name Kuruntotti in certain places.

§§ Applied also to Kadamba *(Anthocephalus cadamba)*

joint near the flower. *Calyx* – gamosepalous, fivefid. *Petals* – 5. connate at base and adnate to the staminal tube. *Stamens* – many, the *filaments* are united to form a staminal tube or column, truncate or more often five-toothed at apex. The filaments become free or separate in groups at various levels on the tube. *Pistil*-5-carpellary, syncarpous the carpels generally glabrous, (not winged) *ovary*-five chambered, with one ovule in each loculus and with ten stylar branches ending in capitate stigmas. The carpels when ripe separate from the axis. Each carpel is rounded at its back, indehiscent or sometimes more or less two-valved, but never glochidiate. *seeds* - ascending.

PAVONIA ZEYLANICA Cav.

Family :	—	Malvaceae
Tamil	—	Kurundotti, Mammatti, Sevegan, Cittamutti
Telugu	—	Peramutti, Chinnamutava pulagamu, Chinnamutem, Karubenda.

Distribution and habitat.

The plant has been recorded as occuring in the Deccan, Guzerat, Sind, Circars, and Carnatic from Godavari southwards to Cape Comorin. It is a common plant of many dry districts growing by the side of roads, field bunds, foot of hills etc.

Habit and general features.

Pavonia zeylanica cav. is an erect branching undershrub 60 cms. or more high with slender terete branches, bearing simple, long stalked, roundish usually three lobed leaves and small pinkish solitary axillary flowers each with an involucre of 8–12 free. subulate persistent bracteoles about 9 mm. long. Flowering time – nearly throughout the year, mostly from August to December.

External morphology :

Leaves: simple, alternate, fairly long-petioled, – the *petioles* 1·2 to 3 cms. long, viscous hairy; stipulate; the *stipules* – filiform; *blade* – roundish 1·2 to 3 cms. or more long, cordate or truncate at base the outline regular or more often three lobed with the middle one usually the longest, dentate or less commonly entire, and stellately hairy on both surfaces.

Flowers : small, pinkish, solitary and axillary with an involucre of 8–12 subulate free bracteoles, each about or slightly more than twice the length of the calyx (9 to 12 mm. long). *Peduncles* – slender, viscous hairy, 2·5 to 3 cms. long with a joint about three quarters of their length from the base. *Calyx* – gamosepalous five - lobed the lobes lanceolate : *Corolla* – of five free pinkish petals that are longer than the bracteoles, connate at the bases and adnate to the staminal

tube. *Stamens* – numerous, mon-adelphous, tube five-toothed at apex, the filaments becoming free in groups at various levels on the staminal tube and bearing small kidney-shaped anthers. *Pistil* - five-carpellary, syncarpus; *Ovary* – five chambered with one ovule in each cell.

Fruit: enclosed within the persistent involucre of bracteoles. The ripe carpels are wedge shaped, rounded in the back or dorsal side, glabrous, slightly wrinkled and narrowly winged. *Seeds* - minutely pubescent, brownish black.

DAS'APUSPAM

The term *das'apuspam* in Āyurveda denotes a group or category that includes the following ten drugs namely: *Viṣnukrānti, Musali, Sahadevi, Bringaraja, S'as'as'ruti, Dūrva, Indravalli, Lakṣmi (Lakṣmaṇa,) Bhadra, and Lajjalu.*

दशपुष्पम

विष्णुक्रान्ती च वाराही देवी भृंगी शशश्रुतिः ।
दूर्वेन्द्रवल्ली लक्ष्मीश्च भद्रा स्पर्शा सहेत्यमूः ॥
दशापुष्पाभिधानाः स्युः पापालक्ष्मीहराः शुभाः
बालग्रहहरां व्रण्यास्त्रिदोषोत्थज्वरापहाः ॥

(ह्र. प्रि)

Viṣnukrānti ca Vārāhi Devī Bhṛṅgi S'as'asrutiḥ |
Dūrvendravallī Lakṣmīs'ca Bhadrā Spars'ā Sahetyamūḥ ||
Das'apuṣpā bhidhānāb syuḥ pāpālakṣmīharāḥ s'ubhāḥ |
Bālagrahaharā vraṇyāstridoṣottha juarāpahāḥ ||

