

Anatomical Variability in Seed Coat of Some *Cassia* L. (Caesalpinioideae) Species with Taxonomic Significance

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ABSTRACT: Transactions of seed coat of twelve species of *Cassia* L., namely *C. alata* L., *C. angustifolia* vahl., *C. auriculata* L., *C. didymobotrya* Fresen., *C. glauca* Lam., *C. grandis* Linn., *C. hirsuta* Linn., *C. marylandica* L., *C. mimosoides* DC., and *C. pleurocarpa* F.Meull, *C. siamea* Lam., and *C. spectabilis* DC., were examined under scanning electron microscope. Variation in shape and size of the palisade and hourglass cells, occurrence of double layer of palisade cells in *C. mimosoides*, absence of endotestal hourglass cells in *C. glauca*, *C. marylandica* and *C. mimosoides*, appeared to be distinguishing characteristics for each species having taxonomic significance. The usefulness of these diagnostic characters of the testa depends on the levels of variation present among the different species of the same genus which may help in designing a key for identifying the taxa at specific level along with other characters of the seed.

KEY WORDS: *Cassia*, Anatomy, Seed coat, Palisade, Hourglass.

INTRODUCTION

Anatomical study of the seed coat has probably of great value in determining taxonomic significance. A perusal of literature reveals that little work on this aspect has been done (Carlquist, 1961; Wunderlich, 1967; Vaughan and Whitehouse, 1971). In legumes most of the published accounts have dealt with comparative and developmental studies of seed coat (Corner, 1951; Chalon, 1875; Harz, 1885b, Pammel, 1889; Pitot, 1935; Sterling, 1954; Ambegaokar, 1976), but a few were based on its taxonomic significance. Later on anatomical characters of seed testa were suggested as an additional parameter for analysis of taxonomic and phylogenetic values (Lersten, 1982; Tobe *et al.*, 1987).

Although micromorphological characteristics of the seeds of different species of *Cassia*, with taxonomic significance have been discussed in the previous published accounts (Sahai *et al.*, 1997; Sahai, 1999). An attempt was made here to investigate anatomical variability of seed coat in different species of *Cassia* species and elucidate the usefulness of diagnostic characters in separating the species of a particular genus.

MATERIALS AND METHODS

Mature seed samples of 12 *Cassia* L. Species were procured from natural populations inhabiting eastern and southern parts of India. Seeds were cleaned with 90% alcohol and air dried before processing for SEM. Single seed of each species was sectioned longitudinally through the midplane mounted on stub with glue and coated with gold palladium in a sputter coater. Seeds were scanned in the Scanning electron microscope (Philips XL-20) at an accelerating voltage of 10 kv.

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RESULTS

Followings were the anatomical details of L. S. of seed coat :

1. *C. alata* L.: The layer of palisade cells was relatively broad. Cells were variable in shape. Osteoscleried or hourglass cells were also varying in shape and size due to thick waxy deposition followed by 5-6 layered lignified parenchymatous zone. Just adjacent to this, irregularly arranged intercellular spaces were seen which indicated the presence of inner hourglass (endotestal) cells (Fig. 1 A, Table 1).
2. *C. angustifolia* Vahl: On the outer surface, there was a thick waxy layer of cuticle followed by long, compact and thick palisade cells. Directly beneath the palisade cells, a prominent layer of hourglass cells was present, which was thin and compressed towards the hilar region. Below the hourglass cells, a multilayered lignified parenchyma of mesophyll cells was present. An inner layer of hourglass cells was also present in the form of deep rift, formed by broken side-walls of the cells. This layer was absent at the hilar region (Fig. 1 B, Table 1).
3. *C. auriculata* L.: Palisade cells were thick and compact followed by a layer of more conspicuous, pillar shaped hourglass cells. Several layers of lignified parenchymatous mesophyll were present followed by a well defined endotestal layer of hourglass cells of varying shape and size (Fig. 1 C, Table 1).
4. *C. didymobotrya* Fresen: Palisade cells were long, fibrous and loosely packed followed by hourglass cells which were short and irregular in shape. Inwards from the hourglass cells broad area of multilayered mesophyll with lignified parenchymatous cells was present (Fig. 1 D, Table 1). Inner hourglass cells were also present throughout the seed.
5. *C. glauca* Lam.: Palisade cells were thin, short, fibrous and loosely packed directly followed by 4-5 sclereified rectangular cells of mesophyll. Hourglass cells were absent (Fig. 1 E, Table 1).
6. *C. grandis* Linn.: Palisade cells were short, thin and compactly arranged. Below the palisade cells a narrow layer of hourglass cells was present. The cells were varying in shape. Mesophyll was multilayered with thin papery and loosely packed parenchymatous cells. Immediately internal to them, a layer of inner hourglass cells was present, whose cells were small, toothed and suppressed in some places (Fig. 1 F, Table 1).
7. *C. hirsuta* Linn.: Palisade cells were thin, short and fibrous. Hourglass cells were not visible or may be undeveloped. Inward from the palisade layer, 6-7 layered thick, compact lignified parenchyma was present and followed by a broad gap which indicates the existence of inner hourglass cells (Fig. 2 A, Table 1).
8. *C. marylandica* L.: Palisade cells were thin, fibrous, elongated and loosely packed. Hourglass cells were well developed more or less pillar shaped with wide intercellular spaces but present only at the redicular portion of the seed. Inwards from them, multilayered parenchymatous zone with lignified, double layered polygonal cells, was present. Inner hourglass cells were absent (Fig. 2 B, Table 1).
9. *C. mimosoides* DC.: Palisade cells were in two layers. Cells of the first layer were compact with variable gaps. Cells of second layer were thin, short and loosely packed, followed by suppressed and irregularly distributed hourglass cells. Inwards from the hourglass cells, a multilayered zone with compact, lignified and more or less rectangular parenchymatous cells was present. Inner layer of hourglass cells was absent (Fig. 2 C, Table 1).

