

# SEED COAT STRUCTURE IN BIGNONIACEAE

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**Abstract:** The Bignoniaceae, or Trumpet Creeper Family, is a family of flowering plants has remain neglected so far. There is very little work on the seed structure. Seed structure is often neglected by many authors in taxonomic works. Several botanists have emphasized the importance and utility of seed anatomy in solving the taxonomic and phylogenetic problem. The microscopic characters of the seed have not been exploited fully in understanding the taxonomy and phylogeny of the angiosperms families. The studies of seed coat structure have positively shown the great utility in relation to taxonomy and phylogeny of the Bignoniaceae.

**Key words:** Bignoniaceae, Tabebuia Taxonomy, Phylogeny, Angiosperms, Catalpa ovata

## INTRODUCTION

The family Bignoniaceae is one of the most important tropical families which have attracted the attention of the taxonomists in other parts of the world. There are about 800 species in 113 genera (Gentry, 1979b) and with a few exceptions most of them (78%) are essentially tropical. Its is fairly represented in India but except the earlier account of (Clarke, 1884) in *flora of British India* and the review of the family by (Chatterjee, 1948a) there are no recent works on this family in the Old world and the New world there have been many nomenclatural changes, generic mergers, establishment of new genera etc.

The importance of seed structure in angiosperms was realized long ago by (Netolitzky, 1926). who definitely pointed out that the seed-structure should be the basis of natural classification of flowering plants. During the past two decades a series of publications have appeared on the structure of the seed-coat in different families of angiosperms. The microscopic characters of the seed have not been exploited fully in understanding the taxonomy and phylogeny of the angiosperms families. (Corner, 1976) has emphasized the importance of seed anatomy in his book 'The seeds of dicotyledons' where the seed structures of the angiosperm families have been described. Corner's (1949, 1951, and 1976) studies have positively shown the great utility of seed characters in solving the taxonomic and phylogenetic problems. Other important works on seed structure in relation to taxonomy are by (Reeves, 1936). on Malvaceae, (Narayana, 1962) on (Aizoaceae, Rao, 1936) on Hamamelidaceae and (Singh, 1964). (Singh, D, 1965, 1967, 1970), (Singh, K. and Dathan 1969,1971). on Cucurbitaceae etc. further references to the seed structure of any other family is given in (Corner, 1976) book.

The family Bignoniaceae have remain neglected so far. There is very little work on the seed structure of the family except the embryological studies in some members by

Govindu (1951) and on *Orxylum indicum* by Ghatak (1956).

## MATERIALS AND METHODS

Mature seeds of 20 species of Bignoniaceae belonging to 18 genera were collected and studied. The species are described below in alphabetical order. For the seed-coat anatomy the seeds were boiled in water for 12-25 hours or kept in aqueous solution of picric acid for 15-20 days for softening. The seeds were then washed thoroughly first with water and later on with 70% alcohol until the traces of acid were removed. Then the seeds were passed through alcohol-xylol series or alcohol-chloroform series or tertiary butyl alcohol series and embedded in paraffin wax. Microtome sections cut at 12-14  $\mu$  were stained with safranin fast green combination and Heidenhains iron-alum haematoxylin. In some cases hand sections were also made. For free-hand sectioning the mature dried seeds were boiled in water for 13-18 hours and stored in 70% alcohol for 4-8 weeks. The sections were stained with safranin-fastgreen and mounted in Canadabalsam.

## OBSERVATIONS

**1. *Campsis radicans*-** Seed coat is made up of three zones. The outer zone is generally single layered in thickness and sclerenchymatous. Cells of this zone are quadrangular in shape. The middle zone is 4-10 cells in thickness, parenchymatous. Cells are polygonal to oval in shape; cell-wall is thicker at some places. The inner zone is single celled in the middle region but many celled at the lateral ends, these cells are dark coloured and are probably filled with tannin.

**2. *Catalpa bignonioides*:** Seed coat is composed of three zones. The outer zone is one to six cells in thickness, sclerenchymatous. Generally at the edges this zone is single celled in thickness but in the middle region it is up to 6-celled thick. Middle zone is 3-5 celled thick and is

made up of elongated cells. Inner zone is composed of 4-6 layers. There is no difference in the cells of middle and inner zone except that the size of the cells of the inner zone is smaller than those of the middle zone.

**3. *Catalpa ovate*:** Seed coat is made up of four zones. The outer zone is single layered, heterocellular. Cells are sclerenchymatous, quadrangular to round in shape. Second zone is 5-8 celled thick, parenchymatous. The maximum thickness of this zone is observed at the two longitudinal ends. In the middle region the size of the cells of this zone decreases from inside to outside. The third zone is highly sclerenchymatous, two to three cells thick. The fourth and inner most zones are 2-5 celled thick; cells are parenchymatous, polygonal.

