

Coleus vettiveroides K.C. Jacob; Botany and Pharmacognosy

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Coleus vettiveroides K.C. Jacob (Lamiaceae) is an important drug in the indigenous systems of medicine. Its roots are included in the single drug list of the Ayurvedic Formulary of India, as *Hrivera* in Sanskrit and in the Siddha Formulary as *Kuruver* in Tamil. *Coleus vettiveroides* is not widely distributed in India, but is endemic to Tamil Nadu, and under cultivation in certain places of Tamil Nadu. Since not much information is available on this plant, both the botanical and the pharmacognostical aspects have been studied along with microscopical characteristics of the roots, which would be useful for authentication.

Keywords: *Coleus vettiveroides*, Botany, Pharmacognosy, *Kuruver*, *Hrivera*

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The family Lamiaceae (earlier known as Labiatae) of the order Lamiales has over 3000 species, and although cosmopolitan in distribution in the world, is centred more around the Mediterranean region, Indo Malaysian region and in Australia. They are mostly herbs and undershrubs, similar in habit and structure. Several species are economically valuable as source of volatile oils and condiments. *Coleus vettiveroides* belongs to sub-order *Ocimoideae* within the Lamiales, and the genus *Coleus*, with about 150 species, has many horticultural forms and hybrids with ornamental leaves. However, in the Indigenous Systems of Medicine like Ayurveda and Siddha, 3 species of *Coleus* are considered important for their medicinal value:

1. *Coleus amboinicus* Lour. syn. *C. aromaticus* Benth.
2. *Coleus forskohlii* Briq. syn. *C. barbatus* Benth.
3. *Coleus vettiveroides* K.C. Jacob.

These three species can be identified in the field by the following characters:

1. Leaves fleshy
 - a. large succulent herbs, leaves strongly aromatic, pungent to taste; roots not aromatic: *Coleus amboinicus*

- b. small, sparsely branched, rhizomatous succulent herbs; leaves not aromatic or pungent; roots strongly aromatic *Coleus vettiveroides*
2. Leaves not fleshy *Coleus forskohlii*

Coleus and many of its species are well recorded for their botanical characters in books on flora^{1,2,3} and in horticultural literature. Of these three species mentioned earlier in this paper, *C. amboinicus* Lour. and *Coleus forskohlii* Briq. are well known in the indigenous medical literature. But *Coleus vettiveroides* has received scanty attention, and there is a paucity of information on it. The roots of *C. vettiveroides* are used as ingredient in compound formulation of Ayurveda and Siddha. In this paper, an attempt has been made to describe *Coleus vettiveroides* first for its botanical features. The latter part of the paper deals with the pharmacognosy of the root, and its microscopical characteristics in powder form, which would be helpful when it is used as an ingredient in compound formulations of Ayurveda and Siddha.

Methodology

Methods of cultivation of the plant, and harvesting of its roots were learnt by a visit to the farm land in Kollidam, a village on the banks of the river Kollidam, Nagai district, Tamil Nadu, where the plant

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was under cultivation. Fresh whole plants collected from the cultivated fields in Kollidam, formed the material for this part of the study. They were identified and preserved both as herbarium sheets (No. 00543) and also in Formalin-Acetic acid-Alcohol (FAA). Dried specimen (No. J/165-Rt 8) was deposited in the crude drug museum of CSMDRIA, Chennai. Free-hand sections were taken of the aerial parts of the fresh plant to study the anatomical structure. Clearing and staining were done by the methods described by Johansen⁴. Methods of study followed for the Pharmacognosy of roots are described under Pharmacognostical aspects⁵.

Results and discussion

1. Botanical aspects^{6,7, 8}

Coleus vettiveroides (Fig.1) is a small, bushy, profusely branching, erect, succulent, aromatic herb growing upto a meter, with clusters of adventitious roots, upto 50 cm in length and 1mm in thickness. Stem slightly quadrangular, young stem woolly, mature stem glabrescent, purplish in colour, upto 1 cm thick, about 1.2 cm in the nodal region, with fragrant odour at the basal region. The leaves are 10 -15 cm long, 8 - 13 cm wide, base and apex rounded, not aromatic; petiolate, petiole upto 2.5 cm long and about 2 mm thick; leaves opposite, fleshy and thick, green, pubescent, woolly on both sides, ovate in shape; 5 pairs of veins are present, more prominent on the lower surface; margin toothed with triangular teeth; flowers are rarely seen as the plants are cut and harvested before flowering. If flowers are present, they are typical of the family, with bilabiate blue corolla, arranged in whorls, in terminal racemes, and nutlets tiny. *Coleus vettiveroides* is native to Sri Lanka, occurring along river bank in sandy loams. It also occurs in India, and is endemic to Tamil Nadu, where it is currently cultivated.

