

MARCO-AND MICROMORPHOLOGY OF ASPHODELUS AESTIVUS BORT.

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ABSTRACT

The macro-and micromorphological characters of the root, leaf and inflorescence of *aestivus* Bort. were studied to find out the diagnostic features of these organs in both the entire and powdered forms.

INTRODUCTION

Plants of the genus *Asphodelus* (Liliaceae) are herbaceous, characterised by the presence of anthraquinones^(1,2) and represented in Libya by five species⁽³⁾. The species *A. aestivus* Bort. is a wild plant, with tuberous root, having basal leaves and racemose inflorescences. The plant usually flowers in January⁽³⁾.

The natives in Libya, use the fresh slices of the tubers of this plant, as a remedy for external fungal infection.

In the present work, the macro-and micromorphology of the root, leaf and inflorescence of this plant is described.

EXPERIMENTAL

Plant Material :

The plant material was collected from the coastal region of Tripoli in February 1992, and authenticated by Dr. N. Siddiqui, Faculty of Science, El-Fateh University, Tripoli, Libya. A voucher specimen is kept in Pharmacognosy Dept., Faculty of Pharmacy, El-Fateh University.

Macromorphology :

1- The root :

The root (Fig. 1 A) are numerous and tuberous; firmly matted, cylindrical, stout, fleshy and soft.

They are brownish-yellow, break with short fracture exposing a yellowish organ interior, having slightly sweet taste and no characteristic odour.

2- The leaves :

The leaves (Fig. 1 A) are numerous, simple, sessile, exstipulate and the base is covered with dense splitting fibrous sheath (10 cm long). They have strap-shaped lamina, linear, triquetrate with entire margin and acute apices.

The leaf is glabrous, showing parallel venation, papery texture and has neither characteristic odour nor taste. It measures 70-100 cm in length and 2-5 cm in width.

3- The inflorescence :

The inflorescences (Fig. 1 A) have six racemed panicles arranged alternatively on a leafless scape and carrying pedicellate flowers.

Each raceme is subtended by sessile triangular-lanceolate bracts, each with smooth surface, violet colour and entire margin. They measure 1.3-6 cm in length and 0.5-1.3 cm in breadth.

The scape (Fig. 1 A) is stout, smooth, green in colour and solid. It measure 1.15 cm in length and 0.2-0.5 cm in diameter.

The flower (Fig. 1 B) is actinomorophic, hemaphrodite, trimerous and measuring 2-2.4 cm in length and 0.4-0.6 cm in diameter.

The pedicel (Fig. 1 A) is cylindrical, green smooth and measuring 0.9-1.6 cm in length and 0.3-0.4 cm in diameter.

The perianth (Fig. 1 B) is petalloid, consists of six free lanceolate to linear-oblong lobes having obtuse apices, pinkish-white in colour and

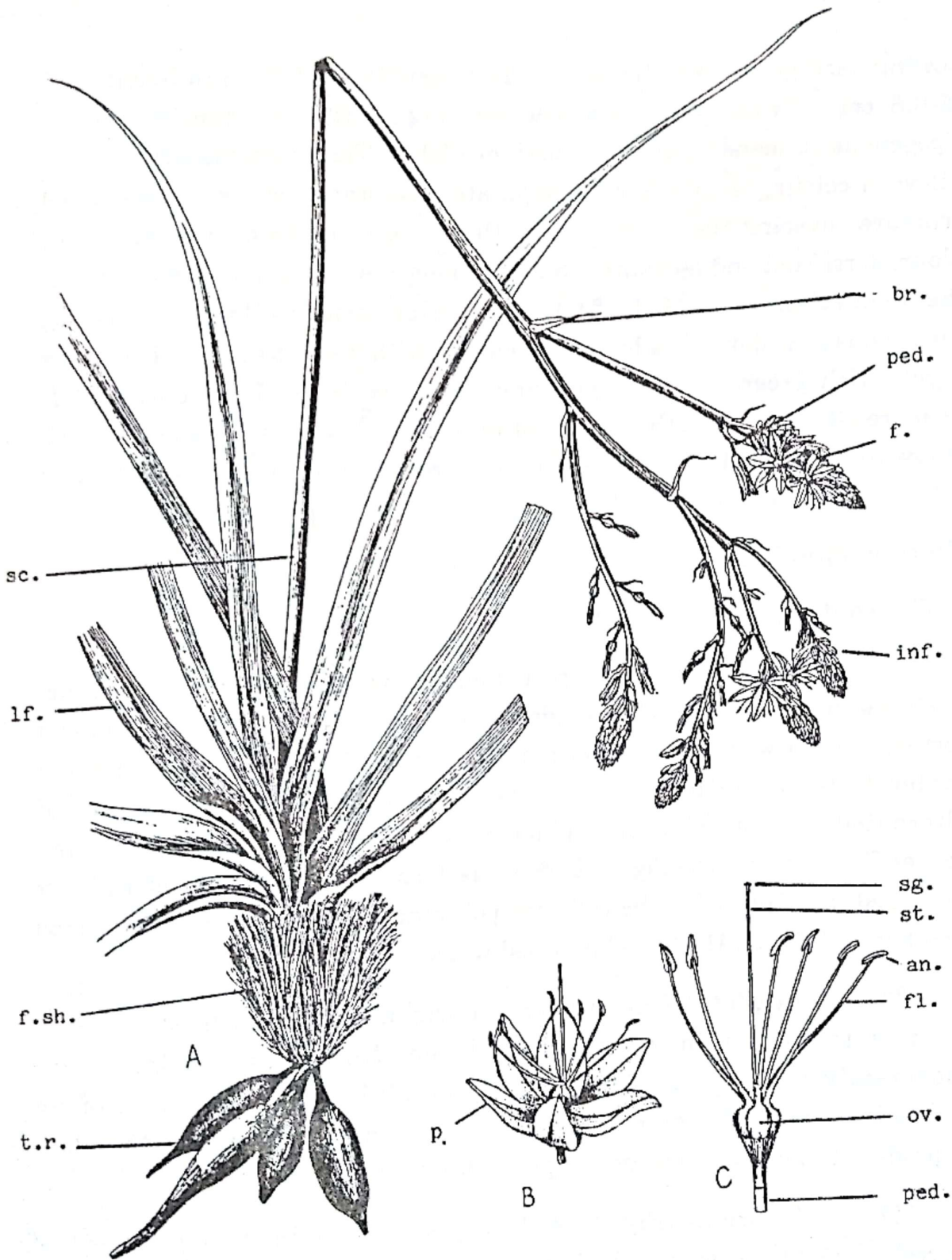


Fig.(1): Sketch of *Asphodelus aestivus* Bort.
 A- A flowering plant.....(X 0.5)
 B- The flower.....(X 1)
 C- Dissected flower.....(X 2)

an., androecium; br., bract; f., flower; f.sh., fibrous sheath;
 fl., filament; inf., inflorescence; lf., leaf; ov., ovary; p., perianth;
 ped., pedicel; sc., scape; sg., stigma; st., style; t.r., tuberous root.

