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DEVELOPMENT AND STRUCTURE OF SEED COAT IN *LAVETERA* L. AND *ANODA* CAV.

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Structure of mature seeds in relation to exo and endomorphic features were compared in 3 species of *Lavetera* L. and *Anoda* Cav. of the family Malvaceae. The seed coat shows uniform pattern of organisation in all, but same variations are clearly marked. A key is proposed for the identification of different species of both taxa on the basis of exo and endomorphic features of the seed coat.

Key words : *Anoda*, Exo-tegmic, *Lavetera*, Malvaceae, Seed coat.

INTRODUCTION

Several studies on the anatomy of the seed and seed coat have been made from time to time and the earlier work was reviewed by Netolitzky (1926). Considerable studies on the seed coat anatomy of Malvaceae were made by Reeves (1936a,b), Kumar *et al.* (1985) and Kumar and Singh (1986, 1987a,b). However, the genera *Lavetera* and *Anoda* remain untouched. Wunderlich (1967), Singh, D. (1969) and Corner (1976) have pointed out the significance of seed coat anatomy in identification of different species of various taxa. In the light of the above views the present investigations were undertaken, to study the seed coat development in *L. trimestris* L. and mature seed coat in *L. cretica* L., *L. thuringiaca* L., *A. cristata* (L) Schlecht, *A. dilleuiana* Cav. and *A.wrightii* A. Grey.

MATERIALS AND METHODS

Young buds to mature seed of *L.trimestris* were collected from the plants growing in Uni. Bot. Have Copenhague, Denmark and mature seeds of the remaining 5 taxa were also obtained from the same place. The materials were fixed in formaline-aceto-alcohol and finally preserved in 70% alcohol. Free hand and microtome sections as well as macerations were examined in this study.

OBSERVATIONS

The development of seed was studied only in *L.trimestris* while the structure of mature seeds in 3 species of both taxa.

Changes in the outer integument : It is 2 layered at organised embroyo sac stage and remains so till maturity (Fig. 1A). During seed development the cells enlarge horizontally and their nuclei and contents are gradually absorbed (Fig. 1B,C). At maturity the epidermal cells are tangentially flattened and thin walled, whereas, those of the hypodermis develop rod shaped thickenings on radial walls (Fig. 1C).

Changes in the inner integument : It is 5 layered at the organised embryo sac stage (Fig. 1A) and the first visible change is seen in the outer epidermis. The cells start radial elongation and lose cytoplasmic contents and nuclei (Fig. 1B). Finally they become thick walled forming macrosclereids having a biconvex lumina with a spherical body. The light line area is in the upper half (Fig. 1C). The layer just below the palisade zone accumulates pigmented contents which also extend to the next layer in mature seeds. The remaining middle layers are partially absorbed, whereas, the inner epidermis becomes tanniferous forming the characteristic fringe layer (Fig. 1C).

Mature seeds : The seeds are kidney shaped, brown to deep brown with prominent hilum and micropyle region in the centre of the notch. Seeds are non-hairy in *L cretica* and *L thuringiaca* while only few small unicellular hairs are present at the micropylar region in *L. trimestris* and in all the 3 species of *Anoda*. The seed anatomically consists of seed coat, remnants of perisperm, few layers of endosperm around the embryo and in between the cotyledons. The curved embryo with foliaceous cotyledons show conduplicate ptyxis (Fig. 1L, M; 2D, E). Cotyledons are 155-168 µ in *L.trimestris* and *A. wrightii*, 98-110 µ in *L.thuringiaca*, 145-152 µ in *L.cretica* and 230-245 µ in *A.cristata* and *A.dilleuiana*. A single palisade layer of large cells 48-52 x 10-14 µ in *L. cretica* and

