Zagazig J. Pharm. Sci., Dec. 1999
Vol. 8 , No. 2 , pp 22 - 39

MACRO- AND MICROMOPPHOLOGICAL STUDY OF THE ROOT , STEM , LEAVES AND INFLORESCENCE OF *ANISACANTHUS VIRGULARIS* NEES (ACANTHACEAE)

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ABSTRACT

A macro- and micromorphological study of *Anisacanthus virgularis* Nees. have been carried out, with the aim of finding out the diagnostic features of the different organs of the plant in both the entire and powdered forms.

INTRODUCTION

Anisacanthus virgularis Nees is an erect shrub growing in Mexico, America and cultivated in Egypt. It belongs to Acanthaceae, a family comprising around 250 Genera and 2700 species [1-6] .

In folk medicine, several Acanthaceae plants (especially leaves and stems) have been used for the treatment of heart disease, cancer, gonorrhea, snake bites, eczema, pulmonary tuberculosis, neurodermatitis, hepatitis , hypertension, diabetes and as an aphrodisiac [7-10].

A chemical study of the aerial parts of *Anisacanthus virgularis* has been completed by the same authors and is due to be published elsewhere soon. This investigation resulted in the isolation of two frurofuranoid lignan glucosides as well as some flavonoids, steroids and triterpenoids.

Nothing could be traced in the literature concerning the macro-and micromorphology of the plant.

The present study includes a macro- and micro-morphological study of the root, stem , leaves and inflorescence of the plant with the aim of finding out the characteristics by which the different organs of the plant can be easily identified in both entire and powdered forms .

plant material :

The plant material was collected in March and April 1998 from plants cultivated in The Botanical Gardens of The Faculty of Science, University of Ain-Shams , Cairo, Egypt. The plant was identified by Prof. Dr. S. F. Khalifa, Department of Botany, Faculty of Science, University of Ain- Shams, Cairo. A voucher specimen is deposited in the Departmet of Pharmacogenosy , Faculty of Pharmacy, Zagazig University , Zagazig , Egypt.

Fresh samples as well as samples preseved in 70% alcohol containing 25% glycerol were used .

I - Macromorphology :

Anisacanthus virgularis Nees (Fig. 1 A) is an erect herbaceous plant, reaches up to 75 cm in height and has heavily branched stem carrying many flowers in a racemose or paniculate - racemose infloresence [11] .

The root (Fig. 1 B) is a dark brown tap root , bearing several long tapering lateral roots and measures : 19 - 30 cm in length and 0.2 - 0.6 cm in diameter . The fresh root is flexible while the dry one breaks with a splintery and fibrous fracture.

The stem (Fig. 1 A) is herbaceous , erect and cylindrical with green surface. The stem is manopodially branched and shows internodes 1.5 - 2.1 cm in length and 0.2-0.6 cm in diameter . The fresh stem is flexible, but when dry breaks with a splintery and fibrous fracture.

The leaves (Fig. 1 A & C) are simple, lanceolate, exstipulate, with entire margins , symmetric bases and acuminate apices being arranged in an opposite decussate manner ; they range from 3 to 5 cm in length and from 0.7 to 1.4 cm in breadth . The leaves have green surfaces . They have reticulate pinnate venation with prominent midrib and main veins on the lower surface only. Trichomes are oftenly present on the midrib and margins of the leaf. The lower leaves are petiolate while the upper ones are sessile .

The inflorescence (Fig.1 A & D-I) is racemose, or paniculate - racemose with bracteate, hermaphrodite, complete, zygomorphic, hypogenous, orange flowers, measuring 3.8-4.5cm in length and 0.3 - 0.5 cm in diameter . Bracts are folaceous , similar to the leaves, but some what shorter ; they measure 0.7 - 1.4 cm in length and 0.15 - 0.30 cm in breadth . The calyx is deeply clefted into 5 ovate- lanceolate segments ; they measure 0.5-0.7 cm in length and 0.15 - 0.17 cm in breadth. The corolla is orange , tubular with 4- lobed limbs; it is nearly pubescent outside and measures 3.7-4.3 cm in length. The corolla tube measures 2.4 - 2.6 cm in length , and the lobes measure 1.3-1.5 cm in length and 0.3 - 0.4 cm in breadth. The androecium consists of two free epipetalous stamens , nearly equal to the corolla - lobes in length . It is formed of yellowish filaments, measuring 0.8-0.9 cm in length and 0.10 - 0.15 cm in diameter , and dorsifixed, bilobed , oblong orange- black anthers , measuring 0.30 - 0.32 cm in length and 0.15 - 0.20 cm in diameter. The gynaecium is orange, yellow, formed of superior , bicarpillary ovary, a filiform style and a short , papillosed stigma. The ovary measures 0.20 - 0.22 cm in length and 0.12 - 0.12 cm in diameter . The style measures 3.3- - 4.0 cm in length and 0.30 - 0.35 mm in diameter, while the stigma measures 0.35 - 0.38 mm in length and 0.29 - 0.30 mm in diameter. The plant flowers from March to April.

II- Micromorphology :

The root :

A transverse section in the root of *Anisacanthus virgularis* (Fig. 2 A) is circular in outline showing an outer brownish cork followed by parenchymatous phelloderm. The pericycle constitutes a continuous ring of lignified sclerenchyma surrourding the vascular

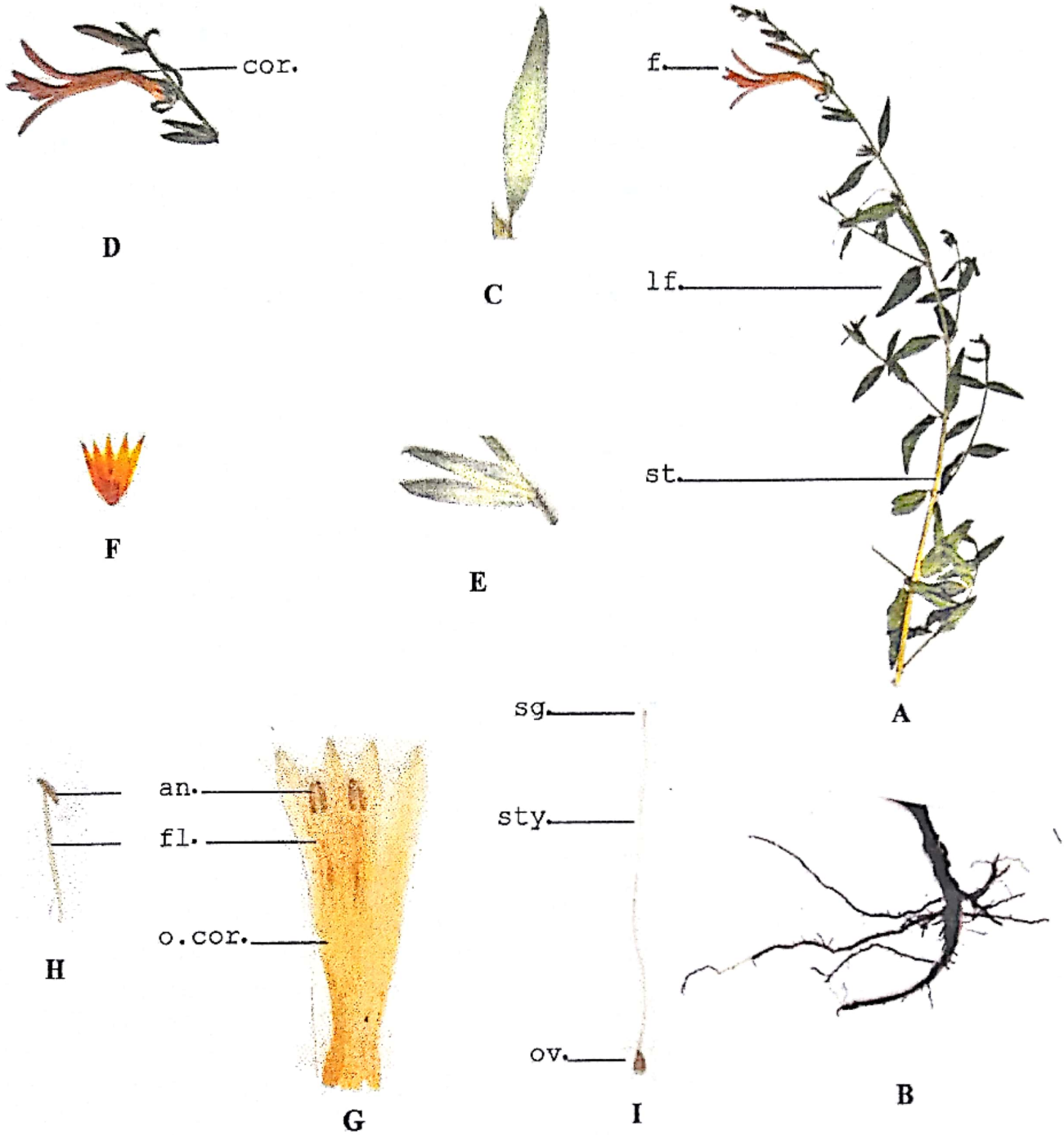

Fig.(1):Macromorphology of *Anisacanthus virgularis* Nees.

