

# Anatomical Investigation of *Cassia uniflora* Mill.

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## Abstract

*Cassia uniflora* Mill. Irwin and Barneby belonging to the family Caesalpiniaceae has been recorded for the first time. The specimens were found growing along road sides intermingled with *Cassia tora* Linn. Anatomical peculiarities and key characters of this species have been studied in present paper. It provides the significant contribution for identification.

**Keywords:** *Cassia uniflora*, anatomical peculiarities.

## Introduction:

The family Leguminosae (or Fabaceae) consists of 700 genera and 17000 species. It is considered to be the largest family of flowering plants after Compositae (Asteraceae) and Orchidaceae (Heywood, 1978).

The genus *Cassia* L. is the largest genus in the subfamily Caesalpinioideae of the Leguminosae, and is probably one of the twenty five largest genera of dicotyledons (Irwin and Turner 1960).

*Cassia uniflora* is a plant in the family Caesalpiniaceae. The taxon *Cassia sericea* Sw. which is currently accepted as *Senna uniflora* Mill. Irwin and Barneby was reported for the first time from Eastern Karnataka and subsequently from Pune (Singh N.P,1979). This has also been reported from Madhya Pradesh (Dhar and Jhabua district), Andhra Pradesh and Kerala (Samvartsar S.1996, Reddy C.S. et.al.,2000).

After a thorough survey of literature, critical examination of the specimens and expert opinion from Botanical survey of India, It was identified as *Senna uniflora* Mill. Irwin and Barneby.

## Material and Method:

Material was preserved in F.A.A. (5ml formaldehyde, 5ml glacial acetic acid, 90 ml 70% alcohol) for anatomical studies. Present study is based mostly on microtome sections, macerations and peelings of fresh and preserved material. Free hand sections were taken where felt necessary.

The microtome sections and necessary free-hand section of root, young stem, old stem and leaves material were taken of studying anatomy.

Sections through base middle and apical portion (near lamina base) of petiole were taken for studying petiolar anatomy. Pieces of petiole were fixed in F.A.A. and processed for free hand and microtome sections.

All the sections were stained in safranin and dehydrated following the usual method of Johansen (1940) and mounted in Canada balsam. The details of stem and petiole anatomical character were studied under light microscope (Getner). Some quantitative characters such as in case of petiole, petiole length, cross-sectional area of petiole, distance from vascular bundle to adaxial and abaxial surfaces, number of pith bundles, number of vascular bundles in wings were studied and analysed for the patterns of variability.

For studying vessels, wood samples from thick woody branches (of 5-7cm in diameter) in case of woody and thickest portion of stem in herbaceous species were collected from plants. First the dried material of wood from stem was cut into small longitudinal pieces. The pieces were further cut into small thin slices or slivers and proceeded for maceration by (Jeffrey's Method: In plant Microtechnique by Johansen, 1940, P.104) using a mixture of equal parts of 2% aqueous nitric acid and 5% aqueous chromic acid. The softening time for wood varied according to material but in general, material was put into macerating mixture for about 24-72 hours. Softened material crushed very gently with the use of thick glass rod with rounded end. If material did not crumble easily then macerating mixture was replaced with fresh fluid and process was continued separated elements thoroughly washed with water to remove the acid and stained with aqueous safranin (1%). Vessel elements were selected, dehydrated and mounted in glycerin. Observations have been confined to the late metaxylem elements. All measurements were taken by ocular lens scale for their size 15-20 vessels members of each type from root and stem were studied for their size.

**Observations:****Macromorphology: (Plate no.111)**

Herbs, erect, annuals; young parts pubescent, at length glabrescent. Leaves 5.3- 8.9 cm long; leaflet opposite , 2-4 pairs with a stalked gland (c 3.5 mm long) between each pair , 2.5-4.5 × 1.8 - 2.2 cm , obovate - oblong, base cuneate, apex rounded , apiculate. Flowers 3-4 in axillary racemes. Pods subcompressed, thickened on both the sutures, beaked with persistent style and stigma . Seeds upto10, subquadrangular, rhomboidal , smooth, dull brown.

Fls. & Frts. : August - November.

Distib. : In waste places throughout the region.

**Micromorphology:****T. S. of Root ( Plate No.112):**

Cork cambium superficial, 2 to 3 layered. Cortex narrow, cell slight thick walled and divide tangentially, with scattered patches of stone cells; few solitary rhombohedral crystal and pigmented cells (fig.2). Endodermis and pericycle indistinct. Secondary cambium produced normally. Secondary growth normal. Secondary phloem with paired and solitary sphaero crystals (fig.4). Cambium 4-5 layered. Rays uniseriate or biseriate . Vessels solitary, paired, some in radially multiple of 3 to 5, circular, oval, flattened with circular outline (fig.6). Paratracheal parenchyma produced around vessels (fig.5). Stele polyarch, pith absent (fig.3).

**Root vessels ( Plate No.113):**

Vessels circular and slight narrow (fig.1, 2 and 6) predominantly longer than broad, at one or both ends. Perforation plates commonly 2 per vessels, simple present on almost transverse or slight inclined end walls circular in shape as broad as end walls (fig.2), terminations. Predominantly tapering and few horizontal, without or with ling narrow ligule at one or both ends (fig.2 and 5). Occasionally short vessels with perforation on lateral wall noticed (fig.2,3 and 4). Sculpturing pattern on lateral wall. Pitting, pits simple mostly uniformly crowded, rounded elliptic in outline, slightly vary in size, small to medium sized arrangement alternate or irregular in many rows (fig.5).

Vessels measurement :

Class	Length x Breadth
Extremely small ( class A ) :	104 – 170 x 16 - 20 $\mu$ m.

**T. S. of stem:****primary growth ( Plate No.114):**

Young stem pentangular with five ridges and five furrows (fig.1). Epidermis typically 1- layered, cells barrel shaped, uneven, smaller and roundish over ribs, outer walls flat and inner walls somewhat roundish, cuticle thin. Cortex-outer collenchymatous 4 to 5 layered forming hypodermis with pigmented cells (fig.3), cells polygonal, oval or rounded thin walled, enclosing small intercellular spaces. Endodermis distinct, single layered with solitary rhombohedral crystals (fig.4). Pericycle homogenous , parenchymatous, cell small, thin walled, irregular 3 to 4 layered (fig.2).