Anatomy

Stem—TS of fresh stem shows a quadrangular outline with a single layer of epidermis covered with a thin cuticle; numerous long pointed warty trichomes, uniseriate, multicellular, bent or straight, occasionally with collapsed cells, are present. Below the epidermis 2 - 5 rows of collenchymatous cortical tissue is present. Rest of the cortex is parenchymatous containing numerous simple and compound starch grains. Patches of lignified fibres present at fairly regular intervals towards inner cortex. Four large vascular bundles are present at the corners of the

squarish stem (Fig. 7); phloem is narrow; cambium conspicuous; xylem is composed of isolated or radially divided groups of vessels amongst tracheids and xylem parenchyma. Uniseriate medullary rays are present in between the xylem rows. Most of the secondary xylem formed in the interfascicular region consists only of parenchyma and fibres. Pith is parenchymatous with intercellular space; simple and compound starch grains and small prismatic crystals of calcium oxalate up to 30 µm in length are present in the cells of the pith (Figs. 13,14, 15,16).

Leaf

Petiole — TS of petiole is nearly circular in outline with a depression on the adaxial side. A layer of thick walled epidermis covered with thin cuticle bearing plenty of covering and glandular trichomes present. Covering trichomes are warty, simple, thick-walled, straight or bent, uniseriate and multicellular. Glandular trichomes are stalked with a head of 4 cells. Several well-developed layers of collenchymas are present beneath the upper epidermis and occurs as a sheath to the ground tissue. The number of such layers are greater on the adaxial side, but only to 2 or 3 layers are there on the abaxial side. Ground tissue is parenchymatous. Vascular tissue forms an arc that has widely spaced bundles, along with four isolated strands of xylem on the adaxial side. Xylem vessels are arranged radially above a small patch of phloem on the abaxial side. A few small prismatic crystals of calcium oxalate are present in the ground tissue (Fig. 9).

Midrib — TS of leaf passing through the midrib shows a cuticularised upper and lower epidermis with stomata on both surfaces. Palisade tissue of the lamina does not extend into the midrib region. The upper epidermis shows a single layer of cells comparatively bigger in size than those of the lower epidermis, with plenty of uniseriate and multicellular covering trichomes. Trichomes are warty, straight and bent, with an occasional collapsed cell. Glandular trichomes are stalked with a head of 4 cells. On the adaxial side, the midrib region shows a patch of collenchymatous cells in a depression below the upper epidermis. Four or five vascular strands are present in the ground tissue of the midrib with radially arranged xylem vessels on the adaxial side and a narrow band of phloem below. Prismatic crystals of calcium oxalate upto 25 µm in size are present in the parenchymatous cells of the ground tissue (Fig. 8).

Lamina — Cuticle present; upper epidermal cells are tabular in TS, comparatively larger in size than the cells of the lower epidermis; the basal epidermal cells of trichomes are also larger than their adjacent cells; trichomes present on both the upper and lower surfaces of the lamina are similar to those on the other parts of the plant. Two or three rows of palisade parenchyma cells are found below the upper epidermis, with some rows of well-aerated spongy parenchyma below; vascular strands and a few oil globules present in lamina. In surface view, epidermal cells of the upper epidermis (adaxial surface) are almost straight walled, with a slight waviness at places; stomata present, diacytic; the cells of the lower epidermis (abaxial surface) show sinuous walls in contrast to the cells of the upper epidermis in surface view, and more numerous diacytic stomata are present (Figs.10,11,12).

