



**ANATOMICAL INVESTIGATIONS ON *GOMPHRENA CELOSIODES* MART. (AMARANTHACEAE) OF MAHARASHTRA**

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This paper includes detailed anatomical studies of node, petiole, stem and leaf of *Gomphrena celosioides*. It also shades on its stomata, trichome, other epidermal contours and vessels. During the study we observed details of collenchyma and parenchyma layer, sclerenchyma, pith, numbers of vascular bundles and its type, mesophyll structure as well as types of stomata and trichomes were found to be important characters for the identification of *Gomphrena* species. This study also observed special character like Kranz anatomy in the leaf section. In addition, stomatal index, stomatal frequency, stomatal size as well as trichome frequency and trichome size of this species were calculated. Therefore, these detail anatomical observations aid in the taxonomic classification and identification of the plant.

**Keywords:** Amaranthaceae, Anatomy, *Gomphrena*, Kranz cell, Stomata.

## Introduction

Anatomy of plant organ is classified source of data used in plant taxonomy. Anatomical data are also useful solving problems of relationship. The beginning of history of use of anatomical data in taxonomy can be traced back to Grew and Malpighi<sup>1,2</sup>. Since then, anatomical data has been used and culminated in the most recent works of Metcalfe and Chalk<sup>3,4</sup>. The family Amaranthaceae is a large dicotyledonous family comprises 64 genera and 800 species, most abundant in tropical regions and especially Africa and tropical America<sup>5</sup>. The role of anatomical features is crucial in determining relationships between different taxa<sup>6</sup>. *Celosioides* possess very nutritious and can contribute significantly to the human health requirements<sup>7</sup>. At maturity, the leaf trace is often extremely complicated among the families of Amaranthaceae<sup>8</sup>. According to Sinnott and Bailey<sup>9</sup>, three most important types of nodes such as unilacunar- only single gap-one trace; trilacunar-three gaps- three traces and multilacunar; many gaps- many traces. The presence of special features of Kranz anatomy is observed in Amaranthaceae<sup>10</sup>. Kranz anatomy was present in *G. celosioides*<sup>11</sup>. The various taxonomic problems in a variety of plant groups can be resolved systematically through the use of petiole vascularization<sup>12</sup>. Kranz anatomy are observed in *Gomphrena* species<sup>13</sup>. In angiosperm, epidermal outgrowths exhibit a great diversity of

form, structure and function<sup>14</sup>. Therefore, they are of great taxonomic importance<sup>14</sup>.

Essentially, the anatomical features of the *G. celosioides* plant may be used to reliably identify species, and the majority of the characteristics can be used to differentiate the species from other members of the genus and family in general<sup>15</sup>. This present paper deals with details of anatomical studies in the *Gomphrena celosioides*.

## Material and Methods

The fresh plant material was collected from Nashik district, and then to prepare an herbarium sheet. The plant specimen was identified and authenticated from Botanical Survey of India, Pune, (MS), Ref. No.-BSI/WRC/PI Id.2023/07, Specimen No.01 and Collection No.07. Plant Materials were fixed in Formalin Acetic Acid and preserved in 70 % alcohol. Thin sections were taken from fresh parts of plants and stained with safranin and counter staining with alcian blue<sup>16</sup>, semi-permanent slides were made by ringing with Dibutylphthalate Polystyrene Xylene and nail paint and viewed under light microscope. Using a camera, photographs of selected good sections were taken. Leaf Peels were obtained by using the method of Nayeem & Dalvi<sup>17</sup>. The term used for described stomata are as those of Metcalfe & Chalk<sup>3</sup>. The S.I. (Stomatal Index) was calculated as defined by Salisbury<sup>18</sup>. Stomata & trichome

frequency were calculated as defined by Ghose and Davis<sup>19</sup>. The terms for describing trichome are mainly after Ramayya<sup>20,21</sup>. Stomatal frequency is the number of stomata per unit area of leaf surface. Stomatal index, Stomatal frequency and Trichome frequency have been calculated out of ten reading. The Stomatal index, stomatal frequency and size are tabulated in Table 1, 2 and 3 respectively. The frequency of trichomes and size are tabulated in Table 4 and 5.