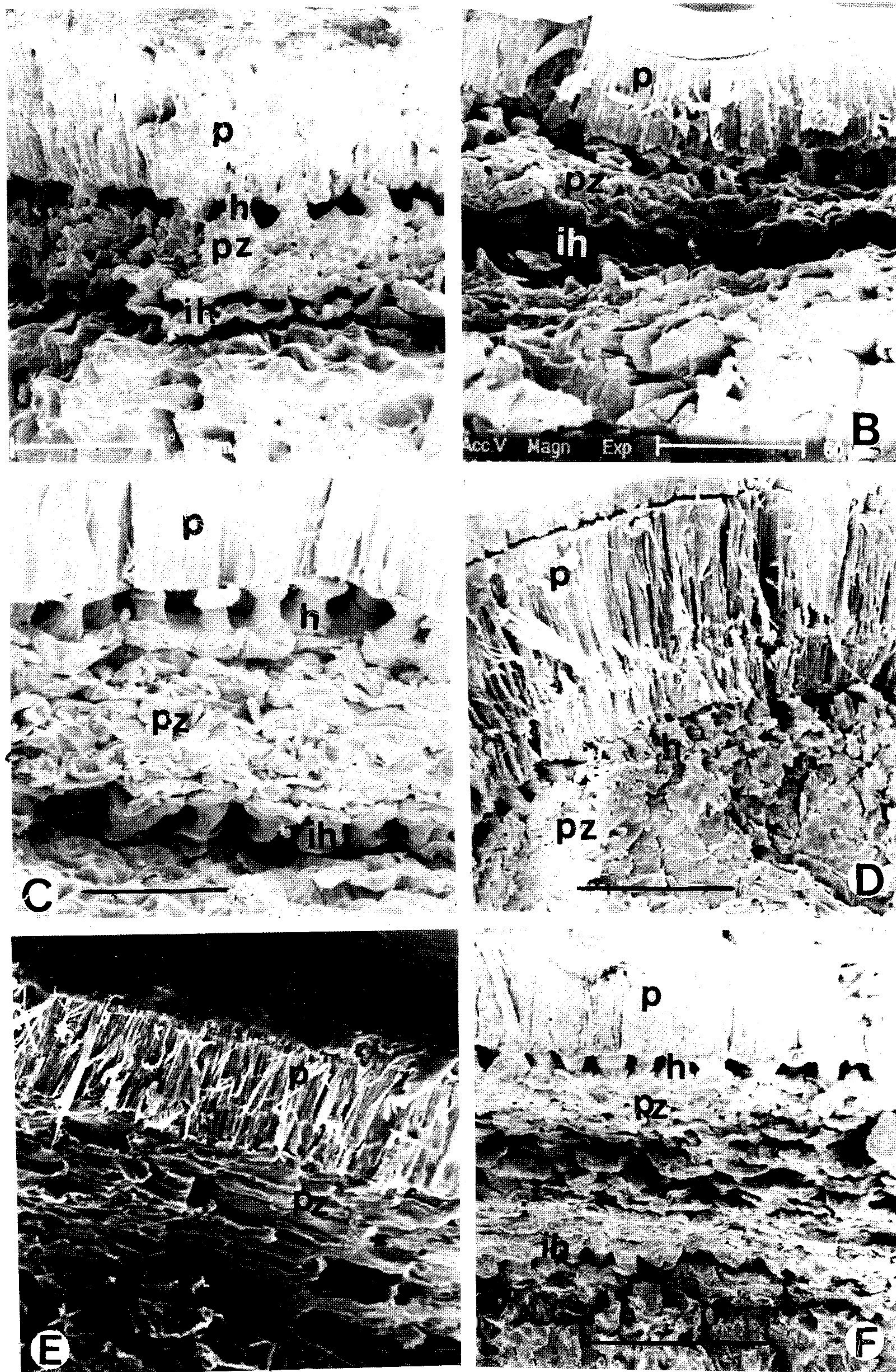


Fig. 1. Characteristics of seed coat of *Cassia* L. species in transaction. A: *C. alata*, B: *C. angustifolia*, C: *C. auriculata*, D: *C. didymobotrya*, E: *C. glauca*, F: *C. grandis*. p = palisade; h = hourglass cells; pz = parenchymatous zone; ih = inner hourglass. Bar A-E = 50 μ m, F = 100 μ m.

10. *C. pleurocarpa* F. Meull: Palisade cells were thick, long and compactly arranged followed by the hourglass cells, which were extremely short and variable in shape. Just below the hourglass cells, a multilayered mesophyll with lignified parenchymatous cells of varying shape was present. Adjacent to the hourglass, mesophyll cells were long, broad and compact in comparison to the rest of the cells. Inner hourglass cells were so rudimentary in some places as to be indistinguishable (Fig. 2 D, Table 1).
11. *C. siamea* Lam : Palisade cells were medium sized thick, compact and broad followed by hourglass cells, which were conspicuous, broad, short and irregular in shape. Inwards from the hourglass, a narrow zone of 3-4 layered mesophyll with lignified parenchymatous cells was present. Inner hourglass cells were quite distinct with wide intercellular spaces but irregular in shape and broken in some places (Fig. 2 E, Table 1).
12. *C. spectabilis* DC: Inwards from the broad layer of cuticle, there was a layer of long, thin and loosely arranged palisade cells. Hourglass cells were compressed in manner of narrow rift. Just below the rift, multilayered lignified narrow parenchymatous zone was present. Reduced inner hourglass cells were also seen in the photograph (Fig. 2 F, Table 1).

DISCUSSION

