

Full Length Research Paper

Systematic studies (morphology, anatomy and palynology) of economically viable grass *Brachiaria mutica* (Forsskil) Stapf in Eastern India

Saurav Dwari and Amal Kumar Mondal*

Plant Taxonomy, Biosystematics and Molecular Taxonomy Laboratory, Department of Botany and Forestry, Vidyasagar University, Midnapore-721 102, West Bengal, India.

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Poaceae is the one of the largest family among the monocotyledons in the world. Plants of this family are very frequent like other grasses. *Brachiaria mutica*, an economically important plant is considered as one of the best tropical grass for general purposes. The species were commonly used as green foliage, grazing and local resources for animal fodder. The present study deals with few systematic parameters viz. morphology, anatomy, palynology of *B. mutica* which is commonly known as para grass in Eastern India. The result showed some distinct morphological and anatomical as well as palynological characters. All the detailed systematic study of this plant has not worked earlier.

Key words: *Brachiaria mutica*, morphology, anatomy, palynology, economically viable, Eastern India.

INTRODUCTION

Para grass is a common weed in many cane growing areas. It has been used in tropical locations as a fodder species, especially as a pounded pasture in beef production (Bor, 1960). This plant can be a very aggressive invader, particularly in low-lying ungrazed areas and in sugar cane crops. It is often found in wet situations, especially drains, but will also grow in deep soils in non-swampy areas (Gamble and Fischer 1915-1935). *Brachiaria mutica*, known as para grass (Africa, Australia) or buffalo grass is under the tribe Paniceae and subfamily Panicoideae of family Poaceae (Hutchinson, 1973). Poaceae, also known as gramineae is one of the largest family of the world (Bessey, 1915). In India, this family has 263 genera and 1291 species. It is the largest family of the India (Champion and Seth, 1968). Among these genera, *B. mutica* is very common in West Bengal as well as in India. *B. mutica* is sometimes known as *Urochloa mutica* (Forsskil) T.Q. Nguyen (Karthikeyon and Kumar 1983). This plant is an important plant of tropical countries used as green foliage, hay or browse (Jain, 1986). They are also useful for banks of streams to control erosion. It can tolerate drought, lateritic soil, that

generally occur in flat poorly drained environments (Shukla, 1996).

Morphological, anatomical (Esau, 1965), palynological characters are very important to characterize and classify any plant properly. These characters are also required for database preparation in this digital world by which further experiments or research will be done. These characters are very important for proper and rapid identification, but detail morphological, anatomical, palynological studies of *B. mutica* as well as other grasses are very less. Morphological, anatomical and pollen characters are now applied in solving of controversial taxonomical and phylogenetical problems (Balasbramanian et al., 1993).

Major morphological characters are hair structure, stomatal structure, flowers structure etc. while major anatomical characters are cortex, vascular bundle characters etc. Characters of pollen grain are apertural form, number, distribution and position, exine ornamentation and stratification etc.

MATERIALS AND METHODS

Plant specimen was collected from Gangetic region (surrounding of the river Ganga) of West Bengal which is situated in the eastern part of India. Herbarium specimen of the species was then prepared. Next the plant is identified and deposited in the herbaria

*Corresponding author. E-mail: amalcaebotvu@gmail.com.

