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A STUDY OF THE SEEDLINGS OF SOME COMMERCIALLY IMPORTANT TREES OF KERALA

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Summary

Seedlings of fifty commercially important tree species of Kerala forests were studied. Seedlings used for the study were of nursery origin, raised from the seeds of identified mother trees, or collected from natural forests Morphology of the seedlings were studied under a stereomicroscope at low magnifications. Descriptions of the seedlings and necessary drawings, are provided so as to facilitate easy identification. Based on the study, an artificial key for the fifty species, to distinguish from one another, is also provided.

Introduction

The importance of identification of seedlings in forestry operations can not be overemphasised. Correct identification becomes a prerequisite when natural regeneration is the main stay for restocking felled areas. Seedlings of many commercially important tree species are collected from forests and used for planting degraded or partially worked forests. Such seedlings are reported to establish fairly well (Rai, 1979; Rai and Shsttigar, 1979). This increases the need of field identification·of seedlings of our important tree species.

Floras describing seedlings are not many. However, in recent years some substantial studies of forest tree seedlings have come up (Berger, 1972; Vogel, 1979). Distinguishing seedlings of one species from a natural seedling population is still considered to be very difficult and scarcely attempted botanically. Nevertheless, Duke's (1969) study has proved that keying out the seedlings is also possible with whatever vegetative characters they have. The present study is based on this proven fact.

Difficulties in the'identification of seedlings arise in many ways. Remnants of decaying seed and fruit walls and mature trees in the immediate vicinity facilitate seedling identification. But the field conditions may not satisfy this always. Fruit and seed walls may decay completely and because of the dispersal of the diaspores (dispersal units) parent trees may not be in the vicinity of the seedlings. Sometimes the cotyledons undergo enlargemsnt and modification. With the result, conspecificity of the seeds and seedlings may be suspected. In addition, other serious difficulties creep in because of seedling heteroblasty, i. e. dissimilarity of seedling organs to that of mature trees. Heteroblasty in the general morphology of the leaves (Vogel, 1979) such as shape and size, features of leaf margin, internode length, leaf arrangement, etc. are very common.

The above difficulties could be overcome if an illustrated flora and a key for their identification is prepared. With this objective, the project was undertaken to render a means for easy identification of the seedlings of the commercially important tree species of Kerala.

Materials and Methods

A list of commercially important tree species indigenous to the natural forests of Kerala was prepared. Seedlings of some species, whose identity was certain with the mother tree in proximity, were collected directly. Species for which seedlings could not be obtained from natural forests, seedlings required for the study were raised in nursery. In these cases, mature fruits and seeds were collected from identified mother trees in natural forest stands. The seeds were sown in polybags, trays or in nursery beds and sufficient number of seedlings required for the study were raised.

Seedlings were studied fresh, or preserved in formalin-aceto-alcohol for further studies. Observations were made under a stereomicroscope so that a hand lens description is generated. Along with the descriptions, drawings were also prepared so as to facilitate easy identification.

Seedling annotations are given as a supplementary aid for confirmation of identity. The annotations are reduced to synopses. The style is also made simple so as to be workable by any nonspecialist. Technical terms, used in conventional seedling floras (Berger, 1972; Lubbock, 1892; Vogel, 1979). have been avoided to the extent possible and replaced with descriptive phrases. Parts of the seedling as explained in the descriptions are given in Fig. 1.

The sequence of annotation follows morphological details of 1. seedling stature, 2. roots, 3. hypocotyl, 4. epicotyl, 5. upper internodes, 6. cotyledons and 7. leaves. Of these, the cotyledons alone provide the largest number of characters, much more than the leaves. In general, the following features are recorded for the cotyledons: presence or absence, number, emerging from the seed coat or not, isomorphic or anisomorphic, remaining addressed or separated, stalked or sessile, pendulous or straight, colour, size, general features of shape, surface, indumentum, etc.

A few of the terms used in the description of seedlings are explained below.

anisomorphic, cotyledons, when they differ in size, shape or other morphological features.

crenate, margin of leaves when round-toothed.

cotyledons, seed-leaves of the seedling.

dentate, margin of leaves with perpendicular teeth.

epicotyl, internode between the cotyledons and the first leaf.

foliar, cotyledons, when they are thin as the leaves.

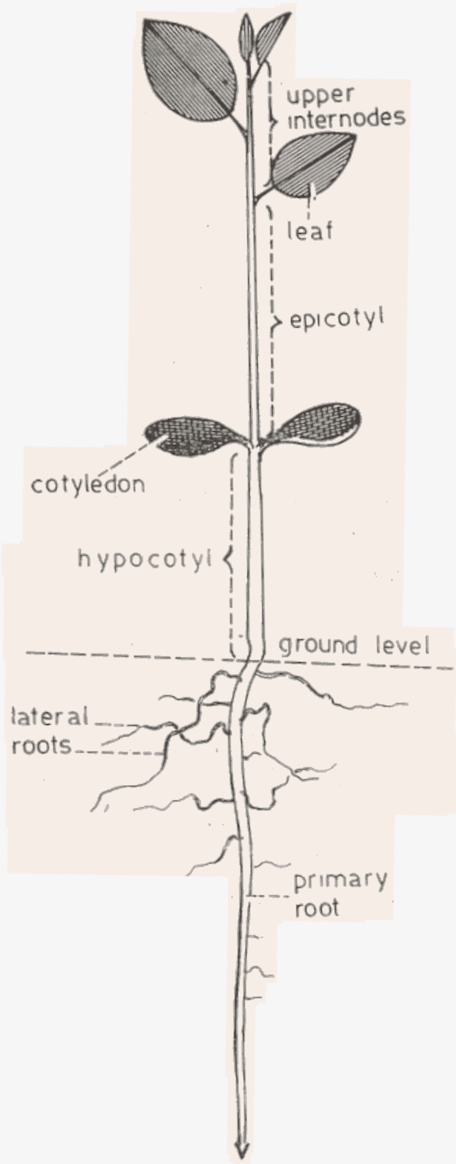

Fig. 1. Diagrammatic sketch of an angiosperm seedling.

hypocotyl, internode between the cotyledonary node and the root.

isomorphic, cotvledons when thev are similar to each other.

pseudoepicotyl, a false epicotyl; = epicotyl + first few internodes which form a single unit, whenfhe leaves of the first few nodes are reduced to scales.

serrate, margin *of* leaves when saw-toothed; when the teeth point forward.

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Key to Identification

1 a.	Leaves of seedlings compound	
1 b.	Leaves of seedlings simple	
2 a.	Cotyledons as thin as the leaves (=foliar) ..	
2 b	Cotyledons thicker than the leaves (= coriaceous)	
3 a.	Cotyledons palmately 5-lobed	***Canarium strictum***
3 b	Cotyledons entire. not lobed	4
4 a.	Leaves invariably opposite throughout; upper leaves often with a winged petiole or rachis	***Vitex altissima***
4 b	Leaves invariably alternate or rarely the lowest pair opposite	
5 a.	Leaflet margin dentate	
5	Leaflet margin entire	
6 a.	Cotyledons subcircular; terminal leaflet usually deeply lobed	***Chukrasia tubularis***
6 b	Cotyledons elliptic-oblong; terminal leaflet not deeply lobed	***Toona ciliata***
	Leaves palmate-compound; cotyledons ovate-cordate, tip acuminate	***Bombax ceiba***
	Leaves pinnate-compound; cotyledons elliptic, elliptic-oblong or subcircular, tip invariably obtuse or round	8
8 a.	Leaflet tip acute, acuminate or mucronulate	9
8 b	Leaflet tip invariably obtuse or emarginate	10
9 a.	Hypocotyl 5-10 mm long, cylindric; leaflets obtusely acute and mucronulate at the tip. lateral nerves 4-5(-6) pairs	***Pterocarpus marsupium***
	Hypocotyl 5-6 cm long, 4-angular; leaflets acute and not mucronulate at the tip, lateral nerves (4-)6-8 pairs	***Acrocarpus fraxinifolius***
	Cotyledons oblong, entire; leaves (apparently leaflets) 8-12 x 5-7 mm long, oblong ...	***Phyllanthus emblica***
	Cotyledons elliptic, with a marginal acumen slightly above the base; leaflets 15-17.5 x 10-12.5 mm, obovate	***Dalbergia latifolia***
	Cotyledons large (2.5-4.5 x 2-3 cm), reniform: hypocotyl absent or 10-15 mm long	12
	Cotyledons small (1.5-2(-3) x (0.5-10.8-1.2 cm). not reniform, elliptic or oblong; hypocotyll 3-8 cm long	13

12 a.	Cotyledons sessile; hypocotyl 10-13 mm long; epicotyl 4-4.5 cm long; leaves of the first 4-5 nodes reduced to scales so as to make a pseudohypycotyl of 10-17 cm long	*Pongamia glabra*
12 b.	Cotyledons stipitate, petioles 1-2 cm long, hypocotyl absent; epicotyl 6-17 cm long, basal leaves not reduced to scales	*Butea monosperma*
13 a.	Lower leaves and leaflets of upper leaves deltoid-ovate	*Erythrina stricta*
13 b.	Leaves/leaflets not deltoid-ovate	14
14 a.	Cotyledons obovate. base sagittate	15
14 b.	Cotyledons not obovate, base not sagittate	16
15 a.	Leaflets 9-15 x 4-7 mm, elliptic-oblong, tip obtuse	*Albizia procera*
15 b.	Leaflets 30-60 x 15-30 mm, elliptic, tip acuminate	*Xylia xylocarpa*
16 a.	Cotyledons orbicular-oblong	*Cassia fistula*
16 b.	Cotyledons narrowly oblong	*Schleichera oleosa*
17 a.	Cotyledons thicker than the leaves	18
17 b.	Cotyledons as thick as the leaves (=foliar)	35
18 a.	Leaves of the first 3-4 nodes whorled; cotyledons thick, ruminate	*Vateria indica*
18 b.	Leaves not whorled	19
19 a.	Leaves all opposite, lateral nerves very numerous, close and parallel	20
19 b.	Leaves all alternate or sometimes the first pair opposite, lateral nerves few	21
20 a.	Upper internodes 4-angular	*Calophyllum apetalum*
20 b.	Upper internodes cylindric	*nagassarium*
21 a.	Leaves 3-ribbed	*Cinnamomum malabathrum*
21 b.	Leaves pinnately reticulate	22
22 a.	Leaf margin aentate	*Artocarpus hirsutus*
22 b.	Leaf margin entire	23
23 a.	Cotyledons held in opposite directions on the stem	24
23 b.	Cotyledons held in the same direction on the stem	26
24 a.	Cotoledons deeply 2-lobed; hypocotyl2-3 cm long, leaf base round or subcordiform ...	*Hopea ponga*
24 b.	Cotyledons entire; hypocotyl absent or 4-5 mm long	25

25 a.	Cotyledons anisomorphic, one cylindric with a lenticular depression, the other small, biconvex, spatulate	*Artocarpus heterophyllus*
25 b.	Cotyledons isomorphic, elliptic, plano-convex	*Palaquium ellipticum*
26 a.	Cotyledons not emerging from the seed coat/fruit wall; if emerging not separating from each other	27
26 b.	Cotyledons emerging from the seed coat, separating from each other	32
27 a.	Epicotyl strigose-pubescent	28
27 b.	Epicotyl glabrous	29
28 a.	Leaves obovate; body of the nut winged ...	*Dipterocarpus indicus*
28 b.	Leaves elliptic; body of the nut not winged ...	*Dipterocarpus indicus*
29 a.	Endocarp-cotyledon complex compressed, biconvex, surface fibrous	*Mangifera indica*
29 b.	Endocarp-cotyledon complex cylindric, surface not fibrous	30
30 a.	Leaves obovate, cotyledons emerging from the fruit but remaining adpressed together :	*Terminalia bellirica*
30 b.	Leaves elliptic or elliptic-lanceolate; cotyledons not emerging from the seed coat ...	31
31 a.	Endocarp covering the cotyledons white, horizontally striated; leaves elliptic-caudate	*Polyalthia fragrans*
31 b.	Endocarp 'covering the cotyledons brown, not striated: leaves elliptic-acuminate ...	*Cullenia exarillata*
32 a.	Cotyledons hemispherical; leaves elliptic ...	*Persea macrantha*
32 b.	Cotyledons oblong or reniform; leaves ovate, obovate 'or oblanceolate	33
33 a.	Leaves deltoid-ovate; cotyledons 5-6 mm broad; hypocotyl 3-3.5 cm long	*Erythrina stricta*
33 b.	Leaves not deltoid-ovate; cotyledons 15-20 mmbroad; hypocotyl absent or 10-15 mm long	34
34 a.	Leaves all simple, obovate or oblanceolate, tip of the petioles with two linear appendages	*Holigarna arnottiana*
34 b.	Leaves simple, upper ones compound, tip of the petioles devoid of appendages	*Pongamia pinnata*
35 a.	Leaf margin crenate, dentate, serrate or repand	36
35 b.	Leaf margin entire	46
36 a.	Leavas all opposite	37

36 b. Leaves all alternate, some times the basal pair alternate 39

37 a. Leaves obovate, margin crenate, when bruised stains the skin red .... *Tectona grandis*

37 b. Leaves ovate or elliptic, margin denate or serrate, when bruised does not stain the skin red 30

38 a. Tip of the cotyledons retuse; leaf margin dentate, leaves all simple, ovate, oldet leaves with iong terete petioles .... *Gmelina arborea*

38 b. Tip of the cotyledons round; leaf margin serrate, upper leaves compound and with winged petioles/rachis .... *Vitex altissima*

39 a. Cotyledons deeply 3-lobed, labes lanceolate. 5-6 cm long; upper leaves compound ... *Canarium strictum*

39 b. Cotyledons ovate, obreniform or obtusely trapeziform; leaves all simple 40

40 a. Cotyledons broader than long, obreniform or obtusely trapeziform 41

40 b. Cotyledons not broader than long, ovate ... 43

41 a. Leaves narrowly elliptic. tip acute .... *Terminalia arjuna*

41 b. Leaves obovate; tip acuminate 42

42 a. Young leaves golden tomentose; cotyledonary blade 1 x 1.5 cm .... *Terminalia paniculata*

42 b. Young leaves not tomentose; cotyledonary blade 3.5-4 x 2-2.5 cm ... . *Terminalia crenulata*

43 a. Leaves ovate 44

43 b. Leaves oblanceolate 45

44 a. Upper leaves peltate, margin denticulate, tip acuminate. petioles 3-7 cm long ...... *Macaranga peltata*

44 b. Leaves basifixed, margin coarsely serrate, tip acute, petioles 5-7 mm long .... *Grewia tiliifolia*

45 a. Lateral nerves of the leaves 10-18 pairs or more; cotyledons 0.7-0.9 x 0.5-0.9 crn ... *Dillenia pentagyna*

45 b. Lateral nerves of the leaves below 10 pairs; cotyledons 4-5 x 3-4 cm .... *Elaeocarpus tuberculatus*

46 a. Leaves all opposite 47

46 **b.** Leaves all alternate, or sometimes the first pair opposite 50

47 a. Leaves estipulate: coyledons narrow, tip truncate .... *Santalum album*

47 b. Leaves with interpetiolar stipules; cotyledons ovate or suborbicular, tip obtuse or retuse 48

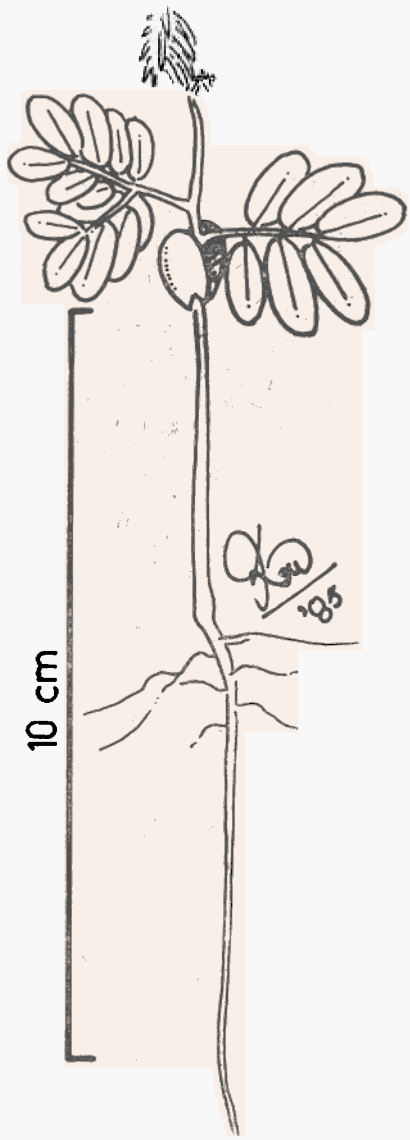
48 a.	Cotyledonary blade 12-15 x 10-12 mm, tip retuse; hypocotyl 30-35 mm long; epicotyl 40-45 mrn long; petiole of the leaves 10-12 mm long or longer	***Hymenodictyon orixense***
48 b.	Cotyledonary blade 1.5-2.5 x 1.5-2.5 mm, tip acute or obtuse; hypocotyl 2-3.5 mm long; epicotyl 3-5 rnm long; petiole *of* the leaves (1-)6-10 rnm long	49
*49a.	Upper internodes 10-15 mm long	***Mitragyna parvifolia***
*49b.	Upper internodes 5-7 mm long	***Haldina cordifolia***
50 a.	Upper internodes winged	***Lagerstromia microcarpa***
50 b.	Upper internodes terete	51
51 a.	Cotyledons broader than long	52
51 b.	Cotyledons not broader than long	58
52 a.	Cotyledons obreniform	53
52 b.	Cotyledons obtusely subtrapeziform or sub-orbicular	56
53 a.	Petiole of'the cotyledon 1-3 mm long ...	***Bridelia squaosa***
53 b.	Petiole of the cotyledon 10-50 mm long ..	54
54 a.	Cotyledonary blade 3-3.5 x 2-2.5 cm	***Terminnlia crenulata***
54 b.	Cotyledonary blade 1.5-1.7 x 1 cm	55
55 a.	Leaves etliptic-ovate, tip acute, young leaves . glabrous	***Anogeissus latifolia***
55 b.	Leaves obovate or elliptic-obovate. tip acuminate, yaung leaves golden tomentose ...	***Terrninalia paniculata***
56 a.	Cotyledonary blade 5-6 x 5-8 rnm	***Lagerstroemia reginae***
56 b.	Cotyledonary blade 2-3 x 4-7 cm	57
57 a.	Leaves narrowly elliptic, 1 cm broad, margin entire or obscurely dentate	***Terminalia arjuna***
57 b.	Leaves obovate. 2-5 cm broad, margin entire	***Terminulia chebula***
58 a.	Leaves palmately reticulate or 5-7 ribbed from base	***Macaranga peltata***
58 b.	Leaves pinnately reticulate	59
59 a.	Leaves 30-40 mm broad, ovate, base cordiform	***Pterocarpus marsupium***
59 b.	Leaves 5-7 mm broad, oblong, base round, upper leaves bifariously arranged on short branches and appearing compound	***Phyllanthus emblica***

Seedlings of ***Mitragyna parvifolia*** and ***Haldina cordifolia*** resemble very much and is very difficult to distinguish them.

Acrocarpus fraxinifolius Wt. et Arn, - Malayalam: Korangadi, Malamkonna. Narivenga (Fam.: Caesalpiniaceae).-

Seedlings: erect. ***Roots:*** primary root slender, tapering, lateral roots any. ***Hypocotyl:*** 5-6 cm long 0.5-0.75 mm thick, 4-angular, basal half glabrous, upper half puberulent. ***Epicotyl:*** 4-6 mm long, terete or slightly compressed, hirsute. ***Upper internodes:*** as long as the epicotyl. ***Cotyledons:*** epigeal, 2, opposite, thin, foliar, green, glabrous, 17-20 x 12-14 mm, sessile, elliptic, base obtuse, tip obtuse or round; pinnate reticulate. ***Leaves:*** foliar, alternate, paripinnate, leaflets in the first two leaves 4, 6-12 in upper ones, opposite, subsessile, petiolule 1 mm long, puberulent. blade 10-50 x 4-20 mm, ovate, base round, tip acute, margin entire, glabrous, lateral nerves 4-8 pairs.

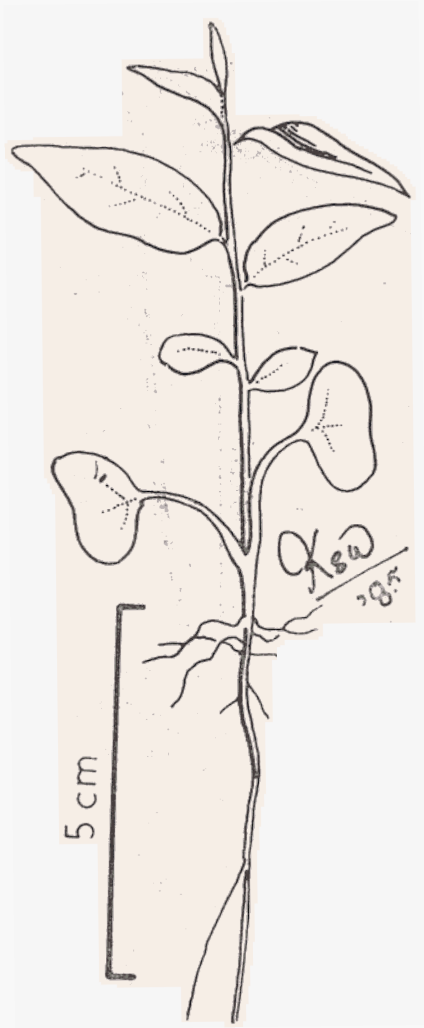
Occurs in the evergreen and semievergreen forests up to 1,200 m throughout Kerala.



Albizia procera (Roxb) Benth. -Malayalam: Karumthakara (Fam.: Mirnosaceae).

Seedlings: erect. ***Roofs:*** primary root flexuous, white: ***Hypocotyl*** : 1.7-4 cm long, 1-1.5 mm thick, base often abruptly thickened. ***Epicotyl:*** 4-6 mrn long. ***Upper internodes:*** 5-15 mm long. ***Cotyledons:*** well above the ground level, 2, opposite, thick, green, isomorphic, subsessile, blade 5-7 x 4-6 mm, 2-3 mm thick, elliptic-obovate, base sagittate, tip round. ***Leaves:*** foliar, spiral, stipulate, first leaf simply paripinnate, upper ones biparipinnate, pinnae 2 in lower ones. 4 in upper ones, leaflets 4 11 pairs, opposite, shortly petiolate, blade 9-15 x 4-7 mm in lower ones, 16-37 x 8-17 mm in upper onts, elliptic-oblong, halves dissimilar, tip obtuse, base unequal, margin entire, glabrous.

