MORPHO-ANATOMY OF LEAF, STEM AND ROOT OF *ALTERNANTHERA SESSILIS* (L.) R. BR. EX DC AND *ALTERNANTHERABETTZICKIANA* (REGEL) G. NICHOLSON(AMARANTHACEAE) AND ITS SIGNIFICANCE IN DRUG IDENTIFICATION.

Project submitted

TO

MAHATMA GANDHI UNIVERSITY

In partial fulfillment of the requirements in degree

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Submitted by

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DEPARTMENT OF BOTANY

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THRIKKAKARA

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CERTIFICATE

This is to certify that this project work entitled **Morpho-Anatomy Of Leaf, Stem And Root Of *Alternanthera sessilis* (L.) R. Br. Ex Dc And *Alternantherabettzickiana* (Regel) G. Nicholson(Amaranthaceae) And Its Significance In Drug Identification** is a bonafide piece of project work done by **SNEHA ALIAS(**Reg.no**: 200021023417)** in the Department of Botany, Bharata Mata College, Thrikkakara under my guidance and supervision for the award of Degree of Bachelor of Science in Botany during the academic year 2020-2023. This work has not previously formed the basis for the award at any other similar title of any other university or board.

Place: Thrikkakara

Date :

Head of the Department:

Supervising teacher: Dr. Surya Sukumaran

Signature:

DECLARATION

I hereby declare that this project entitled **Morpho-Anatomy of Leaf, Stem And Root of** ***Alternanthera sessilis*** **(L.) R. Br. ex Dc And** ***Alternanthera bettzickiana*** **(Regel) G. Nicholson (Amaranthaceae) And Its Significance In Drug Identification** is the result of work carried out by me under the guidance of **Dr. Surya Sukumaran** , Department of Botany ,Bharata Mata College, Thrikkakara. This work has not formed on the basis for the award at any other similar title of any other university of board.

Sneha Alias

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ABSTRACT

The current study discusses about the morpho-anatomical traits of leaf, stem and root of *Alternanthera sessilis* and *Alternanthera bettzickiana* and its significance in identification and differentiation of raw drug originated from these species. The plant characters of diagnostic importance are for example of leaf shapes, type of stomata, presence of trichome, colour, number of stamens etc… are observed. *Alternanthera sessilis* has a green stem whereas *Alternanthera bettzickiana* has a brown stem. *Alternanthera sessilis* has three stamens while *Alternanthera bettzickiana* has five. This study offers referential botanical data for accurate plant identification and also helps in advanced studies of those two closely related species.

INTRODUCTION

The study was focused on the function and adaptive value of anatomical features which help to reveal more clearly the homologies of structure for the classification of organisms and the reconstruction of phylogeny.

It should now be clearly recognized and freely admitted that internal or endomorphic characters are inherently no more conservative or reliable than are exomorphic ones. Extensive comparative investigations of a wide range of angiosperms demonstrate that each morphological character tends to be relatively stable in certain groups of plants and highly plastic and variable in others.

The taxonomic value of cytological and genetical studies lies chiefly in the interpretation of species and groups of lower rank. Anatomical structure, on the other hand, is most likely to provide evidence concerning the interrelationships of larger groups such as families, or in helping to establish the real affinities of genera of uncertain taxonomic status of family or genus, thus greatly simplifying the task of the herbarium botanist.

Regarding aesthetic ties between classification and art, the former are still unmistakably a science. The classification is not an experimental science as chemistry, physics, or molecular biology, but it is a science in the sense of description and arrangement of information in an orderly fashion, the development of hypotheses, and the devising of tests to attempt their disproval.

The descriptive information in characters of organisms is gathered, evaluated and arranged in an orderly fashion into a hierarchical classification, which is the hypothesis of relationships suggested by the data as ‘characters and states’. Tests are made by gathering these new data and comparing their anatomical distributions with an already extent datasets of other types.

Morphological features have the advantage of being easily seen, and hence their variability has been much more appreciated than that of other kinds of features.

One special challenge with morphological data involves dealing with phenotypic plasticity. In particular, due to their sessile life style and the modular construction, they have the capacity to produce new copies of organs with different sizes and shapes depending upon the specific environmental stimulus.

The present study is an approach to understand adaptations that use engineering principles to interpret functional relationship of plant structure.

A genus of flowering plants in the Amaranthaceae family is called Alternanthera. The majority of the genus, species are found in the tropical Americas, but there are also members in Asia, Africa, and Australia. In India, the genus is represented by 12 species. Generic names for the plants in this genus include joyweeds and Joseph's coat. Many species are well-known noxious weeds.