Regarding gross internal structure of the seed coat of the legumes, the subepidermal layer is rarely present. However, the palisade and hourglass layer always exhibit their presence in varying shape and size, and this variation has often been applied in taxonomic studies. By following this, much emphasis has been laid upon the relative length and shape of palisade and hourglass cells. It was observed that each species was characterized by its own palisade and hourglass cells.

During the study of seed coat of legumes, some workers (Bragg and Bridges, 1984; Trivedi and Gupta, 1987) pointed out that there is no correlation between seed size and length of the palisade and hourglass cells. Present observations on the species of *Cassia* were in accordance with their findings, as in *Cassia grandis* the seed was largest amongst the all species studied here, but palisade and hourglass cells were smaller than the others as well as the shape of hourglass cells was relatively different (Fig. 1 F, Table 1). Hence the length and the shape of the palisade and hourglass cells may be useful in separating the species of a particular genus.

While dealing with seed anatomy of legumes Corner (1951) stated that the outer columnar epidermal cells (palisade) characteristically occurred in a single row. Counter palisade (second row of the palisade) cells were present in the hilum area of only papilionoid seeds. Later on Bragg and Bridges (1984) reported this double layer of palisade cell in some species of *Cassia* (*Caesalpinioideae*) i.e. *C. fasciculata*, *C. alata* and *C. roemeriana* and suggested that the presence of double layer of palisade is a generic character in *Cassia*. However, I could not find double layer of palisade in *C. alata*. It could be found only in *C. mimosoides* (Fig. 2 C). Hence presence of double layer of palisade in *Cassia* can not be a generic character but may be used as a taxonomic criterion for separating species of *Cassia*. As concerned with the inner layer of hourglass cells, three species i.e. *C. glauca*, *C. marylandica* and *C. mimosoides* had shown total absence of it.

