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A STUDY OF MORPHOLOGICAL AND ANATOMICAL FEATURES OF ALMANIA NODIFLORA. L (FAMILY: AMARANTHACEAE)

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Abstract - A study of anatomical features of mature leaves, stem and root of *Almania nodiflora* (Family: *Amaranthaceae*) was examined with the microscope. It shows new characters. The internal structures were evaluated to clarify their effectiveness in solving taxonomic complexity and identification difficulty in this genus. In this genus to determine the special types of cells i.e., vascular bundles in root cells and also cortical cells in stem. Observation of transverse section showed that the epidermis is single layered with narrow tangential cells. Ground tissue consists of parenchyma and collenchyma. The vascular bundles are ovate shape and arranged in concentric rings. Also they maybe United, conjoint, collateral vascular bundles occurs. All the leaves are petiolate. Most of the mesophyll cells - the so called "kranz mesophyll cells" - are in direct contact with the bundle sheath but some are "non kranz mesophyll cells"- lack such contact. These plants are C4 plants they can photosynthesize with carbon fixation. Many species in the family have vitamins and pigments also. It is a medicinal plant *A. nodiflora* helps to cure some medicines like heart, eye problems, therapeutic, dietary formulation, cancer treatments. It is a good source of anti-oxidants.

Keywords - *nodiflora*, tangential, anatomical, concentric, kranz.

I. INTRODUCTION:

Systematic position

- ☐ Family: *Amaranthaceae*
- ☐ Cladus: *Amaranthaceae*
- ☐ Sub family: *Amaranthoideae*
- ☐ Genus: *Allmania*

☐ Species: *nodiflora*

☐ Varieties: *A.n.var.aspera-A.n.var.dichotoma-A.n.var.procumbens-A. N. Varroxburghii.*

☐ Varieties: *A.nvar. Angustifolia. A. N. Var. aspera-A. n-var. Dichotoma-A. n .var*

Allmania nodiflora (L.) R. Br. Ex Wight is a dicot member. It belongs to the *Amaranthaceae* family. *Amaranthaceae*, called the *Amaranth* family of flowering plants (order *caryophyllales*) is with about 175 genera and more than 2500 species, mostly herbs and shrubs, which were distributed nearly worldwide. *Amaranthaceae* family also called a *Pigweed* family. Several

Amaranthaceae species are used by humans, some as horticultural plants such as *Amaranthus caudatus*, commonly known as "love-lies-bleeding". The roots, stems, leaves or flowers of many species are red in colour because of the presence of characteristic "betalain" pigment. The coloured vegetative tissues of plants in the family *Amranthaceae* contain various pigments and are often produced in high biomass and therefore attract interest as potential alternatives to the well known betalains from beet roots. These are water soluble vacuole yellow (betaxanthins) and violet (betacyanins) pigments that replace anthocyanins in most plants of the families of the order *caryophyllales*. *Amaranthaceae* species are bisexual (or) monoecious it's means they have both male and female reproductive organs. *Amaranthaceae* is a wide spreadband "cosmopolitan" family from the tropics to cool temperate regions. The *Amaranthaceae* species are predominantly tropical. Many of the species are halophytes, tolerating salty soils, or grow in dry steppes or semi deserts. In India *Amaranth* family is represented by 50 species, found mostly in subtropical and tropical regions (Berghofer & Schoenlechner, 2002). It is distributed some states of India like Andhra Pradesh Assam, Karnataka, Kerala, Odisha and Tamilnadu. *Allmania nodiflora* is an annual herbaceous weed which reproduces

exclusively by seed. It is a common weed on especially sandy soils, sandy shores, fields, road sides (Barobar & Ahmed, 2014), and dunes, deciduous forests. We can find them occasionally at higher elevation of up to 100m. The plants appear in June while flowering time is August-February in agricultural fields and found during August/October/ November in other habitats. *A. nodiflora* has several names in different places and languages. Some of which were listed below Table 1 listed from India (east & south) as per catalogue of life.