A- The aerial part (X 0.4). B- The root (X 0.2) . C- The leaf (X 0.8) .
D- The flower (X 0.7) . E- The bract (X 1.7) . F- The calyx (X 1.7) .
G- Opened corolla (X 1.3) . H- The androecium (X 1.7) .
I- The gynaecium (X 1.5) .

an.,androecium; **br.**,bract; **cor.**,corolla; **f.**,flower; **fl.**,filament; **lf.**,leaf; **o. cor.**,opened corolla; **ov.**,ovary; **st.**,stem; **sg.**,stigma; **sty.**,style .

tissues. The vascular tissue comprises a narrow phloem and a wide xylem with a central tetrarch primary xylem.

The cork (Fig. 2 B & C) is wide, consists of 9-11 layers of polygonal moderately thick- walled , suberized, tangentially elongated cells arranged in radial rows .

The phelloderm (Fig. 2 B) is wide , formed of 10 - 15 rows of thin - walled, more or less tangentially elongated parenchymatous cells. It shows scattered groups of sclereides with thick - lignified pitted walls and wide lumen . Scattered, elongated nearly rounded cystoliths containing deposit of calcium carbonate are present.

The pericycle (Fig. 2 B & D) is sclerenchymatous , formed of 2-4 rows of sclereids with thick pitted lignified walls and wide lumen. It shows scattered elongated or nearly rounded cystoliths containing deposit of calcium carbonate.

The vascular tissue (Fig. 2 B) is formed of an outer cellulosic phloem and a wide lignified central xylem traversed by medullary rays ; the cambium is indistinguishable . The phloem is formed of thin walled cellulosic elements and few scattered cystoliths . The xylem (Fig. 2 B) is wholly lignified and formed mainly of fibres . The wood fibres (Fig. 2 B & D) are spindle - shaped with thick , lignified, pitted walls with slit-like pits, moderately narrow lumen and acute or blunt apices . Tracheids (Fig. 2D) are few showing thick - lignified walles with numerous oval pits. Vessels (Fig. 2B & D) are few showing lignified pitted walls . The medullary rays (Fig. 2B) are usually biseriate , formed of lignified rectangular thick - walled, lignified cells in the xylem region and cellulosic in the phloem region.

Powdered root :

The powdered root (Fig. 2 C & D) is brownish in colour with characteristic odour and taste. It is characterized microscopically by the following feautes:

1-Fragments of brownish cork showing polygonal cells with moderately thick suberized walls .

2-Fragments of lignified pitted vessels and few tracheids

3-Numerous fragments of lignified wood fibres with thick, lignified , pitted walls, narrow lumen and acute or blunt apices.

4-Numerous elongated cystoliths of calcium carbonate, with blunt extremities .

The stem :

A transverse section in the stem of *Anisacanthus virgularis* (Fig. 3 A) is circular in outline. It shows an outer epidermis surrounding a relatively narrow parenchymatous cortex with an outer 4- 5 rows of collenchyma, lined by differentiated pericycle and endodermis enclosing a continuous ring of vascular bundle surrounding a wide-mostlty lignified - pith .

The epidermal cells (Fig. 3C) are polygonal , axially elongated with straight anticlinal walls and covered with thick smooth cuticle.

Stomata (Fig. 3C) are few, of the diacytic type, and surrounded by two subsidiary cells.

Glandular and non-glandular trichomes (Fig. 3D) are present . The non- glandular trichomes are curved , short , bicellular, covered with thick warty culticle, and have wide lumens and subacute apices. The glandular trichomes are short , having one-celled stalked and a glandular disc - shaped head formed of 4 - 8 radiating cells.

Elongated cystoliths with blunt extremities and containing calcium carbonate (Fig. 3D) are observed in the epidermal cells.

The cortex (Fig. 3A &B) is parenchymatous with a subepidermal layer of collenchyma in 4 - 5 rows of small thick -walld cellulosic, rarely lignified cells. The parenchyma is fromed of 5-6 rows of large thick - walled cellulosic , usually lignified and pitted cells with narrow intercellular spaces .

The endodermis (Fig. 3 A & B) is composed of well differentiated parenchyma and having no casparian strips .

The perciycle (Fig. 3 A & B) is parenchymatous with scattered groups of thick - walled, pitted and lignified sclereids with narrow lumens .

The vascular tissue (Fig. 3A & B) is formed of an outer cellulosic phloem and a wide lignified xylem ; the cambium is indistinguishable . The xylem is formed of fibres (Fig. 3 B & D) having thick - lignified , pitted walls, narrow lumen and acute apices . Vessels (Fig. 3B & D) are lignified , diffused either isolated or in radial rows being annular and pitted. Tracheids (Fig. 3D) are few, lignified and showing numerous pits. Wood parenchyma (Fig. 3D) is diffused and formed of moderately thick - walled , pitted and lignified polygonal cells . The medullary rays (Fig. 3B) are unisereate being lignified and occur only in the xylem region.

The pith (Fig. 3A & B) is formed of moderately lignified and pitted parenchyma with narrow intercellular spaces .

Powdered stem :

The powdered stem (Fig. 3C & D) is yellowish - green in colour, with bitter teste and a characteristic faint odour. It is characterized microscopically by the following features :

1-Fragments of polygonal axially elongated epidermal cells, with straight anticlinal walls and covered with thick smooth cuticle showing few diacytic stomata and numerous elongated cystoliths of calcium carbonate .

2-Fragments of bicellular , non - lignified, non-glandular trichomes covered with thick warty cuticle , and glandular trichomes formed of short unicellular stalk and multicellular head (4 -8 cells).

3-Fragments showing larg thick - walled lignified and pitted parenchyma from the cortex and pith .

4-Fragments of lignified annular and pitted vessels .

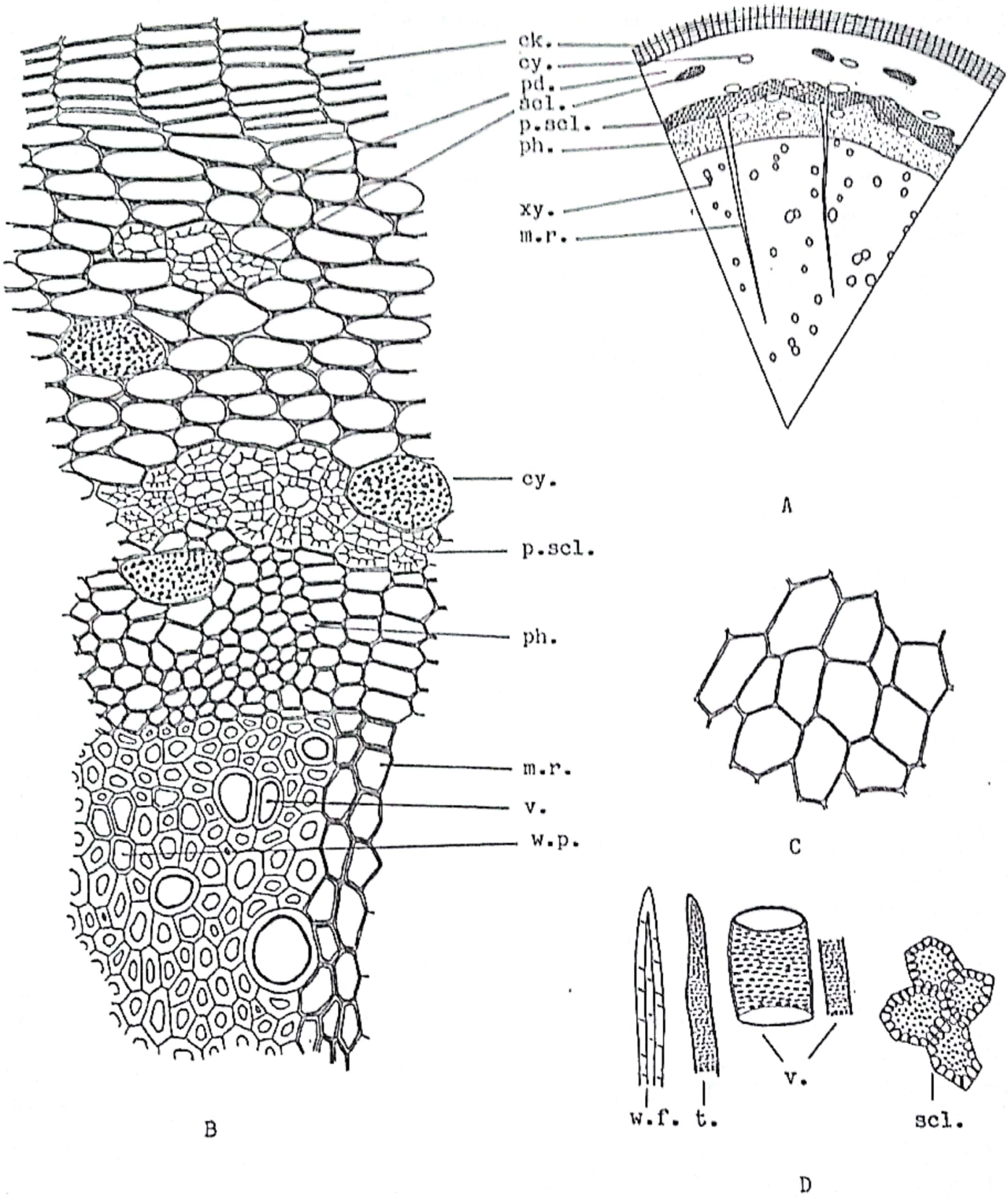

Fig. 2 : The root of *Anisacanthus virgularis.*

A-Diagrammatic transverse section (x 59).