A blooming plant called *A. sessilis* is also referred to as sissoo spinach, dwarf copperleaf, Brazilian spinach, sessile joyweed, and mukunuwenna in Sri Lanka. It is grown as a vegetable all over the world. This herb roots frequently at the nodes and has prostrate stems that hardly ever climb. Oval to roughly elliptic leaves that occasionally have linear-lanceolate shapes are seen. The *A. sessilis* is used as a local remedy to treat hepatitis, tight chest, bronchitis, asthma, and other lung problems. It is frequently combined with other medicinal plants.

Calico-plant or *Alternanthera bettzickiana* is a species of flowering plant in the Amaranthaceae family. It is frequently utilised as a decorative edging plant. It is native to South America, and the cultivar 'Red' resembles some *Alternanthera dentata* and *Alternanthera brasiliana* varieties in terms of appearance. Although it is a herb, it can grow up to 1 m tall on occasion. The stem is erect or creeping, heavily branching, with a quadrangular apex and a cylindrical base that is hairy at the apex and nodes. Leaves are variegated.

REVIEW OF LITERATURE

According to (Anitha and Kanimozhi, 2012), studied about the pharmacogenetic features of *Alternanthera sessilis* plant. The study revealed the presence of calcium oxalate crystals in both stem and leaves. Extensively longer uniseriate trichome was observed in powder analysis. Macrosclerids and scalariform thickening were characteristic observation in the stem maceration. The vascular bundle showed inter fascicular cambial ring which is an anomalous secondary growth. The phytochemical studies on aqueous extracts of leaf showed positive result for Phenols, flavonoids, tannins and saponins. This study will help in standardizing and detection of adulterants.

The study conducted by (Gupta *et al.,* 2012) reported that morpho-anatomical characters of leaf, stem and root of *A. sessilis* and *A. pungens* and its significance in identification and differentiation of raw drug originated from these species. The plant characters of diagnostic importance are for example colour of stem is green in *A. sessilis* and brown in *A. pungens*; flower of *A. sessilis* possess three stamens while *A. pungens* possess five stamens. The study will be useful in confirming the authenticity of raw drug and also serve as a reference for Advanced studies of these two such closely related species

According to (Marcia and Maria, 2004) *A. brasiliana* is a Brazilian perennial herb employed as analgesic and ant inflammatory in the traditional medicine. This work has analysed the morpho-anatomy of the leaf and stem, in order to supply knowledge to the medicinal plant identification. The leaves are simple, entire, decussate, oval-lanceolate and purple, presenting uniseriate epidermis, pluricellular non-glandular trichomes coated by papillose cuticle, anomocytic and diacytic stomata on both surfaces; the mesophyll is dorsiventral, with collateral vascular bundles and druses. The Stem, in secondary growth, has the dermal system similar to the leaf; the angular collenchyma alternates with the chlorenchyma.

The study conducted by (Salma *et al.,* 2018)., reported seven species of the genus *Alternanthera* of Amaranthaceae family were analysed through foliar characteristics. The leaf shapes, stomatal Index, type of stomata and foliar trichomes have been studied. Four species *A. philoxeroides,A. tenella* var. *tenella*, *A. paronychioides* and *A. brasiliana* were observed to have trichomes which were elongated and multicellular. The typical stomatal pattern was diacytic through there occur other types like anisocytic in fewer densities. The stomatal index was highest for *A. paronychioides* and least for *A.pungens.* The study gives an insight into the applicability of foliar Traits in the systematic studies of Alternanthera genus.

According to (Rajput and Rao 2000)., reported that secondary growth in *Achyranthes aspera,A. polygamous*, *A. pungens, A. sessilis,* and *A. triandra* was achieved by the development of a cambial variant resulting in successive rings of xylem and phloem. Each new cambium was developed at a distance about two to three cells external to the phloem produced by the previous cambium. The development of phloem was not synchronous in the species studied. Phloem development started either simultaneously with xylem or after the formation of a few xylem derivatives. In *Achyranthes*, xylem production started first followed by the development of phloem. Development of phloem and the ray less nature of the xylem is discussed. The ease with which morphological traits can be observed has led to a greater appreciation of their variability than that of other types of features.

One special challenge with morphological data involves dealing with phenotypic plasticity. In particular, due to their sessile life style and the modular construction, they have the capacity to produce new copies of organs with different sizes and shapes depending upon the specific environmental stimulus.