(Hṛ—Pri)

The attributes credited to the members of the group (the group as a whole) are that they curb or arrest the incentive for sinful acts, destroy the causative factors of all unhealthy and displeasing features and bestow good health and prosperity (ṣubhaḥ). They are effective in destroying all bad or harmful effects due to the ill or evil influence of *Bālagrahas* (such as *Putana)*. They cure wounds and ulcers as well as fevers caused by the derangement of the three doṣas—*vāta, pitta* and *kapha.*

The botanical sources of a few of these drugs differ in different localities or/and according to authorities.

BHRINGARAJA*

Source plants:

Eclipta alba Hassk
Wedelia calendulacea Less.

Family Compositae.

Sanskrit Text:

Descriptive synonyms:

भृङ्गराजो भृङ्गरजो मार्कवो भृङ्ग एव च
अङ्गारकः केशराज़ो भृङ्गराः केशरञ्जन :

(भा—प्र)

Bhṛṅgarājo Bhṛṅgarajo Mārkavo Bhṛṅga eva ca |
Aṅgārakaḥ Kesʹarājo Bhṛṅgāraḥ Kesʹarañjanaḥ ||

(Bhā - Pra)

The synonyms do not point out any descriptive feature. *Kesaranjana* meaning giving colour to the hair and *Kundalavardhana* promoting growth of hair indicate qualities of the drug.

Properties and uses

भृङ्गारः कटुकस्तीक्ष्णो रूक्षोष्णः कफवातनुत् ।
केश्यस्त्वच्यः कृमिश्वासकासशोथामपाण्डुनुत् ॥
दन्त्यो रसायनो बल्यः कुष्ठनेत्रशिरोर्तिनुत ।

(भा. प्र)

Bhṛṅgāraḥ Kaṭukastīkṣṇo Rūkṣoṣṇaḥ Kaphavātanut |
Kesyastvacyaḥ Kṛmisʹvāsakāsasʹothāmapāṇḍunut ||
Dantyo Rasāyano Balyaḥ Kuṣṭhanetrasʹirortinut |

(Bha--Pra)

कासश्वासहरं कण्ठ्यं भृङ्गं केश्यं च वर्णदम्

(हृदयप्रिय)

* Three varieties are mentioned in texts namely (i) Svetapuspi (white flowered) (ii) Pitapuspi (yellow flowered); and (iii) Nilapuspi (blue flowered). *Eclipta alba* is considered the white flowered variety and *Wedelia calendulacea* the yellow flowered one.

Kāsasʹvāsaharam Kaṇṭhyam Bhṛṅgam Kesyam ca varṇadam.

It is pungent and bitter, hot and dry, reduces kapham and vatam, is good for the hair and skin, destroys or expels intestinal worms, cures cough and asthma, strengthens teeth and body, and is a good rejuvenator (Rasayani). It is used with benefit in leprosy and diseases of the eye and scalp. It is considered a specific particularly in night blindness, eye diseases, partial headache as well as diseases pertaining to hair, and growth of hair.

सर्वांशो ग्राह्यः Sarvamsʹo Grāhyaḥ—The entire plant is used in medicine.

ECLIPTA ALBA Hassk.

Synonym: *Eclipta erecta* Linn.

Family	–	Compositae
Sanskrit	–	Bhringarāja, Keśarāja, Keśaranjana, Mahabringa.
Malayāḷam	–	Kaṟyonni, Kuñjuṇṇi
Tamil	–	Karisàlanganni, Kaikesi
Hindi	–	Babri, Bhangra, or Bhangara, Mochkand.

Distribution and habitat.

Cosmopolitan in India in all districts with warm climate at all elevations in waste places roadsides etc. Common in Bengal, Central India, Punjab, Konkan, Deccan, Western Peninsula etc.