showing dark green to violet nerves. It measures 1.4-1.6 cm in length and 0.5-0.6 cm in width. The androecium (Fig. 1 B & C) consists of six hypogenous stamens longer than perianth lobes. The filaments are filiform, yellow in colour, recurved, with papillate base and forming dome-shaped structure covering the ovary. The anthers are ovoid to oblong, brown in colour, dorsifixed and measure 2-3 mm in length and 1-1.2 mm in diameter. The gynaecium (Fig. 1 B & C) is superior, tricarpeillary, trilocular, syncarpous and showing a long style ending with a short stigma. The ovary is yellowish green in colour showing ovules with axial placentation. It measures 3 mm in length and 2 mm in diameter. The style is cylindrical, yellow in colour and terminates with yellow stigma. It measures 18-20 mm in length and 1 mm in diameter.

Micromorphology :

1- The root :

A transverse section of the root (Fig. 2 A) is nearly circular in outline. It shows an outer lignified metaderm, a relatively wide parenchymatous cortex, limited with the endodermis and surrounding a complete ring of a central stele. The pericycle enclose 24-26 closed vascular bundles of alternated arcs of xylem and phloem. A narrow pith is present in the center. The metaderm (Fig. 2 B & C) is formed of 7-10 rows of radially arranged lignified cells. The cells are polygonal to subrectangular in shape and having slightly thickened lignified walls.

The cortex (Fig. 2 B) is primary in origin, wide and consists of 21-24 rows of rounded thin walled parenchyma. Numerous idioblasts with moderately thick cellulosic wall and containing yellow content of antraquinones, which stained red with dilute potassium hydroxide. Abundant raphides of *CaOx* are occasionally present in cortex.

The endodermis (Fig. 2 A & B) is well defined and formed of barrel-shaped thin walled cells having casperian strips on their radial walls.

The pericycle (Fig. 2 B) consists of one row of polygonal, thin-walled parenchymatous cells.

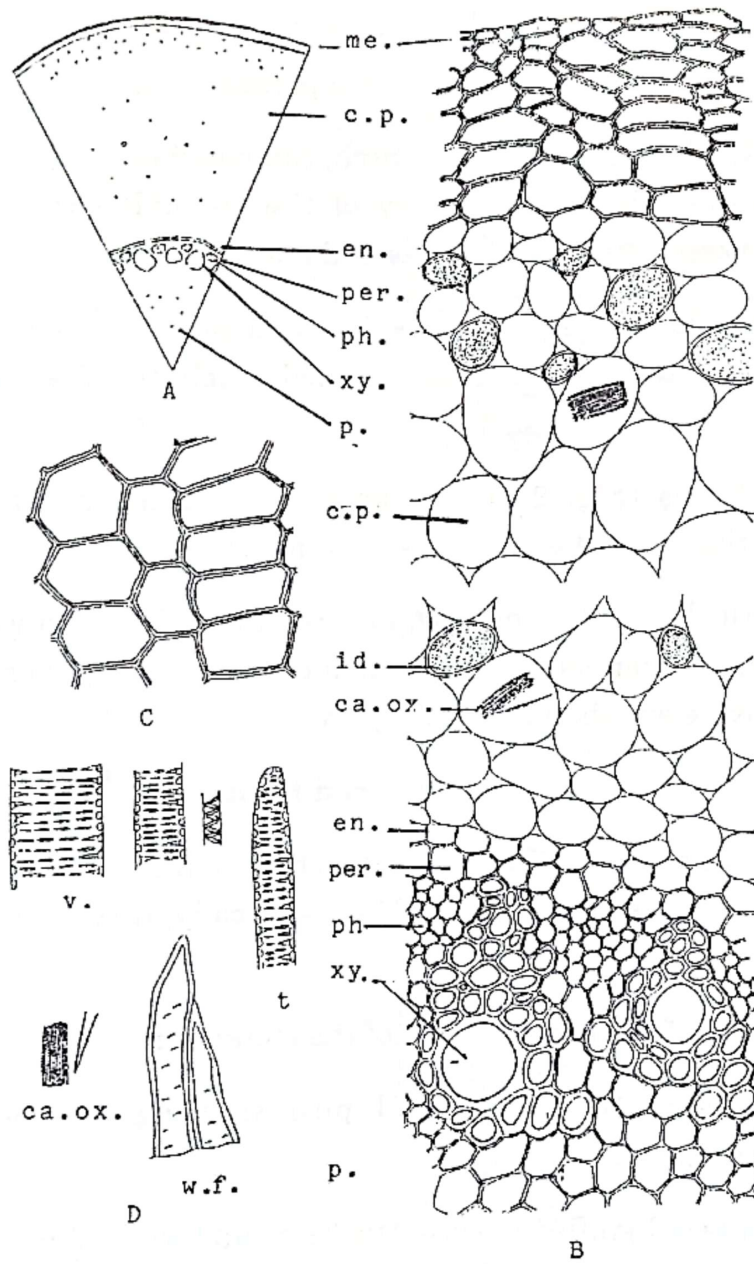


Fig.(2): The root.

A-Diagrammatic transverse section of the root.

B-Detailed transverse section of the root.

C-The metaderm in surface view.

D-Isolated elements.

All (X137.5) except A(X15).

C.p.,cortical parenchyma;ca.ox.,calcium oxalate;
 en.,endodermis;id., idioblast; me.,metaderm;p.;
 p.,pith;per.,pericycle;ph.,phloem;t.,tracheids;v.,
 vessels;w.f.,wood fibres;xy.,xylem.

The phloem (Fig. 2 B) consists of thin-walled cellulosic elements of sieve tubes, companion cells and phloem parenchyma.

The xylem (Fig. 2 B & D) is exarch, composed of radial groups with the protoxylem towards the periphery of the stele. It consists of lignified elements of vessels, tracheids, fibres and nonlignified wood parenchyma.

The vessels (Fig. 2-D) have spiral and pitted thickening. Tracheids (Fig. 2 D) are few, pitted and having moderately thick walls and rounded ends.

Wood fibres (Fig. 2 D) are axially elongated having acute ends, moderately thick pitted walls and wide lumens.

The pith (Fig. 2 B) is narrow, formed of rounded, thin walled cellulosic parenchyma. Numerous, idioblasts containing anthraquinones or raphides of calcium oxate are observed in the pith.

