The leaf architecture and its taxanomic significance in some species of *cassia*

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Abstract

The paper deals with the leaf architecture of 11 Species belonging to genera Cassia of the family Caesalpiniaceae. Leaves are pinnately compound, univeined. The venation pattern is pinnate, semicaraspedodromous. Areoles predominantely perfectly developed and variable in a size and shaped and by all categories of major and minor veins. Highest vein order is seen up to 7^0*, vein ending whether simple or branched may or may not terminate in terminal tracheides. The qualitative and quantitative features are charted. Incomplete marginal ultimate venation is observed in majority of the species studied where as in others. Marginal looped vein is present.*

Keywords*: - Leaf architecture, venation pattern, semicraspedodromous, cassia.*

Introduction:-

The Fabaceae or Leguminosae commonly known as the legume, pea or bean family are a large and economically important family of flowering plants. It includes trees, shrubs and herbaceous plant perennials or annuals, which is easily recognized by their fruits. The group is widely distributed and is the third largest land plant family. *Cassia* Linn. is one of the largest genus among the five largest genus of Leguminosae family. It comprised of about 500 to 600 species (Airy-shaw, 1973). Monumental work on this genus was carried out by Bentham (1971) and Bentham and Hooker (1976).

Leaf is perhaps anatomically the most varied organ of angiosperms and it's anatomically variations often concure closely with generic and specific occasionally familian lines (carlquist 1961). Various parts leaf like epidermis, veins, mesophyll pattern, crystals, trichomes etc. have been studied continuously by various workers. Leaves are highly polymorphic organs and provide sets of diverse features.The present study deals with the leaf architecture from different taxa of genus *Cassia* Linn.

Therefore the present work is undertaken to give comprehensive account of the venation pattern and leaf architecture in 11 species of *Cassia*. The venation pattern in the genus is also not attempted before and thus data produce here is for the first time.

Material and Methods:-

Material of 11 species (see table no.-1) for the present investigation was collected from different localities around the Amravati districts and fixed in FAA. Leaves were cleared by treating them with 5% aqueous sodium hydroxide which was repeatedly replaced by fresh solution until leaf material got cleared, followed by treatment with 2% acetic acid, after washing thoroughly with distilled water. The lamina in case of small leaves or portion of lamina in case of large leaves after washing with distilled water stained with aqueous safranin and mountedin glycerine or dehydrated. Major venation patterns were studied under lens both dissecting and compound microscope. For minor venation pattern and details of leaf architecture, compound microscope observations were made. Terminology of Hickey (1973, 1979) is followed for describing leaf architecture. Whole lamina photographs were taken with the help or coslab (scope image 9.0) digital pc- microscope camera focused through the eye piece.

Observation:-

Leaves are basically compound and alternate and opposite leaf shape may be ovate to obovate. Lamina is symmetrical, base slightly asymmetrical. The apex is acute to obtuse or mucronate and the base is acute, obtuse or rounded. (see in table no. 1) The margin is entire in all cases. The texture is membranaceous. The venation is pinnate where a single primary vein serves as origin for the higher order venation. The first, second and third degree veins are considered as major and the higher order veins, the minor venation patterns.

Major venation pattern:-

The venation pattern conforms to pinnate semicraspedodromous type in all species. The venation is clearly differentiated into size classes due to their relative thickness and pattern of distribution. The primary vein or midrib is thickest vein of the leaf and its thickness decrease gradually towards apex and it gives off other degree veins on either side. In all cases, a single strand enters the base of the lamina from the petiole and forms the primary vein which after its depature from petiole it traverse straight and short distance branches laterally.
Major veins are generally jacketed by parenchymatous sheath called ‘Bundle sheath’ (fig.no-11). The thickness of the sheath may vary. The primary vein mostly stout occasionally massive or moderate.
The next smaller size class of veins are secondary veins (2^0 veins). The secondary’s have their origin on either side of the primary vein an alternate manner (fig no-1,4). The number of secondary veins on either side of the primary vein is not constant and vary from species. Similarly the angle of the divergence - acute moderate and nearly uniform of secondaries on the primary vein from base to apex. In *C. uniflora* the angle of divergence is acute moderate to wide only lowest pair of secondary veins more acute than pairs above it. In *C. auriculata* and *C.occidentalis* upper secondary veins more obtuse than lower secondary veins. In *C. javanica* the angle of divergence is acute wide, upper secondary veins more acute than lower. The course of secondary vein is curved uniformly in *C. surattensis, C. occidentalis , C. uniflora, C. absus, C. fistula, C. siamea, C. auriculata*; straight uniformly in *C. tora, C. obtusifolia* ; slightly curved in *C. alata* ; straight at lower secondary vein and slightly curved at upper secondary veis in *C. javanica*. Intersecondary veins are observed in all cases except in *C. uniflora*. Composite intersecondary veins are observed in *C. tor a, C. obtusifolia, C. fistula, C. absus, C. javanica, C. alata* and simple intersecondary veins are absent in all cases. Loop forming branches are joining super adjacent secondary at an acute angle in all cases except *C. uniflora* it is at obtuse angle.