Table 1: Local names of *Allmania nodiflora*

S. NO	Local language	Name
1.	Kannada	Kandubuddegida., Hasirubuddesopu;
2.	Malayalam	Pee-Tardavel., Pee- coipa., Vellakakeera;
3.	Tamil	Kumattikkirai., Kiraikkummati
4.	Telugu	Gurugukura;
5.	Others	Node flower allmania

A. nodiflora has some synonyms like *Colossal nodiflora* L., *Chamissoa nodiflora* (L) mart, *Allmania pyramidalis* Koord. Some of the synonyms are *Allmania albino* (Willd), *R. Br. Celosia nodiflora* L., *Chamissoa albida* (Willd) (Pullaiah & Mohammed, 2000). It is aerial, erect growing up to 10- 50 cm height. It is used as a green leafy vegetable, among the food crops as they provide adequate amounts of essential proteins, beta carotenes and carbohydrates for trade plants. It is a source of energy and micronutrients which are essential to health. During their studies on *A. nodiflora*, Rao & Das, 1971 identified that this species exhibits phenotypic plasticity. *Amaranthaceae* family is well known for Kranz anatomy in the leaves of its members i.e., it is a special structure in the leaves of C4 plants where the tissue equivalent to spongy mesophyll cells is clustered in a ring around the leaf veins outside the bundle sheath cells. They have a large no of chloroplasts and have thick walls that are impervious to gaseous exchange. The term Kranz means Wreath or ring in German (Brown, 1973; Drake et al., 2016). As we mentioned about the studies on the *Amaranth* family members especially *A. nodiflora*, morphological studies revealed the following characters. It is erect or obovate, linear or oblong, 1.5 to 6.5 mm long. 0.3 to 2. 5 cm wide carried on 2-10 mm long stalks. Flowers are white or greenish or red. Flower heads are globes, becoming somewhat elongated with 3-7 flowered cymes. Bracts and bracteoles are ovate, lanceolate 3.5 mm white in margin and with green or purple mid vein, apex long acuminate. Tapals obliquely spreading at opening later, erect, ovate and lanceolate. Inflorescence is racemose (i.e., in this type of inflorescence, the flowers branch laterally on the floral axis.

Here the floral axis keeps on growing and the flowers develop in an acropetal pattern) Stamens 5, filaments are connate at the base. Ovary ovoid, glabrous, style nearly as filaments. Flowering season during May – June; Fruits are urticulate, enclosed in persistent perianth, pale green, ovoid 3-3.5mm in diameter opening by lid. *Allmania nodiflora* is functionally hermaphroditic because the central in three flowered in three flowered groups is fertile, while the lateral flowers are sterile. (Jacob Solomon Raju Aluri, Prasada Rao.Chappidi (2018); Seeds are 1. 5-2mm in diameter. For Cultivation it is grown best in light soils and a sunny position. A very variable species, it has in the past been treated as several distinct species but all forms grade into one another and is treated as one. raising on up to 10 to 50 cm tall. Stem is branched, Root is tap root, leaves are obovate, linear or oblong, 1.5 to 6.5 mm long. 0.3 to 2. 5 cm wide carried on 2-10 mm long stalks. Flowers are white or greenish or red. Flower heads are globes, becoming somewhat elongated with 3-7 flowered cymes. Bracts and bracteoles are ovate, lanceolate 3.5 mm white in margin and with green or purple mid vein, apex long acuminate. Tapals obliquely spreading at opening later, erect, ovate and lanceolate. Inflorescence is racemose (i.e., in this type of inflorescence, the flowers branch laterally on the floral axis. Here the floral axis keeps on growing and the flowers develop in an acropetal pattern) Stamens 5, filaments are connate at the base. Ovary ovoid, glabrous, style nearly as filaments. Flowering season during May – June; Fruits are urticulate, enclosed in persistent perianth, pale green, ovoid 3-3.5mm in diameter opening by lid. *Allmania nodiflora* is functionally hermaphroditic because the central in three flowered in three flowered groups is fertile, while the lateral flowers are sterile. (Jacob Solomon Raju Aluri, Prasada Rao.Chappidi (2018); Seeds are 1. 5-2mm in diameter. For Cultivation it is grown best in light soils and a sunny position. A very variable species, it has in the past been treated as several distinct species but all forms grade into one another and is treated as one.



