Bull. Pharm. Sci., Assiut University, Vol. 20, Part 2, December 1997, pp. 127-140.

MACRO AND MICROMORPHOLOGICAL CHARACTERS OF *ABERIA CAFFRA* (HOOK.f. & HARV.) WARB. CULTIVATED IN EGYPT. PART II: FLOWERS AND FRUITS

D. W. Bishay, H. M. Sayed, S. A. Youssef and R. M. Abd Elsalam

Department of Pharmacgonosy, Faculty of Pharmacy, Assiut University, Assiut, Egypt

في هذا الجزء من الدراسة تم عمل دراسة عيانية ومجهرية لأزهار وثمار نبات الأبريا كافرا (هوك.ف. وهارف) وارب لامكان التعرف عليها سواء كانت كاملة أو على هيئة مسحوق.

The macro and micromorphological characters of both male and female flower, as well as fruit of Aberia caffra (Hook.f. & Harv.) Warb. are presented. They were found helpful in identifying them in both the entire and powdered forms.

INTRODUCTION

In a previous publication,[1] the habitat of *Aberia caffra* (Hook.f. & Harv.) Warb. (*Flacourtiaceae*), its folk medicinal uses, macro- and micromorphological characters of the stem and leaf were presented. The present investigation deals with macro- and micromorphology of the flowers and fruits of the same plant, in order to complete all the specifications by which the plant could be identified both in the entire and in the powdered forms.

MACROMORPHOLOGY

1- The male flower (Fig. 1,A)

The flowers are grouped in an umbel like cyme of 7-11 pedicellate flowers and flower buds. They are yellowish green in colour, with faint odour and slight bitter taste. They are zygomorphic staminate, polymerous, apetalous with the floral formula %, ♂ P_{5-7}, A_{7-11}. The male flower has sepaloid perianth, which is nearly ovate in shape with acute apex and an entire margin. It is green in colour measuring (0.3-0.6) cm in length and (0.2-0.4) cm in width. The androecium has 7-11 stamens on fleshy receptacle, filaments are free, about 4-6 mm in length. Anthers are dorsifixed and bilobed enclosing spherical pollen grains.

2- The female flower (Fig. 1,B) (Pistillate flower)

The flowers are solitary, axillary, pedicellate, yellowish-green in colour with faint odour and slight bitter taste. They are zygomorphic, pistillate polymerous, apetalous with the floral formula %, ♀ P_{5-7}, $G_{(5)}$. The female flower has sepaloid perianth which is similar to that of the male flower. The ovary is superior, syncarpous each carple is unilocular with two anatropous ovules attached to parietal placenta. It is globular in shape measuring (0.2-0.5) cm in diameter, with 5-7 short free styles and stigmae.

3- The fruit (Fig. 1,G)

Fruit is solitary, fleshy, berry, globular in shape, hairy, with persistent perianth and short stalk, it is yellowish-green to orange in colour when mature, measuring (1.5-2.5) cm in diameter. It carries remainings of stigma at its apex. The fruits is 10-12 seeded.

The seed (Fig. 1,J) is broadly ovate in shape, flattened, with arillus[2,3] of silky hair originating from the hilum and envelopes the whole seed. Raphe runs from its apex along the middle of one of the flat surfaces to the chalazal end. The seed is dark yellow to brownish in colour, measuring (0.8-1.4) cm in length and (0.4-0.9) cm in width. It has a leathery testa, two planoconvex thin cotyledons and

Received in 27/3/1997 & Accepted in 13/7/1997

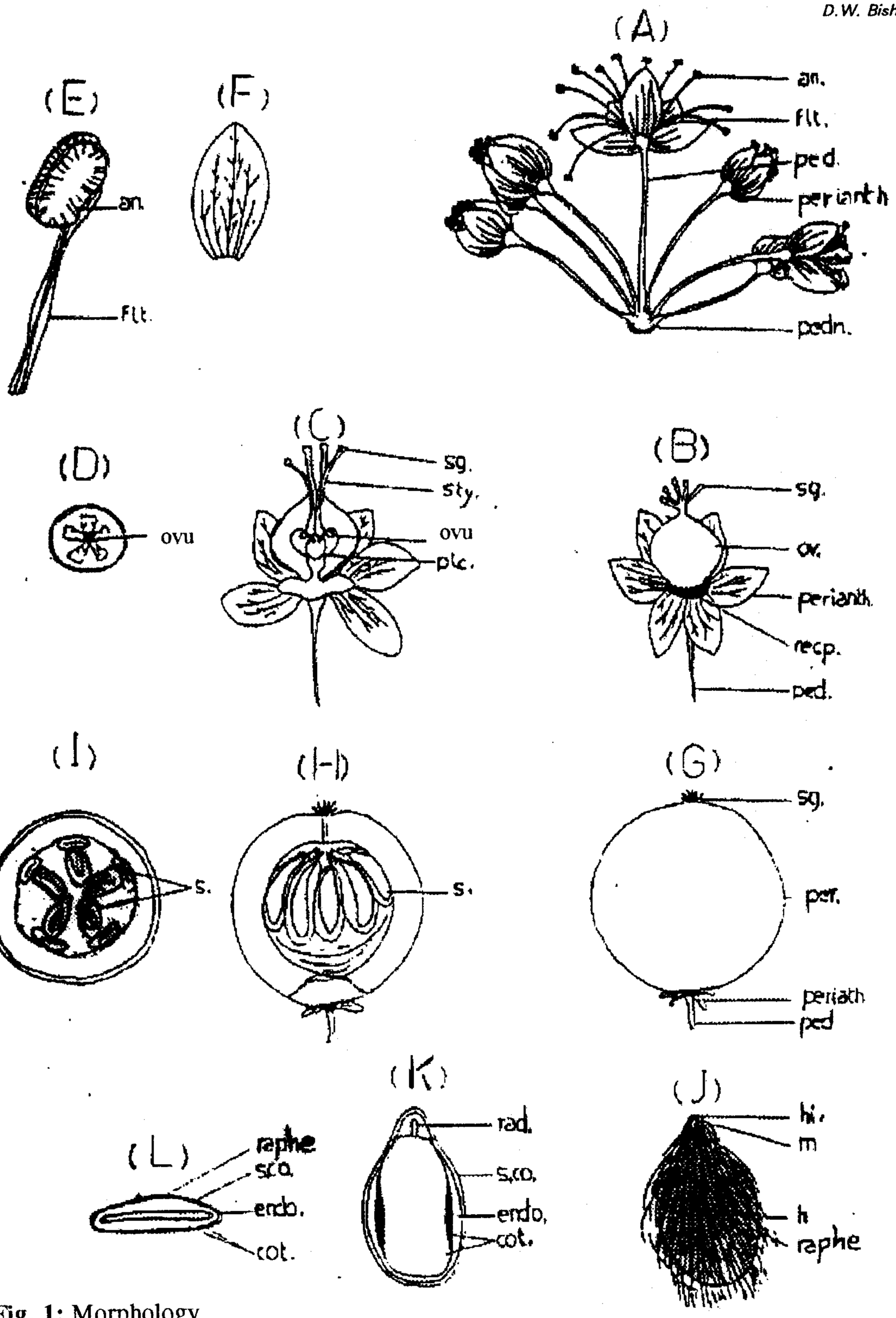


Fig. 1: Morphology

(A) The male flower	(x 3.25)	(B) The female flower	(x 3.25)
(C) Vertical section in female flower	(x 3.25)	(D) TS in the ovary	(x 3.25)
(E) The stamen	(x 6.5)	(F) Perianth (sepaloid)	(x 6.5)
(G) The fruit	(x 1.3)	(H) Vertical section in the fruit	(x 1.3)
(I) TS in the fruit	(x 1.3)	(J) The seed	(x 3.25)
(K) Longitudinal section in the seed	(x 3.25)	(L) TS in the seed	(x 3.25)

