

## MACRO- AND MICROMORPHOLOGICAL STUDY OF THE ROOT, STEM, LEAVES AND SHEATH OF *FICUS ELASTICA* ROXB VAR. *DECORA*, FAMILY MORACEAE

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### Abstract

The macro- and micromorphological study of *Ficus elastica* Roxb var. *decora*, was carried out with the aim of finding out the characteristic features of the different organs of the plant in both entire and powdered forms.

### INTRODUCTION

*Ficus elastica* Roxb. var. *decora* is a large tree cultivated in Egypt. It belongs to family Moraceae that comprises around 53 genera and over 1400 species distributed mainly in tropical, subtropical regions and some are found in temperate regions<sup>(1-3)</sup>.

Some *Ficus* species were mentioned in several reports for their anti-inflammatory, analgesic, antihypertensive, hypoglycemic and antimicrobial activities<sup>(4-8)</sup>. The chemical study of the aerial parts of the plant has been carried out by the same authors of this article and resulted in the isolation of triterpenoids, a steroid, flavonoids and a cinnamic acid derivative and will be submitted soon for publication elsewhere.

The literature showed no report concerning the macro- and micromorphology of the plant. The present work covers macro- and micromorphological study of the root, stem, leaves and sheath with the aim of finding out the diagnostic features by which the plant can be easily identified in both entire and powdered forms.

### EXPERIMENTAL

#### Plant Material:

The plant material of *Ficus elastica* Roxb. var. *decora* was collected in April 2000 from the private garden of the Faculty of Pharmacy, Zagazig University, and was identified by Prof. Dr. Abd El-Aziz Kamel Dawh, Prof. of Horticulture, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. Fresh samples were used throughout the study.

#### I. Macromorphology:

*Ficus elastica* Roxb. var. *decora* (Fig. 1A) is a large tree that reaches up to 10 m in height. It shows spreading branches with reddish-green sheath at the growing tips<sup>(9)</sup>. The trunk and other parts of the tree exude a thick white latex by incision to produce rubber<sup>(10)</sup>. The plant shows a large woody root.

The young root (Fig. 1B) is dark brown, cylindrical, fusiform, tap root, bearing many short tapering branched lateral roots with smaller rootlets. It has rough surface and breaks with a fibrous fracture showing a yellowish interior. It measures 20-40 cm in length and 4-10 cm in diameter.

The main trunk of the plant (Fig 1A) is erect, cylindrical, woody, reaching up to 10 m in height and

50-70 cm in diameter. The outer surface is brown in color, rough, wrinkled and some times shows lenticels. The terminal and lateral branches (stems) (Figs. 1A & 1C) are thinner and having short internodes, green, glabrous, faintly longitudinally striated and measure 4-10 cm in length and 2-3 cm in diameter.

The leaves (Figs. 1A & 1D) are large, leathery, glabrous, alternate, exstipulate, simple, ovate with acuminate, recurved apices, symmetric bases and entire margins. They measure 15-30 cm in length and 13-18 cm in breadth. The upper surface is dark green while the lower one is lighter in color. Leaves are pinnately veined with large central vein that is prominent at the lower surface, joining the secondary veins almost at right angles and running parallel up to the margin with distinct reticulate venation in between<sup>(9)</sup>. The petiole is cylindrical, solid, glabrous and green in color. It measures 4-6 cm in length and 0.5-1 cm in diameter.

The young leaves are enclosed inside a delicate reddish green sheath (Fig. 1E) at the terminal tapering ends of the branches. The sheath measures 20-22 cm in length and 0.5-3.5 cm in breadth.

#### II. Micromorphology:

(Cell dimensions of the different tissues of the root, stem, leaf, and sheath are listed in Table 2)

#### The root

A transverse section through the root (Fig. 2B) is almost rounded in outline. It has an outer brownish cork followed by a wide parenchymatous phelloderm traversed by a complete ring of thick-walled lignified sclereides in its outer part. Laticiferous tubes (canals) and diffused small groups of lignified fibers are observed in the cortical region. The pericycle is formed of an interrupted ring of lignified fibers surrounding a wide vascular tissue. The vascular tissue comprises a narrow phloem and a wide xylem with a central tetrarch primary xylem.

The cork (Figs. 2B & 3A) is wide and consists of 3-5 layers of polygonal, moderately thick-walled, suberized, tangentially elongated cells arranged in radial rows.

The phelloderm (Figs. 2A & 2B) is parenchymatous and traversed by a continuous ring of lignified sclerenchymatous layer. The sclerenchymatous layer (Figs. 2B & 3B) consists of 1-2 rows of thick-walled

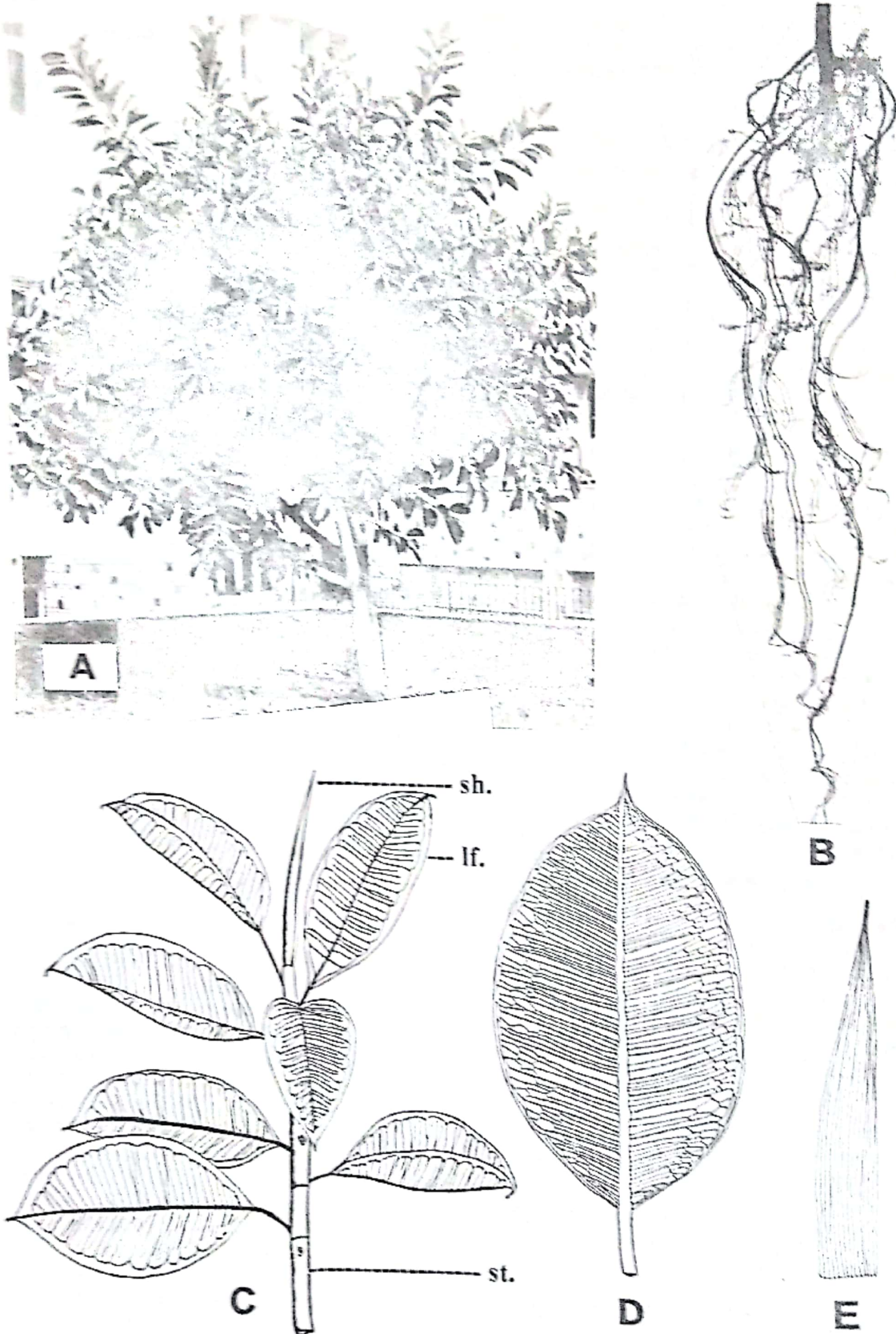


Fig. (1): Macromorphology of *Ficus elastica* Roxb. var *decora*

- |                        |           |             |           |
|------------------------|-----------|-------------|-----------|
| A- The whole tree      | (X 0.017) | B- The root |           |
| C- Branch of the plant | (X 0.150) | D- The leaf | (X 0.180) |
| E- The sheath (opened) | (X 0.300) |             | (X 0.300) |
- lf., leaf; sh., sheath; st., stem.

pitted lignified sclereides. The parenchymatous layer (Fig. 2B) is formed of 15-30 rows of thin walled cellulosic cells with narrow intercellular spaces. Numerous branched laticiferous tubes, as well as, few groups fusiform fibers with acute apices and narrow lumens are scattered throughout the parenchymatous phelloderm. The fibers have non-lignified outer walls but lignified inner sides. The laticiferous tubes contain grey granular contents which give greenish color with ferric chloride (T.S) and a yellowish-brown color with caustic alkali.

