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Structural Analysis of Root and Wood Vessels in *Cassia fistula* L. and *C. siamea* Lamk.

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Abstract: *In this present study structure of the root and wood vessels of Cassia fistula L. and C. siamea Lamk. Studied in detailed. This shows secondarily formed root vessels are predominantly circular broader, solitary and few in groups with simple perforation plates, lateral walls with simple circular spits. Wood Vessels cylindrical to triangular, 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, triangular and circular in shape as broad as end walls termination horizontal and tapering without or with short ligule at one or both ends. The present investigations found as significant contribution regarding detailed anatomical information about root and wood vessels can help the systematics and also taxonomists for interpreting phylogeny and relationship of the taxa.*

Keywords: *Cassia*, Vessels, Root, Wood, Perforation plates, Sculpturing pattern, Pitting, Taxonomy, Phylogeny

I. INTRODUCTION

The genus *Cassia* ranks among the 25 largest genera of the dicotyledonous plants (lrwin and Turner, 1960). It is commonly found in the tropical and sub-tropical regions of the world comprising trees, shrubs, vines and herbs. In West Africa, it contains about 22 species aside from the introduced of cultivated ones (Hutchison and Dalziel , 1958). Irwin and Barneby (1981) subjected the genus into some nomenclatural and taxonomic changes that eventually led to the splitting of the genus into smaller genera viz: *Cassia, Senna* and *Chamaecrista.* Irwin and Barneby (1981) premise their work on the argument that while *Cassia* sens. lat. is clearly an isolated group, the differences between the three groups within it are as large or even larger than those which delimit some genera elsewhere in the Leguminosae. However, Lock (1988) observed that series of problems have arisen because of the name changes consequent upon the work of Irwin and Barneby (1982). This is because many workers especially on the African flora would probably prefer to continue to use *Cassia* in its broad sense and this would within reason be acceptable if there was no overlap between floras of Africa and South America.

Anatomical characters including vessels element, wood anatomy etc. Baranova (1992) states, “Numerous unsolved taxomic problems have caused systematists to go beyond the methods of herbarium taxonomists and begin to use laboratory disciplines. Anatomical data can be employed either for practical purpose such as identification, group making etc. or for studying phylogenetic trends and degree of relationship. Bailey (1951) has written a wonderful paper justifying the use and abuse of anatomical data in classification and phylogeny. Swamy and Bailey as back as (1949) said that, “before attempting to arrange surviving Angiosperm in phylogenetic series, it is essential to obtain reliable evidence regarding salient trends of evolutionary specialization in the various organs and internal structures of these plants”. Quite a good amount of data is available about wood structure of economically important species. The concentration on wood anatomy was to such an extent that Metcalfe (1954) commented, “this is a weakness since its treats of this as though it were (i.e. wood anatomy) a subjected apart from the rest of anatomy”.

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II. MATERIAL AND METHODS

For studying vessels, dried pieces of old root and stem were selected for maceration and observations of vessel elements. First the dried materials of root and stem were cut into small longitudinal pieces. The pieces were further cut inot small thin slices or sliver and proceeded for maceration by (Jefferys 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 glycerine or Canada balsam. Measurements were made by occular lens scale for their size. 15-20 vessel members of each type from root and stem were studied for their size. For comparison vessel elements were grouped as per the classification given by Radford et al. (1974), as follows.

Classification:
Class A – Extremely small- less than 175 µm.
Class B – Very short – 175-250 µm.
Class C – Moderately short- 251-350 µm.
Class D – Medium size – 351-800 µm.
Class E – Moderately long – 801-1100 µm.
Class F – Very long- 1101-1900 µm.
Class G – Extremely long – Over than 1900 µm.

