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DEVELOPMENT, STRUCTURE AND DEHISCENCE OF THE POD OF *CAJANUS CAJAN* WITH ITS PHYLOGENY

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Monocarpellary, apocarpous, superior ovary, marginal placentation, mechanical tissues and marginicidal dehiscence are the primitive characters observed in *Cajanus cajan* L. Ovary wall transforming into fruit wall is histologically differentiated into epicarp, mesocarp and endocarp.

Keywords: *Cajanus cajan;* Dehiscence; Phylogeny.

Introduction

The present study takes into consideration the development, anatomy, dehiscence and histochemistry of legumes of *Cajanus cajan* L. belonging to family Papilionaceae. The significance of carpological studies has been emphasized by various authors for its application in phylogenetic and evolutionary studies and systematic treatments [1,2].

Materials and Methods

Different developmental stages of flowers and fruits were collected, fixed in F. A. A and dehydrated through T. B. A series, embedded in 'Tissue-prep' of 56.5° C. Serial section of 6-8 µm were cut, stained with Safranine-Fast green for general histology. Histochemical stains used were I_2 KI[3], PAS[4] and CBB[5] for starch, polysaccharides and protein respectively. Photomicrographs were taken with a Carl-Zeiss Photomicroscope. For Scanning Electron Microscopy (SEM) fresh samples were fixed on a stud with double sided tape. They were coated with gold-palladium using SEM coating unit E 5 100 (Poloron equipment Ltd.) and observed under Cambridge stereo-scan S_4 Electron Microscope placed at ATIRA, Ahmedabad.

Observations

The legume has 3-5 ovules on marginal placenta and a zone of separation present on neutral side of it indicates the fusion of the carpel margin. The fruit is laterally compressed and in transection ovary is oval, with dorsal and ventral sutures (Fig. 2).

Ovary wall : It is distinguished into outer epidermis, mesoderm (ground tissue) and inner epidermis (Fig. 3). A layer of radially elongated cells with abundant cytoplasm and centrally placed spherical nuclei without any cuticle constitute the outer epidermis (Fig. 3). Along with many multicellular glandular, unicellular eglandular trichomes, anomocytic, tetracytic and cyclocytic stomata have been observed on outer epidermis. The sutural regions of the ovary wall are thicker than the lateral regions. The mesoderm is 20-22 layers thick in the sutural regions (Fig. 4,5) and 10-12 layers thick in the lateral regions with polygonal cells having tannin (Figs. 3-5). The ventral and dorsal sides have two vascular bundles and lateral side has only pro-vascular strands. The inner epidermal cells are thin walled and radially elongated with dense cytoplasm (Fig. 3,5). Anticlinal, periclinal as well as oblique divisions are noticed in the outer epidermis, mesoderm and inner epidermis.

Fruit development : Laterally compressed pods have trichomatous surface (Fig. 1). The pericarp developed, from the ovary wall is distinguished into epicarp, mesocarp, and endocarp (Fig. 6). The transection of the middle region of the young

pod is oblong, but the mature fruit is cylindrically oblong.

Epicarp : The multi layered epicarp is developed from the outer epidermis of the ovary wall by anticlinal, periclinal divisions and cell enlargement. Rhomboidal crystals are observed in the epicarpic cells. The stomata are anomocytic and/or cyclocytic. Two types of trichomes i. e smooth walled uniseriate with pointed apex (Fig.10,11) and multicellular pointed trichomes with an enlarged base (Fig. 10,12) are observed on the surface. In the apical region the epicarpic cells are smaller and thin walled. A thin layer of cutin is observed at the maturity of the fruit, which shows polygonal cuticular foldings and stomata in the same level of the fruit surface by SEM observation (Figs. 9-11). The inner epicarpic cells are two layered and sclerenchymatous.

Mesocarp: Development of the parenchymatous mesocarp is from the mesoderm of the ovary wall. The mesocarp of the sutural regions are 30-35 layers thick (Figs. 7,8) and the lateral regions are of 25-30 layers. Thickness of the fruit increases due to an increment in the number of cells. The mesocarp of the young fruit has deeply stained cytoplasm and nuclei, but the mature cells are vacuolated. Scattered tanniferous cells are observed in the mesocarp. The outer cortex is 6-10 layered and parenchymatous whereas inner cortex is 1-2 layered and of thick walled cells in the basal and apical portions.

