

MACRO AND MICROMORPHOLOGY OF *CRINUM ASIATICUM* LINN. CULTIVATED IN EGYPT PART 2- THE INFLORESCENCE

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تم في هذا البحث إجراء دراسة عيانية ومجهرية لنورة نبات الكرينم أسياتيكم المنزرع في مصر بهدف التعرف على أجزاء النبات سواء كانت كاملة أو على هيئة مسحوق.

The present work deals with the macro and micromorphology of the inflorescence of *Crinum asiaticum* Linn. (Fam. Amaryllidaceae).

INTRODUCTION

In a previous work the macro and micromorphology of *Crinum asiaticum* Linn. were presented.¹ *Crinum asiaticum* Linn. (Fam: Amaryllidaceae) is an ornamental plant of temperate zones. Bulbs of various *Crinum* species have been used to treat various ailments like cough and colds, renal and hepatic conditions,² sexually transmitted diseases and backache.³ The plant has many folkloric and medicinal uses. The bulb is laxative and also used for urinary troubles. It can be crushed, roasted and used for treatment of rheumatism and piles. Its leaf juice is used for ear-ache.⁴ Fresh root is emetic⁵ and diaphoretic.⁵

In the course of pharmacognostical study of this plant, we report the botanical study of the flowers of *Crinum asiaticum* Linn.

Plant material

The plant material was obtained from plants cultivated in the experimental station of medicinal plants, Faculty of pharmacy, Assiut University, Assiut, Egypt. The plant was collected in April, and was identified by Prof. Dr. Gamal Taha, Prof. of Horticulture, Faculty of Agriculture, Assiut University. Fresh materials were preserved in alcohol 70 % containing 5 % glycerin.

Macromorphology

The inflorescence (Fig. 1): is a terminal, umbellate with 2 unequal bracts and carried on greenish scape. The scape is about 35-45-55 cm long and 0.8-1-1.4 cm in diameter at the base. It carries 5-10-15 flowers in an umbel.

The bract (Fig. 1): is large, leathery, spathaceous, sessile, triangular-lanceolate and deciduous. The outer surface is greenish in colour while the inner one is of paler colour. They have entire revolute margins and acute apices. The bract is traversed longitudinally with parallel veins. The margin of the outer (larger) bract is recurved so as to overlap the inner one thus forming a sword-like sheath enclosing the flower before opening. The bract measures about 5-6-8 cm long and 1.5-2-2.5 cm wide at the base.

The bracteole (Fig. 1): each flower is subtended by membranous, sessile, strap-shaped bracteole with entire margin and acute apex. The outer surface is greenish while the inner one is of paler colour. The bracteole measures 4-5-6 cm long and 0.3-0.5-0.7 cm wide.

The flower (Fig. 1): is pedicellate, funnel-shaped, creamy white in colour, possesses no odour and mucilaginous bitter taste. It is actinomorphic, hermaphrodite, inferior and measuring 10-12-15 cm long and 6-8-10 cm in diameter at mouth of the funnel.

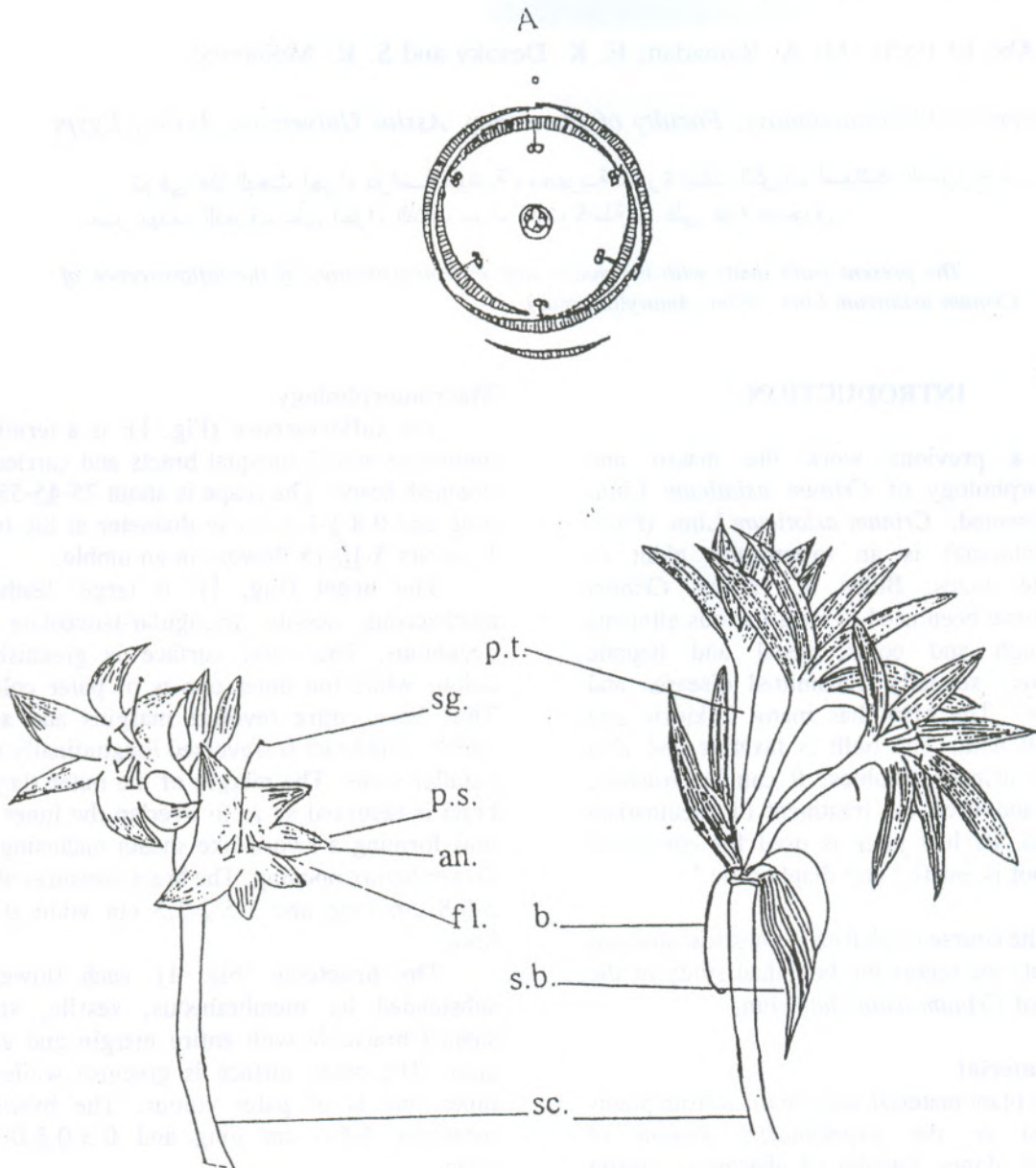


Fig. 1: Sketch of the flower of *Crinum asiaticum* Linn

x 0.3

A- Floral diagram.