Powdered Root

The powdered root (Fig. 2 C & D) is brown in colour, having faint sweet taste and no characteristic odour. Microscopically, it is characterised by the following:-

- 1- Fragments of the lignified cells of the metaderm.
- 2- Fragments of the cortex and pith showing idioblast, containing anthraquinones.
- 3- Fragments of lignified vessels, tracheids and wood fibres.
- 4- Abundant raphides of calcium oxalate either free or inside parenchymatous cells.

2- The leaf :

A transverse section in the leaf (Fig. 3 A) appears triquetrate in outline with groups of collenchymatous tissue under the ridges. It shows an upper and lower epidermises enclosing a differentiated mesophyll. The vascular bundles are 21-23 in number, collateral and showing collenchymatous pericyclce.

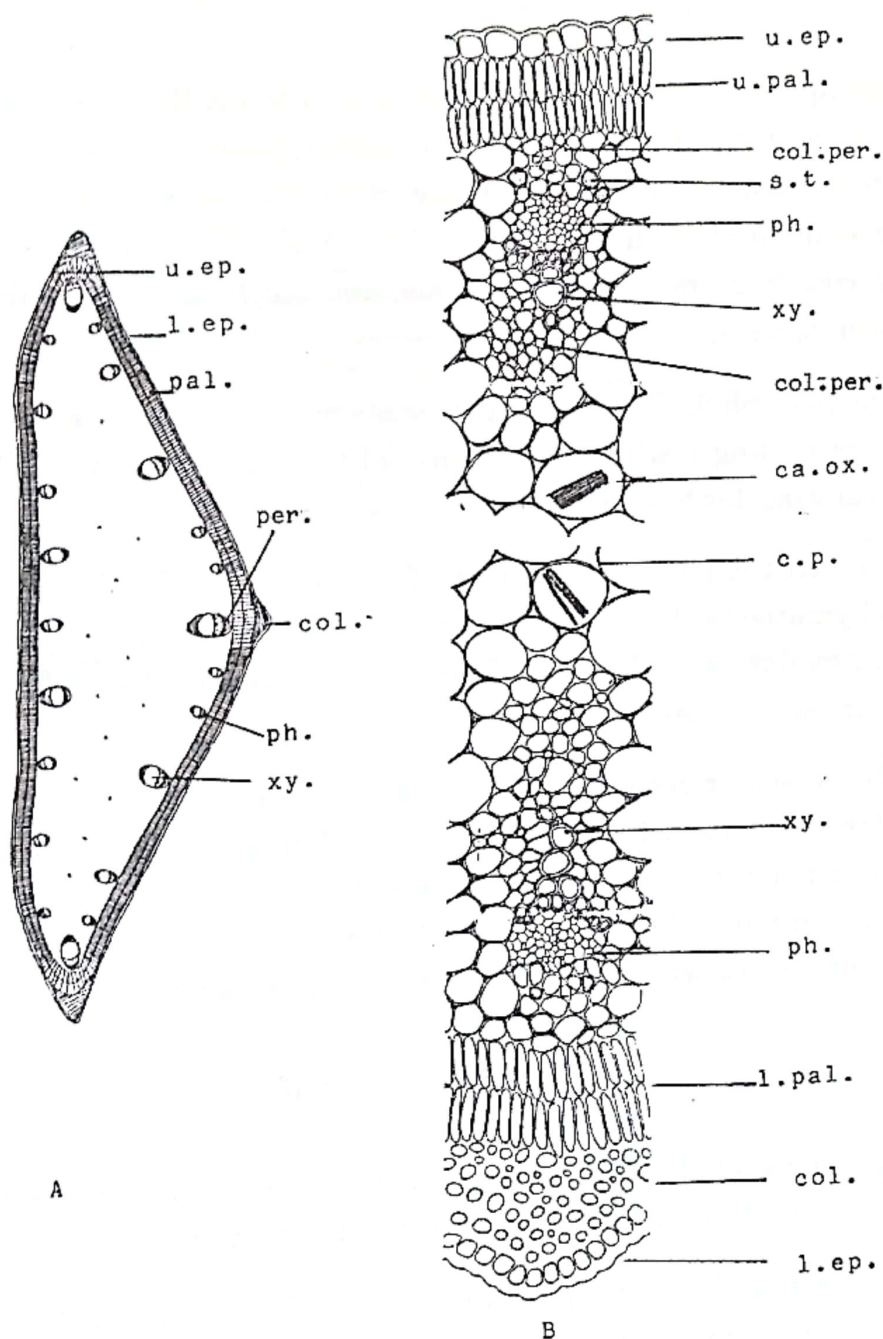


Fig.(3): The leaf.
 A- Diagrammatic transverse section of the leaf.
 B- Detailed transverse section of the leaf.
 A (X 13.2) & B (X 96.8)

c.p.,cortical parenchyma;ca.ox.,calcium oxalate;
 col.,collenchyma;col.per.,collenchymatous pericycle;
 l.ep.,lower epidermis;l.pal.,lower palisade;mes.,
 mesophyll;per.,pericycle;ph.,phloem;s.t.,secretory
 tube;u.ep.,upper epidermis;u.pal.,upper palisade;
 xy.,xylem.

The upper and lower epidermises (Fig. 3 & 4 A,B,C) are nearly similar in T.S. being formed of a single row of rectangular to subrectangular cells. In surface view, both and also those of the neural region are polygonal, axially elongated with straight anticlinal walls and covered with thin smooth cuticle. Stomata are numerous, anomocytic and more abundant on the upper surface.

The mesophyll (Fig. 3 & 4 A) consists of two continuous rows of palisade cells surrounding a wide zone of cortical tissue, traversed by 21-23 closed collateral vascular bundles.

The cortical tissue consists of 14-16 rows of thin walled round parenchymatous cells in which abundant solitary needles and raphides of calcium oxalate are observed. Occasional secretory tubes having brown granular contents, are also present.

The vascular system (Fig. 3 & 4 A & E) is represented by 21 to 23 oval vascular bundles, each sheathed by collenchymatous pericycle. The phloem is formed mainly of cellulosic soft elements of sieve tubes, companion cells and phloem parenchyma. The vessels are lignified, have spiral thickening and accompanied with non-lignified wood parenchyma.

Powdered Leaf

The powdered leaves are green in colour having faint odour and no characteristic taste. It is characterised by the following:-

- 1- Numerous fragments of upper and lower epidermises, showing anomocytic stomata.
- 2- Fragments of columnar cells of the palisade tissue.
- 3- Fragments of cylindrical secretory tubes showing brown granular content.
- 4- Numerous solitary needles or raphides of calcium oxalate either free or inside cortical cells.