Vascular bundles are arranged in circular form in the basal region of the fruit, which further branches up in the middle portion. In the early stages of the fruit development, one median dorsal bundle, two ventral bundles and lateral provascular bundles are observed and the mature fruit shows 10-16 differentiated vascular bundles in each lateral side. In the apex two vascular bundles are seen, which are centrally placed. Bundles are conjoint, collateral and open with endarch xylem. From the fourth stage of development, some of th parenchyma cells above the bundle become lignified to form a bundle cap (Fig. 7,8).

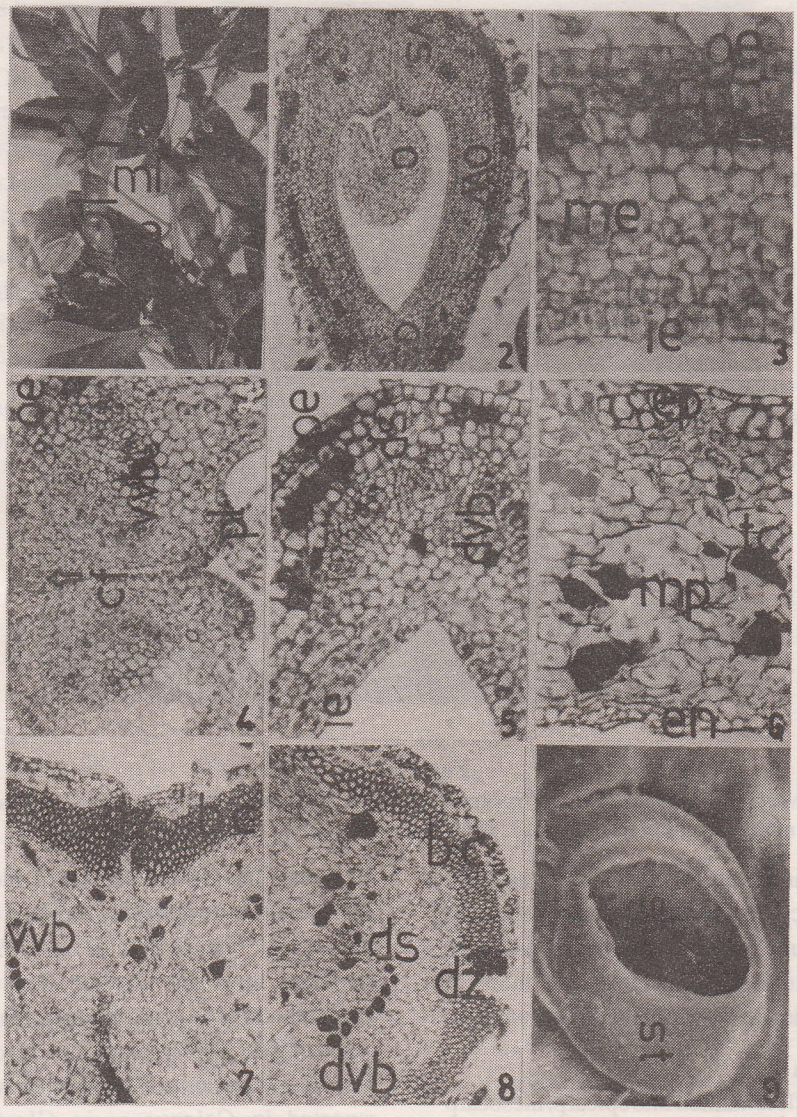
Endocarp: The endocarp is multilayered formed due to divisions and enlargement of the cells of the inner epidermal cells which are parenchymatous with adjacent 2-3 layers of thick walled cells (Fig. 6) having spindle shaped, pitted fibres. On SEM observation the inner surface of the fruit shows wavy cuticular mounts (Fig. 13).

Placenta and septum: Marginal placenta projecting into the carpel chamber from the ventral margin of the fruit and consists of compactly arranged parenchyma cells. Developing vascular bundles are seen in the middle part of the placenta which get differentiated at maturity.

The fruit develops a false septum by the divisions of the inner epidermal cells of the margins which is lacking in ovary stage. The septal cells are polygonal, thin walled and closely packed. Both septa extend from the margins come closer but not face to form a complete chamber.

Dehiscence: The anatomical structure of the pod is associated with marginicidal dehiscence (Fig. 7, 8). The fruit splits along the dorsal and ventral sutures due to the tearing of the weak parenchyma cells and the differential shrinkage of the fibres. The thick walled cells of the epicarp and endocarp create a tension after the shrinkage of parenchyma cells which exert pressure on the valves to facilitate their separation and thus cause the liberation of the seeds.

Histochemistry: Starch grains are adundant in the developing fruits specially in



Figs 1-9.