The tertiaries which have their origin mostly from the secondary veins are markedly thinner than secondaries. The tertiary veins arise from the secondaries having no definite patterns of angle of origin predominant tertiary vein angles of origin on exmedial and admedial sides are RR/RR in most of species (given in table no.2) AO/RR in *C. fistula*, RA/RR in *C. absus*, AO/AR in *C. uniflora*, AR/RR in *C.surattensis*. The pattern is random reticulate in all cases except in *C. fistula* and *C. javanica* is orthogonal reticulate (Hickey 1973). The precurrent tertiaries form the opposite secondaries joining are present in all cases. Their course is simple and forked in *C. auriculata, C. absus, C. occidentails*, only froked in *C. siamea, C. fistula, C. uniflora, C. javanica, C. alata , C. surattensis,* straight in *C. for a* and sinous in *C.obtusifolia*.

The relation to midvein is at right angle and oblique in most of species longitudinal (approximately parallel) in *C. siamea* and *C. tora*. Pre dominantly the arrangement is alternate in all species.

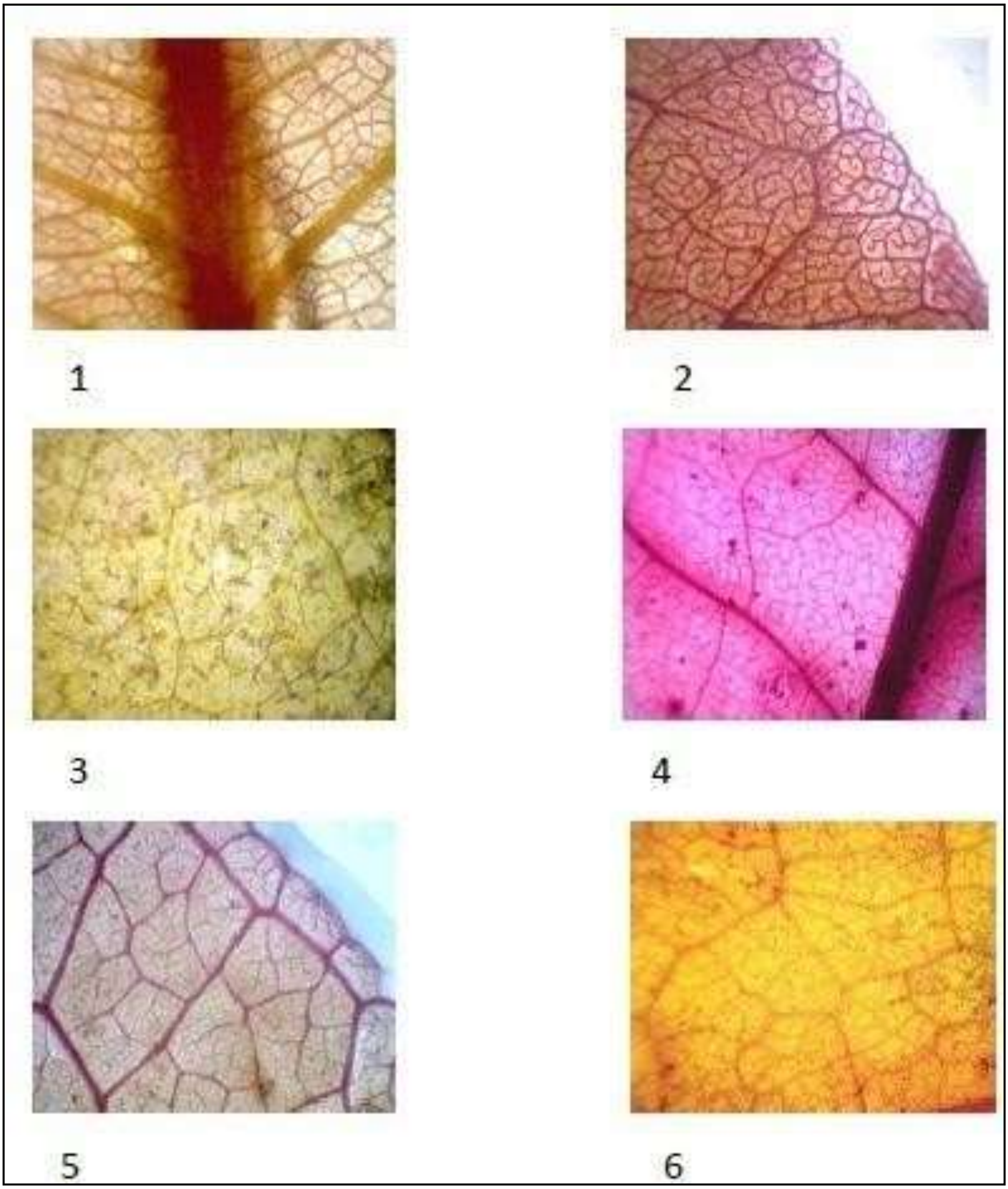

Plate No.01: Fig.01 *C. fistula* midrib; Fig.02 *C. javanica* margin; Fig.03 *C. obtusifolia*. Areoles and vein endings; Fig.04 *C. occidentalis* Midrib and areoles; Fig.05 *C. siamea* Looped margin; Fig.06 *C. surattensis* veinlets

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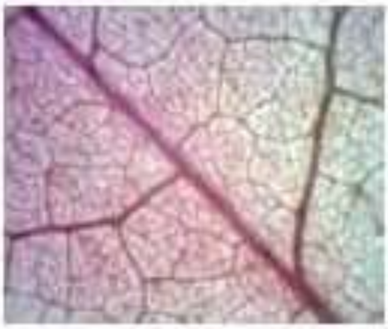