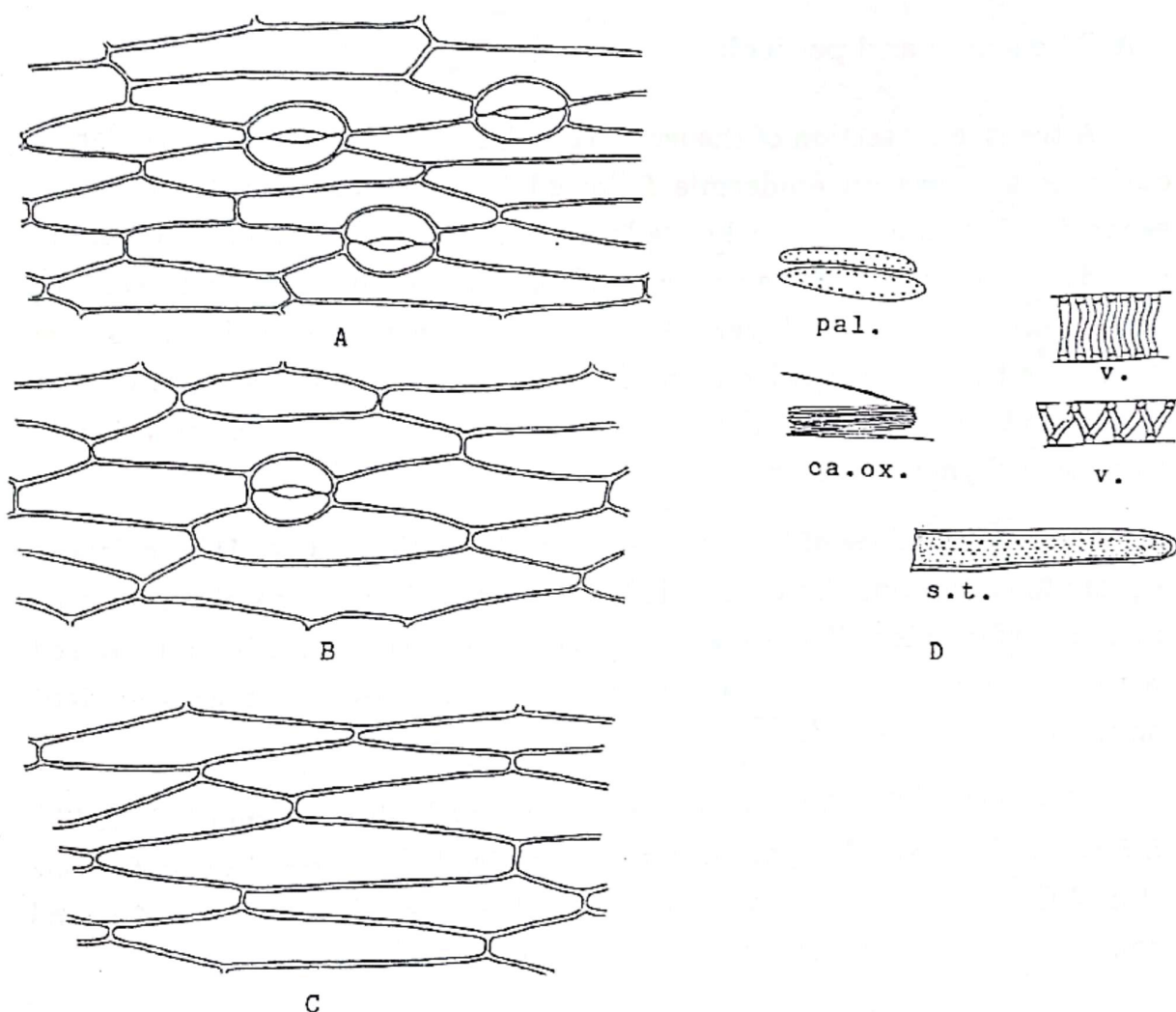


Fig.(4): The leaf.

A-Upper epidermal cells of the leaf.

B-Lower epidermal cells of the leaf.

C-Neural epidermal cells of the leaf.

D-Isolated elements .

All(X211).

Ca.ox.,calcium oxalate;pal.,palisade;s.t.,secretory tube;v.,vessels.

4- The Inflorescence :

A- The scape and pedicel:

A transverse section of the scape (Fig. 5 A) appears oval to circular in outline. It shows an epidermis followed by a narrow cortex which is separated from a wide central stele by a sclerenchymatous zone. Numerous closed vascular bundles are present and partially embedded in both sides of the sclerenchymatous layer. Abundant large vascular bundles are distributed in the central region. The pedicel (Fig. 5 B) is more or less similar to that of the scape but the cortex is separated from the central stele by a collenchymatous layer.

The epidermises of both scape and pedicel (Fig. 5 C & D) consists of square to subrectangular cells in T.S. which are polygonal, axially elongated in the surface view. The cells have straight anticlinal walls and covered with smooth cuticle. Stomata are present, anomocytic and more abundant on the surface of pedicel.

The cortex (Fig. 5 C) consists of 3-4 rows of chlorenchyma followed by 5-6 rows of thin-walled parenchymatous cells. The sclerenchymatous zone (Fig. 5 C) consists of 5-6 rows of large pitted cells, thick walled, lignified and showing intercellular spaces:

The vascular bundles (Fig. 5 A & C) are numerous closed, collateral, scattered in the stele and accompanied with small arcs of pericyclic fibres.

They are more crowded and smaller in size near the sclerenchymatous zone, larger and fewer in number towards the center.

The pericyclic fibres (Fig. 5 C & E) are spindle-shaped, moderately thick-walled, lignified and showing slit-like pits and acute apices.

The phloem (Fig. 5 C) consists of well marked sieve tubes and companion cells. The xylem (Fig. 5 E) is composed of lignified vessels with spiral, annular and pitted thickening as well as pitted tracheids. Wood parenchyma are few, thin walled and more lignified.