II. Pharmacognostical aspects

The three species of *Coleus* are easily identifiable in the field, but as their parts are sold as drugs in trade in a dry form, they require special study and enumeration of diagnostic features based on principle of pharmacognostic characterisation. *Coleus amboinicus* is used in Ayurveda and Siddha, under the name of *Parnayavāni* and *Karpuravalli* respectively, but its leaves, and not roots, are the parts recommended, whereas the roots of *C. forskohlii* (*Gandira*) and *C. vettiveroides* are accepted as medicinally valuable. *C. forskohlii* roots are tuberous and fleshy, and easily recognized morphologically in trade specimens as well as in microscopical study. Both the above species of *Coleus* have received much attention and *C. forskohlii* is included in the Ayurvedic Pharmacopoeia of India, with quality parameters. Roots of *C. vettiveroides* is described below for its pharmacognostic characteristics.

The dried roots of *C. vettiveroides* are called *Hrivera* in Sankrit and *Kuruver* in Tamil. It is an important drug used in Ayurveda and Siddha systems of medicine. *Kuruver* was cultivated on a large scale originally in North Arcot, Coimbatore, Madurai, Thanjavur and Tirunelveli districts in Tamil Nadu. Today it is under cultivation only in four villages near Kollidam in Nagai district and propagated by stem cuttings (Figs. 3&4). Roots are harvested once in three months. The roots are cut just above the root stock (Fig.2). The cluster of roots are loosened gradually and carefully by flooding the underground part with water, and working with hands to release the

root cluster from the sandy soil. They are not uprooted by pulling them out of the soil, and care is taken to avoid damage or loss of roots. They are then carefully washed free of adhering soil drained and dried in shade (Figs.5&6). The dried and fragrant roots are packed in gunny bags and stored in shelves in the godown, for the market.

The following paragraphs explain the methods and materials used to establish the identity of the whole drug or its powder, or when used as an ingredient in compound formulations.

Reference samples were collected in person from cultivated fields in Kollidam. The reference samples were Pharmacognostically examined and representative material deposited in the crude drug museum of the Captain Srinivasa Murthi Drug Research Institute in Ayurveda and Siddha, Chennai. Dried roots were purchased from the market in Chennai under the name, *Kuruver*, and identified as genuine on the basis of the study of the reference sample. Free-hand sections were taken of all the samples and studied for anatomical and diagnostic features, using methods recommended in standard pharmacognosy text⁴. Powdered roots were also examined Pharmacognostically and camera lucida drawings given to illustrate the characteristic diagnostic features. Photomicrographs were taken at various magnifications using Olympus BX51 microscope unit attached with an Olympus digital camera. The details given below are from such studies made on the market samples.

Macroscopy

Clusters of adventitious roots 10 - 50 cm in length, well branched, thick at the base, narrow towards the tip, fibrous, very thin and easily breaking, 1 - 1.5 mm in diameter, pale brown in colour, taste not specific, odour aromatic.

Microscopy

In the TS, dried root shows cork which consists of 6 - 8 layers of broken rectangular, tangentially elongated cells below which are 1 or 2 layers of tangentially elongated cork cambium followed by a parenchymatous secondary cortical region forming the ground tissue, in the cells of which isolated and compound starch grains upto 20 μm in size and occasionally small prismatic crystals of calcium oxalate upto 30 μm in size are present; stone cells absent; phloem shows the presence of isolated or small groups of lignified fibres with broad lumen.