The pericycle (Fig. 2B) consists of numerous groups of lignified fibers (10-40 fibers in each group) that are separated by parenchyma. The pericyclic fibers (Figs. 2B & 3B) have thick non-lignified outer walls and lignified inner sides with narrow lumens and acute apices. Laticiferous tubes (Figs. 2B & 3B) are found within the parenchyma and associated with fibers.

The vascular tissue (Fig. 2B) is formed of an outer narrow phloem and an inner xylem with cambium in between and transversed by uniseriate medullary rays. The phloem (Fig. 2B) consists of polygonal, thin-walled cellulosic elements showing few idioblasts containing brown contents. The cambium (Fig. 2B) consists of 5-7 rows of thin-walled, tangentially elongated, rectangular meristematic cells. The xylem (Figs. 2B & 3B) is wide and consists of lignified xylem vessels, wood parenchyma and wood fibers that are arranged alternatively with thin walled cellulosic parenchyma to form lignified and non-lignified tangential bands traversed radially by thick-walled lignified and pitted medullary rays. Xylem vessels (Figs. 2B & 3B) have thick lignified walls and are of annular and pitted types. The wood parenchyma is vasocentric and formed of polygonal, thick walled, lignified, pitted walls. Wood fibers are fusiform with thick lignified walls, narrow lumens and acute apices. Calcium oxalate clusters and prisms are numerous especially in the wood parenchyma surrounding the wood fibers forming crystal sheath (Fig. 2B & 3B). The medullary rays (Figs. 2B & 3B) are 1-2 cell wide, usually uniseriate and radially elongated being sub-rectangular cellulosic in the phloem region and thick-walled, lignified, pitted in the xylem region.

#### Powdered root

The powdered root (Fig. 3) is yellowish brown in color with faint characteristic odor and bitter taste. It is characterized microscopically by the following:

- 1- Fragments of polygonal thick-walled suberized cork cells.
- 2- Fragments of thick-walled lignified and pitted sclereides with narrow or wide lumens.
- 3- Fragments of branched laticiferous tubes with greyish granular contents.
- 4- Fragments of fusiform pericyclic fibers with thick lignified walls, narrow lumens and acute apices.

- 5- Fragments of lignified annular and pitted xylem vessels.
- 6- Fragments of thick-walled lignified wood fibers accompanied by parenchyma containing prism and cluster crystals of calcium oxalate (forming crystal sheath).
- 7- Fragments of thick-walled lignified and pitted wood parenchyma.
- 8- Fragments of thick-walled lignified and pitted medullary rays.
- 9- Isolated cluster and prismatic crystals of calcium oxalate.
- 10- Starch is absent.

#### The stem

A transverse section through the stem (Fig. 4A) is nearly circular in outline showing an outer epidermis surrounding a wide cortex. The cortex shows 2-3 layers of subepidermal parenchyma, 7-12 layers of collenchyma and 15-17 layers of thick-walled parenchyma. The endodermis is well distinguished. The pericycle consists of an interrupted ring of non-lignified fibers surrounding a wide vascular cylinder and a central pith.

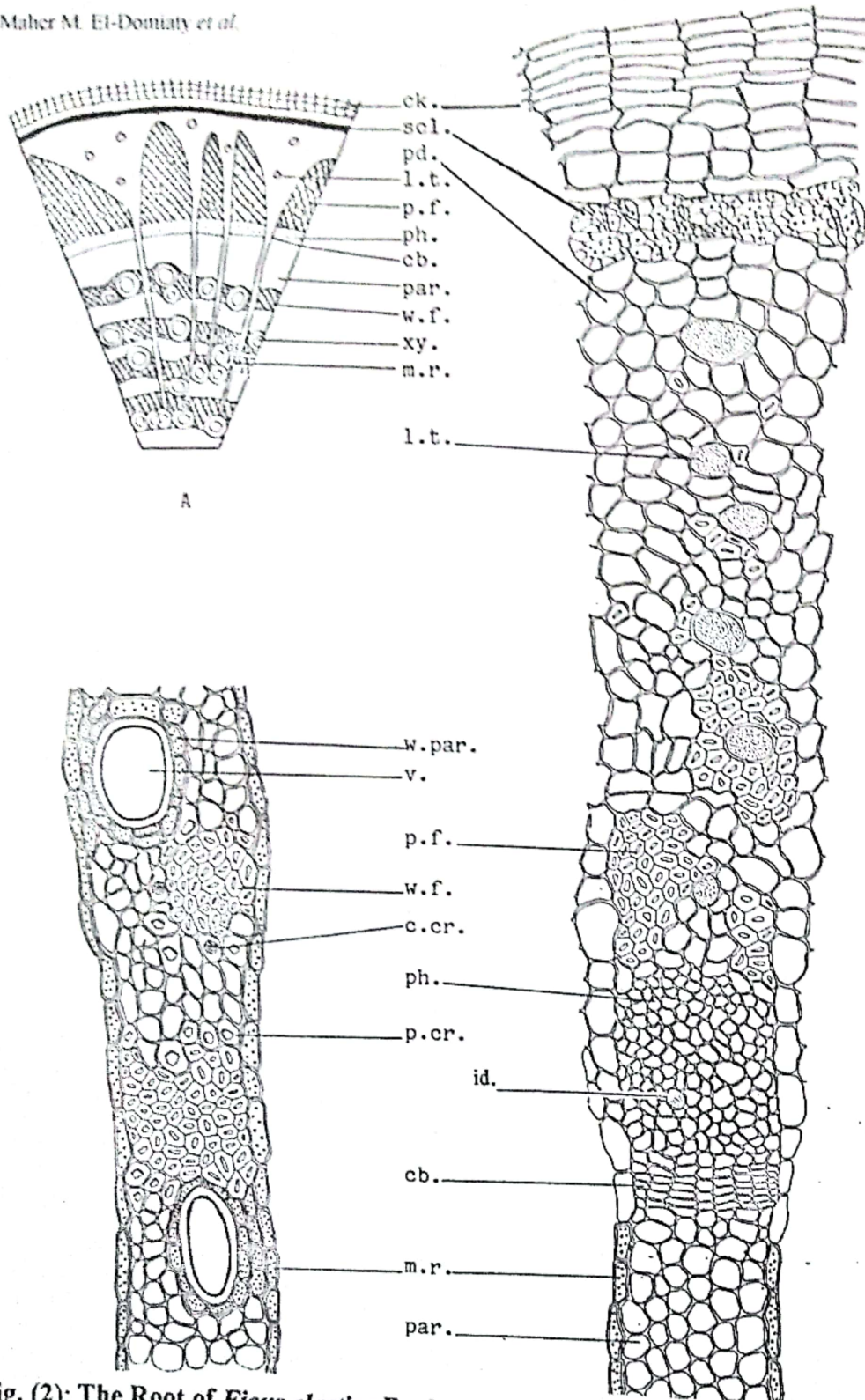
The epidermal cells of the stem (Figs. 4B, 5A) are polygonal to sub-rectangular with straight anticlinal walls and covered with thick, smooth cuticle. Cluster and prismatic crystals of calcium oxalate are frequently observed in the epidermal cells. Stomata and trichomes are absent. The cortex (Figs. 4A & 4B) is formed of 2-3 layers of thin-walled cellulosic hypodermal parenchyma showing few scattered lignified thick-walled sclereides followed by a layer of collenchyma in 7-12 rows of small thick-walled cellulosic cells and a parenchymatous layer comprising 13-18 rows of thick-walled cells with wide intercellular spaces.