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Plate No.02: Fig.07 *C. tora* midrib and areoles; Fig.08 *C. tora* margin; Fig.09 *C. absus* areoles and vein endings; Fig.10 *C. uniflora* vein ending; Fig.11 *C. alata*

midrib and areoles; Fig.12 *C. auriculata* areoles;
Fig.13 *C. fistula* midrib and areoles

Table No. 01

Sr. no.	Name of the Species	Locality	Leaf/ Leaflet				
			Shape	Size	Apex	Base	Margin
1	*C. absus*	Along road sides of Chatri Talav lakes in Amravati.	Elliptic-obovate	2-4.5 x 1.3-2.5cm	Mucronate	ObtuseOr subacute	Entire
2	*C. tora*	Diff. habitats around Amravati.	Obovate	2.5-6x1.3-3cm	Obtuse	Acute	Entire
3	*C. obtusifolia*	Diff. habitats around Amravati	Ovate-oblong	2.5x1.6-3.1cm	Obtuse	Acute	Entire
4	*C. uniflora*	Along road side in Amravati.	Obovate – lanceolate to oblanceolate	5.8-6.3x3.6-4cm	Mucronate	Obtuse	Entire
5	*C.occidentalis*	Diff. localities around Amravati	Ovate to oblong-lanceolate	2.5-4.5x1.5-3.5cm	Attenuate	Obtuse	Entire
6	C.auriculata	Along road sides of Asegaon to Paratwada	Oblong-obvate	1.5-2.5x0.7-1.5cm	Mucronate	Rounded	Entire
7	*C. alata*	Near Wadali garden Amravati	Oblong-obovate	3.8-8.1x2.2-6.2cm	Emagrinate-obtuse	Obtuse-acute	Entire
8	*C. Surrattensis*	Near school of scholars Benoda branch Amravati	Ovate-oblong or obovate	1.5-6.5x1.2-3.0cm	Acute	Rounded	Entire
9	*C.javanica*	Main gate on right side of SGBAU Amravati	Elliptic-oblong	3-1x1.5cm	Obtuse	Rounded	Entire
10	*C.siamea*	Along road sides of diff. localities around Amravati	Ovate-oblong	5.2-5.8x2.1-3cm	Mucronate	Rounded	Entire