An., anther; b., bract; fl., filament; p.s., perianth segment; p.t., perianth tube; sc., scape; s.b., spatheous bract; sg., stigma.

The perianth (Fig. 1): consists of 6 delicate segments arranged in 2 alternated whorls. They are connate below forming nearly subcylindrical tube. The perianth lobes are white in colour, linear lanceolate in shape, having entire undulated margins and acute apices, measuring 5-6-8 cm long and 1-1.5-3 cm wide at the base.

The androecium (Fig. 1): consists of 6 epiphyllous stamens arranged in 2 alternated whorls attached in the margin of the corona. Each stamen consists of a filiform simple, cylindrical white filament and narrow pale yellow, versatile, entrose anther. The filament measures 4-4.5-5 cm in length and 1-1.5-2 mm in diameter. While the anther measures 1-1.5-2 cm in length and 2-3-4 mm in diameter.

The gynaecium (Fig. 1): is inferior, tricarpeal, consisting of trilocular, syncarpous ovary and long style ending with short capitate stigma. The ovary is smooth greenish in colour and measuring 0.6-0.8-1 cm long and 5-6-8 mm diameter. The style is cylindrical filiform, whitish in colour. The ovary contains few anatropous ovules in each locule arranged on an axial placenta.

The pedicel (Fig. 1): is cylindrical, with smooth, green outer surface and measures 1-1.5-2 cm in length and 3-4-5 mm in diameter.

The floral formula could be expressed as follow:

$$\oplus, \ominus, P_{(3+3)}, A_{3+3}, G_{(3)}$$

Micromorphology

The perianth (Fig. 2A): The perianth segment is formed of inner and outer epidermises enclosing a homogenous mesophyll in between, which is traversed longitudinally by several vascular strands.

The epidermis (Fig. 3A,3D): Both upper and inner epidermises are formed of polygonal, axially elongated, isodiametric cells, with straight anticlinal walls and covered with thin smooth cuticle, few stomata of anomocytic type are present in the lower epidermis, being oval or rounded in shape usually surrounded by 4-7 epidermal cells and measure 25-30-35 μ in diameter. In the free region of the perianth segment, the cells measure 20-25-30 μ in length and 10-15-20 μ in width, while in the perianth tube regions, the cells are more elongated in

shape and measure 45-50-65 μ in length and 5-10-15 μ in width. Trichomes are not observed.

Outer (lower) epidermis (Fig. 3B,3C) are more or less similar to those of the inner epidermis, measuring 25-30-40 μ in length and 15-20-25 μ in width. Somata of anomocytic type are present, being oval or rounded in shape usually surrounded by 4-7 epidermal cells and measure 25-30-35 μ in diameter. Trichomes are absent.

The mesophyll (Fig. 3E): Consists 6-13 rows of rounded, thin-walled parenchyma. The mesophyll becomes narrow at the margin at the ultimate extremities of the wing. The parenchyma cells contain mucilagenous masses which stain red with ruthenium red, blue with methylene blue and give no colour with corallin soda, in addition to starch granules both simple and compound of 2-7 components, measuring 5-10-15 μ in diameter and have a centric hilum. Acicular crystals of calcium oxalate are present as raphides or isolated needles measuring 15-20-25 μ in length.

The vascular system (Fig. 3E): Is represented by several closed collateral vascular bundles. Each bundle is formed of an upper arc of xylem, which consists of lignified vessels with spiral, annular and scalariform thickenings, measuring 10-20-25 μ in diameter, and lower narrow band of phloem, which consists of sieve tubes and companion cells. The pericycle is represented by an upper batch of cellulosic parenchyma.

The androecium

The filament (Fig. 4): A transverse section in the filament appears circular in outline showing an epidermis surrounding a wide ground tissue and a central vascular strand. The strand consists of soft phloem and xylem of few narrow spiral, annular and scalariform vessels, measuring 5-10-15 μ in diameter. Acicular crystals of calcium oxalate, mucilagenous masses and starch granules similar to those mentioned before are observed in the ground tissue cells.

The epidermis (Fig. 4C): Is formed of polygonal axially elongated, subrectangular cells with straight anticlinal walls and covered with