Vasculature present in the form of discrete conjoint, collateral and open bundles alternating with conjunctive tissue. Vascular cambium continuous in 3 to 4 layers (fig.2). Xylem inner to cambium in closed cylinder, traversed by narrow rays. Primary phloem outer to cambium contains solitary and paired sphaero crystals (fig.5). Pith wide, homogenous, cells parenchymatous, thin walled clear, pentagonal, hexagonal and polygonal with sphaero crystals, enclosing few small intercellular spaces at meeting corner of walls, cells adjoining xylem small, compact (fig.6).

**Secondary growth ( Plate No. 115) :**

Cells of cortex divide tangentially to keep pace with growing girth. Cortex cells with pigmented cells at few places (fig.2). Endodermis single layered with rhombohedral crystals. Pericycle sclerenchymatous (fig.3). Simultaneously pericycle divides to form cambium at few places that produces parenchyma cells to inner side. Secondary growth normal. Later stage vasculature forms complete ring over the entire circumference. Phloem thin walled with sphaero crystals (fig.4). Cambium 4-5 layered. Rays uniseriate (fig.5). Secondary formed vessel predominantly solitary and few paired, circular with angular outline, primary formed vessels predominantly in radial multiple of 3 to 7, circular flattened, pentangular with angular outline. Pith parenchymatous, cells thin walled, oval to rounded, enclosing small intercellular spaces with sphaero crystals and starch grains (fig.6).

**Wood vessels ( Plate No.116) :**

Vessels cylindrical to quadrangular (fig.2 and 5), predominantly longer than broad at one or both ends, perforation plates-commonly 2-per vessels simple present on almost transverse or slight inclined end walls,

mostly squarish and few circular in shape as broad as end walls (fig.1 and 6), terminations horizontal without or with short ligule at one or both ends (fig.1 and 3). Occasionally short vessels with perforation on lateral walls noticed (fig.1).

Sculpturing pattern on lateral walls pitting, pits simple evenly crowded, elliptic in outline, slightly vary in size, medium in size; arrangement alternate in many rows (fig.5).

Vessels measurement :

Class	Length x Breadth
Extremely small ( class A ) :	123 – 172 x 29– 24 $\mu\text{m}$ .
Very short ( class B ) :	184-188 x 28- 44 $\mu\text{m}$ .
Moderately short ( class C ) :	252 x 22 $\mu\text{m}$ .

#### **T. S. of Petiole ( Plate No.117) :**

Trans-sectional outline flattened on the both sides (fig.1). Epidermis 1- layered, cells roundish to squarish slight horizontally elongated or barrel shaped, outer and inner wall roundish, cuticle thick. Hypodermis, continuous collenchymatous, 1-2 layered, cells hexagonal. Ground tissue parenchymatous, more or less compact, thin walled enclosing small intercellular spaces, cell polygonal to rectangular, irregular with starch grains and sphaero crystals (fig.6).

Vasculature in the form conjoint, collateral and open bundles of central rounded shape and laterally closed two large bundles (fig.1). Vasculature surrounded by single layered thin walled cells with starch grain. Perivascular sclerenchyma cells forming cap on each bundles. Vessels angular flattened hexagonal with angular outline, predominantly arranged in radial multiple in 7 to 8 some solitary (fig.3). Phloem with small cells, slight thick walled (fig.5). Thick walled cells present in the centre of petiole (fig.3).

#### **T. S. of Rachis ( Plate No.118) :**

Transectional outline flattened towards adaxially and angular towards abaxial (fig.1). Epidermis single layered, cells small, oval to rounded outer and inner wall rounded, cuticle thick. Hypodermis distinct, continuous collenchymatous, 1 to 2 layered. Ground tissue parenchymatous cells thin walled, irregular, uneven, enclosing small intercellular spaces. Rhombohedral crystals seen along the boundary of parenchymatous layered cells (fig.3). Vasculature in the form of discrete, conjoint, collateral and open bundles arranged in ring and two larger bundles towards wings (fig.1). Perivascular sclerenchyma forming semicircular cap on each bundles (fig.2). Vessels circular, flattened to oval with angular outline arranged predominantly in radial multiple of 3 to 9 (fig.5). Ray uniseriate with starch grain. Phloem slightly thick walled with sphaero crystals. At the center thin walled oval to circular parenchymatous cells present enclosing small intercellular spaces with sphaero crystals (fig.6).

#### **T. S. of Leaflet ( Plate No.119):**

Lamina amphistomatous, dorsiventral. Epidermis cutinized and cuticularised, cells sinuous situation prominent in adaxial epidermis. Adaxial epidermal cells rectangular, outer wall flattened and inner wall rounded few cells larger in distantly placed. Abaxial epidermal cells squarish and rectangular, outer wall rounded, flattened and inner wall rounded. Stomata paracytic.

Mesophyll differentiate into palisade and spongy parenchyma into palisade and spongy parenchyma. Palisade single layered, densely filled with chloroplast, cells columnar, somewhat compactly placed. Spongy parenchyma 3 to 4 layered; cells irregular, loosely placed with large intercellular space filled with chloroplast. Vein bundles embedded in spongy parenchyma, bundle sheath parenchymatous., Stomata forming large substomatal chambers.

Midrib:- Ridge on upper side, Epidermis cutinized and cuticularised, adaxial epidermal cells rectangular outer wall flattened and inner wall rounded. Abaxial epidermal cells comparatively smaller, cells rounded and squarish, outer and inner wall rounded or flattened. Collenchymatous hypodermis on lower side forming 2 to 3 layered. Palisade continue on upper side, cells are smaller and compactly placed. Ground tissue parenchymatous, cells thin walled irregular, enclosing very small intercellular spaces.

Vasculature in the form of central "C" shaped crescent. Vessels radially multiple in 5 to 6, polygonal or oval separated by thin walled cells. Phloem cells thin walled. Bundle sheath parenchymatous.