Fig1: *Allmania nodiflora* habit

II. METHODOLOGY

Sample collection: Root, Stem, Petiole and Leaf of *A. nodiflora* were collected from Adikavi Nannaya University campus.

2.2 Other materials required: Blades, watch glass, slides, brush, coverslips, microscope.

2.3 Reagents

Glycerin and Saffranin

2.4 Preparation of reagents

2.4.1 Preparation of glycerine: To make glycerine, start by cutting some animal fat into small cubes and cooking them in water over low heat for 30 minutes. Then increase the heat to medium, and stir the fat every few minutes until it's completely melted. Next, strain the fat, and reheat it over low heat until it reaches 113 degrees Fahrenheit (Thwaites, 1969; Martin & Strauss, 1956)

2.4.2 Preparation of Safranin Add 20 mg Saffranin powder to a 100 ml beaker. Pour 20 ml distilled water in the beaker and make 0.1 % of Saffranin staining solution by constant stirring. Transfer 20 mg of fast green dye in another 100ml beaker. Moreover, make it 0.% staining solution by adding 20ml distilled water in it. Filter both the staining solutions to avoid particles (Shabman, 2009; Rosenberg, 1971; Srebotnik & Messener, 1994). **Materials&Methods** The root, stem, petiole and leaf of *A. nodiflora* plant were taken. The collected plant parts were washed thoroughly under running tap water to remove dirt and were blotted on to a blotting paper to remove moisture. The thin sections of plant material were taken with the help of sharp blade and to them add few drops of glycerine and safranin solution place the slides under the microscope and then observe the internal structures of leaf, stem, root and petiole.

2.5 Staining technique In this staining technique the sections are immediately fixed on a slide. The transverse sections were cut with sharp blade and then these sections were put on a slide and glycerine was added to them. Then these sections were stained with safranin (Sass,1961). On this section a coverslip is placed and observed under the microscope. The microscope was adjusted to 10X. The safranin is a biological stain used in histology and cytology. It is used as counterstain. In some staining protocols, it is used for colouring cell nuclei red. And through this stain the anatomy of the plant parts will be easily visible.

Take Transverse section of root, stem, leaf and petiole of *A. nodiflora* with the help of blade.

III. RESULTS AND DISCUSSION

The morphological and anatomical details of root, stem, leaf and petiole of *A. nodiflora* was observed and studied and the details were given below.

Root .

1 Morphology



Fig 2: Morphology of root

A. nodiflora shows a long, central and dominant root from which lateral roots were grown (Fig 2). Typically a taproot is somewhat straight and very thick, is tapering in shape and grows directly downward which were helpful to absorb the water, nutrients and minerals from the soil and helps in anchoring of the plant. Roots are in light brown colour.

3.1.2 Anatomy of root

The root anatomy of *A. nodiflora* (Fig3) shows epidermis, cortex, ground tissue and vasculature. Epidermis is present. It is single layered. Narrow tangential cells with thin walls. Out line is curved. Cortex is five layered. Intercellular spaces are seen among the cells of the ground tissue. It consists of parenchyma. The cells are polygonal in shape. Vascular cylinder and pericycle is present which is one layered. Pericycle followed by endodermis is seen, it is one layered. Vascular bundles are arranged in concentric rings. Vascular bundles are ovate. Exarch condition is present, it means the development of protoxylem from the outer most edge of procambial cylinder. Development is from outside to inside protoxylem is found outside the metaxylem. Xylem is present from the periphery of xylem the phloem is present. Parenchymatous pith region is seen. Fig 3: T. S of root

