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Research Article

Anatomical Studies of *Delonix elata* (L.) Gamble (Cesalpiniaceae)

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Abstract

The present investigation has been carried out to determine the anatomical features of whole plant of *Delonix elata*, is an important medicinal plant used in the traditional system of medicine. This plant used for the treatment of different diseases and ailments for human beings. The plant is popularly known as vadanarayanan in Tamil. In the traditional medicinal system, the leaves, and root are used to treat arthritis. Anatomical studies of the leaf, stem, flower, fruit, seed, wood and powder macroscopically studies were investigated to certain the relevance of these characters in establishment of interspecific similarities and differences in these taxa. The results showed that there is wide, uniform in thickness all around periderm of the root. Periderm it is 150 µm wide and has 12-15 layers of thin walled tabular cells. The cells are aligned in regular radial rows. The innermost layers of the peridem contain reddish spherical bodies of variable size. Sclerotic cylinder inner to the periderm is a thin continuous of small rectangular phloem elements which are in compact radial rows. Secondary xylem cells occupies the central wide core. The sclerenchyma cells include literiform fibers and gelatinous fuses. The latter type of fibres is seen in a few tangential blocks. The vessels are solitary and diffuse in distribution; central vessels are narrow measuring 30 µm in diameter. The vessels in the periphery are 70 µm wide.

Keywords: Anatomy, vadanarayana, *Delonix elata*, Leaf, Stem, Flower, Fruit, Seed, Wood and Powder microscopic studies

Introduction

Study of medicinal plants based on ancient literature and their investigation in the light of modern knowledge is known as ethnology. However, the branch of medicine dealing with history, collection, selection, identification and preservation of crude drugs and raw materials is pharmacognosy, while the branch dealing with the study of action of drug is pharmacology. The Casealpinoidae includes 171 genera and about 2250 species of tropical and sub tropical trees and Shrubs (Lewis *et al*., 2005) listed 5 tribes, namely Cercideae, Ceasalpinieae, Cassieae, Amheristeae and Detarieae as the of phylogenetic analysis (Polhill and Raven,1981), (Bruneau *et al*., 1980). Listed only 4 tribes, Cassieae, Detarieae, Caesalpinieae and Cercideae as the components of the Casealpinoidea (Herendeen *et al*., 1980). Herbal medicine has been practiced worldwide and is now recognized by World Health Organization (WHO) as an essential building block for primary healthcare

(Stuessy, 1980). Though the traditional Indian system of medicine has a long history if use, they lacked adequate scientific documentation, particularly in the light of modern scientific knowledge.

Materials and Methods

Plant Material

The *Delonix elata* leaf, stem, flower, fruit, seed and wood specimens were collected from Narthamalai, Pudukottai, Tamil Nadu. This investigation was conducted at the Plant Anatomy Research Centre, Pharmacognosy Institute, West Tambaram, Chennai 2009. Care was taken to select healthy plant and normal organs. The required samples of different organs were cut and removed from the plant fixed in FAA (Farmalin-5ml+Acetic acid-5ml +70% Ethyl alcohol-90 ml). After 24 hrs of fixing, the specimens were dehydrated with graded series of tertiary - Butyl alcohol as per the schedule given by Sass, 1940. Infiltration of the specimens was carried by gradual addition of paraffin wax (melting point 58-60^{o}C) until solution attained super saturation. The specimens were cast into paraffin blocks.

Sectioning

The paraffin embedded specimens were sectioned with the help of Rotary Microtome. The thickness of the sections was 10-12 µm. Dewaxing of the sections was by customary procedure (Johansen, 1940). The sections were stained with Toluidine blue as per the method published by (O'Brien *et al*., 1940). Since Toludine blue is a polychromatic stain. The staining results were remarkably good; and some cytochemical reactions were also obtained. The dye rendered pink colour to the cellulose walls, blue to the lignified cells, dark green to suberin, violet to the mucilage, blue to the protein bodies etc. Where ever necessary sections were also stained with safranin and Fast-green and IKI (for Starch).

Stomatal morphology

For studying the stomatal morphology, venation pattern and trichome distribution, Paradermal sections (sections taken parallel to the surface of leaf) as well as clearing of leaf with 5% sodium hydroxide or epidermal peeling by partial maceration employing Jeffrey's maceration fluid (Sass, 1940) were prepared. Glycerine mounted temporary preparations were made for macerated/cleared materials. Powdered materials of different parts were cleared with Naoh and mounted in glycerine medium after staining. Different cell component were studied and measured.

Pharmacognostical Studies

Pharmacognostical Studies were carried out the following the method of (Wallis, 1997) to ascertain the correct identity of the drug plants.

Preparation of Leaf powder

Leaves of the study plants were collected and shade dried for four days, sun dried for a day and then stored in black polythene bags. The leaves were powdered in a pulverizer as and when required, sieved, labeled and stored in Polyethylene terithalate (PET) bottle (Johansen, 1940).

Results and Discussion

Macroscopic or morphological characters morphology is the study of structure and form of plants, usually dealing with the size, shape and nature of organism and its component organs. Morphological evidence provides the basic language for plant characterizations, identification, classification and relationships. Generally, morphological data are easily observable and obtainable, and thus most frequently used in taxonomic study and that's why, useful in pharmaconostic study to the authentication of plant. *In vivo* plant leaves abruptly 2-pinnate, 10-20 cm long, main rachis slender, pinnae 4 - 8 pairs, opposite leaflets 10-20 pairs, 3 by 8 mm, closely set along the rachis, glabrous, coducous. Inflorescence - racemose, pedicels stout, finely pubescent. Flower- Pale yellow flowers with reddish filaments, partially zygomorphic. Calyx - 5, polysepalous or slightly fused 2-2.5 cm long, coriaceous, silky-pubescent outside, segment linear-oblong, acute. Corolla - 5, polypetalous, odd petal smallest,

aestivation ascending imbricate, the margins of all much curled. Androecium - Stamens 10, free, declinate, long exserted filaments villous below, anthers Gynoecium - Monocarpellary, superior ovary, marginal placentation. Fruit - legume, pods 12.5 -18 by 2-3.2 cm attenuated at both ends. Organoleptic characters various sensory parameters of the plant material (such as colour, odour, size, shape, and taste) powder of leaf, stem bark, seed, flower and root of *in vivo* plants, were depicted in (Table 1). The Stems are greenish - purple in color. The leaves are green on upper surface and whitish on lower surface. The whole plants are odourless, and are bitter in taste were studied by organoleptic evaluation.

Table 1. Organoleptic characters of *Delonix elata* (L.) Gamble *in vivo* parts

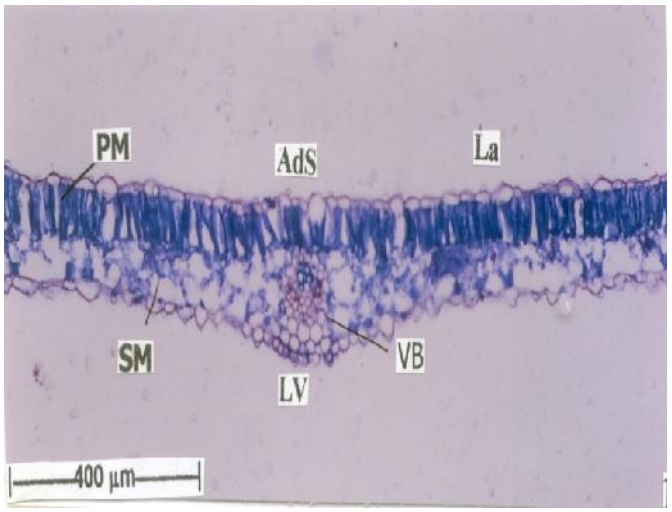
Plant parts	Colour	Odour	Taste
Leaf	Brown	Odourless	Punchy
Stem bark	Dark Brown	Odourless	Bitter
Flower	Brown	Odourless	Bitter
Seed	Light Brown	Odourless	Bitter
Root	Light Brown	Like tea dust	Bitter

Among organoleptic characters, of the odour of *in vivo* roots are somewhat pleasant and tea dust like and the leaves, stem bark, flower and seed of the shows no specific odour. All the four samples are more or less bitter in taste.

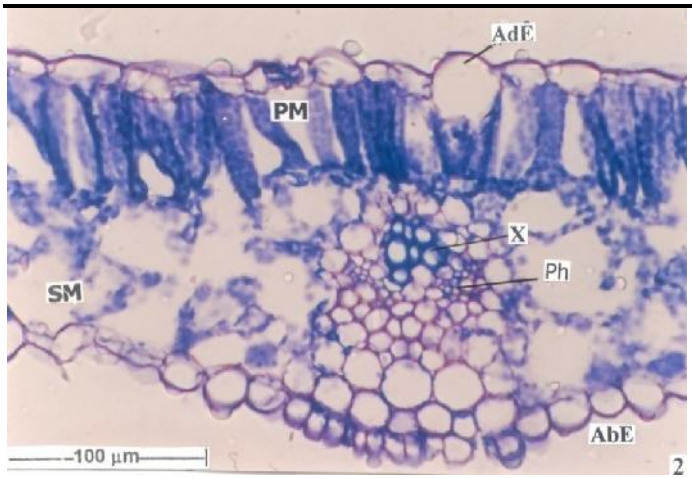
Delonix elata (L.) Gamble.: Habit

A genus of tree with large showy flowers, distributed in tropical Asia and Africa. Two species are grown in India, mostly for ornamental purposes. *Delonix elata* Gamble syn. *Poinciana elata* Linn. An erect tree, 20-30ft high reported to occur wild in some parts of Kathiawar and South India and frequently planted as an avenue tree. It bears feathery foliage and handsome pale yellow flowers with reddish flowers filaments (Sass, 1940), (Gamble JS, Fisher CEC. 1915-1936), (Stuessy, 1990). *In vivo* leaf the leaflet is thin with fairly prominent lateral vein and midrib. The lamina is 110 mm thick, the lateral vein is 170mm thick and the midrib is 180 mm thick. The lamina has wide epidermal layers with barrel shaped thin walled cells. The adaxial epidermis 10-20 mm thick.