Plant Name: *Gomphrena celosioides* Mart.

Collection Number: 07

Latitude: 19.937295°

Longitude: 73.824353°

### Result and Discussion

The main objective of the present research work is the details anatomical study of the *Gomphrena celosioides* Mart. species from Nashik region, Maharashtra.

#### *T.S. of Node:*

The leaves are opposite and ex stipulate. The stem contains a continuous vascular cylinder (Fig.1), the median trace departs first (Fig.2), whereas the lateral to do so little upwards. The nodes are three lacunars three - traced (Fig.3).

#### *T.S. of Stem:*

It is circular in outline and ridged. The epidermal cells are small, thick walled with thick cuticle. The epidermis is followed by few layered collenchyma. 3-4 layers of parenchyma cells followed by endodermis. The vascular bundles are Bicollateral. They were surrounded by three to four layered sclerenchymatous sheaths. The pith is wide and made up of large parenchymatous cells. The tanniferous cells are common (Fig. 4). The shape of vessel is cylindrical and tubular. The perforation plate occurs at terminal overlapping with each other in the middle. The shape of perforation plate is mostly circular to elongate. The end walls are

circular the lateral wall thickenings are spiral. The scalariform, spiral thickening occurs on lateral vessels. The reticulated and pitted thickening founds on both sides of the vessels. (Fig.5)

#### *T.S. of Petiole:*

In T. S; it is more or less elongated and deeply channelled adaxially. The epidermis is single layered followed by 3-4 layers of collenchyma. The cuticle is thicker adaxially. The epidermis is interrupted by many unicellular trichomes. The rest of the ground tissue is parenchymatous. The vascular bundles are 5 in numbers. Pith is parenchymatous. Tanniferous cells are common in ground tissue. (Fig. 6)

#### *T.S. of Leaf:*

The leaves are dorsiventral. In T.S it is wavy adaxially. The epidermal cells are squarish on both sides. The cuticle is thick adaxially. The epidermis is interrupted by trichomes. The mesophyll is composed of palisade and spongy tissue. The former is two layered and the latter shows loosely arranged cells. The hypodermis is collenchymatous and usually two layered adaxially in the midrib region. It is followed by parenchymatous tissue. A single - lunar shaped vascular bundle occur in this region. The Vascular bundles are 3 in numbers. It is capped by sclerenchymatous sheath continuously from outside. Kranz cells are found. The tanniferous cells are common in the palisade and ground tissue. Presence of sand crystals. (Fig. 7)

#### *Foliar epidermis:*

Leaves are amphistomatic.

A) Leaf Adaxial : Stomata are anomocytic and anisocytic; orientation random; distribution diffuse. subsidiary cells 3-4, walls straight; rarely oblique. S.I on/around Vein is 24.35 % and Intercostal is 22.88 % (Table No. 1). Size of the stomata i.e. length and breadth are shown in Table No. 3. Number of non-glandular multicellular trichomes are found with Foot cells. (Fig. 8)

**Table 1: Stomatal Index (S.I.).**

Name of Plant	Leaf Adaxial		Leaf Abaxial	
	On/Around Vein (%)	Intercostal (%)	On/Around Vein (%)	Intercostal (%)
<i>Gomphrena celosioides</i>	24.35	22.88	17.23	27.34

\*The table relate to a mean of ten count.