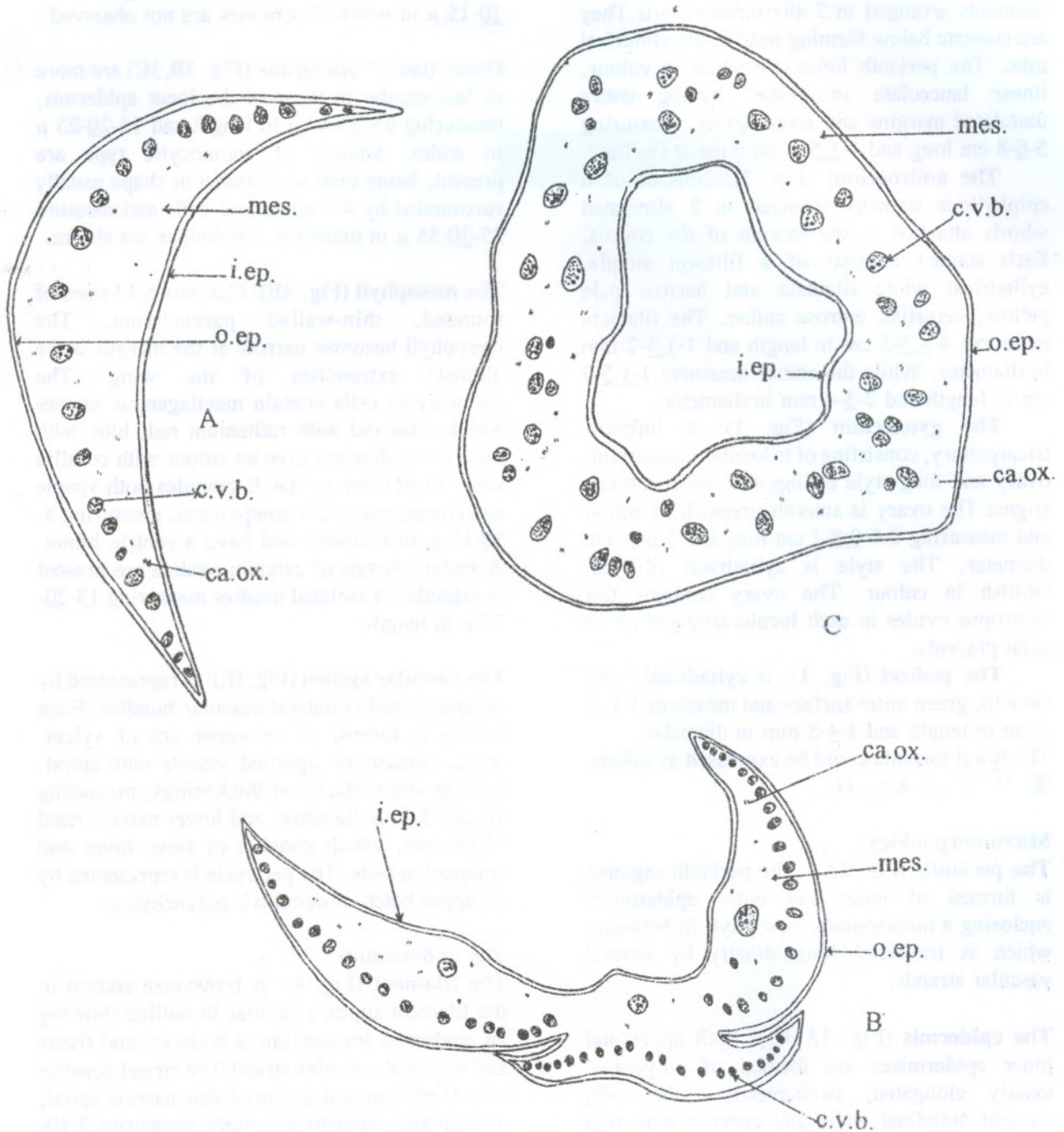


Fig. 2: The perianth of *Crinum asiaticum* Linn.

A- Diagrammatic T.S. in the free perianth segment x 40

B- Diagrammatic T.S. in the fused portion of the perianth x 3

C- Diagrammatic T.S. in the perianth tube x 40

Ca.ox., calcium oxalate; c.v.b., closed vascular bundle; i.ep., inner epidermis; mes., mesophyll; o.ep., outer epidermis.

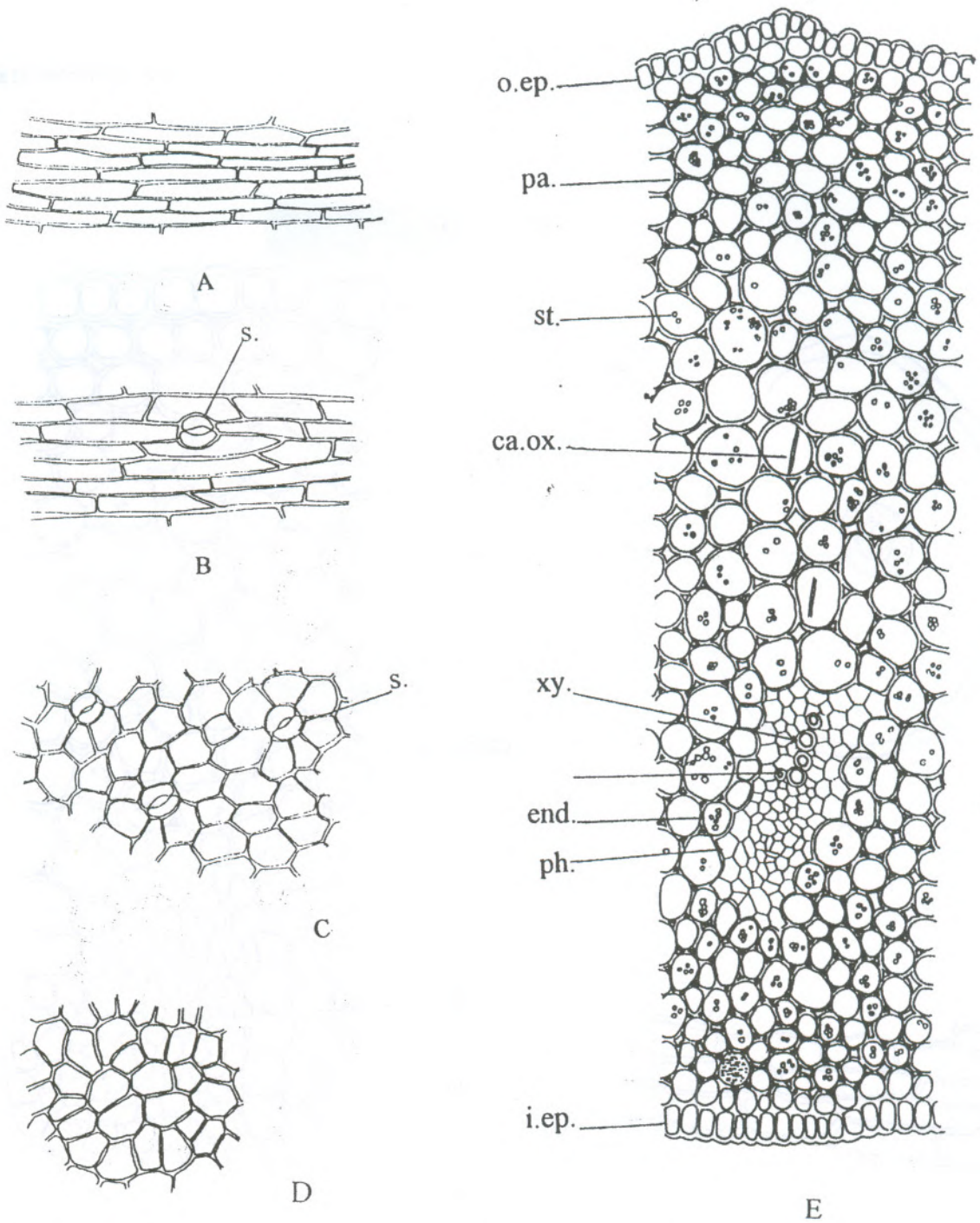


Fig. 3: Detailed T.S. in the perianth tube and surface preparation of the perianth.

- | | |
|---------------------------------------|------|
| A- Perianth tube inner surface | x 26 |
| B- Perianth tube outer surface | x 26 |
| C- Perianth segment lower surface | x 26 |
| D- Perianth segment upper surface | x 26 |
| E- Detailed T.S. in the perianth tube | x 26 |

Ca.ox., calcium oxalate; end., endodermis; i.ep., inner epidermis; m.c., mucilage cell; o.ep., outer epidermis; pa., parenchyma; ph., phloem; st., starch granules; s., stomata; xy., xylem.

