

Anatomical Study of Some Plants in Family Bignoniaceae

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Abstract—The present investigation focuses on a comparative anatomical study of the stem and leaf in selected species of Bignoniaceae. Observed anatomical variations reveal structural adaptations related to functional efficiency, ecological strategies, and evolutionary relationships. The study underscores the significance of anatomical evidence in elucidating structural organization and taxonomic relationships within the family Bignoniaceae. The family Bignoniaceae is a pantropical lineage comprising approximately 82 genera and nearly 860 species, predominantly represented by woody trees and lianas, with a limited number of shrubs and herbs. Members of this family are typically characterized by a woody habit, opposite compound leaves, and conspicuous, tubular, zygomorphic flowers. According to recent angiosperm classification systems, Bignoniaceae is placed within the order Lamiales.

Index Terms—Bignoniaceae, anatomy, leaf, stem.

I. INTRODUCTION

Plant anatomy is the branch of botany that deals with the study of the internal structure of plant organs through techniques such as section cutting and microscopic observation. Various plant organs including roots, stems, leaves, flowers, and seeds exhibit characteristic anatomical features that reflect their specialized functions. The development, organization, and differentiation of tissues within plant organs are closely related to their physiological roles, and each tissue is structurally adapted to perform a specific function.

The study of plant anatomy also contributes to a better understanding of the structural hierarchy of plants, ranging from cells and tissues to organs and organ systems. It helps in correlating structure with function, comparing anatomical variations among different vascular plant groups, and interpreting patterns of primary and secondary growth arising from different

types of meristems. Additionally, anatomical features often reflect ecological adaptations, enabling predictions about the environmental and climatic conditions to which plants are adapted.

Plant anatomical studies further bridge the gap between morphology, development, genetics, physiology, ecology, and evolution. Structural differences observed in plants can ultimately be traced to genetic regulation and natural selection. Therefore, the interpretation of plant anatomy provides insights into plant development, survival strategies, and evolutionary relationships.

The family Bignoniaceae is a predominantly woody family comprising approximately 82 genera and about 860 species, distributed mainly in tropical regions. Most members are trees and lianas, though shrubs and herbs are also present. The family is easily recognized by its woody habit, opposite and compound leaves, and large, tubular, zygomorphic, and often showy flowers. In modern angiosperm classification systems, Bignoniaceae is placed under the order Lamiales and forms a well-supported lineage closely related to the Lamiaceae. Anatomical studies of this family provide valuable information for understanding its taxonomic position, adaptive features, and evolutionary significance.

The family Bignoniaceae comprises flowering plants commonly known as *bignonias* or *trumpet vines*. Many species of this family are of considerable importance due to their commercial, ornamental, and ethnobotanical uses. Members of Bignoniaceae are especially valued as ornamental plants because of their attractive foliage and large, brightly coloured, trumpet-shaped flowers. Several species are widely cultivated in gardens, parks, and avenues as flowering trees, shrubs, or climbers in addition to their aesthetic value, some species are also used in traditional medicine and landscaping, highlighting the economic and cultural significance of the family.

II. METHOD AND MATERIALS

Fresh and healthy plant specimens were selected for the study of the internal structure of stem and leaf. The collected plants were identified with the help of standard floras.

Fresh stem and leaf samples were sectioned manually using a sharp blade. Thin transverse sections were selected and subjected to a dehydration series using graded alcohol solutions (30%, 50%, 70%, 90%, and absolute alcohol). The sections were then stained using safranin and light green to differentiate various tissues. After staining, sections were cleared in xylene and mounted permanently in DPX. Prepared slides were observed under a compound microscope, and anatomical features were studied and recorded.

III. OBSERVATION AND DISCUSSION

Sr. No.	Common Name	Botanical Name	Family
1	Ranshing vel (Chinese trumpet vine)	<i>Campsis grandiflora</i>	Bignoniaceae
2	Aakash shevga (tulip tree)	<i>Spathodea campanulata</i>	Bignoniaceae



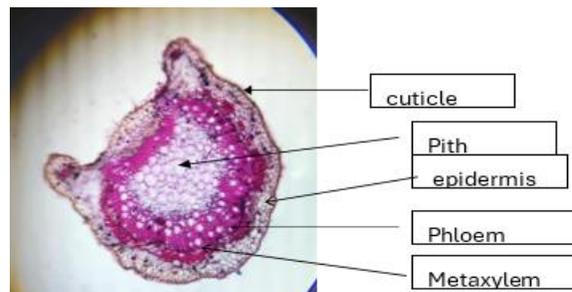
Campsis grandiflora

External Morphology

Campsis grandiflora belongs to the family Bignoniaceae and is commonly known as the Chinese trumpet vine. It is a fast-growing, deciduous, woody climber bearing large, showy, trumpet-shaped orange flowers. The stem is woody, and the leaves are opposite and pinnately compound, consisting of 7–11 leaflets. Leaflets are lanceolate to ovate with serrate