A twig showing compound leaf: A Compound leaf enlarged



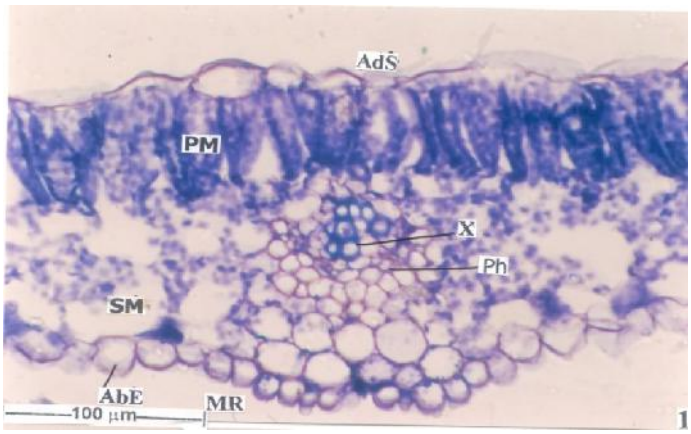
T.S of leaf let through midrib with lamina



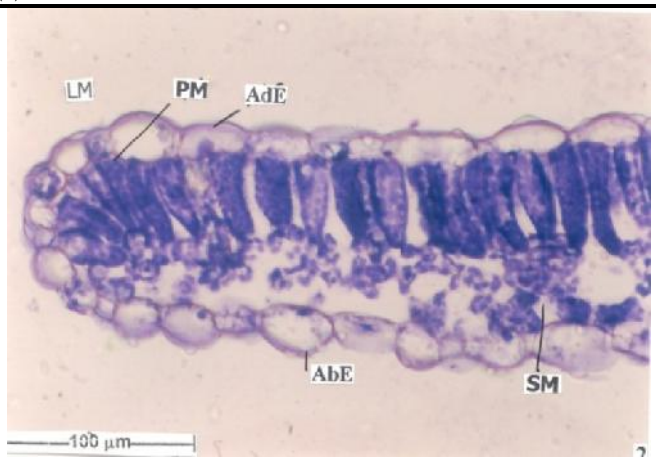
Midrib with lamina enlarged

PM: Palisade Mesophyll; **SM:** Secondary Metaxylum; **AdS:** Adaxial Side; **LV:** Lateral Vein; **La:** Lamina; **VB:** Vascular Bundle; **X:** Xylem; Ph**:** Phloem; **AbE:** Abaxial Epidermis

The abaxial epidermis has spindle shaped dilated cells with hemispherical outer tangential walls. The cells are 20 mm thick. The mesophyll tissue is differentiated into adaxial band of thick, cylindrical loosely arranged palisade cells; the cells are 40 mm in height. The abaxial portion has four to five layers lobed loosely, arranged spongy parenchyma cells and wide air- chambers. The midrib has single collateral vascular strand which consists of conical cluster of thick walled xylem elements and two or three nests of phloem elements. The vascular strand is surrounded by thin walled parenchyma cells. The abaxial part of the vascular strand has wider, circular cells and those cells adjacent to the vascular strand are smaller and angular.



Abaxial epidermis



T.S. of Leaf margin

Abbreviations

AdS: Adaxial Side; **PM:** Palisade Mesophyll; **SM:** Secondary Metaxylum; **MR:** Midrib; **X:** Xylem; **Ph:** Phloem; **LM:** Lamina

The palisade zone is extended and horizontally transcurrent in between thin adaxial epidermis and the vascular bundle.

The palisade zone is extended and horizontally transcurrent in between thin adaxial epidermis and the vascular bundle.

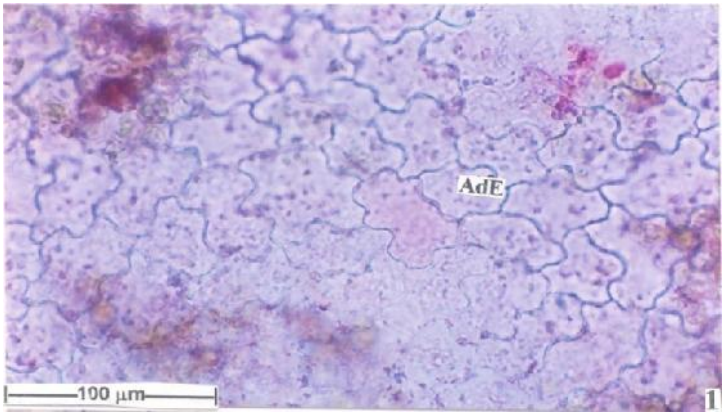
Surface view of the epidermal cells and stomata

The adaxial epidermis is apostomatic (without stomata). The cells of the epidermis have wavy anticlinal walls and amoeboid outline. The abaxial epidermis is stomatiferous. The stomata are paracytic type. These are two unequal subsidiary for each stoma; these cells occur parallel and lateral to the guard cells. The epidermal cells are amoeboid in outline with thin wavy walls. The midrib is fairly prominent and straight. The lateral veins are thin and are right angles to the mid veins. The lateral veins branch profusely giving rise to tertiary veins which form distinct and indistinct vein-islets. The vein-terminations are distinct and they range from simple un branched to repeatedly branched dendroid types. The terminatious are curved or straight. The secondary rachis is circular is sectional view with adaxial groove. It is 1 mm thick. It consists of a thin epidermal layer of small squarish cell with prominent cuticle. The ground tissue is

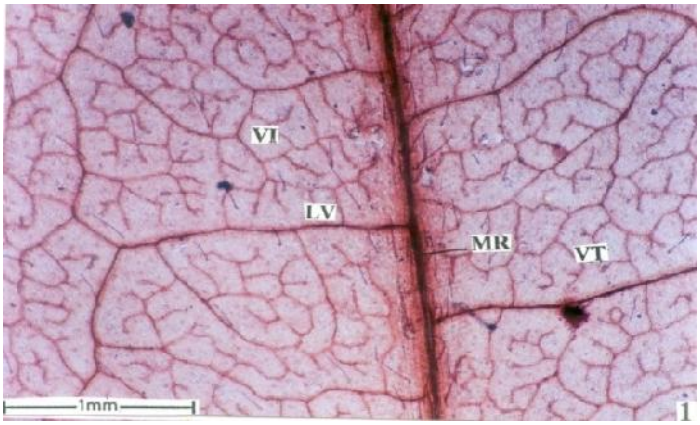
homogeneous and parenchymatous; the cells are small, angular, thin walled and compact. The ground parenchyma is 300 mm wide from the vascular cylinder to the epidermis. The vascular strand is urn-shaped; it is wide and deep and open towards the adaxial side. It is 530 mm in horizontal plane; 200 mm thick in radial plane. The vascular strand has a thick sheath of sclerenchyma, several, circular discrete phloem nests and radial files of circular, thick walled, wide xylem elements. The meta xylem is 25 mm in diameter.

Primary rachis

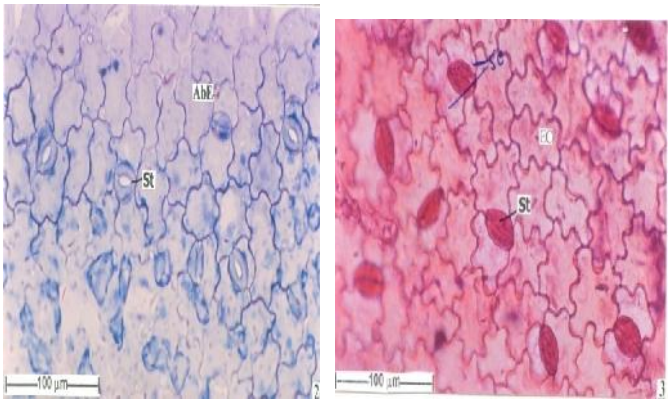
The cross sectional outline of the rachis differs from base to the tip. The basal part of the rachis is wide and circular with shallow adaxial groove. It is 4 mm in diameter. The terminal part of the rachis is shield shaped with wide, fairly deep adaxial depression and lateral short ridges. The terminal rachis is 3.2 mm thick. The basal part of the rachis has wider parenchymatous ground tissue and broad, circular closed, hollow vascular cylinder. The cylinder is 2.2 mm in diameter. The cylinder has dense radial rows of fibers and circular wide vessels at frequent inter walls. The terminal part of the rachis, the vascular system consists of a wide, hollow u-shaped strand and a flat horizontal plate like strand. The outer ground tissue is narrow while the central ground tissue is wide and parenchymatous. The vascular strands have closely arranged parallel rows of xylem elements, outer zone of phloem nests and thick sclerenchyma sheath all around the vascular cylinder.