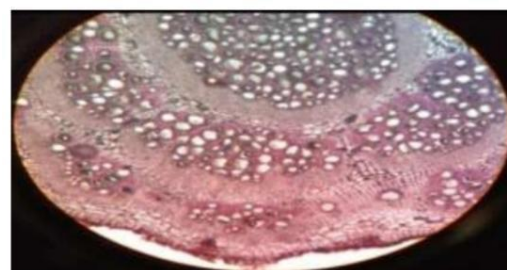


Fig 3: T. S of root

3.2 stem

3.2.1 Morphology of stem

Stem is green and partially red coloured, branched from or near base. In the stem nodes and internodes are present. Aerial, erect, rising and some of the hairs are present on the

stem. Stem is cylindrical and partially weak. Stem is creeping and bend on the earth surface (Fig 4). 2.2



Fig 4: Morphology of stem

Anatomy of stem: The stem anatomy of *A. nodiflora* (Fig 4) shows the epidermis, cortex, ground tissues and vasculature. Epidermis: It is a single layered. Outline is curved showing ridges and furrows. Some of the phloem tissue is present in the ridged portions. Cortex: It is 2-3 layered. Collenchyma tissue is present and is chlorenchymatous. Cortical cells may contain stored carbohydrates or others substances. Such as resins, latex, essential oils and tannins. Endodermis is present. It is one layered. Vascular tissues: 1-8 vascular bundles are seen. These Vascular bundles are conjoint, collateral, open and endarch. The arrangement of the vascular bundles is circular. The shape of the Vascular bundles is ovate. Xylem is present towards the center and phloem is present towards outside. Xylem and phloem are separated by cambium. Sclerenchyma caps the vascular bundles which provide support to the plant. Pith: At the centre of the stem parenchymatous pith region is present.

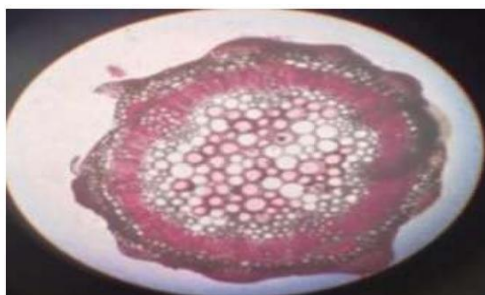


Fig 5: T. S of stem

3.3.1: Morphology of leaf



Fig 6: Morphology of leaf

Leaves are green in colour. This species exhibits phenotypic plasticity especially in the leaf shape which ranges from, obovate, linear, or oblong 0.3 to 2.5 cm wide. Acute leaf, some of the hairs are present on the leaf those hairs are simple. The simple leaves are arranged in this manner when a single lamina is connected to the main stem by a petiole, and the simple leaf may be incised to any depth but not down to the midrib or petiole. Leaf colour varies from green some times to red colour with decreasing salinity this species attains bushy habit bearing broad green leaves.

3.3.2 Anatomy of leaf

The leaf anatomy of *A. nodiflora* (Fig 7) shows the epidermis, mesophyll and vasculature. Leaf in T. S shows crescent shape. Epidermis: It is present and single layered with narrow tangential cells with thin walls and barrel shaped cells. Present on both the upper and lower sides of the leaf. Mesophyll tissue: There are two types of mesophyll tissues are present. These are palisade and spongy tissues. The palisade tissue is present towards the upper region and it is 2 layered. The spongy tissue is present towards the lower and it is 3 layered. Vascular bundles: They are arranged in mesophyll tissue. 3 vascular bundles are seen among the mesophyll tissue. These vascular bundles are oval in shape. Xylem is present towards the center and phloem is present towards the outside. Anomocytic stomata are seen.



Fig7: T. S of leaf

3.4 Petiole

3.4.1 Morphology of petiole

The morphology of *A. nodiflora* petiole is very short and the structure of the petiole is crescent and in green colour (Fig 6).