The present study is an approach to understand adaptations that use engineering principles to interpret functional relationship of plant structure.

Microscopical methods are also often necessary to establish the botanical identity of commercial samples of medicinal plants, timbers, fibres, etc and may play an important part in checking adulteration and substitution. These practical applications alone provide sufficient cause to justify the use of anatomical methods in taxonomic investigations. Finally, it may be pointed out that a complete anatomical survey is necessary as a preliminary to the interpretation of paleo botanical remains (Metcalf and Chalk, 1950).

Vegetative anatomical characters have been used with more regularity than floral ones. It is desirable to solve taxonomic problems. The anatomy of leaf and stem could potentially yield different information from that from reproductive organs.

The most valuable sources for comparative anatomical data about angiosperms are reported by Metcalfe and Chalk (1950, 1983). The useful source of data on leaf structure of tropical trees reported by (Roth, 1984;Hils*et al.*, 1988 and Gornall, 1989) reported that, the detailed anatomical monographs of vegetative (petiole & blade) and reproductive (cotyledons) characteristics in monocots.

The internal architecture of leaf blades, especially vascularization, has also been addressed and resulted in classifications of terms and features such as venation patterns and margin types reported by (Hickey, 1973; Dilcher, 1974; Hickey and Wolfe, 1975 and Melville, 1976).

According to (Metcalfe 1979; Barthlott, 1981; Juniper and Jeffree, 1983; Stace, 1984; Kerstiens, 1996) and Riederer and Muller (2006) reported by the important features of leaves for taxonomic purposes are the epidermis and the cuticle.

The vegetative parts of the plant are of a more modular construction that has repeating units of structure without fixed numbers of parts, in contrast to floral features that are more definite in number. This makes adaptive sense in that the vegetative parts of the plant have many varied functions, such as support, food production, water transport and storage, in contrast to the more narrow (but obviously most important) role of floral features in reproduction. Vegetative features tend to be more plastic and variable and hence, more difficult to use for taxonomic purposes. Despite these problems, many features dealing with leaves, stems, and roots have been used, with most attention being given to leaves. Leaf blades differences in size and shape have been examined extensively in taxonomic studies. Two aspects are of particular importance, the blade outline and the internal architecture reported by White (1990) and Tomlinson (1986).

According to Rejdali (1991) and Bussotti and Grossoni (1997) variations in the epidermal cells also have been used taxonomically to include features of the generalized epidermal cells, the stomata and the trichomes.

SIGNIFICANCE OF THE STUDY

Anatomy is a powerful analytical tool in comparative biology because it provides the most informative and the unambiguous summaries of any set of biological observations represented in a consistent, testable and reproducible framework. Anatomy or the internal form and structure of plant organs, is another classical source of data used in plant taxonomy. Since they frequently suggest homologies of morphological character-states, anatomical data are typically very helpful in solving relationship problems.

OBJECTIVES OF THE STUDY

- To establish a morphological profile (Stereo microscopy) of leaf and stem characters.
- To establish an anatomical profile (Microscopy) on leaf, stem and root characters.

MATERIALS AND METHODS

Habit and leaf morphology

Studies were carried out in species with different habit and leaf characteristics namely the average leaf length, width, petiole length and leaf area. Difference in the habit and leaf morphology were reported (Table-3).

Anatomy of leaf

Study of leaf anatomy of fifteen species was carried out. Thin sections of leaf lamina, midrib and petiole were taken and temporary slides were prepared. They were analyzed by trilocular compound microscope (Model No. 10093409) and imaged using the camera, Olympus E-PL3.

The sections were stained with Toluidine blue O and Phloroglucinol following the method of Brian et al., (1985). Toluidine blue O is a metachromatic stain. The staining results in the lignified tracheary elements becoming dark blue, sclerenchyma cells blue to blue-green, parenchyma to light blue, collenchyma to reddish purple, sieve tubes and companion cells to greenish colour. Callose and starch depositions were seen as unstained. Phloroglucinol staining results lignin becoming reddish in colour.

Anatomy of leaf lamina and midrib

Anatomical studies were conducted using fresh adult leaves, located between the fifth and the sixth nodes and with maximum development of the leaf blade was observed. The hand sections were made at a position approximately half way between the base and the apex of the leaf lamina. All the sections were immersed in water to avoid air bubbles. Epidermal peelings were taken by the direct peel method, mounted in glycerin and observed under the microscope.