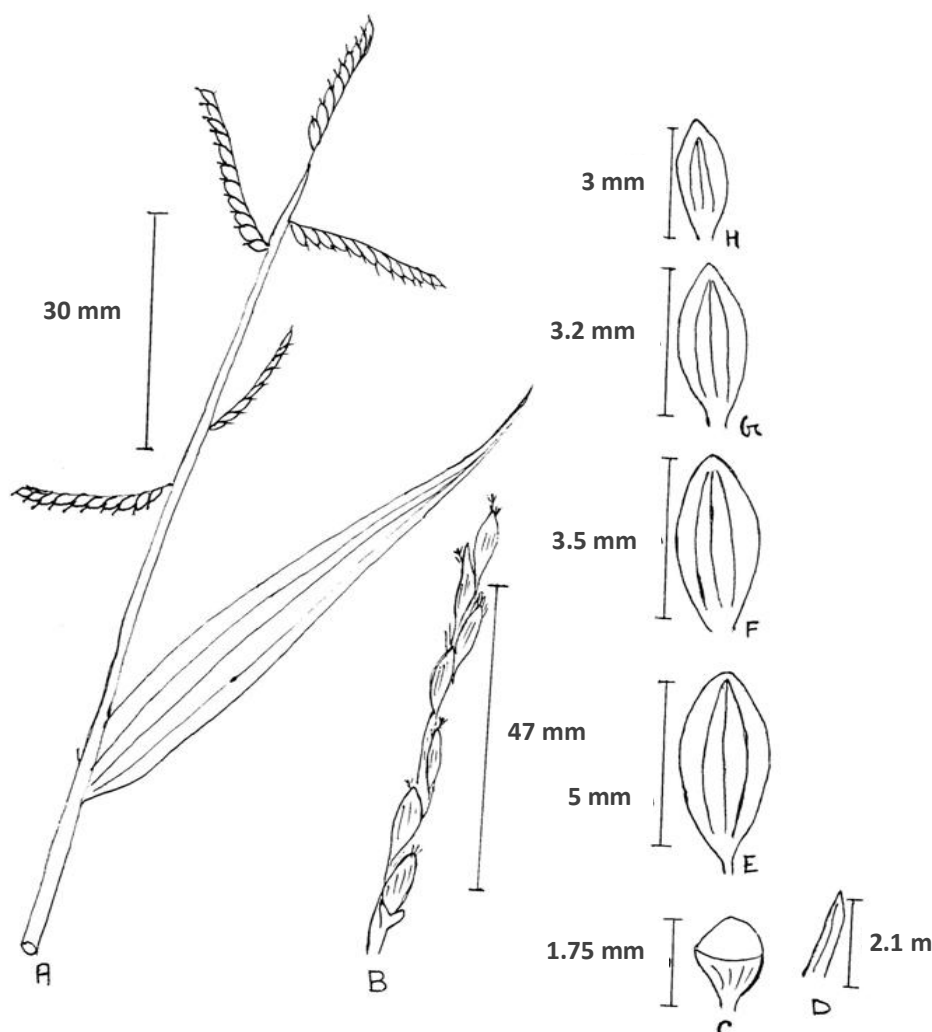


Figure 1. Full dissection of *Brachiaria mutica* (Forsskil) Stapf.

of Vidyasagar University. Plant sample was washed in deionized water and some plants were fixed in alcohol for anatomical studies. Twigs, roots, stems, leaves, flowers, seeds and pollens were collected time to time during visit. Flowering twigs were collected for morphological study. Pollens were collected for pollen study. During morphological studies, flowering twig and herbarium samples were examined through the conventional taxonomical procedure adopted by Bentham and Hooker (1873) and Prain (1903). Morphological parameters which have taxonomic value (length of vegetative and floral parts, type of stamen, carpel) were determined. Anatomical study was done by simple transverse section of root stems (culms) and leaves (Johanson, 1940). To study the stomata, the paradermal cross sections were taken (Algan, 1981). For palynological study, the acetolysis technique of Erdtman (1971) was used. Chemicals were treated to remove resistant outer exine wall layer of pollen grain. Acetolysis stain is brownish in colour and acetolysis mixture was prepared in a measuring cylinder by slowly adding concentrated H_2SO_4 and acetic anhydride in 1:9 ratio. Glycerine gelly, 50 gm gelatin, 150 ml glycerol, 175 ml DH_2O was mixed thoroughly and boiled in water bath for 1 to 2 h and 7 gm phenolic crystals were added to the mixture and mix thoroughly until warm and melted. The glycerine jelly was then poured on a Petri dish making a thin uniform layer of 0.5 cm thick. It was cooled

and preserved in a refrigerator.