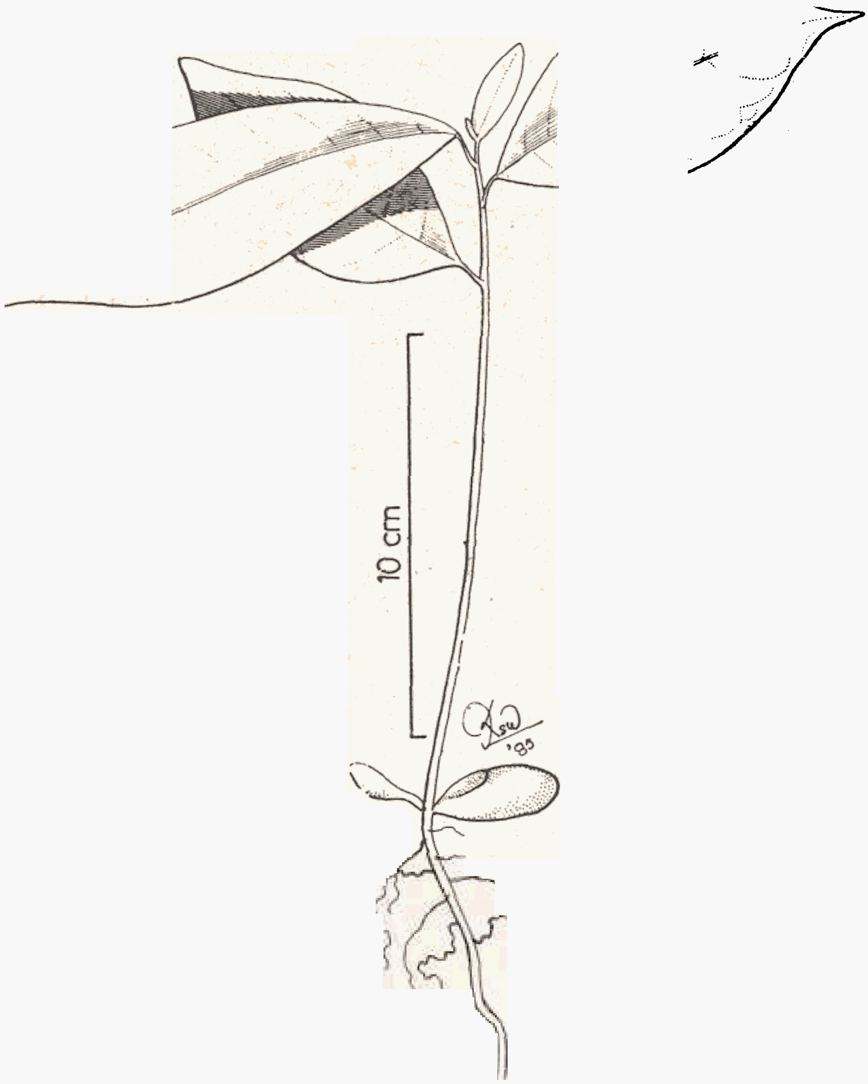
Distributed in the moist deciduous forests throughout Kerala upto 600 m.



Anogeissus latifolia (DC.) Wall. ex. Guill. et Perr. -Malayalam: Mazhu-kkanjiram (Fam : Combretaceae).

Seedlings: erect. ***Roofs:*** primary Foot long. ***Hypocotyl:*** reddish, 2-5 rnm long, minutely pubescent. ***Epicotyl:*** 1.5-2 cm long. ***Upper internodes:*** 0.5-2 cm. long. ***Cotyledons:*** above the ground level, 2, opposite, thin, foliar, isomorphic, petioles 12-20 mm long, blade 5-10 x 7-14 mm, obreniform, base cuneate, tip emarginate. ***Leaves:*** foliar, first pair often subopposite, upper ones alternate, petioles 1-2 mrn long or subsessile, blade 10-35 x 6-12 mrn, elliptic-ovate, base obtuse, tip acute, margin entire, lateral nerves **4-5(-6)** pairs, puberulent beneath.

Occurs in the dry deciduous forests up to 600 m; regeneration is falrly high



Artocarpus heterophyllus Lamk. ***Syn.:* *A. integrifolia*** auct. non Linn. -Malayalam: Plavu (Fam.: Moraceae).

Seedlings: erect. ***Roots:*** primary root 2-3 mm thick, thicker than the stem, orange red. lateral roots many. ***Hypocotyl:*** short or absent. ***Epicotyl:*** very short, first few leaves reduced to scales so as to make a long pseudo-epicotyl. ***Upper internodes:*** 1-1.5 cm long, puberulent. ***Cotyledons:*** almost at the ground level, 2, opposite, non-foliar, thick, anisomorphic, larger one 15-20 x 8-12 mm, ellipsoid with an elliptic concavity at the base, smaller one shortly stalked, 10-12 x 4-5 mm, 3-4 mm thick, elliptic, plano-convex. ***Leaves:*** alternate, scale leaves minute. foliar ones petiolate, petioles 5-7 mm long, blade 8-15.5 x 4-5 cm, of the lower 1-2 elliptic. of the upper ones elliptic-obovate or elliptic-oblong, base cuneate or acute, tip obtusely acuminate, margin entire, glabrous, lateral nerves 5-7 pairs, intercostae reticulate.

Distributed in the evergreen forests from 450 to 1.200 m.

Actocarpus hirsutus Lamk. Malayalam: Ayini-plavu (Fam.: Moraceae).

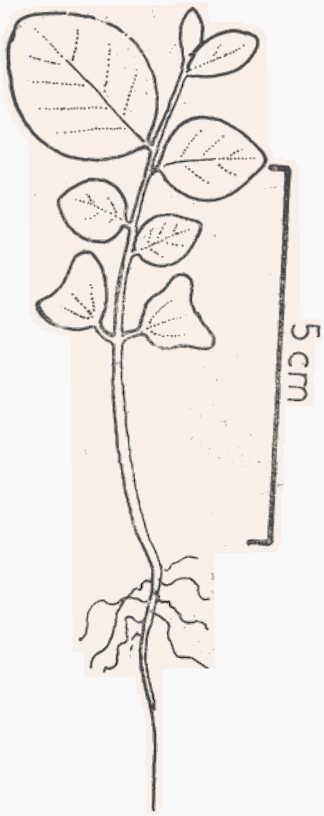
Seedlings: erect. ***Roots:*** primary root 1-1.5 mm thick. orange red, lateral roots many. ***Hypocotyl:*** absent or 2-3 mm long. ***Epicotyl:*** 5-10 cm long. ***Upper internodes:*** 1.5-2 cm long, rusty pubescent. ***Cotyledons:*** at the ground level, 2, thick, non-foliar, non-photosynthetic, petiolate, petioles 2-3 mm long, flattened, blade 8-15 x 5-8 mm, elliptic, plano-convex, blades of the two cotyledons closely adpressed and held together to one side. ***Leaves:*** foliar, alternate, stipulate, stipules 5-7 mm long, narrow, petioles 4-6 mm long, pubscent, blade of the first 5-6 leaves 3.5-8 x 2-4.5 cm, elliptic, base obtuse, tip acute, margin denticulate, glabrous above, scabrous beneath, lateral nerves 6-8 pairs, intercostae reticulate, blade of upper leaves 17-21 x 6-8.5 cm, very obovate or oblanceolate, base acute, tip accuminate, otherwise similar to the lower ones.

Distributed throughout Kerala upto 900 m in evergreen, semievergreen and moist deciduous forests.

Bombax ceiba Linn. **Syn.** *B.* ***malabaricum*** DC. -Malayalam. Elavu (Fam.. Bombacaceae).

Seedlings: erect. ***Roots:*** yellowish white, primary root straight, lateral roots flexuous. ***Hypocotyl:*** 5-7 cm long, 1-2 mm thick, pale green, glabrous. ***Epicotyl:*** 1-2 cm long. ***Upper internodes:*** 2.5-3.5 cm long. ***Cotyledons:*** well above the ground, 2, opposite, thin, foliar, green, petioles 5-10 mm long. blade 3-3.5 x 2-3 cm, base subtruncate or round, tip acuminate. margin entire, 5-7 nerved from base, glabrous. ***Leaves:*** foliar, spiral, palmately compound, rachis of the first 2-3 leaves 2.5-4 cm long, leaftets 3 in first 3-4 leaves, 4-5 in upper ones, shortly stipitate or sessile, blade 3-7 x 1.5-3 cm lower ones, 12-20 x cm in upper ones, lanceolate, tip acuminate, base acute to obtuse, margin entire, lateral nerves 5-7 pairs; glabrous.

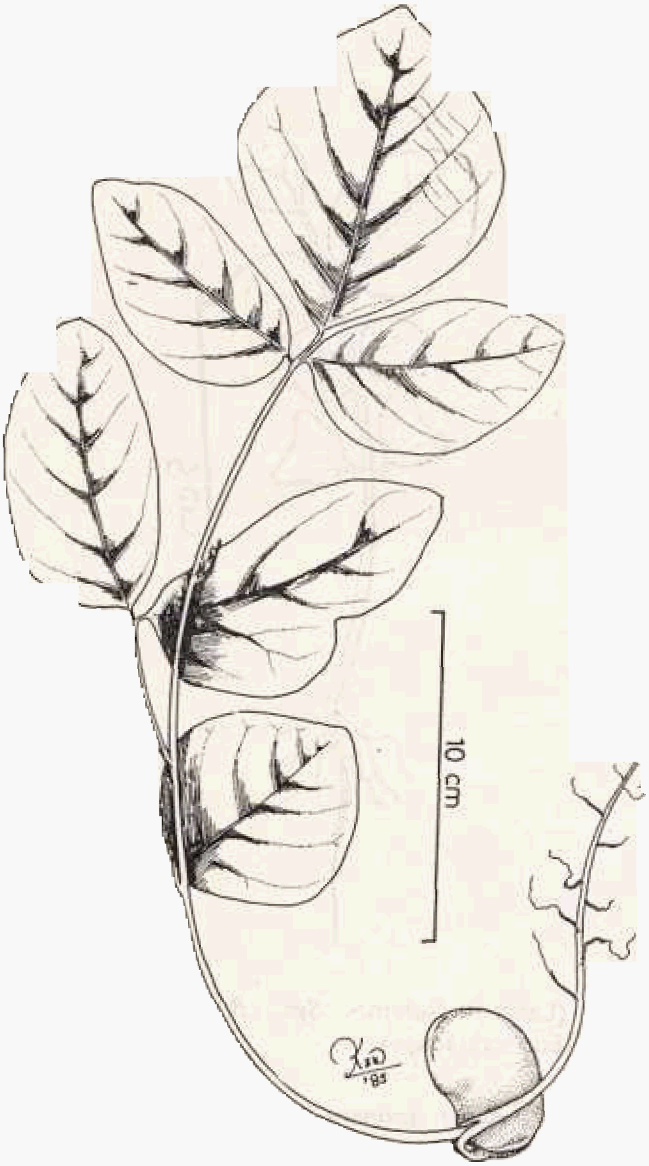
Very common in the semievergreen and moist deciduous forests.



Bridelia sqonmosa (Lamk.) Gehrm *Syn. B. retusa* Spreng. -Malayalam: Mullu-venga (Fam.: Euphorbiaceae).

Seedlings: erect. ***Roots:*** primary root straight, lateral roots many. ***Hypocotyl:*** 3-3.5 cm long, 1 mm thick, slightly thicker than the epicotyl, pubescent. ***Epicotyl: ca.*** 1 cm long, pubescent. ***Upper internodes:*** more or less equal to the epicotyl, pubescent. ***Cotyledons:*** well above the ground, 2, opposite, isomorphic, thin, foliar, green, petiolate, petioles 1-3 mm long, pubescent, blade 5-6 x 10-12; mm broader than long, obreniform, base obtuse or subtruncate. tip emarginate, margin entire, 3-5 nerved-from base, puberulent. ***Leaves:*** foliar, alternate, bifarious, petioles 1-2.5 mm long, puberulent, blade of first 1-2 leaves 5-10 x 5-7 mm, ovate or elliptic-ovate, base obtuse, tip obtuse, margin entire, puberulent, blade of upper ones 2-3 x 1.5-2 broadly elliptic or elliptic-ovate, base obtuse, tip obtuse, lateral nerves 5-7 pairs, intercostae subparallel, puberulent.

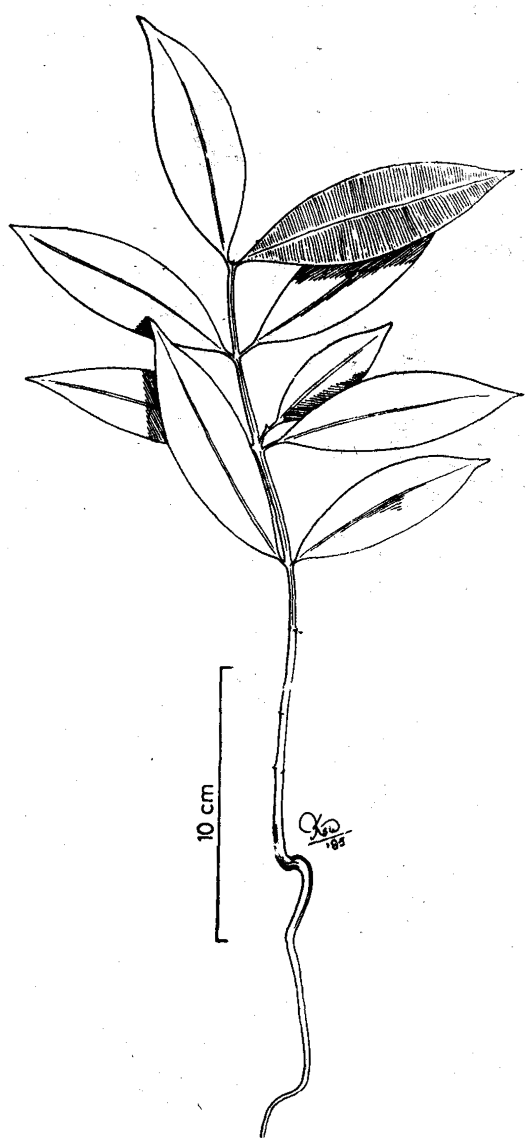
Found in the moist deciduous and semievergreen forests up to 1,200 m; regeneration fairly high.



Butea monosperma (Lamk.) Taub. ***Syn.: B. frondosa*** Roxb. -Malayalam: Plash, Chamatha (Fam : Fabaceae).

Seedlings: erect. ***Roots:*** primary root 1-2 mm thick. thinner than the stem; white, lateral roots many. ***Hypocotyl:*** absent. ***Epicotyl:*** 6-17 cm long, 2-3 mm thick, pubescent. ***Upper internodes:*** 1 cm long, pubescent. ***Cotyledons:*** at the ground level, 2, non-foliar, yellowish, petioles 1-2 cm long, curved down, blade 4-5 x 2-3 cm, reniform, flat, blades of the two cotyledons closely adpressed and held together to one side, not emerging from the seed coat. ***Leaves:*** foliar, alternate, stipulate, pubescent, first 1-2 leaves simple, petioles 4-5 mm long, pubescent, blade 6-9 x 6-9 cm, ovate, base obtuse, tip obtuse, margin entire. lateral nerves 4-5 pairs, intercostae reticulate, puberulent, upper leaves gradually transforming to trifoliolate ones, rachis 6-10 cm long. pubescent, petiolules 5-10 mm long, blades 4-10 x 5-8 cm. that of the medium leaflet rhomboid, that of the lateral leaflets asymmetric, otherwise similar to the lower leaves.

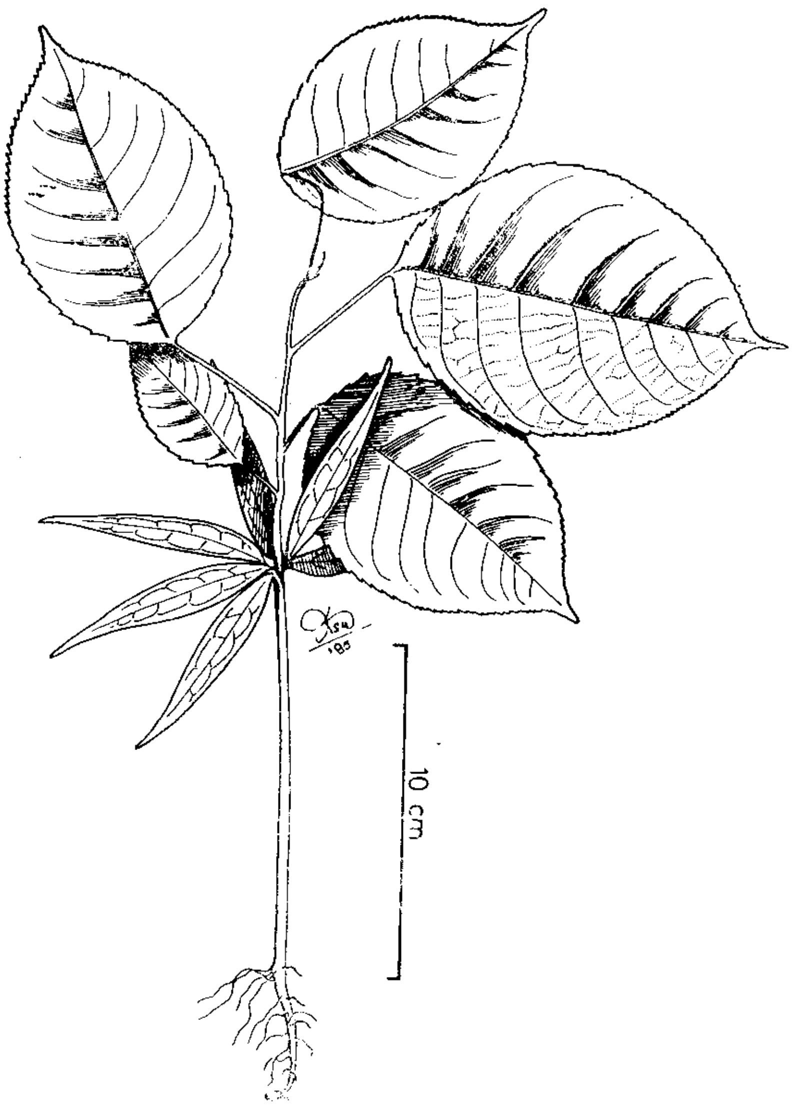
Chiefly in dry deciduous forests up to 600 m.



Calophyllum apetalum Willd ***Syn.: C. decipiens*** Wt. -Malayalam: Cheru-punna (Fam.: Clusiaceae).

Seedlings: young ones not seen, older ones erect. ***Roots:*** primary root straight. ***Internodes:*** 1-2.5 cm long, 2-2.5 mm thick. ***Upper internodes:*** 4-angular. ***Leaves:*** foliar, opposite, petioles 8-10 mm long, blade 6-12 x 2-3.5 cm, narrowly elliptic, base attenuate,lip acuminate, margin entire, glabrous, lateral nerves very numerous, thin, parallel, 0.5 mm apart.

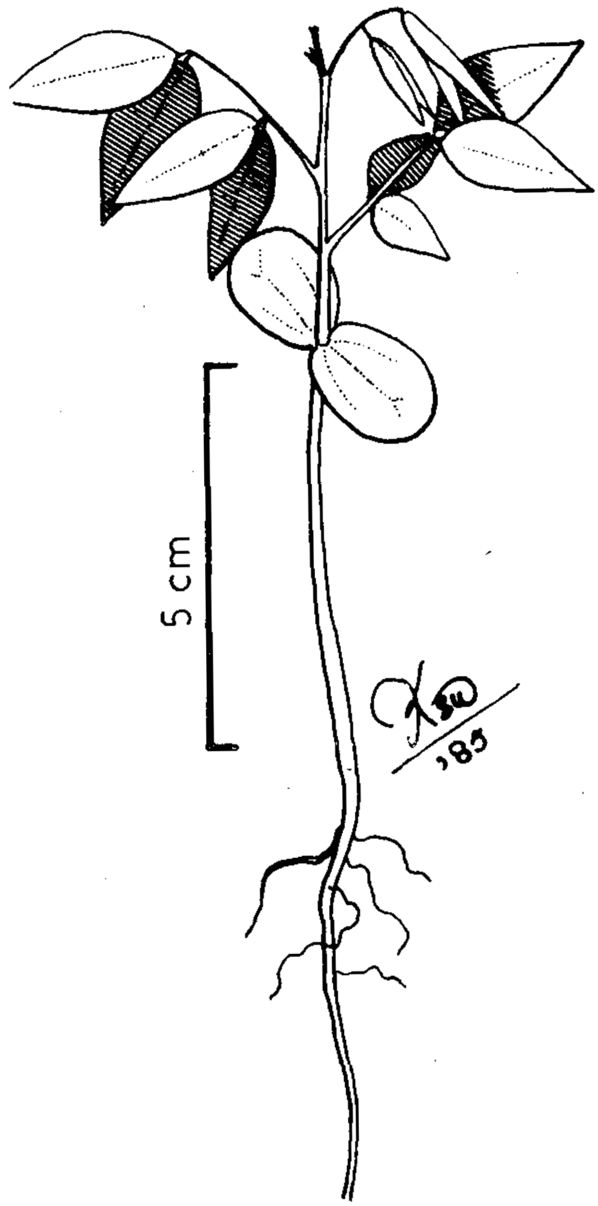
In evergreen forests along river banks up to 600 m.



Canarium strictum Roxb. -Malayalam: Thelli (Fam.: Burseraceae).

Seedlings: erect. ***Roots:*** primary root tapering, lateral roots thin. ***Hypocotyl:*** 10-12 cm long, 1-2 mm thick. reddish. upper half grooved. ***Epicotyl:*** 1-2.5 cm long. strigose. ***Upper internodes:*** 1-2.5(-3) cm long. pubescent. ***cotyledons:*** well above the ground. 2. opposite, thin, foliar, green. petiole 3-4 X 1.5 mm. shallowly grooved. blade deeply palmatifid. lobes 3. 6-7.5 cm by 7-13 mm. base narrow. tip acuminate. margin entire. glabrousr lateral nerves 6-7 pairs, looping to form a submarginal nerve. ***Leaves:*** foliar. alternate, petiole 1-3.5 cm long. cylindric. hirsute, blade of the first leaf 5.5 x 2.7 cm, those of upper ones 10-12 x 5.5-8 cm. broadly elliptic. base obtuse, tip acuminate. margin serrate and ciliate, lateral nerves 7-10 pairs, intercostae subreticulate. nerves and veins pubescent.