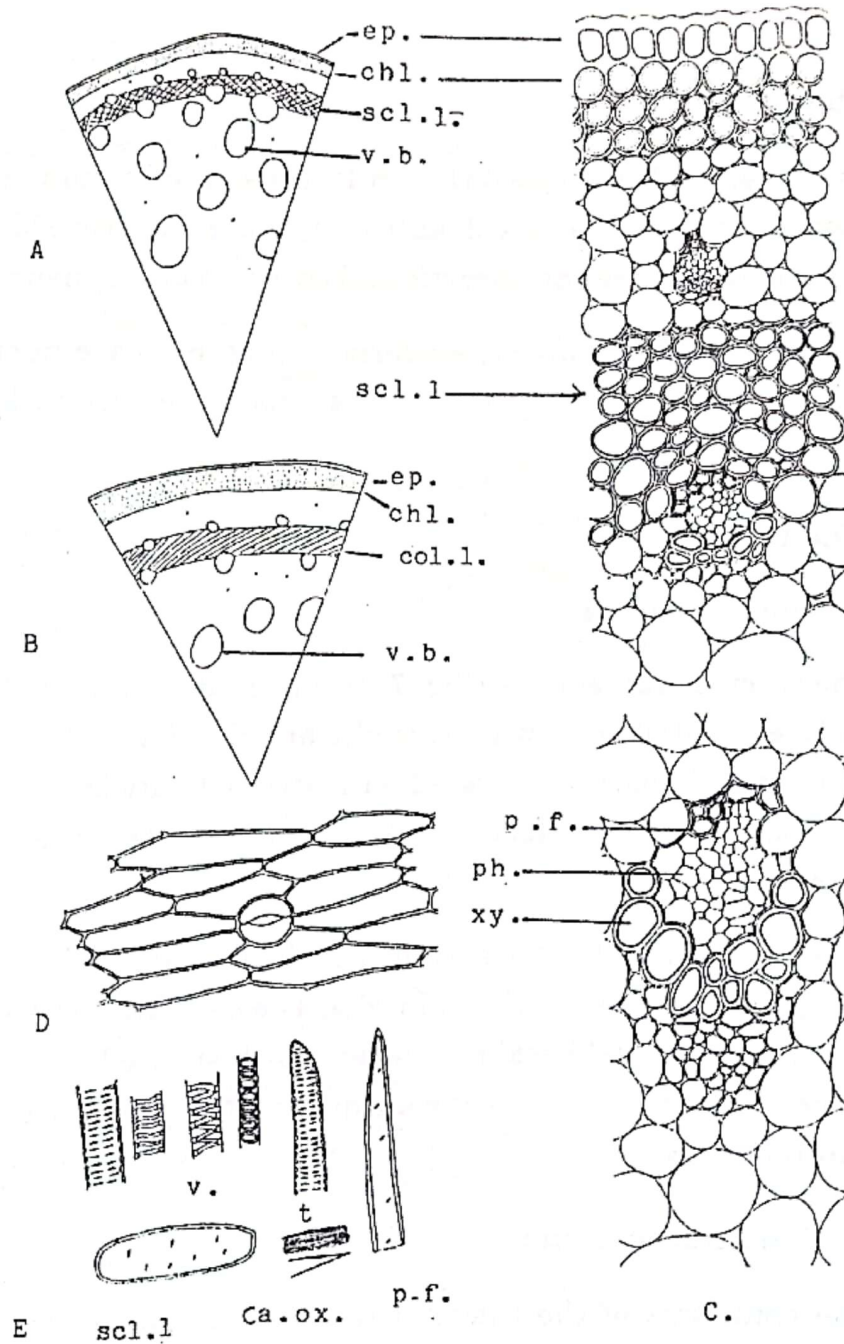


Fig.(5): The scape and pedicel of the inflorescence:

- A- Diagrammatic transverse section of the scape.
 - B- Diagrammatic transverse section of the pedicel.
 - C- Detailed transverse section of the scape.
 - D- Epidermis of the scape.
 - E- Isolated elements of the scape.
- All (X 135) except A B (X 15:1).

c.p.,cortical parenchyma;ca.ox.,calcium oxalate;chl.,
 chlorenchyma;col.l.,collenchymatous layer;ep.,epidermis;
 p.f.,pericyclic fibres;ph.,phloem;scl.l.,sclerenchymatous
 layer;t.,tracheids;v.,vessels;v.b.,vascular bundle;xy.,xylem.

B- The Bract :

The outer surface (lower) (Fig. 6 B) consist, of rectangular to axially elongated cells having straight anticlinal walls and covered with smooth cuticle. Stomata are few, anomocytic and observed on the neural region.

The cells of inner (upper) epidermis (Fig. 6 A) are nearly similar to those of the outer one. Few anomocytic stomata are observed on the apical and neural regions.

C- The Flower :

1- The Perianth :

The outer (lower) surface (Fig. 7 B) is formed of polygonal, isodiametric to axially elongated cells with straight anticlinal walls. The cells of the apical and middle part are covered with striated cuticle while those of the basal region showed smooth cuticle. Anomocytic stomata are observed in the neural region.

The inner (upper) surface (Fig. 7 A) is formed of polygonal cells with straight or slightly wavy anticlinal walls. The cells are covered with smooth cuticle at the middle and basal regions and with straited cuticle at the apical and neural regions. Stomata of the anomocytic type are present at the apical and neural regions.

2- The Androecium :

The epidermis of the filament (Fig. 8 A & B) consists of polygonal, axially elongated cells, having straight anticlinal walls and covered with striated cuticle. The cells of the basal region are papillosed and covered with smooth cuticle. The papillae are conical in shape or more pronounced to form finger-like structure on the margin. The epidermial cells of anther lobe (Fig. 8 C) are polygonal in shape, papillosed and covered with striated cuticle.

The fibrous layer of anther (Fig. 8 D) is formed of lignified cells, polygonal in shape having straight and beaded anticlinal walls.