RESULTS

Morphological description

B. mutica (Forsskil) Stapf is a creeper, decumbent, stoloniferous, perennial grass with long coarse stolons. Culms are semi erect, greenish, cylindrical, node and internodes prominent, internodes solid, glabrous, node swollen and soft. Culm at first spread horizontally then upward. Sheath is mostly longer than internodes, papillose, pubescent, highly hairy. Hairs are unicellular and cylindrical in type. They were about 0.35 to 1 mm long and their arrangement is hirsute type (Figures 1 and 2). Leaves (blades) sample are 30 - 33 cm long, apex acuminate, margin scabrous, pubescent. Inflorescence panicle (racemes) 10 - 25 cm long lowermost branches

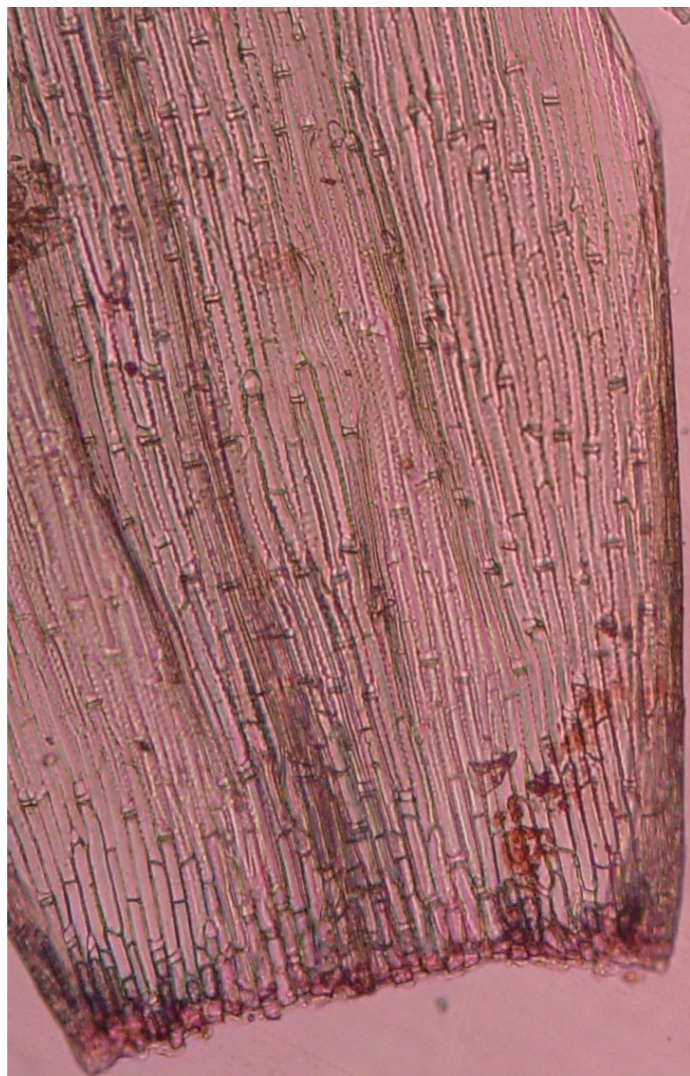


Figure 2. Close up picture of second glume showing detail structure.

Table 1. Morphological measurements of *Brachiaria mutica* (Forsskil) Stapf.

Number of character	Organ	Measurement of length
1	Stem	15 - 30 cm
2	Hair	0.35 - 1 mm
3	Leaves	30 - 33 cm
4	Inflorescence	10 - 25 cm
5	First glume	5 mm
6	Second glume	3.5 mm
7	Third glume (lemma)	3.2 mm
8	Fourth glume (palea)	3 mm
9	Lodicule	2.1 mm
10	Rachis	1.75 mm

compound, upper sample, branches and branchlets bears spikelets. Panicle with spreading branches (Table 1), flowers spikelets solitary, first glume acute, about 5 mm long, were not clasping at base (Figure 3), second glume and lemma equal, they later subtending a hyaline palea, fertile lemma slightly shorter and obtuse. Androecium Stamens 3, free, exerted, filaments short, anthers bicelled, versatile, dehiscing, and longitudinal (Figure 4). Gynoecium monocarpellary, ovary superior, unilocular, single ovule, placentation basal, style two, medium, stigma feathery, stigmas are red in color (Figures 5 and 6). Fruit is Caryopsis type.