Margin:- Palisade continue towards margin. Epidermal cells of margin comparatively smaller. Vein bundle present in margin.

#### **Conclusion:**

The present work found as significant contribution towards the anatomical study of this plants. Regarding the root anatomy cortex parenchymatous with scattered patches of stone cells and pigmented cells were observed. Secondary phloem with patches of stone cells and paired and solitary sphaero crystals. Xylem shows a biseriate rays.

Vessels in root mainly have simple pits, uniformly crowded, simple ligulate, scattered, some solitary, few in groups.

Young stem pentangular. Outer cortex shows pigmented cells. In secondary growth of stem observed a narrow cortex with pigmented Cells. Phloem shows narrow zones with pigmented stone cells and rhombohedral crystals.

Secondarily formed vessels were predominantly solitary, paired and few in groups, perforation plates simple, lateral walls with simple circular pits. Pith parenchymatous with sphaero crystals.

In petiolar anatomy vascular strands are single medullated, completely closed cylinder. Ground tissue parenchymatous with starch grains and sphaero crystals. In rachis vasculature arranged in ring. Parenchymatous ground tissue with rhombohedral crystals. Sphaero crystals found in phloem. Midrib of leaflet with palisade layer found on adaxial side.

Hence to conclude the present anatomical study *Cassia uniflora* have their own specific characters which are uncommon to the plant of the same genus.

**Plate No. 111**



Habit : *Cassia uniflora* Mill.

Plate No. 112

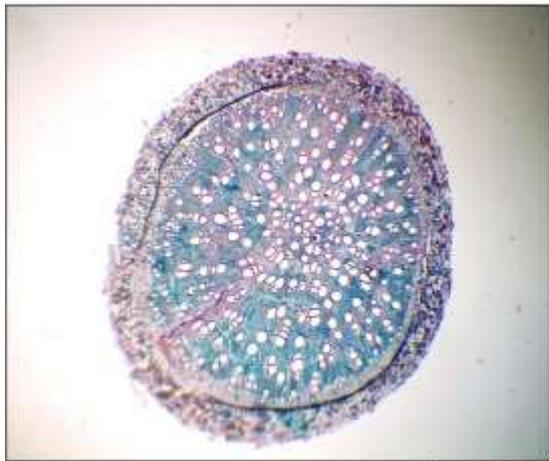


Fig. 1 Entire View  
25302.320  $\mu\text{m}^2$

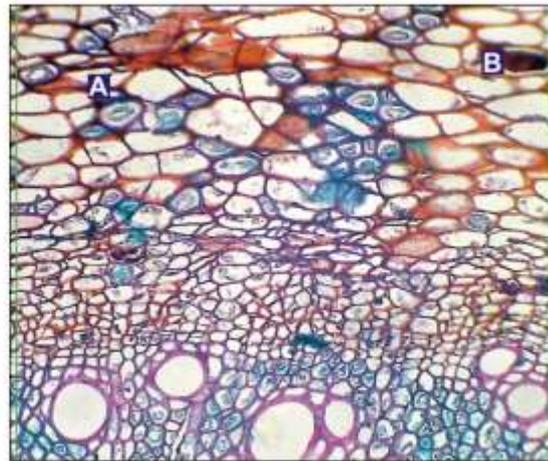


Fig. 2 Cross View  
A - Stone Cells, B - Pigmented Cells  
30817.240  $\mu\text{m}^2$

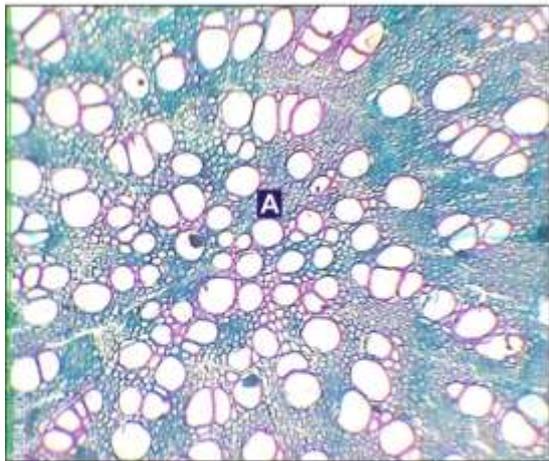


Fig. 3 A-Polyarch Stele  
16594.960  $\mu\text{m}^2$

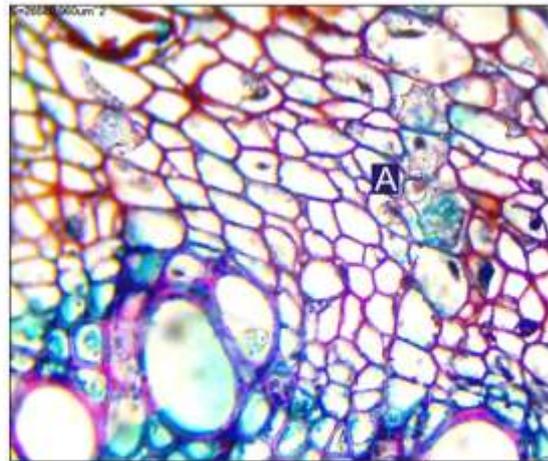


Fig. 4 Phloem  
A - Sphaero Crystals  
26580.960  $\mu\text{m}^2$

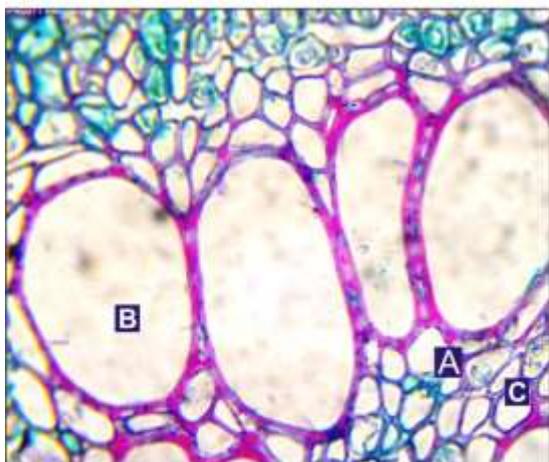


Fig. 5 Xylem  
A- Vessels B - paratracheal parenchyma  
C - Starch grain  
40371.840  $\mu\text{m}^2$