Anatomy of petiole

Mature leaves from the true mangrove plants were selected for anatomical studies of the petiole. Sections were taken at the middle of the petiole.

Anatomy of stem and root

The study of primary and secondary anatomical structure of the stem and root was done by collecting the tertiary branches from the mother plant and root respectively. The Transverse Section (TS), Tangential Longitudinal Section (TLS) were observed under a light microscope.

RESULTS AND DISCUSSION

EXTERNAL MORPHOLOGY

Alternanthera sessilis

LEAF: Leaves are green, simple and sessile, and are arranged alternately on stem. The leaves have a pointed apex and a tapered base, and they are oblong or elliptical in shape. The leaf margin is entire, meaning that it is smooth and does not have any teeth or serrations. The leaves are smooth and have a glossy surface. (Fig.1A)

STEM: Stem is green, slender, and cylindrical and it is herbaceous (non-woody) in nature. The stem is erect or prostrate and can grow up to 1 meter in length. Fine hairs that are difficult to see cover the stem.

ROOT: The fibrous root system of *Alternanthera sessilis* consists of several thin roots arising from the main tap root as lateral rootlets. Typically, the roots only reach a superficial depth in the soil. Roots are cylindrical,1-6mm in diameter.

Alternanthera bettzickiana

LEAF: *Alternanthera bettzickiana* typically has simple, whole (i.e., smooth-edged) leaves that are oriented in an opposing pattern on the stem. They are acute or acuminate at the apex, long-attenuate into an imperceptibly delimited petiole. Leaf blades might be red, green, purple, or occasionally tinted with red or yellow or variegated leaves can also be seen on this plant. Petioles can be up to 1-2 cm long, although they can also be extremely small or non-existent. The leaf blade has a dorsiventral structure, which means it has two distinct sides, an upper surface and a lower surface. The lower surface is paler and may be slightly hairy, whereas the upper surface is typically shiny and smooth. The leaf's veins are noticeable and create a network of tiny veins all over it.

STEM: Having distinct nodes and internodes, *Alternanthera bettzickiana's s*tem is a typical dicot stem. The stem develops a leaf or a leaf-bearing structure at each node, such as a flower or a branching point. It has a cylindrical shape and can be green or reddish-brown in colour. It has a thin coating of cuticle covering it, which serves to stop water loss and safeguards the underlying tissues. Along with xylem and phloem, the stem also has a network of vascular tissues. It is possible for adventitious roots to form at the stem's base, which aid in securing the plant in the ground and allowing it to take in water and nutrients from its surroundings. Aside from the main stem, the stem may also produce lateral branches that spread out from it and contribute to the growth of the plant's overall size and shape.

ROOT: *Alternanthera bettzickiana* has a taproot at the centre of its root system, from which lateral roots radiate out.

ANATOMY

Alternanthera sessilis

LEAF: Adaxial epidermal cells are polygonal, while abaxial cells are sinuous with rosette collections of calcium oxalate crystals. On both sides, anomocytic and diacytic stomata are seen(Fig.1D). Diacytic type is present more on the abaxial surface. There are two different forms of trichomes: (a) multicellular, non-glandular, uniseriate trichomes with distinctive interlocking cells, and (b) capitate trichomes with a 3–4 celled stalk and a single, spherical, ellipsoid head. Both varieties of trichomes have an obvious papillose cuticle. The trichome separation regions on the epidermis can be seen. A single layer of top epidermis and a double layer of lower epidermis are visible in a transverse leaf section taken through the midrib and are both surrounded by a thin, smooth cuticle. The dorsiventral mesophyll is made up of four layers of spongy parenchyma and one layer of palisade parenchyma. The palisade parenchyma is dominated by idioblasts with druses. Four to five layers of chlorenchyma underlie the upper and lower epidermis, respectively.(Fig.1C)

Survey of stomata have revealed different patterns that have importance at many levels in the hierarchy, although more at higher levels reported by Stace (1969,1984); Payne (1970, 1979); Baranova (1972); Fryns-Claessens and Van Cotthem (1973); Raju and Rao (1977); Eggli (1984); Inamdar *et al.,* (1986); Yukawa *et al.,* (1992) and Croxdale (2000).