an., anther; cot., cotyledon; endo., endosperm; flt., filament; h., hair; hi., hilum; ov., ovary; ovu., ovule; ped., pedicel; pedn., peduncel; ra., radical; s., seed; sg., stigma; sty., style; s.co., seed coat.

comparatively wide endosperm. It has a characteristic nauseating slight bitter, oily taste and disagreable odour.

MICROMORPHOLOGY

1- Male flower

a- The pedicel (Fig. 2,A): A transverse section in the pedicel is more or less polygonal to irregular in outline with outer hairy epidermis followed by wide cortex, endodermis and pericycle are indistinguishable. The vascular system composed of a complete ring of phloem and xylem enclosing a central pith.

The epidermis consists of one row of square to rounded cells, which appear in surface view (Fig. 2,B) polygonal with straight anticlinal walls, covered with thin smooth cuticle, measuring (23-38-42 μ) in length, (7-12-19 μ) in width and (15-19-23 μ) in height. Stomata are mostly absent. Non-glandular unicellular hairs measuring (53-61-80 μ) in length and (7-11-19 μ) in width are observed.

The cortex consists of rounded to oval parenchymatous cells with wide intercellular spaces, some containing cluster and prismatic crystals of calcium oxalate.

The vascular system consists of a complete ring of phloem of soft cellulosic elements of seive tissue and phloem parenchyma containing small clusters of calcium oxalate. The xylem elements consist mainly of lignified spiral and reticulate vessels measuring (11-15-19 μ) in diameter. The pith is narrow of polygonal to rounded parenchyma, some containing calcium oxalate crystals.

b- The perianth (Fig. 3): A transverse section in the sepaloid of the perianth is cresent shaped with outer and inner hairy epidermises, enclosing undifferentiated parenchymatous mesophyll with scattered vascular bundles and containing calcium oxalate crystals. The inner and outer epidermises (Fig. 3,B) are square to subrectangular in shape, in transverse section, while in surface view the inner epidermal cells are polygonal, with slightly wavy anticlinal walls, covered with smooth cuticle, measuring (34-61-65 μ) in length, (15-19-23 μ) in width and (19-26-34 μ) in height. Stomata are mostly absent. The outer epidermal cells appear polygonal with relatively straight anticlinal walls, covered with smooth cuticle and measuring (42-50-57 μ) in length, (19-30-54 μ) in width and (23-34-40 μ) in height. Stomata are of anomocytic type, measuring (23-27-34 μ) in length and (19-23-26 μ) in width. Non-glandular unicellular hairs measuring (65-79-115 μ) in length and (7-11-15 μ) in width are present in both surfaces.

c- The androecium (Fig. 2,D): The filament in transverse section is circular in outline, with an outer epidermis and parenchymatous ground tissue and central vascular elements. The epidermal cells in surface view (Fig. 2,E) are polygonal to subrectangular in shape, with straight anticlinal walls, covered with smooth cuticle measuring (23-30-42 μ) in length and (3-5-7 μ) in width. No stomata or hairs are observed.

The anther in transverse section (Fig. 2,F) shows subrectangular epidermal cells with thick slightly lignified walls. They are polygonal to nearly rounded in surface view (Fig. 2G) measuring (19-23-26 μ) in length, and (7-11-15 μ) in width and (50-54-65 μ) in height. The fibrous layer is formed of several rows of polygonal cells with thickened beaded lignified walls measuring (26-34-38 μ) in length and (19-23-30 μ) in width. Pollen grains are smooth, spherical with three germ pores, measuring (20-23-30 μ) in diameter.

The powder (Fig. 3,D): It is yellowish-green in colour with faint odour and slight-bitter taste. It is characterised microscopically by the following:

1- Fragments of the epidermal cells of the pedicel, consisting of polygonal, axially elongated cells with straight anticlinal walls covered with smooth cuticle, unicellular non-glandular hairs and no stomata are observed.
2- Fragments of parenchymatous cells of the cortex containing clusters and prismatic crystals of calcium oxalate.
3- Fragments of the epidermal cells of the perianth, polygonal to subrectangular with slightly wavy anticlinal walls, covered with smooth cuticle non-glandular unicellular