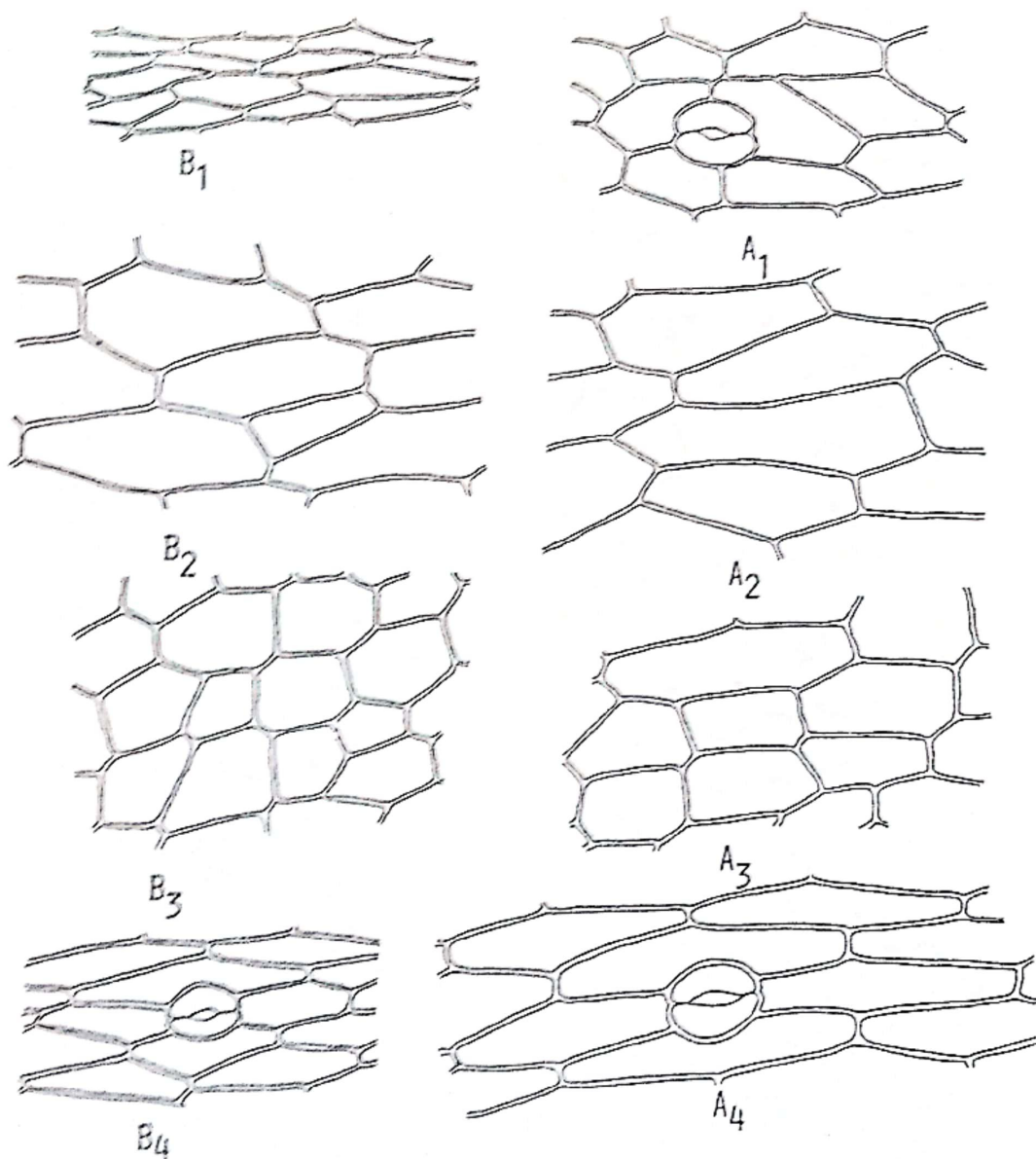


Fig.(6): The bract.

A- Inner (upper) epidermis of the bract.

A₁-At the apex.

A₂-Of the middle.

A₃-Of the lower part.

A₄-Over vein.

B- Outer (lower) epidermis of the bract.

B₁-At the apex.

B₂-Of the middle

B₃-Of the lower part.

B₄-Over vein.

ALL (142.9).

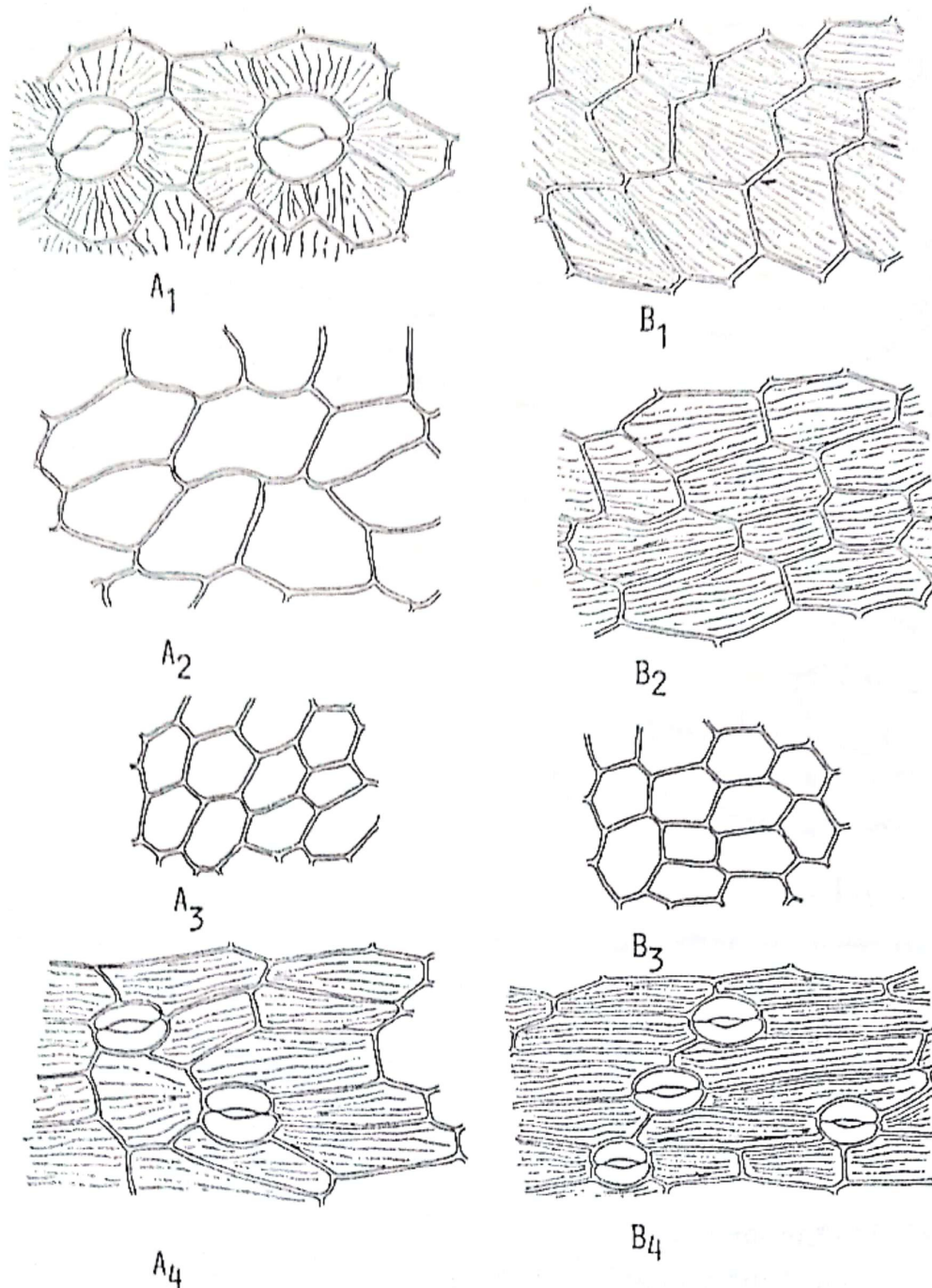


Fig.(7): The perianth.