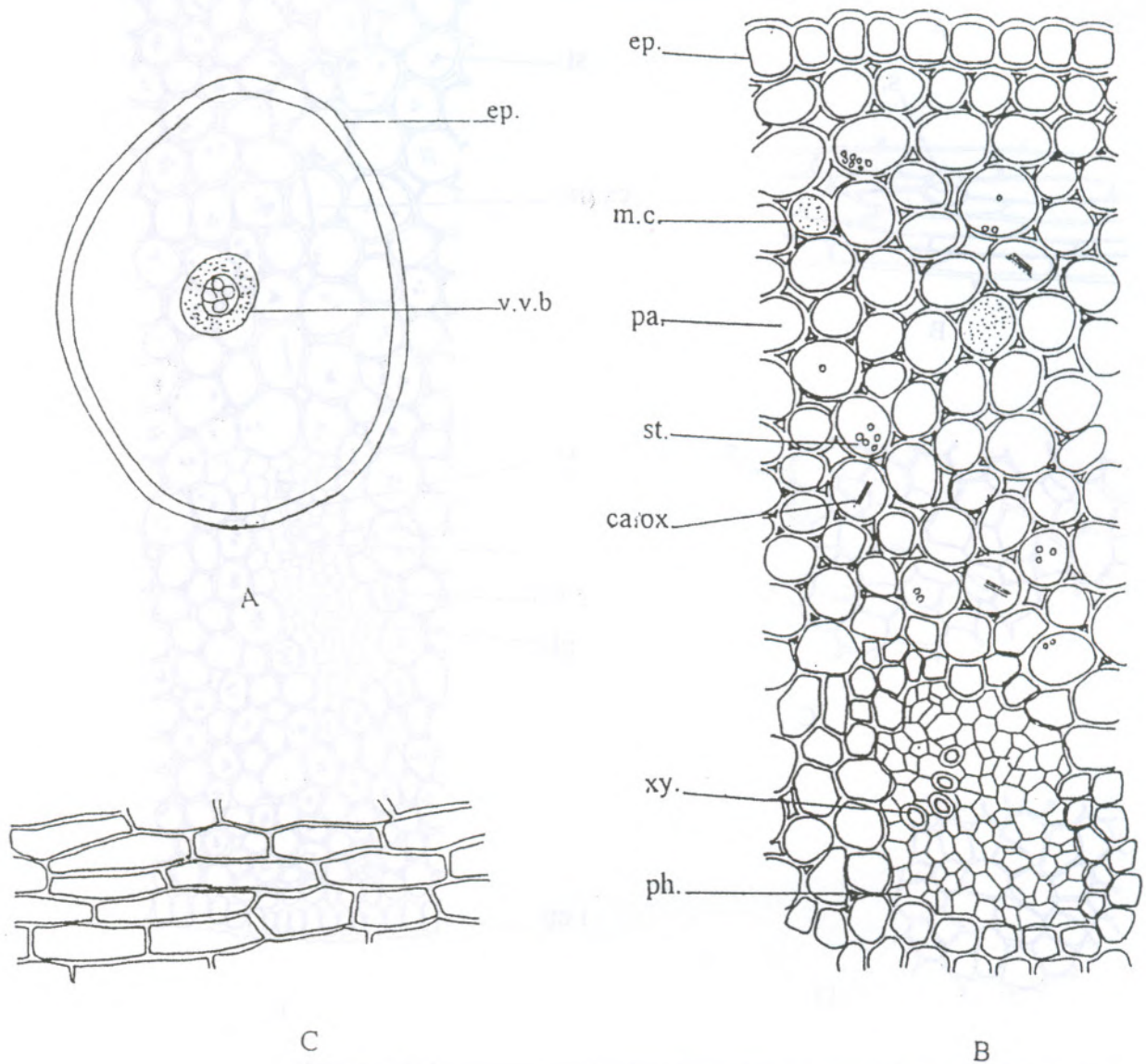


Fig. 4: The androecium.

A- Diagrammatic T.S. in the filament x 100

B- Detailed T.S. in the filament x 400

C- Surface preparation of the filament x 400

Ca.ox., calcium oxalate; ep., epidermis; m.c., mucilage cell; pa., parenchyma; ph., phloem; st., starch granules; v.v.b., vasocentric vascular bundle; xy., xylem.

smooth cuticle, measuring 30-50-65 μ in length and 10-15-20 μ in width. Trichomes and stomata are absent.

The anther (Fig. 5A): Consists of nearly two equal anther lobes attached by the connective, through which runs a small vascular strand. Each anther lobe is formed of 2 pollen sacs. The anther is formed of an epidermis, a fibrous layer of 2-3 rows and the remains of the tapetum.

The epidermal cells (Fig. 5C): Are polygonal, isodiametric or slightly elongated with thin straight anticlinal walls, and covered with thick striated cuticle. The cells measure 20-25-40 μ in length and 15-25-30 μ in width. Trichomes and stomata are not observed.

The fibrous layer (Fig. 5B,5E): Is formed of 2-3 rows of cells. The number usually increases towards the connective and decreases towards the line of dehescence. The cells have usually bar-like thickening and appearing in surface view to be polygonal to isodiametric with distinct beaded walls and measuring 25-30-35 μ in length and 30-35-40 μ in height. Within the fibrous layer a thin-walled collapsed and ruptured parenchymatous cells constituting the remaining of the tapetum.

The pollen grains (Fig. 5D): Are discoid, sometimes oval in outline. Each grain possesses 2 lanceolate germinal furrows which extended from pole to pole. The grains have warty granular exine and measuring 25-30-40 μ in diameter. Germinal pores are not observed.

The gynaecium

The ovary (Fig. 6A): A transverse section in the ovary is trilocular rounded in outline and shows glabrous outer and inner epidermises enclosing the ground tissue (Fig. 6B) is formed of an outer zone of collenchyma followed by comparatively wide zone of lacunous parenchyma containing mucilagenous masses, starch granules and needle-shaped crystals of calcium oxalate, it is traversed by several vascular strands of cellulosic phloem and xylem shows few lignified vessels.

The outer epidermis (Fig. 6C): Consists of polygonal usually isodiametric, small cells with straight anticlinal walls and covered with thin smooth cuticle, measuring 10-20-35 μ in length and 10-15-20 μ in width. Few stomata of anomocytic type are present.

The style (Fig. 7C): Transverse section in the style appears circular in outline. It has an epidermis surrounding a wide parenchymatous ground tissue traversed by 3 small vascular strands. In the centre, there is a small triangular cavity. The cells of ground tissue containing mucilagenous masses, starch granules and needle-shaped crystals of calcium oxalate.

The epidermis (Fig. 7B): Consists of polygonal axially elongated cells with straight anticlinal walls, measuring 25-50-55 μ in length and 5-10-15 μ in width. The cells are covered with thin smooth cuticle. Trichomes and stomata are absent.

The stigma (Fig. 7A): The epidermal cells of the stigma are polygonal and papillosed with straight anticlinal walls, measuring 20-35-50 μ in length. Trichomes and stomata are absent.

The pedicel (Fig. 8A): A transverse section in the pedicel appears oval to subcylindrical in outline. The glabrous epidermis is followed by wide ground tissue consisting mainly of parenchyma with peripheral collenchyma. Numerous closed collateral vascular bundles are scattered in the ground tissue. They are more crowded and smaller in size outwards, being larger and fewer towards the centre.

The epidermis (Fig. 8C): Is formed of thin-walled, polygonal axially elongated cells with more or less straight anticlinal walls and covered with thick smooth cuticle, measuring 25-50-75 μ in length and 10-15-20 μ in width. Stomata of anomocytic type are present, being oval to rounded in shape, usually surrounded by 4 epidermal cells, measuring 20-25-30 μ in diameter and 25-30-35 μ in length. Trichomes are absent.