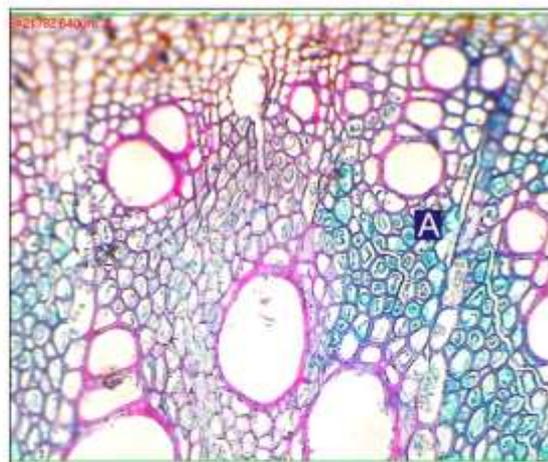


Fig. 6 A - Uniseriate medullary rays  
21782.640  $\mu\text{m}^2$

Root : *Cassia uniflora* Mill.

Plate No.113



Fig. 1 : 164 x 28  $\mu$ m  
Extremely small vessel



Fig. 2 : 170 x 20  $\mu$ m  
Extremely small vessel



Fig. 3 : 104 x 16  $\mu$ m  
Extremely small vessel with  
lateral perforation plate



Fig. 4 : 142 x 26  $\mu$ m  
Vessel with 3 perforation plate



Fig. 5 : 148 x 28  $\mu$ m  
Extremely small ligulate vessel  
with quadrangular perporation plate



Fig. 6 : 162 x 16  $\mu$ m  
Extremely small vessel

Root vessels : *Cassia uniflora* Mill.

Plate No. 114

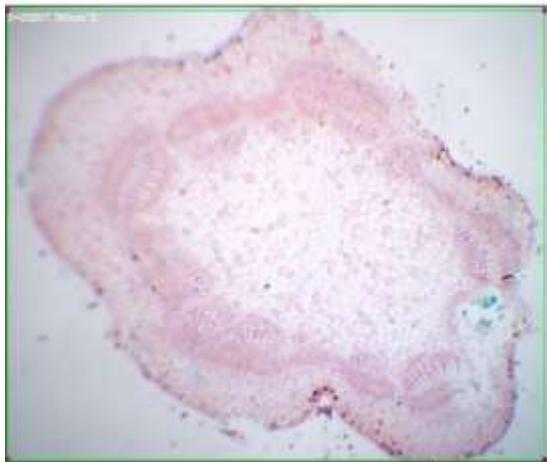


Fig. 1 Entire view  
29207.760  $\mu\text{m}^2$

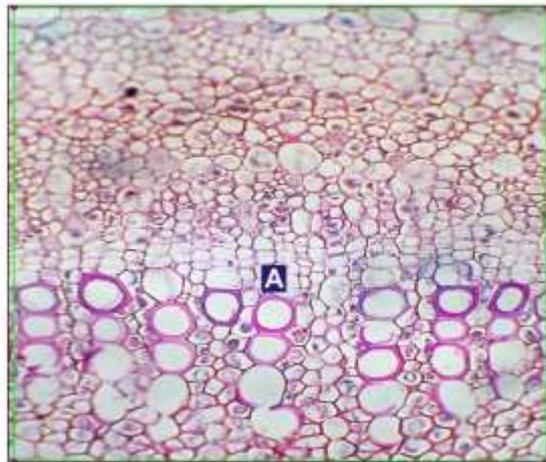


Fig. 2 Vascular bundle showing  
A : vessle in radial multiple  
27810.680  $\mu\text{m}^2$

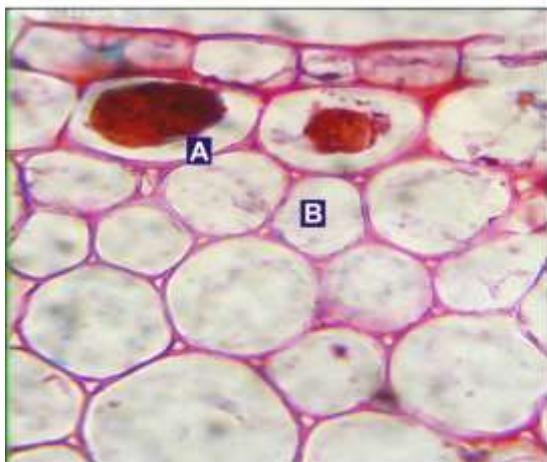


Fig. 3 Cortex  
A - Pigmented cell, B - Collenchyma  
29630.440  $\mu\text{m}^2$

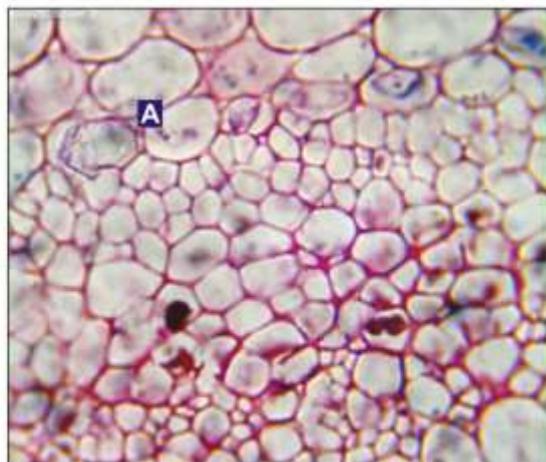


Fig. 4 Single layer endodermis  
A : Rhombohedral crystal  
29565.120  $\mu\text{m}^2$

