

# SEED STRUCTURE IN *PAVONIA* SPECIES (MALVACEAE)

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## Abstract

Seed morphology of six species of *Pavonia* has been studied. Seeds are reniform in shape and dull grey or brown in colour. Seed surface is hairy in four species but smooth in *Pavonia sepium* and *P. xanthogloea*. Seed coat has membranous testa and massive tegmen. Some cells of the outer epidermis of testa develop into unicellular, thick-walled and curved hair. In *P. praemorsa* and *P. schimperiana*, the base of hair shows fluted wall. Pillar like pigmented cells are seen at the chalazal end. The cells of outer epidermis of tegmen form palisade-like macrosclereid layer which show a distinct light line. Inner epidermal cells of the tegmen form the fringe tissue. Nucellus is present towards chalazal end except in *P. spinifex* where it is completely digested. Embryo is dicotyledonous and curved. The cotyledons show complex folding. Lysigenous ducts are present except for *P. spinifex*. Druses of calcium oxalate are observed in some cells of the embryo.

## Introduction

The genus *Pavonia* Cav. of tribe Ureneae, family Malvaceae is economically important. It has about 200 species distributed in tropical and sub-tropical regions (Airy Shaw, 1973). Literature survey shows that little work has been done on the seed anatomy of *Pavonia* except that of Venkata Rao (1955) on *P. zeylanica*. The present paper, therefore, describes the anatomy of mature seed of *P. praemorsa* Cav., *P. schimperiana* Hochst, *P. sepium* A. St. Hil., *P. spinifex* Cav., *P. xanthogloea* Ekman and *P. zeylanica* Cav. which have not been studied so far.

## Material and method

The seeds were received from India and abroad (Table 1). They were softened in glycerine and hot water (1:1) and usual methods of dehydration, infiltration and embedding in paraffin wax were followed. Sections cut between 15 to 20  $\mu$ m thickness were stained in safranin and fast green combination. Maceration of seed coat was done in Jeffrey's solution (Johansen, 1940).

Table 1

Name of the species	Place from where collected/obtained
<i>Pavonia praemorsa</i> Cav.	Botanical Garden, Adelaide, S. Australia.
<i>P. schimperiana</i> Hochst.	National Botanical Research Institute, Lucknow.
<i>P. sepium</i> A. St. Hil.	I. N. T. A. Botanical Garden, Buenos-Aires, Argentina.
<i>P. spinifex</i> Cav.	Botanical Garden, Zagreb, Yugoslavia.
<i>P. xanthogloea</i> Ekman	I. N. T. A. Botanical Garden, Buenos-Aires, Argentina
<i>P. zeylanica</i> Cav.	Ajmer, Rajasthan.

**Observations**

*Seed* - Seeds of all the six species of *Pavonia* are reniform in shape but they vary in size (Table 2). The surface is tomentose except in *P. sepium* and *P. xanthogloea* where it is smooth. The seeds are brown in colour except *P. spinifex* which has grey seeds.

