

STRUCTURAL AND PHYLOGENETIC SIGNIFICANCE OF THE CAPSULE WALL OF *ANDROGRAPHIS ALATA* (VAHL) NEES (ACANTHACEAE)

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The loculicidal capsule of *Andrographis alata* dehisces xerochastically at maturity. The pericarp is distinguished into epicarp, mesocarp and endocarp. Placenta is parenchymatous and borne on heterogenous septa. Ejaculators support the seeds. Phylogenetically the capsule shows more primitive characters than advanced ones.

Keywords : *Andrographis alata*; Loculicidal capsule; Structure.

Introduction

The literature survey shows that studies on Acanthacean capsules are rare. Sell¹ and Roth² worked out some capsules of Acanthaceae for their anatomical features. The present study reveals the structure, dehiscence, phylogenetic and taxonomic significance of the capsule wall of *Andrographis alata*.

Materials and Methods

The mature and dehisced capsules of *A. alata* were collected from Kerala and fixed in FAA, dehydrated, embedded and microtomed by usual methods of Johansen³. The sections were stained with Safranin-Fast Green combination and Methelene Blue. Starch grains and alkaloids were localized following Johansen³. The photomicrographs were taken with Carl-Zeiss Photomicroscope.

Observations

The mature capsule (Fig. 1) is greenish brown in colour with seeds borne on short placentae, supported by ejaculators. The seed chambers are separated by a true septum which does not form an axis in the centre (Fig. 2). Pericarp can be distinguished into three distinct zones, i. e. epicarp, mesocarp and endocarp (Fig. 5). A distinct endocarp is absent in the terminal region where the seed chambers are not extended.

Epicarp: In surface view, the terminal and basal epicarpic cells are polygonal and the middle epicarpic cells are tangentially elongated. At the zone of dehiscence, the cells are thin walled and vertically oriented. Glandular trichomes with one celled head and two celled stalk (Fig. 5) are scattered on the surface. Trichome scars are also observed. Diacytic type of stomata are most common, but anisocytic, contiguous (superimposed and juxtaposed) and arrested development are also observed on both sides of the dehiscence zone and at the region of lateral sutures. In sectional view, the single layered, parenchymatous and tangentially elongated epicarpic cells are protected by 2.5-3.0 μ m thick cuticle (Figs. 5,6) which shows numerous striations in surface view.

Mesocarp: The heterogenous mesocarp is made up of outer parenchyma and inner sclerenchyma (Figs. 5-7). The outer mesocarp is 1-2 layered, the inner mesocarp is 3-6 layered in the terminal, 6-8 layered in the middle and 20-22 layered in the basal regions (Figs. 4-6). At the zone of dehiscence, cells are smaller. The pericarp is thicker on both sides of the dehiscence zone with 2-3 layered outer mesocarp and 10-12 layered inner mesocarp (Fig. 7). The outer mesocarpic

cells of the middle region, are rich in starch grains while the basal region in alkaloids.

Endocarp: The single layered sclerenchymatous endocarpic cells are vertically arranged at the zone of dehiscence (Fig. 6) and obliquely arranged in the lateral sides (Fig. 5). Endocarpic cells border the septa and in the septal region, the cells are vertically arranged.

Septa and placenta: septa is formed by the union of the two carpel margins (Fig. 3). Mesocarpic cells extend to the septa to form a 12-14 layered outer (towards seed chamber) sclerenchymatous tissue on both sides and middle 6-10 layered large parenchyma cells with small intercellular spaces (Fig. 3). The septa does not fuse in the centre to form an axis, but bear parenchymatous placenta composed of small cells. Two rows of seeds are formed in each cavity.

Ejaculator: In continuation with the placenta, from the cells of funicle, ejaculators emerge (Fig. 2) which tightly held the seeds. Structurally, the ejaculator cells are lignified with special type of thickenings.

Vascular system: Vascular bundles are conjoint, collateral with endarch xylem (Fig. 7). In the middle portion of the fruit, 1 marginal, 1 dorsal and 4 lateral bundles are present in each half. In the terminal portion two adjacent vascular bundles are seen inner to the mesocarp which is surrounded by a parenchymatous bundle cap.

Dehiscence: The loculicidal capsule of *A. alata* dehisces xerochastically. The splitting open of the capsule takes place through the thin and weak zone of dehiscence and both the chambers are divided into two separate halves. The seeds, which are tightly held with the ejaculators are thrown out at the time of dehiscence.

Discussion

Pericarpic layers as observed in *A. alata* have also been observed in the capsules of *Datura*, *Hibiscus*, *Nyctanthes* and some other capsules^{2,4-6}. Different types of stomata, stomatal abnormalities, trichomes and scars are reported earlier in some fruits of *Acanthaceae*^{7,8}. The structure of the mesocarp is similar to that described by Sell¹ and Roth² with outer parenchymatous mesocarp and inner sclerenchymatous mesocarp. Heterogenous mesocarp is also reported in the capsule of *Nyctanthes*⁶. The sclerenchymatous endocarp has also been observed in *Hibiscus*⁵ and *Nyctanthes*⁶. Parenchymatous placenta acts as the shrinking tissue and the ejaculators play a major role in the dehiscence and liberation of seeds^{1,7}.

Zone of dehiscence of the capsule develops at the region of median dorsal vascular bundle. After maturity, the capsule splits open from tip to base through the dehiscence zone and each half of the septa is attached to each valve. Lignified cells of the beak help to initiate the dehiscence. The motory system of the loculicidal capsule dehiscing into two valves rests on the presence of longitudinally arranged sclerenchymatous fibres of the mesocarp and septum². The parenchymatous cells of the pericarp and septa act as the shrinking tissue. The dynamic tissue contract during drying but is prevented from the static fibrous tissue. When the parenchymatous cells break by the tension caused by the fibres, the valves bend to opposite directions. The obliquely arranged endocarpic cells also help in the bending movement.