Anatomical description

Root

Epidermis is uniseriate composed of a row of closely set, thin walled tabular cells with thick cuticle. Cortex is massive and composed of parenchyma cells with conspicuous intercellular spaces (angular). Beneath the epidermis, that is, towards the periphery of the cortex several layered thick exodermis is present. The innermost layer of cortex is known as endodermis which is composed of a row of barrel shaped closely packed cells. Pericycle is the outermost uniseriate layer of stele. Vascular bundle is polyarch and radial, that is, phloem strand alternate to xylem strand (Mitra and Mitra, 1968) and Xylem exarh. Protophloem lies towards periphery, and metaphloem lies towards the centre. Pith is large, central in position, and surrounded by a circle of metaxylem vessels. It is composed of loosely arranged parenchymatous cells (Figure 7).

Stem (Culm)

Epidermis is the outermost single layered, composed of closely fitted tabular cells. Outer wall cuticularised. True cortex is absent, not differentiated into extrastelar and intrastelar regions. Next to epidermis, there occur several layer of parenchymatous cells, which contain abundant chloroplast that is, cells are chlorenchymatous. Then several cell-layer thick continuous band of sclerenchyma is present. Vascular bundle are closed and collateral remain scattered in parenchymatous ground tissue. They were more crowded towards the periphery. The bundle sheath was surrounded by sclerenchyma sheath; peripheral bundles touch the sclerenchymatous band. Xylem occurs in the form of letter "Y"-two metaxylem with larger cavities situated laterally that is, at the two arms of the letter "Y and two protoxylem vessels with smaller cavities in mature bundle lowermost protoxylem undergoes dissolution forming a cavity known as protoxylem lacuna and Xylem endarch. Phloem is above the two metaxylem vessels. Pith and medullary rays are not differentiated due to the scattered arrangement of

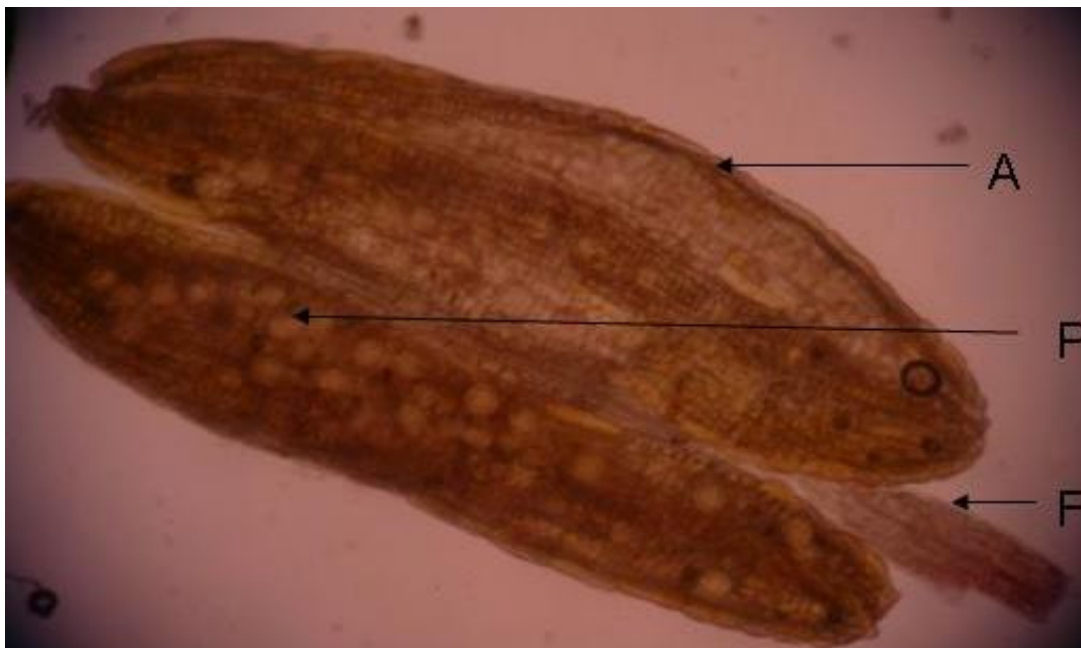


Figure 3. Stamen of *Brachiaria mutica* (A, anther; P, pollen; F, filament).