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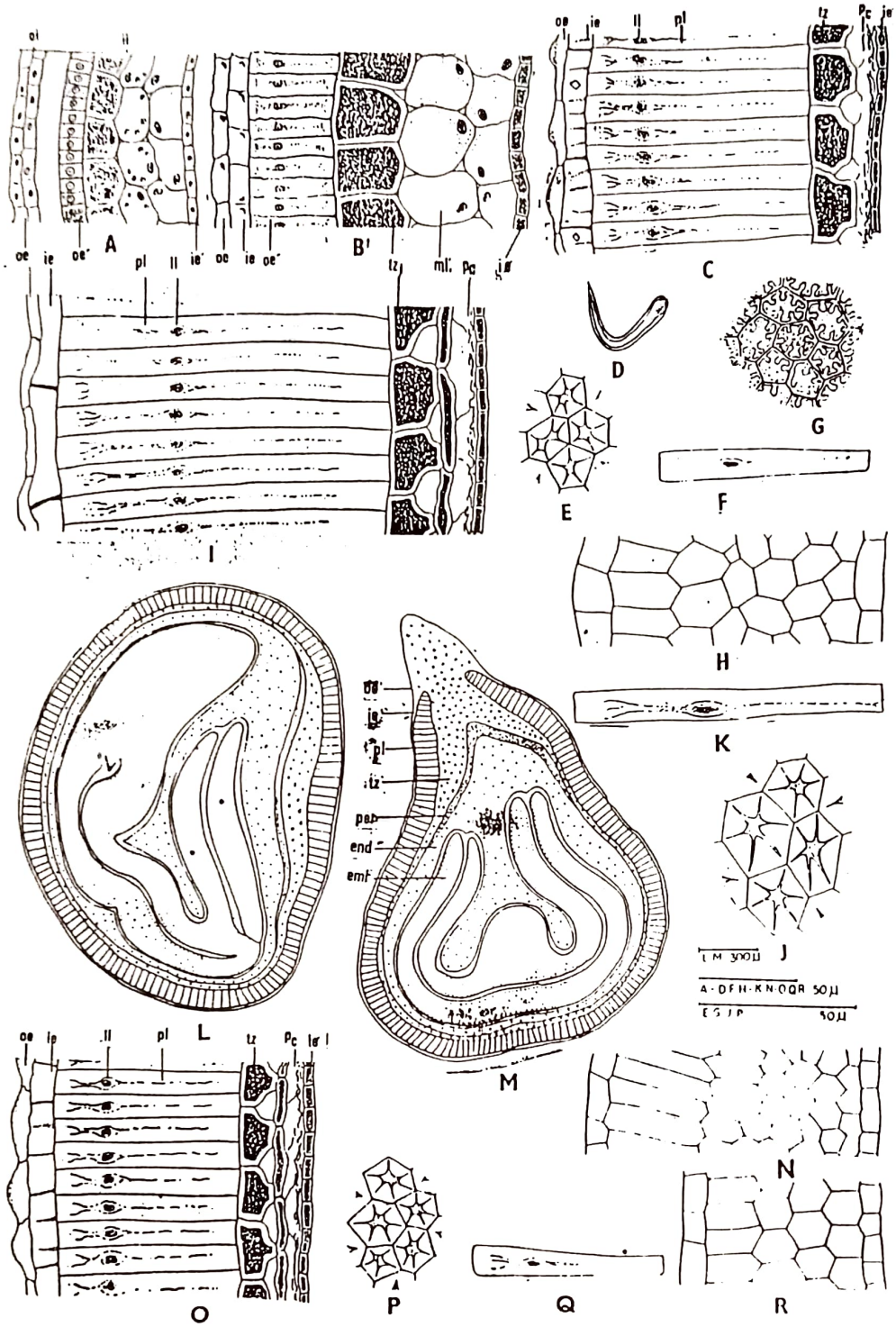

Fig. 1 (A-R). Development and structure of seed in *Lavetera* spp.

A-H. *L.trimestris* : *A*, l.s. part of integuments at organised embryo sac stage. *B*, l.s. developing seed coat. *C*, t.s. mature seed coat. *D*, epidermal hair, *E,F*, outer surface and lateral views of palisade cells from maceration. *G*, surface view of cells in fringe layer from maceration. *H*, v.s. of cotyledon. I-N. *L.cretica* : *I*, t.s. of the mature seed coat. *J*, *K*, outer surface and lateral views of palisade cells from maceration, *L,M*, l.s. and t.s. of almost mature seed *N*, v.s. of cotyledon.