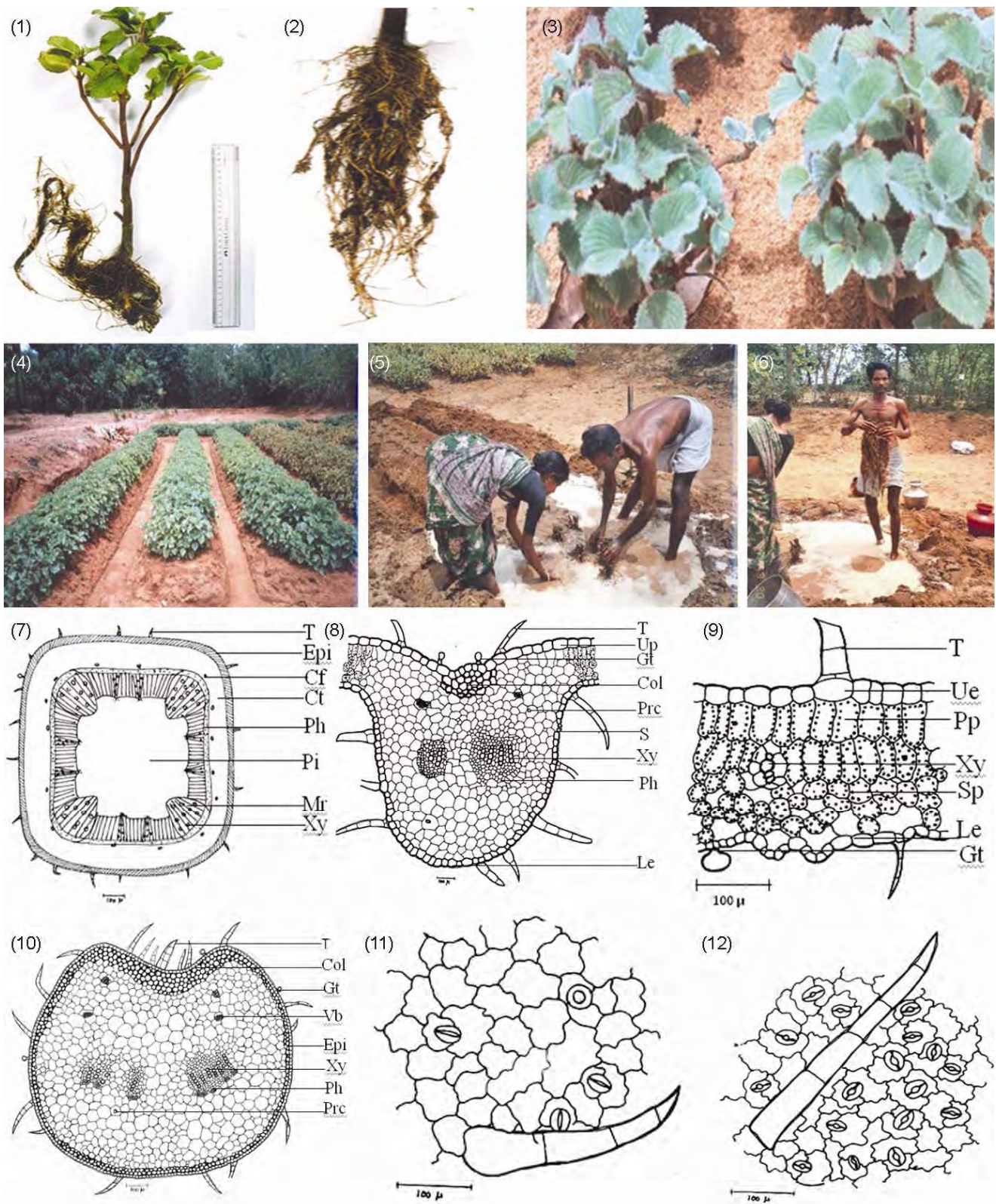


Fig.1—12: 1 Fresh plant; 2 Freshly cut roots; 3 Close up of individual plants; 4 A view of the field; 5 Lifting the roots, after flooding the bed; 6 Draining the water; 7 Diagrammatic TS of stem; 8 TS of leaf midrib; 9 TS of petiole; 10 TS of lamina; 11 Lower epidermis in surface view; 12 Upper epidermis in surface view

Narrow thin-walled rectangular cells of cambium in 2 or 3 rows present; Xylem is composed of radially arranged xylem vessels, isolated or rarely 2 or 3 in groups and abundant parenchyma, many cells of which show reticulate thickening as seen in radial sections. Medullary rays well developed, thin walled, multiseriate, diverging towards periphery with cells filled with starch grains. Pith absent or very small (Figs. 17,18).

Powder

Powder of crude drugs requires special examination using pharmacognostic methods. While the analysis and identification of whole crude drugs of the Ayurveda, Siddha and Unani systems present no complications, powders are not so easily identified as to their origin, particularly when they are added in that form to the compound formulations, containing several other ingredients with similar anatomical features. Therefore, the diagnostic characteristics by which a powder can be traced to its plant source, and distinguished from closely resembling allied drugs is an important part of pharmacognosy of any crude drug of the ASU systems. It is in that context the powder of *C. vettiveroides* roots has been examined and details presented below.