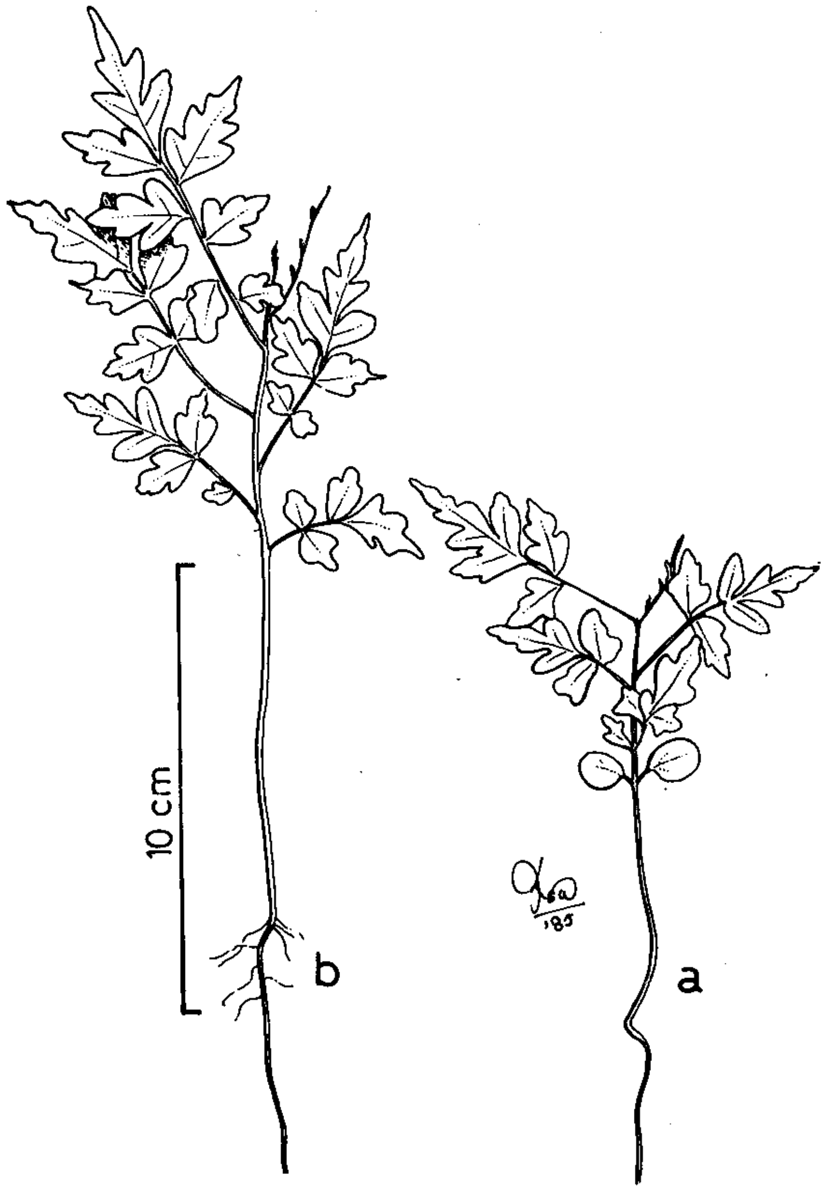
Chiefly confined to evergreen and semi-evergreen forests up to 1,500 rn: Regeneration fairly high.



Cassia fistula Linn. -Malayalam: Kanikkonna (Fam.: Caesalpiniaceae)

Seedlings: erect. *Roots* primary root straight. lateral roots present. ***Hypocotyl*** 3-6.5 cm. long 2-2.5 mm thick. Epycotyl 1 5 - 2 cm long ***Upper internodes*** 8-10 mm long. *Cotyledons* well above the ground, 2, isomorphic. thick. green. 15-20 x 8-12 mm. sessile, oblong-orbicular. base obtuse, tip round or subtruncate. margin entire. 3-5 nerved from base. coriaceous. ***Leaves*** foliar. spiral. paripinnate. leaflets opposite. first 3-4 leaves with 2 pairs of leaflets. upper ones with 3 pairs. petiolules 1-2 mm long, leaflet blade 2-4.5 X 1-2 cm. ovate of elliptic-ovate. base obtuse or acute. tip acute, margin entire, lateral nerves 6-9 pairs. very thin. intercostae reticulate, glabrous.

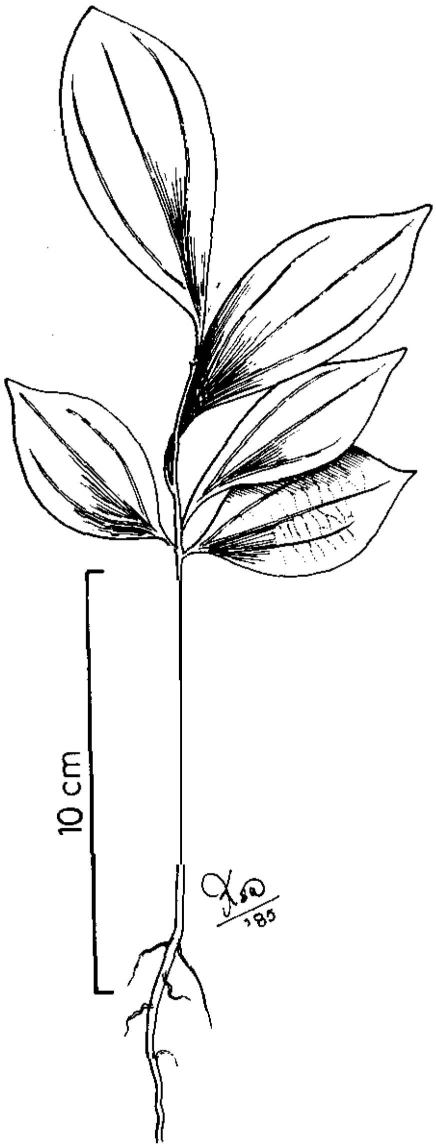
Dry and moist deciduous forests up to 900 m; regeneration poor owing to repeated annual fires.



Chukrasia tabularis A. Juss. - Malayalatn: Chuvanna akil (Fam.: Meliaceae).

Seedlings: erect. ***Roofs:*** tap root very thin. brown. lateral roots present. *Hypocotyl:* 4-6 cm long. 0.5-0.75 mm thick. brown, puberulent. *Epicotyl:* 8-10 rnm long, brown, puberulent. *Upper* ***internodes:*** 1 1.5 cm long, puberulent. ***Cotyledons:*** well above the ground. 2, opposite, thin, foliar. green, simple, petioles 3-4 mm long. blade 12-15 x 8-11 mm. orbicular. base of the two halves dissimilar, one acute. other obtuse. margin entire, 3-nerved from base. glabrous. ***leaves*** foliar. first pair opposite. upper ones altrenate, 3-9 cm long, imparipinnate. rachis 1.5-4.5 cm long. leaflets 3-7. 10-35 x 5-20 mm, pinnatisect. glabrous.

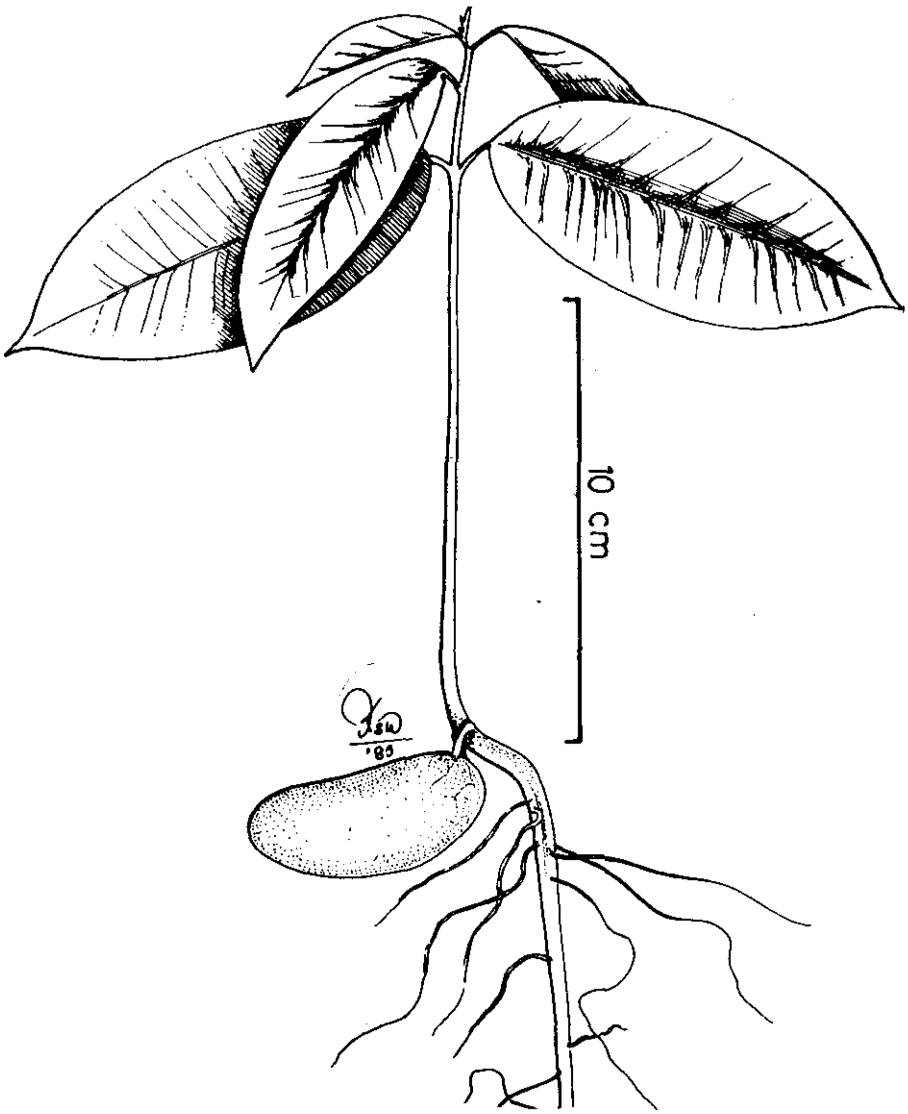
Occurs in semievergreen and moist deciduous forests from 300-1.300 m: in the semievergreen forests the species regenerates profusely.



Cinnamomum malabathrum (Burm. f.) Bl. ***Syn.: C. ceylanicum*** sensu Gamb. - Maiayalam: Edana, Karuva. Vazhana (Fam : Lauraceae).

Seedlings: young ones not seen, older ones erect. ***Roots***: tap root straight. *Cotyledons* not seen. *Hypocotyl* **+ *Epicotyl*** 8-9 cm long. ***Upper internodes*** 1-3 cm long. ***leaves*** foliar. spiral. simple. petioles 6-10 mm long, biade 5-14 x (2.5-)3.5-5 cm. elliptic. base acute. tip obtusely acuminate. margin entire; 3-ribbed from slightly above the base, intercostae parallel or subreticulate, glabrous.

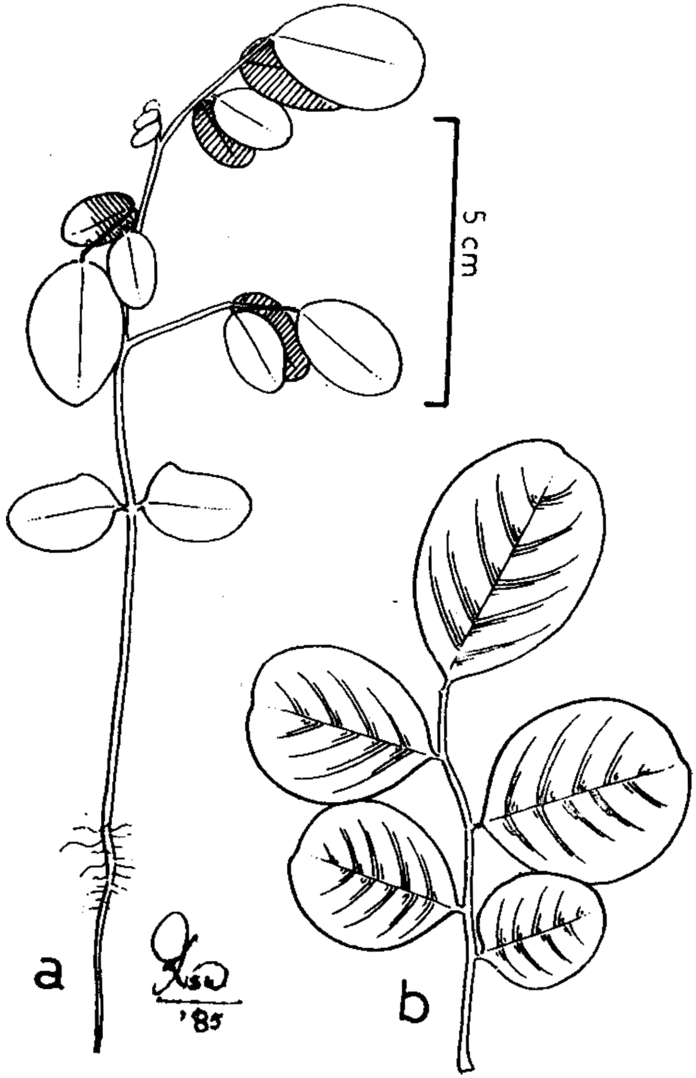
Exclusively confined to the evergreen forests above 900m.



Cullenia exarillata Robyns. ***Syn : C excelsa*** Wt. - Malayalam: Mullan-chakka (Fam.: Bornbacaceae).

Seedlings erect. ***Roots:*** primary root thinner than the hypocotyl, lateral roots many, thin. *Hypocotyl* 7-15 mm long, 5-6 mm thick. *Enicotyl* 12-15 cm long. ***Upper internodes:*** 2-3 cm long. ***cotyledons*** slightly above the ground. thick, opposite, non-photosynthetic, petioles 1 5-3 mm long, blades of the two cotyledons closely adpressed together and held to one sid :. conforming to the shape of the seed, not emerging from the seed coat, 4-5x 2-2.5 cm. subcylindric. ***Leaves:*** foliar. first pair opposite. upper ones alternate. simple, stipules caducous. narrow. petioles 8-10 mm long. blade 10-12 x 3.5-4.5 cm. elliptic. base obtuse, tip acurninate. lateral nerves many. thin, glabrous. underneath orange tinged, young leaves folded and drooping.

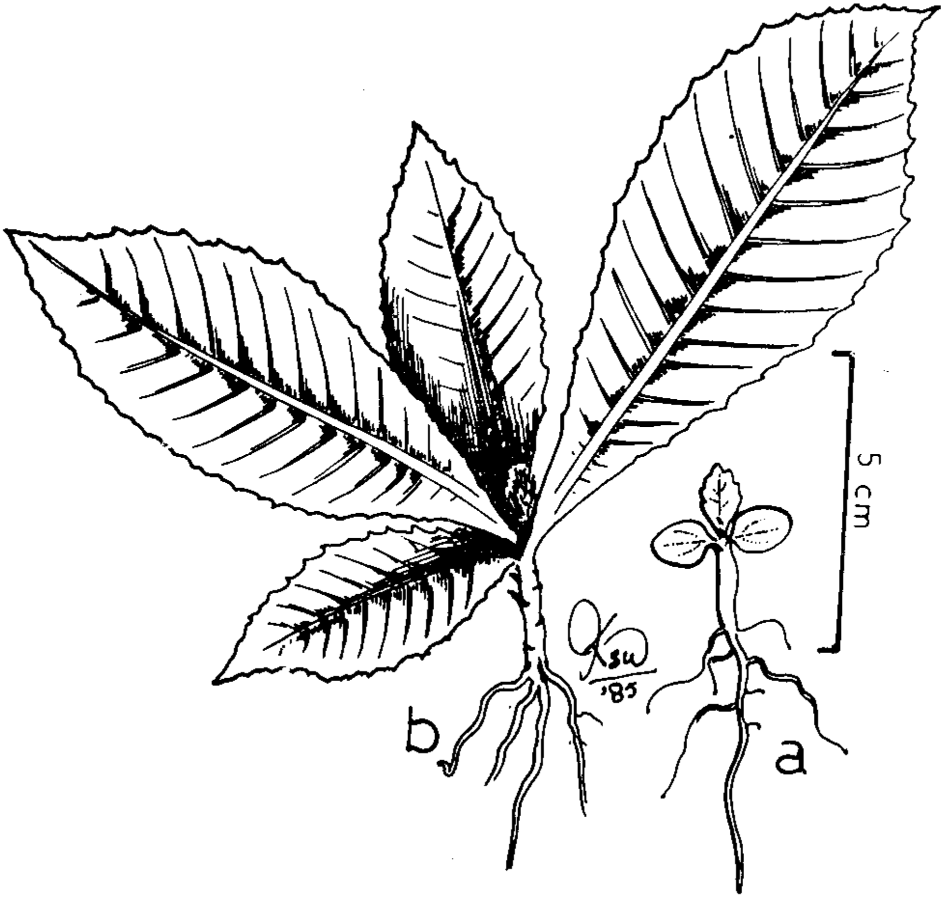
Exclusively confined to evergreen forests from 703-1.600rn: regeneration fairly high; seedling swarms of this species are often fond along with those of ***Mesua nagassariurn*** and *Palaquium* ***ellipticum.***



Dalbergia latifolia Roxb. - Malayalam: Veeti (Fam.; Fabaceae)

Seedlings: erect. ***Roots:*** yellowish. *Hypocotyl 3-6* cm long, initially slightly 4-angular. *Epicotyl:* 2-3 cm long. ***Upper** internodes* 2-2.5 cm long. ***cotyledons*** well above the ground level. 2. opposite. thin. foliar. coriaceous, green, isomorphic. subsessile. blade 1.5-1.75 x 1-1.25 cm. oblong, halves dissimilar, one half with an acumen slightly above the base, base obtuse, tip round. ***Leaves*** foliar. spiral, simply imparipinnate. rachis 2-4(-7) cm long. first 1-2 leaves 3-foliolate. upper ones 4-5 foliolate. petiolules 2 mm long, blade 20-25 x 12-17 mm. elliptic. in older leaves 3-4.5 x 2-3 cm. obovate. base obtuse, tip round, margin entire. lateral nerves 4-5 pairs, glabrous.

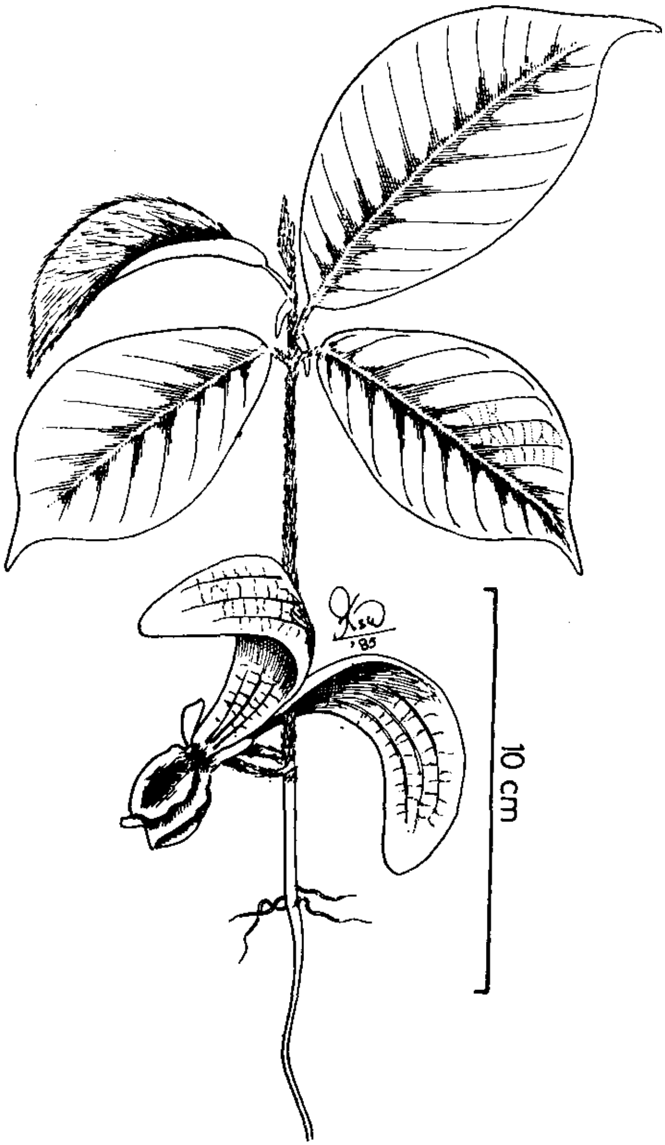
Occurs in semievergreen and moist deciduous forests up to 1.200m.



Dillenia pentagyna Roxb. - Malayalam: Malam-punna (Fam. Diileniaceae)

Seedlings: erect. ***Roots:*** primary root thin. lateral roots from the base of the hypocotyl grow faster and make the primary root inconspicuous. ***Hypocotyl:*** 7-11 rnm long. 1-1.5 mm thick. ***Epicotyl*** and ***Upper internodes:*** very short. ***Cotyledons:*** well above the ground. 2. thin, opposite, foliar. green. isomorphic. petiole 2 rnm long. blade 7-9 x 5-9 mm. ovate. base obtuse. tip obtuse. margin entire. 3-nerved. glabrous. ***Leaves:*** foliar, spiral, stipulate. simple. petiole sheathing. blade of the first few leaves 9-20 x 6-12mm. elliptic. of upper ones 5-10 x 2.4-4 cm. obovate or oblanceolate. base attenuate. tip acute. margin serrate, strigose.

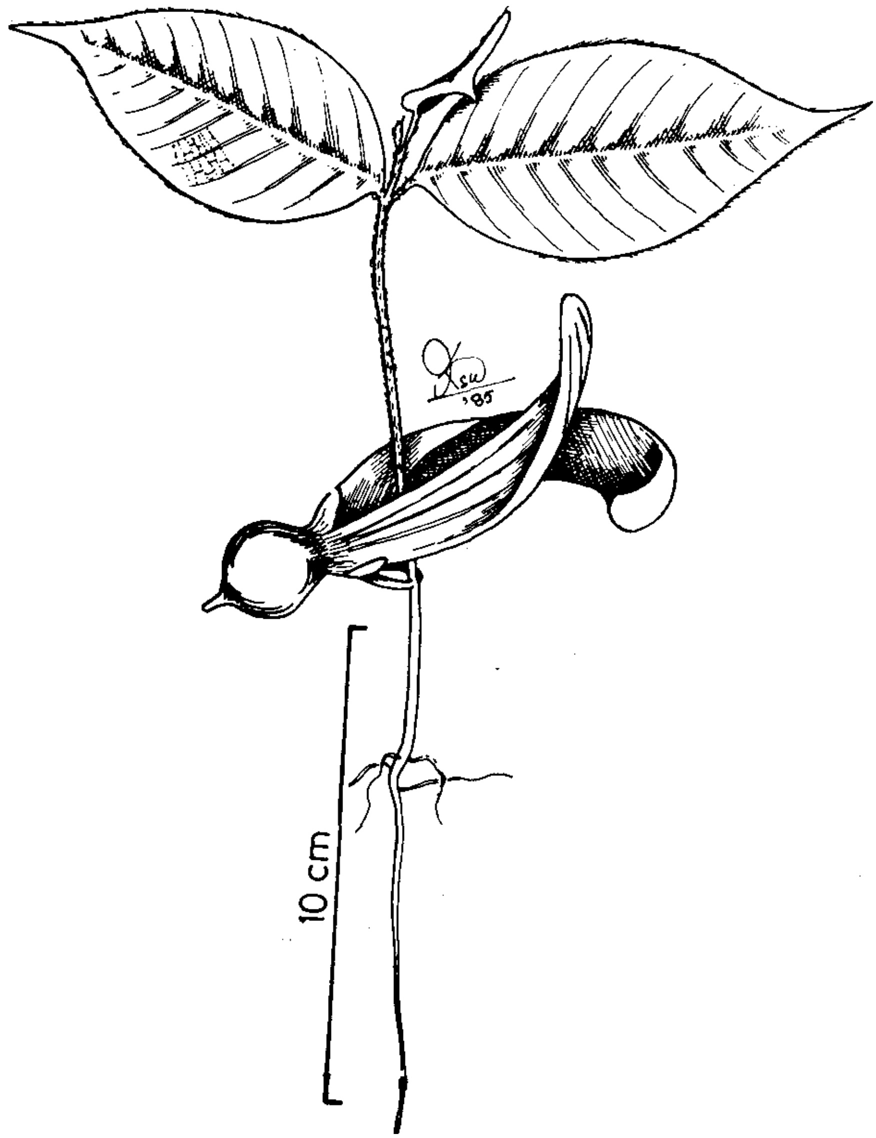
Very common in the moist deciduous forests up to 900 m; older seedlings semipyrroresistant.