B-Detailed transverse section (x351).

C-Cork cells (x 252).

D-Isolated elements (x 240).

ck., cork ; **cy.**, cystolith; **m.r.**, medullary rayes ; **pd.**, phelloderm; **ph.**, phloem ; **p.scl.**, pericyclic sclerieds ; **scl.**, scleried ; **t.**, tracheid ; **v.** vessel ; **w.f.**, wood fibre ; **w.p.**, wood parenchyma ; **xy.**, xylem.

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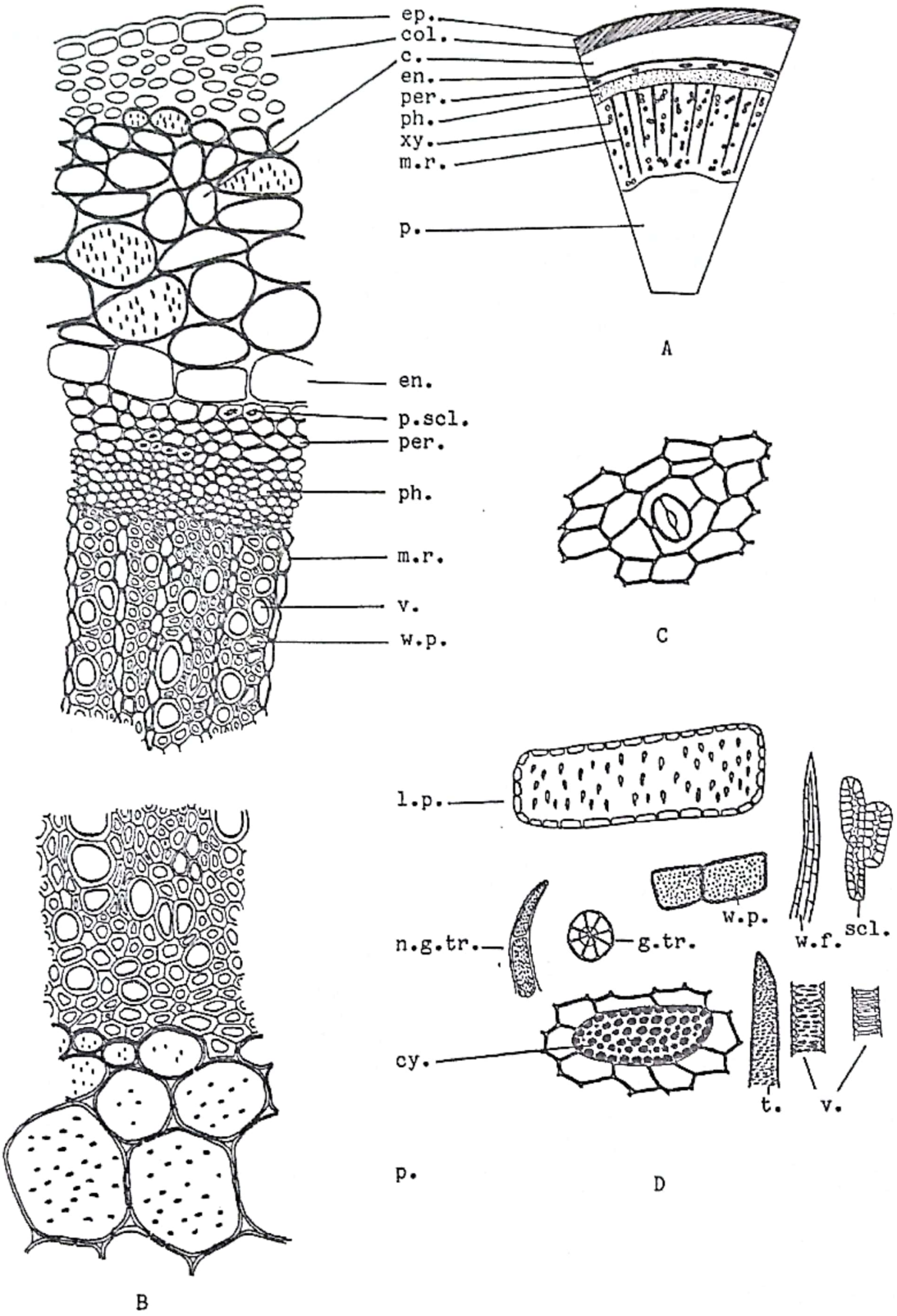

Fig.3 : The stem of *Anisacanthus virgularis*.

A-Diagrammatic transverse section (x 36). C-Epidermal cells (x 260).
B-Detailed transverse section (x 253). D-Isolated elements (x 249).

c., cortex ; **col.**, collenchyma ; **cy.**, cystolith ; **en.**, endodermis ; **ep.**, epidermis ; **g.tr.**, glandular trichomes ; **l.p.**, lignified parenchyma; **m.r.**, medullary rays; **n.g.tr.**, non-glandular trichome ; **p.**, pith ; **p.scl.**, pericyclic sclerieds; **per.**, pericycle ; **ph.**, phloem ; **st.**, stomata ; **t.**, tracheid ; **v.**, vessel ; **w.f.**, wood fibre ; **w.p.**, wood parenchyma ; **xy.**, xylem.

5-Few fragments of lignified and pitted tracheids .

6-Fragments of lignified wood fibres with acute apices , thick , lignified , pitted walls and narrow lumen.

7-Fragments of lignified wood parenchyma with moderately thick and pitted walls.

The leaf :

A transverse section of the leaf (Fig. 4A & B) shows an isobilateral structure with two upper and a single lower palisade one , both being interrupted by collenchyma in the midrib region . The midrib is prominent on the lower surface and traversed longitudinally by a crescent - shaped vascular bundle ; the pericycle is parenchymatous .

The upper and lower epidermal cells of the leaf (Fig. 5A & B) are formed of polygonal , nearly isodiametric cells having wavy anticlinal walls and covered with thick smooth cuticle .

The upper and lower neural epidermal cells (Fig. 5C & D) are polygonal, axially elongated with straight anticlinal walls and covered with thick , smooth cuticle.

Stomata (Fig. 5B) are present only on the lower surface of the leaf . They are of diacytic type ; each is surounded by two unequal - subsidiary cells.

Glandular and non- glandular trichomes (Fig. 5) are present . The non- glandular trichomes are unicellular, bicellular and tricellular, covered with thick-warty cuticle , having wide lumen and subacute apices. The glandular trichomes are shortly stalked with glandular disc - shaped head , which is composed of varying number of cells (4 - 8) .

Numerous cells of the epidermis are modified to cystoliths containing deposits of calcium carbonate (Fig. 5 D & E) are observed. They are elongated cystoliths (rarely rounded) with blunt extremities .

The mesophyll (Fig. 4 A & C) is isobilateral, formed of two rows of palisade cells abutting the upper epidermis and a single row of palisade cells towards the lower epidermis with a relatively narrow spongy tissue in between. The palisade cells are columnar with thin straight radial walls. the spongy tissue is formed of 3 - 5 rows of oval or rounded loosely packed parenchyma .

The cortex of the leaf (Fig. 4A & B) is parenchymatous with subepidermal collenchyma abutting the upper and lower epidermises. The collenchyma consists of 1-3 rows of thick - walled cellulosic cells. The parenchyma is formed of 3-4 rows of thin - walled cells with narrow intercellular spaces .

The pericycle (Fig. 4A & B) is formed of parenchymatous, undifferentiated cells .

The vascular bundle (Fig. 4A, B , & 5 E) consists of cellulosic phloem with thin - walled elements and xylem formed of lignified spiral and annular vessels.