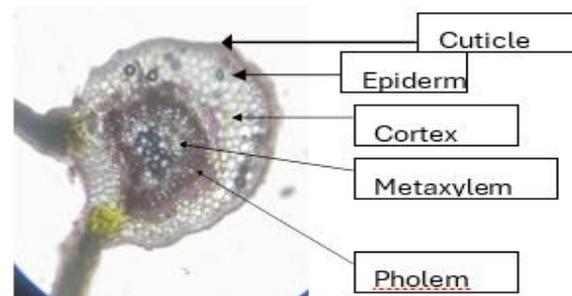
margins and short petiolules. The rachis length ranges from 4–13 cm.

The inflorescence is terminal and short paniculate, with a peduncle measuring about 15–20 cm. Flowering occurs from May to August, during which the plant is covered with dense bright green foliage and attractive flowers.



Campsis grandiflora (T.S. Stem)

A thin transverse section (T.S.) of the Bignoniaceae stem observed under a compound microscope shows a well-organized internal structure from periphery to centre. The outermost epidermis is single-layered, composed of compact rectangular cells without intercellular spaces, and is externally covered by a cuticle; multicellular epidermal hairs are present in some regions. Beneath the epidermis lies the cortex, which is differentiated into hypodermis, general cortex, and endodermis. The hypodermis consists of collenchymatous cells, especially well developed in ridges, and lacks intercellular spaces. The endodermis forms the innermost layer of the cortex and is made up of compact, barrel-shaped cells rich in starch grains, thus forming a starch sheath. Internal to the endodermis is the pericycle, composed of lignified, sclerenchymatous polygonal cells. The vascular system consists of conjoint, bicollateral, open vascular bundles arranged in a ring, with each bundle comprising xylem, phloem, and cambium.



Campsis grandiflora (T.S. Leaf)

A transverse section of the leaf in Bignoniaceae exhibits a well-defined dorsiventral structure. Both the upper (adaxial) and lower (abaxial) surfaces are covered by a single-layered epidermis, externally protected by a cuticle and bearing epidermal hairs. The midrib region is prominent and shows well-developed collenchymatous tissue on the upper side along the median line, providing mechanical strength and flexibility, while the remaining ground tissue is parenchymatous.

The vascular bundles in the leaf are typically bicollateral, though their number and arrangement vary among genera. In *Campsis grandiflora*, seven vascular bundles are observed in the midrib region; in *Spathodea campanulata*, seven vascular traces enter the petiole; and in *Pyrostegia venusta*, five vascular bundles are present. The mesophyll is clearly differentiated into palisade parenchyma beneath the upper epidermis, consisting of elongated, chloroplast-rich cells specialized for photosynthesis, and spongy parenchyma below, made up of loosely arranged cells with large intercellular spaces that facilitate gaseous exchange.

Stomata are mainly confined to the lower epidermis, making the leaf hypostomatic, which helps in reducing water loss while allowing efficient gas exchange. Overall, the anatomical features of the Bignoniaceae leaf indicate adaptations for photosynthesis, mechanical support, and water conservation, and provide important diagnostic characters for the family.



Spathodea campanulata

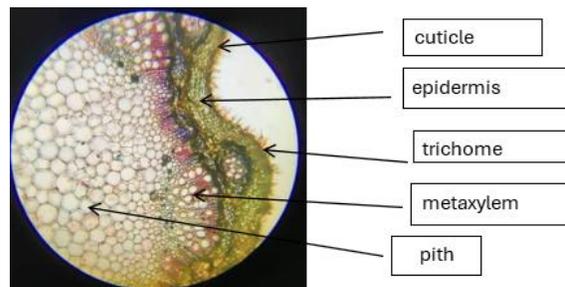
External Morphology

Spathodea campanulata belongs to the bignoniaceae family is commonly known as African tulip tree or sausage tree it is large tree that can reach 50ft in height. The leaves are pinnately arranged and grows in 40 cm long. Leaf size of *spathodea campanulata*

17.3cms is length and width 9.7cms. shape is oblong Apex is acute and entire margin. Leaf surface is hairy colour is dark green. They are broze in colour when young turning deep – glossy – green at maturity this is one of the nicest blooming trees.