Observations:
***Cassia fistula* L.**
Root vessels -

Vessels circular (fig.1) and broader, 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, predominantly circular in shape as broad as end walls (fig. 1 and 2), terminations horizontal, without ligule at both ends. Occasionally short vessels with perforation on lateral wall noticed (fig.5). Sculpturing pattern on lateral walls. Pitting, pits simple mostly uniformly crowded, elliptic in outline, slightly vary in size medium to large; arrangement alternate in many rows (fig.6).

Vessels measurement -

Class	Length x Breadth
Extremely small (Class A)	56 -101 × 22- 36 µm.
Very short (Class B)	178 × 78 µm.

Wood vessels -

Vessels cylindrical to triangular (fig.1 and 3), 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, triangular and circular in shape as broad as end walls (fig.1 and 5), termination horizontal and tapering without or with short ligule at one or both ends. Occasionally short vessels with perforation on lateral wall noticed.

Sculpturing pattern on lateral walls pitting, pit simple, uniformly crowded, elliptic in outline, vary in size small to medium sized, arrangement alternate or irregular in many rows. (fig. no. 2 and 3)

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Vessels measurement -

Class	Length x Breadth
Extremely small (Class A)	106-162 × 26-62

Fig. 1 : 56 x 28 µm
Extremely small vessel with circular perforation plate

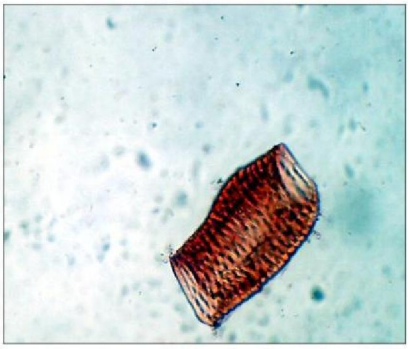

Fig. 2 : 60 x 36 µm
Extremely small vessel

Fig. 3 : 61 x 22 µm
Extremely small vessel

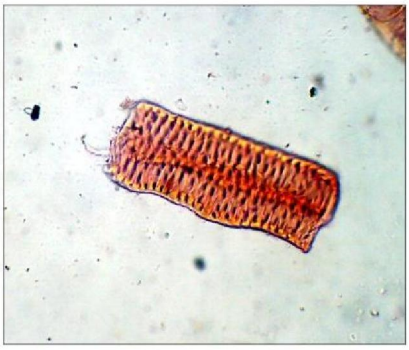

Fig. 4 : 70 x 28 µm
Extremely small vessel

Fig. 5 : 101x 22 µm
Extremely small vessel with lateral perforation plate

Fig. 6 : 178 x 78 µm
Short vessel with circular perforation plate

T. S. of Root vessels : *Cassia fistula* L.

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Plate No. 39

Fig. 1 : 106 x 48 µm
Extremely small vessel with short ligule and circular perforation plate

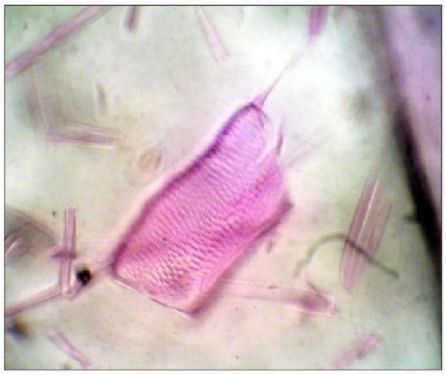

Fig. 2 : 130 x 58 µm
Extremely small vessel

Fig. 3 132 x 62 µm
Extremely small vessel with circular perforation plate

Fig. 4 135 x 26 µm
Extremely small vessel

Fig. 5 144 x 38 µm
Extremely small vessel with ligule

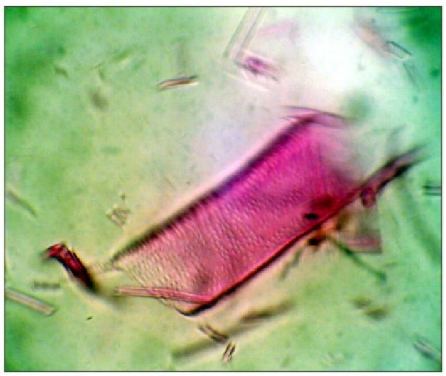

Fig. 6 162 x 46 µm
Extremely small vessel

Wood Vessels : *Cassia fistula* L.