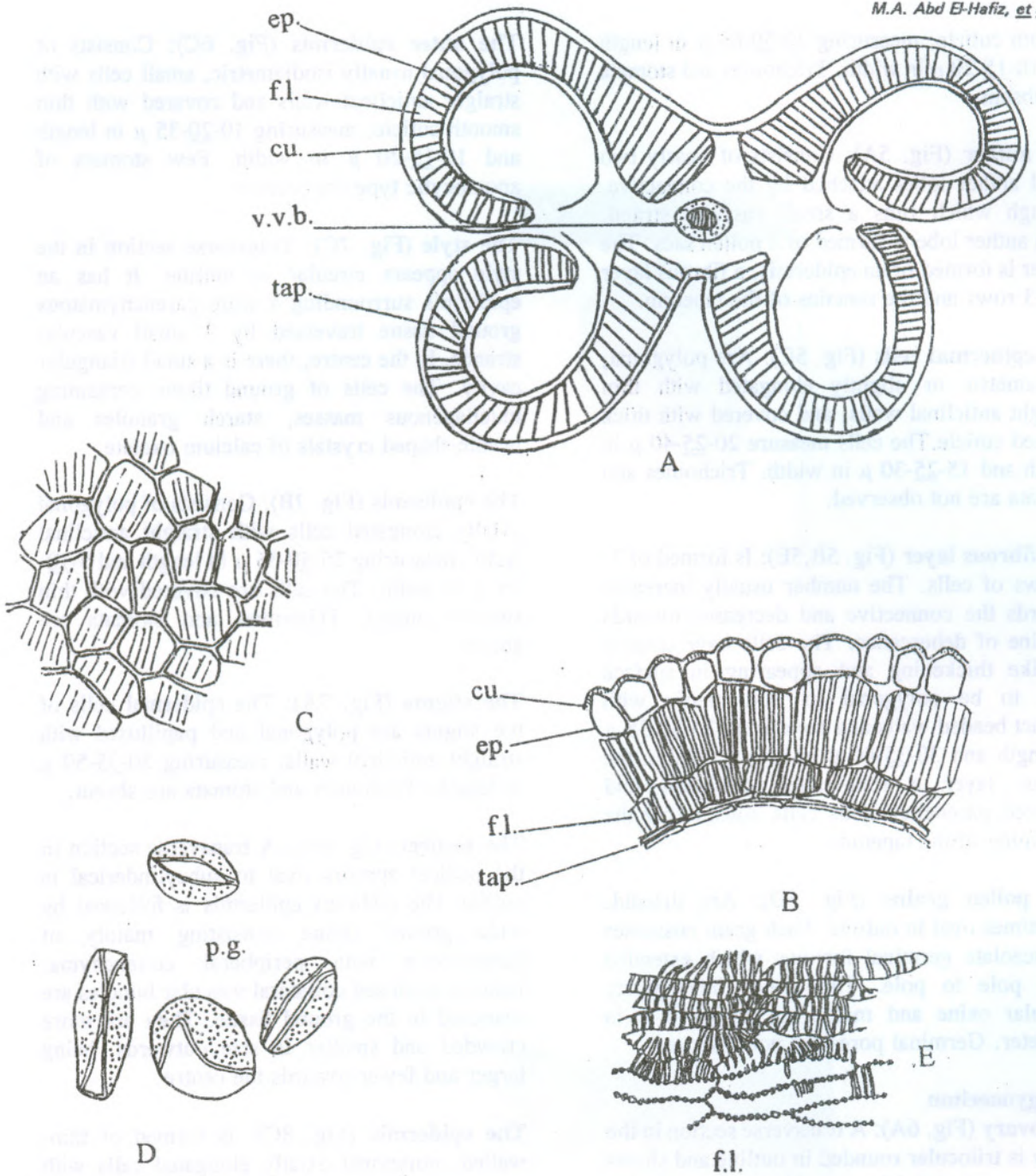


Fig. 5: The androecium (cont.)

- A- Diagrammatic T.S. in the anther wall x 400
- B- Detailed T.S. in the anther wall x 400
- C- Epidermal cell of the anther x 400
- D- Pollen grains x 400
- E- Fibrous layer of the anther x 400

Cu., cuticle; ep., epidermis; f.l., fibrous layer; p.g., pollen grain; tap., tapetum; v.b., vascular bundle.