Anatomy of *spathodea campanulata*

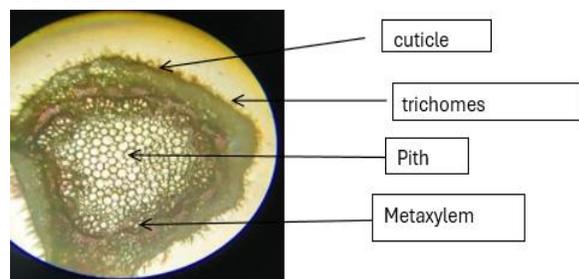
T.S. of Stem



A thin transverse section (T.S.) of the supplied Bignoniaceae stem examined under a compound microscope reveals a well-differentiated internal structure. The outermost layer is the epidermis, which is single-layered and composed of compact, rectangular cells without intercellular spaces. The epidermis is externally covered by a cuticle and bears multicellular epidermal hairs that provide protection. Beneath the epidermis lies the cortex, which is distinctly differentiated into hypodermis, general cortex, and endodermis. The hypodermis consists of a few layers of collenchymatous cells providing mechanical support, while the general cortex is made up of thin-walled parenchymatous cells. The innermost layer of the cortex is the endodermis, formed of compact, barrel-shaped cells rich in starch grains and therefore termed the starch sheath.

Internal to the endodermis lies the pericycle, represented by patches of lignified sclerenchymatous cells that are polygonal in shape and contribute to stem rigidity. The vascular system is arranged in a ring of conjoint, bicollateral, and open vascular bundles. Each bundle consists of xylem towards the center, phloem on both outer and inner sides, with a cambial strip in between, indicating secondary growth potential. Trichomes are also observed on the stem surface; these may be unicellular or multicellular and glandular or non-glandular, serving protective and secretory functions.

T.S. of Leaf:



Leaves in members of the Bignoniaceae typically possess a single-layered epidermis on both the upper (adaxial) and lower (abaxial) surfaces, often bearing epidermal hairs on both sides. Collenchymatous tissue is prominently present along the median region of the upper surface of the leaf midrib, providing mechanical support. In this family, vascular bundles are characteristically bicollateral, but their number and arrangement vary among genera. In *Campsis grandiflora*, the transverse section of the leaf shows seven vascular bundles, while in *Spathodea campanulata*, seven vascular traces enter the base of the petiole.

The cuticle forms the outermost protective layer covering the epidermis and is composed mainly of cutin. It is impermeable to water and plays a crucial role in reducing transpiration and protecting the leaf from environmental stress. The upper epidermis consists of compact, parenchymatous cells with outer walls thickened by the cuticle. It serves as a protective layer and helps regulate water loss. Beneath the upper epidermis lies the palisade parenchyma, composed of closely packed, elongated cells rich in chloroplasts. This tissue is the primary site of photosynthesis and, despite its compact arrangement, remains partially exposed to intercellular spaces to facilitate gaseous exchange.

Below the palisade layer is the spongy parenchyma, consisting of loosely arranged cells with prominent intercellular spaces. This tissue plays a vital role in the exchange of gases between the internal leaf tissues and the external atmosphere. Stomata are mainly confined to the lower epidermis in dicot leaves, where they regulate the exchange of gases and the loss of water vapour through transpiration. The lower epidermis is single-layered, composed of parenchymatous cells without intercellular spaces, and is covered by a thin cuticle. Trichomes are present on both epidermal surfaces and may be unicellular or multicellular, branched or unbranched, and glandular or non-

glandular, serving protective and sometimes secretory functions.

IV. CONCLUSION

The family Bignoniaceae, belonging to the order Lamiales, is of considerable economic importance and includes many ornamental, timber, and medicinal plants widely used in traditional medicinal systems. Members of this family exhibit therapeutic properties such as antidiabetic, anti-inflammatory, immunostimulant, antimicrobial, and anti-snake venom activities. Anatomical studies of *Campsis grandiflora* and *Spathodea campanulata* revealed the absence of stomata on the adaxial epidermis. In *Campsis grandiflora*, the cortex is multilayered and the vascular bundles are conjoint and collateral, whereas *Spathodea campanulata* shows a single-layered epidermis with compact cells and the presence of trichomes. Both species are economically significant due to their ornamental, timber, and medicinal value. A key diagnostic feature observed in the present study is the presence of characteristic bicollateral vascular bundles, which serves as an important identifying character of the family Bignoniaceae.

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