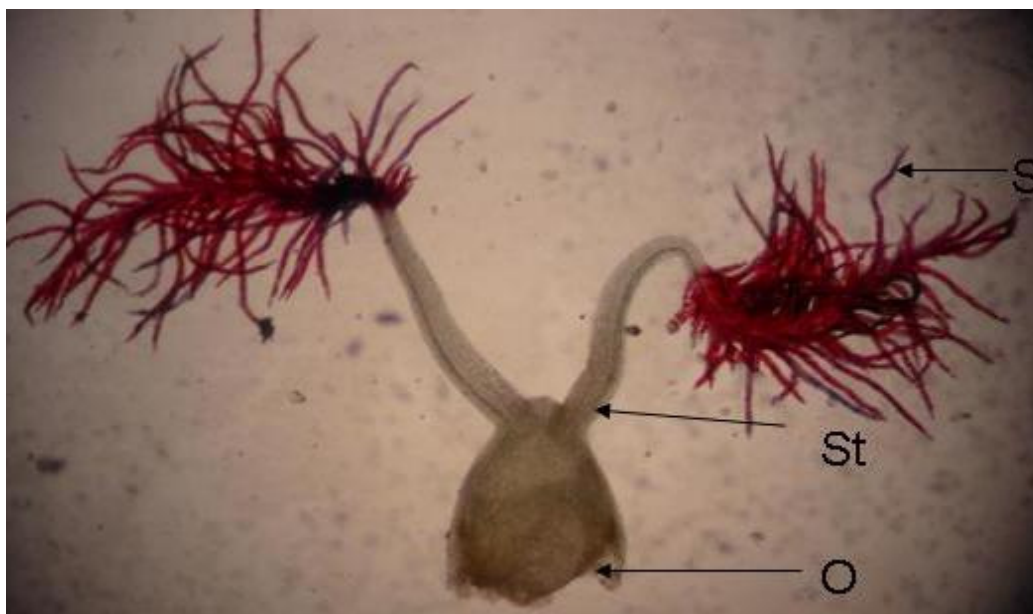


Figure 4. Carpel of *Brachiaria mutica* (S, stigma; St, style; O, ovary).

bundles over the ground tissue (Figures 8 and 9).

Leaf

There are two epidermal layers viz., an upper and a lower epidermis. Both the epidermal layers are composed of

compactly arranged, almost oval or rectangular thin walled cells and possess distinct cuticle. Stomata were present on both epidermis (Figures 10 and 11); upper epidermis with distinct ridge and furrow. Mesophyll tissue is not differentiated and is composed only of spongy type of isodiametric cells. Chlorophyll containing cells are prominent vascular bundles of different sizes. The