Powdered leaf :

The powdered leaf (Fig. 5) is pale green in colour, with a faint characteristic odour and a slightly bitter taste . It is characterized by the following features:

1-Numerous fragments of upper and lower epidermises with straight or wavy anticlinal walls, covered with thick smooth cuticle and showing diacytic stomata on the lower one. Some epidermal cells are modified to cystoliths containing calcium carbonate .

2-Numerous fragments of unicellular , bicellular and tricellular non- glandular trichomes covered with thick warty cuticle; and shortly stalked glandular trichomes with glandular disc-shaped head (4 - 8) cells.

3-Fragments of lignified spiral and annular vessels .

The microscopical numerical values of the leaf are summerized in Table 1 and the microscopical dimension of the different tissues are listed in Table 2.

Table1: Microscopical numerical values of the leaves of *Anisacanthus virgularis*

The numerical value	Recorded value
Stomatal index of lower epidermis	16.6 - 19.1
Palisade ratio of upper epidermis	10.0 - 10.5
Palisade ratio of lower epidermis	8.0 - 9.0
Vein- islet number	8.0 - 11.0
Veinislet termination number	7.0 - 9.0

The flower :

The bract :

A transverse section in the bract (Fig. 6 A) is similar to that of the leaf except that the collenchyma is abutting only the lower epidermis .

The inner (upper) surface (Fig. 6 B_1- B_3) consists of polygonal, nearly isodiametric cells having slightly wavy anticlinal walls being straight at the apex and at the base . They are covered with smooth cnticle . The cells of the outer (lower) epidermis (Fig. 6 C) is formed of polygonal cells with wavy anticlinal walls in the apical and middle region and polygonal slightly wavy cells in the basal region ; they are covered with smooth cuticle. The upper and lower neural epidermal cells (Fig. 6 D) are polygonal axially elongated with straight anticlinal walls and covered with smooth cuticle.

Stomata are of the diacytic type (Fig. 6 B & C), numerous on the outer surface and observed only on the basal region of the inner surface .

Shortly - stalked glandular trichomes (Fig. 6 B & C) with unicellular stalk and a glandular disc- shaped head , composed of 4 - 8 cells .

Elongated cystoliths with blunt extremities and containing calcium carbonate (Fig. 6B & C) are observed on both surfaces .

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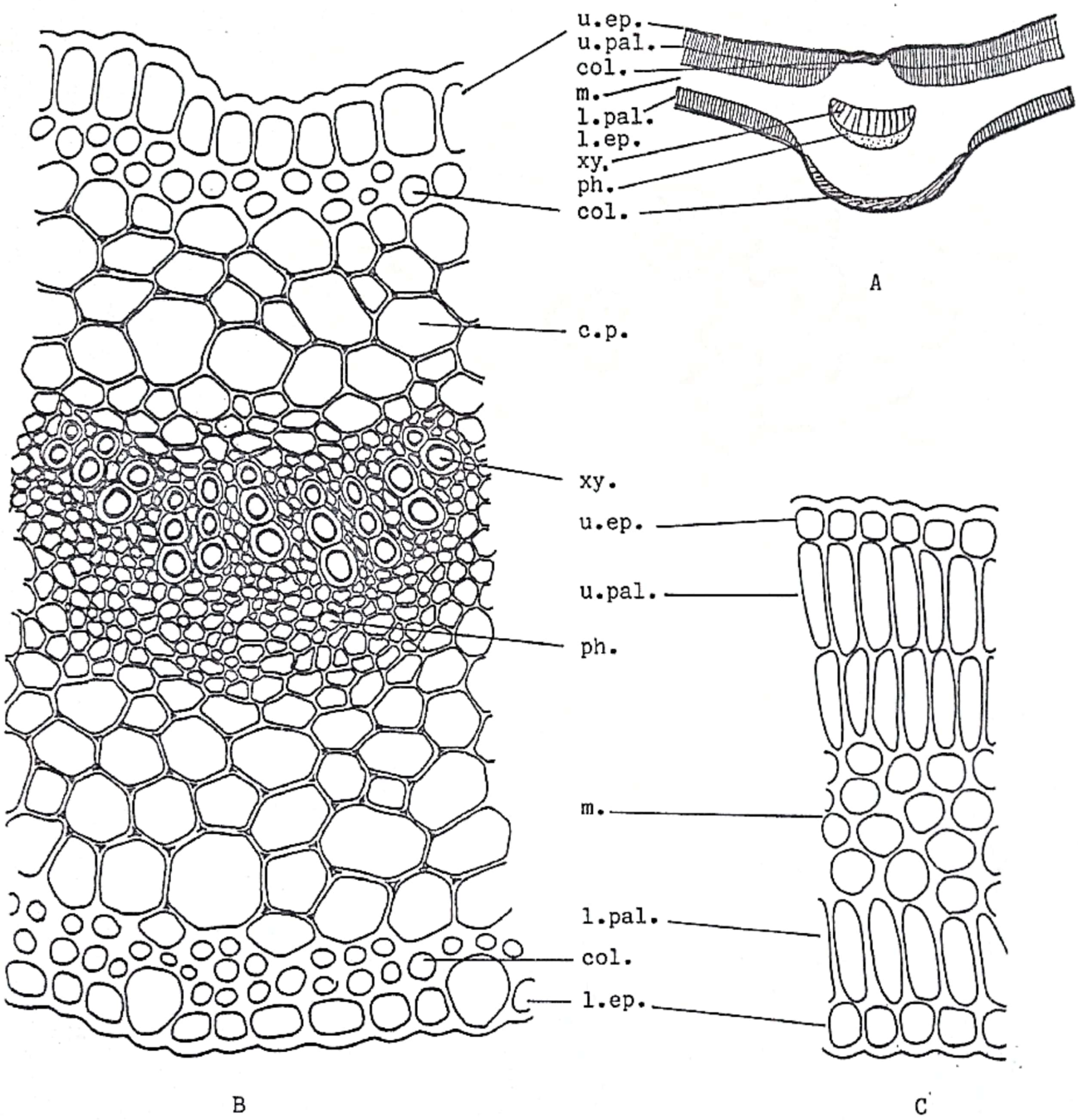

Fig. 4: The leaf of *Anisacanthus virgularis.*

A-Diagrammatic transverse section.

B-Detailed transverse section of the midrib.

C-Detailed transverse section of the lamina.

(All x 501, except A x 30).

c.p., cortical parenchyma ; **col.**, collenchyma ; **l.ep.**, lower epidermis ; **l.pal.**, lower palisade ; **m.**, mesophyll ; **ph.**, phloem ; **u.ep.**, upper epidermis ; **u.pal.**, upper palisade ; v., vessel ; xy, xylem.