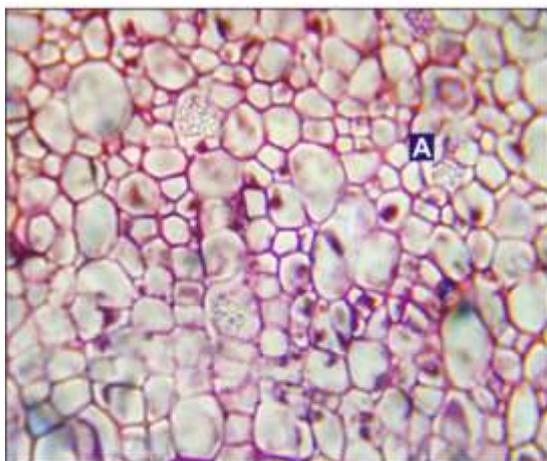


Fig. 5 Phloem  
A : Solitary & paired sphaero crystal  
31170.240  $\mu\text{m}^2$

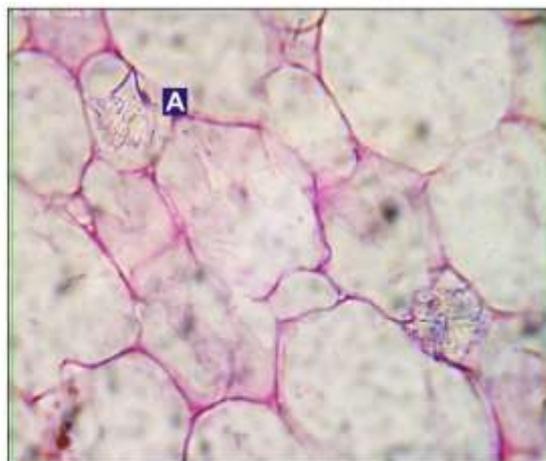


Fig. 6 Pith cell  
A : Sphaero crystal  
15508.400  $\mu\text{m}^2$

Primary growth of stem : *Cassia uniflora* Mill.

Plate No. 115



Fig. 1  
Entire view  
413446.560  $\mu\text{m}^2$



Fig. 2  
Cross view  
A - Pericycle  
38214.960  $\mu\text{m}^2$

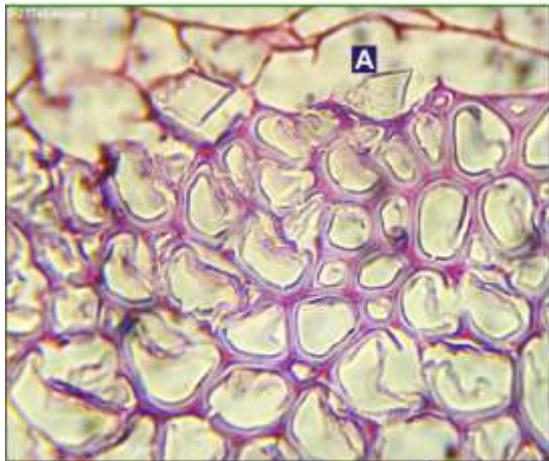


Fig. 3  
Endodermis  
A : Rhombohedral crystal  
27748.480  $\mu\text{m}^2$

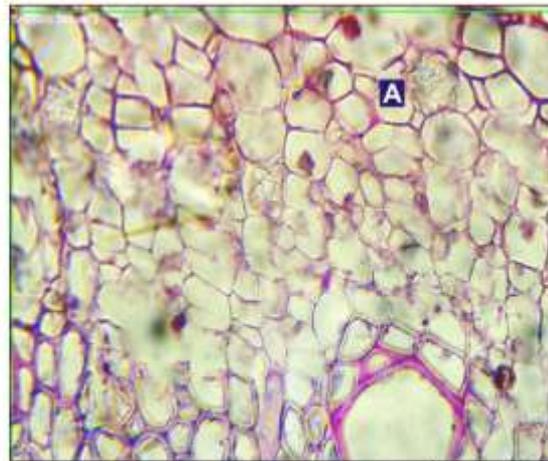


Fig. 4  
Phloem  
A : Sphaero crystal  
27888.280  $\mu\text{m}^2$

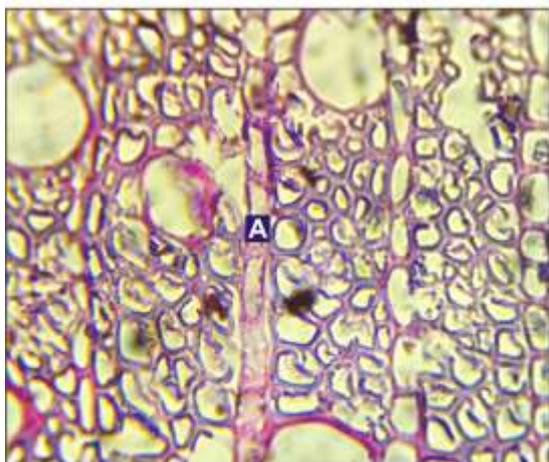


Fig. 5  
A : Uniseriate rays  
35834.240  $\mu\text{m}^2$

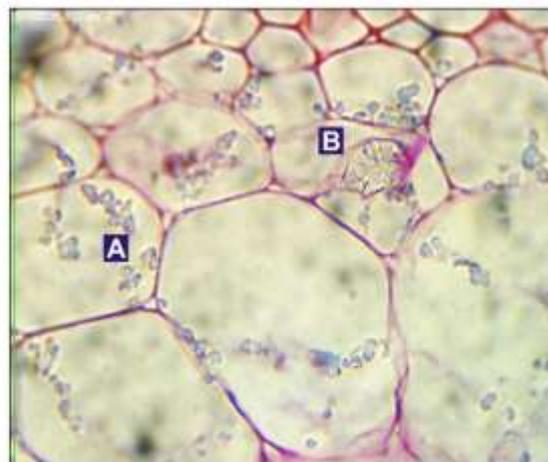


Fig. 6  
Pith cells  
A : Starch grain B : sphaerocrystals  
32236.800  $\mu\text{m}^2$

Secondary growth of stem : *Cassia uniflora* Mill.