In conclusion anatomical structures of seed coat studied in twelve species of *Cassia*, varied species to species. The significant variation was recorded in respect to shape of palisade and hourglass cell, number of parenchymatous layer in mesophyll zone, presence of double layer of palisade and presence and absence of inner layer of hourglass cells. These all

characters within a genus can be useful for assessing relationship and delimiting taxa. Similar study is important within all other genera of the family for further evaluation of their taxonomic significance as well as evolutionary trends.

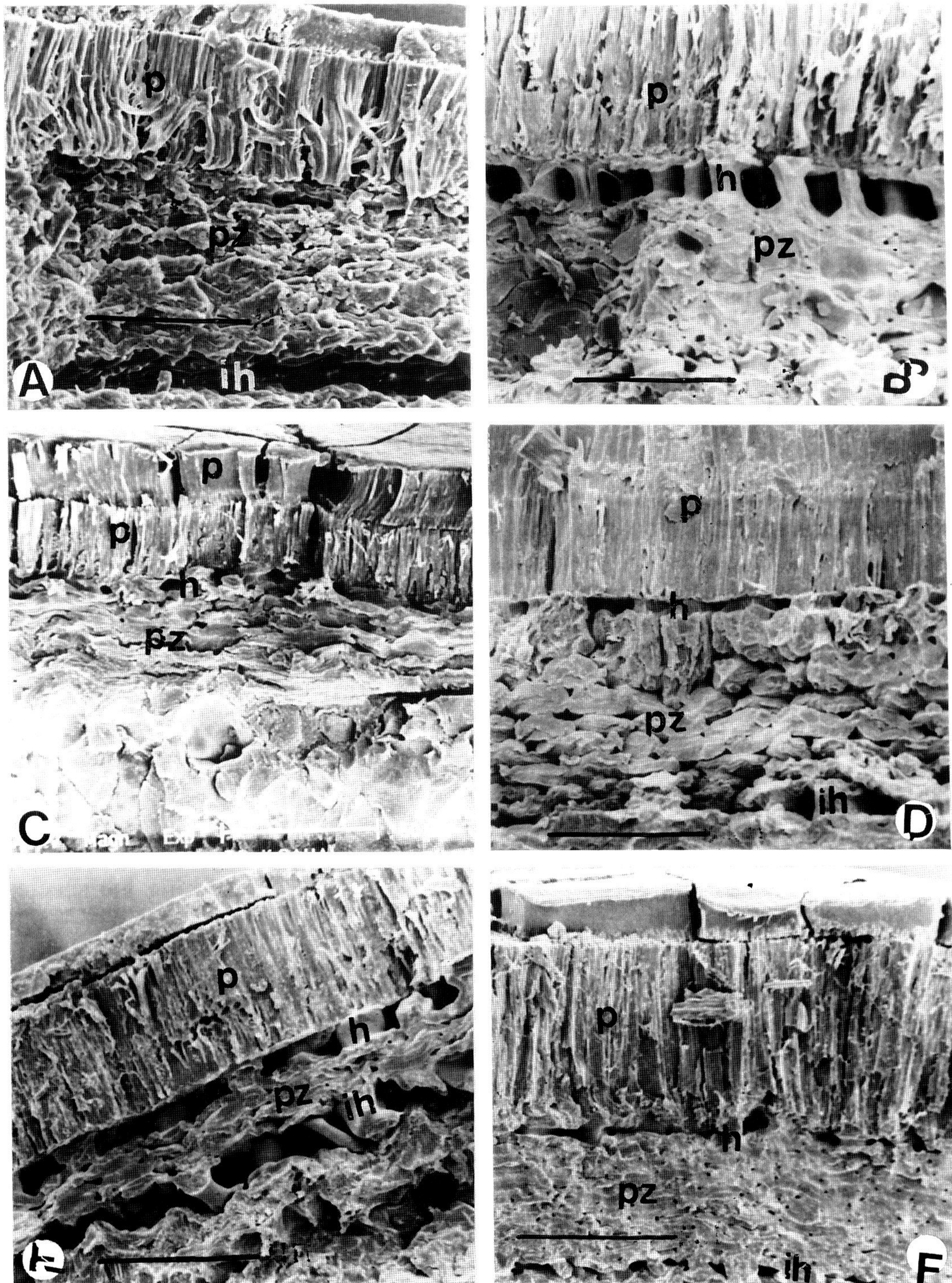


Fig. 2. Characteristics of seed coat of *Cassia* L. species in transaction. A: *C. hirsuta*, B: *C. marylandica*, C: *C. mymosoides*, D: *C. pleurocarpa*, E: *C. siamea*, F: *C. spectabilis*. p = palisade; h = hourglass cells; pz = parenchymatous zone; ih = inner hourglass cells. Bar = 50 μ m.