O-R *L.thuringiaca* : *O*, t.s. of mature seed coat. *P,Q*, outer surface and lateral views of palisade cells from maceration. *R*, v.s. of cotyledon. (*emb*,embryo; *end*, endosperm; *ie*, inner epidermis of outer integument; *ie'*, inner epidermis of inner integument; *ii*, inner integument; *11*, light line; *ml'*, middle layer of inner integument; *oe*, outer epidermis of outer integument; *oe'*, outer epidermis of inner integument; *oi*, outer integument; *pc*, parenchymatous cells; *per* perisperm; *pl*, palisade cell; *tz* tannin zone)

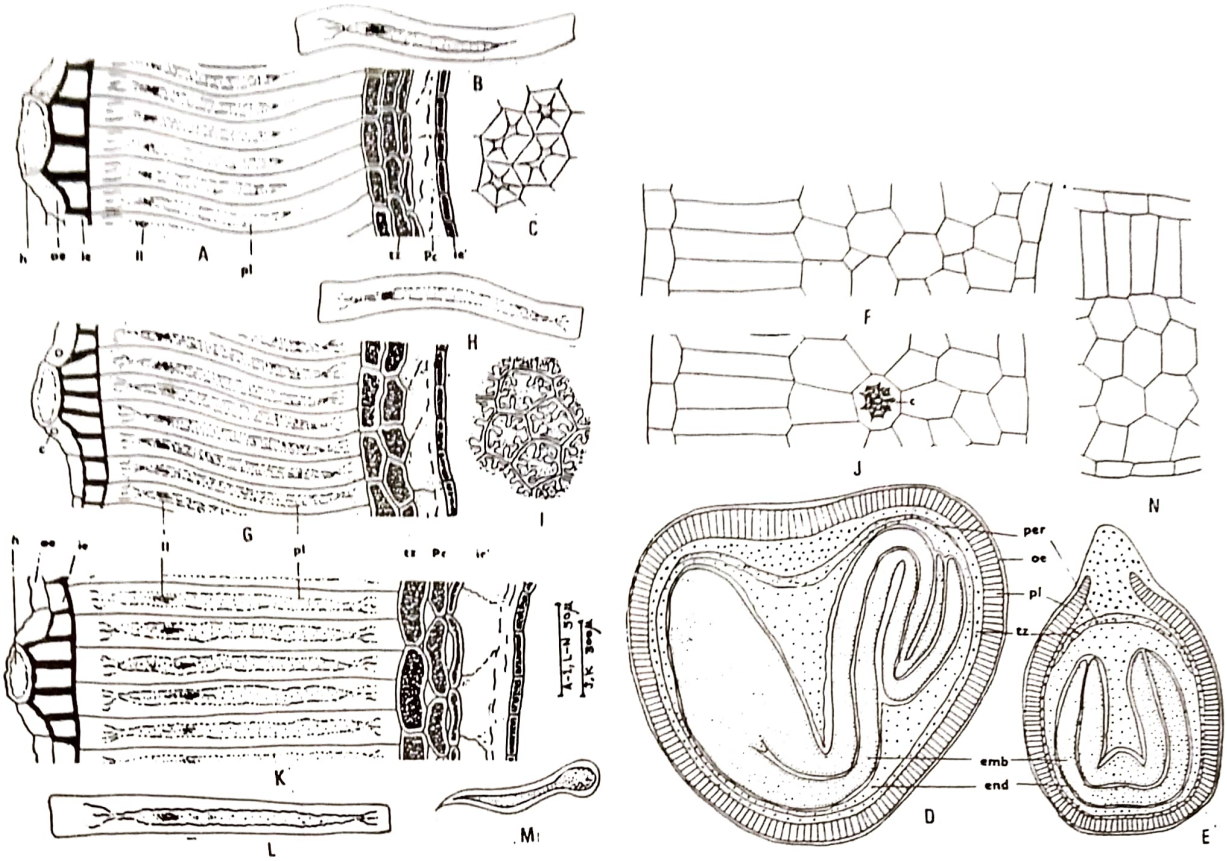

Fig. 2(A-N).Structure of mature seed coat in *Anoda* spp.
A-F. *A.cristata* : *A* t.s. of mature seed coat. *B, C,* Lateral and outer surface views of palisade cells from maceration. *D,E,* l.s. and t.s. of almost mature seed with perisperm and endosperm *F,* v.s. cotyledon with sphaerocrystal. G-J. *A.dilleuiana* : *G,* t.s.of mature seed coat with crystal in epidermal cells. *H,* Lateral view of palisade cell. *I,* Surface view of cells in fringe layer. *J,* v.s. of cotyledon. K-N. *A.wrightii* : *K,* t.s. of mature seed coat *L,* lateral views of palisade cell. *M,* epidermal hair. *N,* v.s.. of cotyledon.
(*c,* crystal; *emb,* embryo; *end,* endosperm; *h,* hair; *ie,* inner epidermis of outer integument; *ie'*, inner epidermis of inner integument; *ll,* light line; *oe,* outer epidermis of outer integument; *pc,* parenchymatous cells; *pl,* palisade cells; *tz,* tannin (pigmented) zone).