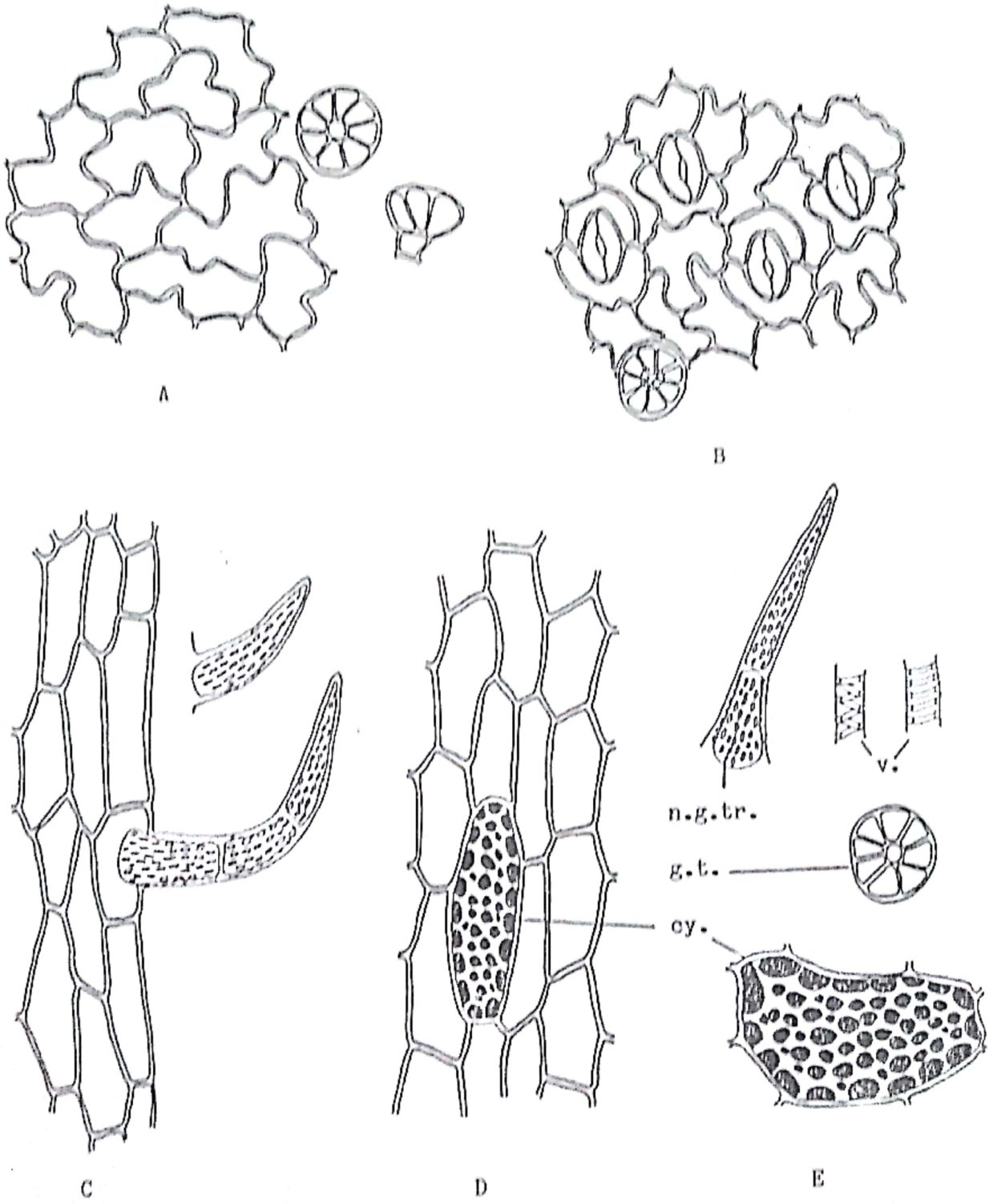

Fig. 5: The leaf of *Anisacanthus virgularis*.

A-Upper epidermis. B-Lower epidermis.
C-Upper neural epidermis. D-Lower neural epidermis.
E-Isolated elements.
(All x 498)

cy., cystolith ; g.tr., glandular trichome ; n.g.tr., non-glandular trichomes ; st., stomata.

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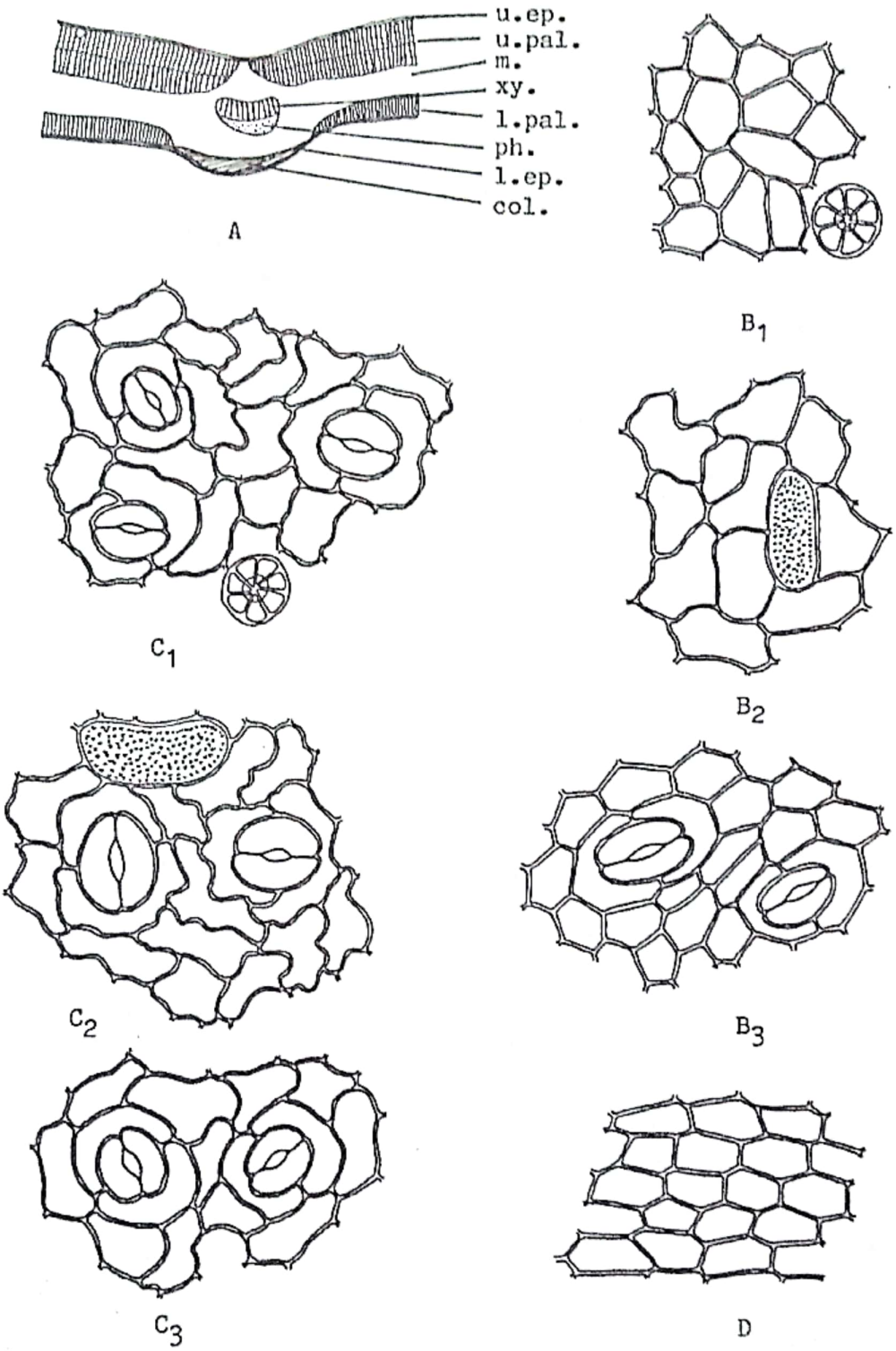

Fig. 6: The bract of *Anisacanthus virgularis.*

A-Diagrammatic transverse section.

B-Inner epidermis (B_1, at the apex; B_2 at the middle and B_3 at the base).

C-Outer epidermis (C_1, at the apex; C_2, at the middle and C_3, at the base).

D-Neural epidermis.

(All x 394, except A x 71)

c.p., cortical parenchyma ; **col.**, collenchyma ; **cy.**, cystolith ; **g.tr.**, glandular trichomes ; **l.ep.**, lower epidermis ; **l. pal.**, lower palisade ; **m.**, mesophyll ; **n.g.tr.** ; non-glandular trichomes ; **ph.**, phloem ; **u.ep.**, upper epidermis ; **u. pal.**, upper palisade ; **xy.**; xylem.

The calyx :

A transverse section in the sepals (Fig. 7 A & B) is composed of two epidermises enclosing a heterogenous mesophyll in between being collenchymatous towards the inner epidermis and parenchymatous towards the outer one. The mesophyll is traversed longitudinally by two main vascular bundles .

The inner (upper) epidermal cells (Fig. 7C) are polygonal , nearly isodiametric at the upper and basal regions and axially elongated at the midde part , having straight anticlinal walls at the middle and basal regions and wavy at the apical part . The outer (lower) epidermal cells (Fig. 7D) are polygonal, nearly isodiametric at the upper and basal regions and axially elongated at the middle region , and all have straight anticlinal walls.

Few diacytic stomata (Fig. 7C & D) are observed on both surfaces of the especially on the apical regions.

Glandular trichomes (Fig. 7A & C) formed of short unicellular stalk and multicellular (4 - 8 cells) are observed on both surfaces , being more numerous on the lower one. Unicellular non- glandular trichomes, covered with thick - smooth cuticle, with marrow lumen and acute apices (Fig. 7C) are observed on the inner surface only especially at the apical and basal regions.

Enlongated cystoliths with blunt extremities , containing calcium carbonate (Fig. 7C) are also oberved.

The corolla :

A transverse section in the corolla tube (Fig. 8 A & B) shows an inner and an outer epidermises enclosing a narrow mesophyll which is traversed longitudinally by 8 closed collateral vascular bundles.

The inner (upper) epidermis (Fig. 8 C_1 - C_3) is formed of polygonal cells with straight anticlinal walls. they are isodiametric at the appex and axially elongated at the middle and basal regions. The outer (lower) epidermal cells (Fig. 8 D_1 - D_3) are polygonal having slightly wavy anticlinal walls at the apex and middle , being straight at the base . They are isodiametric at the apex and axially elongated at the middle and basal regions .

Shortly stalked glandular trichomes with disc-shaped glandular head (4- 8 cells) and non - glandular trichomes, which are uniseriate , usually multicellular (3 - celled) occure on both surfaces (Fig. 8) . Stomata and cystoliths are absent .