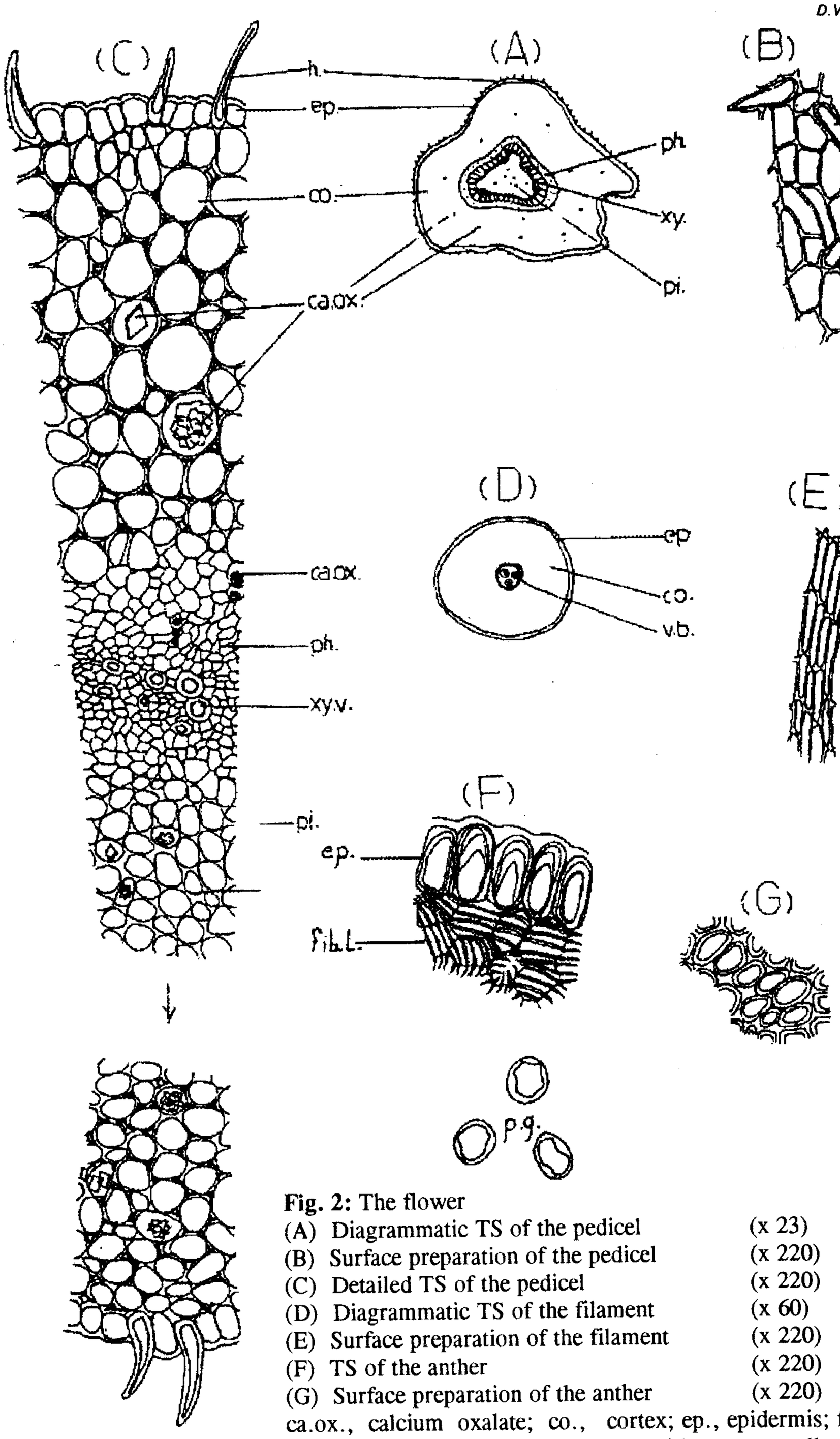


Fig. 2: The flower

(A) Diagrammatic TS of the pedicel	(x 23)
(B) Surface preparation of the pedicel	(x 220)
(C) Detailed TS of the pedicel	(x 220)
(D) Diagrammatic TS of the filament	(x 60)
(E) Surface preparation of the filament	(x 220)
(F) TS of the anther	(x 220)
(G) Surface preparation of the anther	(x 220)

ca.ox., calcium oxalate; co., cortex; ep., epidermis; fibl., fibrous layer; h., hair; ph., phloem; pi., pith; p.g., pollen grain; v.b., vascular bundle; xy., xylem; xy.v., xylem vessels.

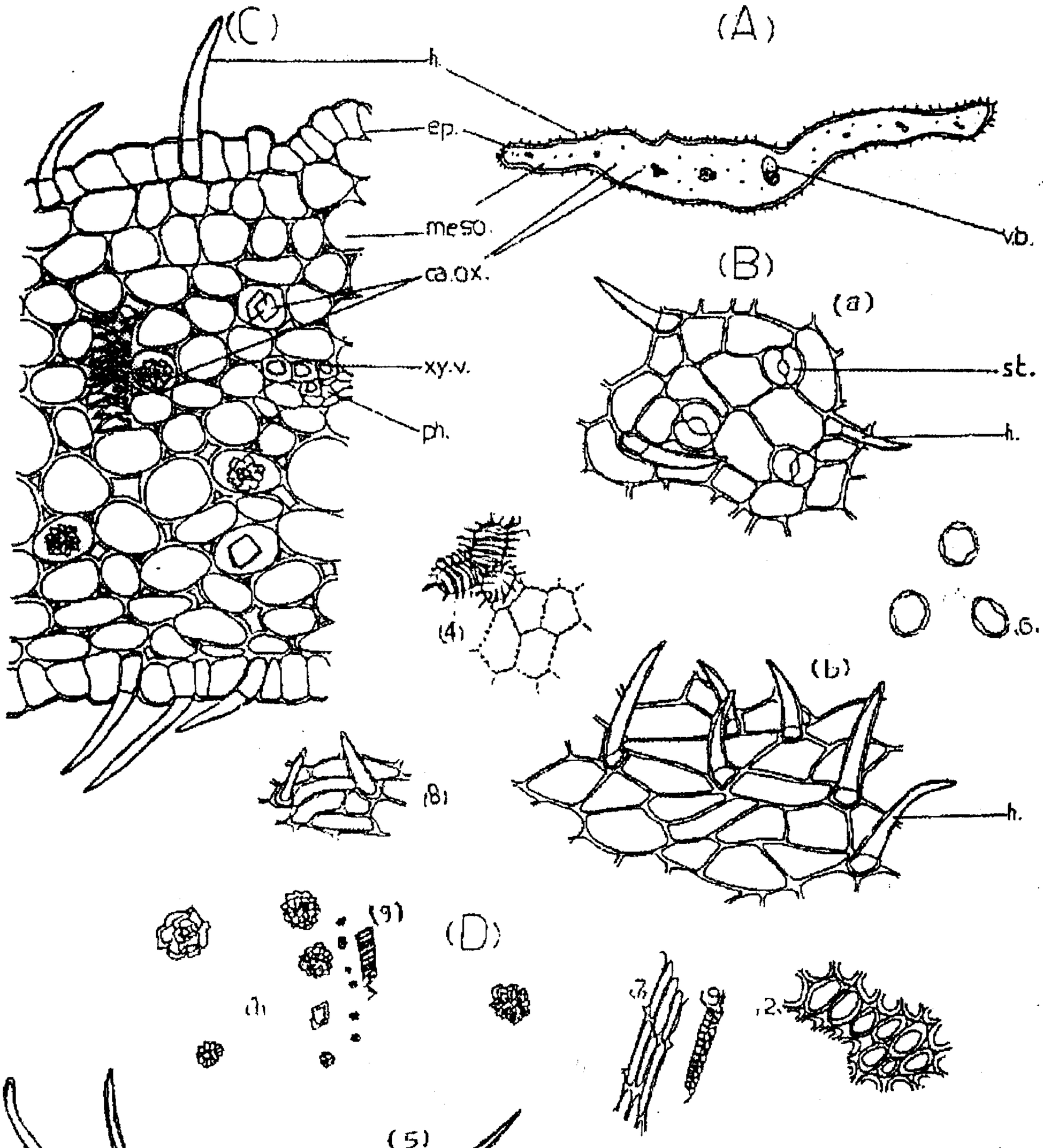


Fig. 3: The flower
(A) Diagrammatic TS of the sepaloid (x 23)
(B) Surface preparation of the sepaloid (x 220)
a- outer surface b- Inner surface
(C) Detailed TS of the sepale (x 220)
(D) Powder of the male flower (x 220)

1- Calcium oxalate crystals
2- Epidermis of anther
3- Inner surface of the sepaloid
4- Fibrous layer of anther
5- Outer surface of the sepaloid
6- Pollen grains
7- Surface of the filament
8- Surface of the filament
9- Xylem vessels

ca.ox., calcium oxalate; ep., epidermis; h., hair; meso., mesophyl; ph., phloem; st., stomata; v.b., vascular bundle; xy.v., xylem vessels.

trichomes and occasional anomocytic stomata are observed.