33-40 x 14-18 µ in *L.trimestris* and *L.thuringiaca* while 56-78 x 13-18 µ in all the 3 species of *Anoda*. The mesophyll layers are 4 to 6 without any crystals or glands except *A.dilleuiana* where crystals are present (Fig. 1N, R; 2F, J, N).

The seed coat is exo-tegmic having 6 zones. The seed epidermis consists of thin walled empty, tangentially elongated cells with sinuate walls, more so in *L. trimestris, L. thuringiaca, A. cristata* and *A. wrightii* (Fig. 1C,O; 2A,K). Small crystals are seen in the seed epidermis of *A.dilleuiana* (Fig. 2G). Small curved hairs of about 50-85 µ are present only at the micropylar region in *L.trimestris* (Fig. 1D), while hairs of 100-110 µ are present over the entire surface of seed in all the 3 species of *Anoda* (Fig. 2M). Seed hypodermis also consists of tangentially elongated cells with rod shaped thickenings on radial walls in *L.trimestris* and *L.thuringiace* (Fig. 1C, O), while in all the other species of both genera the thickenings are uniform on the inner tangential and radial walls (Fig. 1 I; 2A, G, K). In *L. trimestris* the cells of this layer possess small crystals, one per cell (Fig. 1C). Cells below the hair bases are radially elongated and comparatively thick walled in all the 3 species of *Anoda* (Fig. 2A, G, K). The palisade zone comprises of regular compactly arranged macrosclereids with biconvex lumina in the upper half having dark spherical body in all the species of *Lavetera* (Fig. 1 C, F, I, K, O, Q), while the lumina region is spread over the entire cells having diffused spherical body in the upper half in all the 3 species of *Anoda* (Fig. 2A, B, G, H, K, L). These are weakly 'S' shaped in *A. cristata* and *A. dilleuiana* and straight in other species of both

taxa (Fig. 2A, B G, H). The size of macrosclereids is 90-116 x 12-15 μ in *L. trimestris* and *L. thuringiaca* (Fig. 1F,O), and 155-200 x 14-16 μ in the remaining species of both genera (Fig. 1K; 2B, H, L). The pigmented zone comprises a single layer in *L.trimestris*, 2 layered in *L.cretica*, *L.thuringiaca* and *A.dilleuiana* and 3 layered in *A.cristata* and *A.wrightii*. The cells are thick walled with heavy pigmented contents, stellate, having prominent air spaces in all the investigated species, (Fig 1C, I, O: 2K) excepting *A.cristata* and *A.dilleuiana* where the cells are compactly arranged without air spaces (Fig. 2A, G). The colourless zone formed by the partially absorbed remaining mesophyll cell is present in all the species studied (Fig. 1C, I, O; 2A, G, K). The cells in the fringe layer are full of tannin, narrow, thick walled (Fig. 1C, I, O: 2A, G, K) and with characteristic peg like ingrowths (Fig. 1G: 2I) originating from cell walls in tangential sections.

CONCLUSION

The seed coat is 5-7 layered and has a common pattern of organisation in all the investigated species of both genera of the family Malvaceae. The exo as well as endomorphic features of seeds are useful in identification of various species. The following key indicates our views in this ragard.

Seeds non-hairy- (or very few at the micropylar region)

1. Seed coat 6 layered, outer epidermis with compressed cells, hypodermal cells more elongated. .....*L.cretica*
2. Seed coat 6 layered, outer epidermis with sinuate cell walls, hypodermal cells rectangular. ..... *L.thuringiaca*
3. Seed coat 5 layered, outer epidermal cells with irregular walls, hypodermal cells with one crystal. .....*L.trimestris*

Seeds hairy -

4. Seed epidermis with some pigmented contents, palisade cells 'S' shaped with allround thickenings, pigmented zone 3 celled with no spaces in between. ..... *A.cristata*
5. Seed epidermis with one crystal per cell, palisade cells 'S' shaped, thickenings in the upper region, pigmented zone 2 celled ..... *A.dilleuiana*
6. Seed epidermis without any contents, palisade cells straight, pigmented zone 3 celled with air spaces. ..... *A. wrightii.*

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