A-Inner (upper) epidermis of the perianth.

A₁-At the apex.

A₂-Of the middle.

A₃-Of the lower part.

A₄-Over vein.

B-Outer (Xlower) epidermis of the perianth.

B₁-At the apex.

B₂-Of the middle.

B₃-Of the lower part.

B₄-Over veim.

All (X 209.1)

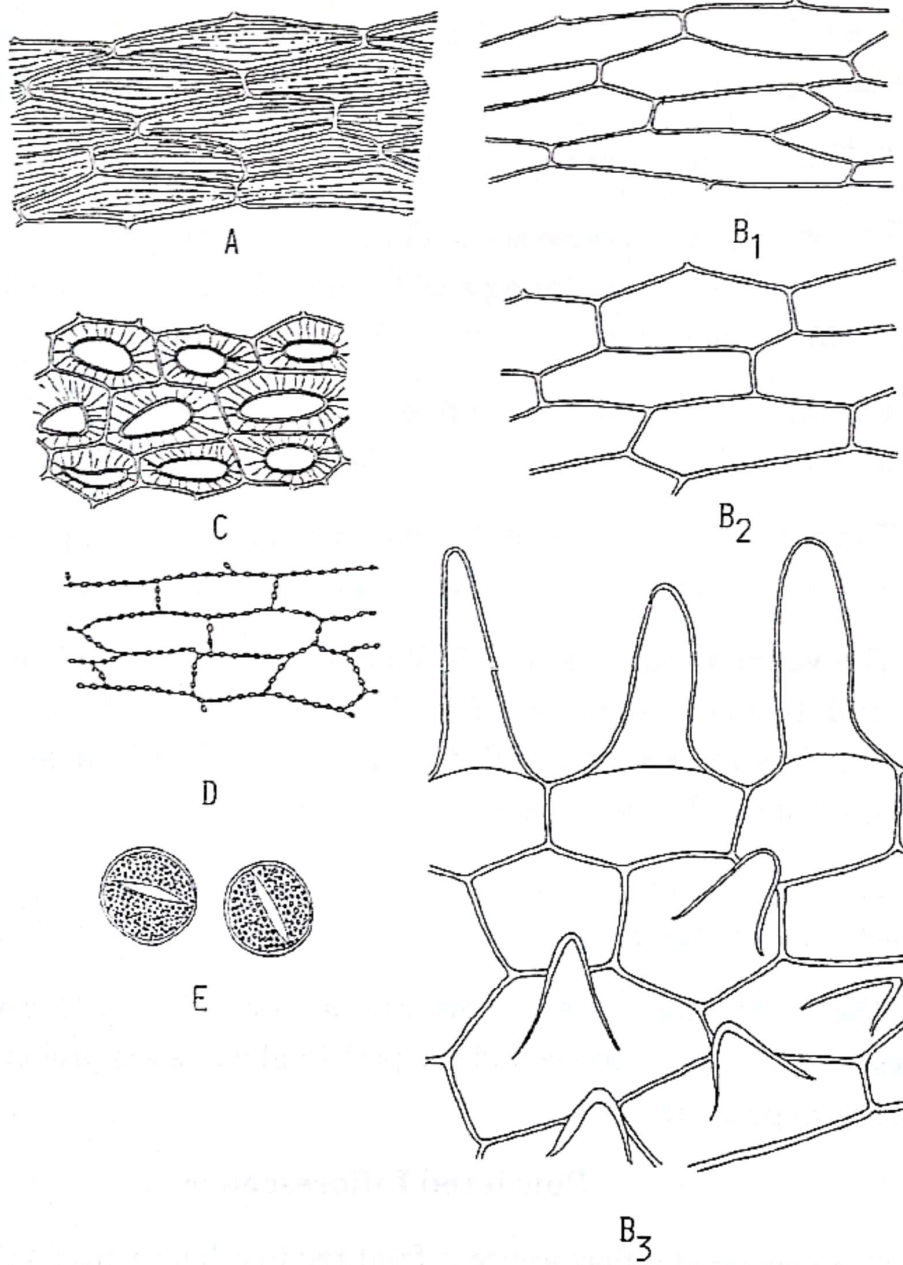


Fig.(8): The androecium.

A-Epidermis of the filament.

B-Epidermis of the filament at the basal part .

B₁-Inner.

B₂-Outer.

B₃-Marginal.

C-Epidermis of the anther .

D-The fibrous layer in surface view.

E-The pollen grain .

All (X174.8).

The pollen grains (Fig. 8 E) are numerous, spherical to subspherical in shape having one germinal pore and granular exine.

3- The Gynaecium :

The ovary: a transverse section in ovary wall (Fig. 9-B) shows an outer and inner epidermises enclosing a wide cortical tissue which is traversed by three main vascular strands.

The outer epidermis (Fig. 9 B & E) consists of polygonal isodiametric cells with straight anticlinal walls and covered with smooth cuticle.

The cortical tissue (Fig. 9 B) consists of 18-22 rows of parenchymatous cells and containing occasional raphides of calcium oxalate.

The vascular bundles (Fig. 9 B) are closed, collateral like those of the root and leaf and surrounded with undifferentiated parenchymatous pericycle. The vessels are lignified with spiral thickening accompanied with non-lignified wood parenchyma.

The epidermis of the style (Fig. 9 D) is formed of polygonal to subrectangular cells, axially elongated, and covered with striated cuticle.

The epidermis of the stigma (Fig. 9 C) consists of thin-walled cells, covered with smooth cuticle and the periclinal walls are prolonged outward into conical papillae.

Powdered Inflorescence

The powdered inflorescence is faint red in colour, with no characteristic odour or taste. It is characterised microscopically by the following:-

- 1- Fragments of lignified pitted parenchyma of the sclerenchymatous zone of the scape.
- 2- Fragments of lignified pericyclic fibres.
- 3- Fragments of the floral leaves showing anomocytic stomata.
- 4- Fragments of the epidermal cells of the filament and anther lobes showing papillosed cells.