4- Fragments of the fibrous layer of anther.
5- Scattered calcium oxalate clusters and prismatic crystals as well as unicellular non-glandular hairs.
6- Smooth spherical pollen grains.
7- Few spiral and annular lignified xylem vessels.

2- The female flower (Fig. 4)

The structure of pedicel and perianth are similar in outline and arrangement of layers to those of the male flower.

a- The gynaecium (Fig. 4,A): A transverse section in the ovary is circular in outline with inner and outer epidermises enclosing wide parenchymatous ground tissue traversed by several vascular strands. The outer epidermal cells are nearly rectangular in transverse section; polygonal to subrectangular in surface view (Fig. 4,E), with straight thickened anticlinal walls measuring (7-11-15 μ) in length, (4-7-11 μ) in width and (23-30-34 μ) in height. They carry unicellular non-glandular hairs covered with warty cuticle, measuring (61-76-96 μ) in length and (4-8-15 μ) in width but no stomata. The ground tissue consists of parenchyma cells free of calcium oxalate crystals with wide intercellular spaces and traversed by small vascular strands consisting of very small spiral and annular xylem vessels. The inner epidermis of the ovary wall consists of one row of rectangular narrow cells (Fig. 4,C,E) measuring (7-11-15 μ) in length, (4-7-11 μ) in width and (15-23-34 μ) in height. The cells carry few unicellular non-glandular hairs on their radial sides measuring (96-115-126 μ) in length and (7-11-15 μ) in width.

b- The style (Fig. 4,D): It appears rounded in transverse section with an outer epidermis, parenchymatous ground tissue and small central vascular bundle. In surface view the epidermal cells (Fig. 4,E) are nearly quadrangular to subrectangular with straight anticlinal walls and covered with thin smooth cuticle measuring (11-15-23 μ) in length and (7-11-15 μ) in width and (11-15-23 μ) in height.

c- The stigma (Fig. 5): It consists of polygonal cells, with straight anticlinal walls, covered with smooth cuticle and carrying long papillae, measuring (38-42-46 μ) in length.

The powder (Fig. 5): It is pale-yellowish green in colour with faint odour, slight bitter taste and characterised microscopically by the following:

1- Fragments of the epidermal cells of pedicel, lower and upper epidermal cells of the perianth, resembling those of the male flower.
2- Fragments of polygonal to subrectangular epidermal cells of the ovary wall, covered with smooth cuticle carrying unicellular non glandular hairs.
3- Fragments of epidermal cells of style composed of small polygonal cells with straight anticlinal walls, covered with thin smooth cuticle and carrying unicellular, non-glandular hairs covered with warty cuticle.
4- Scattered covering trichomes and calcium oxalate crystals.
5- Fragments of spiral, and annular lignified xylem vessels.

3- The fruit (Figs. 6,7,8)

a- The fruit stalk (Fig. 6): A transverse section in the fruit stalk is nearly circular in outline with an outer hairy epidermis, followed by parenchymatous cortex. The pericycle is represented by groups of fibres enclosing the vascular tissues and narrow pith.

The epidermal cells appear square to subrectangular in transverse section, while being in surface view, (Figl 6,D) polygonal to nearly isodiametric with straight anticlinal walls, covered with smooth cuticle and measuring (23-46-53 μ) in length, (15-19-23 μ) in width and (23-26-36 μ) in height. They carry numerous unicellular, non-glandular hairs covered with smooth cuticle, measuring (50-53-61 μ) in length and (11-15-19 μ) in width.

The cortex is composed of rounded

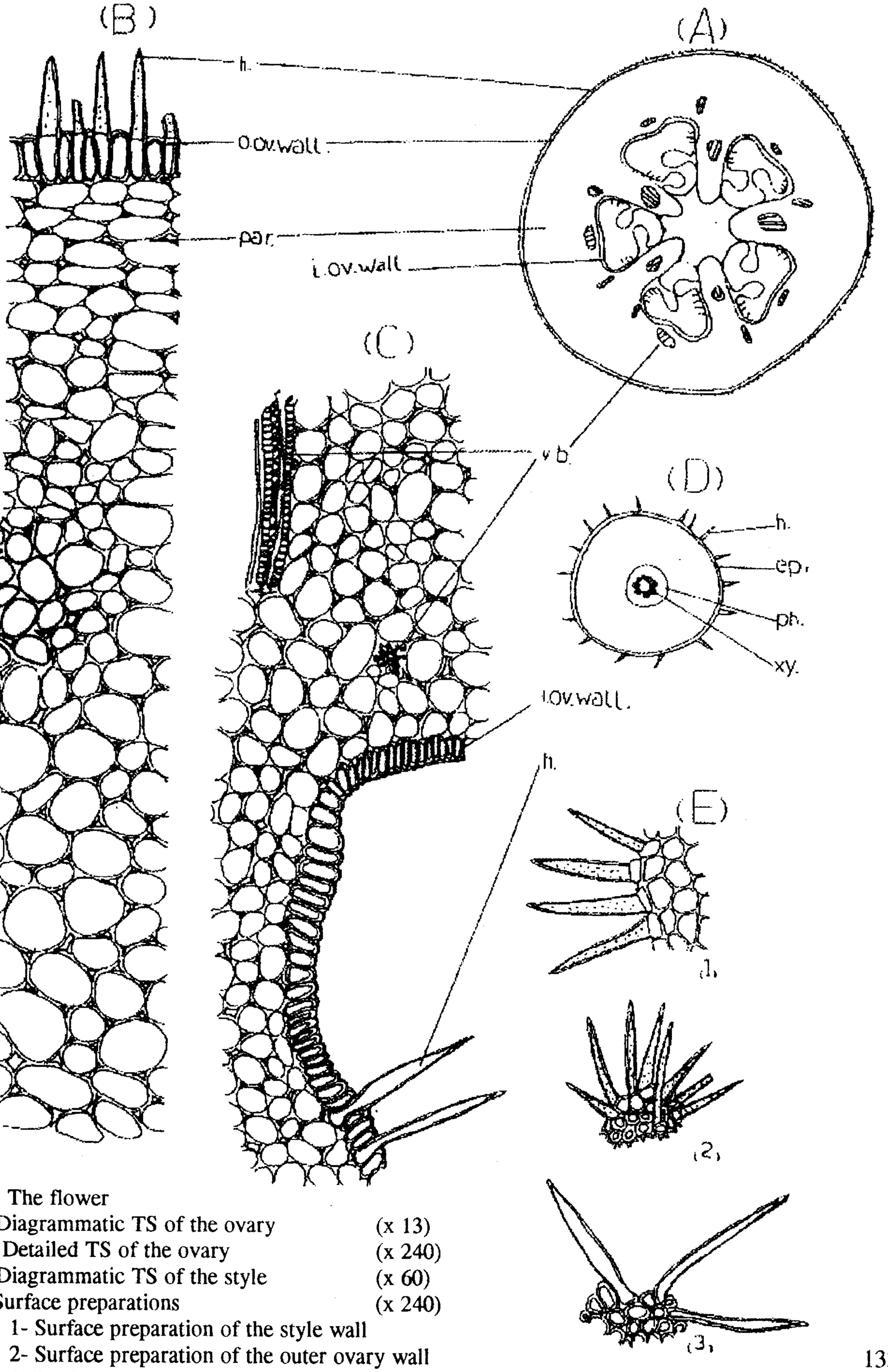


Fig. 4: The flower

(A) Diagrammatic TS of the ovary (x 13)
(B,C) Detailed TS of the ovary (x 240)
(D) Diagrammatic TS of the style (x 60)
(E) Surface preparations (x 240)
1- Surface preparation of the style wall
2- Surface preparation of the outer ovary wall
3- Surface preparation of the inner ovary wall