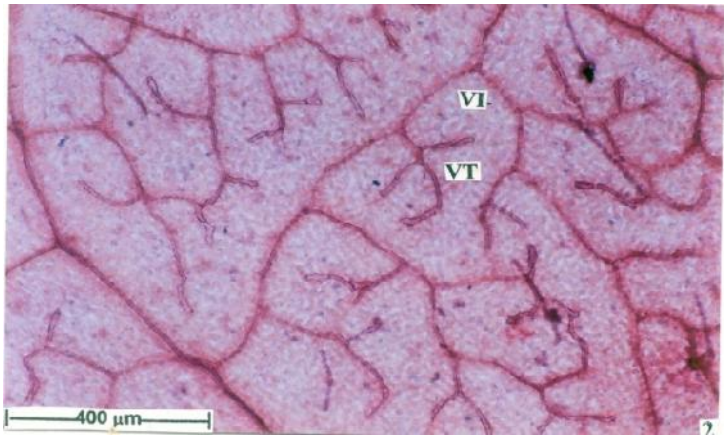
Adaxial epidermis



Vein-islets: vein termination



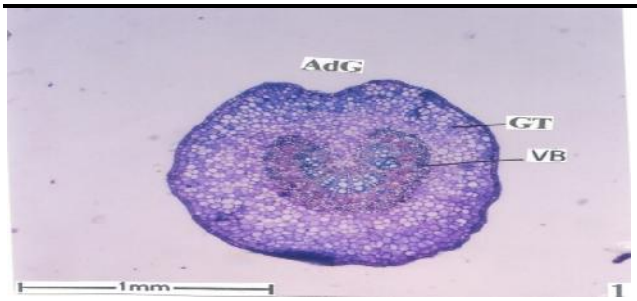
b. Abaxial epidermis with stomata



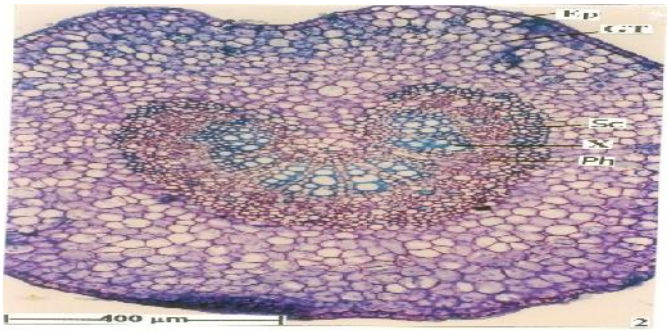
B .Venation pattern: Magnified View

AdE: Adaxial Epidermis; **AbE:** Abaxial Epidermis; **St:** Stomata; **Sc:**Secretary Cavity; **Ec:** Epidermal cells

LV: Lateral vein; **MR:** Midrib; **VT:** Vein-terminations; **VI:** Veins



T.S of rachis

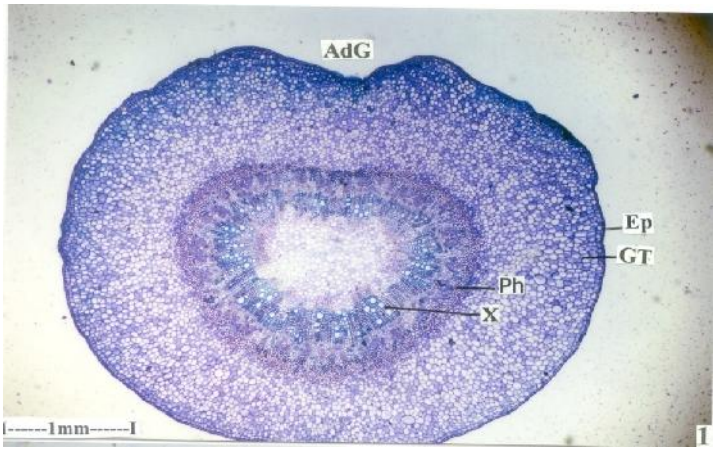


T.S of rachis entire view magnified view

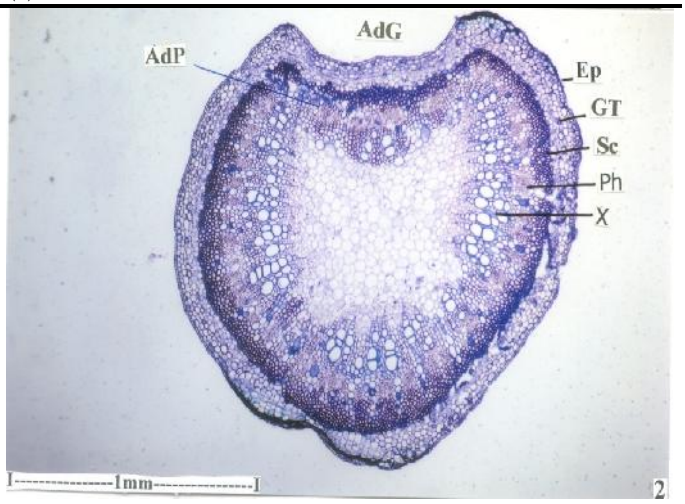
Abbreviations

AdG: Adaxial groove; **GT:** Ground Tissue; **VB:** Vascular Bundle; **EP:** Epidermis; **Sc:** Secretary Cavity; **X:** Xylem; **Ph:** Phloem

The sclerenchyma cylinder has thick lignified walls and narrow lumen. The vascular cylinder consists of outer wider zone of phloem where the phloem elements are in regular radial rows. The xylem cylinder has dense radially aligned fibers, and radially multiples of wide, angular thick walled vessels.



T.S. of primary rachis basal region Ground plan

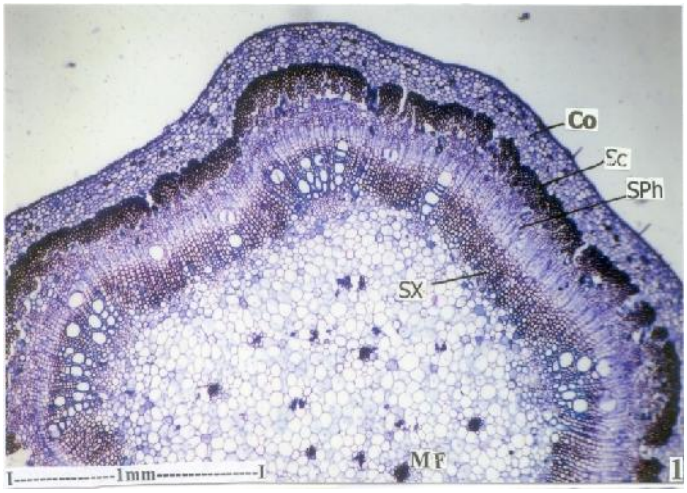


T.S. of primary rachis tip region Ground plan
Abbreviations

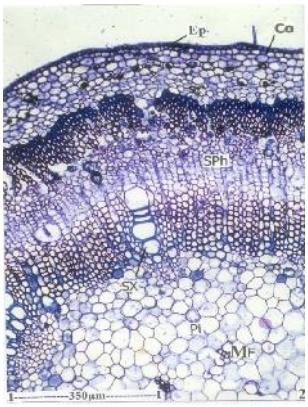
AdG: Adaxial groove; **EP:** Epidermis; **GT:** Ground Tissue; **X:** Xylem;**Sc:** Sclerenchyma; **AdP:** Adaxial Parenchyma

***In vivo* Stem**

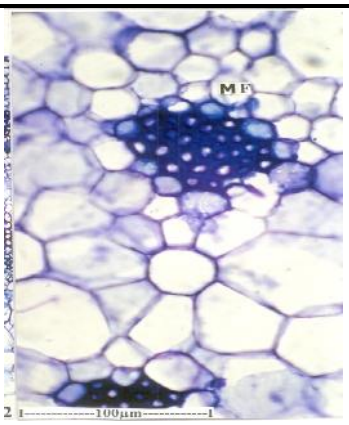
The young inter node is slightly angular in outline. It is about 3 mm thick. It has a thin layer of epidermis which consists of small darkly staining cells. A hypodermal layer of similar cells, lent hyaline is seen inner to the epidermis. The cortex is 100 mm wide; it consists of small, compact parenchyma cells. Some of the cells have tannin content.



T.S of stem half portion Magnified



T.S of stem



Structure of the Medullaryfiber

Abbreviations

Co: Cortex; **Sc:** Sclerotic Cylinder**; SX:** Secondary Xylem; **SPh:** Secondary phloem; **MF:** Medulary fibre; **EP:** Epidermis; **Pi:** Palisade index

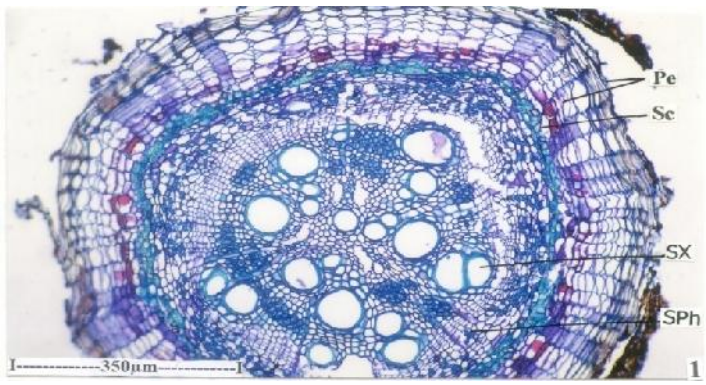
The vessel rows are sparse and occur only in restricted places. The vessel diameter is 50 mm. The pith is wide and partenchymatous. The cells are angular, thin walled and compact. Scattered in the pith are small clusters fibers. They have thick and lignified walls and narrow lumen. Some of the pith cells are circular which are surrounded by radial rosette of rectangular cells.

***In vivo* Root**

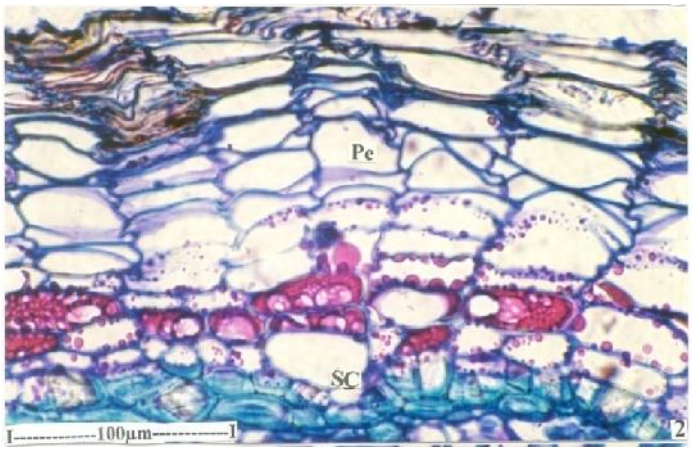
The root is 900 mm thick. It consists of the following tissue zones: Periderm. It is wide, uniform in thickness all around the root. It is 150 mm wide and has 12-15 layers of thin walled tabular cells. The cells are aligned in regular radial rows. The innermost layers of the periderm contain reddish spherical bodies of variable size. Sclerotic Cylinder inner to the periderm is a thin continuous cylinder of sclereids. The sclereid cylinder is two or three cells thick. Secondary phloem is fairly wide. It consists of small rectangular phloem elements which are in compact radial rows.