The presence of thick cuticle layer covers the epidermis of stems and leaves of *all taxa* helps better adaptation to adverse moisture limited conditions. The plants with waxy cuticle in the leaves and stems minimize the loss of water under salinity and drought stress conditions reported by Esau (1977) and Fahn and Cutler (1992)

The presence of sclereids in leaves is taxonomically valuable reported by Tucker (1977) and Flores-Cruz *et al.,* (2004). The isolateral (unifacial) leaf anatomy is common in plants growing stress habitat because it tends to minimize heating of leaves and thus reduces transpiration demands. The succulence is another major strategy of halophytes reported by Ehleringer and Forseth (1980).

Transverse cut of the midrib reveals a biconvex form with a conspicuous abaxial face, 3–4 layers of angular collenchyma on the adaxial side, and 4–7 layers on the contralateral side. The ground parenchyma contains collateral vascular bundles and thick-walled parenchymatous cells next to the phloem. Vascular bundles differ in number and arrangement.

STEM: Transverse section of the stem reveals a round form. The epidermis is made up of polygonal cells and is single-layered. On the stem, non-glandular trichomes are present. The cortex is made up of angular collenchyma and 6-7 layers of loosely organised parenchymatous cells with alternate strands of chlorenchyma. The initial cambium develops xylem centripetally and phloem centrifugally in the vascular cylinder. Vascular bundles are grouped in a ring and are conjoint and collateral. Each vascular bundle has a patch of pericyclic fibres covering it. Large parenchymatous cells with a thin wall make up the pith, which is wide. In the cortex and pith, idioblasts that contain druses are present. (Fig.1B)

Endress *et al.,* (2000) reported that the ecophyletic plant anatomy explains many of the structural features of secondary xylem must be of ecological and physiological and adaptive level. The greater availability and higher reliability of molecular phylogenies, helps to examine the trends of evolution in wood anatomical (and other) features and their ecological correlations.

ROOT: Transverse section of the root reveals a circular outline. The cork is made up of 4-5 layers of suberised rectangular cells that are tangentially elongated, followed by 4-5 layers of parenchymatous cortex that are loosely organised. Endodermis and pericycle cannot be distinguished. Phloem is a narrow tissue made up of companion cells, sieve tubes, phloem parenchyma, and phloem fibres. Tracheary components are distributed radially in the xylem. Xylem is exarch and made up of vessels, tracheids, fibres, and xylem parenchyma.(Fig.1E).

Alternanthera bettzickiana

LEAF: In the cross-sectional view, leaf seems thick, with an even surface and a less obvious spindle-shaped midrib. There are thin epidermal layers in the midrib. Small, round, and with thick walls, the epidermal cells. The adaxial and abaxial sides each have 20 µm-thick epidermal layers. In the midrib region, there are two equally developed vascular bundles positioned side by side which are elliptical in form. The vascular bundles are 100 x 160 µm, and the xylem is made up of a large, compact cluster of angular, narrow, thick-walled cells. The phloem elements consist of phloem parenchyma and a semi-circular row of sieve elements. A parenchymatous bundle sheath layer encircles the vascular bundles.(Fig.2B).

STEM: In transverse view, the stem is smooth and even and is circular. Its thickness is 2 mm. The vascular cylinder is 500 m in diameter, the pith is 1 mm wide, and the cortical zone is 150 m thick. The epidermis is made up of rectangular, broad cells with thick cuticle. The outer cortex is made up of three to four layers of collenchyma and around six layers of a wide, spindle-shaped, hollow compact cylinder, which contains an inner cylinder of secondary xylem and an outer thick cylinder of secondary phloem. The vascular cylinder is made up of a number of radially long triangular segments that are laterally joined by small vascular tissue segments. The secondary phloem is made up of slightly larger parenchyma cells and radial, thin lines of tiny, darkly pigmented sieve components. Sclerenchyma cells are seen in thick tangential segments at the distant intervascular area on the periphery part of the phloem cylinder. In particular, the sclerenchyma segments are seen on the outside of the radially extended triangular segments of the vascular cylinder. Single, widely dispersed vessels make up secondary xylem. The vessels are lignified, spherical, with thick walls. The vessels' diameters range from 20 to 40 millimetres. The xylem fibres have polygonal shapes. They feature wide lumens and extremely thick secondary walls that are lignified.(Fig.2A).