Laticiferous tubes and idioblasts containing cluster and prismatic crystals of calcium oxalate are frequently distributed in the cortical parenchyma. The laticiferous tubes are simple, non-branched and fusiform in shape. They contain greyish granular contents that give greenish color with ferric chloride (T.S) and an intense yellowish-brown color with caustic alkali. Calcium oxalate clusters and prisms are also found.

The endodermis (Fig. 4B) is composed of well-differentiated parenchyma but with no casparian strips.

The pericycle (Figs. 4B & 5B) consists of groups of non-lignified fibers (9-15 fibers in each group). The fibers having wide lumens and acute or blunt apices.

The vascular system of the stem (Fig. 4B) consists of a continuous ring of an outer phloem and an inner xylem showing cambium in-between and traversed by biseriate medullary rays. The phloem (Fig. 4B) consists of polygonal thin-walled cellulosic elements.



**Fig. (2): The Root of *Ficus elastica* Roxb. var *decora*.**

A- Diagrammatic transverse section of the root

B- Detailed transverse section of the root

(X 24)  
(X 188)

ca.ox., calcium oxalate; cb., cambium; c. cr. cluster crystal of calcium oxalate; ck., cork; id., idioblast; l.t., laticiferous tube; m.r., medullary ray; par., parenchyma; p.f., pericyclic fiber; pd., phelloderm; ph., phloem; p.cr., prismatic crystal of calcium oxalate; scl., sclereides; v., vessels; w. par., wood parenchyma; w.f., wood fiber.

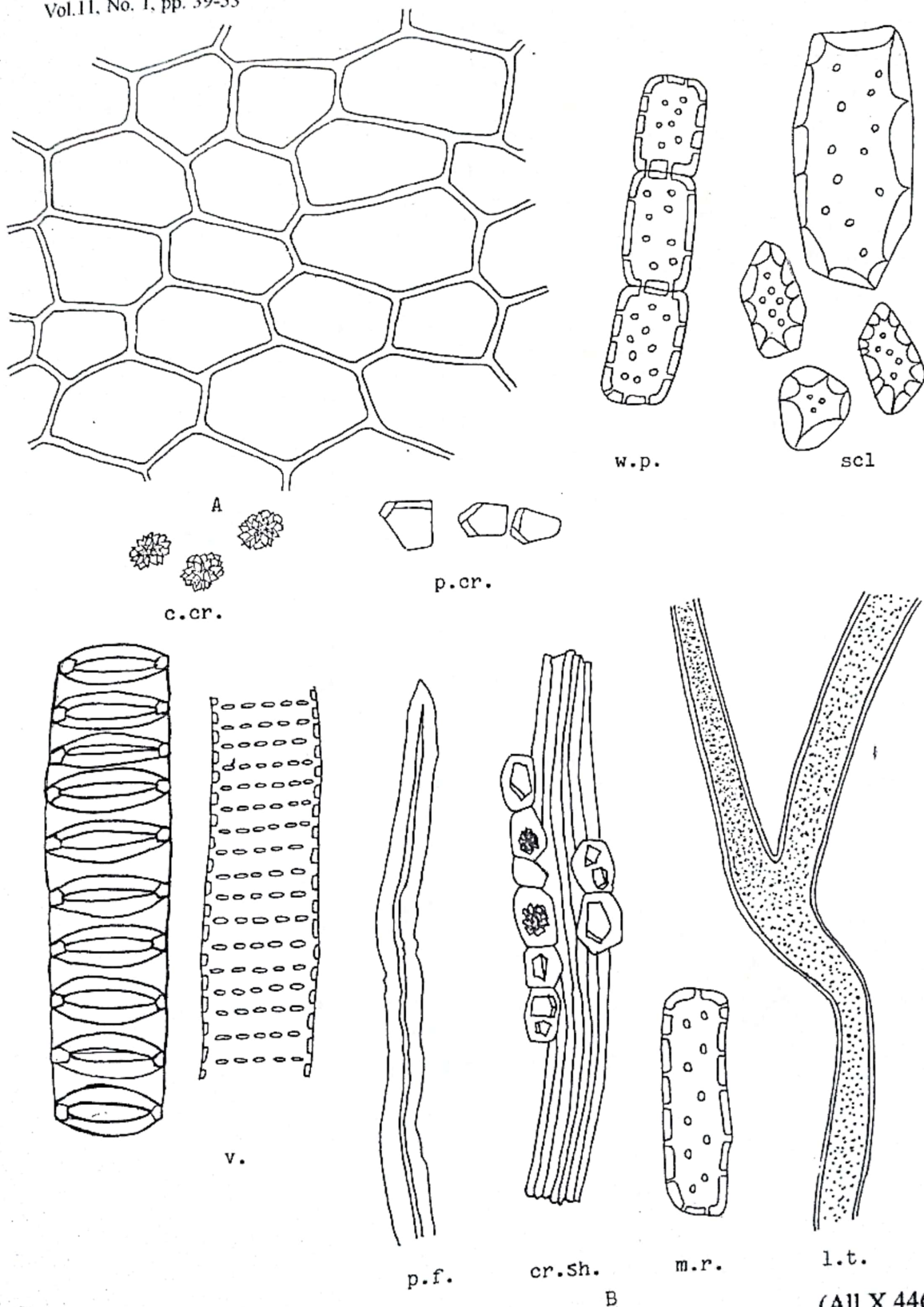
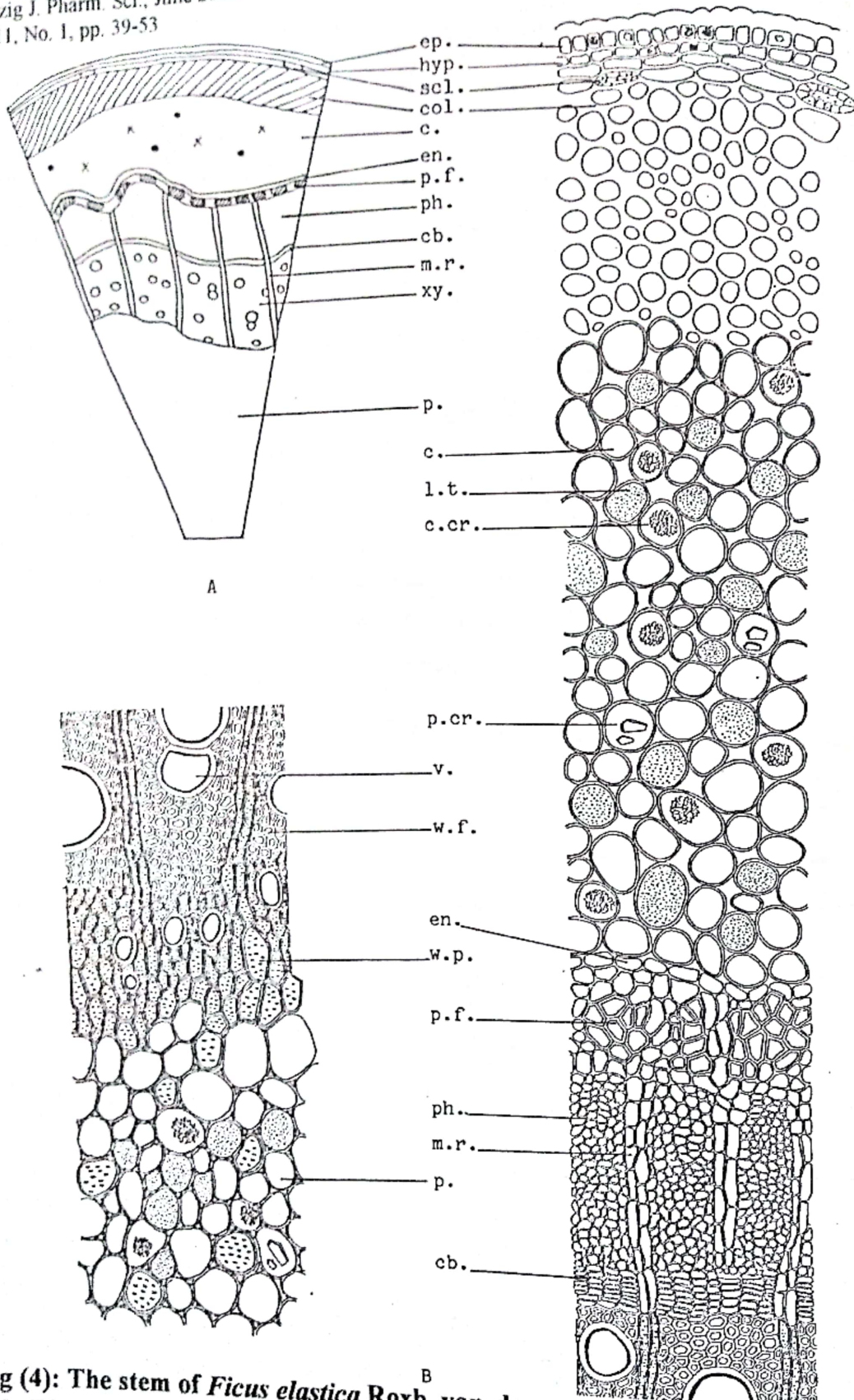