**Table 2: Stomatal frequency (per sq.cm.).**

Name of Plant	Leaf Adaxial		Leaf Abaxial	
	On/Around Vein	Intercostal	On/Around Vein	Intercostal
<i>Gomphrena celosioides</i>	37.3	31.8	13.4	15.2

\*The table relate to a mean of ten

B) Leaf Abaxial : Epidermal cells sides mostly 4-6, mostly wavy rarely straight stomata mostly anomocytic and anisocytic, orientation random distribution diffuse. Subsidiary cells 3-4, walls wavy to straight, undulate, sinuous mostly. S.I

on/around Vein is 17.23 % and Intercostal is 27.34% (Table No. 1). Size of the stomata i.e length & breadth are shown in Table No. 3. Non-glandular multicellular trichomes are more in numbers with foot cells. (Fig. 9)

**Table 3: Size of the Stomata (µm)**

Name of Plant	Leaf Adaxial						Leaf Abaxial									
	Length In Range (Stomata)	Mean	Breadth In Range (Stomata)	Mean	Length In Range (Pore)	Mean	Breadth In Range (Pore)	Mean	Length In Range (Stomata)	Mean	Breadth In Range (Stomata)	Mean	Length In Range (Pore)	Mean	Breadth In Range (Pore)	Mean
<i>Gomphrena celosioides</i>	24.5-35µm	29.05µm	17.5-24.5µm	21.35 µm	10.5-14µm	11.9 µm	3.5-3.5 µm	3.5 µm	24.5-31.5µm	28.7 µm	21-24.5µm	23.1 µm	10.5-17.5µm	14.35µm	3.5-3.5µm	3.5 µm

\*The table relate to a mean of ten count.

**Table No:4. Trichome frequency (Per.Sq.cm)**

Name of Plant	Leaf Adaxial		Leaf Abaxial	
	Vein	Intercostal	Vein	Intercostal
<i>Gomphrena celosioides</i>	1.1	2.5	4.3	3.6

\*The table relate to a mean of ten count.

**Table No:5. Size of Trichome (µm)**

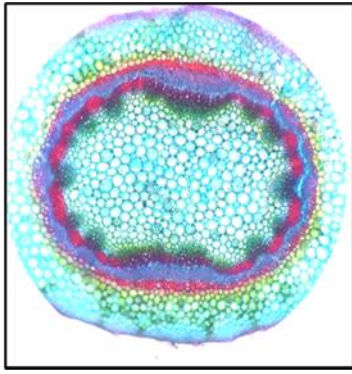
Name of Plant	Leaf Adaxial				Leaf Abaxial			
	Length in range (µm)	Mean	Breadth in range (µm)	Mean	Length in range (µm)	Mean	Breadth in range (µm)	Mean
<i>Gomphrena celosioides</i>	112.5-1450	870	12.5-25	18.75	575-2225	1217.5	12.5-25	18.75

\*The table relate to a mean of ten count.

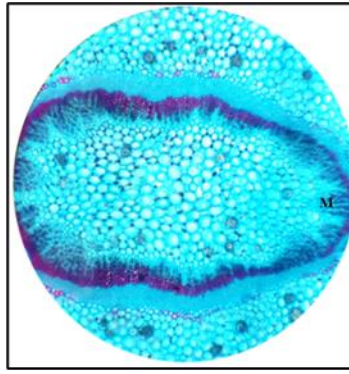
**Trichomes:**

Leaf Adaxial and Leaf Abaxial : Multicellular long trichomes; Trichome is eglandular; mostly distributed throughout the leaf lamina, more on abaxial side. Foot one celled broad embedded in epidermis, body long, broad at the joints, innersides are thick, lateral walls are thin (Fig.10). Trichome frequency is higherst on abaxial side than adaxial ones. Length of trichome mean 870 and 1217.5 respectively on an average adaxially and abaxially side. Breadth of trichome mean is 18.75 on both adaxially and abaxially side (Table No.5).