ROOT:

Thin root: The thin root has a diameter of 1 mm. It consists of periderm, cortex, and a thick vascular cylinder. The periderm is uniformly thick and composed of six layers. The suberised, rectangular periderm cells have thick walls. They appear in tightly packed radial rows. The cortex, which is three layered and consists of parenchyma, compact, and polygonal cells, is located inside the periderm. A narrow continuous cylinder of meristematic cells was discovered inside the cortex. These cells make up the second ring of the vascular cambium, which develops from the cells of the cortex's inner tissue. The central first formed vascular cylinder consists of the outer zone of secondary phloem and a central dense core of secondary xylem. Small angular sieve components are arranged in narrow radial lines in the secondary phloem. Circular, extremely thick-walled cells with diffuse, long vessels make up the xylem cylinder. The vessels in the root's centre are smaller, while those towards the periphery are from 20 to 50 µm. The xylem fibres are thick-walled, polygonal, and lignified.

Thick root: The diameter of the thick root is 1.2 mm. It has thick periderm, a narrow cortex, and first created vascular cylinders in the centre that are followed by second and third formed vascular cylinders. The epidermis is broken and crushed, and there are five layers of superficial periderm. The periderm cells are tiny, radially arranged, rectangular cells. Larger polygonal parenchyma cells make up the cortex. The root's vascular system displays a peculiar or anomalous type of secondary growth. In the centre, two-fan-shaped collateral xylem and phloem, an outer ring of secondary xylem and secondary phloem, and a third incomplete ring of xylem and phloem surround the first developed secondary xylem and phloem.

DISCUSSION

The study showed few differences and similarities between *A. sessilis* and A. bettzickiana. In *A. sessilis* ,leaves are simple, opposite, elliptic-oblong to oblanceolate, 3–4 x 1 cm with an entire margin and an acute leaf tip. In A. bettzickiana, leaves are simple, opposite, elliptic to oblanceolate or rhomboid-ovate, 1-3–14 x 0.5–5 cm with an entire margin. The leaves are green in *A. sessilis* whereas greenish purple in *A. bettzickiana* ..Petiole is absent in *A. sessilis* and petiolate leaves are seen in *A. bettzickiana*. Both glandular and non- glandular trichomes are absent in both the species. The leaf shape is also found to be characteristic. Acute or acuminate apex is characteristic of A. bettzickiana and the apex is obtuse in *A. sessilis*. Leaf surface is glabrous in *A. sessilis*. In A. bettzickiana, adaxial leaf surface is glabrous and abaxial surface is pubescent.

In *A. sessilis*, stem is prostrate, cylindrical but slightly ridged and branched. In *A. bettzickiana*, stem is erect or creeping, branched ,with the basal part is cylindrical and apical part of the stem is quadrangular.

Parts	*Alternanthera bettzickiana*	*Alternanthera sessilis*
Macroscopic characters		
Stem	Erect or prostrate, cylindrical, branched, solid, green or red	Prostrate, cylindrical but slightly ridged, branched, solid, green
Leaves	Opposite, elliptic or ovate, petiolate ,margin entire , measuring up to 14 cm long and 5 cm broad	Opposite, linear-lanceolate, oblong or ovate, sessile, exstipulate, margin entire, measuring up to 3-4cmlong and 1 cm broad
Flowers	Tepals similar or slightly dissimilar,	Tepals very dissimilar
Androecium	Stamens 5	Stamens 3
Microscopic characters		
Leaf:		
Leaf Apex	Obtuse	Acute or acuminate
Leaf colour	Greenish purple	Green
Stomata	Diacytic or paracytic, more abundant on abaxial surface	Anomocytic and diacytic on both surfaces, although the latter type is predominant on the abaxial surface.Paracytic is also seen.
Trichomes	Non-glandular uniseriate, multicellular with 3-4 cells, and glandular capitate trichomes with a 3-4 celled stalk and a unicellular, spherical or ellipsoid head all coated with a conspicuous papillose cuticle	Non-glandular uniseriate to multicellular trichomes with characteristic interlocking cells, all coated with a conspicuous papillose cuticle, glandular trichomes absent
Epidermis	Uniseriate layer on both surfaces	Uniseriate layer of upper epidermis while biseriate layer on lower epidermis
Midrib	Palisade parenchyma and about 3 layers of spongy parenchyma	Palisade parenchyma single layer and 4 layers of spongy parenchyma
Stem		
Cortex	4-5 layers of thick-walled parenchymatous cells	6-7 layer of loosely arranged, oval to circular parenchymatous cells
Root:		
Cortex	8-10 layers of compactly arranged thin-walled parenchyma in cortex	4-5 layers of compactly arranged parenchyma in cortex region
Vascular bundle	Primary xylem triarch cambium forms a complete ring of xylem surrounded phloem at the centre which results in anomalous secondary growth	Phloem narrows, parenchymatous followed by xylem. Xylem is composed of radially arranged vascular bundle. Xylem exarch, metaxylem vessels meet in the centre.