Secondary xylem

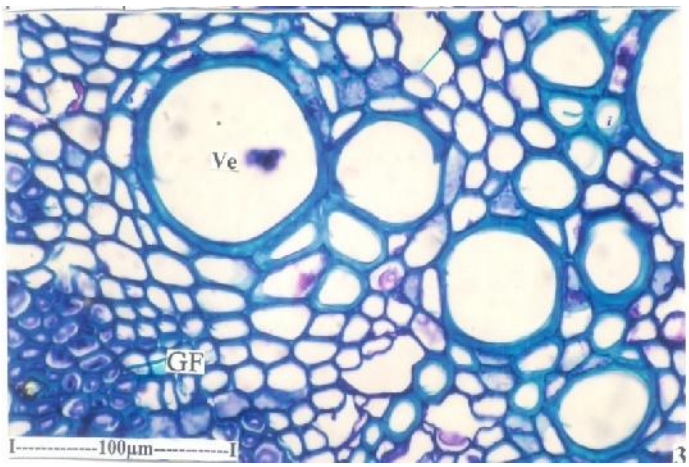
Occupies the central wide core. It has sclerenchymatous ground tissue. The sclerenchyma includes literiform fibers and gelatinous fibers. The latter types of fibers are seen in a few tangential blocks. The vessels are solitary and diffuse in distribution. The central vessels are narrow measuring 30 mm in diameter. The vessels in the periphery are 70 mm wide.



Anatomy of the Root- T.S of root entire view



T.S of root entire view periderm magnified

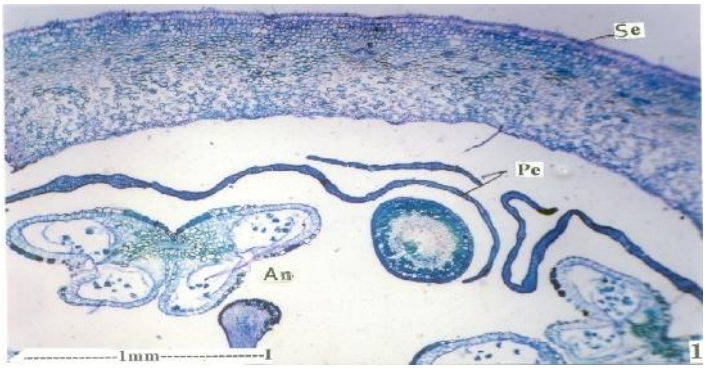


T.S of root showing secondary xylem

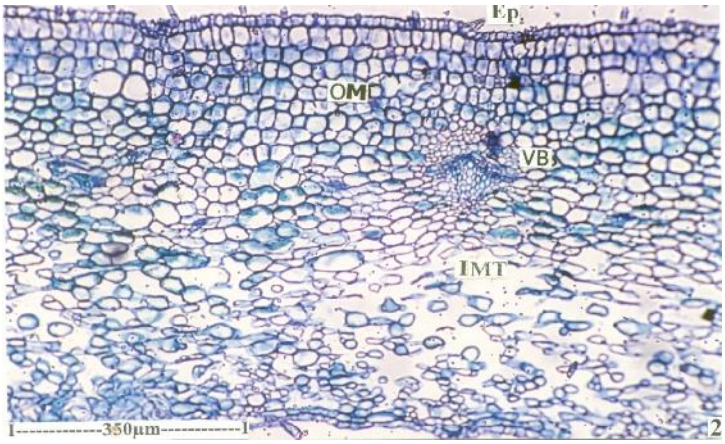
***In vivo* flower**

Sepal

The sepal is 650 mm thick. It has thin lent distinct outer epidermal layer of small radially oblong cells. These is an hypodermal layer of slightly larger, radially oblong cells. The outer mesophyll tissue has six to eight layers of squarish cells arranged in horizontal cells become separated into circular or lobed loosely arranged tissue with wide air-chambers. The inner epidermis not distinct. It is a thin layer broken at certain places. The vascular bundle occurs in a circle which are collateral and less prominent.



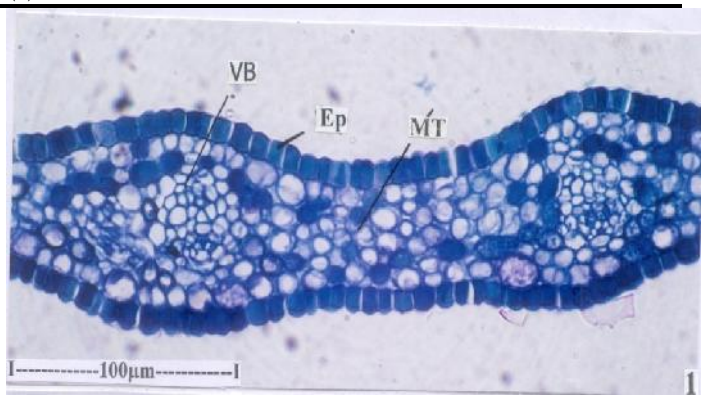
Anatomy of the flower - T.S. of petal through epal petal and anther



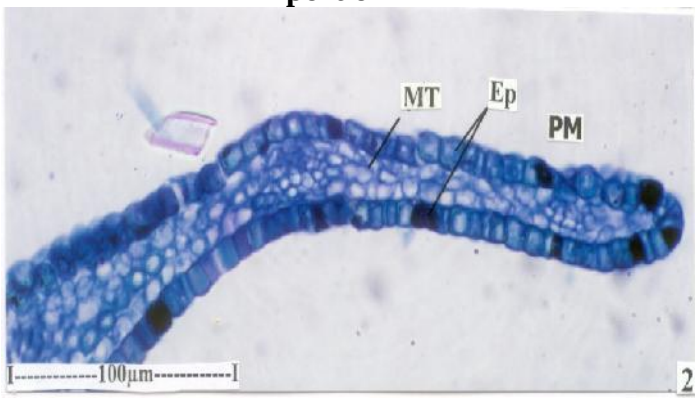
b. T.S. of Sepal enlarged

Abbreviations

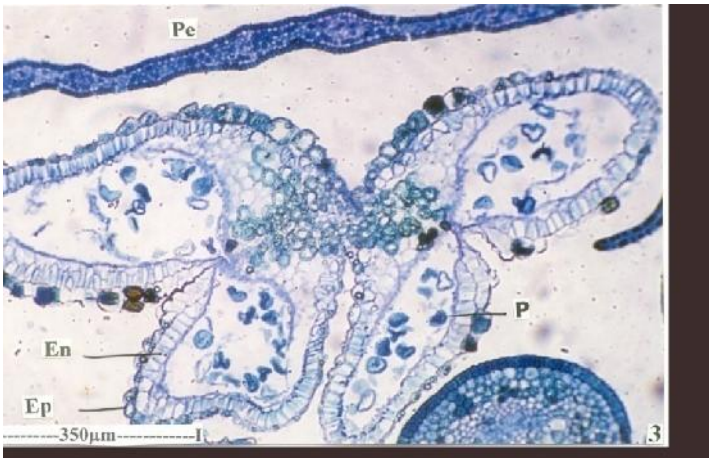
Se: Sepal; **Pe:** Petal; **An:** Anther; **EP:** Epidermis; **OM**: Outer Mesophyll;**VB:** Vascular Bundle; **IMT:** Inner Mesophyll Tissue



Structure of the flower- T.S of petal middle portion



T.S of petal magnified portion



T.S of anther

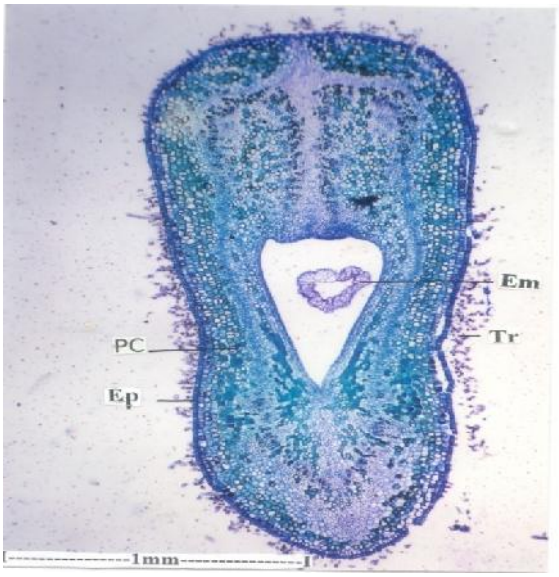
Abbreviations

VB: Vascular Bundle; **EP:** Epidermis; **MT:** Mesophyll Tissue; **PM:** Palisade Mesophyll; **Pe:** Periderm**; En:** Endothecium; **P:** Petal

Petal as seen in cross sectional view, the petal is noded and thicker in the region of vascular strands and thinner in between the vascular strands. The nodal region is 300 mm thick and the intermodal narrow region is 200 mm thick. The outer and inner epidermal cells are quite thick comprising of radially oblong cells and darkly staining contents. The epidermal cells are 10 mm thick. The mesophyll tissue consists of circular, thick walled, less compact parenchyma cells. Tannin is deposited in many of these cells. The vascular bundle is collateral and circular; there is a small cluster of xylem and a few phloem elements in a bundle. One or two layers of parenchyma cells form bundle sheath covering of the vascular strands. The petal margin gradually becomes thinner with bent end. The margin has thick epidermal layers and three or four compact cell layers in the ground tissue. Anther the anther is dithecous and four chambered. The pollen chamber has a prominent papillate epidermal layer of cells. The inner layer of the anther wall is the endothecium. The endothecial cells are rectangular and have spiral thickenings.

***In vivo* Fruit**

The fruit is flat with dilated ends and narrow middle portion.