Plate No. 116



Fig. 1 : 123 x 29  $\mu\text{m}$   
extremely short vessels with  
circular perforation plate



Fig. 2 : 144 x 32  $\mu\text{m}$  extremely short  
vessel with lateral perforation plate



Fig. 3 172 x 24  $\mu\text{m}$   
extremely small vessel



Fig. 4 184 x 44  $\mu\text{m}$   
very short vessel with circular plate

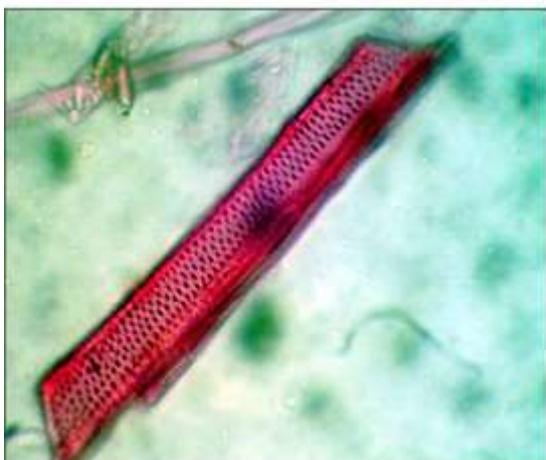


Fig. 5 188 x 28  $\mu\text{m}$   
very short vessel

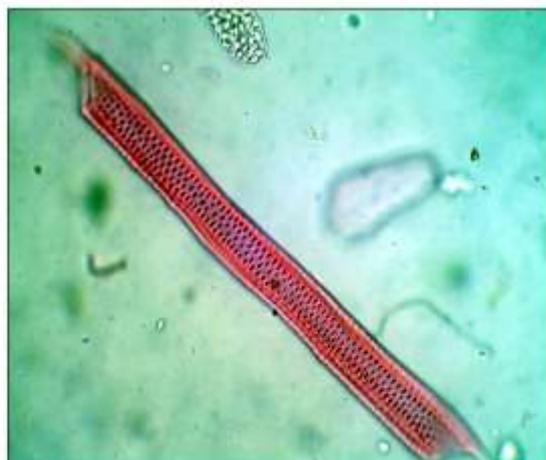


Fig. 6 252 x 22  $\mu\text{m}$   
moderately short vessel

Wood Vessels : *Cassia uniflora* Mill.

Plate No. 117



Fig. 1 Entire View 26758.40  $\mu\text{m}^2$

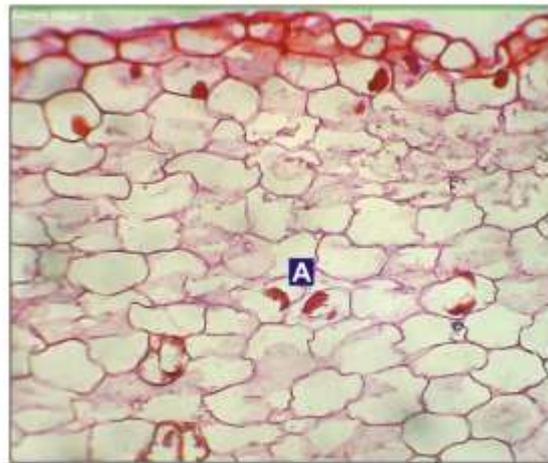


Fig. 2 : Ground tissue  
A : Pigmented cells 40365.000  $\mu\text{m}^2$

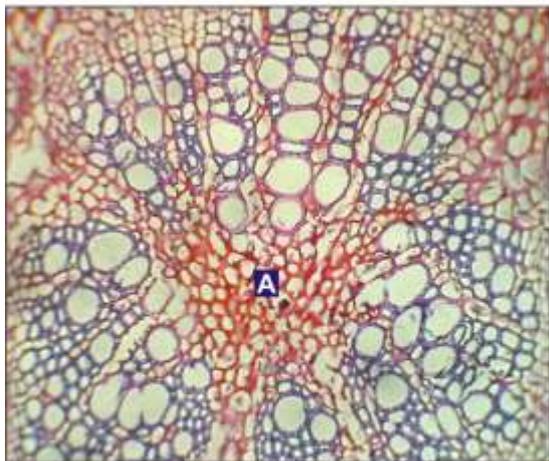


Fig. 3 Central portion of vasculature  
A : Thick wall cell 42858.800  $\mu\text{m}^2$

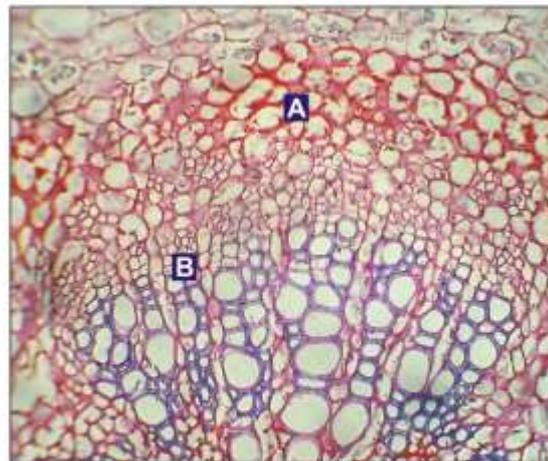


Fig. 4 Cross view of vascular bundles  
A : Perivascular sclerenchyma B : Cambium 41991.360  $\mu\text{m}^2$