Habit of *Alternanthera sessilis*

Habit of *Alternanthera bettzickiana*

Fig .1 A: *Alternanthera sessilis:*Adaxial surface view of leaf.

Fig.1B: Transverse Section of Stem

Fig 1C:Transverse Section of leaf

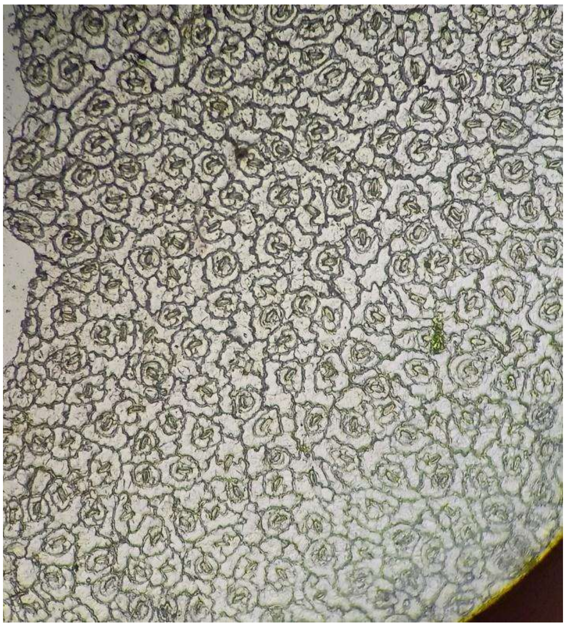

Fig 1D:Anomocytic & Diacytic Stomata

Fig 1E:Transverse Section of root

Fig1F: Tangential longitudinal section of stem

Fig 2A: *Alternanthera bettzickiana*: Transverse Section of stem

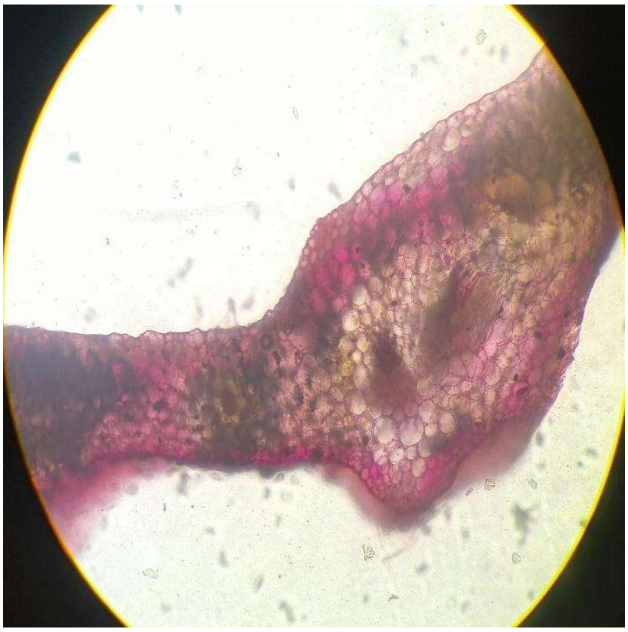

Fig 2B: Transverse Section of Leaf

Fig 2C:Transverse Section of Root

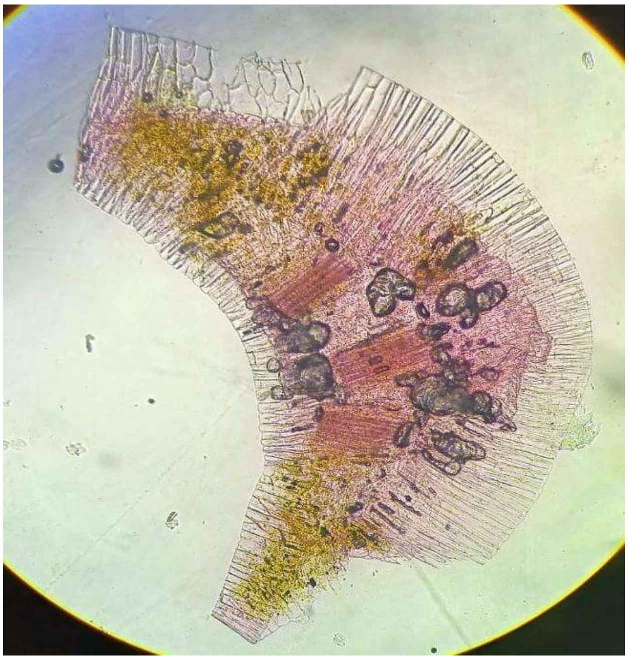

Fig 2D:Transverse Section of Petiole

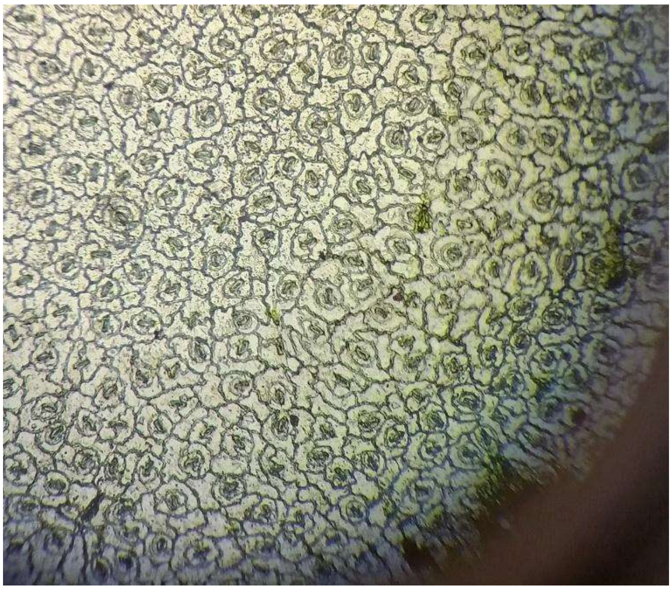

Fig 2E: Paracytic& Diacytic Stomata

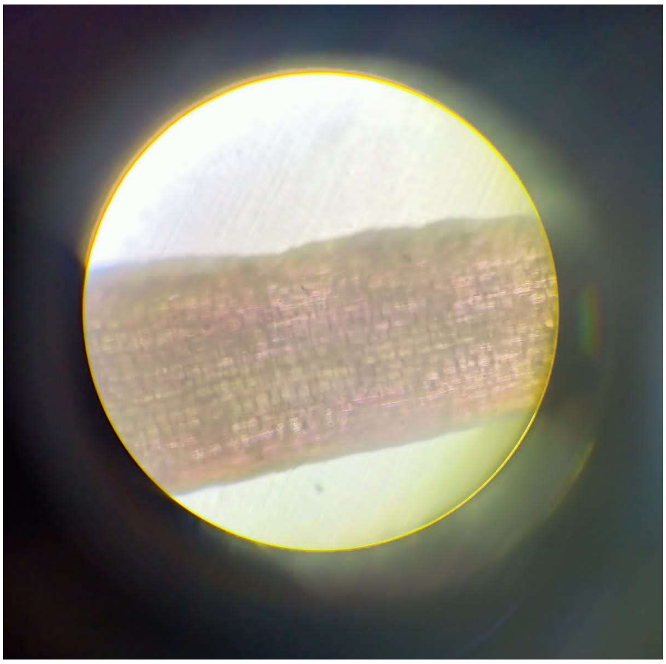

Fig 2F: Tangential Longitudinal Section of stem

CONCLUSION

In conclusion, the study of the morphology and anatomy of *Alternanthera sessilis* and *Alternanthera bettzickiana* has revealed interesting insights into the structural characteristics of these plants. Both species exhibit similar morphological features, such as the presence of opposite leaves, axillary inflorescences, and a taproot system. However, differences in leaf size, shape, and colour can be observed between the two species. The leaves are green in *A. sessilis*, whereas greenish purple in A. bettzickiana.Petiole is absent in *A. sessilis* and petiolate leaves are seen in A. bettzickiana. The stem morphology of the two species also differs in terms of their growth habit, branching pattern, and stem shape. Additionally, anatomical analysis has shown that both species exhibits the presence of bicollateral vascular bundles and undifferentiated pericycle. Diacytic,anomocytic or paracytic stomata is seen in *A. sessilis* whereas diacytic or paracytic stomata is seen in A. bettzickiana.

Overall, the study of the morphology and anatomy of these two *Alternanthera* species provides important information for their taxonomic classification, ecological adaptation, and potential utilization in medicine and agriculture. Further research could investigate the physiological and biochemical characteristics of these plants to gain a deeper understanding of their functional properties and potential applications.

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