T.S of fruit entire view

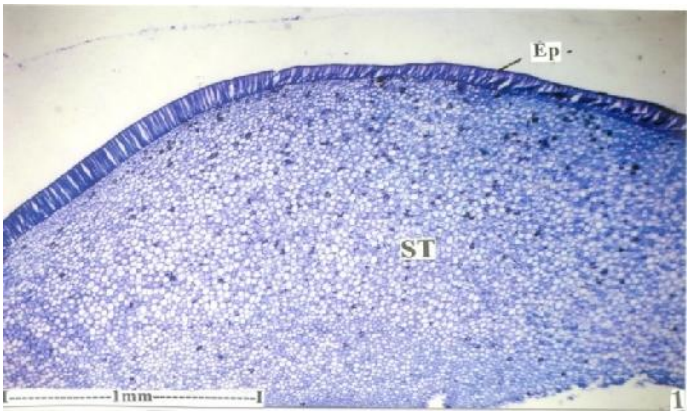
Abbreviations

Ep: Epicarp; **PC:** Parenchymatous; **Tr:** Trichomes; **Em:** Epicarp membrane

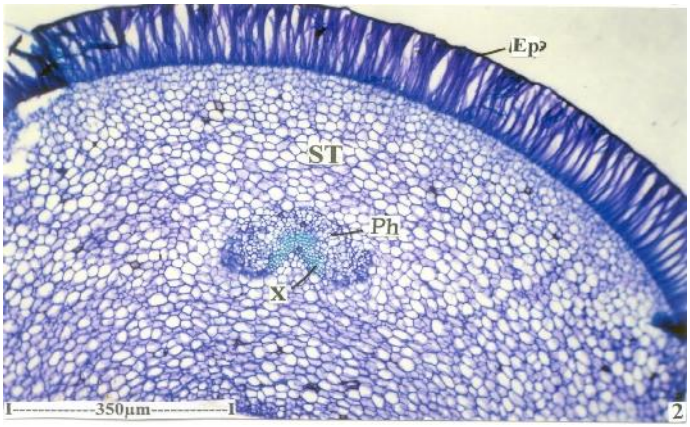
It is 1.05 mm thick along the upper end and 800 mm along the lower end. The young pod has thick pericarp with dense epidermal trichomes, thin, dark epicarp (epidermis), wide parenchymatous mesocarp and thin membranous innermost endodermis. These are two vascular strands, one at each end of the fruit. Some of the pericarp cells (mesocarp) have tannin contents.

***In vivo* seed**

The seed has thick seed coats measuring 700 mm thick. It has wide, continous and smooth epidermis which is made up of thick Columnar or macrosclereids. This layer is 110 mm thick. Inner to the epidermis is a wide homogeneous parenchymatous region (Sarcotesta) where the cells are small, thin walled, polyhedral and compact.



Anatomy of the seed – T.S of seed coat showing epicarp and sarcotesta



T.S of seed coat a portion enlarged

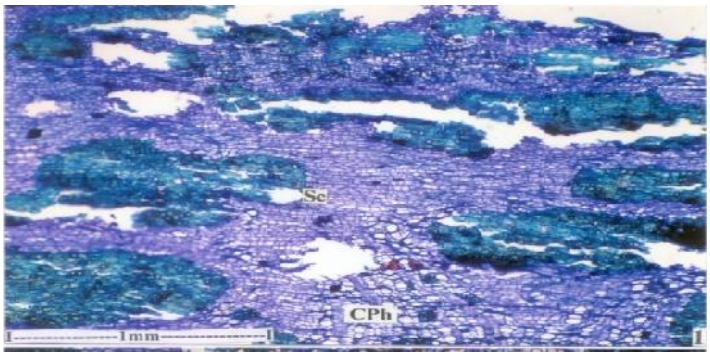
Abbreviations

Ep: Epidermis; **ST:** Sarcotesta; **X:** Xylem; **Ph:** Phloem

Dispersal in the mesocarp are prominent vascular strands. The vascular strand is cup shaped with inner concavity. Xylem elements are in the from an area with outer zone of phloem elements. The vascular strand is 70 mm thick and 200 mm wide.

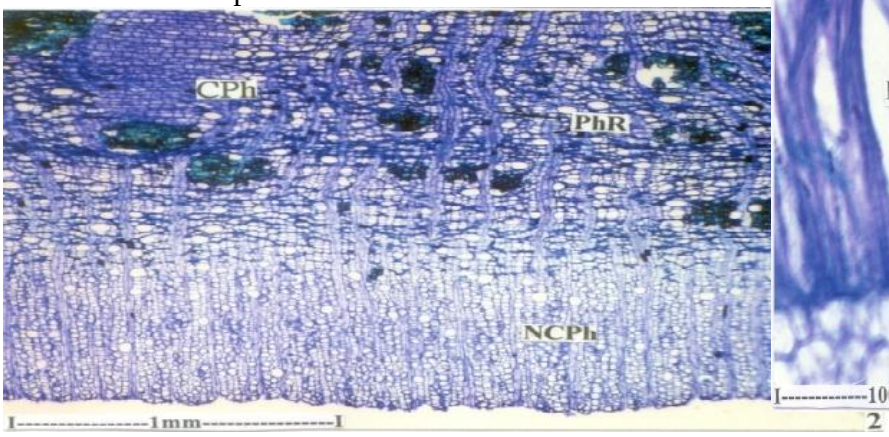
***In vivo* Stem Bark**

The bark is about 4 mm thick. It consists two primary zones, namely periderm and secondary phloem. Periderm it consists of three or four successive phellem cylinders with nonphellem cells in between the phellem cylinders.



Anatomy of the bark- T.S of bark through collapsed phloem

This type of alternating phellem and non phellem arrangement is called rhytidome. Secondary phloem it is major portion of the bark. It extends from the rhytidome to the vascular cambium. The secondary phloem can be and inner zone of noncollapsed phloem. Collapsed Phloem is wider than the non-collapsed zone.



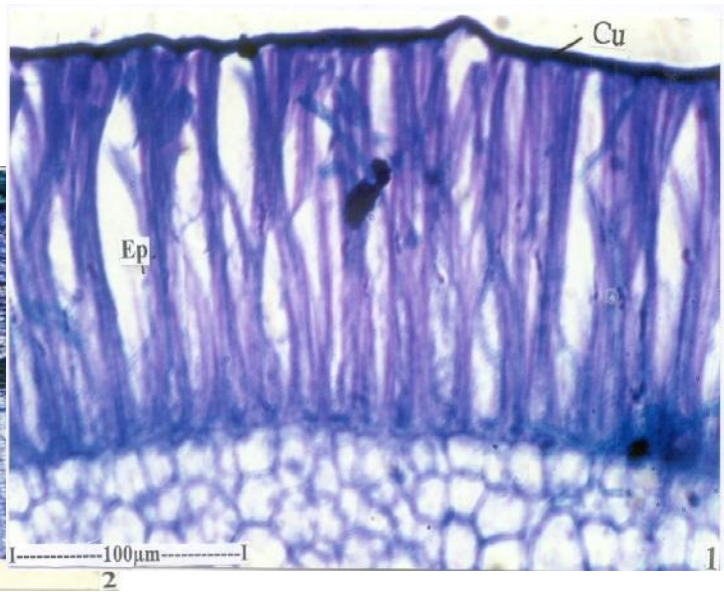
T.S of bark through collapsed and Non- collapsed phloem

CPh: Collapsed Phloem; **PhR:** Phellem Rays; **NCPh:** Non collapsed Phloem; **Sc:** Sclerenchyma

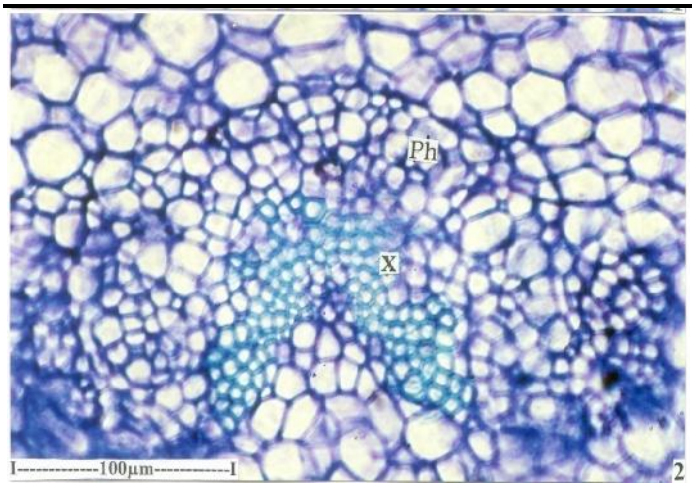
The noncollapsed phloem consists of dilated phloem rays dilated phloem parenchyma and crushed sieve elements. Small groups of sclerenchyma elements are scattered in the phloem tissue. The crushed sieve elements are seen in the form of tangential dark thick lines. Non collapsed Phloem this zone is about 600 mm wide. It has narrow undiated phloem rays, narrow parenchyma cells and intact sieve elements. Sclerenchyma cells are absent in the phloem. The sieve tubes are angular in outline thick walled and wide. They are 25-30 mm in diameter. The companion cells are prominent and lateral in position.

***In vivo* seed**

The seed has thick seed coats measuring 700 mm thick. It has wide, continous and smooth epidermis which is made up of thick Columnar or macrosclereids. This layer is 110 mm thick. Inner to the epidermis is a wide homogeneous parenchymatous region (Sarcotesta) where the cells are small, thin walled, polyhedral and compact. Dispersal in the mesocarp are prominent vascular strands. The vascular strand is cup shaped with inner concavity. Xylem elements are in the from an area with outer zone of phloem elements. The vascular strand is 70 mm thick and 200 mm wide.