11	*C.fistula*	SGBAU Amravati	Ovate	5.10x2.7cm	Acute	Cuneate at base	Entire

Minor venation pattern:-

The highest order veins is identified up to 7^0 in *C. javanica* (fig) but in some up to 6^0 and 5^0 in *C. uniflora*, *C. obtusifolia, C.tora, C. siamea*. The qualitative leaf features on the venation pattern are charted in table no.2. Marginal ultimate venation is incomplete in most of the species (fig no.-8) studied except in *C. auriculata, C. siamea, C. alata and C. fistula* where it is looped (fig no.-2,5,13). The areoles are the smallest area of the leaf tissue surrounded by the major veins which taken together form a continuous field over most of the area of the leaf. The areoles are predominantly perfectly developed, imperfect in *C. absus*. The areoles is not constant, varies in different species. It may be triangular, orbicular, polygonal or rectangular. The arrangement of the areoles is either random or oriented. Venation characters show variations in areolesize, number of veinlets entering per areole and the organization of terminal vein endings in different species.

Vein Endings:-

The ultimate veins of the leaf are either simple or branched. Simple vein ending may be liner or curved. The branched ones may be divide dichotomously once or twice and branches may be symmetrical or asymmetrical. Usually a large number of vein ending are present in a big areole. (fig no.-4). In some of the cases where areoles are devoid of vein endings.

Table No. 02

Venation Type		***C.absus***	***C.tora***	***C.obtusifolia***	***C.uniflora***	***C.occidentalis***
I.Primary vein	Size:	Moderate	Moderate	Moderate	Moderate	Stout
	Course:	Straight unbranched	Straight unbranched	Straight unbranc hed	Straight unbranched	Straight unbranched
II.Secondary vein	Angle of divergence	Acute moderate	Acute moderate	Acute moderate	Acute moderate to wide	Acute moderate
	Variation in angle of divergence	Nearly uniform	Nearly uniform	Nearly uniform	Only lowest pair of secondary veins more acute than pairs above it	Upper secondary veins more obtuse than lower
	Relative thickness	Moderate	Moderate	Moderate	Moderate	Moderate

	Course	Curved uniformly	Straight uniformly	Straight uniformly	Curved uniformly	Curved uniformly
	Behaviour of loop forming branched	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an acute Angle	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an obtuse angle	Joining supra adjacent sec. at an acute angle
	Intersec onadary veins	Composite	Composite	Composite	Absent	Simple
III.Tertiary vein	Angle of origin	RR/RR	RR/RR	RR/RR	AO/AR	RR/RR
	Pattern	Random reticulate	Random reticulate	Random reticulate	Random reticulate	Random reticulate
IV. Higher order venation	Resolution	Vein order distinct	Vein order distinct	Vein order distinct	Vein order distinct	Vein order distinct
	Quaternary vein	Normal Orthogonal	Normal Random	Normal Random	Normal Random	Normal Orthogonal
	Highest vein order	6˚	5˚	5˚	5˚	6˚
	Marginal ultimate Veination	Looped	Incomplete	Incomplete	Incomplete	Incomplete
V. Veinlets		Branched once or twice	None or linear,simple or branched once	Branched once or twice	Simple curved branched twice	Simple curved branched twice
VI. Areoles	Development	Imperfect	Perfect	Perfect	Perfect	Perfect

	Arrange ment	Random	Random	Random	Random	Oriented
	Shape	Irregular	Pentagonal to Irregular	Irregular	Polygonal to irregular	Irregular
	Size	Larger	Larger	Medium	Medium	Medium