**Table 2—Seed characters in *Pavonia* species**

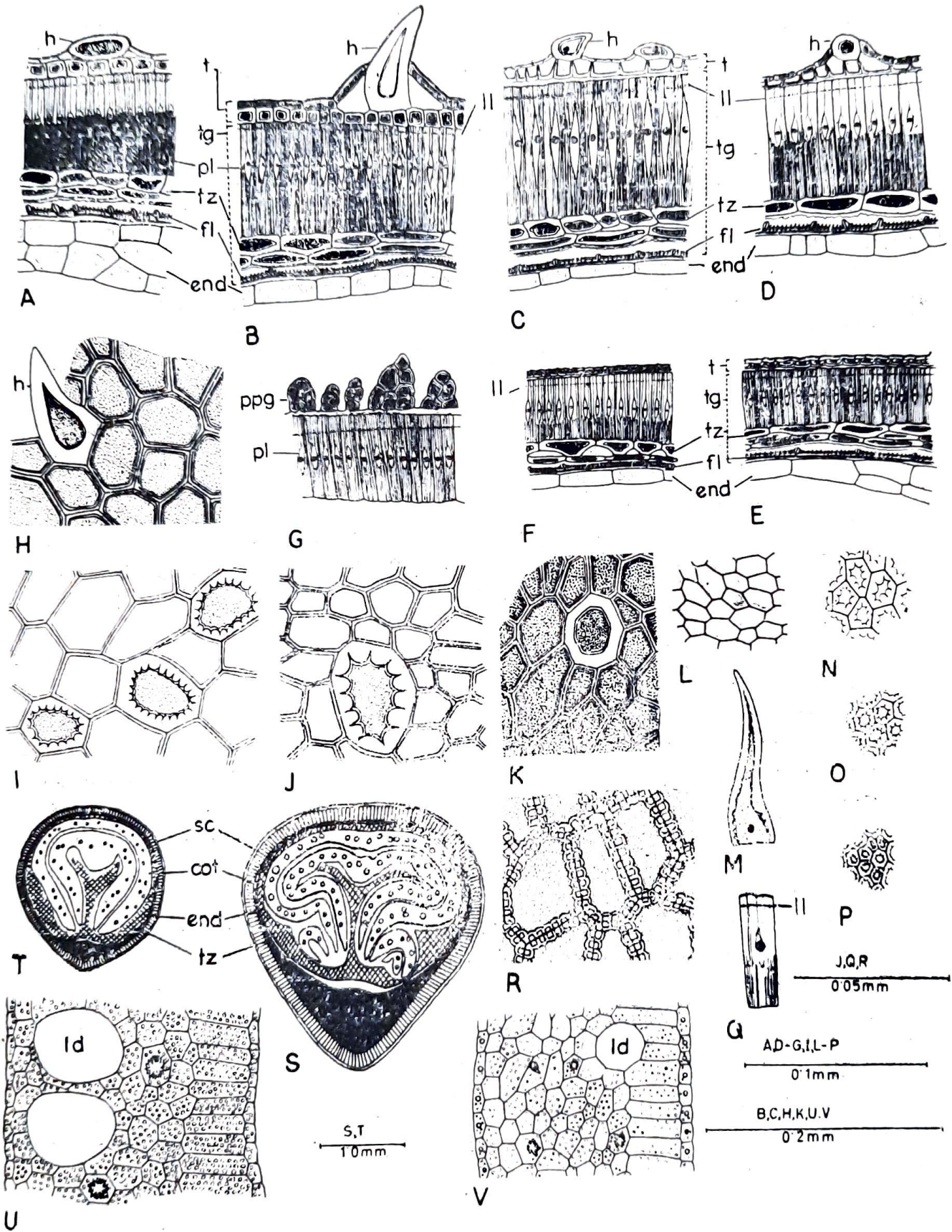
Name taxa	Size in mm (L × B)	Colour	Surface	Average size of palisade-like cells in microns (L × B)
<i>P. praemorsa</i>	3 × 2	Brown	Hairy	52 × 6
<i>P. schimperiana</i>	3 × 2	„	„	86 × 10
<i>P. sepium</i>	2 × 1.5	„	Glabrous	56 × 13
<i>P. spinifex</i>	2 × 1.5	Grey	Hairy	82 × 10
<i>P. xanthogloea</i>	2 × 1.5	Brown	Glabrous	47 × 8
<i>P. zeylanica</i>	2 × 1.5	„	Hairy	56 × 8