Fig (3): The root of *Ficus elastica* Roxb. var. *decora*.

- A- Cork cells of the root.
- B- Isolated elements of the root:

c. cr. caox., cluster crystal of calcium oxalate; ck., cork cells; cr. sh., crystal sheath; l.t., laticiferous tube; m.r., medullary ray; pd., phelloderm; p.f., pericyclic fiber; p.cr., prismatic crystal of calcium oxalate; scl., sclereides; v., vessels; w.p., wood parenchyma.



**Fig (4): The stem of *Ficus elastica* Roxb. var. decora**  
 A- Diagrammatic transverse section the young stem  
 B- Detailed transverse section of the stem

(X 23)  
 (X 184)

c., cortex; cb., cambium; c.cr., cluster crystal of calcium oxalate; col., collenchyma; end., endodermis; ep., epidermis; hyp., hypodermis; l.t., laticiferous tube; m.r., medullary ray; ph., phloem; per., pericycle; p.f., pericyclic fiber; p., pith; scl., sclereides; v., vessel; w.f., wood fiber; w.p., wood parenchyma.

The cambium (Fig. 4B) consists of 6-8 layers of rectangular thin-walled meristematic cells. The xylem (Fig. 4B & 5B) consists of lignified spiral and annular vessels, accompanied by lignified wood fibers having narrow lumens and acute apices in addition to lignified pitted wood parenchyma. The medullary rays (Figs. 4A & 4B) are mainly biseriate and composed of sub-rectangular cells with non-lignified walls in the phloem region and thick-walled lignified pitted walls in the xylem region.

The pith (Fig. 4B) consists of somewhat large rounded thin-walled parenchyma with narrow intercellular spaces. Idioblasts containing prismatic and cluster crystals of calcium oxalate are observed. Laticiferous tubes containing greyish granular contents that give greenish color with ferric chloride (T.S) and intense yellowish-brown color with caustic alkali are also present. Few scattered thick-walled lignified, pitted parenchyma are observed.

#### Powdered stem

The powdered stem (Fig. 5) is dark green in color with faint characteristic odor and bitter taste. It is characterized microscopically by the following:

- 1- Fragments of polygonal epidermal cells with straight anticlinal walls, covered with smooth, thick cuticle and frequently contain prism and cluster crystals of calcium oxalate.
- 2- Fragments of idioblasts containing cluster and prismatic crystals of calcium oxalate.
- 3- Fragments of non-lignified pericyclic fibers with wide lumens and acute or blunt apices.
- 4- Fragments of lignified spiral and annular xylem vessels.
- 5- Fragments of thick-walled lignified wood fibers with narrow lumens and acute apices.
- 6- Fragments of lignified, pitted wood parenchyma and medullary rays.
- 7- Fragments of simple, non-branched laticiferous tubes containing granular contents.
- 8- Fragments of isolated thick-walled lignified sclereides.
- 9- Starch and trichomes are absent.

#### The leaf

A transverse section through the leaf (Fig. 6A) shows an isobilateral structure with one row of upper and lower palisade, both being interrupted by collenchyma in the midrib region. It shows 1-5 layers of parenchymatous hypodermis below the upper and lower epidermises. The midrib is prominent on both sides but more prominent at the lower surface and traversed by a large vascular bundle in a dissected ring where the lower part has a crescent shape. The vascular bundle is surrounded by lignified pericyclic fibers.

The upper and lower epidermises (Figs. 6B, 6C & 6D) are formed of polygonal cells with straight anticlinal walls and covered with thick, smooth

cuticle. The upper and lower neural epidermal cells (Figs. 6E, 6F & 7) are polygonal and axially elongated with almost straight anticlinal walls and covered with thick smooth cuticle. Stomata (Fig. 6D) are present only on the lower epidermis. They are oval or rounded in outline, of the anomocytic type and each is surrounded by 4-5 subsidiary cells. Calcium oxalate clusters frequently occur in the epidermal cells of both surfaces. Trichomes are absent.

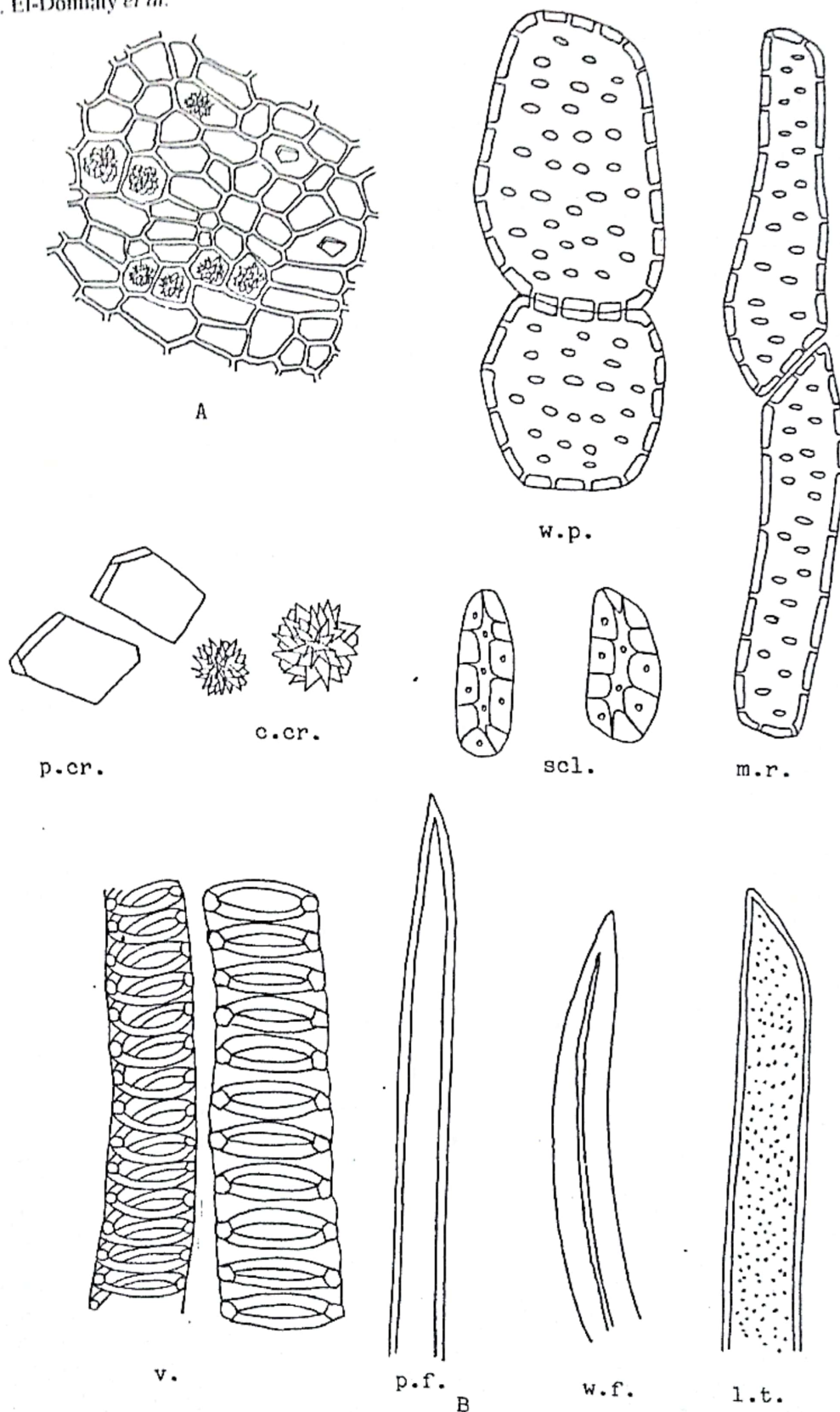
The mesophyll (Fig. 6A & 6B) is isobilateral with one row of upper and lower palisade cells separated from the upper and lower epidermises by 1-5 layers of parenchymatous hypodermal cells and encloses a wide spongy tissue in-between. The hypodermis (Fig. 6B) is composed of large thin-walled parenchyma varying from small rounded to large elongated giant cells. The upper hypodermal cells are much larger than the lower ones. The palisade cells (Fig. 6B) are columnar with thin straight radial walls. The spongy tissue (Fig. 6B) is formed of 20-24 rows of thin-walled more or less rounded parenchyma cells showing wide intercellular spaces.