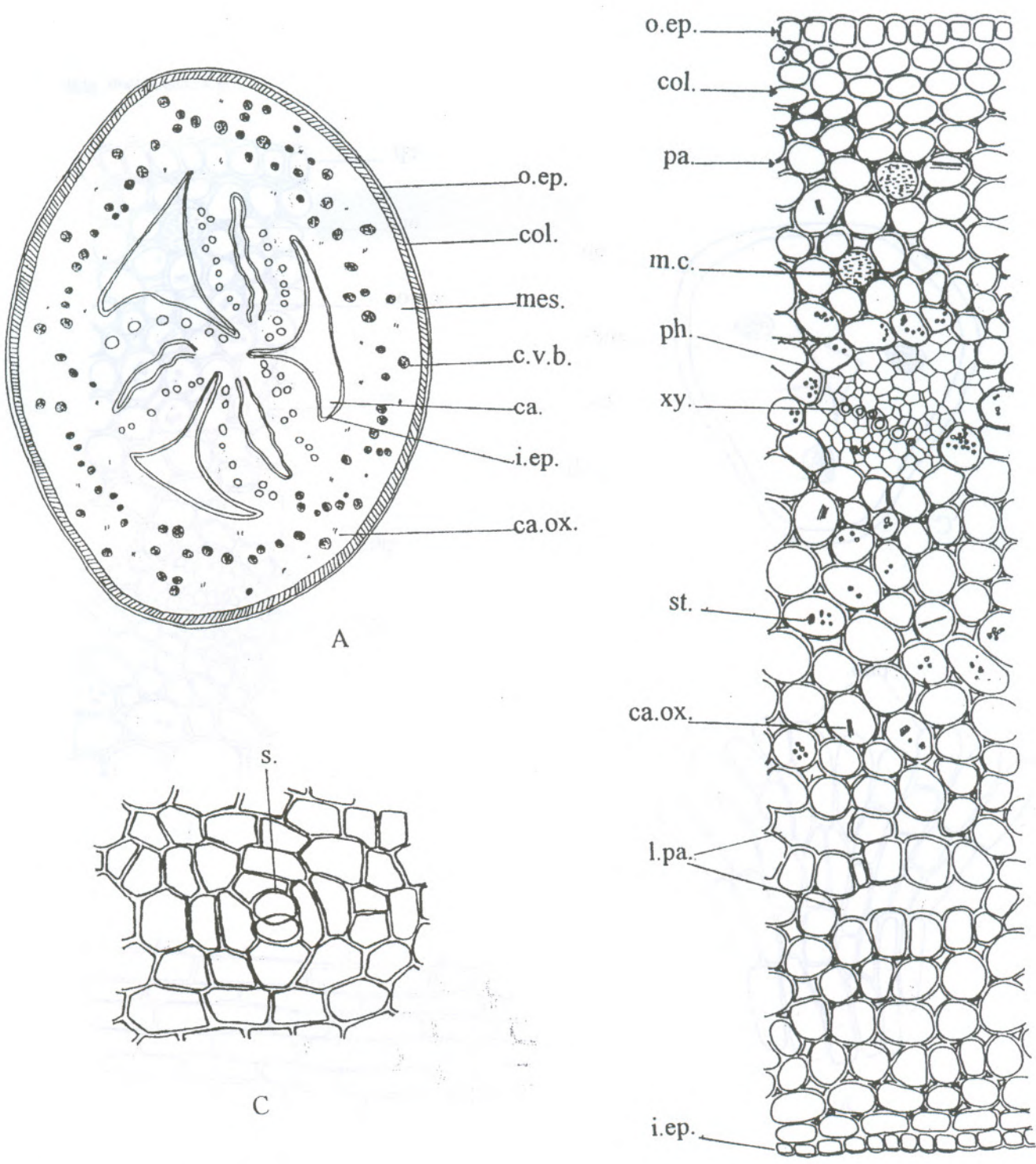


Fig. 6: The gynaecium.

- A- Diagrammatic T.S. in the ovary x 3
- B- Detailed T.S. in the ovary x 26
- C- Surface preparation of the ovary x 400

Ca.ox., calcium oxalate; ca., cavity; c.v.b., closed vascular bundle; col., collenchyma; i.ep., inner epidermis; l.pa., lacunous parenchyma; mes., mesophyll; m.c. mucilage cell; o.ep., outer epidermis; pa., parenchyma; ph., phloem; st., starch granules; s., stomata; xy., xylem.

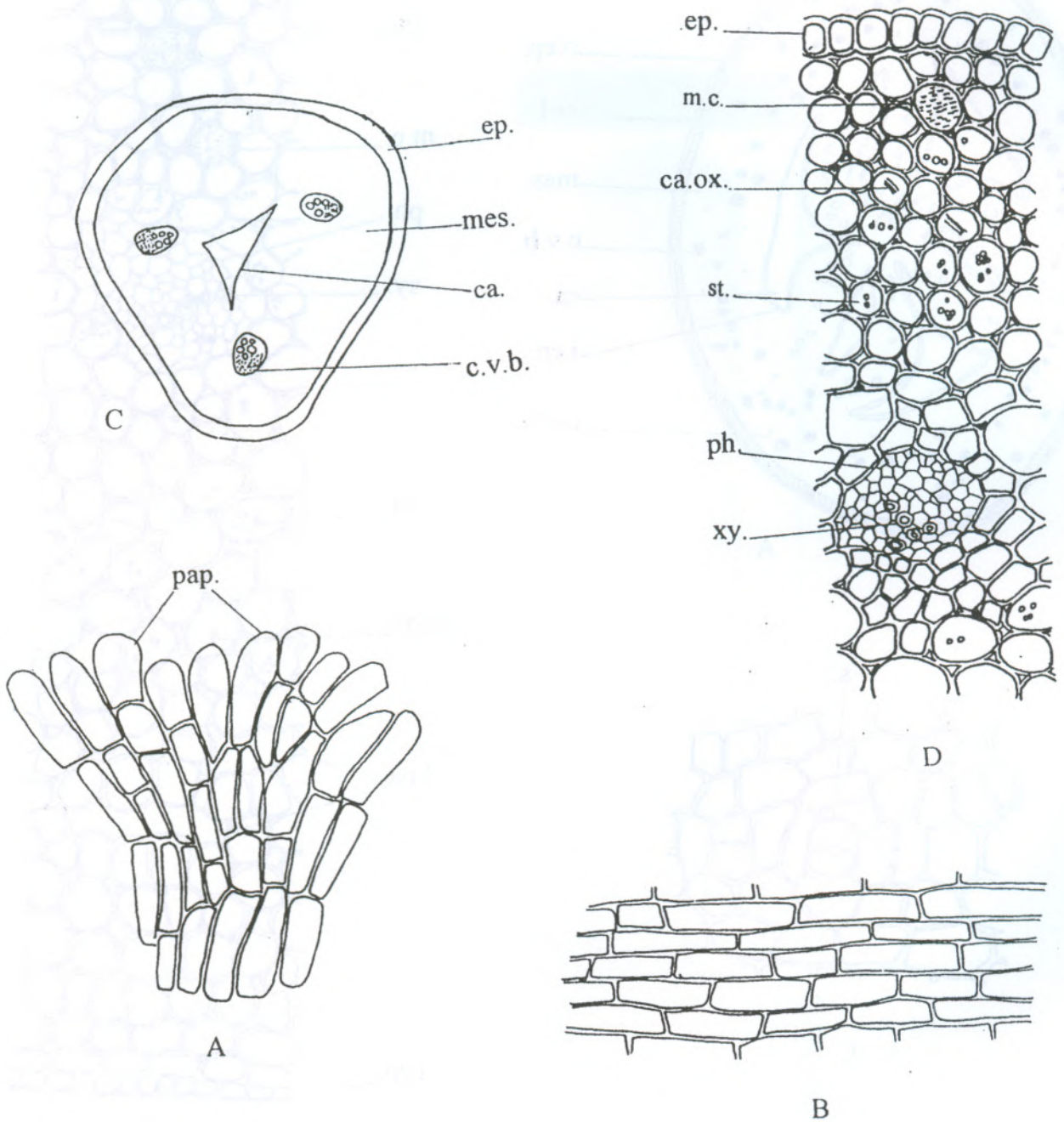


Fig. 7: The gynaecium (cont.)

- A- Surface preparation of the stigma x 400
- B- Surface preparation of the style x 400
- C- Diagrammatic T.S. in the style x 100
- D- Detailed T.S. in the style x 400

Ca.ox., calcium oxalate; ca., cavity; c.v.b., closed vascular bundle; ep., epidermis; mes., mesophyll; m.c., mucilage cell; pap., papillae; ph., phloem; st., starch granule; xy., xylem.