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***Cassia siamea* Lamk.**

Root vessels -

Vessels circular to quadrangular (fig. 3 and 4), predominantly longer than broad at one or both ends. Perforation plates commonly 2-per vessels; frequently 3-per vessel, simple, present on almost transverse or slight inclined end walls, circular and squarish in shape (fig.3), as broad as end walls, terminations tapering and horizontal, without or with ligule at one or both ends. Occasionally short vessels with perforation on lateral wall noticed (fig.5 and 6).

Sculpturing pattern on lateral walls pitting, pits simple, mostly uniformly crowded, eliptic in outline, slightly vary in size, small to medium sized, arrangement alternate or, irregular in many rows (fig. 1 and 5).

Vessels measurement -

Class	**Length x Breadth**
Extremely small (class A)	48 × 18 – 130 × 56 µm.

Wood vessels -

Vessels squarish (fig.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, squarish in shape as broad as end walls (fig.2 and 4), termination horizontal and tapering, without or with short ligule at one or both ends. Occasionally short vessels with perforation on lateral wall noticed (fig.2, 3 and 5).

Sculpuruing pattern on lateral wall pitting, pits simple, uniformly crowded, eliptic in outline, vary in size, small to medium sized, arrangement alternate or in many rows (fig.5).

Vessels measurement -

Class	**Length x Breadth**
Extremely small (Class A)	35 × 19 – 140 × 38 µm

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Plate No. 80

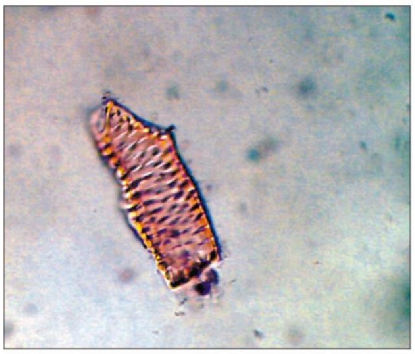

Fig. 1 : 48 x 18 µm
Extremely short vessel

Fig. 2 : 102 x 22 µm
Vessels with 3 perforation plate

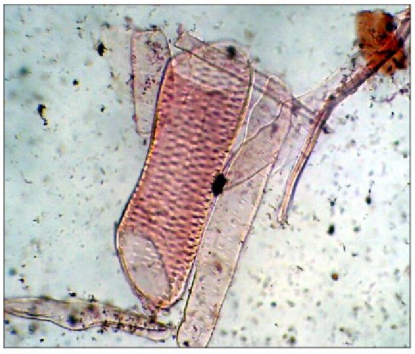

Fig. 3 : 108 x 28 µm
Vessel with quadrangular perforation plate

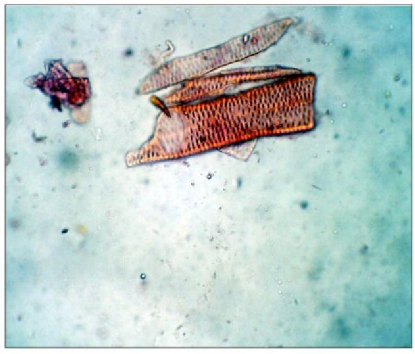

Fig. 4 : 118 x 28 µm
Short ligulate vessel

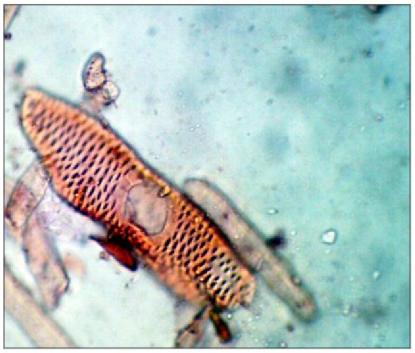

Fig. 5 : 120 x 32 µm
Vessels show lateral perforation plate

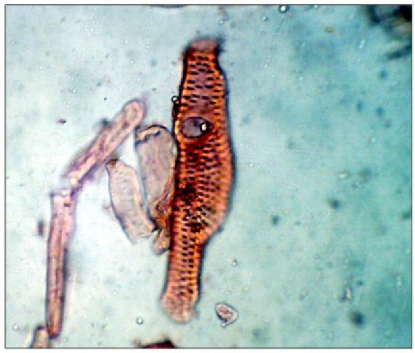

Fig. 6 : 112 x 36 µm
Vessel with lateral perforation plate

Root vessels : *Cassia siamea* Lamk.

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Plate No. 83

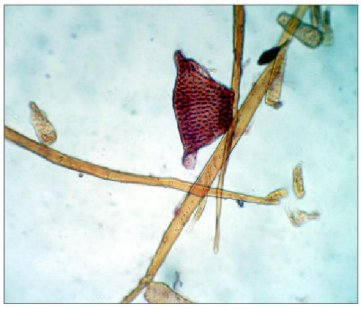

Fig. 1 : 82 x 40 µm
Extremely small vessel

Fig. 2 : 112 x 36 µm
Extremely small vessel with lateral perforation plate

Fig. 3 128 x 26 µm
Extremely small ligulate vessels