In the midrib region, the cortex (Fig. 6A & 7) is parenchymatous with subepidermal layer followed by a wide region of angular collenchyma abutting the upper and lower epidermises. The hypodermis consists of 1-2 rows of thin-walled cellulosic parenchyma. The angular collenchyma consists of 7-10 layers of thick-walled cellulosic cells while the parenchyma region is formed of 12-16 rows of thick-walled cellulosic cells with wide intercellular spaces.

The pericycle (Fig. 6A, 6G & 7) is formed of an interrupted ring of fibers in 2-3 rows being lignified in old leaf and non-lignified in young one. The fibers are spindle shaped with thick-walls, acute apices and wide lumens.

The vascular tissue (Fig. 6A & 7) consists of collateral vascular bundles with few groups of perimedullary phloem within the vascular ring. It is composed of an interrupted ring of an outer phloem and inner xylem surrounding a parenchymatous pith. The phloem (Fig. 7) is formed of polygonal thin-walled cellulosic elements. The xylem (Fig. 6G) is formed of lignified annular and pitted vessels and few pitted lignified tracheids. Fusiform thick-walled lignified wood fibers with acute apices and wide lumens in addition to thick-walled, pitted, lignified wood parenchyma are present. The pith (Fig. 7) is formed of thin-walled cellulosic parenchyma with narrow intercellular spaces.

Numerous simple, long, non-branched laticiferous tubes and cells containing greyish granular and yellowish brown contents, respectively are observed in the mesophyll, cortex and pith (Figs. 6B, 6G & 7). The granular contents give greenish color with ferric chloride (T.S) and yellowish-brown color with caustic alkali. (Figs. 6A, 6B, 6C & 7). Clusters and prismatic crystals of calcium oxalate (Figs. 6A, 6B, 6C & 7) are



**Fig (5): The stem of *Ficus elastica* Roxb. var. *decora***

A- Epidermal cells of the stem.  
 B- Isolated elements of the stem.

(All X 493)

c.cr., cluster crystal of calcium oxalate; l.t., laticiferous tube; m.r., medullary ray; p.cr., prismatic crystal of calcium oxalate; p.f., pericyclic fiber; v., vessels; w.f., wood fiber; w.p., wood parenchyma.



also observed while trichomes are absent. The microscopical numerical values of the leaf are summarized in Table 1.

**Table 1:** Microscopical numerical values of the leaf of *Ficus elastica* Roxb. var. *decora*

The numerical value	Recorded value
Stomatal index of lower epidermis	7.2 – 9.2
Palisade ratio of upper palisade	1-3
Palisade ratio of lower palisade	2-5
Vein-islet number.	2-4
Veinlet-termination number	12-18

#### Powdered leaves:

The powdered leaves (Figs. 6C, 6D & 6G) are dark green in colour with characteristic odour and bitter taste. The diagnostic characters are :

- 1- Fragments of upper and lower epidermises of the leaves with polygonal, nearly isodiametric cells, having straight anticlinal walls, covered with thick smooth cuticle and showing anomocytic stomata on the lower one. Cluster crystals of calcium oxalate are frequently observed in the epidermal cells of both surfaces.
- 2- Fragments of the lamina in sectional view showing isobilateral structure.
- 3- Fragment of the upper and lower neural epidermal cells.
- 4- Fragments of simple, non-branched laticiferous tubes containing granular contents in addition to laticiferous cells containing yellowish-brown contents.
- 5- Fragments of pericyclic fiber with slightly lignified walls, wide or narrow lumens and acute apices.
- 6- Fragments of lignified annular and pitted xylem vessels as well as, tracheids
- 7- Fragments of fusiform, lignified wood fibers with acute apices and wide lumens .
- 8- Fragments showing lignified and pitted wood parenchyma.
- 9- Calcium oxalate clusters and prisms are frequently observed
- 10- Starch and trichomes are absent.

#### The petiole

A transverse section through the petiole (Fig. 8A) is nearly circular in outline. It shows an outer epidermis surrounding a comparatively wide cortex which consists of one row of subepidermal parenchyma and several layers of angular collenchyma followed by a wide zone of thick-walled parenchyma. The endodermis is distinct. The pericycle is parenchymatous enclosing a ring of radial collateral vascular bundles with few groups of perimedullary phloem on the inner side and a central pith.

The epidermal cells of the petiole (Figs. 8B & 8C) are polygonal isodiametric with straight anticlinal walls and covered with thick smooth cuticle.

Numerous prisms and cluster crystals of calcium oxalate are observed in the epidermal cells. Stomata and trichomes are absent.

The cortex (Figs. 8A & 8B) consists of an outer layer of parenchymatous hypodermis followed by 12-14 rows of angular collenchyma and 17-19 rows of nearly rounded to oval thick-walled parenchyma with wide intercellular spaces. Laticiferous tubes containing granular contents, as well as, laticiferous cells containing brown contents are observed in the parenchymatous region. Cluster crystals of calcium oxalate are observed only in the hypodermal layer.

The endodermis is differentiated as a single row of tangentially elongated cellulose cells with no casparian strips. The pericycle (Fig. 8B) consists of 6-8 layers of thin-walled cellulose parenchyma.

The vascular tissue (Fig. 8A & 8B) is formed of several groups of radially arranged collateral vascular bundles separated by parenchymatous, non-lignified medullary rays and showing few perimedullary phloem at the inner side of the bundles. The phloem (Fig. 8B) is formed of thin-walled cellulose elements showing few laticiferous tubes with granular contents and laticiferous cells with yellowish brown contents. The cambium (Fig. 8B) is distinct and formed of 3-4 rows of thin-walled meristematic cells.

They xylem (Figs. 8B & 8D) consists of lignified spiral, annular vessels and non-lignified wood parenchyma, as well as, biseriate medullary rays.

The pith (Fig. 8B) is formed of nearly rounded thin-walled parenchyma becoming larger to the inside. Few laticiferous tubes containing granular contents are observed which give greenish color with ferric chloride (T.S) and intense yellowish brown color with caustic alkali.