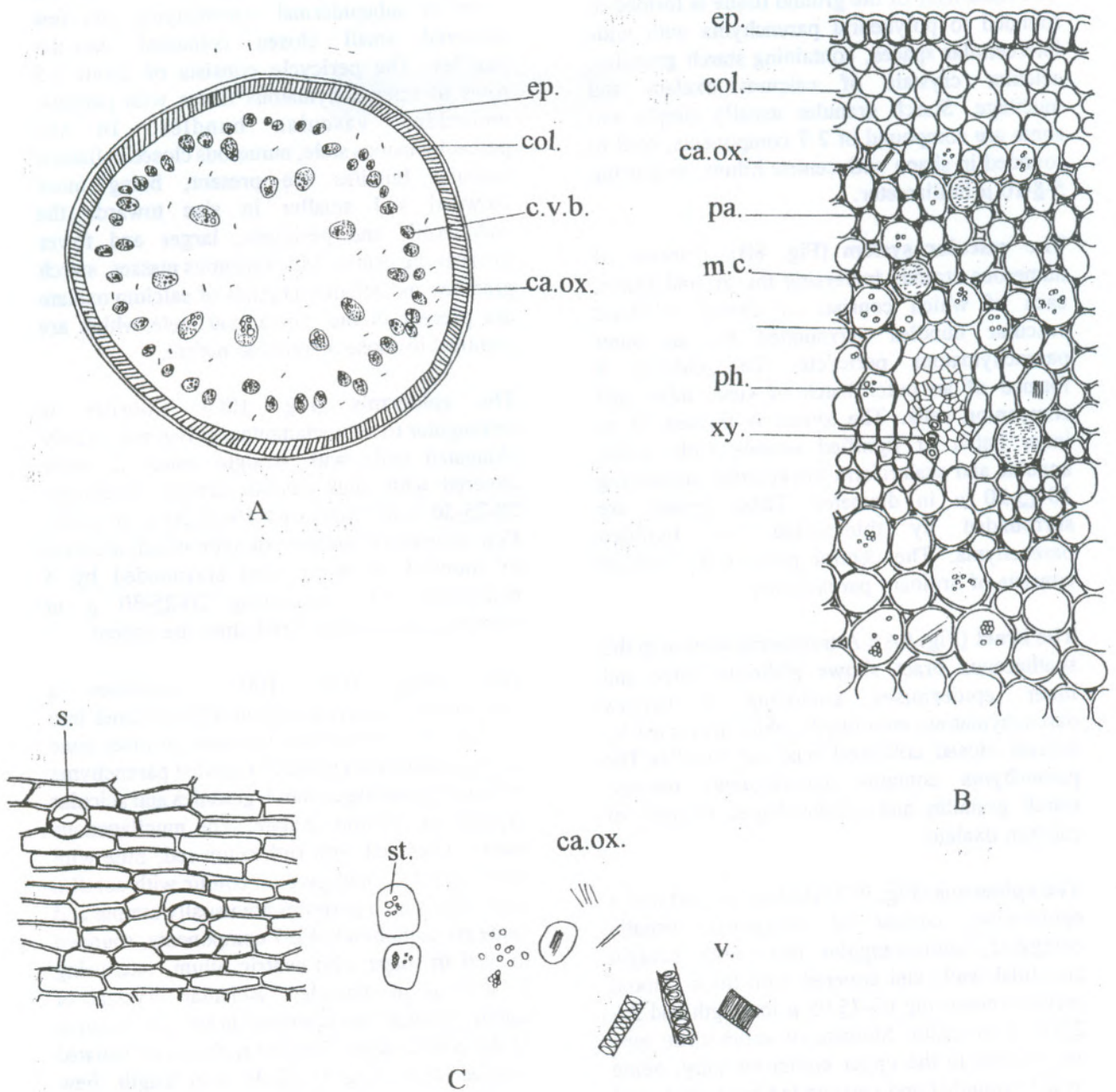


Fig. 8: The pedicel

- A- Diagrammatic T.S. in the pedicel x 26
- B- Detailed T.S. in the pedicel x 26
- C- Isolated elements from the pedicel x 26

Ca.ox., calcium oxalate; col., collenchyma; c.v.b., closed vascular bundle; ep., epidermis; m.c., mucilage cell; pa., parenchyma; ph., phloem; st., starch granules; s., stomata; v., vessel; xy., xylem.

The ground tissue (Fig. 8B): Consists of an outer zone of 3-5 rows of rounded collenchyma. The remainder of the ground tissue is formed of rounded to polyhedral parenchyma with wide intercellular spaces, containing starch granules, acicular crystals of calcium oxalate and mucilage. Starch granules usually simple and some are compound of 2-7 components, oval to rounded in shape with centric hilum, measuring 5-8-10 μ in diameter.

The vascular system (Fig. 8B): Consists of numerous strands traversing the ground tissue, each of which consists of closed collateral vascular bundles surrounded by an outer parenchymatous pericycle. The phloem is formed of an outer batch of sieve tubes and companion cells. The xylem is formed of an inner batch of lignified vessels with spiral, annular and scalariform thickenings, measuring 10-15-20 μ in diameter. These vessels are surrounded by thin-walled non lignified parenchyma. The central part of the pedicel consists of ordinary parenchyma.

The bract (Fig. 9A): A transverse section in the spathaceous bract shows glabrous outer and inner epidermises enclosing a narrow parenchymatous mesophyll, which traversed by several closed collateral vascular bundles. The parenchyma contains mucilagenous masses, starch granules and needle-shaped crystals of calcium oxalate.

The epidermis (Fig. 9C): Both upper and lower epidermises consist of polygonal, usually elongated, subrectangular cells with straight anticlinal walls and covered with thick smooth cuticle, measuring 65-75-95 μ in length and 20-25-35 μ in width. Stomata of anomocytic type are present in the upper epidermis only, being oval to rounded and surrounded by 4 epidermal cells, measuring 20-25-30 μ in diameter are present. Trichomes are absent.

The scape (Fig. 10A): A transverse section in the scape appears oval to subcylindrical in outline. It shows an outer glabrous epidermis

followed by a cortex which is parenchymatous of about 9-11 rows of rounded cells with 3-5 rows of subepidermal collenchyma and few scattered small closed collateral vascular bundles. The pericycle consists of about 3-5 rows of sclerenchymatous fibres with partially embedded vascular bundles. In the parenchymatous stele, numerous closed collateral vascular bundles are present, being more crowded and smaller in size towards the endodermis and pericycle, larger and fewer towards the centre. Mucilagenous masses, starch granules and acicular crystals of calcium oxalate are present in the cortex and stele which are identical to those mentioned before.

The epidermis (Fig. 10C): Consists of rectangular to subrectangular, polygonal, axially elongated cells with straight anticlinal walls covered with thick smooth cuticle, measuring 20-25-30 μ in length and 10-15-20 μ in width. Few stomata of anomocytic type which are oval to rounded in shape, and surrounded by 4 epidermal cells, measuring 20-25-30 μ in diameter are present. Trichomes are absent.