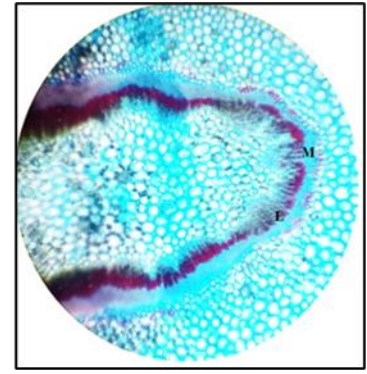
Detailed anatomical studies of *G. celosioides* are given in the present study. During the present investigations, some important features are observed in stem, petiole and leaf anatomy. In the node anatomy, a continuous vascular cylinder is present in the stem. The median trace is the first to depart, with the lateral trace doing little upwards. The nodes are three lacunars, three - traced. T. S. of Stem, the epidermis covering with thick cuticle. The vascular bundles are Bicollateral and they are surrounded by three to four layered sclerenchyma. The organization of Pith is wide



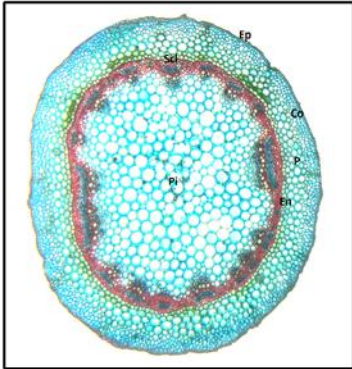
**Fig. 1.:** T.S. of Node (4X)



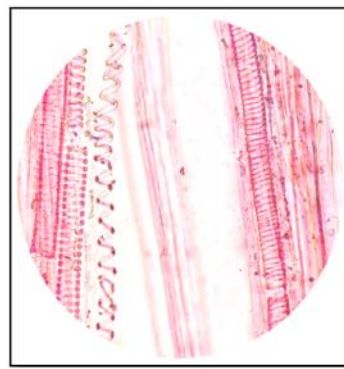
**Fig. 2.:** Node –Median trace (4X)



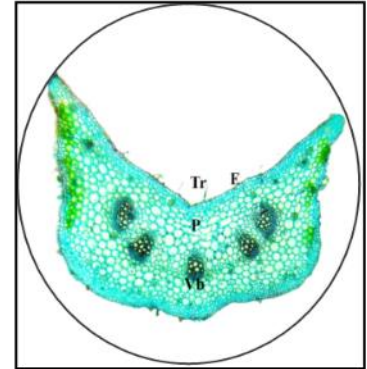
**Fig. 3.:** Node – Lacunar trace (4X)



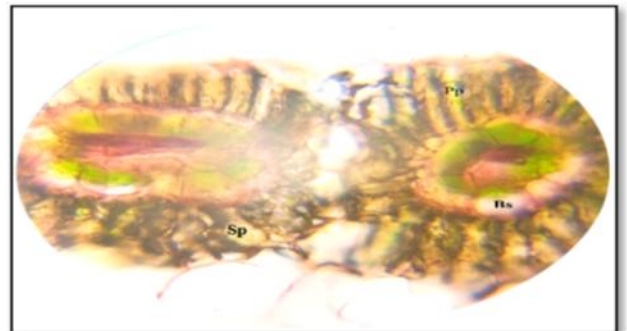
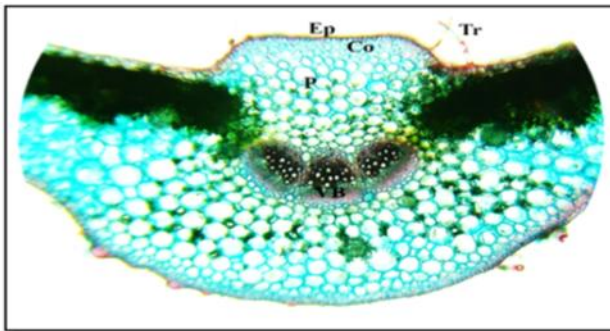
**Fig. 4.:** T.S. of stem (4X)



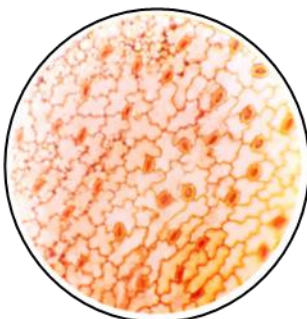
**Fig. 5.:** Tangential longitudinal section (4X)