Anatomy of the seed - Structure of the epidermal columnar sclereids



Vascular bundle of the sarcotesta enlarged

Abbreviations

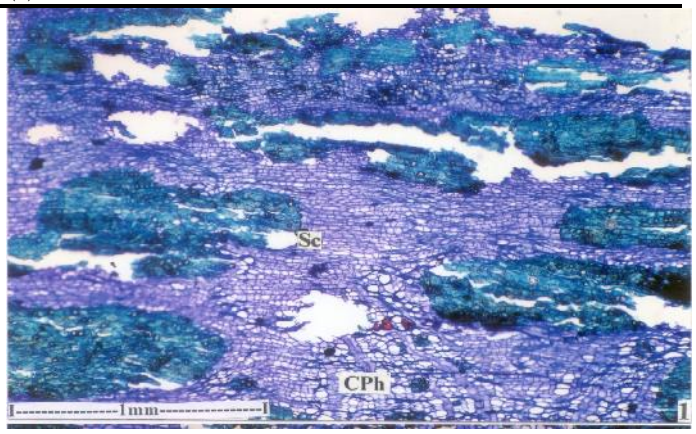
Cu: Columnar**; Ep:** Epidermis; **X:** Xylem; **Ph:** Phloem

***In vivo* Stem Bark**

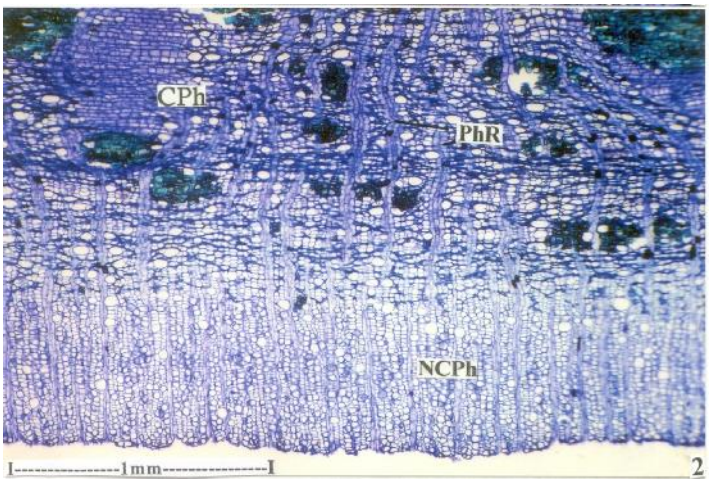
The bark is about 4 mm thick. It consists two primary zones, namely periderm and secondary phloem. Periderm it consists of three or four successive phellem cylinders with nonphellem cells in between the phellem cylinders. This type of alternating phellem and non phellem arrangement is called rhytidome. Secondary phloem it is major portion of the bark. It extends from the rhytidome to the vascular cambium. The secondary phloem can be and inner zone of noncollapsed phloem.Collapsed Phloem is wider than the non collapsed zone. The noncollapsed phloem consists of dilated phloem rays dilated phloem parenchyma and crushed sieve elements. Small groups of sclerenchyma elements are scattered in the phloem tissue. The crushed sieve elements are seen in the form of tangential dark thick lines.

Non collapsed Phloem

This zone is about 600 mm wide. It has narrow undiated phloem rays, narrow parenchyma cells and intact sieve elements. Sclerenchyma cells are absent in the phloem. The sieve tubes are angular in outline thick walled and wide. They are 25-30 mm in diameter. The companion cells are prominent and lateral in position.



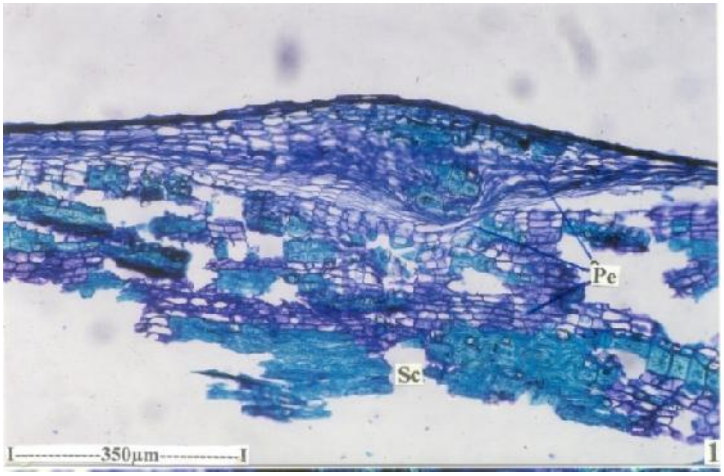
Anatomy of the bark- T.S of bark through collapsed phloem



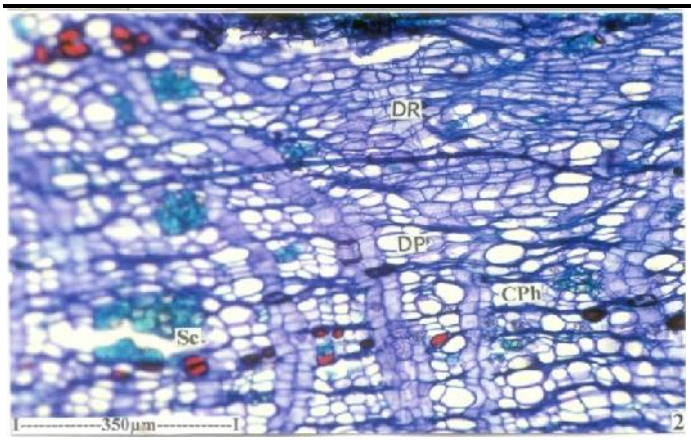
T.S of bark through collapsed and Non-collapsed phloem

Abbreviations

CPh: Collapsed Phloem; **PhR:** Phellem Rays; **NCPh:** Non collapsed Phloem; **Sc:** Sclerenchyma



Structure of the periderm and collapsed Phloem - T.S of periderm

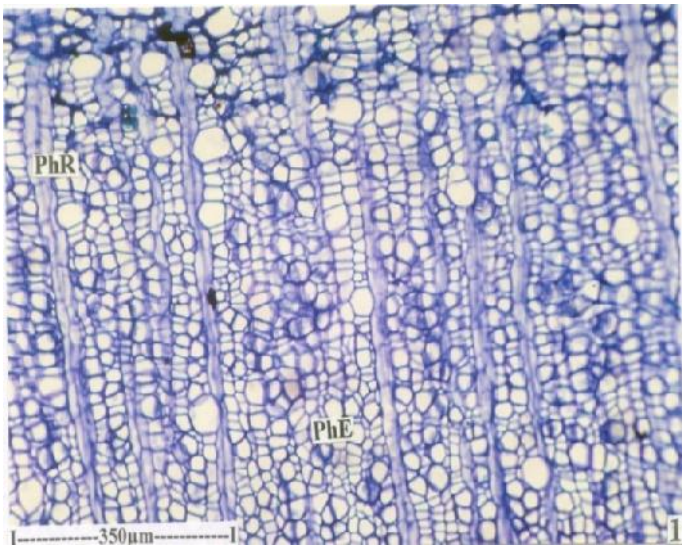


T.S of bark showing collapsed phloem

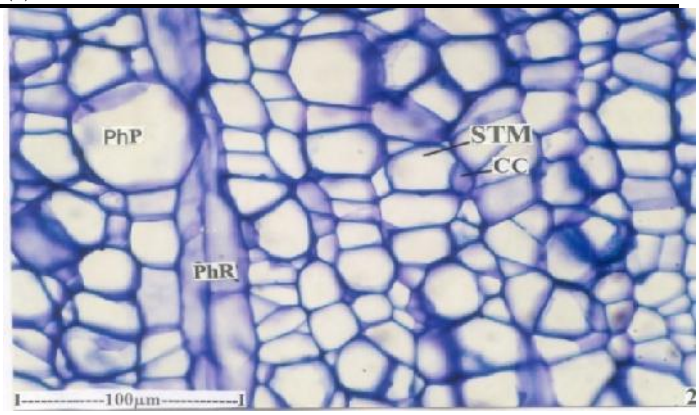
Sc: Sclerenchyma; Pe: Phloem elements; **CPh:** Collapsed Phloem; **DP:** Dilated phloem parenchyma; **DR:** Dilated phloem Rays

Tangential longitudinal sections (TLS) of the phloem

In TLS view, phloem appears nonsteried. The phloem rays are occasionally uniseriate, more predominantly biseriate or multiseriate. The rays are homocellular; the ray cells are polyhedral thin walled and compact. The rays are 150-250 mm in height. They are 30mm wide. Ray frequency is 9 or 10/ mm. The sieve tube members are wide straight and thick walled. They are 200-260 mm in height. The sieve plate is wide, oblique and compound, having about six bars per sieve plate.

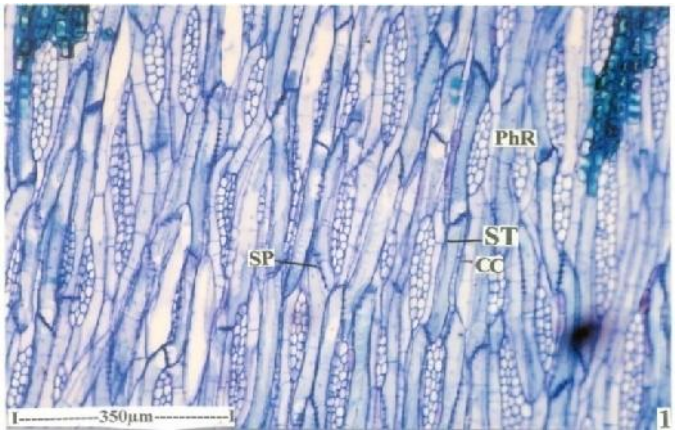


T.S of bark through Non- collapsed phloem

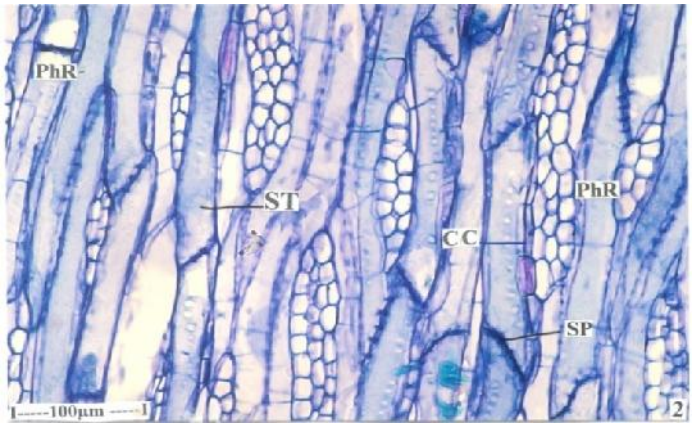


b.T.S of bark through Non-collapsed phloem magnified

PhR: Phellem Rays; **PhE:** Pholem Elements; **PhP:** Phloem Parenchyma; **STM:** Sarcotesta Macrosclerids; **CC:** Companion Cells