ep., epidermis; h., hair; i.ov.wall., inner ovary wall; o.ov.wall., outer ovary wall; par., parenchyma; ph., phloem; v.b., vascular bundle; xy., xylem.

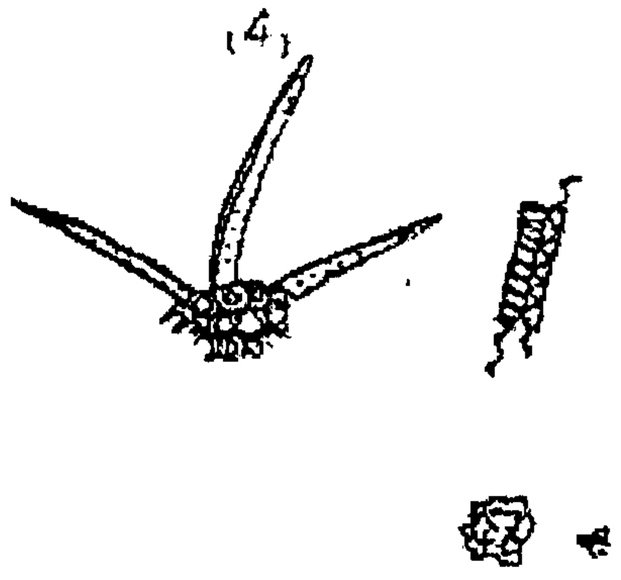


Fig. 5: Powder of the female flower (x 260)

1- Calcium oxlate
2- Inner ovary wall
3- Inner sepale wall
4- Outer ovary wall
5- Outer sepale wall
6- Parenchyma cells
7- Surface of pedicel
8- Stigma wall
9- Style wall
10- xylem vessels
h., hair

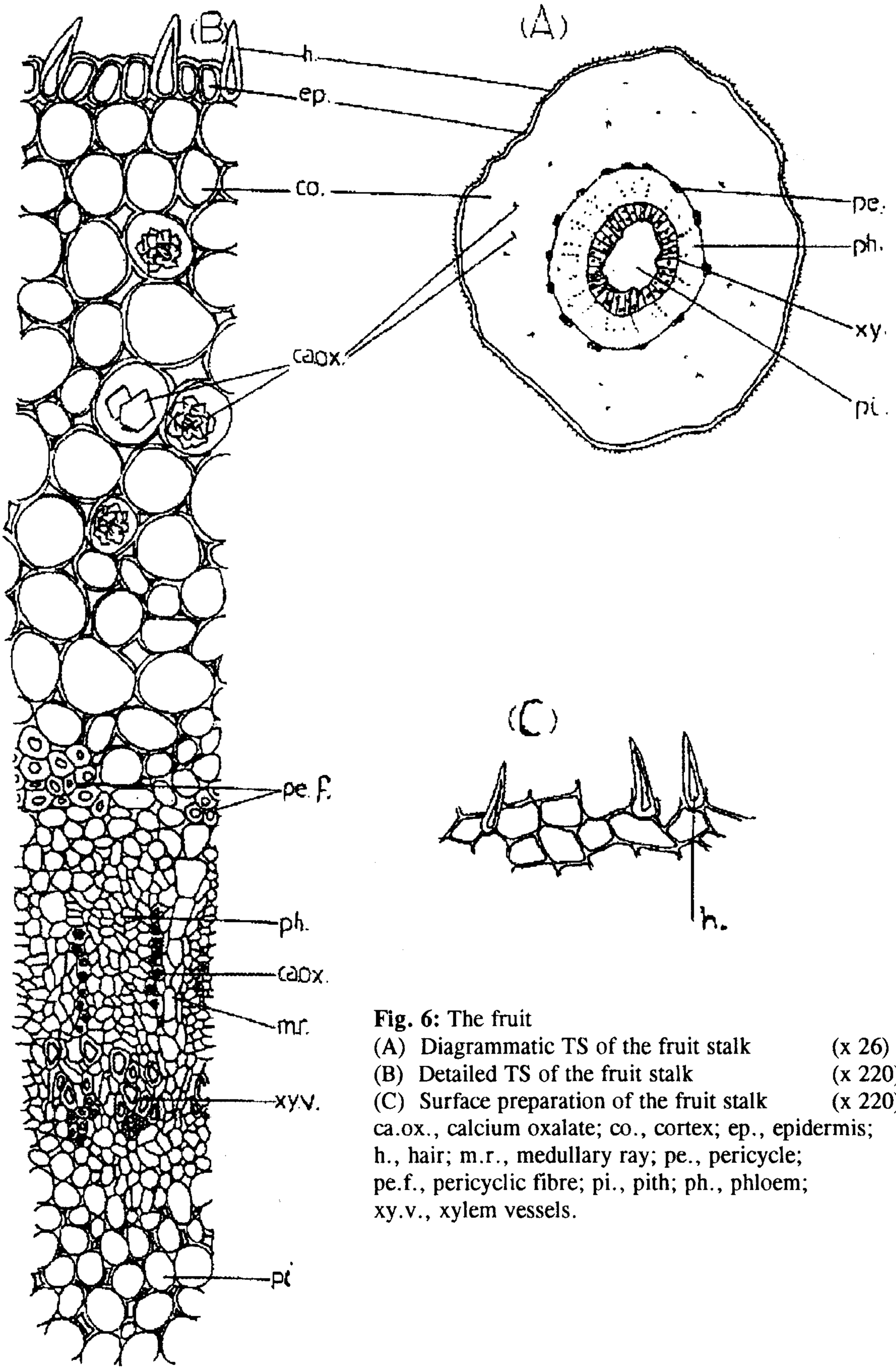


Fig. 6: The fruit
(A) Diagrammatic TS of the fruit stalk (x 26)
(B) Detailed TS of the fruit stalk (x 220)
(C) Surface preparation of the fruit stalk (x 220)
ca.ox., calcium oxalate; co., cortex; ep., epidermis; h., hair; m.r., medullary ray; pe., pericycle; pe.f., pericyclic fibre; pi., pith; ph., phloem; xy.v., xylem vessels.

parenchyma cells with wide intercellular spaces and occasional cluster and prismatic crystals of calcium oxalate.