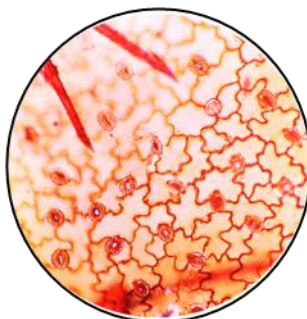
**Fig. 6.:** T.S. of Petiol (4X)



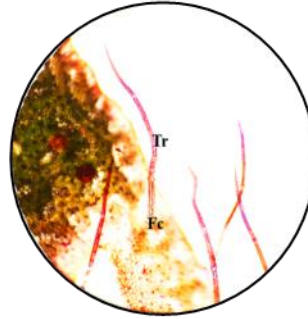
**Fig. 7.:** T.S. of Leaf (4X)



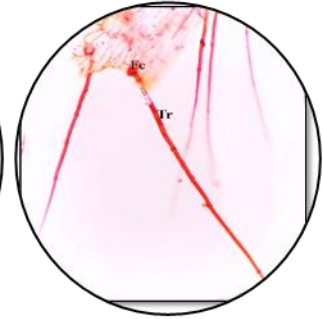
**Fig. 8.:** Adaxial side (4X)



**Fig. 9.:** Abaxial surface (40X)



**Fig. 10 (a).:** Leaf Adaxial Trichome (40X)



**Fig. 10(b):** Leaf Abaxial Trichome (40X)

**Abbreviations**– Bs- Bundle sheath cell, Co-collenchyma, En- Endodermis, Ep- Epidermis, Fc- Foot cell of trichome, L-Lateral trace, M- Median trace, P-Parenchyma, Pi-Pith, Pp- Palisade parenchyma, Scl- Sclerenchyma, SI- Stomatal index, Sp- Spongy parenchyma, Tr- Trichome, VB- Vascular bundle

and made up of numbers of parenchyma cells. On the lateral vessels, scalariform as well as spiral thickening observed. The petiole of *G. celosioides* was crescent shaped. During the present investigation, it showed single layered epidermis followed by 3 layered of collenchyma cells with secondary deposition as a pinkish colour. Epidermal outgrowth i.e., Non glandular, unicellular trichome are observed. Three vascular bundles were present in *G. celosioides*<sup>6,7</sup>. But findings of the present investigations, petiole showed five vascular bundles. In plant taxonomy, anatomy is essentially of great significance. In the leaf anatomy, observed single layered epidermis with outgrowth of trichomes. It having 5-6 layered of parenchyma cells are observed. The presence of trichomes on *G. celosioides* is associated with xeromorphy, which allows it to withstand drought and thrive all year<sup>6,7</sup>. It having three vascular bundles. The mesophyll contains palisade and spongy parenchyma. And during the present investigation, special features like a Kranz cell are also observed in the leaf anatomy<sup>11</sup>. The leaf has specialized ground tissue for photosynthesis<sup>22</sup>.

Leaves are amphistomatic. In *G. celosioides*, anomocytic and paracytic stomatal types are observed on adaxial and abaxial side<sup>23</sup>. But during the present study, both adaxial and abaxial surface of leaf, anomocytic and anisocytic types of stomata

are observed. Non-glandular multicellular trichome are observed on both surface of leaf. The Stomatal index and stomatal frequency on adaxial side is higher than abaxial side of leaf (Table No. 1 & 2). Size of the stomata i.e. length & breadth are difference are shown in Table No. 3. The highest trichome frequency is observed on abaxial side as compared to adaxial side (Table No. 4). The findings of the present investigations have shown that the length of non-glandular trichomes of adaxial and abaxial side were 870  $\mu\text{m}$  and 1217.5  $\mu\text{m}$  respectively (Table No. 5). Breadth of trichomes are same in size i.e. 18.75  $\mu\text{m}$  on both foliar surfaces (Table No. 5). And this study provides valuable information that can be utilized for the proper taxonomic characterisation and identification of plant species that belong to the Amaranthaceae family.

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