TLS of the bark- TLS of phloem under low magnification

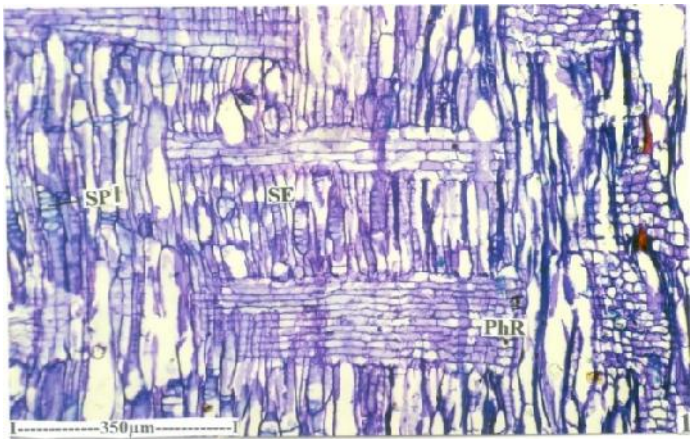


TLS of phloem Enlarged view

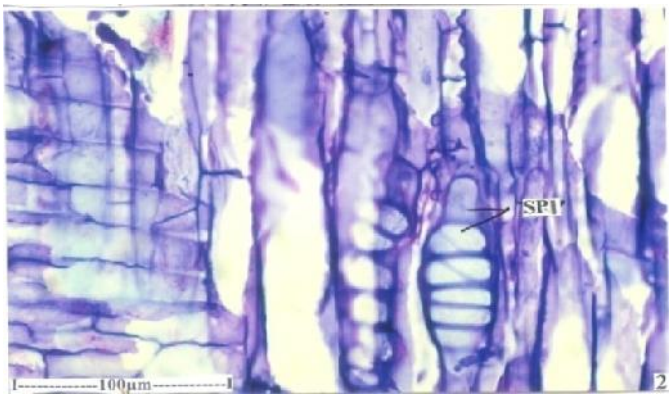
PhR: Phellem Rhytidome; **ST:** Sieve tubes; **CC:** Companion Cells; **SP:** Secondary phloem

Radial longitudinal Section (RLS) of the phloem

In RLS view, the phloem rays appear in horizontal ribbon like bends. They consist of horizontally oblong, rectangular, thin walled cells which are called procumbent cells. Running vertically at right angles to the phloem rays are sieve tubes and parenchyma cells. The sieve plate of the sieve tube member appear in full view plate is 120 mm in height and 30 mm in breadth. The sieve plate is compound having about six cross bars dividing the sieve plate into smaller units.



RLS of the bark- RLS of the phloem

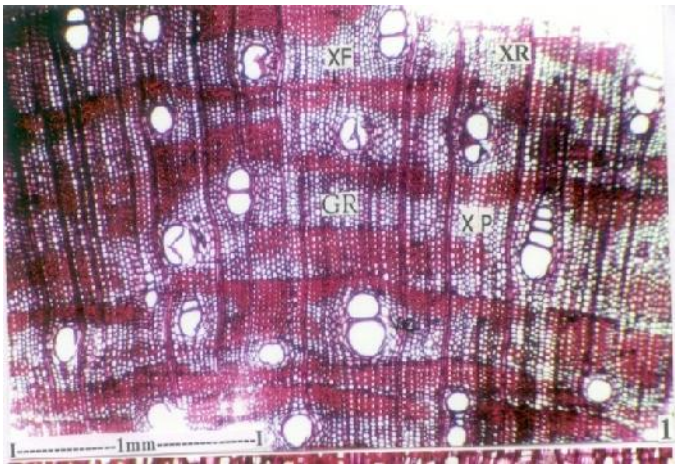


RLS of the phloem showing sieve plate

PhR: Phellem Rays; **SPI:** Sieve plate; **SE:** Sieve Elements

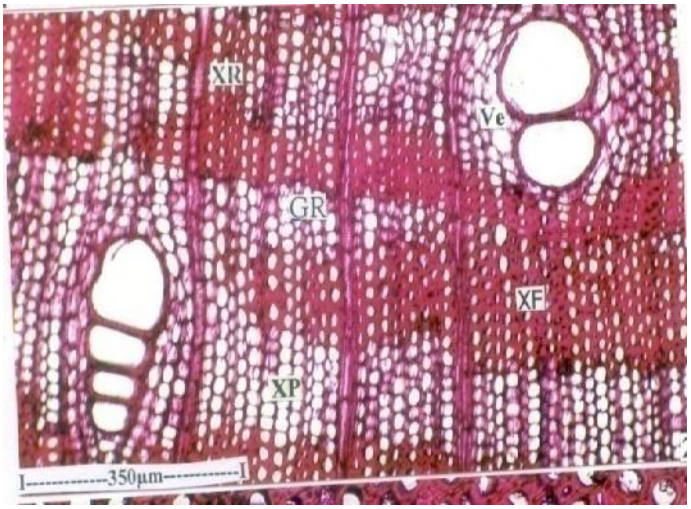
***In vivo* Wood**

The wood has distinct narrow growth rings; the growth rings are variable in bread the and the transition from summer wood to spring wood is gradual. The vessels are diffuse, solitary or in multiples of two or rarely four. The vessels are circular and thick walled. The narrow vessels are diffuse, solitary or in multiples of two or rarely four. The vessels are circular and thick walled. The narrow vessels are 10 mm in diameter; the wider ones are 20 mm diameter. The xylem rays are straight and narrow. They bend when crossing the vessel.



Anatomy of the wood- Cross anatomical features of the wood

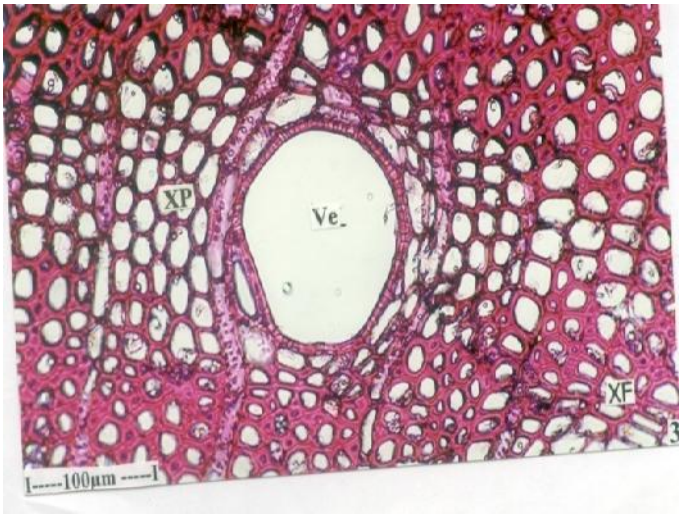
The xylem fibers are thick walled lignified. The summer wood fibers are narrow with thicker walls; the spring wood fibers are wide and comparatively thin walled. In TLS view, the wood has non-storied structure. The xylem rays are 1-3 seriate; short and narrow.



A sector of the wood magnified

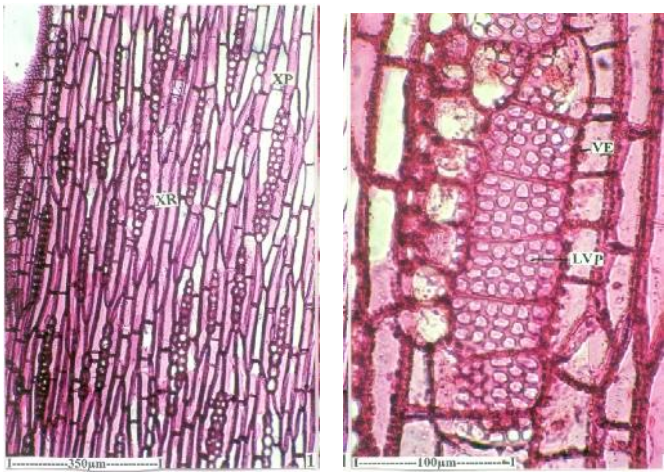
They are 100-200 mm in height and 20- 40 mm wide; ray frequency is 8-10/mm. The xylem fibers

are fusiform and septate; they have walls without pits. The vessels have well developed lateral wall pits; the pits are wide, hexagonal and alternate in arrangement. The xylem parenchyma cells have very thick walls and dense simple pits. RLS of the Wood in Radially LS view, the xylem rays appear homocellular, comprising of horizontally oblong procumbent cells. The cells of the ray have thick lignified walls and dense simple pits.