The pericycle consists of groups of lignified fibres with thick lignified walls, narrow lumina and pointed ends, measuring (7-11-19 μ) in diameter and (384-538-769 μ) in length. The vascular system, consists of soft cellulosic parenchymatous phloem tissue and lignified spiral and reticulate xylem vessels.

The pith consists of ordinary parenchyma cells devoid of calcium oxalate.

The perianth is similar in structure to that of the flower.

b- Pericarp (Fig. 7): A transverse section in the pericarp (Fig. 7,A) is nearly rounded in outline. The pericarp comprises an epicarp of a single row of cells, followed by a collenchymatous hypodermis, a wide parenchymatous mesocarp with few vascular strands and an endocarp composed of single row of thick-walled cells.

The epicarp appears in transverse section as one row of subrectangular cells covered with thick cuticle, being polygonal, nearly isodiametric in surface view (Fig. 7,B), measuring (23-34-38 μ) in length, (7-11-19 μ) in width and (34-38-42 μ) in height. They carry unicellular non-glandular hairs covered with smooth cuticle having acute apices, narrow lumina and measuring (57-80-100 μ) in length and (4-7-11 μ) in width.

The mesocarp consists of an outer collenchymatous zone followed by a wide zone of parenchymatous cells of variable size, with wide intercellular spaces, containing oval to rounded starch granules, simple or in aggregates of 3-15 components, with stellate hilum, measuring (7-11-15 μ) in diameter. The vascular bundle consists of soft phloem tissue, in addition to spiral and annular lignified xylem vessels. The inner rows of the mesocarp cells contains few clusters of calcium oxalate. The endocarp consists of one row of short subrectangular cells covered with thick cuticle.

c- The seed (Fig. 8): A transverse section in the seed (Fig. 8,A&B) is planoconvex in outline. The seed coat consists of an outer and an inner integument. The outer integument is formed of epidermal and parenchymatous subepidermal cells. The epidermis of the outer integument consists of one row of subrectangular brownish cells covered with smooth cuticle and whipy or cottony hairs. In surface view they appear polygonal, nearly isodiametric with slightly wavy anticlinal walls, measuring (76-96-134 μ) in length, (76-96 μ) in width and (42-69-96 μ) in height. The whipy hairs originate at the base level of the epidermal cells measuring (4481-5769-8462 μ) in length and (76-115-123 μ) in width. The epidermis of the inner integument consists of polygonal to subrectangular lignified pitted sclerenchymatous cells followed by few rows of thin walled collapsed cells. The inner layers of the seed coat consists of one row of flask-like cells with thin nonlignified walls. In top view they are polygonal with short papillae, while being polygonal to rounded with thick slightly beaded cellulosic walls in basal view. The endosperm consists of an outer and inner epidermises enclosing several layers of cellulosic polygonal cells with narrow intercellular spaces, containing aleurone grains and fixed oil globules staining red with Sudan III. The cotyledones show well-defined epidermises enclosing several rows of square to polygonal thin-walled cells containing fixed oil globules staining red with Sudan III.

The powder (Fig. 9): Powdered fruit is yellowish-brown in colour with faint odour and slight-bitter oily taste. The microscopical diagnostic features are as follows:

1- Fragments of the epidermal cells of fruit stalk which are subrectangular, axially elongated carrying, unicellular non-glandular hairs.
2- Fragments of outer and inner epidermal cells of fruit sepaloid which are similar to those of flower perianth.
3- Fragments of epicarpal cells, which appear polygonal nearly isodiametric covered with thick cuticle, showing unicellular non-glandular trichomes.
4- Parencyma cells of the mesocarp containing

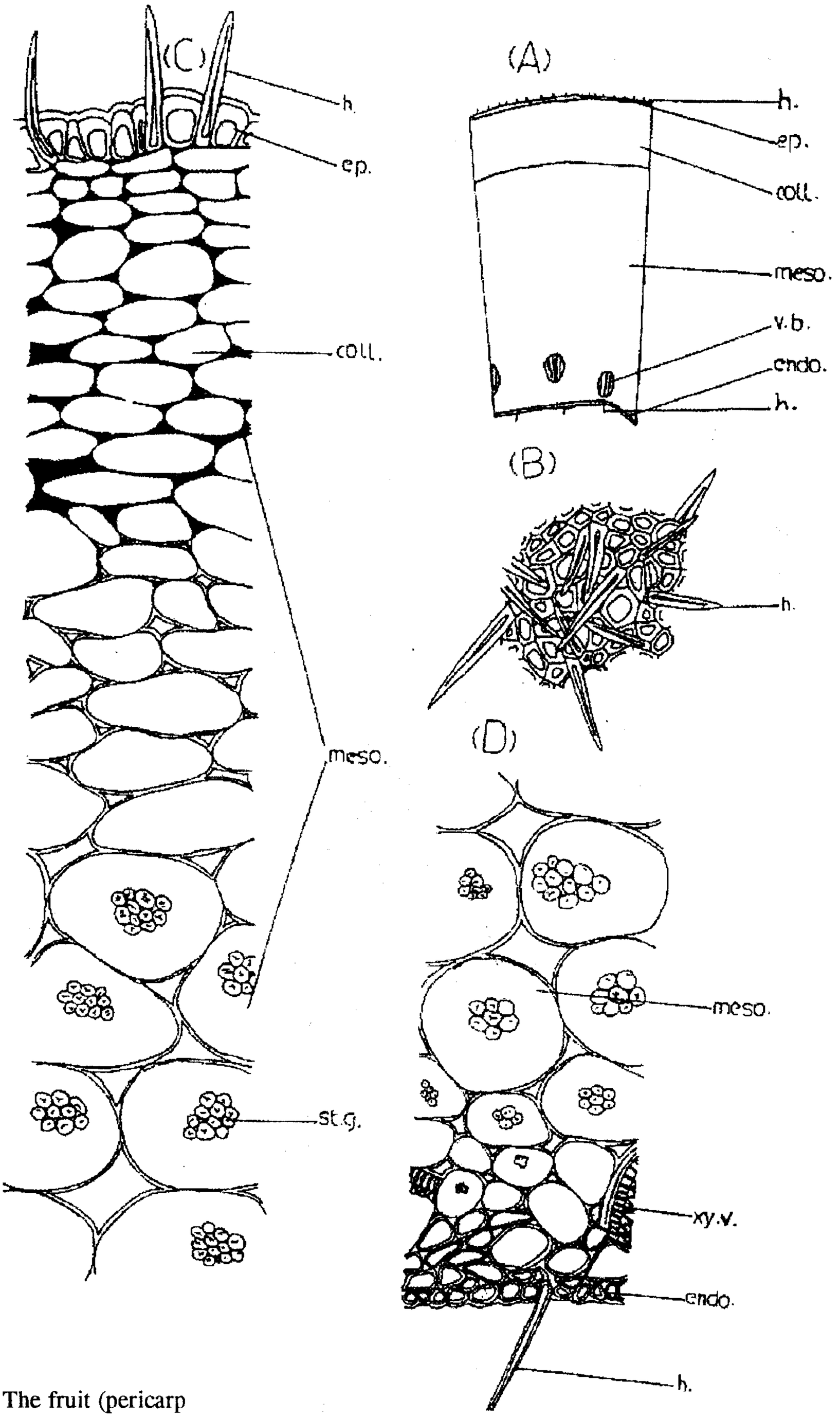
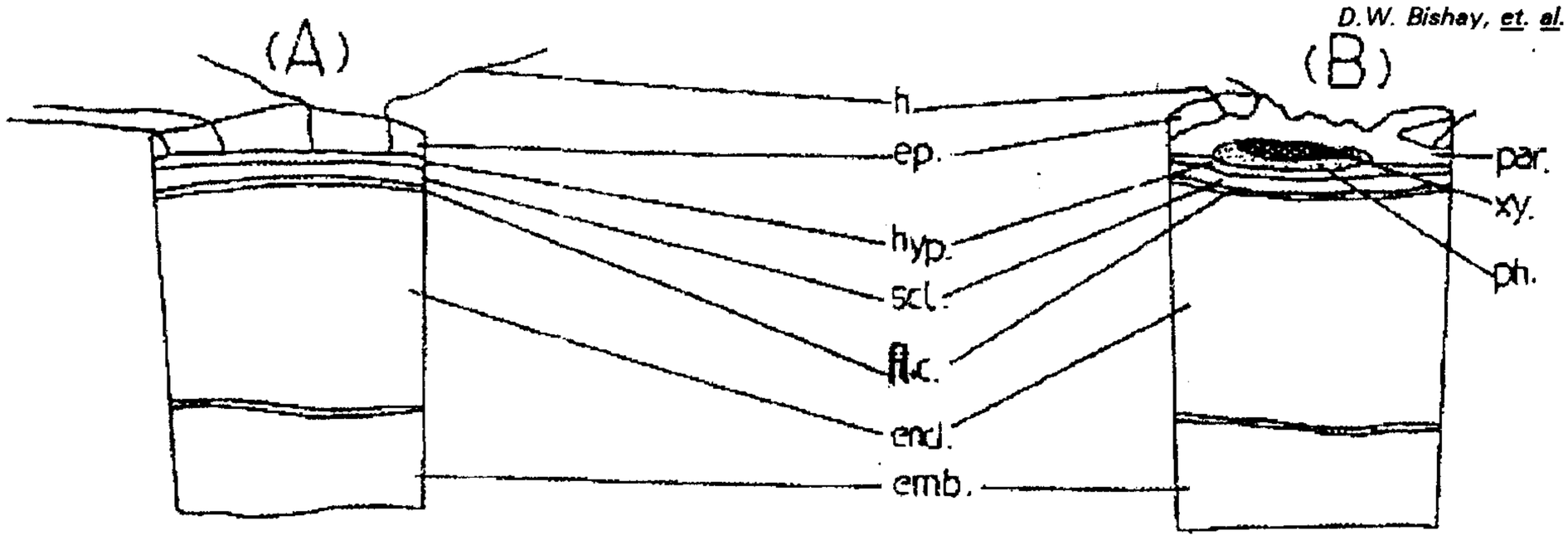