**4. *Clytostoma callistegioides*:** Seed coat is made up of two zones. The outer zone is one the three layered, heterocellular; cells are thick walled, highly lignified. At some places irregularly branched sclereids are cells are thin walled, parenchymatous, sinuate.

**5. *Cresocentia alata*:** Seed coat is composed of two zones. The outer zone is single layered in thickness. Cells are large and pyriform with short neck, sclerenchymatous. The basal, round part of these cells are with muriform thickening. The inner zone is 2-6 celled in thickness; cells are thin walled, parenchymatous. In the middle region, generally the inner zone is 2-4 cells in thickness with irregular, sinuate cells whereas at the edges it becomes up to eight celled thick with polygonal cells (with pitted thickenings).

**6. *C. cujete*:** The seed coat is made up of two zones. The outer one is single layered in thickness and contains pyriform sclereides with long necks. The basal parts of these cells are with thickenings in patches. The inner zone is 3-9 celled in thickness and is quite same as in *C. alata*.

**7. *Dolichandrone spathacea*:** There are two zones which form the seed coat. The outer zone is 5 – many celled thick, sclerenchymatous. In the middle region of the seed the outer zone is usually made up of 5 to 6 layers and the cells in this region are elongated with wavy and thick cell wall. Except that particular place the outer zone is many-celled thick, with polygonal cells. The inner zone is 3-8 layered thick; the cells are thin walled, parenchymatous, oval to irregular in shape, with or without intercellular spaces.

**8. *Incarvillea arguta*:** The seed coat is made up of single zone. The zone is made up of a single layer of thick-walled lignified cells; the epidermis is with tubercles

which are of different sizes. The cells are not distinct and the thickening is uniform throughout the seed coat.

**9. *Jacaranda mimosifolia*:** The seed coat is composed of three zones. The outer zone is covered with a thin and hard cuticle. This zone is 5-12-celled thick, sclerenchymatous. The cells are polygonal to irregular in shape with pitted thickenings. The size of the cells in this zone generally decreases from the outermost side to the innermost side. The middle zone is highly sclerenchymatous, one to four celled in thickness; cells are obliquely placed and form a compact tissue. The inner zone is one to 4-celled thick; cells are generally polygonal in shape and parenchymatous.

**10. *Macfadyena unguis-cati*:** The seed coat is made up of two zones. The outer zone is single layered and heterocellular. The cells are thick-walled and sclerenchymatous; the cells of this zone in the middle region are larger than the cells present at the longitudinal ends. The inner zone consists of 8-20 layers of thin walled, parenchymatous cells which are irregular in shape. The cells of this zone are also smaller at the edges.

**11. *Millingtonia hortensis*:** The seed coat is made up of two zones. The outer zone is 4-5 celled in thickness; cells are very much elongated and compactly arranged in tangential layer. The inner zone is 3-5 layered. Cells in this zone are thin-walled, parenchymatous. In the middle region the cells are elongated whereas towards the edges they become more or less globular with prominent intercellular spaces

**12. *Pachyptera hymenaea*:** Seed coat is made up of two zones. The outer zone is very conspicuous; single layered and heterocellular. Cells are thick walled, with a small lumen, sclerenchymatous, more in breadth than the length. Often at some places this zone becomes many layered. The inner zone is thin-walled, parenchymatous, and 2-4-layered in the middle region but many layered at the edges. The cells in the middle region are comparatively larger in size.

**13. *Pajanelia longifolia*:** The seed coat is made up of zones. The outer zone is sclerenchymatous, generally single layered in thickness except at some places where it becomes 2-3 layered. Cells of this zone are quadrangular, thick walled. Inner zone is 4 – many celled thick, parenchymatous. In the middle region the cells are irregular in shape but at the edges they become polygonal. Just outside to the cotyledons the inner zone at some places becomes highly sclerenchymatous and the cells are polygonal in shape, in these patches.

**14. *Parmentiera cereifera*:** The seed coat is composed of two zones. The outer zone is highly sclerenchymatous, single layered in thickness; cells are very large, thick-walled and with reticulate thickenings. The inner zone 1-4 celled in thickness; cells are small, thin-walled, parenchymatous, + polygonal. In the middle region generally the cells of the inner zone are smaller in size.