Venation Type		***C.auricu lata***	***C.alata***	***C.surat tensis***	***C.javani ca***	***C.fistula***	***C.siame a***
I.Primary vein	Size:	Moderate	Massive	Stout	Moderate	Massive	Moderate
	Course:	Straight unbranche d	Straight unbranc hed	Straight unbranch ed	Straight unbranche d	Straight unbranc hed	Straight unbranch ed
II.Second ary vein	Angle of divergen ce	Acute moderate	Acute moderate	Acute moderate	Acute wide	Acute moderate	Acute moderate
	Variatio n in angle of divergen ce	Upper secondary veins more obtuse than Lower	Divergen ce angle nearly uniform	Divergenc e angle nearly uniform	Upper secondary veins more acute than lower	Nearly uniform	Nearly uniform
	Relative thicknes s	Moderate	Moderat e	Moderate	Moderate	Moderat e	Moderate
	Course	Curved uniformly	Slightly curved	Curved	Straight, lower sec. veins slightly curved	Curved uniformly	Curved uniformly

	Behaviour of loop forming branches	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an acute Angle	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an acute angle	Joining supra adjacent sec. at an acute angle
	Intersecondary veins	Simple	Composite	Simple	Composite	Composite	Simple
III.Tertiary vein	Angle of origin	RR/RR	RR/RR	AR/RR	RR/RR	AO/RR	RR/RR
	Pattern	Random reticulate	Random reticulate	Random reticulate	Orthogonal reticulate	Orthogonal reticulate	Random reticulate
IV. Higher order venation	Resolution	Vein order distinct	Vein order distinct	Vein order distinct	Vein order distinct	Vein order distinct	Vein order distinct
	Quaternary vein	Normal Random	Normal Random	Normal Random	Normal Orthogonal	Normal Orthogonal	Normal Orthogonal
	Highest vein order	6°	6°	6°	7°	6°	5°
	Marginal ultimate veination	Looped	Looped	Incomplete	Looped	Looped	Looped
V. Veinlets		Branched three or more times	Branched twice or thrice	Branched twice or thrice	Branched twice or thrice	Branched twice or thrice	Branched thrice or more times
VI. Areoles	Development	Perfectly	Perfectly	Perfectly	Perfectly	Perfectly	Perfectly
	Arrangement	Random	Random	Random	Oriented	Oriented	Random
	Shape	Pentagonal irregular	Triangular, Polygonal or Irregular	Irregular	Irregular	Irregular	Pentagon al irregular

	Size	Medium	Larger	Medium	Smaller	Smaller	Larger

Discussion:-

Vein architecture or venation pattern is an important feature of taxonomic important Hickey (1971) and Hickey and Doyle (1972) suggested that brochidodromous venation represent the primitive pattern of angiosperms. Whereas other patterns where veins branch off from the major vein and ramify towards the margin and terminate there represent derived pattern. Leaf venation in angiosperm varies both in pattern (Hickey 1973) and regularity (Hickey and Doyle 1972). According to Pray (1954) the vein of first, second and third order form major venation pattern and those of subsequent orders constitute minor venation patterns. Venation pattern of species of *Cassia* is similar to that of majority as dicotyledons. Here venation pattern is details studied in 11 species conforms to pinnate semicraspedodromous. According to Hickey (1973) leaves of these species are pinnately compound, margin entire, intermarginal vein is absent in all species. Marginal ultimate venation into looped and incomplete. Intersecondary veins are observed as a composite and simple. Angle of origin of tertiary veins are exmedial and admedial is observed different among species.

Reports on the significant variation in the size, shape and number of vein endings entering the areole are contradictory (see Nicely 1965 ; Sehgal and Paliwal 1974). Seghal and Paliwal (1974) , Singh et al. (1976), Jain (1978) and Inamdar and Murthy (1978) concluded that there is no direct relationship between size of an areole and the number of vein endings and vein termination in different species. Paliwal and sehgal (1974) found the size of leaves and areoles to be inversely proportional to some extent. However this correlation stand for the species studied in *C. fistula* and *C. uniflora* areole size is smaller where the leaves are largest. In *C. absus* areole size is largest where the leaves are small. But in *C. javanica* these correlation does not stand areole size is small as well as leaves are also small.

The number of vein endings are in no way connected to the size of the areole, as the nearby areoles even though move or less equal in size, vary in their number of vein endings. Hickey (1973) classified the vein endings into simple and branched. Branched ones divide once twice or thrice dichotomously. Both branched and simple vein endings are observed in different species. Very closely related species show exactly similar pattern upto tertiary venation. The venation pattern appears good taxonomic criteria to established relationships within the genus.

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