Fig. 7: The fruit (pericarp
(A) Diagrammatic TS of the fruit (x 13)
(B) Surface preparation of the fruit (x 190)
(C,D) Detailed TS of the fruit (x 190)
coll., collenchyma; endo., endocarp; ep., epidermis; h., hair; meso., mesocarp; st.g., starch granules; v.b., vascular bundle; xy.v., xylem vessels.



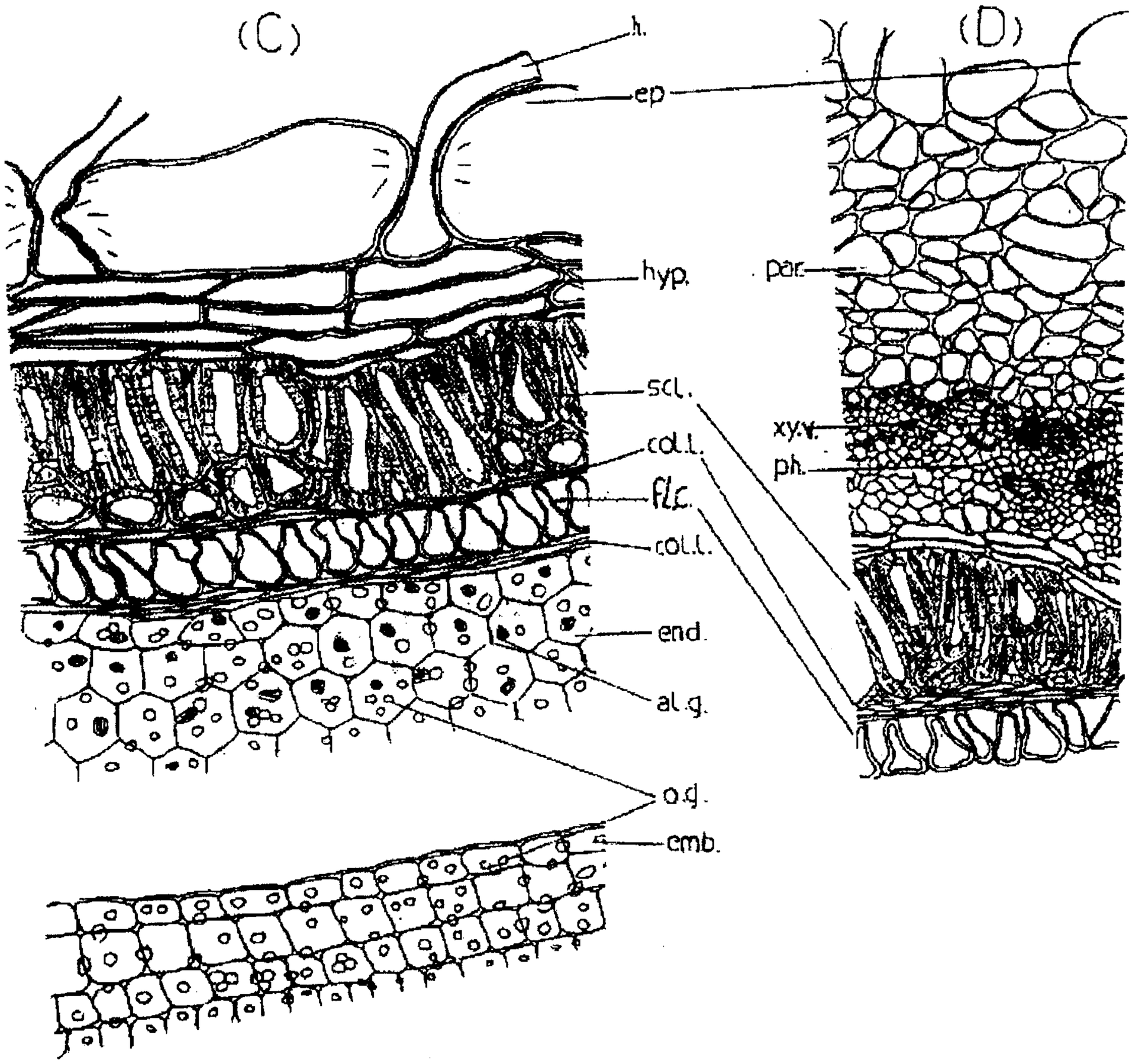


Fig. 8: The seed
(A) Diagrammatic TS of the seed (x 26)
(B) Detailed TS of the seed (raphe region) (x 26)
(C) Detailed TS of the seed (x 220)
(D) Detailed TS of the seed (raphe region) (x 220)

al.g., aleuron grains; f.l., flask layer; emb., embryo; end., endosperm; col.l., collapsed layer; ep., epidermis; h., hair; hyp., hypodermis; o.g., oil globules; par., parenchyma; ph., phloem; scl., sclerenchyma; xy.v., xylem vessels.