*Seed coat*—The seed coat is differentiated into a thin testa and a massive tegmen. The testa which is formed of the outer integument is 2-layered for the major part of the seed (Text-fig. 1 A-F). The number of cell-layers is, however, more towards the chalazal and micropylar ends. Tests forms pillar-like structures at the chalazal end (Text-fig. 1 G, Pl. 1A). These structures are made of thick-walled and pigmented cells separated by radial clefts. The cells of outer epidermis are tangentially stretched in major part of the seed. In surface view they are polygonal and have more or less thickened walls (Text-fig. 1 H-L). Their lumina is devoid of tanniferous substance in *P. praemorsa*, *P. schimperiana*, *P. sepium* and *P. xanthogloea* but it is filled with tanniferous substance in *P. spinifex* and *P. zeylanica* (Text-fig. 1 H, K). In *P. praemorsa*, *P. schimperiana*, *P. spinifex* and *P. zeylanica*, some of the cells of outer epidermis develop into unicellular, thick-walled and curved hair having tanniferous deposits in their lumen (Text-fig. 1 B-D). In *P. praemorsa* and *P. schimperiana* the base of hair shows fluted wall (Text-fig. 1 I, J, M). Epidermal hair are absent in *P. sepium* and *P. xanthogloea* (Text-fig. 1 E, F).

The walls of inner epidermis of testa are much thickened all around in *P. praemorsa* and *P. spinifex* (Text-fig. 1 A, B), but these thickenings are confined along the inner tan-

Text-fig. 1—**A**, L. S. part of seed of *P. praemorsa*; **B**, C. S. part of seed of *P. spinifex*; **C**, C. S. part of seed of *P. schimperiana*; **D**, L. S. part of seed of *P. zeylanica*; **E**, L. S. part of seed of *P. sepium*; **F**, C. S. part of seed of *P. xanthogloea*; **G**, L. S. part of seed of *P. sepium* (chalazal end); **H-L**, surface view of outer epidermis of testa in *P. spinifex*, *P. praemorsa*, *P. schimperiana*, *P. zeylanica* and *P. xanthogloea* respectively; **M**, hair of *P. praemorsa*; **N-P**, C. S. outer half of palisade-like cell in *P. praemorsa*, *P. schimperiana*, *P. xanthogloea* respectively; **Q**, Macerated palisade-like cells of *P. xanthogloea*; **R**, Fringe layer in *P. xanthogloea* (surface view); **S, T**, C. S. mature seed of *P. schimperiana* and *P. sepium* respectively; **U, V**, C. S. part of cotyledon in *P. schimperiana* and *P. xanthogloea* showing lysigenous ducts.

(cot—cotyledon; end—endosperm; fl—fringe layer; h—hair; ll—light line; ld—lysigenous duct; pl—palisade layer; ppg—pillar-like pigmented cell; sc—seed coat; t—testa; tg—tegmen; tz—tanniferous zone).



Text-fig. 1

geatial and radial walls in *P. sepium*, *P. schimperiana*, *P. xanthogloea* and *P. zeylanica* (Text-fig. 1 G-F). The lumen is filled with tanniniferous substance in *P. praemorsa*, *P. sepium*, *P. spinifex* and *P. xanthogloea* but in *P. schimperiana* and *P. zeylanica* such deposits are absent.