3.4.2 Anatomy of petiole

The petiole anatomy of *A. nodiflora* (Fig 8) shows the epidermis, cortex and vasculature. Petiole shape in T. S is round. Epidermis: It is present and it is single layered and simple. Cortex: Epidermis is followed by cortex which is 2-3 layered which consists of collenchyma. Two protruberances are seen. These protruberances are seen at the two end sides of the petiole. Collenchyma and parenchyma tissues are seen in these protruberances. Vascular bundles: These are present in the cortex. 3-4 vascular bundles are present. These vascular bundles are ovate. Bundle sheath is also seen around each vascular bundle. Xylem and phloem is present. Xylem is present towards the center and phloem is present towards the outside.



— — — Fig8: T. S of petiole — — — — —

IV. DISCUSSION

A. nodiflora belongs to the family Amaranthaceae. It is a dicot member and it is having several therapeutic and ecological values. In the present study anatomical characters of *A. nodiflora* were studied in detail. The root system is tap root system indicating it is a dicot member. These roots are in light brown colour. These roots are helpful to absorb the nutrients and minerals from the soil. Stems are green and showed herbaceous nature. Exarch condition is seen in the transverse section of *A. nodiflora*. All the transverse sections taken for the study showed a simple epidermis and cortex tissues which were of collenchyma and parenchyma. Collenchyma provides mechanical strength and support to the plant. Collenchyma is composed by elongated living cells of uneven primary thick walls which possess Hemicellulose, cellulose and pectic materials. It provides support, structure, mechanical strength and flexibility to the petiole, leaf veins, and stem of young plants, allowing for easy bending without breakage. Here in our observation collenchyma cells did possess chloroplasts indicating their role not only in providing mechanical support and probably to some extent may participate in any storage activity if

necessary but also involved in photosynthetic activity. Collenchyma cells may or may not contain a few chloroplasts, and may perform photosynthesis and store food (Carrillo-lopez & Elhadi, 2019). Parenchymatous pith is seen in the root and stem transverse sections. Most of the Amaranthaceae species ground tissue is parenchyma and collenchymas (EI-Ghamery et al., 2017). Leaf and petiole showed similar number of vascular bundles (3 Vascular bundles in leaf and 3-4 vascular bundles in petiole. Among the Amaranthaceae species the leaves are petiolate (Abbas et al., 2017) leaf colour varies from green some times to red colour. With decreasing salinity this species attains a bushy habit bearing broad Green leaves (Rao, 1971) most of the Amaranthaceae species have anomocytic stomata (Abbas et al., 2017) anomocytic stomata also seen in the *A. nodiflora* (Dichler, 1974; Rao & Ramayya, 1977; Wilkinson, 1979; Inamdar, 1969 and Timonin, 1986). The lamina studies (Lamina thickness, area of epidermal cells, thickness of epidermal cells, mesophyll types) in Amaranthaceae family those reported by (Gaafer et al., 2015; Alege and Saudi, 2014; Hong et al., 2005; Muhaiva et al., 2007; Bara, 2013). In most of the Amaranthaceae species protruberances are seen (EI-Ghamery et al., 2017), which were also seen in *A. nodiflora* petiole also. The resulted characters from the petiole study of *A. nodiflora* of Amaranthaceae family were suitable to those reported by Fisher & Evert (1982). Among the Amaranthaceae species sand crystals (Stem), druses (Lamina), Kranz (Lamina) are seen (Abbas et al., 2017).

V. CONCLUSION

In this study the anatomical features of *A. nodiflora* were discussed in detail. This plant is a very important useful medicinal plant as it is used in several therapeutic and dietary formulations. The internal structures were evaluated to add information which may be useful to clarify their effectiveness in solving taxonomic complexity of the genus and family. In future aspect we also extract the pigments, vitamins and some secondary metabolites by using phytochemical analysis which are useful in medicines. Based on the morphological and anatomical structures we can easily identify the genus.

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