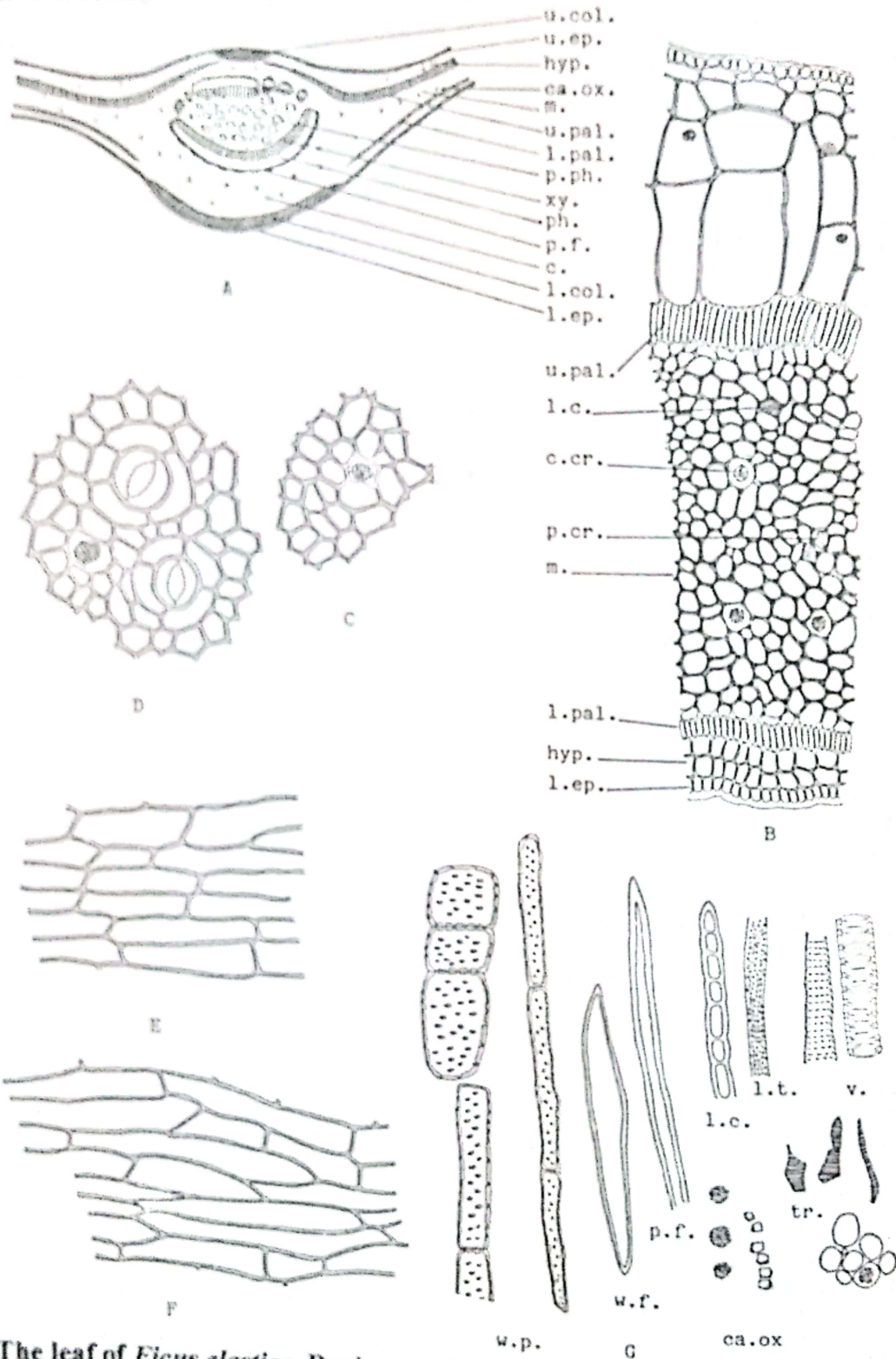
#### Powdered petiole

The powdered petiole (Fig. 8D) is green in color with characteristic odor and bitter taste. It is characterized microscopically by the following :

- 1- Fragments of polygonal isodiametric epidermal cells covered with thin smooth cuticle and showing numerous prisms and clusters of calcium oxalate crystals.
- 2- Fragments of spiral and annular lignified xylem vessels.
- 3- of phloem tissue showing laticiferous tubes. Fragments
- 4- Fragments of isolated laticiferous tubes and laticiferous cells with brown contents.
- 5- Starch and trichomes are absent.

#### The sheath

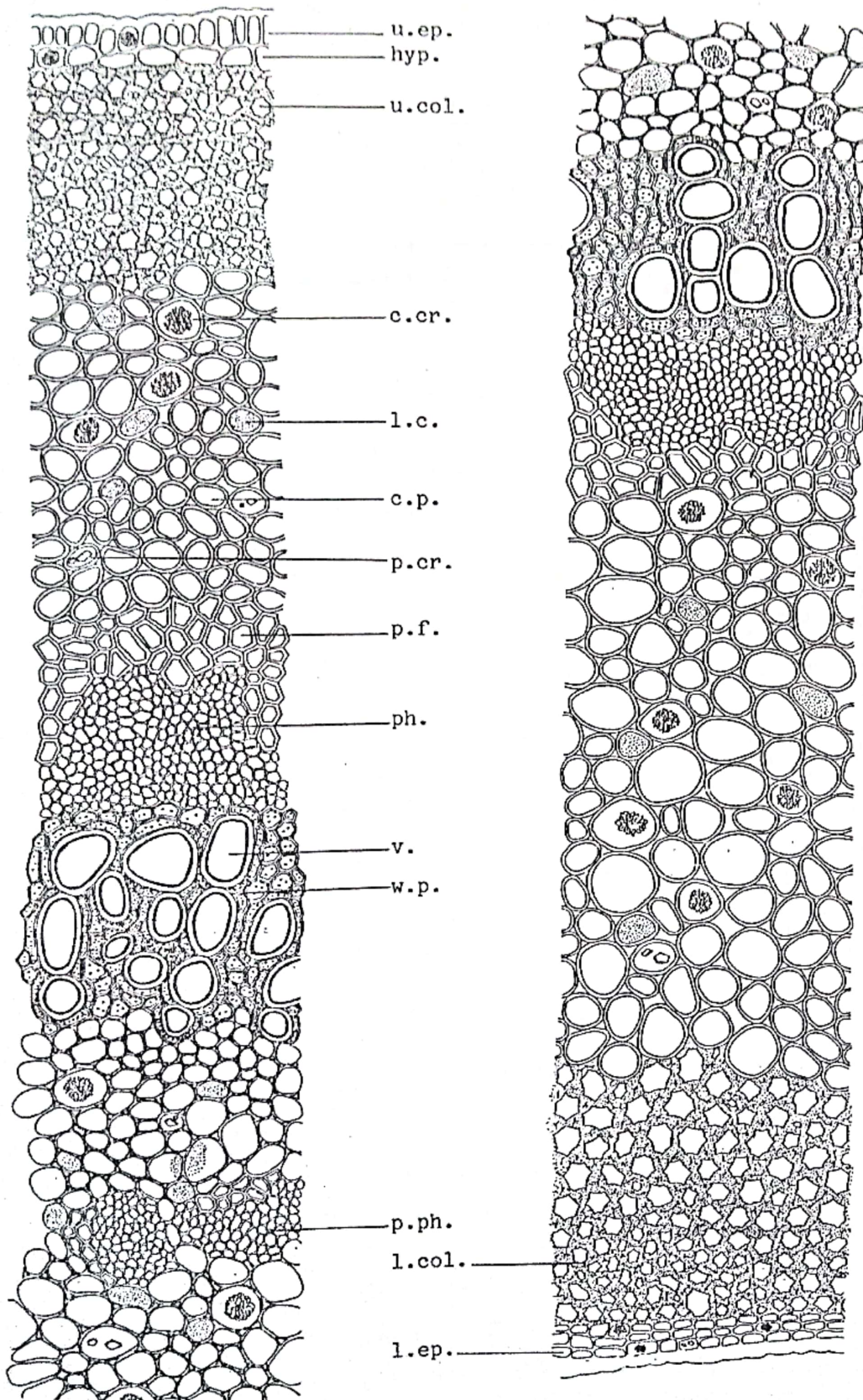
A transverse section through the sheath (Figs. 9A & 9B) shows an upper (inner) and lower (outer) epidermises enclosing a homogenous mesophyll which is transversed tangentially by several vasocentric vascular bundles.