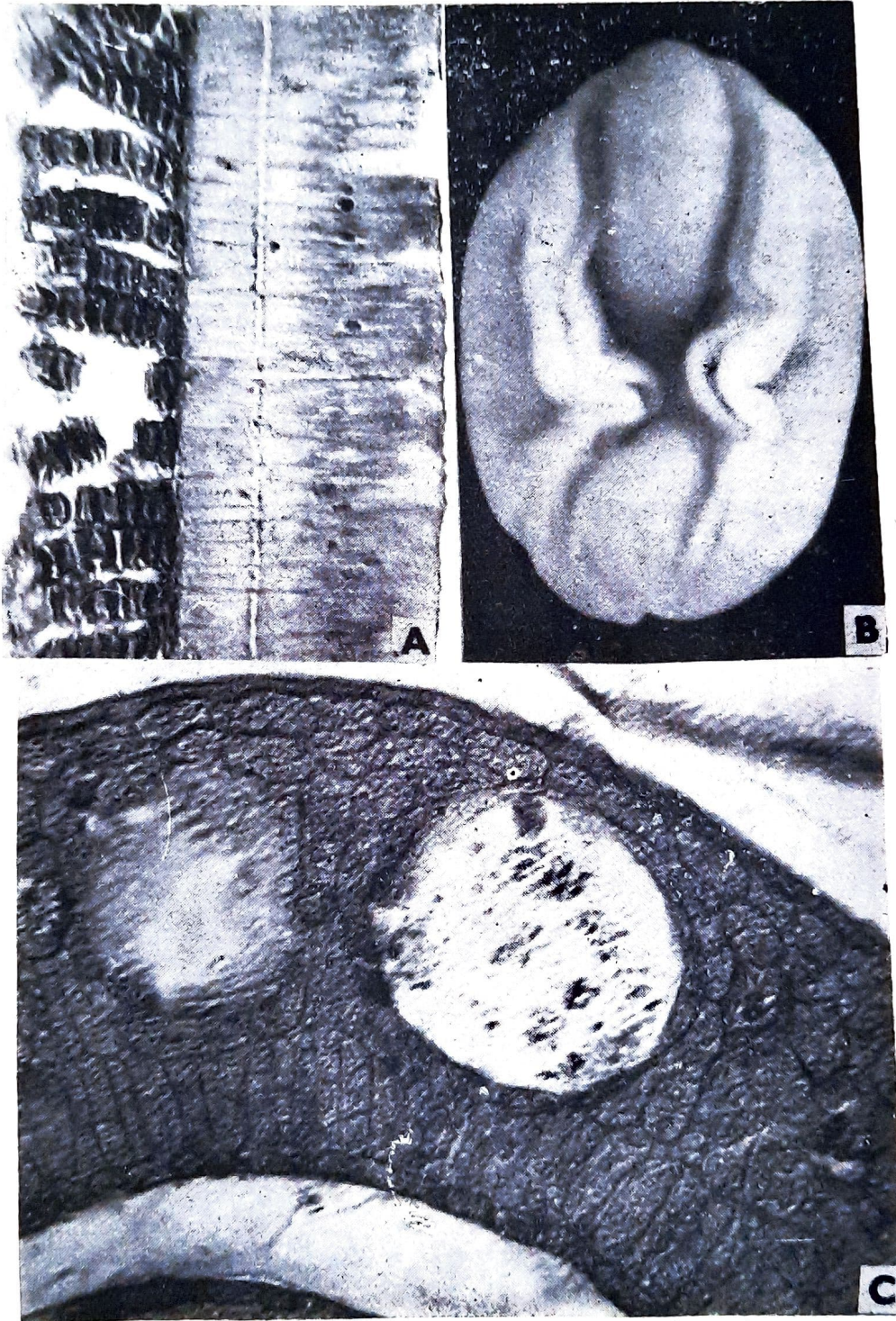
The tegmen is derived from the inner integument. The cells of outer epidermis are elongated in radial direction forming palisade-like macrosclereid layer (Text-fig. 1 A-G). The size of these palisade-like cells is variable in different parts of the same seed and also in different species of *Pavonia*. Measurement of their average length and width on the antiraphe side is given in table 2. The palisade-like macrosclereids are polygonal in cross-section and their lumen is star-shaped in the outer region (Text-fig. 1 N-P). In the middle region, the lumen is biconvex enclosing a dark-brown spherical body (Text-fig. 1 A-G, Q). A distinct light line is seen below the outer tangential wall at a depth of about 8  $\mu\text{m}$  in *P. praemorsa*, *P. schimperiana* and *P. zeylanica* but in *P. sepium*, *P. spinifex* and *P. xanthogloea* it is only 4  $\mu\text{m}$  deep. Towards chalazal and the light line is seen at a greater depth as compared to its position on the antiraphe side. The palisade-like layer is followed by a zone of tanniniferous cells (Text-fig. 1 A-F). The number of these *cell-layers* ranges between 1 to 3 in different species of *Pavonia* (Text-fig. 1 A-F). These cells are tangentially stretched, thick-walled and the lumen is filled with tanniniferous substance. The number of cell-layers is, however, more at the micropylar and chalazal ends. The cells of tanniniferous zone lying next to palisade layer at the chalazal curve elongate radially and form a patch of 'pseudopalisade' layer.