A moderately fine powder of the root is brown coloured, smooth, odour aromatic, no specific taste; for microscopic characters, a small quantity of powder is treated in chloral hydrate solution, washed and mounted in glycerin; another small portion is treated with iodine in potassium iodide solution, washed and mounted in glycerin; a few mg of powder is stained with phloroglucinol, allowed to dry, and conc. hydrochloric acid added before washing and mounting in glycerin; a few mg of powder is boiled in 2% aqueous potassium hydroxide, washed in water, and mounted in glycerin. The various mounts are observed for diagnostic characters that would identify the drug in powder form. The following features are observed, using both low and high power of research type microscope capable of giving magnification upto 500 x.

Starch grains circular to oval in shape, either isolated measuring upto 2 μm in size, or with 2 - 4 grains in groups, upto 20 μm in size; prismatic crystals of calcium oxalate upto 30 μm in size; thin walled lignified fibres with sharp tips upto 970 μm in length; fibre tracheids showing branching or

splitting at the tips; pitted and scalariform thickened vessels upto 600 μm in length; xylem parenchyma cells in various stages of reticulation on its walls and cork cells in surface view; stone cells not detected (Fig. 19).

The only other root drug from *Coleus* species, *Coleus forskohlii* (*Gandira*) can be differentiated from the root of *Coleus vettiveroides* (*Hrivera*) in powders and in formulations by the following characteristics: larger starch grains which are upto 60 μm , with a star shaped cleft hilum and distinct lamellae, stone cells containing rhomboid crystals of calcium oxalate; fibre tracheid that do not show branching; and the absence of reticulated parenchyma cells from the xylem region.

Uses of *Hrivera* in Ayurveda and Siddha formulation

An examination of the various categories of formulations included in the Ayurvedic Formulary of India, shows a wide use of *Hrivera* root powder as *Praksēpa Dravya* (addition of drugs 'in situ') in many processed formulations. These are multi-ingredient formulations, containing anywhere from 5 to 40 drugs, and may be in the forms of *Asava/Arista*, *Arkas*, *Avalekas*, *Curnas* and *Kvatha Curnas*, *Tailas*, *Lepas*, *Vati-Gutikas*, *Rasa* and *Lauha* preparations. In the Siddha Formulary of India, only one formulation in tablet form containing *Kuruver*, the Tamil equivalent, is included currently. The formulations are mostly for internal use, and generally indicate a therapeutic activity in cases of G.I disorders like mal-absorption, flatulence, diarrhoea or dysentery and fever resulting from such G.I related syndromes. Externally, the *Taila* and *Lepa* formulations are used as emollients and plasters over painful areas. The other drugs in such formulations along with which *Hrivera* is usually added are generally plant drugs containing essential oils with known carminative and analgesic properties. Analysis of Ayurveda and Siddha formulations by microscopical characterization is recommended in solid dosage forms wherever the *Praksepa Dravyas* or other ingredients are not above 10 or 12.

It is, therefore, believed that the information on the analytical characters of the root of *Coleus vettiveroides* given in the paper will be useful for including in the Ayurvedic Pharmacopoeia, both as a single drug, and for its detection in compound formulations, where they are an ingredient.