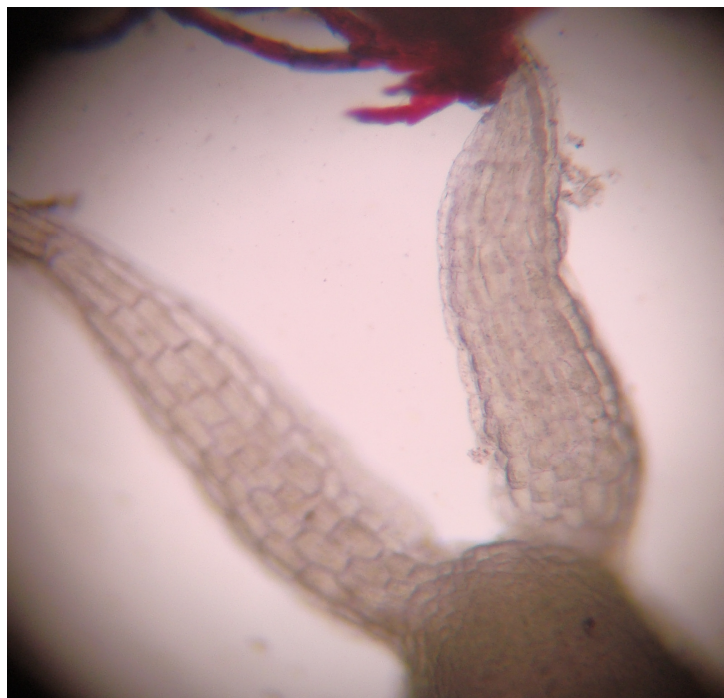


Figure 5. Close up picture of carpel showing detail structure of style and joining of style and stigma.

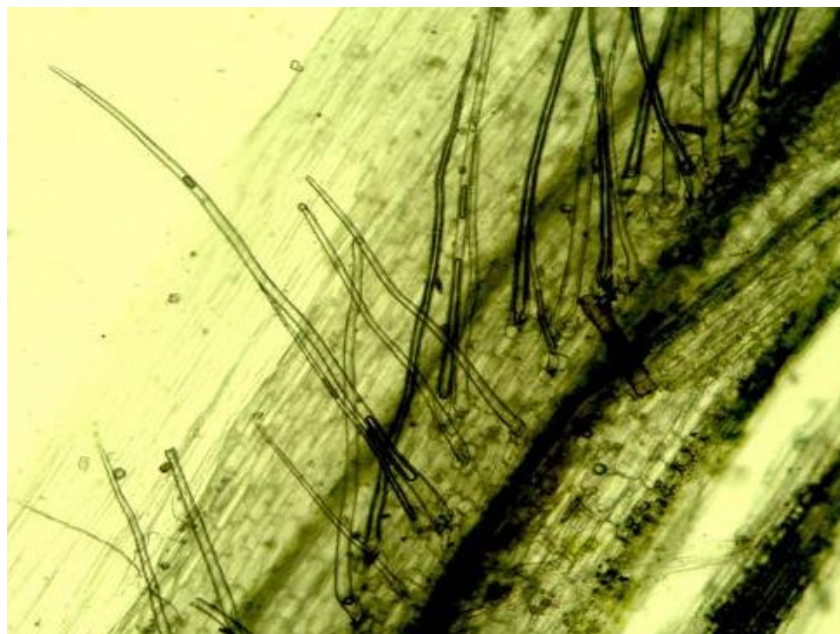


Figure 6. Unicellular cylindrical hairs of leaf sheath.

vascular bundle is collateral and closed; phloem lies towards the lower epidermis and xylem towards the upper side. Each vascular bundle was surrounded by bundle sheaths.

Palynological description

Pollen grains of *B. mutica* were circular in polar view, oblate spheroidal (Jackson and Davdon, 1928) in