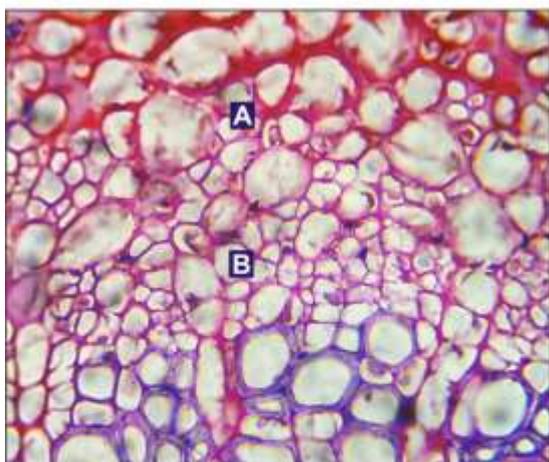


Fig. 5 A-Phloem, B - cambium 42052.320  $\mu\text{m}^2$

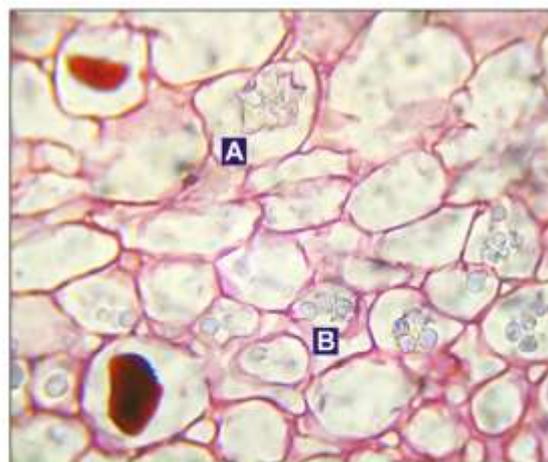


Fig. 6 Ground tissue  
A: Sphaero crystal, B : starch grain 48140.640  $\mu\text{m}^2$

Petiole : *Cassia uniflora* Mill.

Plate No. 118

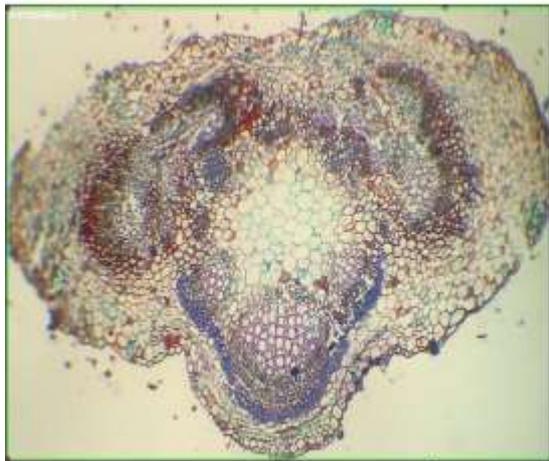


Fig. 1 Entire View 41209.480  $\mu\text{m}^2$

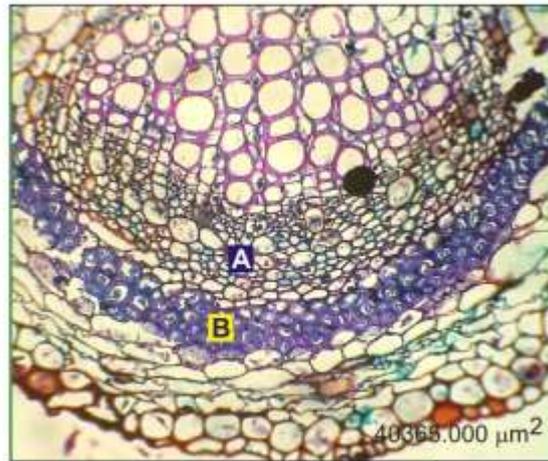


Fig. 2 : 40365.000  $\mu\text{m}^2$   
Cross view of vascular bundles  
A: Thick walled Phloem,  
B : Perivascular Sclerenchyma

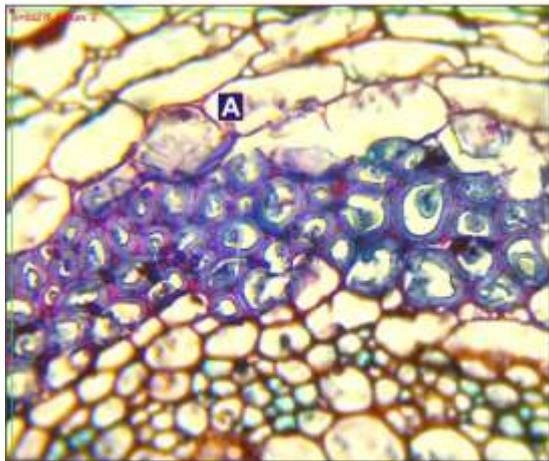


Fig. 3 33275.840  $\mu\text{m}^2$   
Parenchymatous cells  
A : Rhombohedral crystals