Table 1. Micro-anatomical characters of seed coat of *Cassia* L. species.

Name of Species	Seed size (mm)	Palisade cell	Hourglass cells (Osteosclereid cell)	Mesophyll layer (Parenchymatous layer)	Inner hourglass cells (Inner layer of osteosclereid cells)
1. <i>C. alata</i> L.	8 x 6 x 1.5	Long, broad, shape is not clear due to heavy deposition	Irregular in shape and size with heavy deposition	Multi-layered	Very irregular in shape
2. <i>C. angustifolia</i> Vahl	5 x 4 x 3	Compact and thick with medium length	Variable in size separated by irregular intercellular spaces	3 – 4 layered	Present
3. <i>C. auriculata</i> L.	6 x 2 x 1	Long, thick, compact	More conspicuous pillar shaped, separated by wide intercellular spaces	Multi-layered	Present, irregular in shape and size
4. <i>C. didymobotriya</i> Fresen.	7 x 3 x 1	Long, fibrous and loosely packed	Short and irregular in shape and size	Multi-layered	Present throughout the seed
5. <i>C. glauca</i> Lam.	6 x 4 x 2	Thin, short, fibrous and loosely packed	Absent	Multi layered with lignified rectangular cells	Absent
6. <i>C. grandis</i> Linn.	15 x 11 x 4	Short, thin and compactly arranged	Short with variable in shape	Multi-layered, thin, papery and loosely packed	Short variable in size
7. <i>C. hirsuta</i> Linn.	2 x 2 x 1	Thin, narrow, short and fibrous	Not clear	Multi-layered	Present
8. <i>C. marylandica</i> L.	4 x 3 x 1	Thin, long, fibrous and loosely packed	Well developed present only in radicular portion, more or less pillar shaped with wide intercellular spaces	Multi-layered with lignified compact polygonal cells	Absent
9. <i>C. mimosoides</i> DC.	2 x 1.5 x 1	Two layered, first layer is compact with variable gaps. Second layer is thin and loosely packed	Suppressed and irregularly distributed	Compact multi-layered	Absent

Table 1. continued.

Name of Species	Seed size (mm)	Palisade cell	Hourglass cells (Osteosclereid cell)	Mesophyll layer (Parenchymatous layer)	Inner hourglass cells (Inner layer of osteosclereid cells)
10. <i>C. pleurocarpa</i> F. Meull.	5 x 3 x 2	Thick, long and compactly arranged	Extremely short and variable in shape	Multi-layered with intercellular spaces	Present, extremely short
11. <i>C. siamea</i> Lam.	6 x 3 x 1	Thick, compact broad and medium sized	Thick broad and short and variable in shape	2 – 4 layered, sclerified with small spaces at the edge of the cell	Present, broad, irregular
12. <i>C. spectabilis</i> DC.	5 x 4 x 2	Long, thin and loosely packed	Suppressed in the form of narrow line	Multi-layered with lignified and compact narrow cells	Suppressed, irregular

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Cassia L.種皮之解剖變異對其分類的意義

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摘 要

以掃描式電子顯微鏡，觀察十二種 *Cassia* L.植物 (即 *C. alata* L., *C. angustifolia* vahl., *C. auriculata* L., *C. didymobotrya* Fresen., *C. glauca* Lam., *C. grandis* Linn., *C. hirsuta* Linn., *C. marylandica* L., *C. mimosoides* DC., and *C. pleurocarpa* F.Meull, *C. siamea* Lam., 與 *C. spectabilis* DC)的種皮橫切面，就其柵狀與沙漏狀細胞之形態與大小、*C. mimosoides* 具兩層柵狀細胞、*C. glauca*, *C. marylandica*, 及 *C. mimosoides* 不具內種皮之沙漏狀細胞等明顯特徵，顯示這些種皮的特徵具分類上的意義，而這些種皮鑑定特徵的應用，會因其變異在同屬不同種之間的層次而定，而此在確定特定分類階層時，有助於設計一個具有種子相關特徵的檢索表。

關鍵詞：*Cassia*，解剖，種皮，柵狀細胞，沙漏狀細胞。

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