The androecium :

A transverse section in the anther (Fig. 9 A & B) shows two lobes attached by a connective tissue showing three small vascular bundles . Each anther lobe is formed of two pollen sacs .The anther -wall is fromed of an outer epidermis followed by one to two rows of fibrous layer cells and the remains of tapetum .The epidermal cells of the anther lobe (Fig. 9 C) are polygonal nearly isodiametric with straight anticlinal walls and are covered with smooth cuticle. The fibrous layer of the anther (Fig. 9 D) is composed of polygonal isodiametric non - lignified cells having straight and beaded anticlinal walls. The pollen grains (Fig 9 E) are spherical with warty exine three germ pores and three germinal furrows.

The epidermal cells of the filament (Fig. 9 F_1-F_3) are polygonal axially elongated with smooth cuticle. Stomata and trichomes are absent.

The gynaecium :

The epidermis of stigma (Fig. 10A) is formed of polygonal, papillosed cells with straight anticlinal walls and covered with smooth cuticle .

The epidermis of the style (Fig. 10 B_1-B_3) is formed of polygonal, axially elongated cells and covered with smooth cuticle . Stomata and trichomes are absent.

The ovary wall (Fig. 10 C & D) is composed of an outer and inner epidermises enclosing a homogenous mesophyll traversed longitudinally by numerous (9 -11) small vascular bundles. The outer epidermis (Fig. 10 E) consists of thin - walled , polyonal , nearly isodiametric cells with straight anticlinal walls and covered by smooth cuticle. Stomata, trichomes and cystoliths are absent .

Powdered flowers :

The powdered flower is orange -yellow in colour, having a faint characteristic odour and a slightly bitter taste. It is characterized microscopically by :

1-Numerous unicellular and multicellular thick - walled non- glandular trichomes having either narrow or wide lumens and covered with smooth cultricle .

2-Glandular trichomes with unicellular stalks and multicellular heads (4-8 cells) are observed .

3-Numerous spherical pollen grains with warty exine, three germ pores and three germinal furrows.

4-Fragments from the fibrous layer.

5-Fragments of the floral leaves showing epidermal cells with diacytic stomata .

6-Fragments of the epidermal cells of the filament and anther lobes .

7-Fragments of papillosed stigma .

Cell dimensions of different tissues of the root, stem , leaves and the flower are listed Table 2:

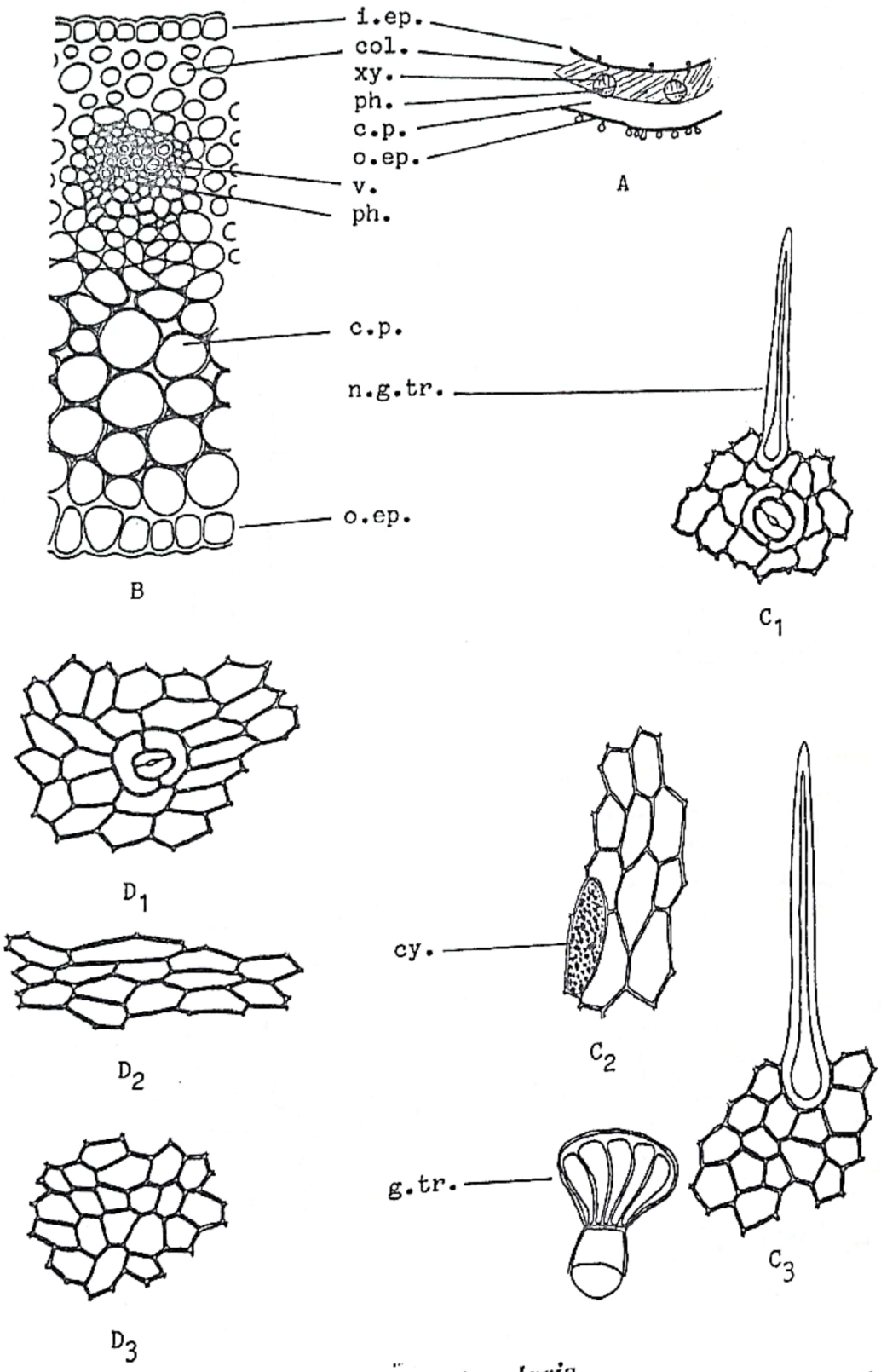

Fig. 7: The calyx of *Anisacanthus virgularis*.
A-Diagrammatic transverse section. B-Detailed transverse section.
C-Inner epidermis (C_1, at the apex; C_2, at the middle and C_3 at the base).
D-Outer epidermis (D_1, at the apex; D_2, at the middle and D_3 at the base).
(All x264, except A x 19)

c.p., cortical parenchyma ; col., collenchyma ; cy., cystolith ; g.tr., glandular trichome ; i.ep., inner epidermis ; n.g.tr., non-glandular trichome ; o.ep., outer epidermis ; ph., phloem ; v., vessel ; xy., xylem.