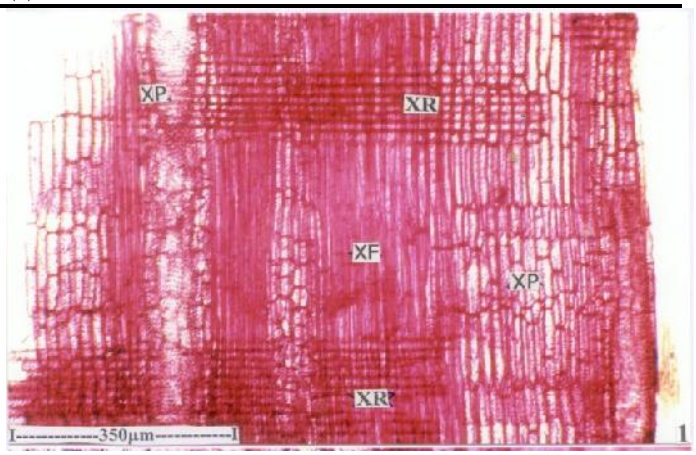
Xylem elements enlarged

XF: Xylem Fibres; **XP:** Xylem Parenchyma; **XR:** Xylem Rays; **GR:** Growth Rings; **Ve:** Vessel

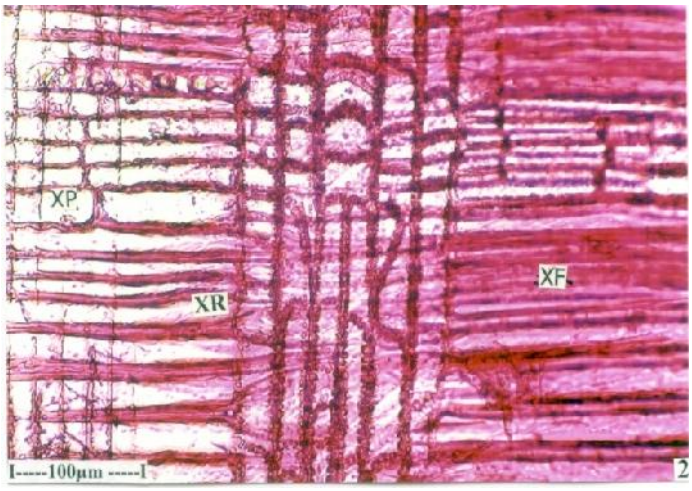


TLS of wood – TLS of wood showing xylem ray and xylem parenchyma A vessel element showing lateral wall pits

XP: Xylem Parenchyma; **XR:** Xylem Rays; **Ve:** Vessel; **LVP:** Lateral Vein pits



RLS of the wood - RLS of wood under low magnification



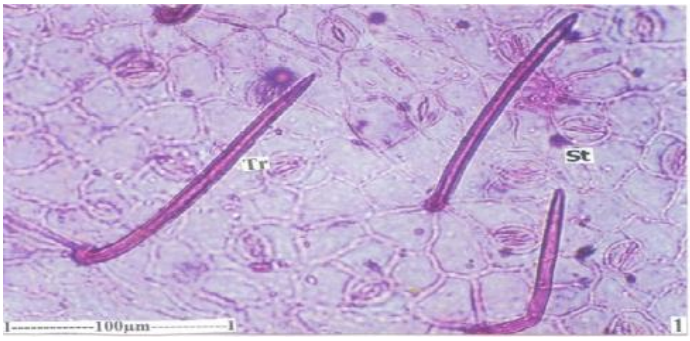
RLS of wood enlarged view

XP: Xylem Parenchyma; **XR:** Xylem Rays; **XF:** Xylem Fibres

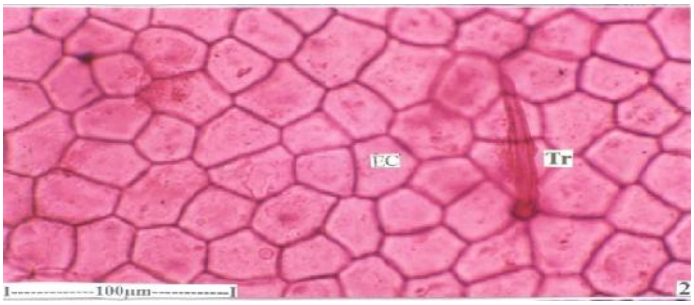
Powder Microscopic results

The dried leaves and flower were powdered and studied under microscope. Different staining reagents (such as iodine for detection of starch grains and phloroglucinol for detection of lignified components) were used. A little quantity of root bark powder was taken onto a microscopic slide; 1-2 drops of 0.1% w/v phloroglucinol solution and a drop of concentrated hydrochloric acid were added and covered with a cover slip. The slide preparation was mounted in glycerol and examined under microscope. The presence of starch grain and calcium oxalate crystal was detected by the

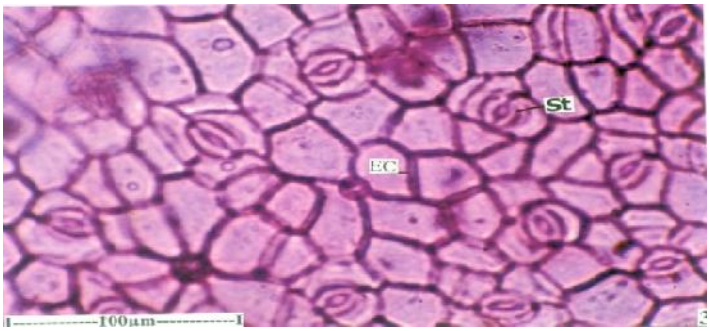
formation of blue colour on addition of 2-3 drops of 0.01 M iodine solution. The characteristic structures and cell components were observed and their photographs were taken using photomicrography. Leaf powder consists of epidermal trichomes and fragments of leaf epidermis. The trichomes are unicellular and un branched. They are short and narrow with uniform thickness. The walls are thick and inner is narrow. The trichomes are 130-150 mm long and 8 mm thick. The trichomes arise from the centre of rosette of epidermal cells. Adaxial epidermis**.**



Powder microscopy of the leaf



Adaxial epidermis



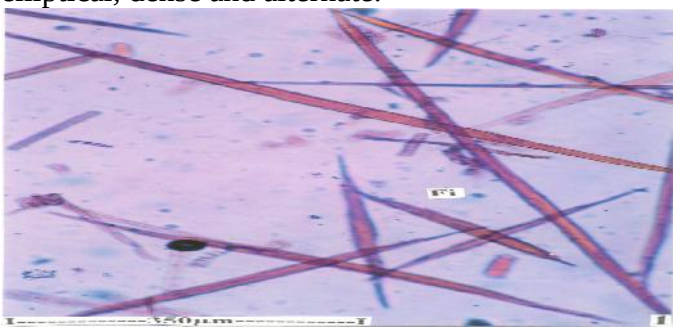
Fragment of abaxial epidermis with stomata

Tr: Trichomes; **St:** Starch; **EC:** Epidermal Cells

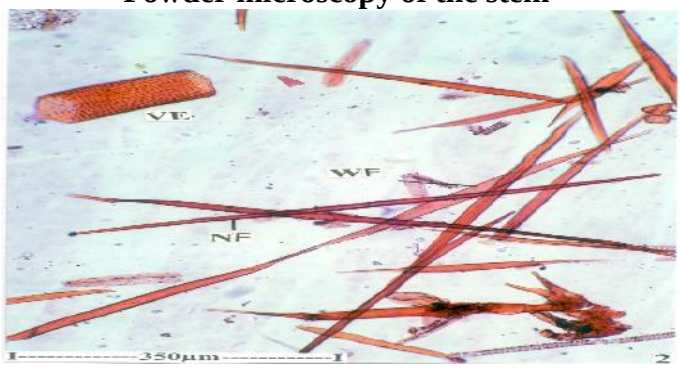
The walls have smooth surface. Abaxial epidermis is tomatiferous. The stomata are paracytic type with two parallel subsidiary cells. The epidermal cells are small, polygonal with thick, straight anticlinal walls. Fragments of upper (adaxial) epidermis are often seen in the powder. The epidermis has no often seen in the powder. The epidermis has no stomata. The cells are polyhedral, thick and straight walled.

Stem and Root powder

The powder contains vessel elements and xylem fibers. The vessel elements are wide, elongated and cylindrical. They have short tails. The perforation plate is simple and oblique. The lateral wall pits are elliptical, dense and alternate.



Powder microscopy of the stem



Narrow, wide fibres and vessel element

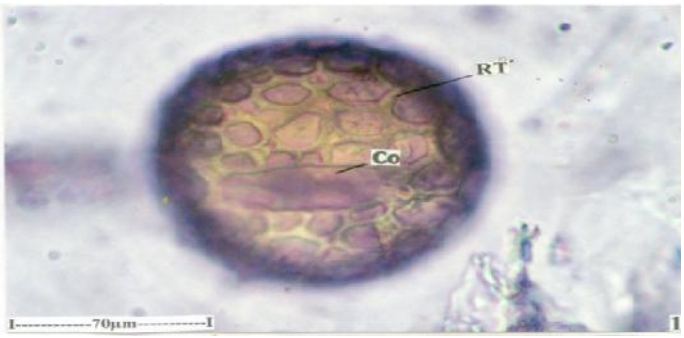
Tailed vessel element showing lateral wall pits

Fi: Fibres; **VE:** Vessel Element; **WF:** Wide Fibres; **NF:** Narrow Fibres; **PP:** Perforation Plate, **LWP:** Lateral Wall Pits

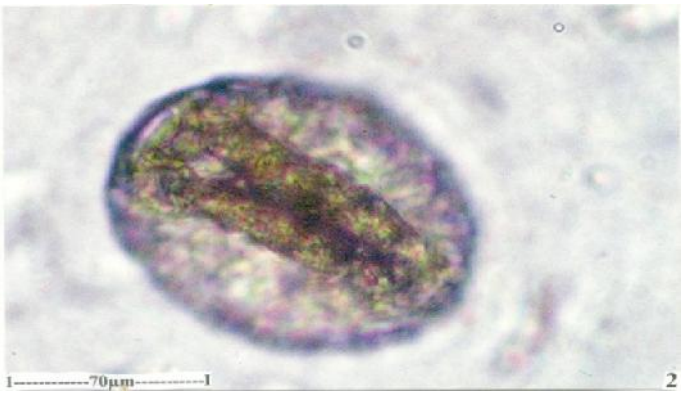
The vessel elements are 200 -250 mm long. The xylem fibers are either wide or narrow; the wide fibers have thin walls and shorter. The narrow fibers are thick walled and longer. The wide fibers are 300-500 mm long; the narrow fibers are more than 700 mm long.

Flower

The flower powder contains fragments of sepals and petals. Pollen grains are abundant in the powder. They are spherical in shape. The exine is reticulate; the reticulatious are thick and the areas are polyhedral. The pollen is monocolpate; the colpa is elliptical and wide extending from and to end.



Powder microscopy of the flower



Flower magnification view

RT: Reticulatious; **Co:** Colpa

Delonix elata widely used in traditional medicines has tremendous medicinal potential owing to its biological functions. However there are no detailed pharmacognostic studies on this plant to help in the proper identification. Hence the present study was undertaken with the aim to provide key diagnostic tools of identification.

Acknowledgments

The authors are thankful to the Dr. P. Jeyaraman, Director, Plant Anatomy Research Centre, Tamaram, Chennai for providing necessary facilities to complete the work. The financial support by University Grant Commission (UGC), New Delhi.

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