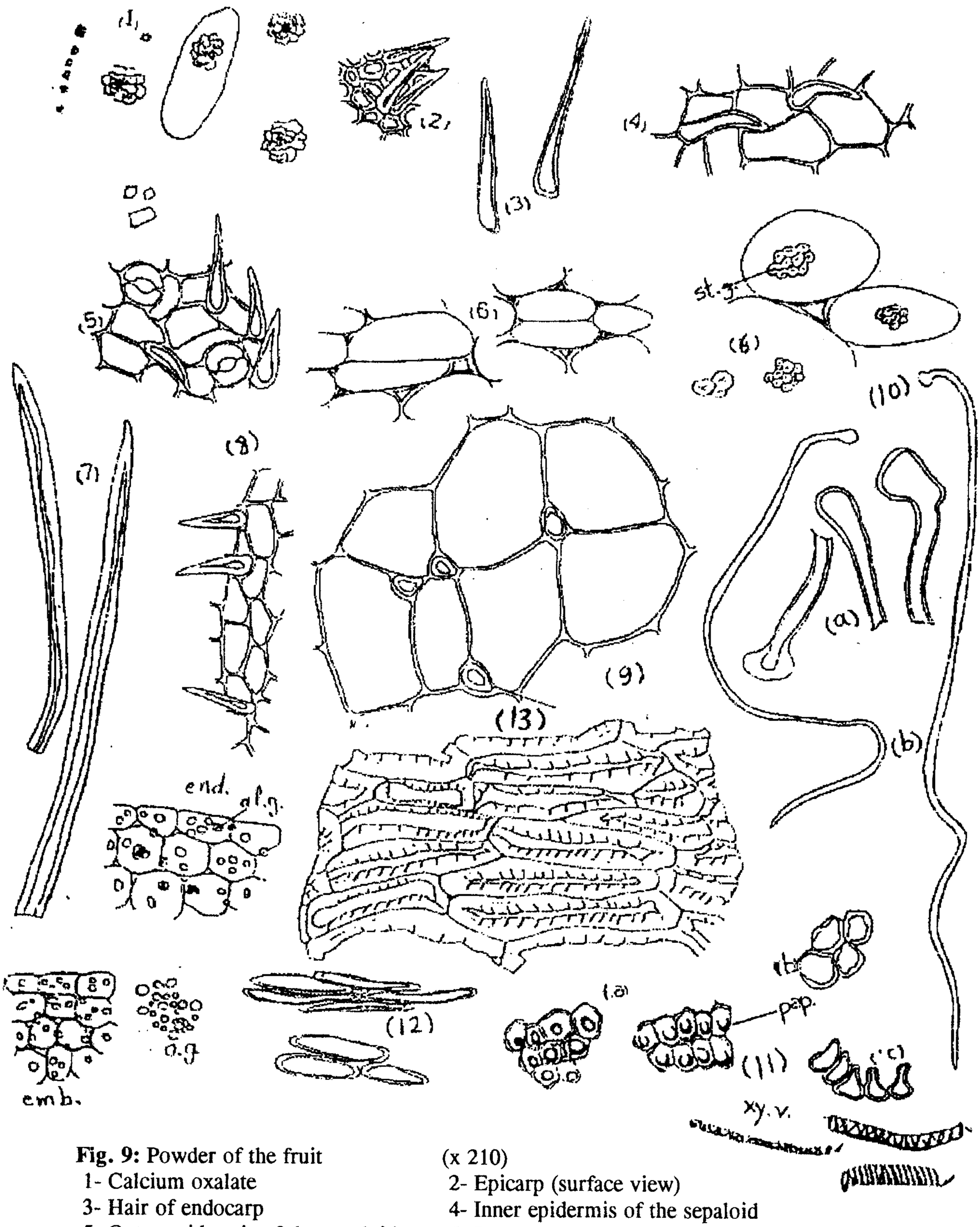


Fig. 9: Powder of the fruit (x 210)

1- Calcium oxalate
2- Epicarp (surface view)
3- Hair of endocarp
4- Inner epidermis of the sepaloid
5- Outer epidermis of the sepaloid
6- Parenchyma cells
7- Pericyclic fibre from the stalk
8- Surface of the stalk
9- Epidermal cells, ci., cicatrex
10- hair. a: (x 260) b: (x 26)
11- Flask cells; a: Top view, b: basal view, c: side view
12- Hypodermis
13- Sclerenchyma

al.g., aleuron grain; emb., embryo; end., endosperm; o.g., oil globules; st.g., starch granules; xy.v., xylem vessels.

oval-to rounded simple and compound starch granules with stellate hilum.

6- Numerous scattered non-glandular hairs, starch granules, prisms and clusters of calcium oxalate crystals from the pericarp.

7- Fragments of outer epidermal cells of the seed coat which are polygonal with slightly wavy anticlinal walls, covered with smooth cuticle and whipy or cottony hairs are observed.

8- Fragments of sclernchymatous epidermis of the inner seed coat which are polygonal to subrectangular in shape with thick, pitted, lignified walls.

9- Fragments of flask-like cells which are thick walled, non-lignified, nearly polygonal carrying short papillae in top view and polygonal to rounded cells with slightly peaded walls in basal view.

10- Fragments of flattened parenchyma cells.

11- Fragments of polygonal endosperm cells containing aleurone grains and fixed oil globules.

12- Fragments of embryo cells containing fixed oil globules.

13- Fragments of lignified pericyclic fibres, lignified spiral and reticulate xylem vessels.

REFERENCES

1- D. W. Bishay, H. M. Sayed, S. A. Youssef and R. M. Abd El-Salam, Bull. Pharm. Sci., Assiut University, 20 (2), 113-125.

2- G. H. Lawrence, "Taxonomy of Vascular Plants", The MacMillan Company, New York, 11th Printing, 613-14 (1966).

3- V. H. Heywood, D. M. Moore and W. T. Stearn Hon, "Flowering Plants of the World", Croom Helm, London, Sydney, 101-102 (1978).