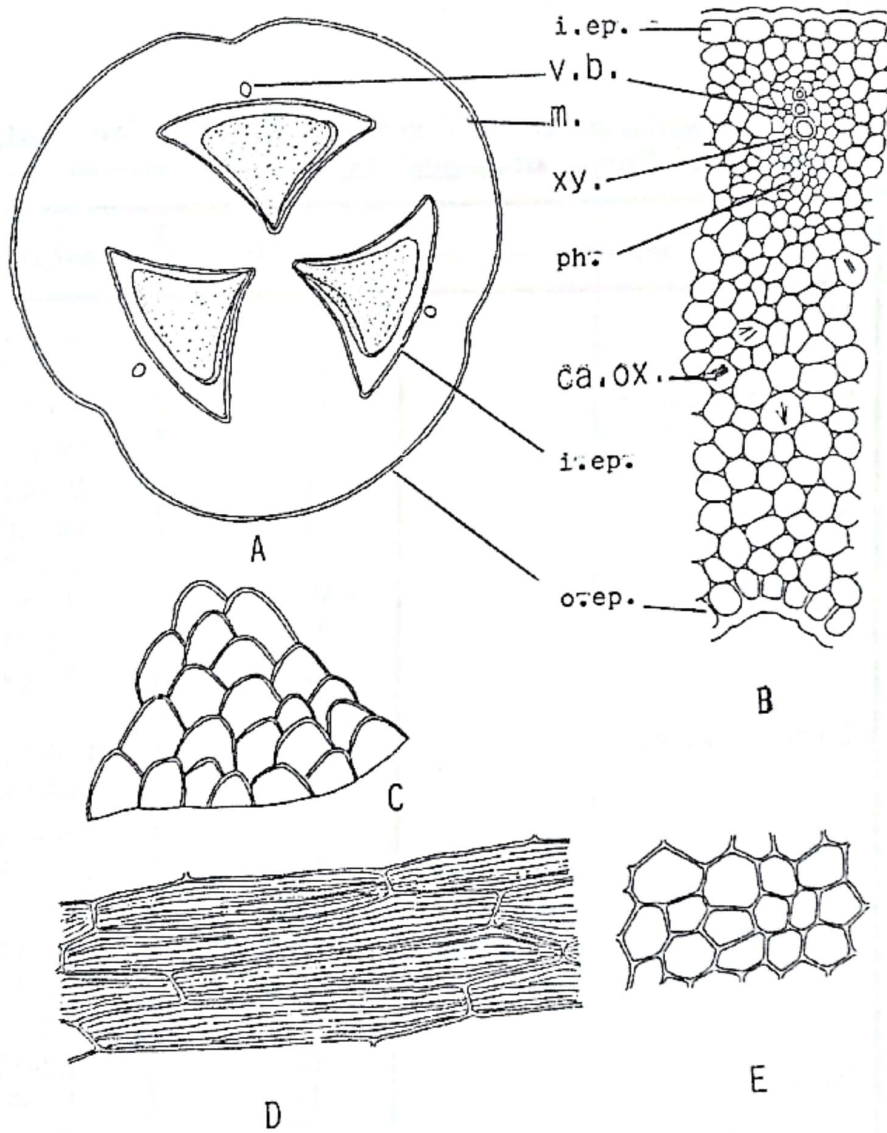


Fig.(9): The gynaecium:

A-Diagrammatic transverse section in the ovary

B-Detailed transverse section in the ovary.

C-Epidermis of the stigma

D-Epidermis of the style.

E-Outer epidermis of the ovary.

All(X 175.4) except A (X18.9).

Ca.ox.,calcium oxalate;i.ep.,inner epidermis;m.,mesophyll

o.ep.,outer epidermis; ph., phloem;v.b.,vascular bundle;

xy.,xylem.

Table (1): Cell dimensions of different tissues of the root, leaf, scape and flower of *A. aestivus*.

Organ	Tissue	Dimensions (μ)	
Root	Metaderm	L	60-120
		W	42-80
	Calcium oxalate	L	60-70
		D	28-100
	Endodermis	H	20-40
	Vessels	W	16-100
	Tracheids	L	1208-1460
		W	30-50
		L	2690-3150
		W	26-48
Leaf	Upper epidermis	L	130-242
		W	18-38
	Lower epidermis	H	30-43
		L	122-290
	Neural epidermis	W	26-44
		L	24-34
	Stomata	L	194-276
		W	22-42
		H	22-32
		L	50-66
Upper palisade	W	36-44	
	L	50-66	
	W	10-18	
Bract	Inner epidermis	L	66-120
		W	28-54
	Middle part	L	150-236
		W	36-64
	Basal part	L	72-178
		W	30-56
	Over vein	L	174-204
		W	26-40
	- Outer epidermis	L	56-138
		W	10-22
L		78-178	
W		24-72	

Organ	Tissue	Dimensions (μ)	
Flower a- perianth	Basal part	L	50-94
		W	30-58
	Over vein	L	66-160
		W	14-30
	- Stomata	L	48-64
		W	32-50
	- Inner epidermis	L	40-100
		W	24-58
	Lower palisade	L	60-86
		W	18-24
	Calcium oxalate	L	90-120
		L	1530-5960
	Secretory tube	W	20-30
		W	6-50
Scape	Epidermis	L	110-196
		W	22-38
		H	28-34
	Stomata	L	52-58
		W	42-48
	Chlorenchyma	D	12-38
		L	150-160
	Sclerenchyma	W	10-44
		L	60-70
	Calcium oxalate	L	5130-6962
		W	8-30
	Vessels	W	12-64
		L	230-296
	Tracheids	W	26-34
		Middle part	L
	W		44-82
	Basal part	L	38-78
		W	26-48
Over vein	L	70-140	
	W	26-86	

Organ	Tissue	Dimensions (μ)	
Bract	- Outer epidermis	44-110	
	Apical part	L 36-70 W 58-120	
	Middle part	L 30-52 W 36-64	
	Basal part	L 24-46 W 60-180	
	Over vein	L 20-36 W 36-68	
	- Stomata	L 30-60 W	
	b- Androecium i) filament	Epidermis	110-210 L 20-46 W
		Epidermis at base	142-248
		Inner	L 24-46 W 154-212
		Outer	L 40-62 W
Marginal		114-212 L 70-120 W 130-200	
Papillae		L 40-68 W 66-110	
ii) Anther		Epidermis	L 38-70 W 74-136
		Fibrous layer	L 24-50 W 74-85
		Pollen grains	D
c- Gynaecium	Epidermis of stigma	30-70 L 30-50 W 190-370	
	Epidermis of style	L 30-40 W 20-56	
	Outer epidermis of ovary	D 16-30 H 20-29 L 10-20 W	
	Calcium oxalate		
	Vessels		

- 5- Fragments of the lignified fibrous layer of anther.
- 6- Fragments of the papillosed stigma.
- 7- Fragments of xylem elements, showing spiral, annular and pitted thickening as well as tracheids.
- 8- Occasional raphides of calcium oxalate.
- 9- Numerous spherical pollen grains showing granular exine.

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دراسة الصفات العيانية والمجهريية لنبات اسفودلاس أستيفز يورت (زونسيل)

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