Dipterocarpus bourdillunii Brand. - Malayalam: Karanjali. Karutha anjali (Fam.; Dipterocarpaceae)

Seedlings erect ***Roots:*** primary root 2-2.5 mm thick, straight, lateral roots many. ***Hypocoty/:*** 3-3.5 cm long, 3 mm thick, glabrous, pubescent towards the tip. ***Epicotyl:*** 10-11 cm long. covered with brown hirsute hairs, ***Upper internodes*** 8-10 mm long, hirsute. *cotyledons* well above the ground. 2. thick, non-photosynthetic. opposite. petioles *2-2* 5 cm long. grooved. hirsute on the outer side. blade of the two cotyledons closely adpressed and held together to one side. not emerging from the nut. ***leaves*** foliar. first pair opposite. upper ones alternate. simple. stipules narrow, pubescent. petioles 8-10 mm long, hirsute. blade 8.11 x 4.5-5.5 cm. elliptic. broadest towards the tip. base obtuse, tip acuminate, margin entire. ciliolate. lateral nerves 10-14 pairs, looping submarginally, intercostae subparallel, hirsute when young, glabrous when old.

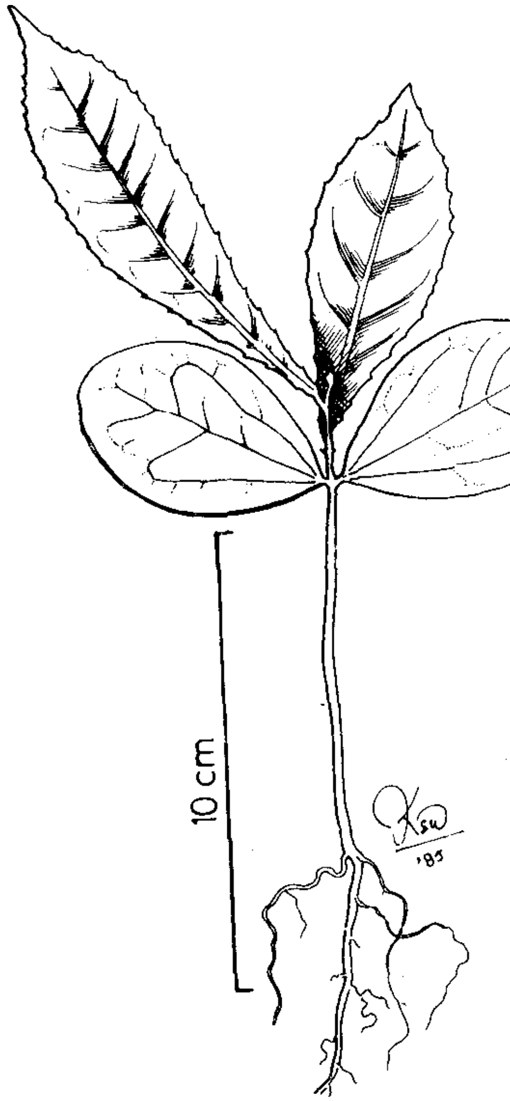
Chiefly confined to low level evergreen forests in South Kerala.



Dipterocarpus indicus Bedd. - Malayalam: Kal-payin (Fam.: Dipterocarpaceae) .

Seedlings erect. ***Roots*** primary root straight. *Hypocoryl:* 2.5-3 cm long, 2 mm thick, slightly thicker than the epicotyl and the primary root, upper half pubescent. ***Epicotyl:*** 7-8.5 cm long, pubescent. ***Upper internodes*** 1-1.5 cm long, pubescent. ***Cotyledons:*** well above the ground. 2. thick. non-photosynthetic. petioles 2-2.5 cm long. blade of the two cotyledons closely adpressed and held together to one side, not emerging from the nut. ***Leaves:*** foliar, first pair opposite. upper ones alternate, simple. petioles 5-10 mm long, pubescent, blade 8-10 x 4 5 cm. broadest at the middle. elliptic. base obtuse. tip acuminate. margin entire. ciliolate. lateral nerves 8-10 pairs, intercostae subparallel, glabrous except the margin.

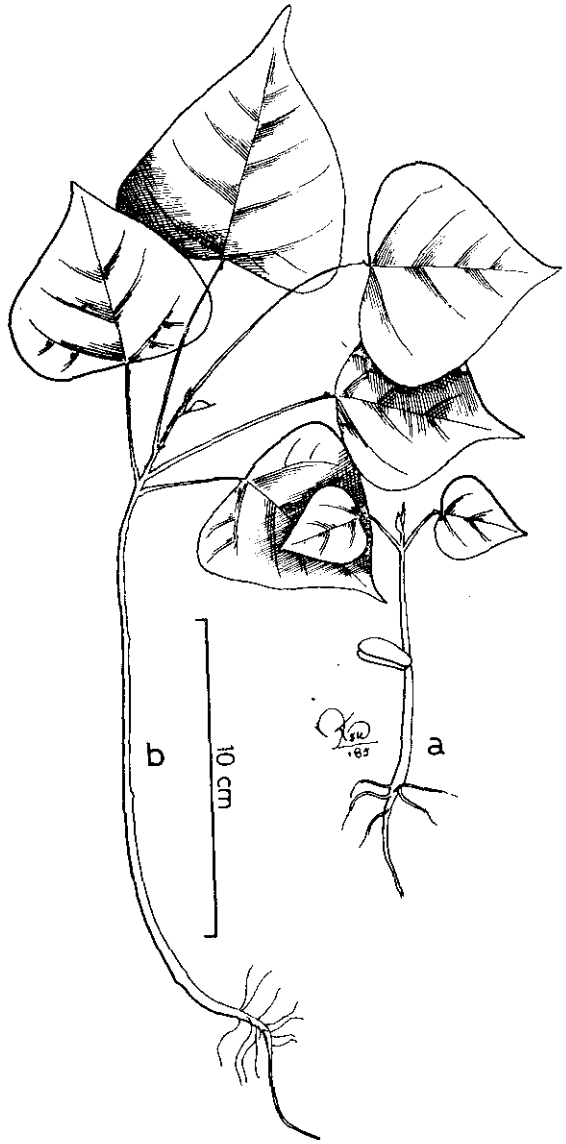
Occurs in evergreen and semievergreen forests up to 900m: regeneration fairly good in alternate years.



Elaeocarpus tuberculatus Roxb. - Malayalam: Bhadraktsham. Rudraktsham (Fam.: Elaeocarpaceae).

Seedlings erect *Roots:* primary root straight. *Hypocotyl* 8-11 cm long, longer than the epicotyl. 2-3 mm thick, red ringed. *Epicotyl* 8-10 mm long. puberulent. ***Upper internodes*** 1-2 cm long. *Cotyledons* well above the ground. 2. thin, foliar. green, petiole 1-2 rnm long. blade 4.5-6 x 3-4 cm. elliptic, tip obtuse to round. base acute to obtuse. margin entire. strongly 3 nerved from base. glabrous. ***Leaves*** foliar. alternate, stipulate. subsessile. blade oblanceolate or obovate. base narrow, tip acuminate. margins serrate, lateral nerves 5-9 pairs, looping to form a submarginal nerve.

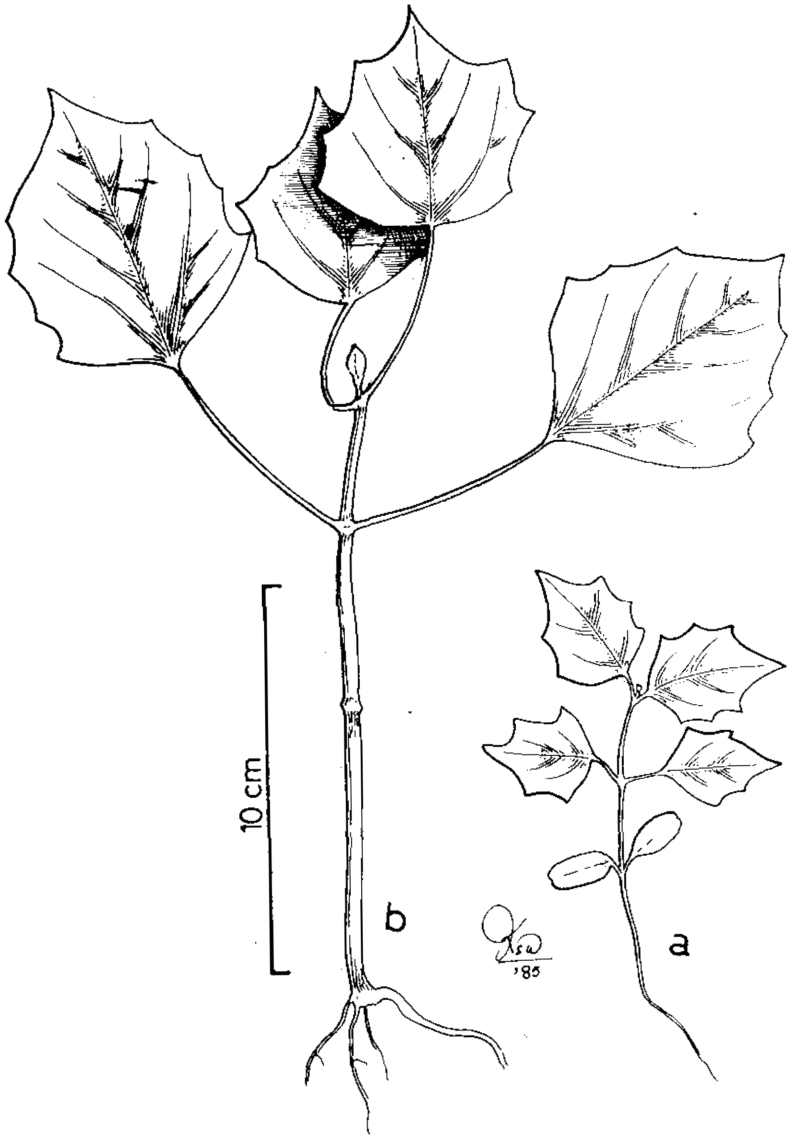
Occurs in evergreen and sernievergreen forests up to 1.500m mostly along river banks; regeneration profuse in evergreen forests and moderate in semievergreens



Erythrina stricta Roxb.- Malayalam: Mullu murukku (Fam.: Fabaceae).

Seedlings: erect. ***Roots:*** primary root 1-1.5 mm thick, lateral roots many. whits. *Hypocotyl* 3-3.5 cm long, 3~3.5mm thick, glabrous. *Epicotyl:* 3-5 cm long, 2 mm thick, thinner than the hypocotyl. greenish. ***Upper internodes*** second internode as long as the epicotyl. upper one, 1-2 cm long. glabrous. ***Cotyledons:*** well above the ground, 2, thick. greenish, isomorphic, asymmetrical, sessile. 1.8-2 x 0 5-0 6 cm. falcate-elliptic. 3-4 mm thick. planoconxex. base cuneate. tip round, margin entire, glabrous. ***Leaves*** foliar. compound, first pair opposite, l-foliolate, rachis 10-15 mm long, with two glands at the tip, petiolule 1-2 mm long, blade 2-2.5 x 2-2.2 cm. ovate base cordate. tip acuminate. margin entire, upper leaves alternate, rachis 3.5-7.5 cm long. petiolule 3-5 mm long, blade 5-8 x 4-7 cm. ovate or deltoid-ovate, base obtuse or subtruncate. tip caudate-acuminate, lateral nerves 3-4(-5) pairs. intercostae reticulate, glabrous.

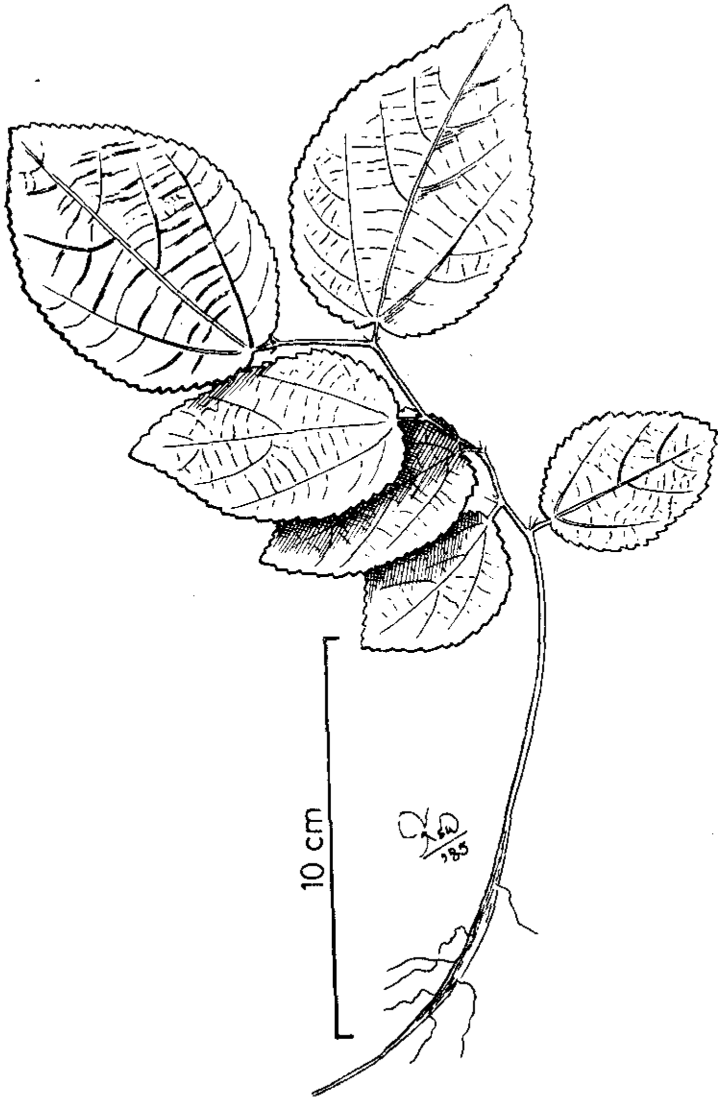
Common in dry and moist deciduous forests up to 1,200 m; fairly common in disturbed rocky areas.



Gmelina arborea Roxb. -Malayalam: Kumbil (Fam.: Verbenaceae).

Seedlings: erect. ***Roots.*** primary root thin. lateral roots present. ***Hypocotyl:*** 1-1.5cm long. *0.5* mm thick, upper half puberulent. ***Epicotyl:*** 2-2.3 cm long, 0.5 mm thick, obtusely tetragonous. puberulent. ***Upper internodes*** 2-4cm long. ***Cotyledons:*** well above the ground. 2. opposite, thin. foliar. green petiole *6-7* rnm long. broader towards the tip. puberulent. blade 12-15 x *7-8* mm. oblong or obtusely quadrangular. base obtuse, tip retuse. 3-5 nerved from base, glabrous to scabridly puberulent. ***Leaves*** foliar. simple, petiolate, petioles 1-12cm in the first 4-6 leaves. 3-5 cm in upper ones, blade 30-35 x 20-25 rnm in the basal 4-6 leaves. 6-8.5 x 6-7.5 cm in the older ones, ovate or deltoid - ovate, base cuneate. tip acuminate. margin dentate. lateral nerves 3-4 pairs. glabrous.

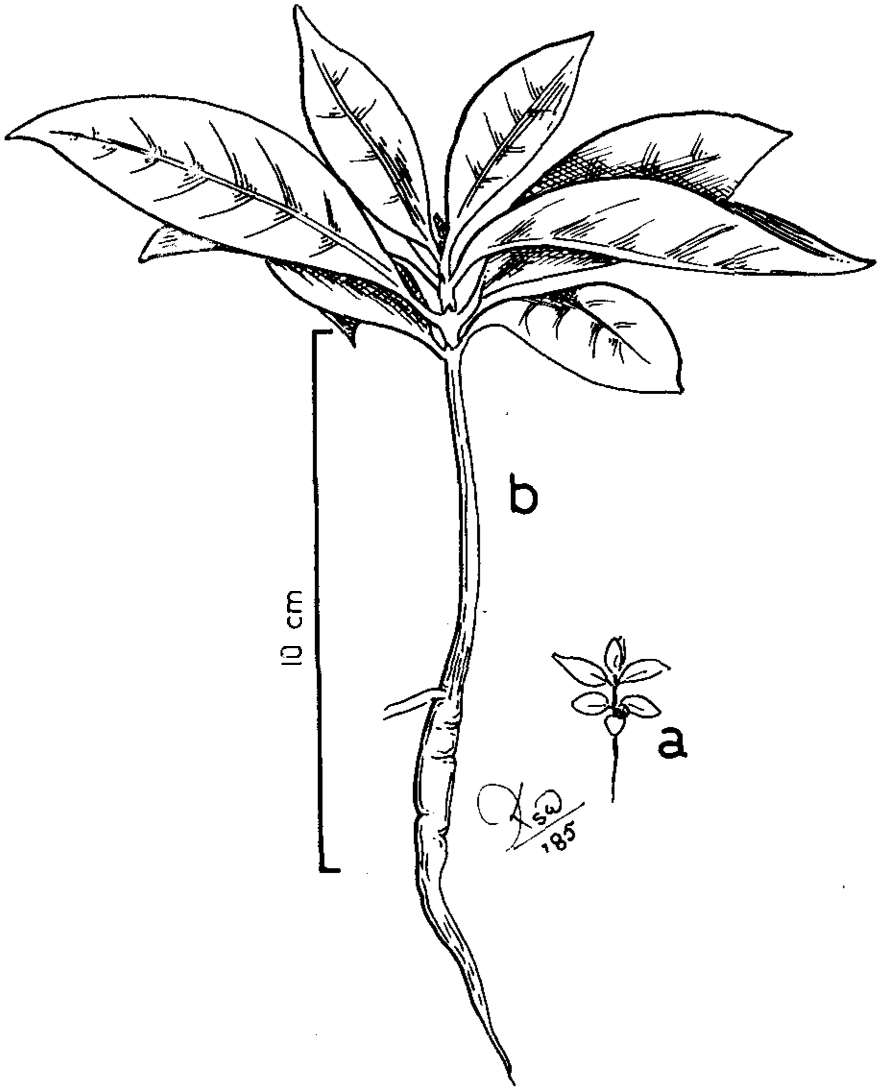
Found in moist deciduous and semievergreen forests up to 1,500 m



Grewia tiliifolia Vahl -Malayalam: Chadachi (Fam.: Tiliaceae)

Seedlings: erect; young ones not seen, ***Roots:*** tap root blackish brown. ***Cotyledons:*** not seen. ***Internodes:*** in older seedlings 1-2.5 cm long. 1-1.5 mm thick, rusty puberulent, ***Leaves:*** foliar. alternate, bifarious, stipules narrow. petioles 8-10 mm long, puberulent, blade 5-8.5 x 3-6 cm. ovate, base cordate. tip acuminate. margin serrate, triply nerved from base, midrib with *2-3* pairs of lateral nerves, intercostae scalariform. scabrous. puberulent above.

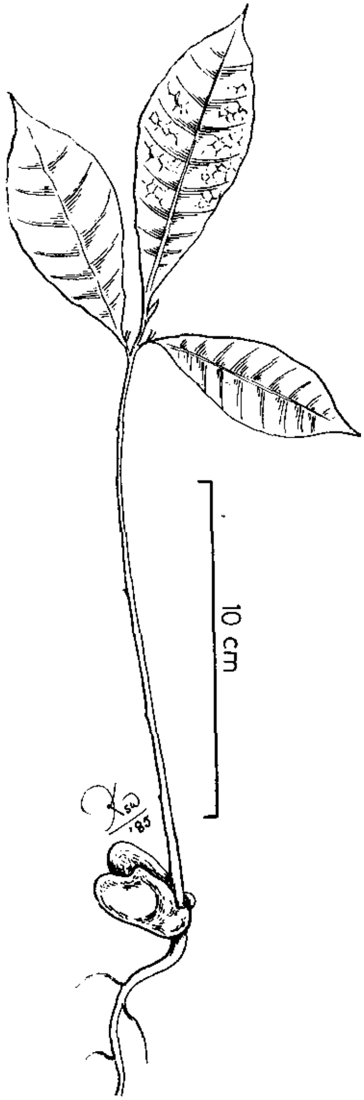
Chiefly confined *to* the moist deciduous forests up to 1,200 m.



Haldina cordifolia (Roxb.) Ridsd. *Syn.:* ***Adina cordifolia*** (Roxb.) Hk. f. ex Brand. -Malayalam: Manja-kadambu (Fam.: Rubiaceae).

Seedlings: erect. ***Roots:*** primary root white, lateral roots present. soon becoming swollen and succulent. *Hypocotyl:* 2-3.5 mm long, greenish white. *Epicotyl:* 3-5 mm long. ***Upper internodes:*** 5-7 mm long, puberulent. ***Cotyledons*** well above the ground, 2. opposite, foliar, green. isomorphic, subsessile. blade 1.5-2.5 mm long, ovate, base truncate or subcordate, tip acute, margin entire. glabrous. ***Leaves:*** foliar. opposite, decussate. stipulate, stipules interpetiolar. deltoid, puberulent, petioles 1-1.5 mm long in the first 5-6 leaves, 5-6 mm in the upper ones. blade 2.5-12.5 x 2-10 mm in the first 5-6 leaves. ovate. base obtuse, tip acute. margin entire, glabrous, 30-70 x 15-30 in the upper ones. elliptic-lanceolate. base attenuate, tip acuminate. lateral nerves 5-7 pairs. intercostae subparallel, minutely puberulent.

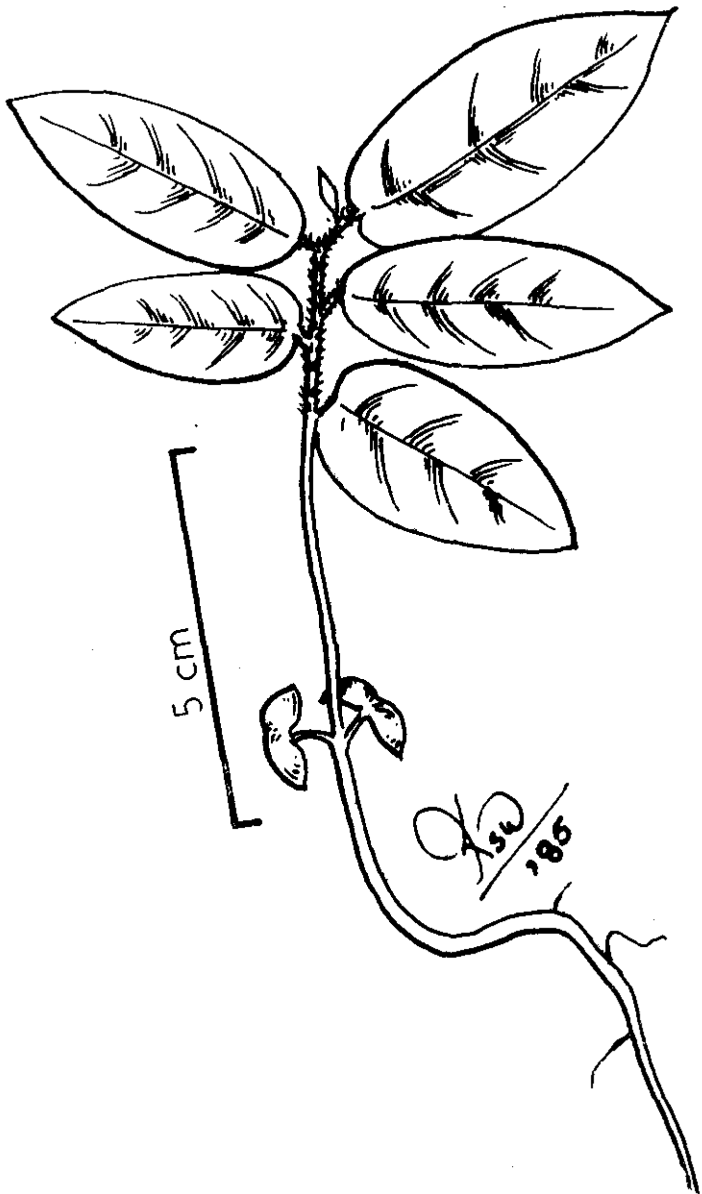
Found in moist deciduous forests up to 450 m,



Holigarna arnottiana Hook. f. - Malayalam: Cheru, Naicheru (Fam.: Anacardiaceae)

Seedlings: erect. **Roots:** primary root 2-3 mm thick. ***Hypocotyl:*** very short or nil. *Epicotyl:* 2-3 cm long, 2-2.5 mm thick; first 4-5 leaves reduced to make a pseudoepicotyl of 10-16 cm length. ***Upper infernodes:*** 0.5-3 cm long. ***Cotyledons:*** at the ground level. 2, opposite, thick, non-photosynthetic. isomorphic. sessile, blade 2.5-3 x 1-1.5 cm, 2-3 mm thtck, flat, asymmetric. roughly elliptic-oblong, attached to the stem by upper proximal margin. ***Leaves:*** alternate. scale leaves caducous. foliar ones simple. petioles 3.5 mm long, with 2 narrow appendages at the tip, blade 6-9.5 x 3-4 cm. elliptic-obovate or oblanceolate. base acute, very narrow. tip acuminate. margin slightly wavy. lateral nerves 6-7 pairs, intercostae reticulate; glabrous.