**15. *Radermachera glandulosa*:** The seed coat is composed of three zones. The outer zone is parenchymatous, 2-4-celled thick, with shortly elongated cells. The middle zone is highly sclerenchymatous, 1-3-celled thick; in the middle region the cells are quadrangular to polygonal in shape whereas near the edges the cells are irregular. The inner zone is parenchymatous, generally 1-celled thick in the middle region and many-celled at the edges.

**16. *Spathodea campanulata*:** The seed coat is made up of two zones. The outer zone is single-layered thick, sclerenchymatous; the cells of this zone are polygonal in shape; the cells present at the lateral edges are comparatively larger in size. As mentioned in the morphology of this seed there is a thick, hard, ridge like structure surrounding the cotyledonary region of the seed. In the transverse section this portion looks like a sclerenchymatous pad. The inner zone is parenchymatous, 1-3-layered thick in middle region. The cells are generally polygonal in shape. At the edges this zone is corky in nature and made up of large number of cells which are round to oval in shape with prominent intercellular spaces.

**17. *Sterospermum chelonoides*:** Seed coat is composed of two zones. The outer zone is highly sclerenchymatous, many celled in thickness. There is a big difference in the thickness of this zone on two sides of the cotyledons as seen in T.S. the cells are polygonal to irregular in shape. Generally the cells are with reticulate thickenings but in some cells striated thickenings have also been observed. Some cells are also without any thickening having also been observed. Some cells are also without any thickening. The inner zone is parenchymatous, 5-20 celled in thickness, with thin-walled polygonal cells. The number of layers in this zone varies considerable on all sides. In between the two zones there is probably a resin canal on the concave side.

**18. *Tabebuia pallida*:** The seed coat is made up of four zones. The outer zone is 3-6-layered in thickness. The cells are elongated with wavy cell wall and pitted thickness. The second zone is single-celled in thickness. The cells are quadrangular in shape. The third zone is

parenchymatous, 3-6-celled in thickness. The cells are irregular and sinuate. The size of the cells of this zone decreases at the edges. The fourth and the innermost zone are 1-3-celled in thickness, parenchymatous; cells are either polygonal or barrel shaped.

**19. *Tecoma Stans*:** The seed coat is made up of two zones. The outer zones are 1-2 layered thick and sclerenchymatous. Cells are thick walled, more in breadth than length. Generally this layer is 1-celled thick in the middle region and may be 2-celled thick at some places especially at the edges. The inner zone is very broad, up to 15-celled thick, parenchymatous. Cells are thin walled, quadrangular to polygonal in shape.

**20. *Tecomella undulata*:** The seed coat is composed of two zones. The outer zone is 1-3-layered in thickness. Cells are thick-walled, sclerenchymatous. In the middle of the seed, this zone is usually single-layered with larger cells. At the lateral edges it is one to three layered thick with smaller cells. The inner zone is 6-10 layered thick. The cells are elongated, polygonal, thin walled, parenchymatous. The size of the cells and the number of layers of this zone is larger at the edges.

## DISCUSSION

The seeds of most Bignoniaceae are alate and the wings are local outgrowths of the seed-coat. The seeds are unitegmic and the seed coat is exotestal, i.e., the mechanical layer is present in the outer integument (corner, 1976). The present study indicates that in most of the species the seed-coat is made up of two zones, but in *Campsis radicans*, *Catalpa bignonioides*, *Jacaranda mimosifolia* and *Radermachera glandulosa* it is composed of 3 zones and in *Catalpa ovata* and *Tabebuia pallida* it is made up of 4 layers. The most conspicuous feature in the structure of the seed-coat is the presence of the mechanical layer. It is either one or more cells thick and consists of lignified or thick-walled cells or a layer of sclerotic cells. The mechanical layer is mostly present in the outer layer where it acts as a protective cover. In some cases there are two mechanical layers as in *Catalpa ovata*. In *Radermachera glandulosa* the mechanical layer is present in the second zone.

In the winged seeds the wings are 1-2 cells thick. The cells are tangentially elongated with thickened walls. In the non-alate seeds such as *Incarvillea* the seed-coat is unique in being undifferentiated in to separate zones. In the two species of *Crescentia* the epidermis or the outermost layer consists of typically pyriform cells with thickenings. In *C. alata* these cells are with muriform thickenings and in *C. cujete* they are sclerotic.

The differentiation of the seed-coat in to separate layers; the nature and thickness of these layers; the nature and position of the mechanical layer as well as the nature of thickening etc. are found to be useful taxonomic characters in distinguishing the different genera and species. It is obvious that the developmental studies will bring out further information for elucidation the phylogeny and taxonomy or the evolution of seed in this family.

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