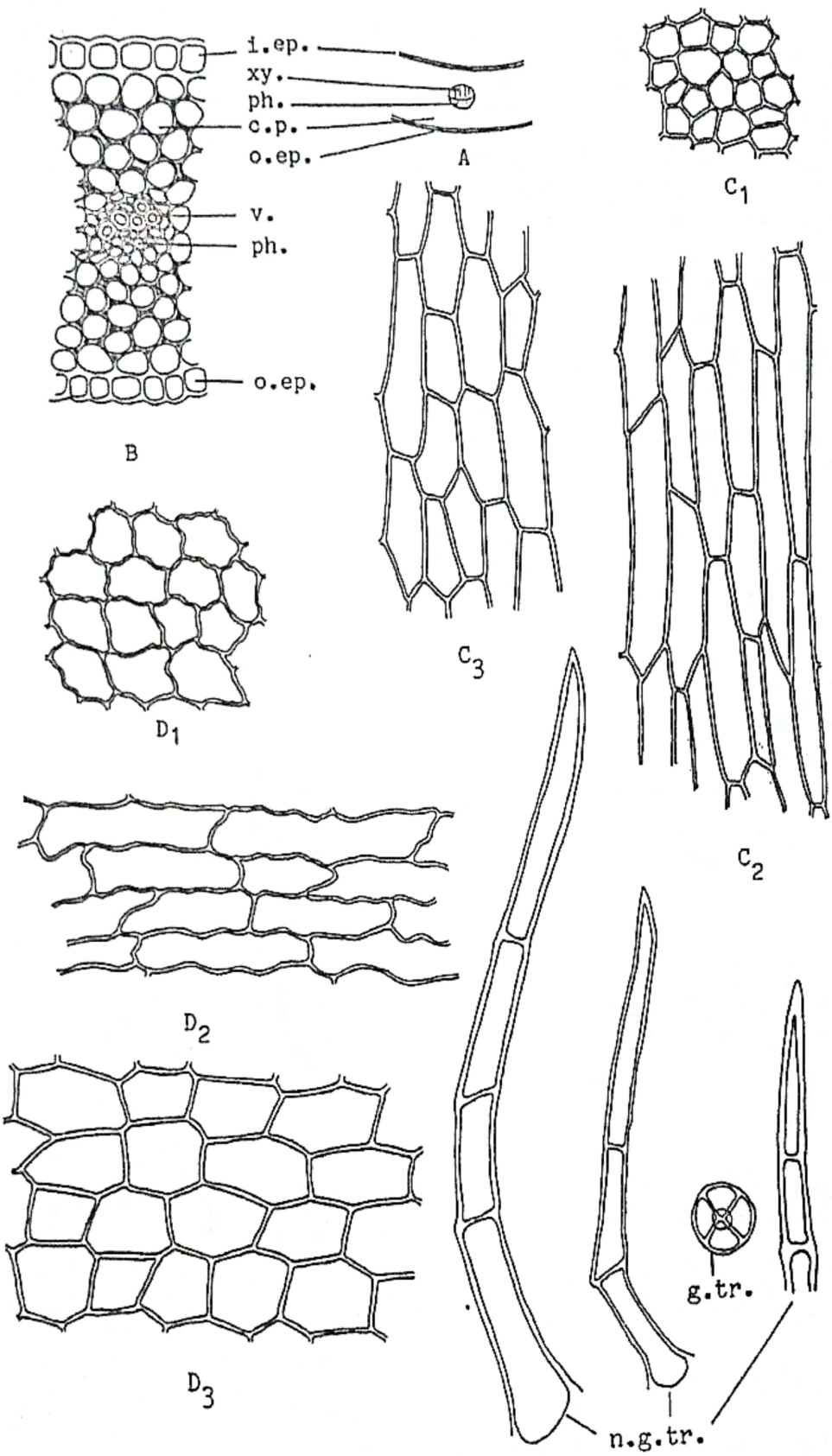

Fig. 8: The corolla of *Anisacanthus virgularis*.

A-diagrammatic transverse section. B-Detailed transverse section.
C-Inner epidermis (C_1, at the apex; C_2, at the middle and C_3 at the base).
D-Outer epidermis (D_1, at the apex; D_2, at the middle and D_3 at the base).
(All x 401, except A x 28)

c.p., cortical parenchyma ; g.tr., glandular trichome ; i.ep., inner epidermis ; n.g.tr., non-glandular trichome ; o.ep., outer epidermis ; ph., phloem ; v., vessel ; xy., xylem.

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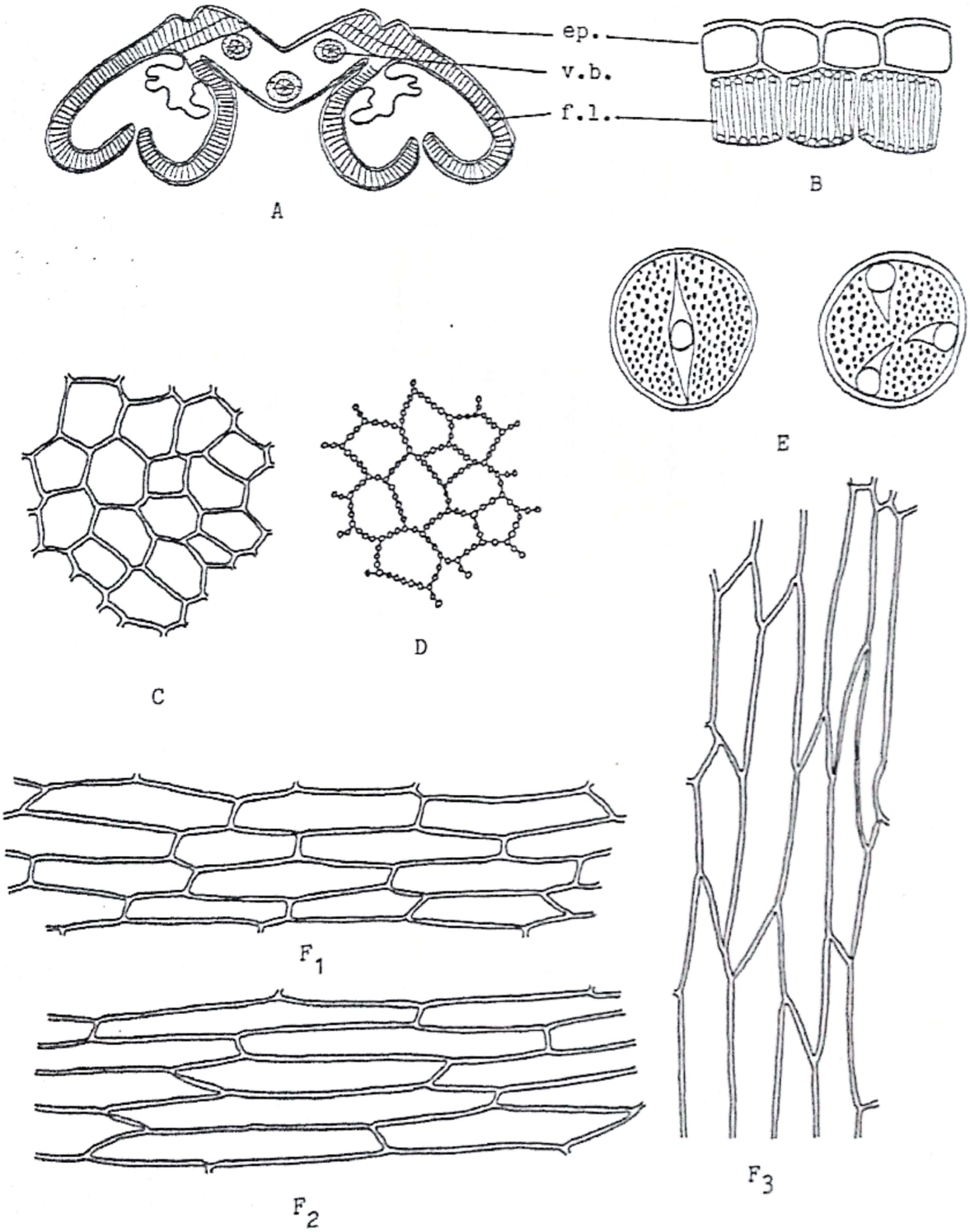

Fig. 9: The androecium of *Anisacanthus virgularis*.

A-Diagrammatic transverse section of the anther.
B-Detailed transverse section in the anther-wall.
C-Epidermis of the anther.
D-The fibrous layer of the anther in surface view.
E-Pollen grains.
F-Epidermis of the filament (F_1, at the apex, F_2, at the middle and F_3, at the base).

(All x 498, except A x 51)

e.p., epidermis ; f.l., fibrous layer, v.b., vascular bundle.

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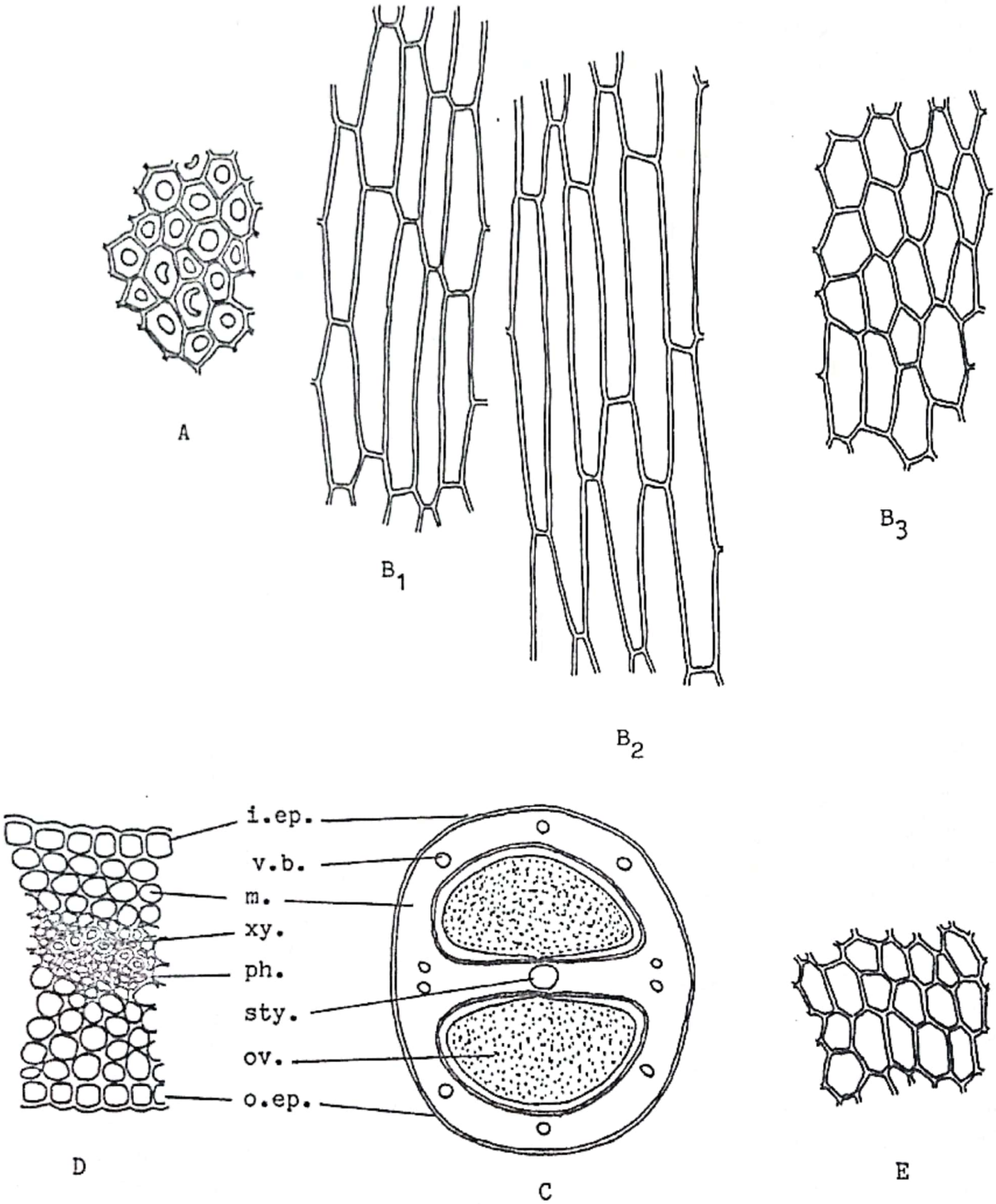