Fig. 4 : 130 x 42 µm
Extremely small vessels with quadrangular perforation plates

Fig. 5 : 132 x 24 µm
Extremely small vessels with circular perforation plate

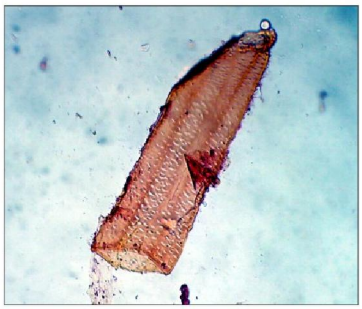

Fig. 6 : 140 x 38 µm
Extremely small vessels with quadrangular perforation plates

Wood Vessels : *Cassia siamea* Lamk.

III. RESULT AND DISCUSSION

No comparative data is available about the root vessels whenever phylogeny of conducting elements is considered it is in relation to the stem. The shortest and broadest vessel elements being most advanced. During the course of evolution vessel elements have become shorter and broader Bailey and Tupper (1918); Cheadle (1943). Vessels mainly have simple pits, uniformly crowded, simple, ligulate, scattered, some solitary, few in groups. Radial multiple in 3 to 8 in, *C. fistula and C. siamea* mostly 2-perforation plates are noticed. Lateral perforation plates observed in selected members. Concerning with shape cylindrical and quadrangular vessels is more common. According to length and breadth vessels fall in 4 classes A, B, C and D as given by Radford (1974), in *C. fistula* medium size and broadest vessels are occurs.

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Secondarily formed wood vessels are predominantly solitary, paired and few in groups. Perforation plates simples, lateral walls with simple circular pits. Various characters of vessels are observed in selected species of *Cassia* considering with length and breadth of vessels shape, pattern of lateral wall thickening, perforation on lateral wall, nature of pittings and perforation plates. Vessels belonging to Radfords class *C. fistula and C. siamea,* falls in class A only. *C. fistula* shows broad vessels as compared to all members. All members studied presently possess ligulate vessels.

IV. CONCLUSION

Root vessels have never been studied from phylogenetic point of view. However, present studies indicate that root vessels element characteristics not shows considerable constancy within the genus. Secondarily formed vessels are predominantly solitary and few in groups with simple perforation plates, lateral walls with simple circular pits, various characters of vessels are observed in selecting members considering with length and breadth . All members possess ligulate vessels.

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