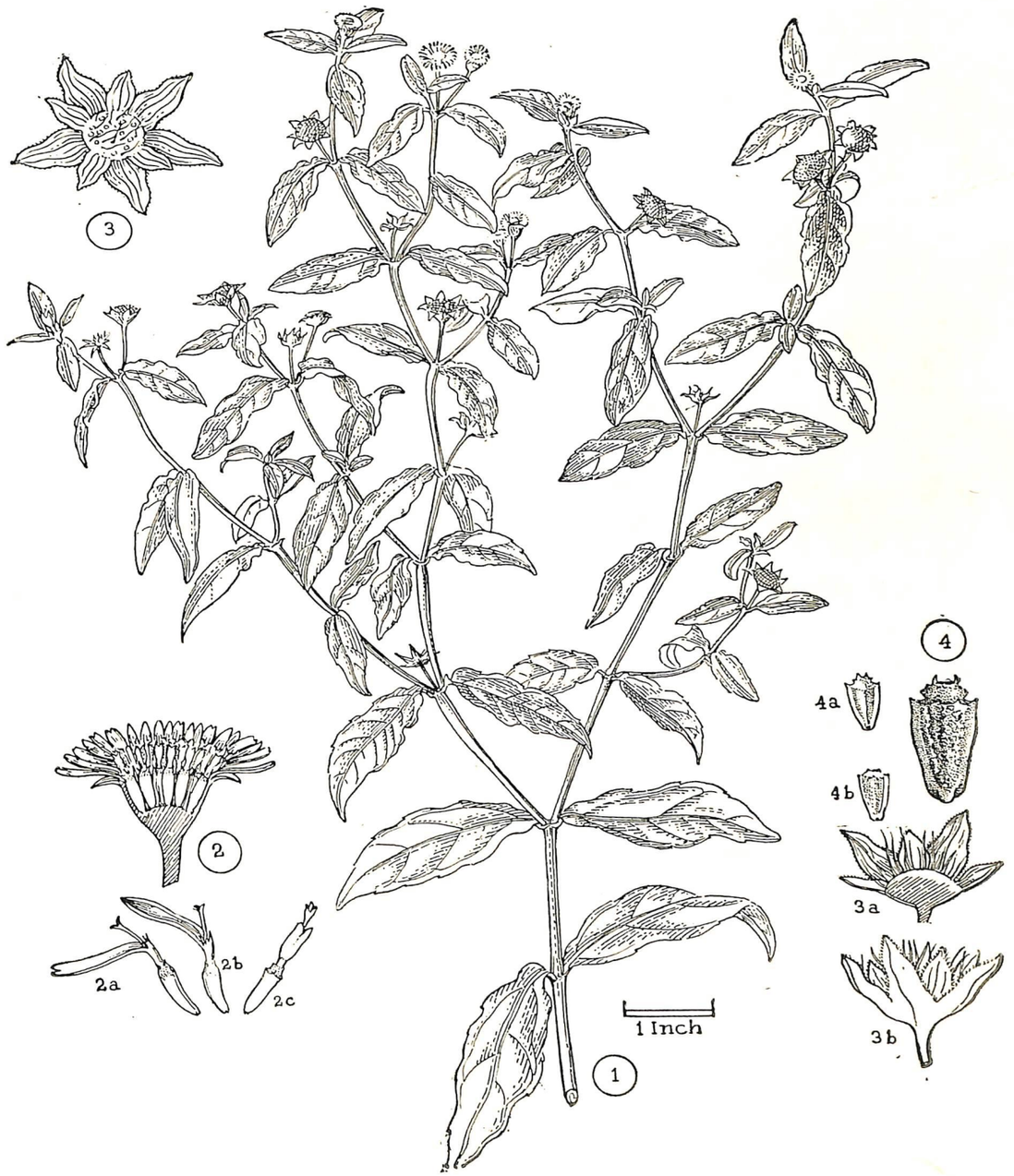
Habit and general features;