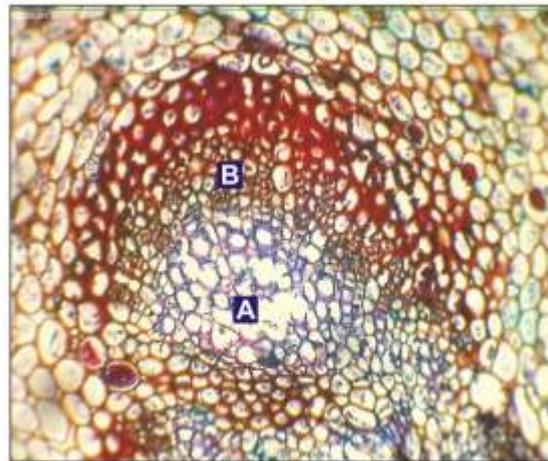


Fig. 4 46156.320  $\mu\text{m}^2$   
Wing vascular bundle  
A - Xylem, B- Phloem

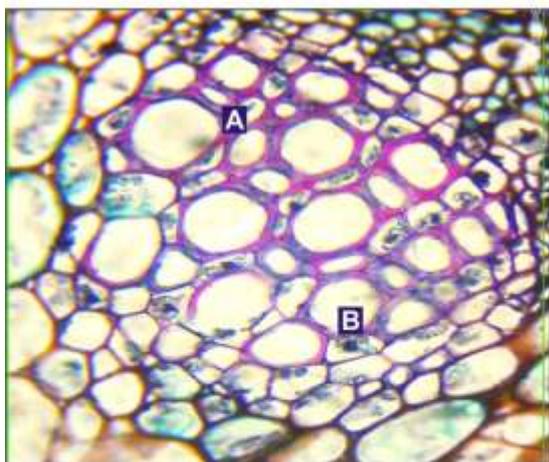


Fig. 5 32030.760  $\mu\text{m}^2$   
A- Vessel, B- Starch grains

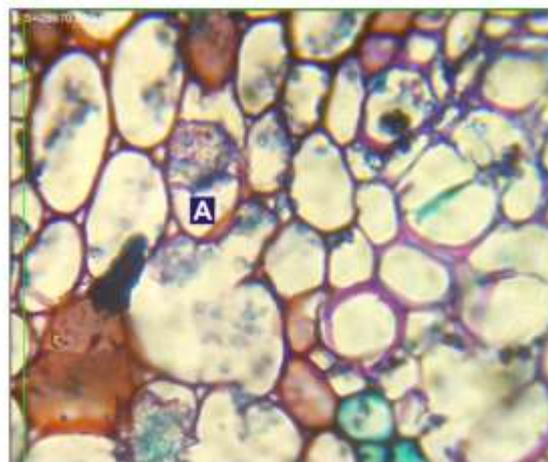


Fig. 6 Pith cells 28870.840  $\mu\text{m}^2$   
A : Sphaero crystals

Rachies : *Cassia uniflora* Mill.

Plate No. 119

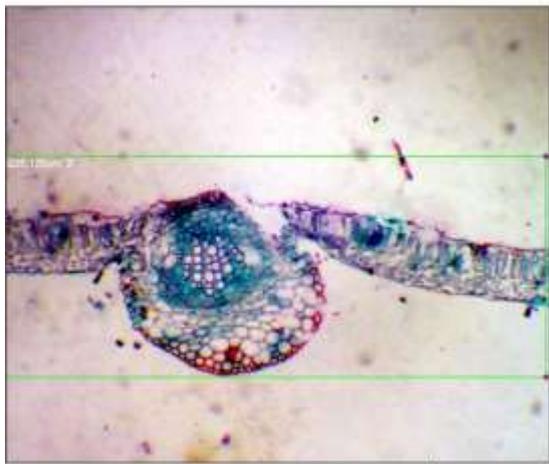


Fig. 1 Entire View  
155225.120  $\mu\text{m}^2$

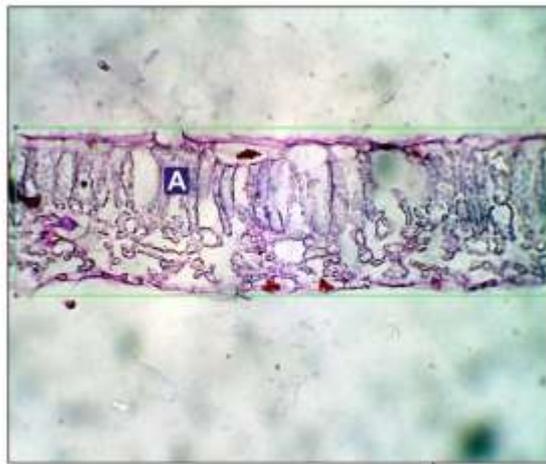


Fig. 2 Lamina  
A - Palisade  
17396.720  $\mu\text{m}^2$

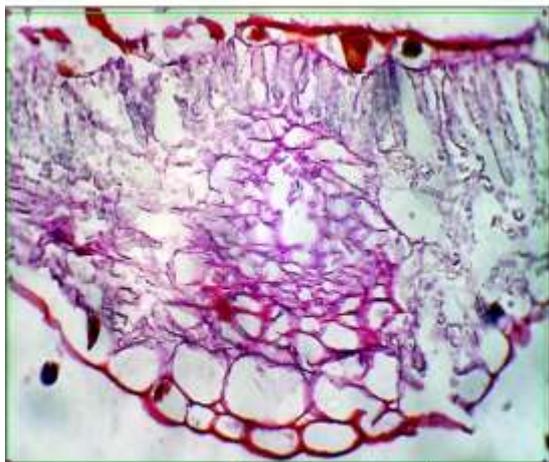


Fig. 3 Vein bundle  
30380.000  $\mu\text{m}^2$



Fig. 4 Mid rib  
A - Vessels, B- Phloem  
50883.360  $\mu\text{m}^2$

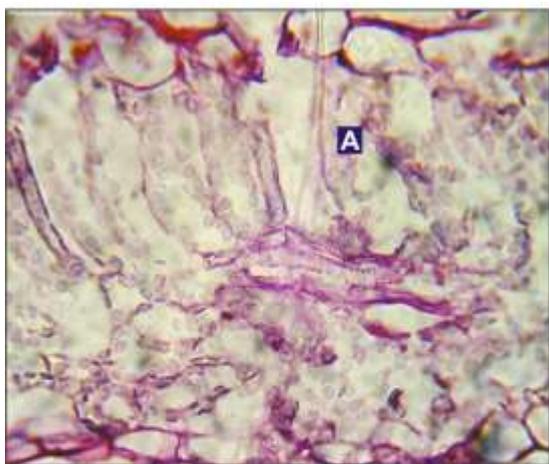


Fig. 5 Lamina A - Stomata,  
B- Substomatal chambers  
48904.800  $\mu\text{m}^2$

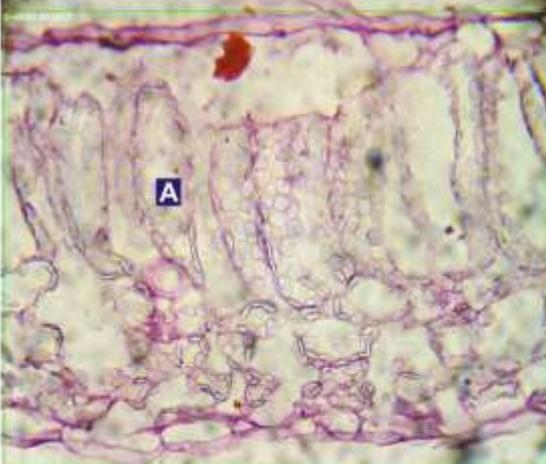


Fig. 6 Single layered  
A: Palisade with densely filled chloroplast  
48361.280  $\mu\text{m}^2$

Leaf : *Cassia uniflora* Mill.

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