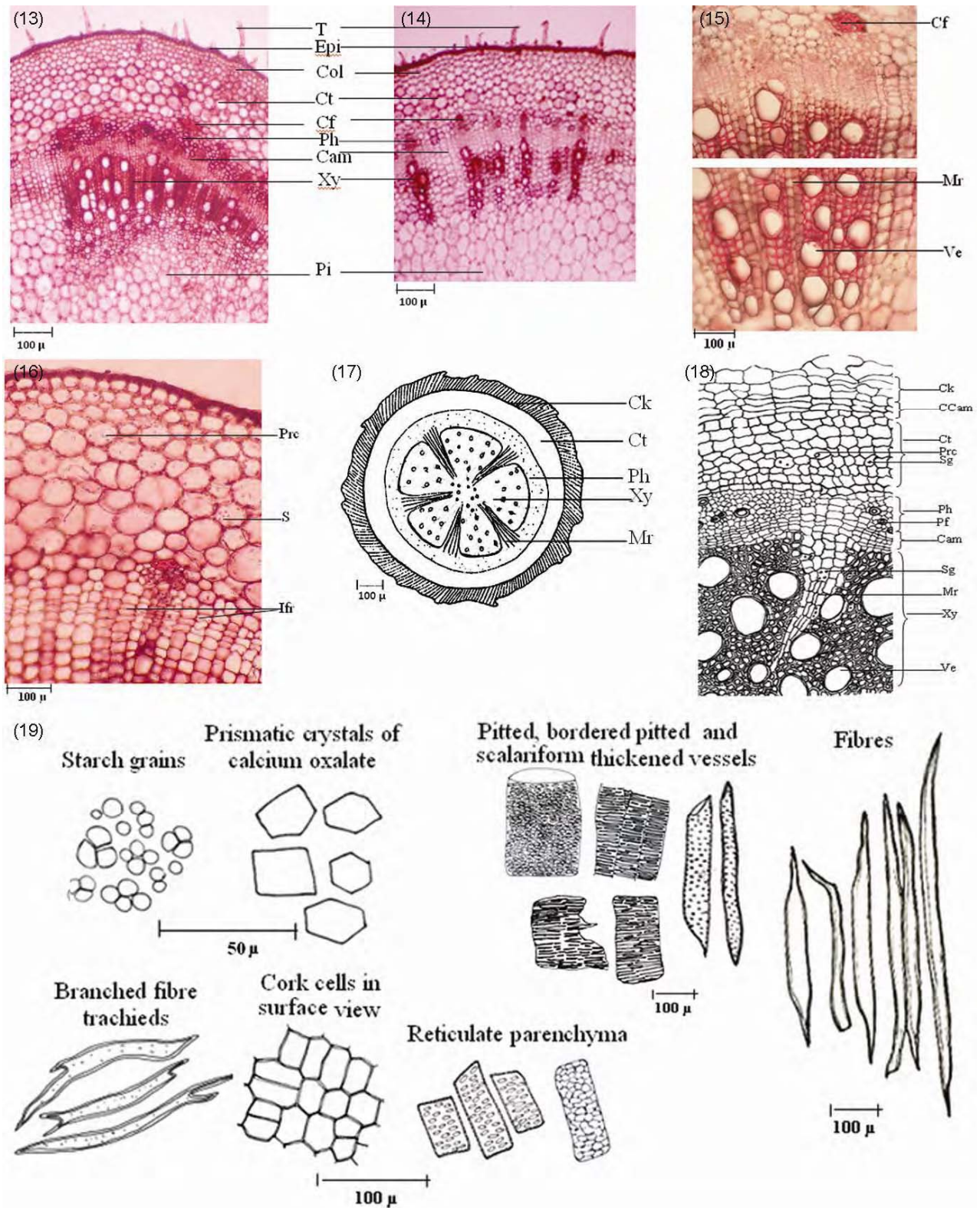


Fig. 13—19: 13 TS of stem undergoing secondary growth shows enlarged portion of primary vascular bundle region; 14 TS of stem showing enlarged portion of interfasicular secondary xylem where secondary xylem vessels get differentiated; 15 TS of stem shows secondary xylem region with medullary rays; 16 Stem cortex region shows prismatic crystals and starch grains; 17 TS of Root-diagrammatic; 18 TS of root; 19 Powder microscopy of the root

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Explanation for the Abbreviation

Cam, Cambium; Ccam, Cork cambium; Cf, Cortical fibres; Ck, Cork; Col, Collenchyma; Ct, Cortex; Epi, Epidermis; Gt, Glandular trichome; Ifr, Interfascicular region; Le, Lower epidermis; Mr, Medullary rays; Pf, Phloem fibres; Ph, Phloem; Pi, Pith; Pp, Palisade parenchyma; Prc, Prismatic crystals of calcium oxalate; Sg, Starch grains; Sp, Spongy parenchyma; T, Trichome; Ue, Upper epidermis; Vb, Vascular bundle; Ve, Vessel; Xy, Xylem