The cortex (Fig. 10B): Comprises a comparatively narrow region differentiated into an outer zone of collenchyma and an inner zone of thin-walled polygonal to rounded parenchyma containing mucilage, starch granules and acicular crystals of calcium oxalate. The mucilagenous masses stain red with ruthenium red, blue with methylene blue and give no colour with corallin soda. The starch granules are usually simple and some are compound of 2-7 components, rounded to oval in shape with centric hilum, measuring 5-10-15 μ in diameter. Acicular crystals of calcium oxalate are scattered in the parenchyma of the cortex in the form of raphides or isolated needles, measuring 15-20-30 μ in length. Few small closed collateral vascular bundles usually partially embedded in the pericyclic ring are present. Each vascular bundle is formed of small phloem which consists of sieve tubes and companion cells and xylem which is composed of 3-5 lignified vessels with spiral, annular and scalariform thickenings. The vessels are

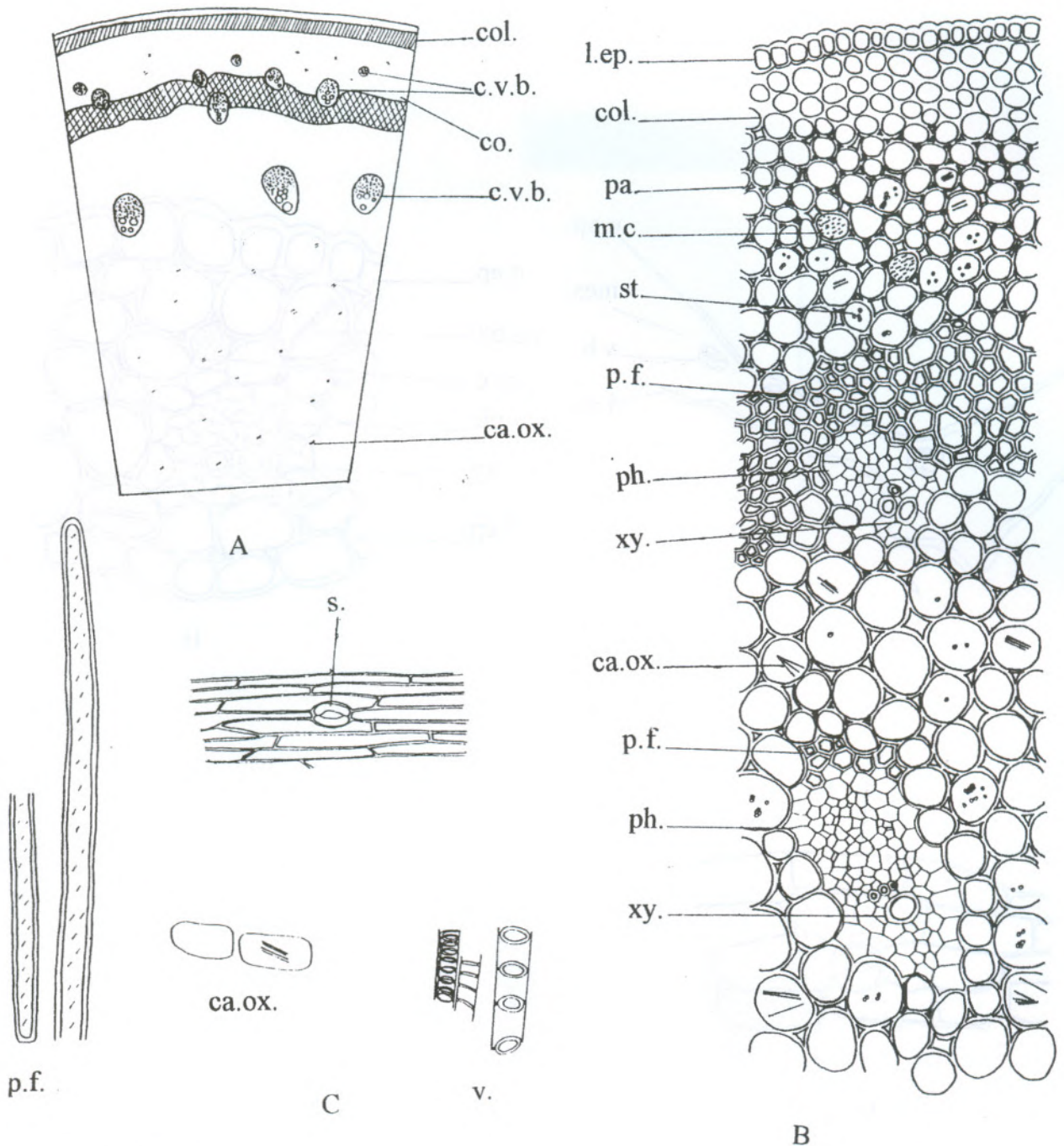


Fig. 10: The scape

- A- Diagrammatic T.S. in the scape x 26
- B- Detailed T.S. in the scape x 26
- C- Isolated elements from the scape x 26

Ca.ox., calcium oxalate; c.v.b., closed vascular bundle; col., collenchyma; co., cortex; ep., epidermis; m.c., mucilage cell; pa., parenchyma; p.f., pericyclic fibre; ph., phloem; st., starch granules; s., stomata; v., vessel; xy., xylem.

surrounded by small thin-walled non lignified wood parenchyma.

The pericycle (Fig. 10B): Constitutes the outermost 3-5 rows of the stele forming with the endodermis a complete ring separating the cortex from the stele. It consists of sclerenchymatous fibres. The pericyclic fibres are very long, with thick lignified walls showing few slit-like pits and having narrow, sometimes moderately wide lumens, blunt apices and measuring 780-785-800 μ in length and 25-30-35 μ in width.

The stele (Fig. 10B): Is formed of wide central zone, and its ground mass is composed of parenchyma resembling the cortical cells. The vascular bundles are similar to those of the cortical ones. The phloem is well marked and formed of sieve tubes and companion cells. The xylem is formed of lignified vessels with spiral, annular and scalariform thickenings, measuring 20-25-35 μ in diameter. The vessels are surrounded by thin-walled non lignified wood parenchyma.

Powdered flower

The dried powder is yellowish brown in colour, with faint odour and mucilagenous bitter taste. The diagnostic microscopical features are:

- 1- Fragments of the perianth, ovary and bract showing polygonal, elongated or isodiametric epidermal cells, having straight anticlinal walls covered with thick smooth cuticle showing anomocytic stomata.
- 2- Fragments of the anther showing polygonal isodiametric epidermal cells with thin anticlinal walls and covered with striated cuticle, as well as polygonal isodiametric cells of the fibrous layer with bar-like thickening.

- 3- Numerous discoid pollen grains with finely granular warty exine, showing 2 germinal furrows.
- 4- Fragments of the pericyclic fibres of the scape with thick lignified walls, wide lumens showing slit-like pits and having blunt apices.
- 5- Fragments of parenchyma containing mucilagenous masses, acicular crystals of calcium oxalate in raphides or single forms as well as starch granules, frequently simple usually compound of 2-7 components.
- 6- Fragments of xylem vessels showing spiral, annular and scalariform thickenings.
- 7- Free starch granules, acicular crystals of calcium oxalate as raphides or single needles and mucilagenous masses.
- 8- Absence of sclereids, pitted or reticulate elements and trichomes.

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