1. Morphology of the fruit 1X; 2. T.S of ovary from flower bud 153 X; 3. A portion of ovary wall in T. S. 325X; 4. Ventral portion of the ovary wall in T. S. 240X; 5. Dorsal portion of the ovary wall in T. S. 320X; 6. A portion of the mature fruit wall from the lateral side 198X; 7. Zone of dehiscence at the ventral side 122X; 8. Zone of dehiscence at the dorsal side 122X; 9. SEM showing stomata 2200X. (b - beak; ba - base; be - bundle cap; cf - carpel fusion; dvb - dorsal vascular bundle; ds - dorsal side; dz - dehiscing zone; en - endocarp; ie - inner epidermis; me - mesoderm; mi - middle; mp - mescocarp; o - ovule; ow - ovary wall; oe - outer epidermis; pl - placenta; st - stomata; stp - stomatal pore; tc - tannin; tr - terminal; vs - ventral side; vvb - ventral vascular bundle).

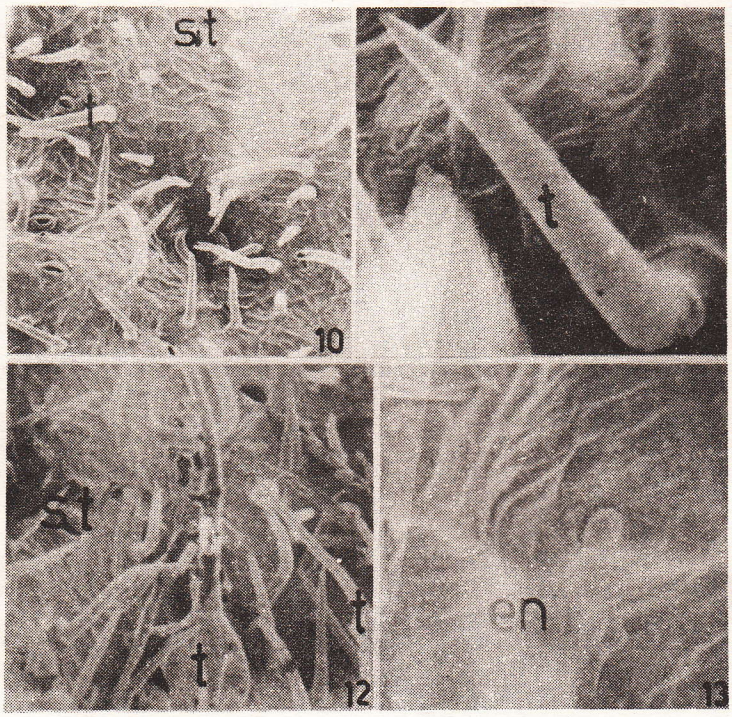


Fig. 10-13.

10. SEM of Mature fruit surface showing trichomes 220X; 11. SEM showing smooth walled richomes 200X; 12. SEM of mature fruit surface 222X; 13. SEM of inner surface of nature fruit 2202X.

the vascular region, placental stalk and outer mesocarpic cells. Protein bodies are localized in the ground tissue of the ovary wall and young fruit. Polysaccharrides are more in sutural region in developing and mature pod.

Discussion

Pericarp differentiation into epicarp, mesocarp and endocarp is same as observed by Dave and Bennet[6-8] in *Cyamopsis*, *Glycine* and *Clitoria* respectively. Besides stomata, glandular and eglandular hairs, mature fruit has a thick cuticle also, which develops and thickens as the fruit matures. Mesocarp is formed from the mesoderm of the ovary wall due to anticlinal, periclinal and oblique divisions. The differentiation of the sutural and lateral mesocarp is also reported earlier in *Cyamopsis* [6] and in *Clitoria*[8]. Vascular cambium does not develop in fruits, but fascicular cambium may be there which is not responsible for growth in thickness[9]. Sclerenchymatous bundle cap has also been reported in *Cajanus* as in *Glycine*[7] and *Cyamopsis*[6]. Endocarp is formed from the inner epidermis of the ovary wall and the lignified endocarp in mature fruit helps in the dehiscence. The growth of endocarpic septum is at right angles to the longitudinal axis of the fruit as in *Cassia tora*[10] and *Clitoria ternatea*[8]. The immense occurrence of major metabolites such as strach, protein and polysaccharrides

suggests that the tissue is metabolically very active in the early stages of fruit development.

The dehiscent fruit with dorsiventral symmetry, superior ovary, marginal placentation, mechanical tissues in endocarp and epicarp, are the characters suggesting primitiveness of the genus in Papilionatea.

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