There are two forms of the plant, one erect, the other prostrate but not differing otherwise. *Eclipta alba* Hassk. is an erect or prostrate branched annual herb the stem and branches strigose with appressed white hairs and often rooting at the nodes, bearing simple, opposite, sessile, lanceolate oblong, sparsely strigose, subentire, acute or subacute, leaves 2·5 to 7·5 cms .long and small involucrate heterogamous heads of small white flowers. In the prostrate forms the leaves are short scarcely exceeding one cm. in length; but there are many intermediate forms. The plant is of considerable repute in native medicine

External morphology

Leaves: simple, opposite, exstipulate, sessile, 2.5 to 7.5 cms. long, and of varying width, oblong lanceolate, subentire, tapering at base, acute or subacute at apex, and sparsely strigose with appressed hairs on both sides. *Heads* – small, 6 to 8 mm. in diameter, solitary or two together, heterogamous, rayed on unequal axillary peduncles. *Involucre* campanulate, *bracts* biseriate, leafy about eight, ovate, acute or obtuse, herbaceous, strigose. The outer broad about 5, inner narrower about 3 not embra-

Plate XXXIV



Eclipta alba Hassk

1. Flowering branch
2. L S. of a head
2*a*, 2*b*, & 2*c*. Ligulate and bisexual flowers
3. Front view of the bracts
3*a* L.S. of the head
3*b*. Lateral view of the head
4. Achene (enlarged)
4*a* & 4*b*. Aehenes from ray and bisexual flowers

cing the achenes. Receptacle flattened with narrow plumose slender flat palea to each flower. Outer flowers pistillate, sub-biseriate, fertile or sterile, ligulate, the ligule, white small, spreading scarcely as long as the bracts not toothed. Inner or disk flowers bisexual, tubular with 4–5 lobes, fertile. *Corolla* of pistillate flowers linear, entire or 2–fid, white, those of bisexual flowers tubular with 4-5 lobes *Stamens* - five. filaments epipetalous, free, anthers united into a tube. Anther bases obtuse. *Pistil* – bicarpellary. Ovary inferior, unilocular with one basal ovule, style arms short obtuse. *Achenes* of ray flowers triquetrous, warted; of the bisexual disc flowers compressed, cuneate, and with a narrow wing covered with warty excrescences. Pappus - O, or occasionally of 1 . 2 very minute teeth on top of the achene.

Officinal part – **The entire plant**

WEDELIA CALENDULACEA Less.

Family		Compositae
Sanskrit	–	Swarṇabhringa, Pitabhringa, Bhringarāja, Kesarāja, Pitabhringarāja.
Malayāḷam	–	Maññakayyonni.
Tamil	–	Patalai kaiantagari
Hindi	–	Bhangea, Bhanra.

Distribution and habitat.

In all plains districts of India, especially Bengal, Assam-Burma, Western Peninsula, Konkan etc. It is fairly common in all wet places.

Habit and general features.

Wedelia calendulacea Less. is a roughly scabrous, procumbent perennial herb growing 30 cms. to one meter high the stems procumbent at base and rooting at the lower nodes, terete, more or less appressed hairy, with opposite entire or crenate serrate often triple nerved leaves 2·5 to 7·5 cms. long and heterogamous rayed axillary or terminal heads of yellow flowers and cuneate triquetrous or compressed, truncate smooth or tubercled achenes without pappus or with a ring of round scales.

External morphology.

Leaves: simple, opposite, exstipulate, subsessile or short petioled, 2·5 to 7·5 cms. long and 7 mm. to 3·2 cms. wide, often triple nerved tapering at base, linear-oblong or oblanceolate or oblong-lanceolate, entire or irregularly subcrenate or crenate-serrate roughly scabrous with short white hairs and ultimately more or less glabrate. *Heads*: 18 mm. to 32 mm. in diameter heterogamous, yellow rayed, solitary, on erect slender axillary or terminal peduncles 5 cms. to 15 cms. long and the latter slighly thickened beneath the heads. The outer or ray florets ligulate, pistillate, fertile, ligules yellow 2–3 toothed; inner bisexual, fertile or occasionally sterile. *Involucre* –

Plate XXXV

Wedelia calendulacea Less.

1. The plant 2. Ray floret 3. Disc floret