**Fig. (6): The leaf of *Ficus elastica* Roxb. var. *decora*.**

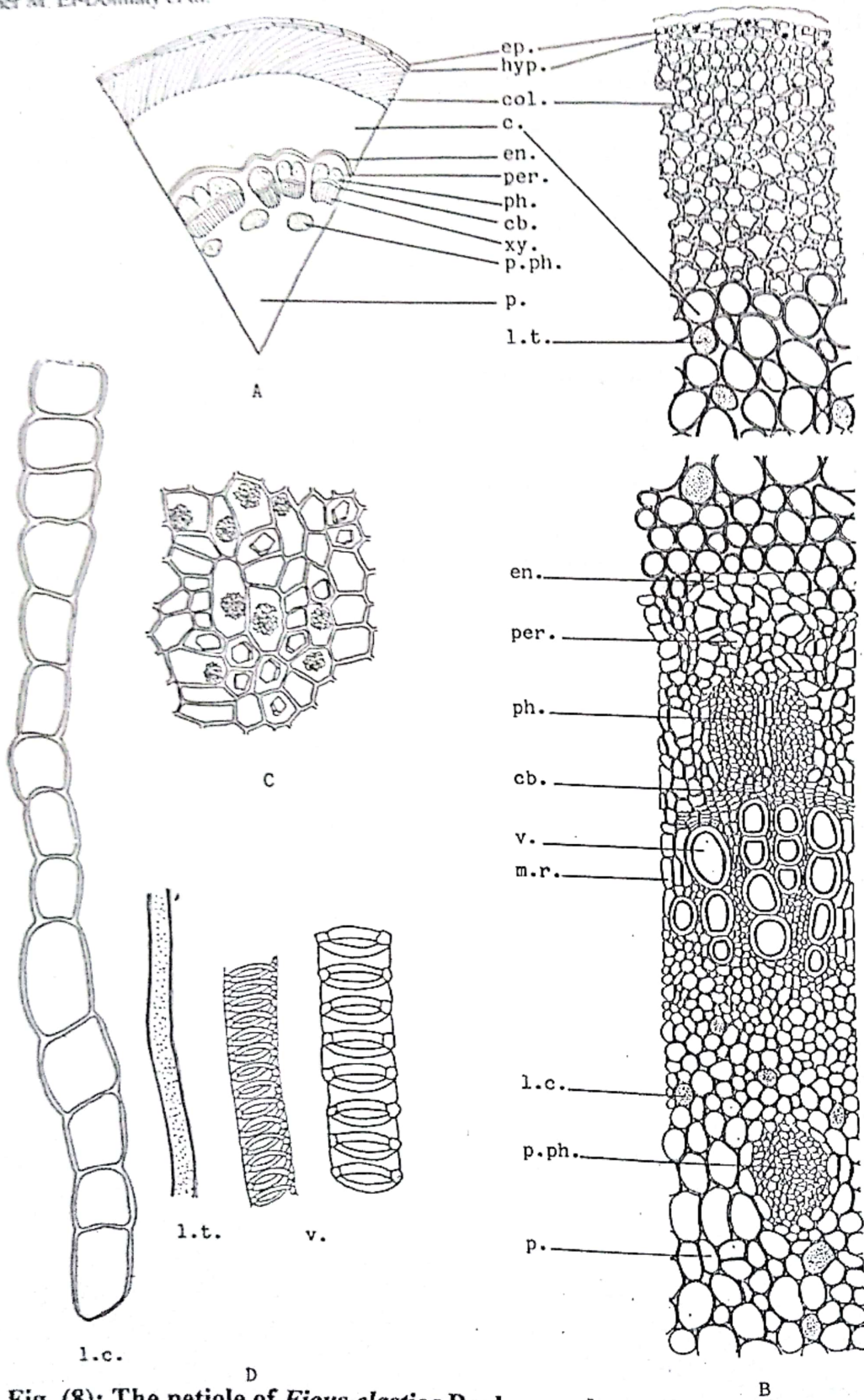
- A- Diagrammatic transverse section of the leaf (X 10)
- B- Detailed transverse section of the lamina (X 120)
- C- Upper epidermal cells of the lamina (X 255)
- D- Lower epidermal cells of the lamina (X 255)
- E- Upper epidermal cells of the midrib (X 198)
- F- Lower epidermal cells of the midrib (X 198)
- G- Isolated elements of the leaf (X 193)

c., cortex; ca.ox., calcium oxalate; c.cr., cluster crystal of calcium oxalate; col., collenchyma; hyp., hypodermis; l.c., laticiferous cell; l.ep., lower epidermis; l.pal., lower palisade; l.t., laticiferous tube; m., mesophyll; p.f., pericyclic fibers; p.cr., prismatic crystal of calcium oxalate; ph., phloem; p.ph., perimedullary phloem; tr., tracheides; u.ep., upper epidermis; u.pal., upper palisade; v., vessels; w.f., wood fiber; w. par., wood parenchyma; xy., xylem.



**Fig. (7): Detailed transverse section in the midrib of the leaf of *Ficus elastica* Roxb. var. decora. (All X 176)**

c.cr., cluster crystal of calcium oxalate; c.p., cortical parenchyma; hyp., hypodermis; l.c., laticiferous cell; l.col., lower collenchyma; l.ep., lower epidermis; p.f., pericyclic fiber; ph., phloem; p.ph., perimedullary phloem; p.cr., prismatic crystal of calcium oxalate; u.col., upper collenchyma; u.ep., upper epidermis; v., vessels; w.f., wood fiber; w.p., wood parenchyma.



**Fig. (8): The petiole of *Ficus elastica* Roxb. var. decora.**

A- Diagrammatic transverse section of the petiole.

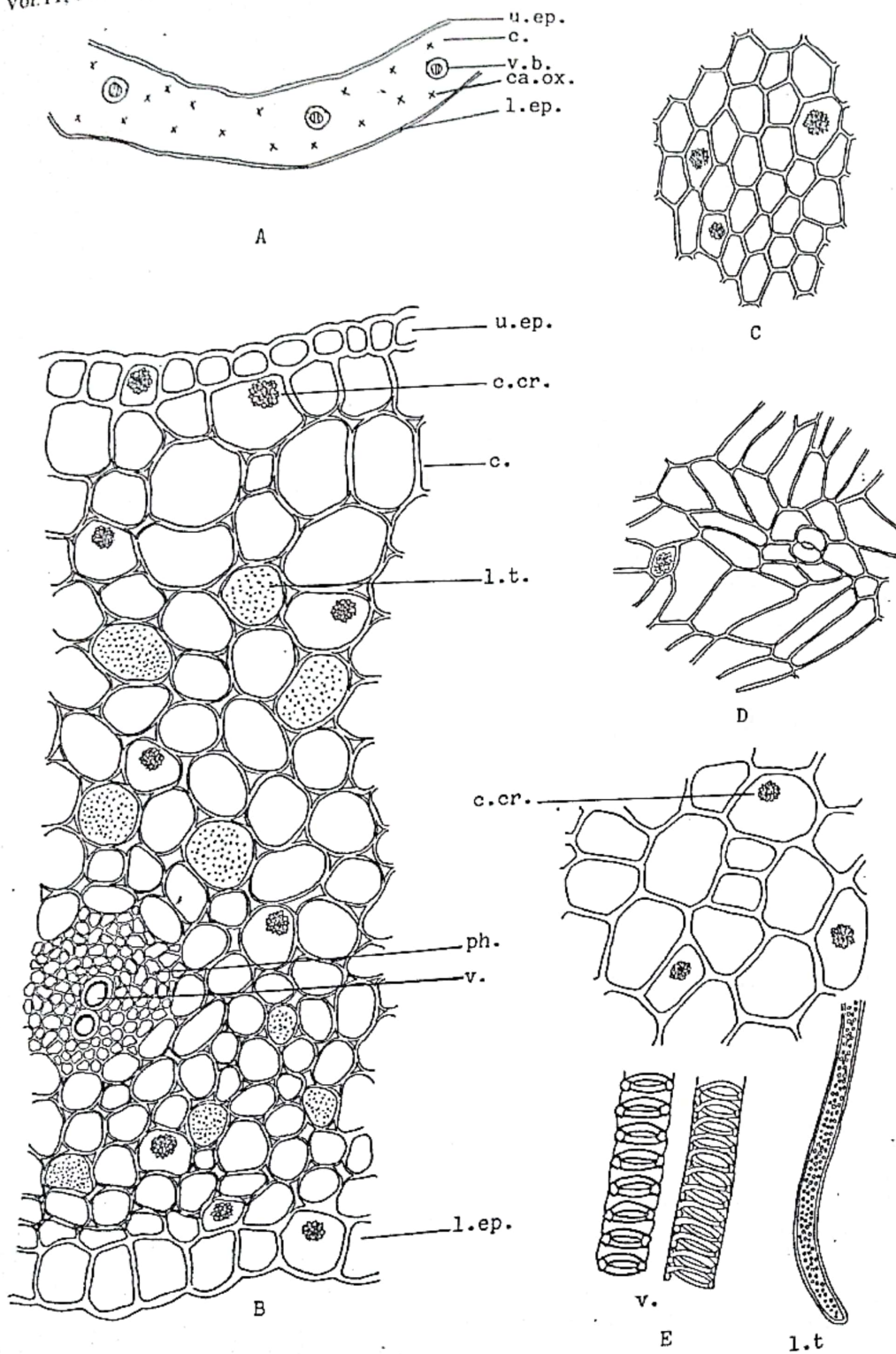
B- Detailed transverse section of the petiole.