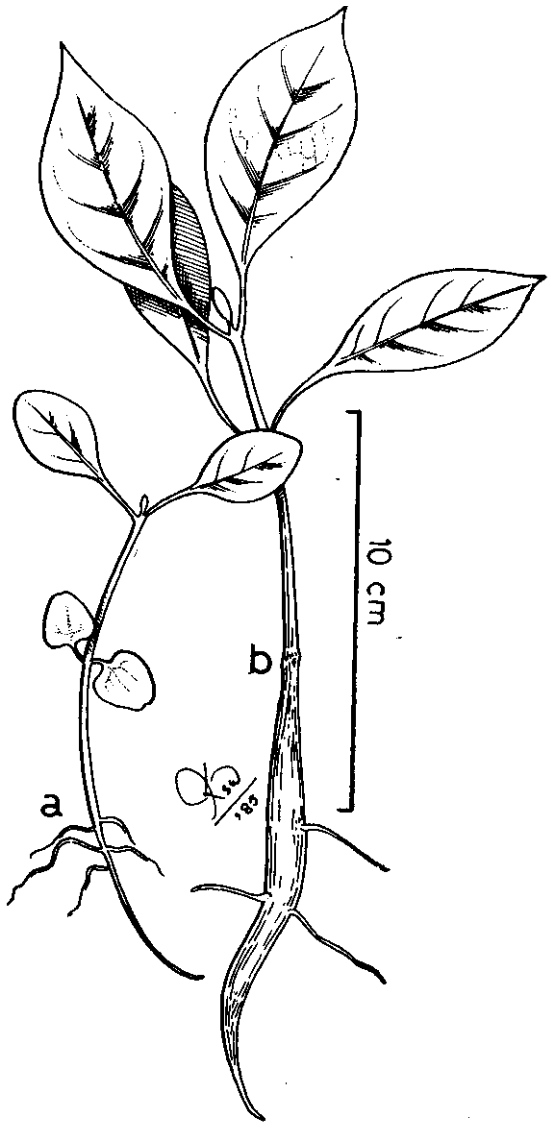
Common in the evergreen and semievergreen forests up to 500m.



Hopea ponga (Dennst.) Mabb. Syn.: ***H. wightiana*** wall. -Malayalam: Ila-ponhu (Fam.: Dipterocarpaceae).

Seedlings: erect ***Primary root:*** 2-2 5 rnm thick, slightly thicker than the stem. ***Hypocotyl:*** 2-2.5-3) cm long, 1 1.4 mm thick. Epicotyl: 3-4 cm long, 1 mm thick. thinner than the tap root and hypocotyl. glabrous. ***Upper internodes:*** 0.5-1.5 cm long pubescent. *Cotyledons:* well above the ground level, 2. opposite, isomorphic, non-foliar. thick. petioles 6-8 mm long, blade 8-10 x 4-5 mm, deeply 2-lobed and appearing subreniform. ***Leaves:*** foliar. alternate. bifarious, petioles 1-3 mm long. pubescent. blade 4-8 x 1.5-2.5 cm. basal leaves more ovate. upper ones gradually changing to lanceolate. base cordate or round, tip obtuse in the cordate ones. acuminate in the lanceolate ones. margin entire. lateral nerves 5-6 pairs, looping intramarginally (visible beneath), intercostae reticulate; glabrous.

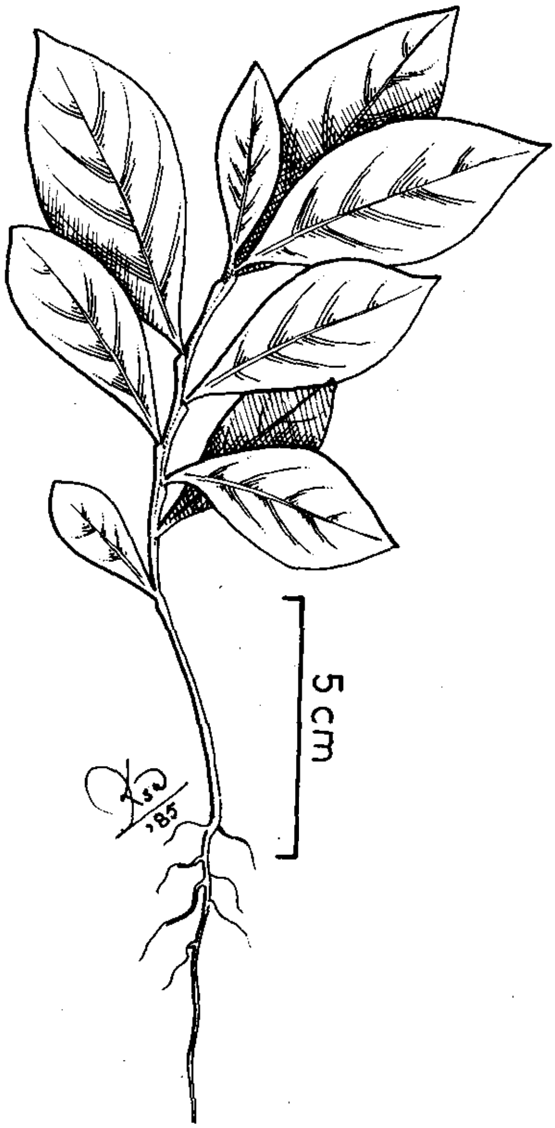
Common in evergreen and semievergreen forests up to 450 m.



Hymenodictyon *orixense* (Roxb.) Mabb. ***Syn.:*** *H.* ***excelsum*** (Roxb.) Wall. -Malayalam: Ilam-chekka. Perum-tholi (Fam.: Rubiaceae).

Seedlings: erect. flimsy. ***Roots:*** primary root white, rudimentary when young. later thickening considerably (-1 cm). *Hypocotyl:* 3-3.5 cm long, 1-2 mm thick, later thickening considerably as the root (-1 cm). ***Epicotyl:*** 4-4.5 cm long, 1-2 mm thick, greenish white. ***Upper internodes:*** 2-2.5 cm long, puberulous. ***Cotyledons:*** well above the ground. 2. opposite, thin, foliar. green, isomorphic, perioles 5-6 mm long. blade 12-15 x 10-12 mrn. ovate. base sub-truncate, tip retuse. margin entire. ***Leaves:*** foliar. opposite, decussate. stipules interpetiolar, triangular, petioles 10-12 mm long in the first 1-2 pairs. -20mm in upper ones. blade 20-30 x 12-15 mm in the first 1-2 pairs. 50-80 x 20-35. mrn in upper ones. elliptic-ovate. base cuneate or attentuate. tip obtuse in the lower ones. acuminate in upper ones, margin entire, lateral nerves 2-3(-5) pairs, intercostae subparallel or subreticulate: glabrous.

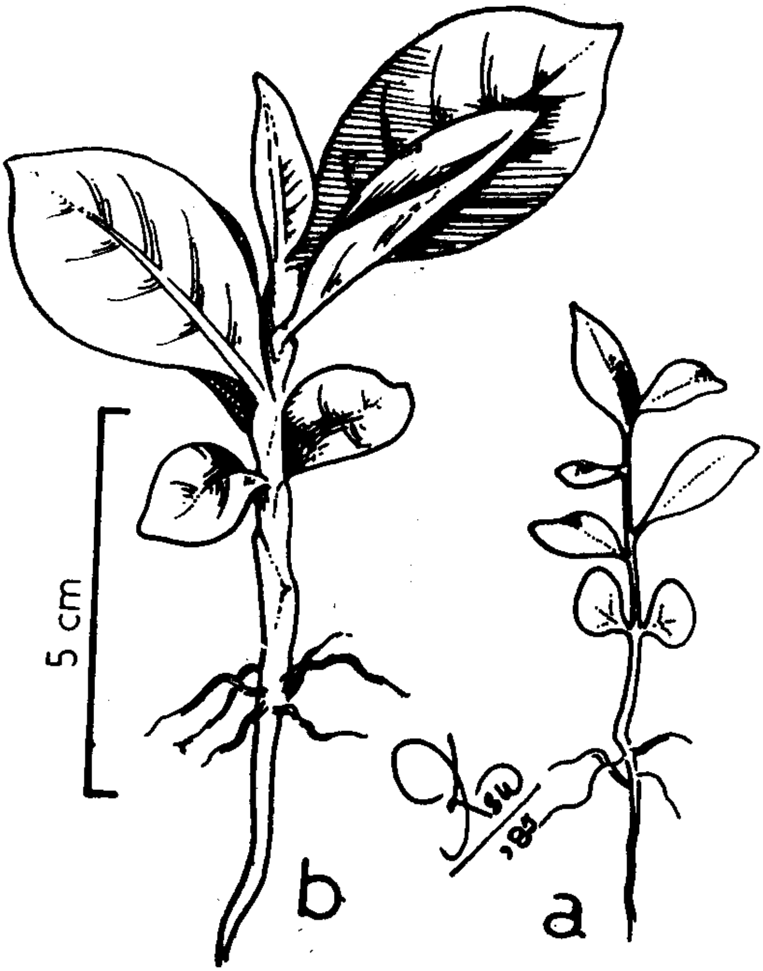
Common in the moist deciduous forests: regeneration fairly good.



Lagerstroemia microcarpa Wt. ***Syn.:** L. **lanceolata*** Wall. ex carke - Malayalam : Venthekku (Fam.: Lythraceae)

Seedlings: erect. young ones not seen. *Roots:* primary root straight. thin. ***Hypocotyl:*** 8-10 mm long. ***Upper** internodes* 6-10 mm long. winged from the base of the petioles. ***Cotydedons:*** not seen. ***Leaves:*** foliar. spiral, yellowish green. simple. sessile, or petioles 1.5-2 mm long, blade *3-6* x 1.5-2 cm. elliptic or obovate. base attenuate, tip in lower leaves obtuse. in upper ones acuminate. margin entire, lateral nerves 3-5 pairs, intercostae subparallel: glabrous.

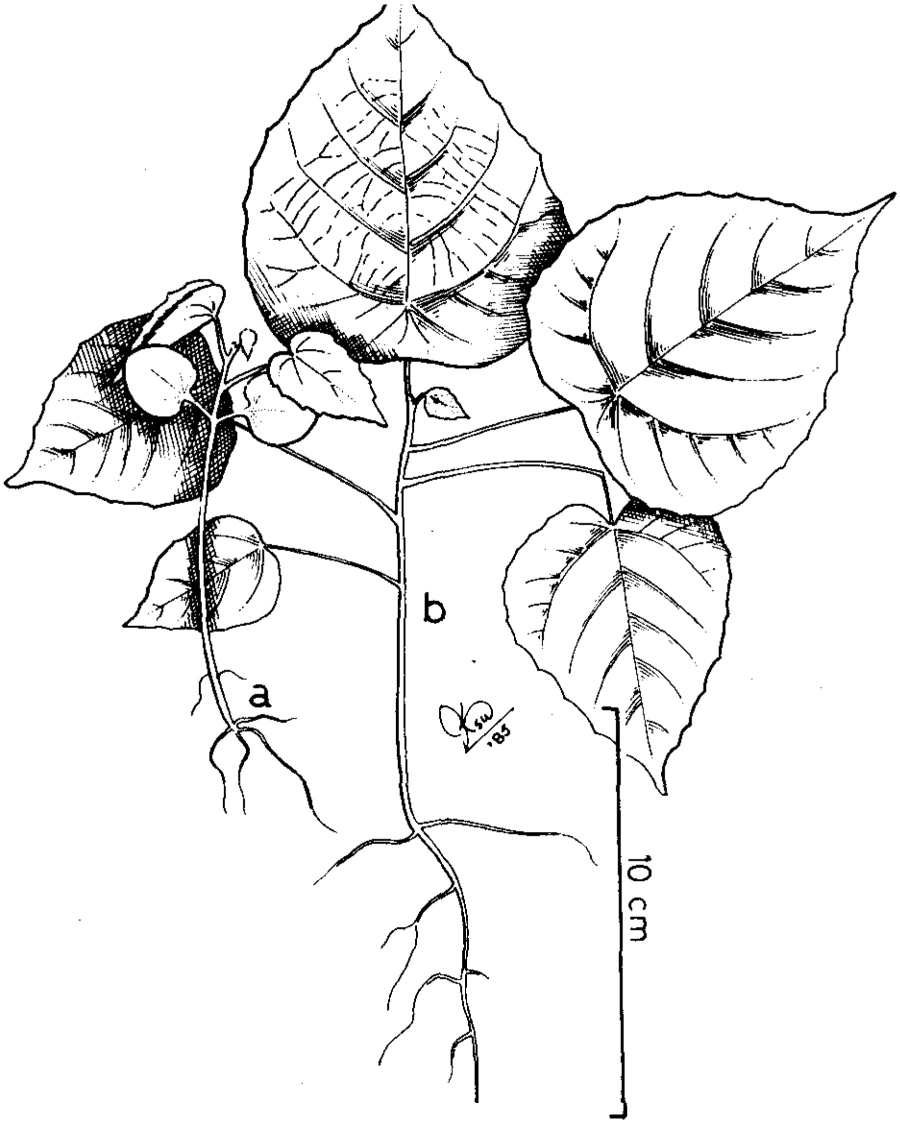
Common in moist deciduous forests, less so in the semievergreens. Regeneration very poor: in disturbed areas saplings very few compared to the mature trees.



Lagerstroemia reginae Retr. - Malayalam : Manimaruthu (Fam : Lythraceae).

Seedlings: erect. *Roofs:* primary root very flexuous, white. *Hypocotyl;* 1-2 cm long, in older seedlings obscurely 4-angular. *Epycotyl:* 3-6 mm long. ***Upper internodes:*** 8-10 mm long. Cotyledons: ahove the ground level. *2.* opposite, thin, foliar. isomorphic. petioles 1-2 mm long, blade obreniform or obcordate. base cuneate, tip emarginate. ***Leaves:*** foliar. alternate, simple. stipules small, blade of lower leaves 7-18 x 4-12 mm. elliptic. later ones 3-6 x 1-3 cm. obovate. base acute, tip acuminate. margin entire, lateral nerves 4-6(-7) pairs; glabrous.

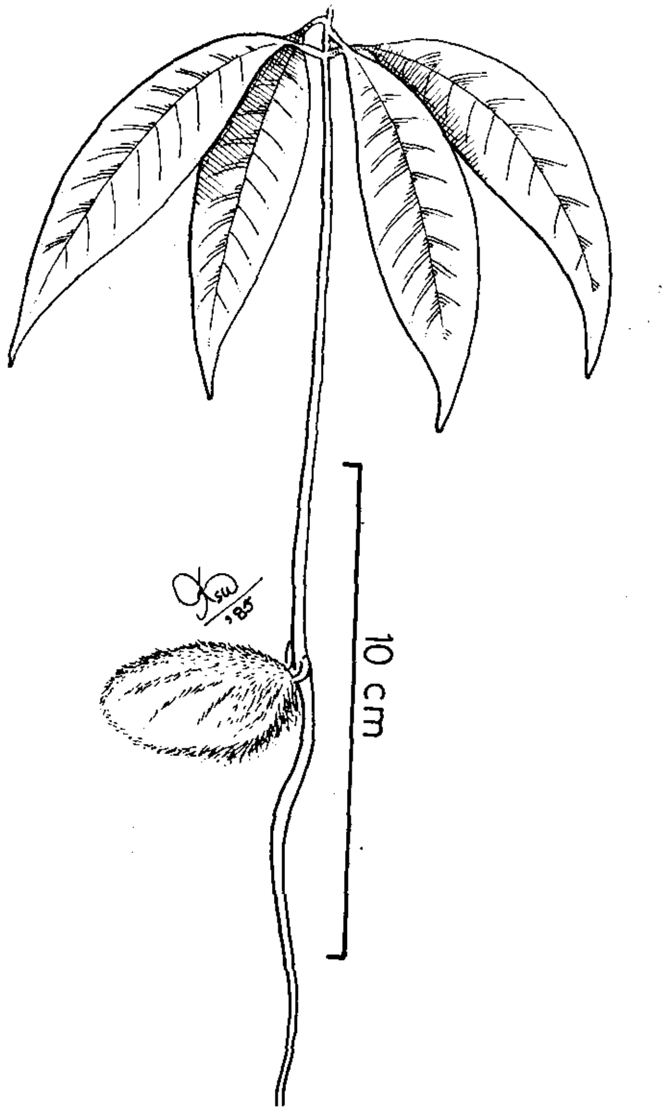
Occurs in semievergreen and swamp forests.



Macaranga peltata (Roxb.) Muell. -Malayalam: Uppila, Vatta (Fam.: Euphorbiaceae)

Seedlings: erect. ***Roots:*** primary root thin, 3-4. lateral roots from the base of the hypocotyl as strong as the primary root. ***Hypocotyl:*** 6-7 cm long, 1-1.5 mm thick, slightly red tinged. often producing a few lateral roots. *Epicotyl:* 2-5 mm long. pubescent. ***Upper internodes:*** 1-1.5cm long. pubescent, circular gland-dotted. Cotyledons: well above the ground. 2. opposite, thin, foliar. green. petioles 6-8mm long. puberulent, blade ovate, 14-16 x 12-15 mm. tip obtuse. base truncate. margin entire, ciliate. 3-5 nerved from the base, midrib with 1-3 pairs of lateral nerves. nerves puberulent below. ***Leaves:*** foliar, spiral. simple. petioles 12-30 mm long in lower ones, 40-60 mm in upper ones. subcylindric. blade 30-40*x* 18-28 mm in lower ones, 60.100 *x* 45-80 mm in later ones. ovate. base cordate in the first few. peltate in upper ones. tip acuminate in the first few. subcaudate in the upper ones, nerves 3-5, arising from the base. in peltate leaves 5-7. midrib with 3-4 pairs of lateral nerves, intercostae scalariform. scabrous above, underneath' scabrous along the nerves and circular gland-dotted.

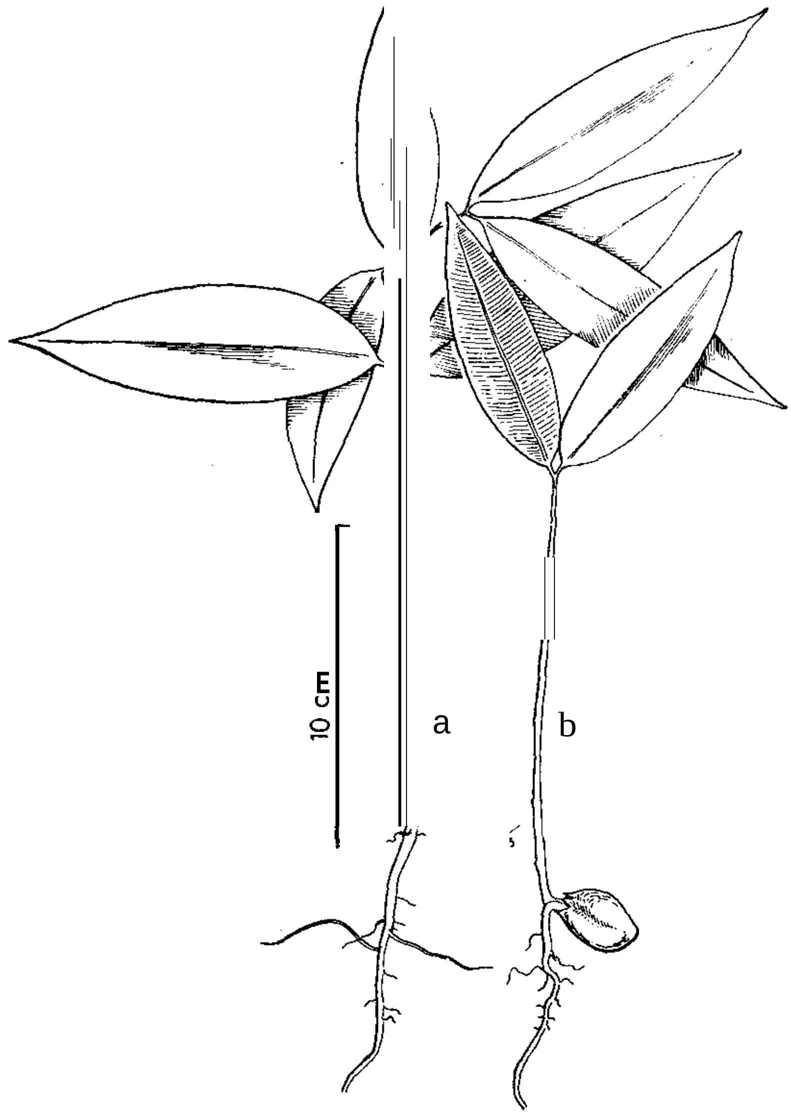
Occurs in disturbed areas of evergreen, semievergreen and moist deciduous forests.



Mangifera indica Linn: Malayalam: Mavu (Fam.: Anacardiaceae)

Seedlings: erect. ***Roots:*** primary root straight, lateral roots many ***Hypocotyl:*** 1.5-2 cm long, 2-2.5 mm thick. glabrous. **Epicotyl:** 13-15 cm long. glabrous. ***Upper internodes:*** *0.5-2* cm long. ***Cotyedons:*** almost at the ground level. *2.* opposite. thick. non-foliar. petioles 4-5 mm long. blades of the 2 cotyledons closely adpressed and held together to one side. not emerging from the drupe, conforming to the shape of the drupe. drupe 3-4 x 2-2.5 cm. 1.5 cm thick, oblong-subreniform. surface fibrous. ***Leaves:*** foliar. first 1-2 pairs opposite, upper ones alternate. simple. petioles 5-6 mm long, blade 7-14 x 2-4 cm, oblong-lanceolate. base acute, tip acuminate. margin entire. lateral nerves 8-12 pairs; glabrous.