The cells of inner epidermis, which form the fringe layer, are tangentially stretched (Text-fig. 1 A-F). In surface view, they are polygonal, thickened along radial walls showing simple pits. The lumen is filled with light brown substance (Text-fig. 1 R). The fringe layer separates from rest part of tegmen resulting in breakdown of its outer tangential wall. Fringe layer is seen closely adhered to the nucellar remains and the endosperm.

*Nucellus*—Nucellar tissue is consumed and crushed and appears as a thin hyaline layer in the mature seeds except at the chalazal end where it is 8 to 10-layered in *P. schimperiana* and *P. xanthogloea*, 6 to 8-layered in *P. zeylanica*, 5 to 7-layered in *P. sepium* and 2 to 3-layered in *P. praemorsa*. However, the nucellar tissue is completely exhausted in *P. spinifex*. The persisting nucellar cells are thin-walled, polygonal and devoid of contents.

*Endosperm*—Endosperm tissue is massive towards the chalazal side ranging from 10 to 12 cell-layers in *P. sepium* and *P. spinifex*, 8 to 10 layers in *P. praemorsa* and *P. xanthogloea*, 5 to 8 layers in *P. zeylanica* and 4 to 6 layers in *P. schimperiana*. A fold of endosperm fills the space between the cotyledonary folds (Text-fig. 1 S, T). Towards antiraphe side, it is single-layered in *P. schimperiana*, *P. spinifex*, *P. xanthogloea* and *P. zeylanica* but the number of layers ranges between 1 to 3 in *P. praemorsa* and *P. sepium*. The cells of endosperm are parenchymatous, thin-walled and filled with reserve food material.

*Embryo*—The embryo is dicotyledonous and curved. The hypocotyl-root-axis is placed at right angles to the cotyledons. The cotyledons ensheath a major part of the hypocotyl-root-axis and are folded in a complex fashion. Cotyledons are dorsiventrally flattened and have a palisade layer below the ventral epidermis (Text-fig. 1 U, V; Pl. 1C). The cells of embryo are full of reserve food material, starch being more evident. Lysigenous ducts are seen in cotyledons except in *P. spinifex* (Text-fig. 1 U, V; Pl. 1C). Druses of calcium oxalate are found in some cells of the embryo in all the species of *Pavonia* studied.



## Discussion

The absence of perisperm as reported by Venkata Rao (1955) in *P. zeylanica* is not confirmed during present study as 6 to 8 layers of nucellar tissue persist at the chalazal end. However, nucellar tissue is completely exhausted in *P. spinifex*.

The embryo pattern of all the *Pavonia* species described here matches with the general plan of the family Malvaceae (Martin, 1946). The occurrence of lysigenous ducts and druses of calcium oxalate in cotyledons (present study) has not been reported by Venkata Rao (1955).

During present investigation, it was observed that some cells of the outer epidermis of testa develop into hair in *P. zeylanica* but Venkata Rao (1955) reported that these cells become papillate but do not develop into hair. It is very likely that Venkata Rao (1955) examined only immature seeds. The presence of pit-like depressions at the base of hair in *P. praemorsa* and *P. schimperiana* has not been reported earlier except for Reeves (1936) who made similar observations in *Modiola caroliniana*. Presence of pillar-like pigmented cells and 'pseudopalisade' in all the six species of *Pavonia* studied presently exhibit a feature of special interest. The first report on the presence of such cells appears in the work of Winter (1960) in *Abutilon theophrasti*. The seed coat is formed of a membranous testa and a massive tegmen. The cells of outer epidermis of tegmen form palisade-like cells in *Pavonia* species (present study), a feature also reported in *P. zeylanica* (Venkata Rao, 1955) and other malvaceous members (see Corner, 1976).

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## Explanation of Plate

### PLATE 1

A-C—A, L. S. part of seed of *P. zeylanica* X 298 showing palisade-like cells, light line and pillar-like pigmented cells at the chalazal end; B, Embryo of *P. schimperiana* X 33; C, C.S. part of cotyledon in *P. schimperiana*, X 307 showing lysigenous ducts and druses of calcium oxalate.