C- Epidermal cells of the petiole.

D- Isolated elements of the petiole.

(X 15)  
(X 123)  
(X 295)  
(X 295)

c., cortex; cb., cambium; col., collenchyma; end., endodermis; ep., epidermis;  
hyp., hypodermis; l.c., laticiferous cell; l.t., laticiferous tube; m.r., medullary ray;  
per., pericycle; ph., phloem; p.ph., perimedullary phloem; v., vessels; xy., xylem.



**Fig. (9): The sheath of *Ficus elastica* Roxb. var. decora.**

- A-A diagrammatic transverse section of the sheath.
- B-A detailed transverse section of the sheath.
- C-Upper (inner) epidermal cells of the sheath.
- D-Lower (outer) epidermal cells of the sheath.
- E-Isolated elements of the sheath.

(X 30)  
 (X 280)  
 (X 260)  
 (X 260)  
 (X 260)

c., cortex; ca.ox., calcium oxalate; c.cr., cluster crystal of calcium oxalate; l.t., laticiferous tube; l.ep., lower epidermis; ph., phloem; u.ep., upper epidermis; v., vessels; v.b., vascular bundle; xy., xylem.

The upper (inner) epidermis (Figs. 9B, 9C) consists of polygonal nearly isodiametric cells covered with thin smooth cuticle. Some cells contain cluster crystals of calcium oxalate. The lower epidermis (Figs. 9B & 9D) is formed of polygonal cells covered with thin smooth cuticle. Cluster crystals of calcium oxalate are observed. Few stomata of the anomocytic type are observed only on the lower surface while trichomes are absent.

The cortex (Figs. 9A & 9B) consists of 16-18 layers of thin-walled parenchyma with narrow intercellular spaces. Laticiferous tubes containing greyish granular contents as well as idioblasts containing red-colored constituents are observed especially in subepidermal layer of the upper (inner) epidermis. The red constituents give yellowish-brown color with caustic alkali indicating their phenolic nature. The red color disappears with chloral hydrate. Numerous cluster crystals of calcium oxalate are observed.

The vascular bundles (Figs. 9A & 9B) are of the vasocentric type showing 2-3 small annular and spiral vessels (Fig. 9E) that are surrounded by polygonal, thin-walled cellulosic phloem elements (Fig. 9B).

**Powdered sheath**

The powdered sheath (Fig. 9E) is reddish green in color with characteristic odor and bitter taste. It is characterized microscopically by the following:

1. Fragments of the inner and outer epidermal cells formed of polygonal isodiametric or nearly isodiametric cells that may contain cluster crystals of calcium oxalate. Few anomocytic stomata are observed only on the lower surface.
2. Fragments of spiral and annular lignified xylem vessels.
3. Fragments showing the parenchyma of the cortex containing small cluster crystals of calcium oxalate.
4. Fragments showing non-branched laticiferous tubes with greyish granular contents.
5. Idioblasts with reddish contents may be also observed.
6. Starch and trichomes are absent.

**Conclusion:**

On reviewing the available literature, it could be concluded that *Ficus elastica* Roxb. var. *decora* can be differentiated from other species of the genus *Ficus* by the absence of flowers, fruits, cystoliths and trichomes.

**Table 2:** Cell dimensions of the different tissues of the root, stem, leaf, and sheath of *Ficus elastica* Roxb. var. *decora*.

Organ	Tissue	Dimensions (μ)
<b>Root</b>	Cork	L = 37 - 67, W = 7 - 13
	Sclereids	L = 27 - 50, W = 33 - 61
	Laticiferous tubes	L = 1279 - 1300, W = 10 - 15
	Pericyclic fibers	L = 740 - 750, W = 8-14
	Vessels	D = 90-100
	Wood parenchyma	L = 34 - 47, W = 27 - 33
	Wood fibers	L = 742 - 750, W = 7 - 20
	Calcium oxalate cluster	D = 13 - 16
	Calcium oxalate prisms	L = 16 - 20, W = 13 - 20
	Medullary rays	L = 82 - 94, W = 23 - 27
	<b>Stem</b>	Epidermal cells
Laticiferous tubes		L = 1200 - 1300, W = 27 - 47
Pericyclic fibers		L = 11350 - 12160, W = 7 - 20
Wood fibers		L = 1542 - 1714, W = 13-20
Wood parenchyma		L = 50 - 80, W = 23 - 61
Vessels		D = 60 - 80
Medullary rays		L = 50 - 122, W = 23 - 27
Calcium oxalate clusters		D = 20 - 27
Calcium oxalate prisms		L = 30 - 33, W = 23 - 27
<b>Leaf blade</b>		Upper epidermis
	Lower epidermis	L = 14-68 W = 14 - 23 H = 14 - 27
	Upper, lower neural epidermis	L = 40-144 W = 10-34, H = 20-34
	Stomata	L = 40 - 54, W = 39 - 50
	The hypodermis	L = 14-244, W = 20-115
	The palisade	L = 27-74, D = 5-9
	Pericyclic fibers	L = 3055-3330, W = 20-27
	Vessels	D = 34 - 74
	Tracheids	L = 47-78, W = 7-23
	Wood fibers	L = 1114-1500 W = 27-40
	Wood parenchyma	L = 135-162, W = 61-67
	Laticiferous tubes	L = 1257- 1270, W = 27-40
	Laticiferous cells	L = 20 - 31, W = 7-13
	Calcium oxalate clusters	D = 7 - 20
	Calcium oxalate prisms	L = 7 - 20, W = 7 - 14

Table 2: Continued

Petiole	Epidermal cells	L = 9-47, W = 9-20 H = 7-11
	Vessels	D = 31 - 54
	Laticiferous tubes	L = 1200 - 1300, W = 27-47
	Calcium oxalate clusters	D = 20 - 27
	Calcium oxalate prisms	L = 27-33, W = 20-27
Sheath	Upper (inner) epidermis	L = 23-33, W = 14-20, H = 12-24
	Lower (outer) epidermis	L = 16-61, W = 14-20, H = 23-40
	Stomata	L = 18-20, W = 17-20
	Vessels	D = 16 - 20
	Calcium oxalate clusters	D = 14 - 20

D = diameter; H = height; L = length; W = width.

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### دراسة عيانية ومجهرية لجذور وساق وأوراق وأغلفة نبات فيكس

#### إيلاستيكا من النوع ديكورا (العائلة التوتية)

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أجريت في هذا البحث دراسة عيانية ومجهرية لجذور وساق وأوراق وأغلفة نبات فيكس إيلاستيكا من النوع ديكورا (العائلة التوتية) للتعرف على النبات في حالته الصحيحة أو مسحوقا .

وقد أمكن التمييز بين النبات محل الدراسة والأنواع وثيقة الصلة به حيث لوحظ عدم وجود الزهور أو الثمار أو الحويصلات الحجرية أو الشعيرات في النبات محل الدراسة.