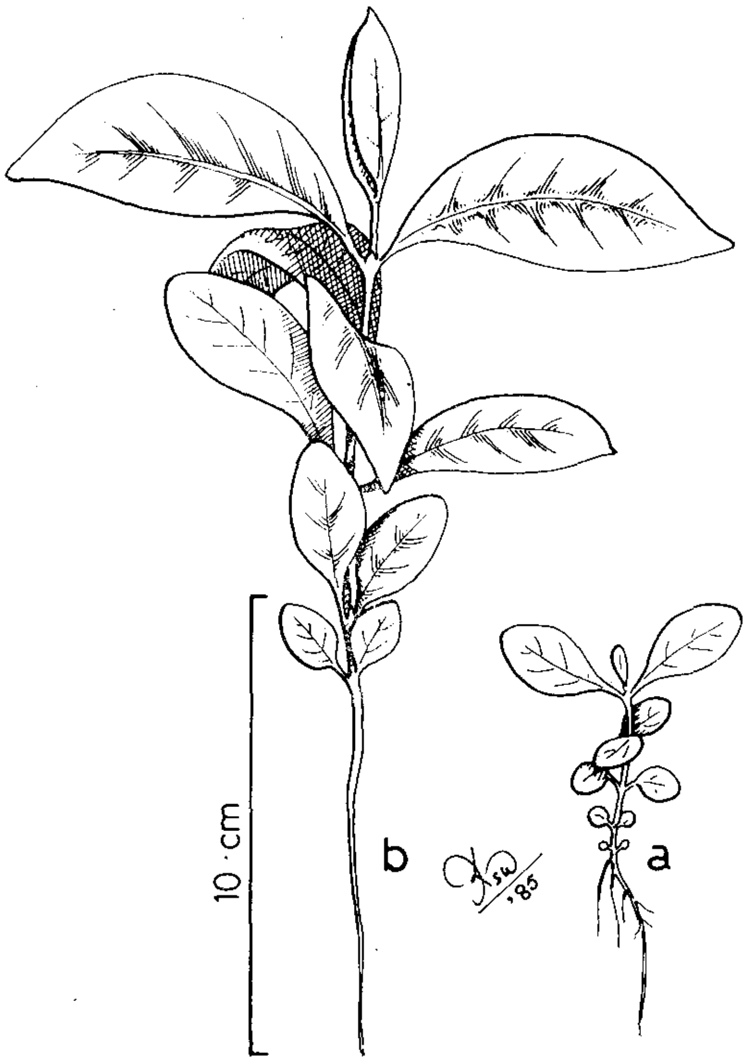
Rare in the evergreens but fairly common in semievergreens up to 1.200 m. Regeneration fairly high; large swarms of seedlings are found around the mother trees.



Mesua nagassarium (Burm. f.) Kosterm. Malayalam: Nangu (Fam.: Clusiaceae).

Seedlings.7: erect. ***Roots:*** primary root brown, flexuous. ***Hypocotyl:*** absent or 2-3 m mlong. ***Epicotyl:*** 2-5(-15) mm long, pink tinged: first few leaves reduced to scales so as to make a pseudoepicotyl of 10-17 cm in length. ***Cotyledons:*** at the ground level. 2. opposite. thick, nonfoliar. nonphotosynthetic. petioles 3-4 mm long. biades of the two cotyledons closely adpressed and held together to one side. planoconvex. not emerging from the seed coat, together conforming to the shape of the saed, seed 20-25 x 15-20 mm. ellipsoid. ***Leaves:*** basal 8-10 reduced to scales, a few lower scales alternate, upper ones opposite, foliar leaves opposite. petioies 3-5 mm long. blade 9-12 x 2.5-3.5 cm. elliptic-lanceolate. base obtuse, tip acuminate, margin entire, lateral nerves numerous. thin, parallel: glabrous. under surface cinnarnomeous pellucid-punctate: young leaves copper red. drooping.

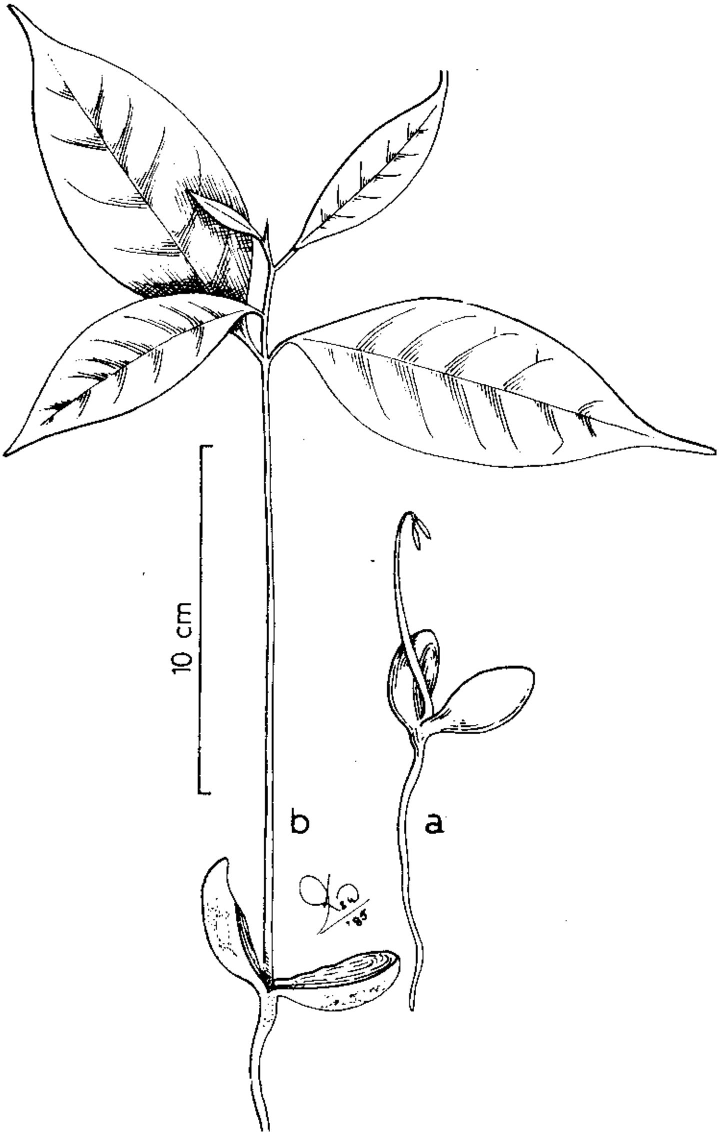
Common in the evergreen foresrs up *to* 1.200 m.regeneration poor although seeding is very profuse.



Mitragyna parvifolia (Roxb.) Korth. *Syn.:* ***Stepliygyne*** *parvifolia* Roxb. -Malayalam: Neer-Kadambu. Vimba (Fam.: Rubiaceae).

Seedlings: erect, fragile. ***Roots:***white, primary root often associated with 1 or 2 strong lateral roots at the base of the hypocotyl. ***Hypocotyl:*** 2-3mm long 1 mm thick. ***EpicotyI:*** 3-5 mm long. ***Upper internodes:*** 10-15 mm long, up to. 25 mm in older seedlings. ***Cotyledons:*** above the ground, 2. opposite, thin. foliar. green. petioles 1 mm long. blade 1-2 mm across, suborbicular. ***Leaves:*** foliar, opposite decussate. stipules interpetiolar. narrowly ovate, petioles 4-10 mm long in lower ones, up to 12 mm long in upper ones, blade 0.5-1.5 x 0.4-08. mm in the first 3-4 pairs, 30-70 x 15-25(-30) mm in upper ones, lower ones ovate. upper ones elliptic-lanceolate. base attenuate in upper ones. tip obtuse or obtusely acute, margin entire, lateral nerves 4-7 pairs; glabrous.

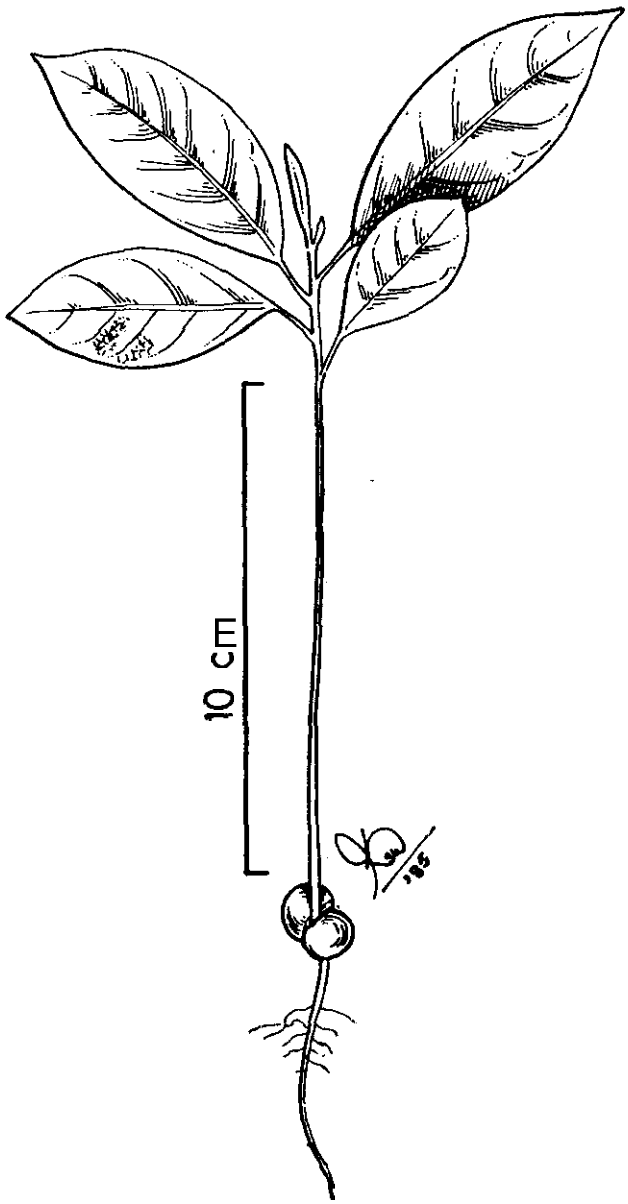
Found in dry deciduous, moist deciduous and semievergreen forests.



Palaquium ellipticum (Dalz.) Baill. -Malaylam: Pali (Farn.: Sapotaceae).

Seedlings: erect. very yong ones pink tinged; latex milky white. *Roots:* tap root flexuous. ***Hypocotyl:*** 4-5 rnm long. 3-4 rnm thick. ***Epicotyl:*** 15-25 cm long. *2-3* mm thick. ***Upper internodes:*** 1-1.5 cm long. ***Cotyledons:*** slightly above the ground, 2, opposite, thick, nonphotosynthetic. pink tinged. isomorphic. petiole 3-4 mm long, blade 30-35 x 19-20 m m 7-10 rnm thick, planoconvex. elliptic-ovate, base obtuse, tip obtuse. ***Leaves:*** foliar, first pair opposite, upper ones alternate, petioles 8-10 mm long, blade 9-12.5 x 3.5-4.6cm. elliptic, base attenuate, tip acuminate, margin entire, lateral nerves 5-7 pairs, intercostae reticulate; glabrous.

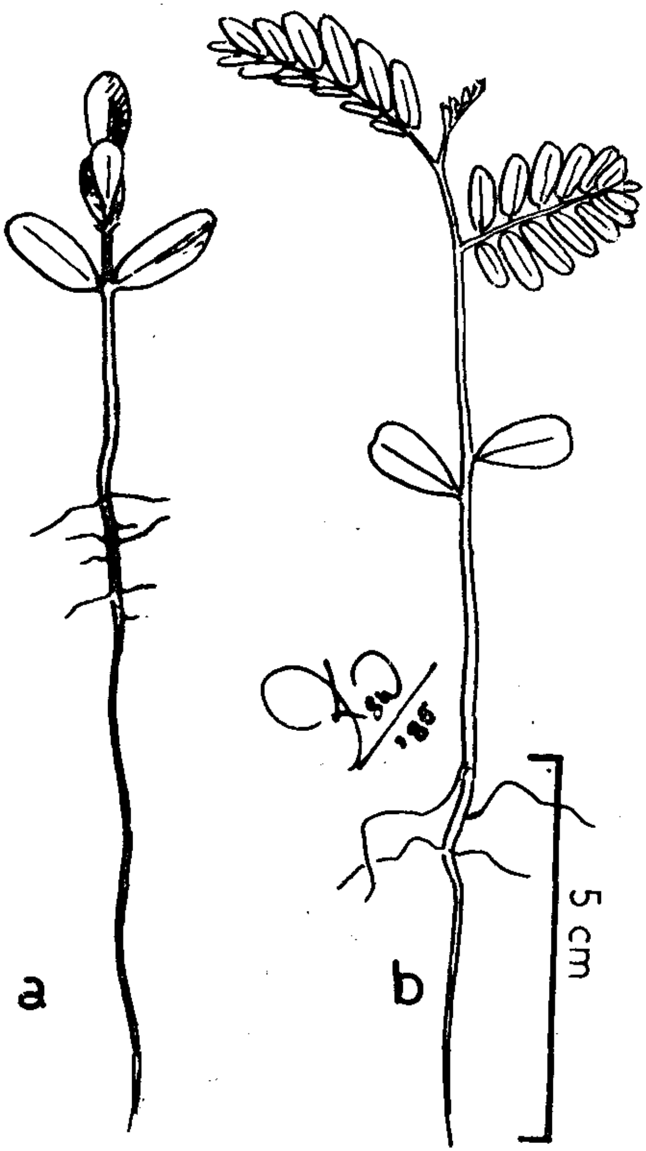
Confined to the evergreen forests between 300-1.200 m; although regeneration is profuse seedlings do not grow more than one meter in height unless optimum light is available.



Persea macrantha (Nees) Kosterm. *Syn: Machilus* ***macrantha*** Nees-Malayalam: Kulamavu (Fam.: Lauraceae)

Seedlings: erect. ***Roots:*** primary root flexuous. lateral roots a few. ***Hypocotyl:*** absent. ***Epicotyl:*** 4-5 mm long: first 6-7 leaves reduced to scales so as to make a pseudoepicotyl of 10-12 cm length. ***Upper*** *internodes:* 0.5-1.5 cm long, glabrous. ***Cotyledons:*** at the ground levei. *2.* opposite. thick. nonfoliar. sessile, 1 x 1 cm. hemispherical, holding the stem in between. ***Leaves:*** alternate. scale leaves inconspicuous, petiole of the foliar leaves 10-13 mm long. blade 4-7 x *2-3* cm. elliptic, base acute. tip acuminate, margin entire,lateral nerves 4-6 pairs. intercostae reticulate; glabrous.

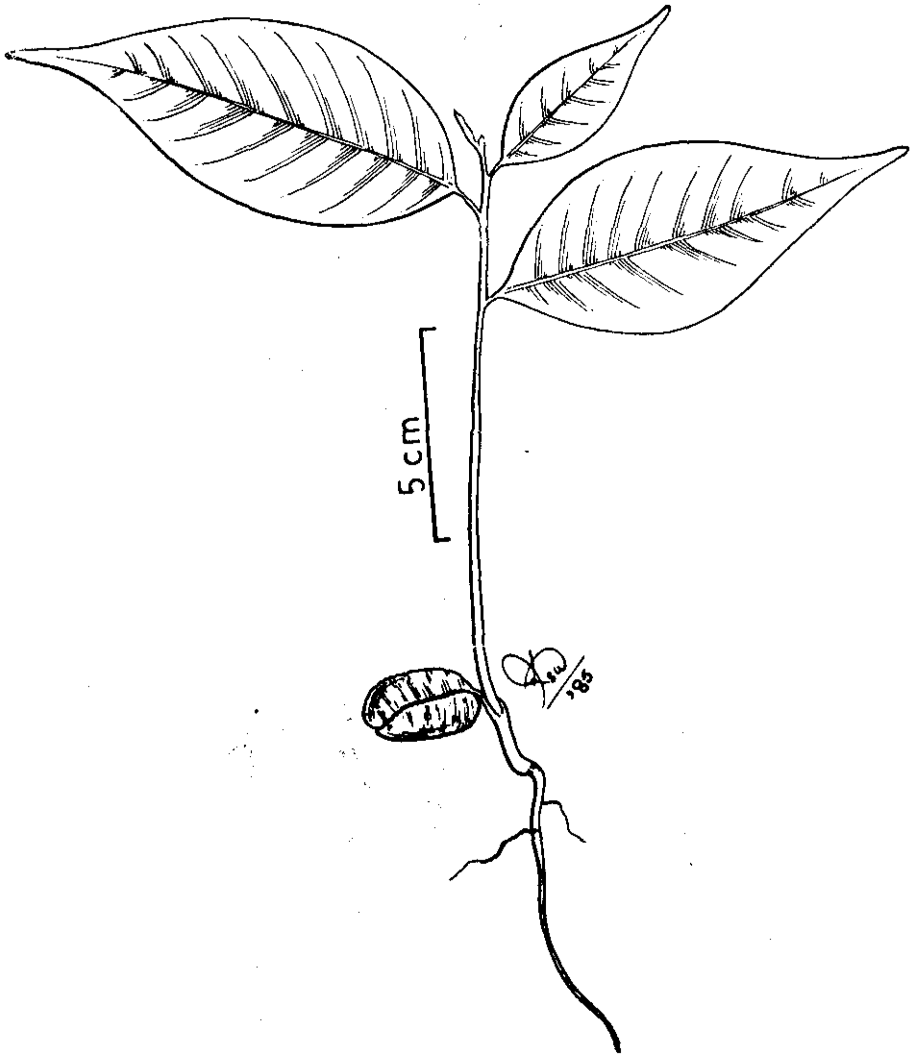
Common in the evergreen and semievergreen forests up to ***ca.*** 2,000 m: rarely encountered in moist deciduous forests.



Phyllanthus emblica Linn. *Syn.:* ***Emblica officinalis*** Gaerr. -Malayalam: Nelli (Fam.: Euphorbiaceae).

Seedlings: erect. ***Roots*** primary root white, flexuous. ***Hypocotyl:*** *2-5* cm long, reddish. ***Epicotyl:*** 8-15 mm long. ***Upper intemodes:*** 3-5 mm long. ***Cotyledons:*** well above the ground level. 2. opposite. thin, foliar, green, isomorphic. petiole *ca.* 1 mm long. red. blade oblong. 12-20 x 5-8 mm. base obtuse, tip obtuse or obliquely sub-truncate. ***Leaves:*** 8-12. foliar. stipulate. basal 3-5 leaves spiral, 8-12 x 5-7 mm obcordiform-oblong, base cuneate. tip emarginate, upper leaves alternate and bifarious on short branches. appearing like compound leaves, 4-12 x 1-3 mm. oblong. base round. tip obtuse. margin entire. glabrous.

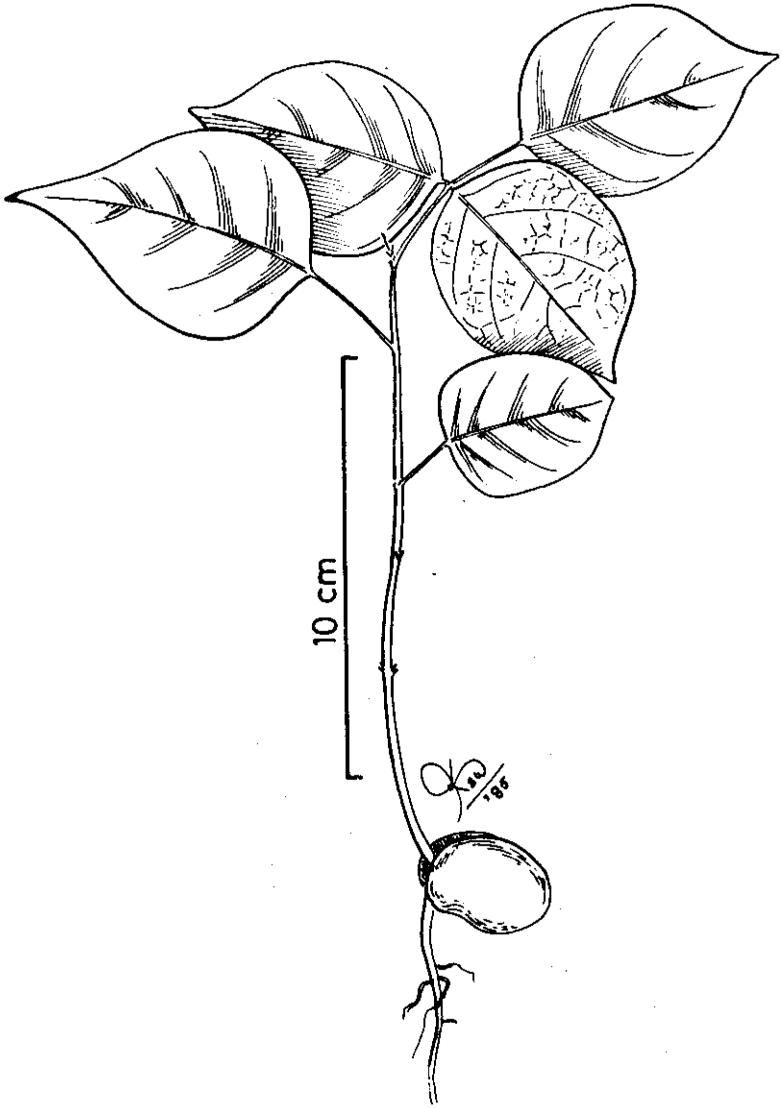
Common in dry and moist deciduous forests.



Polyalthia fragrans (Dalr.) Bedd. -Malayalam: Nedunaru (Fam.: Annonaceae).

Seedlings: erect. ***Roots:*** primary root 2-2.5 mm thick, straight ***Hypocotyl:*** 1-1.5 cm long. 2-3 mm thick, glabrous. ***Epicotyl:*** 9-10 cm long. 1-2 mm thick, thinner than the hypocotyl. puberulent. ***Upper internodes:*** 1-2 cm long. puberulent. ***Cotyedons:*** slightly above the ground level, 2. opposite. thick. non-photosynthetic. petioles 5-7 mm long, blades planoconvex. the two cotyledons closely adpressed and held together to one side. not emerging from the seed, the two together 2-2.5 x 1.5-1.75 cm, cylindric. surface with transverse striations. ***Leaves:*** foliar. alternate, petioles 4-5 mm long, puberulent. blade 10-12 x 4-5 cm. elliptic-lanceolate. base obtuse. tip acuminate. margin entire. lateral nerves 8-11 pairs, intercostae subparallel. glabrous.