The parenchymatous placenta with thick walled cells of the ejaculator acts as a spring and packed tensely in the undehisced fruit. During dehiscence, the placental cells shrink

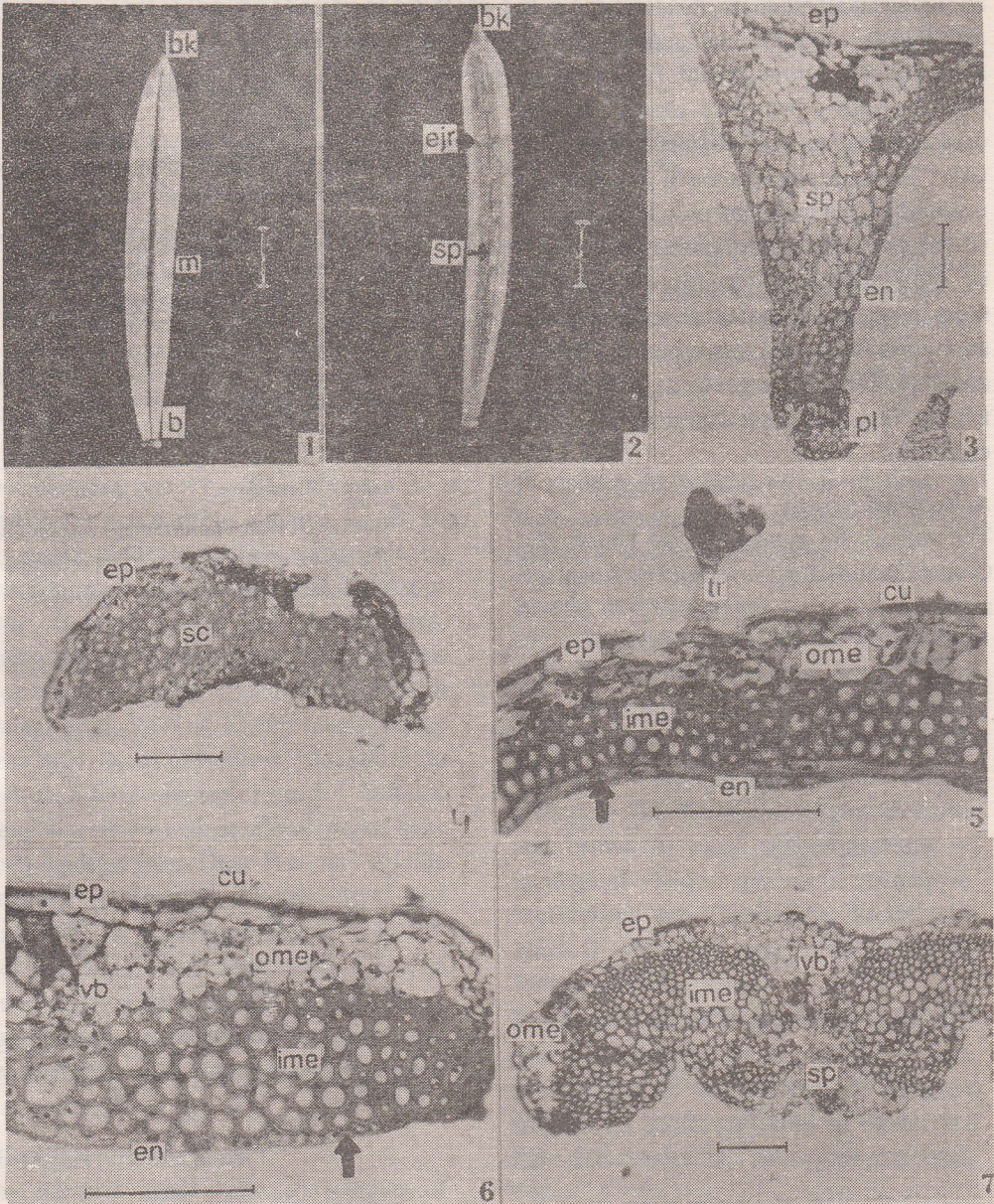


Fig. 1-7: 1. Mature capsule; 2. Capsule cut open to show septa and ejaculators; 3. T. S. of Septa; 4. T. S. of terminal portion; 5. Transsection of the pericarp from middle portion; 6. Transsection of the pericarp from near the zone of dehiscence; 7. T. S. from basal region of fruit.

* Scale bar :- For 1 and 2, 3 mm; For 3 to 7, 100 μ m. b - base; bK - beak; cu - cuticle; ejr - ejaculator; en - endocarp; ime - inner mesocarp; m - middle; ome - outer mesocarp; pl - placenta; sp - septa; sc - sclerenchyma; tr - trichome; vb - vascular bundle.

and the ejaculator suddenly bends downwards and thus the seeds are liberated and thrown away in the sudden movement. The capsule of *A. alata* shows primitive characters like dehiscent fruit² to a derived state of loculicidal type⁹. The axile placentation of Acanthaceae is primitive, but in this genus, placenta borne on the septa shows a step towards advancement, i.e. parietal placentation. More number of seeds, more mechanical tissue and xerochasy are the primitive characters responsible for the consideration of this genus as a primitive member of Acanthaceae with some advanced characters.

Acknowledgement

The authors are thankful to the University Grants Commission, New Delhi for financial assistance.

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