Fig. 10: The gynaecium of *Anisacanthus virgularis.*

A-Epidermis of the stigma.

B-Epidermis of the style (B_1, at the apex; B_2, at the middle and B_3, at the base).

C-Diagrammatic transverse section in the ovary.

D-Detailed transverse section in the ovary wall.

E-Outer epidermis of the ovary.

(All x 498, except A x 51)

i.ep., inner epidermis ; **m.**, mesophyll , **o.ep.**, outer epidermis ; **ov.**, ovule ; **ph.**, phloem ; **sty.**, style ; **v.**, vessel; **v.b.**, vascular bundle; **xy.**, xylem.

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Table 2 : Cell dimensions of the different tissues of the root, stem , leaf and flower of *Anisacanthus virgularis* Nees .

Organ	Tissue	Dimensions (μ)
ROOT	Cork	L = 37 - 71 , W = 31 - 37
	Cystolith	L = 45 - 50 , W = 32 - 35
	Sclereids	L = 35 - 45 , W = 25 - 40
	Vessels	D = 16 - 55
	Tracheids	L = 325 - 346 , W = 15 - 18
	Wood fibers	L = 1287 - 1340 , W = 15 - 20
STEM	Epidermal cells	L= 19 - 40 , W = 10 - 30 , H = 10 - 16
	Stomata	L = 31- 38 , W = 22 - 25
	Non-glandular trichomes	L = 70- 80 , W = 14 - 17
	Glandular trichomes	D (head) = 34 - 36
	Lignified parenchyma	L = 105 - 180 , W = 45 - 60
	Sclereids	L = 39 - 45 , W = 11- 20
	Vessels	D = 18 - 30
	Tracheids	L = 325 - 390 , W = 18 - 21
	Wood fibres	L = 792 - 1188 , W = 14 - 19
	Wood parenchyma	L = 30 - 45 , W = 28 - 30
	Cystolith	L = 90 - 100 , W = 35 - 40
LEAF	Upper epidermis	L = 26 - 50 , W = 15 - 30 , H = 8 - 11
	Lower epidermis	L = 19 - 43, W = 4 - 28 , H = 10 - 12
	Upper neural epidermis	L = 20 - 68 , W = 9 - 19 , H = 15 - 21
	Lower neural epidermis	L = 30 - 50, W = 8 - 19 , H = 9 - 10
	Cystolith	L = 65 - 76 , W = 20 - 40
	Stomata	L= 20- 23 , W = 16 -19
	Non- glandular trichomes	L= 50 - 105 , W = 13 - 17

Table (2) : (Continue)

Organ	Tissue	Dimensions (μ)
	Glandular trichomes	D(head) = 24 - 28
	Palisade	L = 25 - 32 , D = 5 - 11
	Vessels	D = 9 - 13
FLOWER		
Bract	Inner epidermis :	
	at apex	L= 11 - 32 W = 9 -20
	at middle	L = 25 - 39 W = 13 - 27
	at base	L= 16 - 31 W = 8 - 20
	Outer epidermis :	
	at apex	L = 22 - 50 W = 11 - 25
	at middle	L = 27 - 55 W = 8 - 20
	at base	L = 20- 40 W =13- 25
	Neural epidermis	L = 15 - 30 W = 8 - 15
	Cystolith	L = 42 - 54 W = 18 - 22
	Stomata	L = 22- 35 W = 18 - 26
	Glandular trichomes	D (head) = 24 - 27
Calyx	Inner epidermis :	
	at apex	L = 15 - 27 W = 7 - 19
	at middle	L = 25 - 55 W = 11 - 20
	at base	L = 17 - 27 W = 11-22
	Outer epidermis :	
	at apex	L = 20 - 44 W = 9 - 24
	at middle	L = 19 - 60 W = 8 -15
	at base	L = 15 - 30 W = 10- 20
	Cystolith	L = 55 - 65 W = 17 - 20
	Stomata	L = 20 - 23 W = 14 - 19
	Non-glandular trichomes	L = 130 - 200 W = 13 - 25
	Glandular trichomes	D = (head) : 55 - 65
	Vessels	D = 5 - 9

Table (2) : (Continue)

Organ	Tissue	Dimensions (μ)	
Corolla	Inner epidermis :		
	at apex	L= 8 - 17	W = 6- 16
	at middle	L= 44- 115	W= 5-14
	at base	L= 32 - 75	W =11-18
	Outer epidermis:		
	at apex	L= 13 - 32	W= 17-23
	at middle	L=35- 85	W = 8- 18
	at base	L= 20- 40	W = 15-25
	Non-glandular trichome	L= 110-280	W = 10-19
	Glandular trichomes	D (head) = 23 - 26	
	Vessel	D = 5 - 8	
Androecium	Epidemis of the anther	L=12 -23	W= 7 -21
	Fibrous layer of the anther	L= 10-21	W= 10-15
	Pollen grains	D= 45-50	
	Epidermis of filament :		
	at apex	L=36 - 63	W= 6-12
	at middle	L=78 - 120	W= 8-11
	at base	L = 60-120	W = 6 - 15
Gynaecium	Epidermis of stigma	L=11- 17	W = 6 - 14
	Epidermis of style:		
	at apex	L = 50 - 85	W = 7 - 14
	at middle	L=75 -160	W= 7 - 12
	at base	L= 16 - 35	W = 7 - 14
	Epidermis of ovary wall	L= 10- 20	W = 6 - 11
	Vessel	D = 3 - 6	

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

REFERENCES

1-Bailey , L. H. : "The standard cyclopedia of horticulture ", The macmillan Co., New York, p. 290 (1947) .

2-Mabberley , D. J. :"The Plant Book " , (2nd Ed.) Cambridge Univ. Press,p. 40 (1990).

3-Metcalfe, C. R. and Chalk, L.: "Anatomy of Dicotyledons" (4th Ed.) Oxford Univ. Press. p. 1012 - 1023 (1997) .

4-Jensen , H. F. W. , Jensen, S. R. and Nielsen, B. J. : **Phytochemistry** 27 (8) , 2581 (1988).

5- Dufand, T. and Jackson, B. D.; Index Kwinsis (Pantarum Phanerogama), Bruxellis , 137 (1886-1895).

6-El-Tantawy, . ; Khalifa, S. F. and Teleb, S. S. : **Bull. Fac. Sci., Zagazig Univ.** 18 (1) , 1 (1996).

7-Pettit, G. R. , Goswami, A. , Cragg, G. M. , Schmidt, J. M. and Zou, Ji-C. : **J. Nat. Prod.** 47 (6) , 913 (1984).

8-Wu, T.-S, Tien, H-J., Yeh, M.-Y and Lee, K.-H : **Phytochemistry** 27 (12) , 3787 (1988).

9-Wu, T.-S., Yang, C.-C., Wu,P.-L, and Liu, L.-K. : **Phytochemistry** 40 (4) , 1247 (1995).

10-Jantan, J. and Waterman, P. G.; **Phytochemistry** 37 (5) , 1477 (1994).

Received : Juli. 26 , 1999
Accepted : Aug. 30 , 1999

دراسة الصفات العيانية والمجهرية للجذر والساق والأوراق والنورة لنبات أنيساكانثس فرجيولارس نيس فصلية الأكانثس

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فى هذا البحث تم أجراء دراسة للصفات العيانية والمجهرية لنبات أنيساكانثس فرجيولارس نيس للتعرف على هذا النبات سواء كان فى حالته الكاملة أو على هيئة مسحوق.