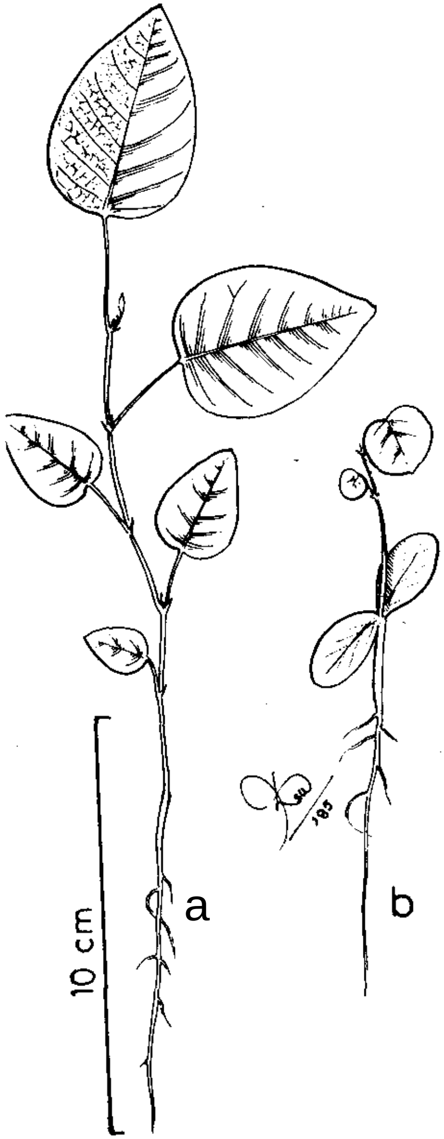
Very common in the evergreen and semievergreen forests up to 1,200 m; the species shows good regeneration in evergreen forests.



Pongamia pinnata (Linn.) Pierre. **Syn.:** ***P. glabra*** Vent. -Malayalam: Pongu. Ungu (Fam.: Fabaceae).

Seedlings: erect. ***Roots*** primary root 3 mm thick. ***Hyocotyl:*** white. 10-13 mm long, 0.5 mm thick. *Hypocotyl:* 4-4.5 cm long: leaves of the first 4-5 nodes reduced to scales so as to make a pseudoepicotyl of 10-17 cm length. ***Upper internodes:*** 3-4 cm long, glabrous, ***Cotyledons:*** at the gound level, 2. opposite, thick, non-foliar. non-photosynthetic, sessile, 25-30 x 18-22 mm. 4-5 mm thick, flat, reniform. not spreading, clasping the stem in between. ***Leaves*** scale leaves 3-4. first pair often opposite. upper scale leaves and foliar leaves alternate, first 2-3 foliar leaves simple, petiolate. petioles 10-17 mm long, blade 4-8 x 3.5-5 cm. ovate, base subtruncate or obtuse. tip acute or acuminate. margin entire, lateral nerves 4-5 pairs, glabrous. upper foliar leaves 3-foliolate. rachis 4-5 cm long, petiolules very short. leaflet blade 6-7 X 4.5-5.5 cm. ovate, base obtuse, tip acuminate. otherwise similar to lower leaves.

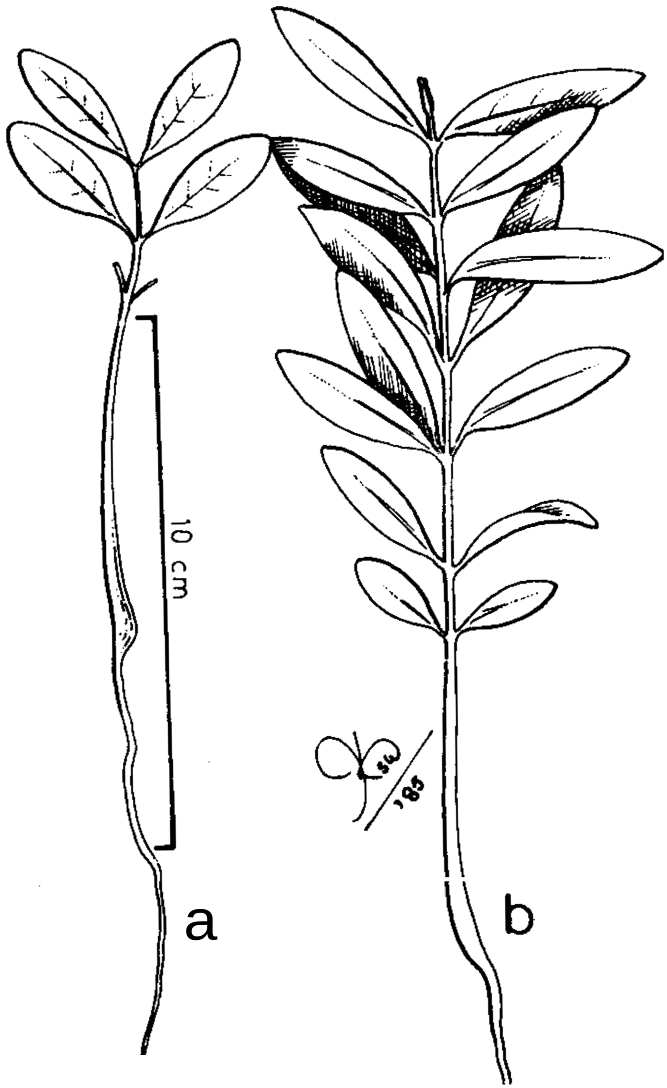
Occurs in evergreen and semievergreen forests but mostly confined to river banks; regeneration fairly high.



Pterocarpus marsupium Roxb. -Malayalam: Vengha ((Fam.: Fabaceae).

Seedlings: erect ***Roots:*** with nodules, primary root thin. ***Hypocotyl*** 5-10 mm long, 2-5 mm thick. thicker than the epicotyl and roots. ***Epicotyl:*** 10-15 mm long, 1 mm thick. ***Upper internodes:*** 2-2.5(-3) cm long. ***Cotyledons:*** well above the ground, 2, opposite, thin, foliar. green. petioles 1-2 mm long. blade 25-28 x 12-17 mm. elliptic. oval, base of the two halves dissimilar. tip obtuse to round, margin entire. ***Leaves:*** foliar. alternate. stipulate. first 5-6 leaves I-foliolate, rachis 5-25 mm long, petiolule 1-1.5 mm long. blade 10-55 X 10-45 mm. ovate, base obtuse or cordate, tip obtusely acute and mucronate. margin entire, lateral nerves 4-5(-6) pairs, glabrous above, scabrous below, later leaves gradually 3-4-7 foliolate, rachis 38-87 mm long. leaflets alternate, petiolules 2.5 mm long. blade of the terminal leaflet 62-87 x 35-62. lateral leaflets 37-70 x 25-55 mm, elliptic. ovate. base round. tip acute. round or retuse and rnucronate. other features similar to unifoliolate leaves.

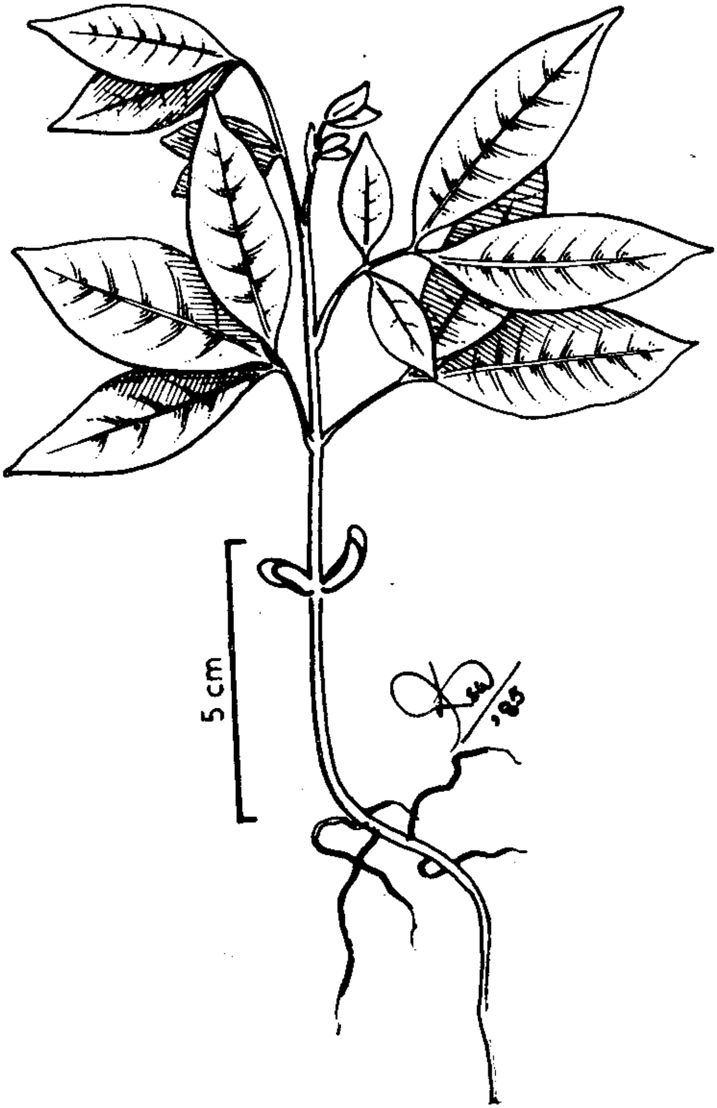
Very common in dry and moist deciduous forests and occasional in semi-evergreens up to 1.300 m.



Santalum album Linn - Malayalam: Chandanam (Fam.: Santalaceae)

Seedlings: erect. ***Roots:*** primary root 1-2 mm thick, tapering. *Hypocotyl:* 50-60 mm long, 2.5 mm thick, basally swollen into a 3-4 mm thick fusiform collet. *Epicotyl:* 10-15(-25)mm long, 0.75 mm thick, glabrous. ***Upper inter-*** nodes: 10-20 mm long. ***Leaves:*** foliar, opposite, simple, exstipulate. petioles 2-4 mm long, blade narrowly elliptic. 25-45(-55) x (8-)lo-14 mm. base acute, tip acute or obtuse. margin entire. lateral nerves 6-7(-8) pairs; glabrous.

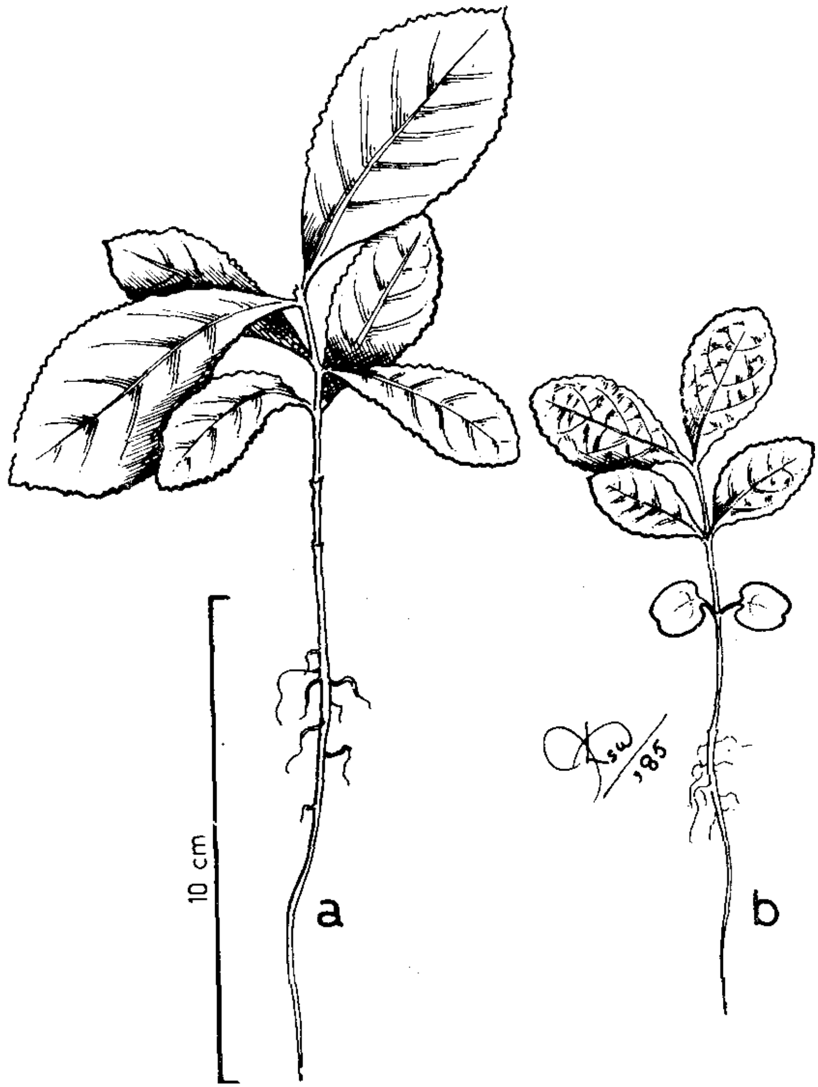
Sporadic in the dry deciduous forests of Kerala; fairly common at Marayur.



Schleichera oleosa (Lour.) Oken. ***Syn:*** *S.* ***trijuga*** Willd. - Malayalam: Poovam (Fam.: Sapindaceae).

Seedlings: erect. ***Roots:*** primary root 1.5-2 mm thick. flexuous, lateral roots many. *Hypocoty/:* 3-3.5 cm long. *Epicotyl:* 2-3 cm long. 2 mm thick, slightly thicker than the roots. ***Upper internodes*** 1-1.5 cm long. puberulent. *Cotyledons:* well above the ground, 2. cpposite. thick. green. isomorphic and slightly dissimilar in size. petioles 1-1.5mm long. blade 1.5-2 X 0.5cm. oblong. planoconvex. base truncate or sagittiform. tip round. ***Leaves:*** foliar, paripinnate, first pair opposite. 3-foliolate, rarely 2-foliolate, rachis 10-12 mm long, petiolules 1-1.5 mm long, blade 4-4.5 x 1.8-2 cm. elliptic. obtusely acute, upper leaves 4-foliolate. rachis 2.5-3 cm long, petiolules 1 mm long. blade of lower pair 20-22 x 8-12 mm elliptic. base acute, tip acute. margin entire, lateral nerves 4-5 pairs, glabrous, blade of upper pairs 50-70 x 18-25 mm. narrowly eliiptic, base acute, tip acuminate. margin entire, lateral nerves 7-9 pairs, intercostae reticulate, glabrous.

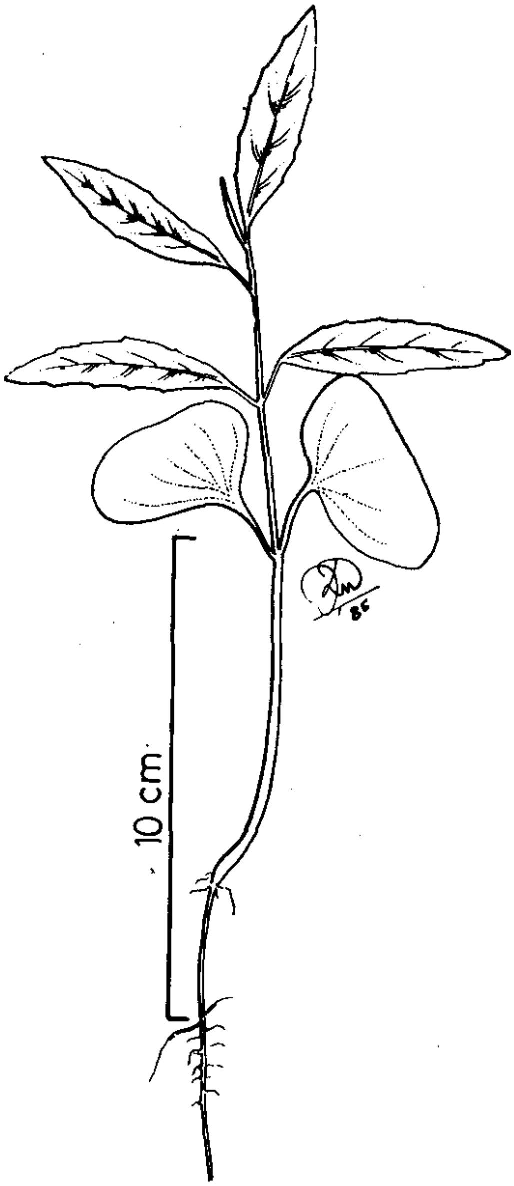
Fairly common in the moist deciduous and semievergreen forests up to 900 m.



Tectona grandis Linn. f. - Malayalam: Thekku (Fam.: Verbenaceae)

Seedlings: erect. ***Roots:*** primary root 1-1.5 mm thick, straight. white. lateral roots present. ***Hypocotyl:*** 2-2.5 cm long. 1-1.5 mm thick, puberulent. ***Epicotyl:*** I .5-2 cm long, pubescent. ***Upper internodes:*** as the hypoctyl: **Cotyledons:** well above the ground, 2. opposite, thin. foliar. green. petioles 4.5 mm long. puberulerit. blade 8-10 X 6-8 mm. ovate. base cordate. tip deeply retuse. margin entire, glabrous. ***Leaves:*** opposite, decussate. petioles obscure. blade of first 2-3 pair of leaves 2.5-3 x 1.8-2 cm. elliptic, base acute, tip obtuse. margin dentate. blade of upper leaves 4–10 x 1.5-4 cm. obovate. base attenuate, tip acute, margin dentate, lateral nerves 4-6 pairs; glabrous or puberulent above. benealh with black punctiform indumenta (observable through a hand lens).

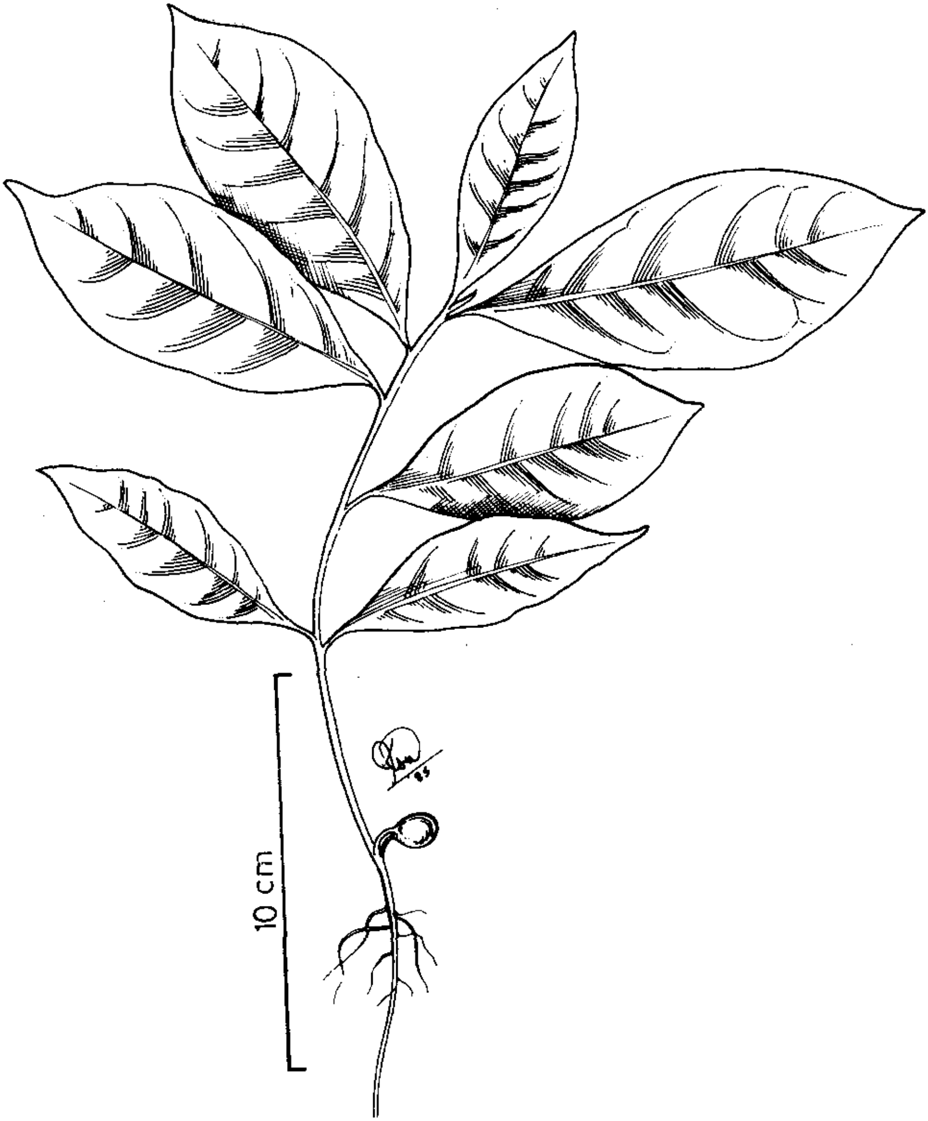
Very common in the moist deciduous forests up to 900m: regeneration is fairly high in undisturbed areas.



Terminalia arjuna Bedd.. (Fam. : Combretaceae).

Seedlings: erect. ***Roots:*** primary root 1-2 mm thick, thinner than the hypocotyl. ***Hyocotyl:*** *6-7* cm long, 2-2.5 mm thick. ***Epicotyl:*** 2-3 cm long, puberulent. ***Cotyledons:*** well above the ground, *2.* opposite. thin, foliar. green, petioles 1.5-1.8 cm long. blade 2-2.3 x 3.5-4.5 cm. broader than long, transversely obtusely traperiform or obreniform. base cuneate or truncate. tip truncate or obscurely emarginate. 5-7 nerved from base. ***Leaves:*** foliar. first pair opposite. upperones alternate, petioles 3-7 mm long.. pubescent, blade 4-7 x 0.7-1.2 mm, bass acute, tip acute, margin obscurely dentate or repand. lateral nerves 5-8 pairs. intercostae reticulate; glabrous.

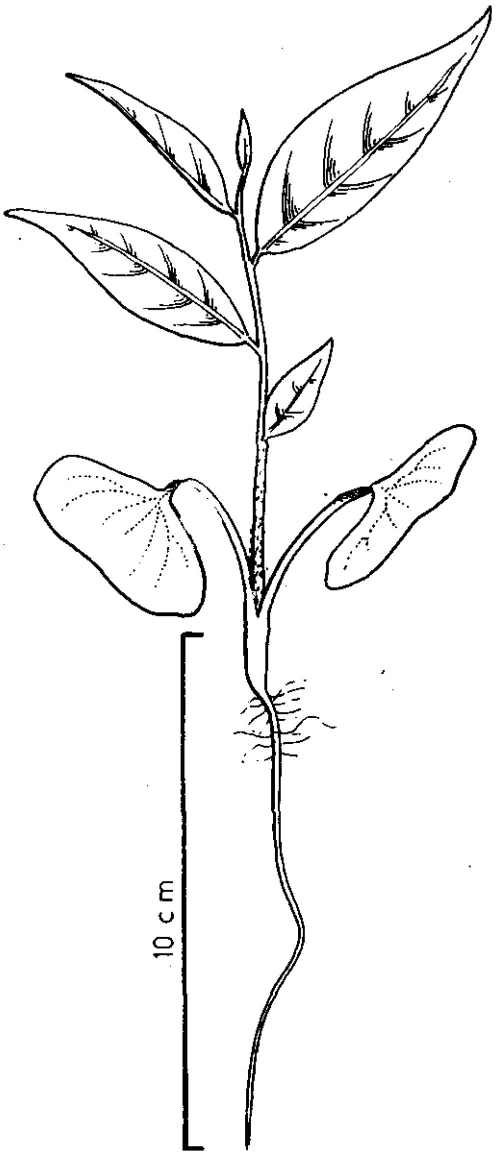
Occurs in drier areas along river banks.



Terminalia bellirica (Gaert.) Roxb. - Malayalam: Thani (Fam.: Combretaceae).

Seedlings: erect. ***Roots:*** primary root thin. *Hypocotyl:* 2-3 mm long or absent. ***Epicotyl:*** 5-6 cm long. 2.5 mm thick. ***Upper internodes:*** 2 5-3 cm long. shorter than the epicotyl. scabrid. *Cotyledons:* almost at the ground level, 2. thick. petioles 8-10 mm long, blades of the two cotyledons closely folded together and held towards one side, not emerging from the drupe. Leaves first pair opposite or subopposite. upper ones alternate. petioles 3-8 mm long, blade 8-12.5 x 2.5-5(-5.3) cm. elliptic-obovale. base attenuate, tip acuminate. margin entire. lateral nerves *6-7* pairs: glabrous.

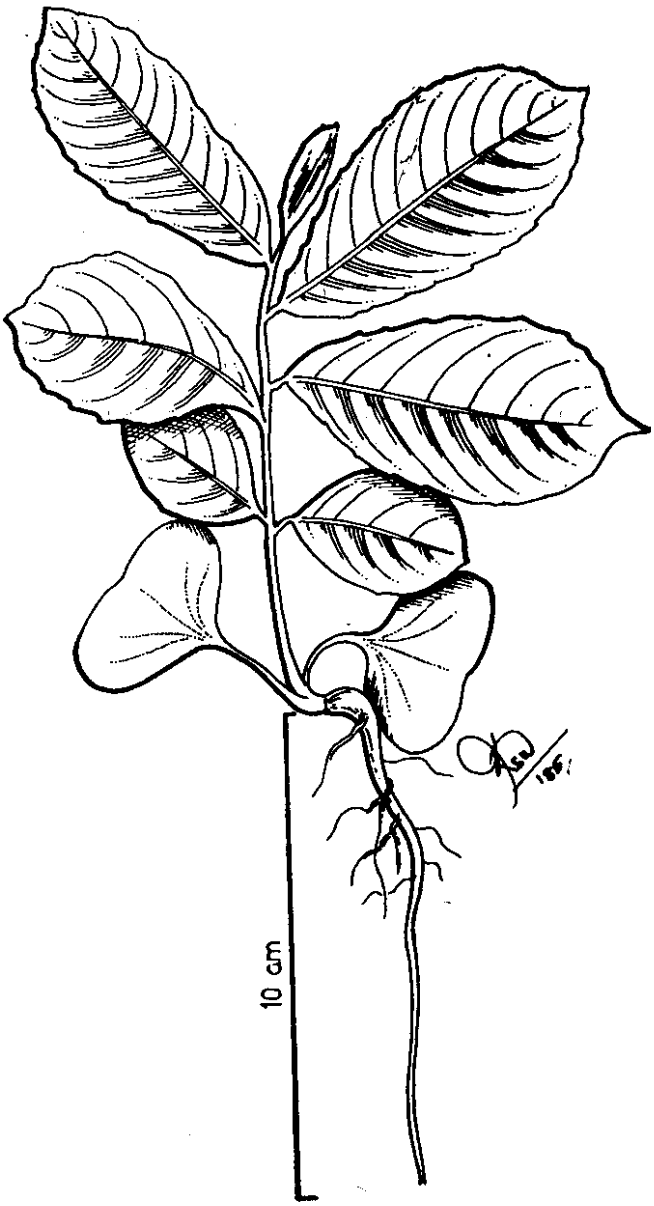
Very common in the moist deciduous forests and rare in semievergreens.



Terminalia chebula Retz. - Malayalam: Kadukka (Fam.: Combretaceae)

Seedlings: erect. *Roots:* primary root yellowish, thinner than the hypocoryl. fiexuous. ***Hypocotyl:*** 7-15 mm long. thicker than the root. slightly compressed. pubescent. ***Epicotyl:*** 2-3 cm long. ***Upper internodes:*** 12-30 mm long. ***Cotyledons:*** slightly above the ground level. 2. opposite, thin. foliar. green. isomorphic. petioles 2.5-3.7 cm long. tomentose. blade 2-2.5 x 3.7-4 cm. broader than long, reniform or obtusely subtrapeziform. base obtuse or subtruncate. tip emarginate. ***Leaves:*** alternate, foliar. petiolate, lowest leaf smallest. upper ones gradually increasing in size, petioles 3-5 mm long, tomentose. blade 2-10 x 1.2-5 cm. ovate, base obtuse. tip acute, margin entire, lateral nerves 4-10 pairs; pubescent.

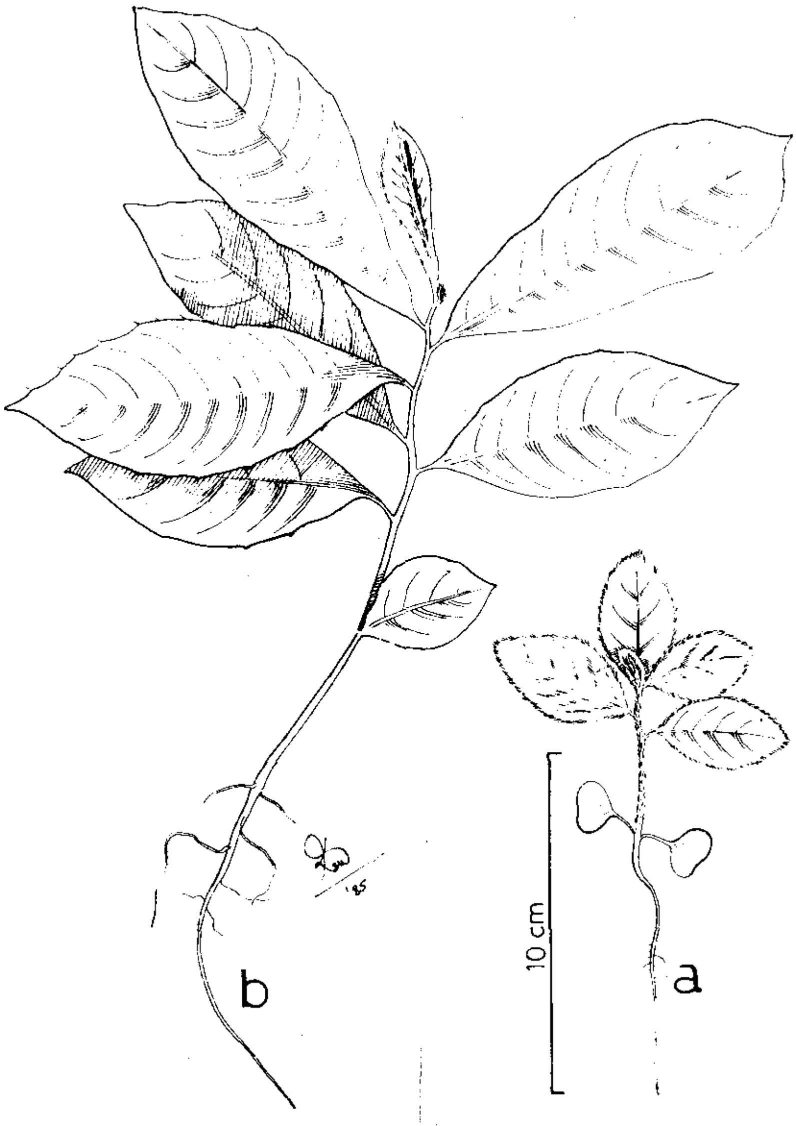
Occurs in dry deciduous forests.



Terminalia crenulata Heyne ex Roth - Malayalam: Kora-maruthu (Fam : Combretaceae)

Seedlings: erect. ***Roots:*** primary root 2.5-3 mm thick. ***Hypocotyl:*** absent. ***Epicotyl:*** 3-4.5 cm long, 1-2 mm thick. puberulent. ***Upper internodes:*** 1-2 cm long, pubescent. ***Cotyledons:*** at the ground level, 2, opposite, thin, foliar. green, petioles 1-2 cm long, blade 3.5-4 x 2-2.5 cm. obreniform, base cuneate, tip emarginate. margin entire. 5-7 nerved from base. ***Leaves*** foliar. first pair opposite, petioles 3-4 mm long. pubescent. blade 2.5-3.5 x 2-2.5 cm, elliptic. base acute, tip obtuse, margin obscurely entire. ciliate. lateral nerves 3-4 pairs. upper leaves alternate. blade 6-8 x 3-4 cm. obovate or elliptic-oblong. base acute, tip acuminate, margin serrulate. ciliate, lateral nerves 8-10 pairs. intercostae subscalariform. nerves pubescent.

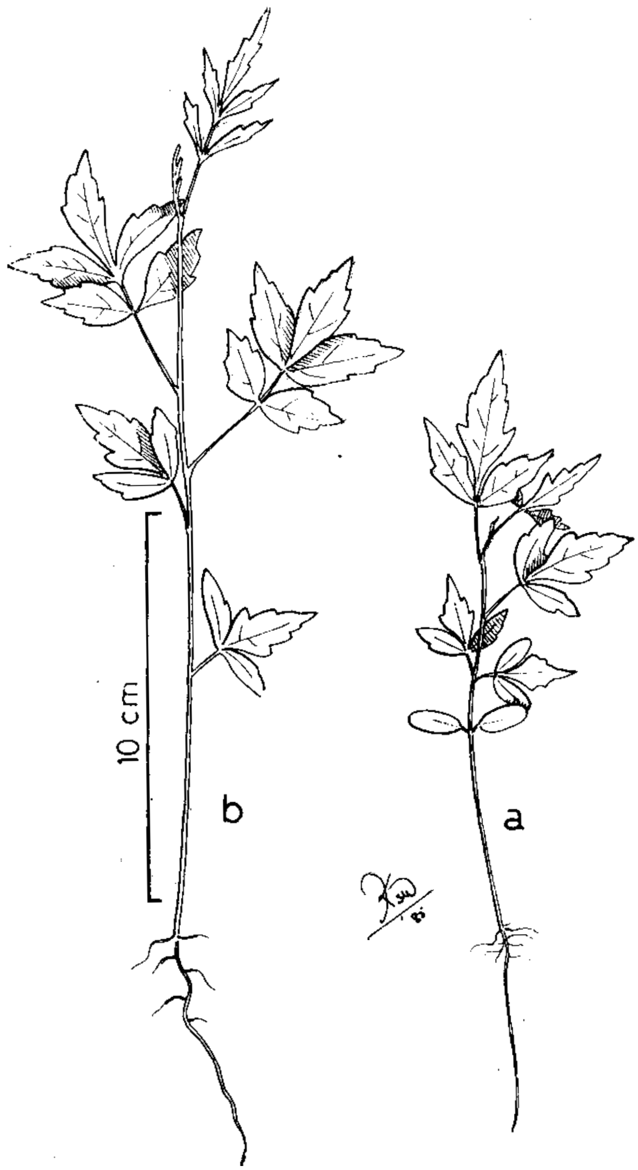
Very common in moist and dry deciduous forests up to 600 m.



Terminalia paniculata Roth - Malayalam: Pilla-maruthu. Poo-maruthu (Fam.: Combretaceae)

Seedlings: erect. ***Roots:*** primary root slightly thicker than the stem, ***Hypocotyl:*** 1-1.5 cm long, sometimes obscure. *Epicotyl:* 2-3 cm long. covered with golden brown hairs. ***Upper internodes:*** 1-1.5 cm long. covered with golden brown hairs. ***Cotyledons:*** above the ground level. 2. opposite. thin, foliar. green, petioles 8-10 mm long, blade 10-12 x 14-17 mm. broader than long. obovate or obcordate. rip emarginate. base cuneate. margin enire 3-5 nerved from base, glabrous. ***Leaves:*** foliar. alternate. sometimes the first pair opposite. petioles 3-6 mm long, covered with golden brown hairs, blade of the first 3-4 leaves 3.5-5.5 x 2-3 cm. elliptic, base acute, tip obtuse. margin obscurely dentate, densely ciliate with golden brown hairs. lateral nerves 4-6 pairs, pubescent along the nerves; blade of upper leaves 8.12 x 4-5 cm. oblanceolate or elliptic. base acute, tip acuminate. lateral nerves 8-10 pairs.

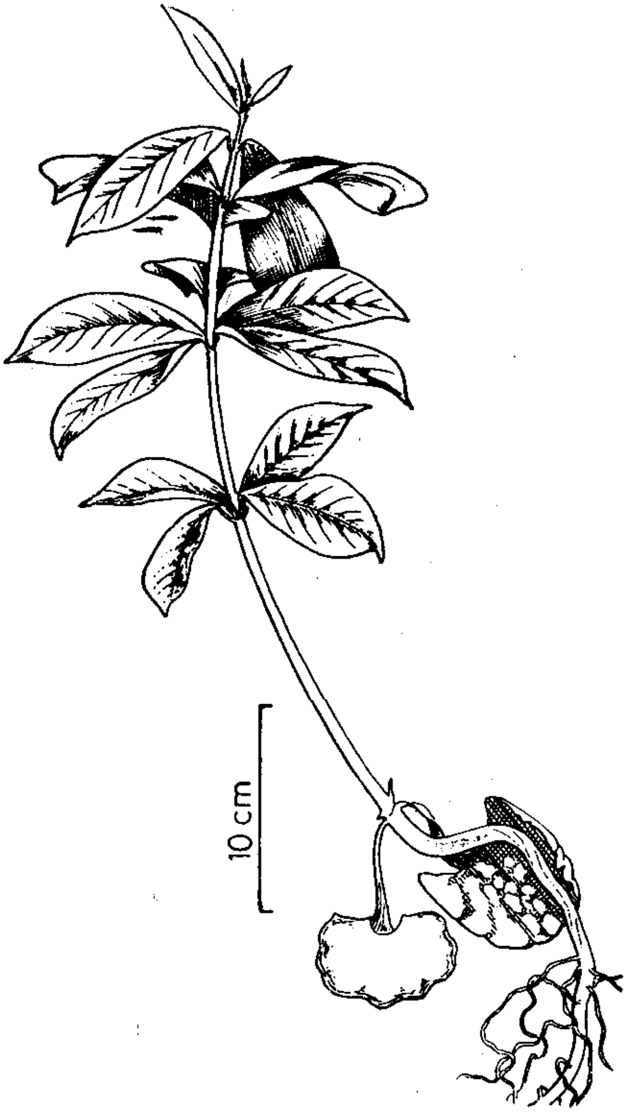
Common in moist and dry deciduous forests and occasional in semievergreens; regeneration fairly moderate.



Toona ciliata Roem *Syn:* ***Cedrela*** **toona** Roxb. ex Rottl. -Malayalarn: Chuvanna-akil (Fam.: Meliaceae).

Seedlings: erect. ***Roots:*** primary root very thin, feeble. Hypocotyl: 4-5 cm long. Epicotyl: 1.5-2 cm long. ***Upper internodes:*** 2-3 cm long, puberuls-ent. ***Cotyledons:*** well above the ground level, *2.* opposite, thin. foliar. green, petiole 2-3 rnm long,. puberulent. blade 10-12 x 5-6 mm elliptic-oblong, base round. tip round. margin entire. ***Leaves:*** foiiar, simply compound. imparipinn-ate. basal pair opposite. upper ones alternate, basal 2-3 leaves2.5-6 x 2.5-3 cm. rachis 7-15 rnrn long.. leaflets 5, opposite. subsessi.le.2-3.5 x 1-1.5 cm. roughly ovate. base acute. tip acute. margin coarsely serrate, lateral. nerves 4-5 pairs, nerves puberulent beneath, glabrous above.

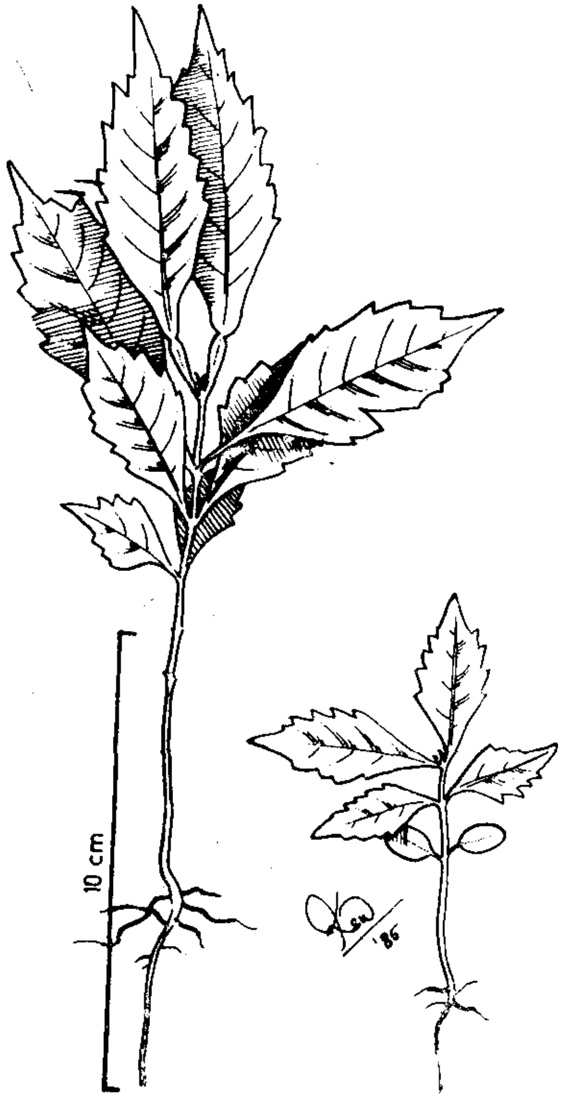
Fairly common in evergreen and semievergreen forests up to 1,800 m



Vateria indica Linn. -Malayalam: Payin. Vella-payin (Fam.: Dipterocarpaceae).

Seedlings: erect. ***Roots:*** primary root thicker than the hypocotyl. ***Hypocotyl:*** 4-8 cm long. *Epicotyl:* 1.2-1.6 cm long. 4-5 mm thick. ***Cotyledons:*** well above the ground. 2. opposite, thick. anisornorphic. petiole of the larger cotyledon 3-5 cm long. blade 6-7 x 5-6 cm, ***ca.*** 1 cm thick, suborbicular. base sagittate. tip round. usually longitudinally 5-7 cleft at the tip. abaxial surface ruminate. tubercled. adaxial surface smooth, petiole of the smaller cotyledon 3-4 cm long. blade 2.5-3 x 4-5cm, broader than long, reniform, base subhastate. tip round, adaxial surface ruminate, abaxial surface smooth. ***Leaves:*** basal 1-2 nodes with 4-6 whorled leaves, number of leaves gradually decreasing with upper nodes and becoming solitary and alternate, stipules linear, 10-13 mm long. petioles 10-15 mm long, thickened at the tip, blade 10-15 x 3-3.5 cm. elliptic-obovate or elliptic-lanceolate. base obtuse, tip acuminate. lateral nerves 10-12 pairs, glabrous.

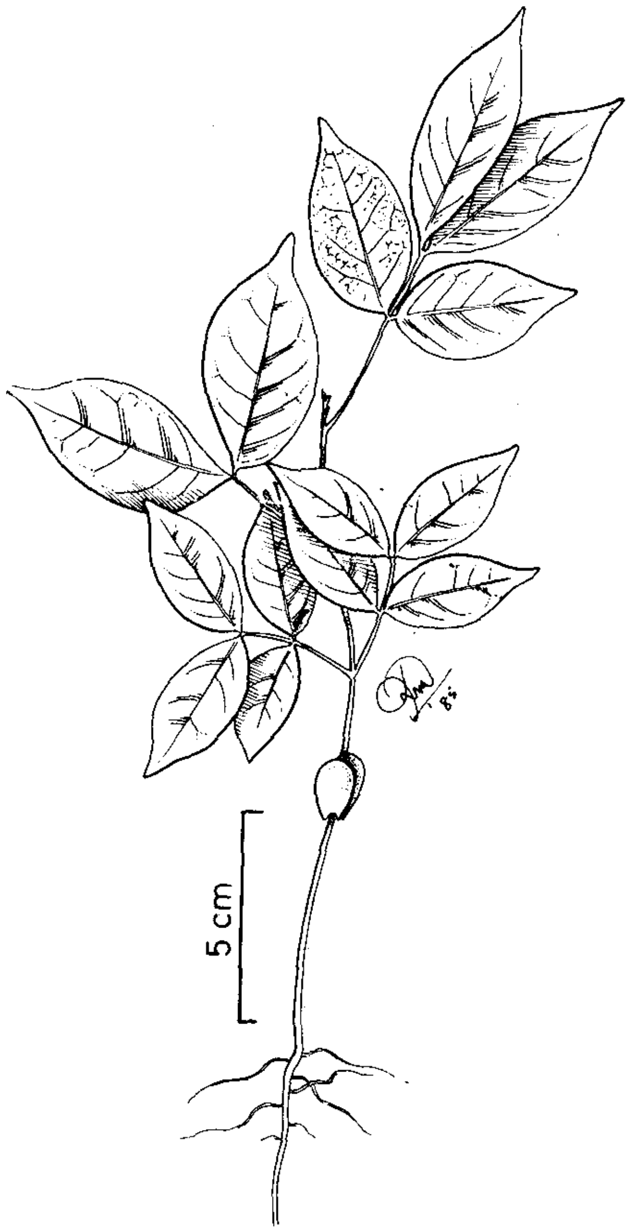
Common in the evergreen forests up to 1,000 m; regeneration profuse.



Vitex altissima Linn. f. -Malayalam: Mayil-ellu (Fam.: Verbenaceae)

Seedlings: erect. ***Roots:*** primary root straight, lateral roots flexuous. ***Hypocotyl:*** 2-3 mm long, 1-1.5 mm thick. *Epicotyl:* 8-10mm long. ***Upper internodes:*** 1-1.5 cm long. ***Cotyledons:*** well above the ground level, 2, opposite, thin. foliar. green, petioles 3-4 rnm long. blade 8-10 x *5-6* mm. elliptic, base obtuse. tip round. ***Leaves:*** foliar. opposite. decussate, lower ones simple, petioles obscure. blade 3-5 x 1-2 cm. ovate or elliptic, base attenuate. tip acute, margin coarsely serrate. lateral nerves 3-15 pairs: intercostae subreticulate. glabrous, upper leaves unifoliate-compound. rachis 1-1.5 cm long. winged, blade 5-8.5 x 2-3 cm, elliptic-lanceolate. base obtusely acute, tip acuminate. lateral nerves 5-7 pairs. other characters similar to tne lower leaves.

Common in moist deciduous and semievergreen forests and occasional in evergreens UP to 1,200 m



Xylia xylocarpa Taub. -Malayalam: IruI. Iru-mul (Fam.: Mimosaceae).

Seedlings: erect. ***Roots:*** primary root straight, 1-1 5 mm thick. ***Hypocotyl:*** 4-6. cm long, 1.5-2 mm thick. ***Epicotyl:*** 2.5-3 cm long, 1 mm thick. ***Upper internodes:*** 2.5-3 cm long, puberulent. ***Cotyledons:*** well above the ground level, 2. thick, nonfoliar, green. isomorphic, petioles 1-2 mm long, blade 12-15 x 10-12 mm 1.5-2 mm thick, planoconvex. obovate or elliptic, base sagittate. tip round, margin entire. ***Leaves:*** first pair opposite, upper ones alternate. simply compound, paripinnate. rachis 3-5 cm long, puberuleni. leaflets 2-4. opposite. stipels narrow. petiolules 1 mm long,. puberulent, leaflet blade 3-6 x 1.5-3 cm. elliptic. base obtuse, tip acuminate. margin entire, lateral nerves 3-5 pairs, intercostae reticulate: glabrous.

Common in the moist deciduous forests and occasionally in open blanks in semievergreens.

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