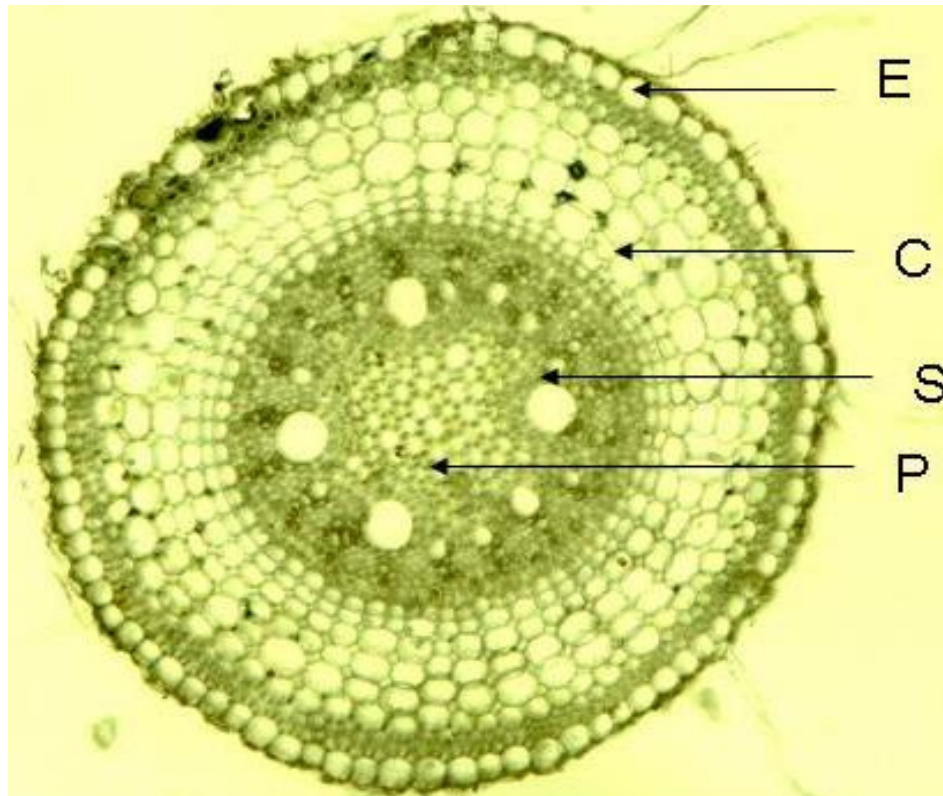


Figure 7. Transverse section of root (E, epidermis; C, cortex; S, stele; P, pith).



Figure 8. Transverse section of the stem (culm) (E, epidermis; C, chlorenchymatous region; VB, vascular bundle).

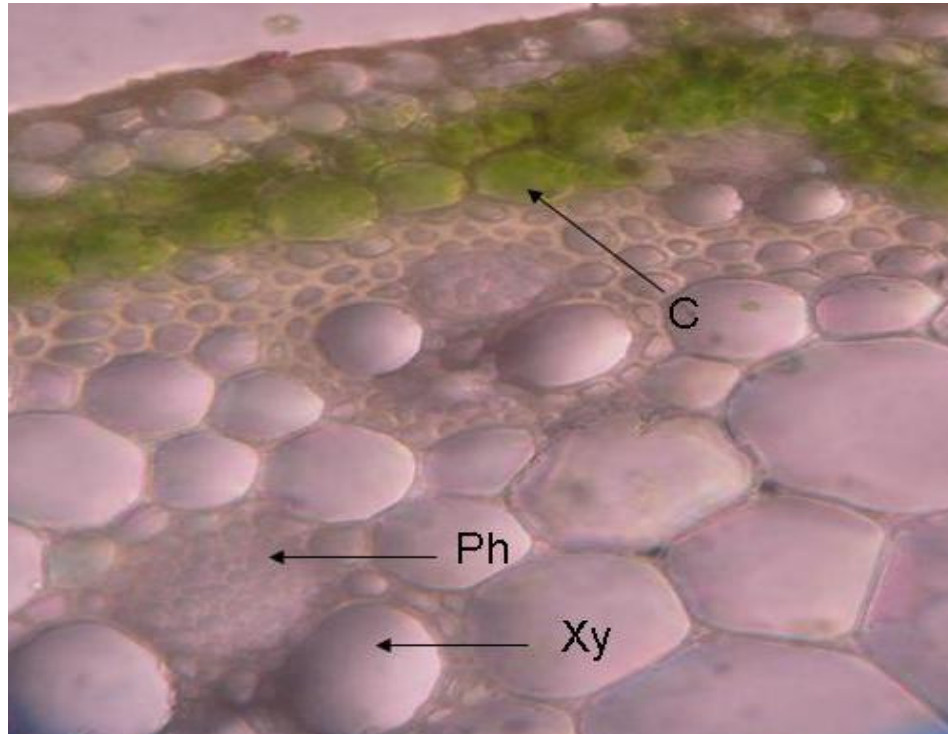


Figure 9. Close up view of transverse section of stem (culm) (C, chlorenchymatous region; PH, phloem; XY, xylem).

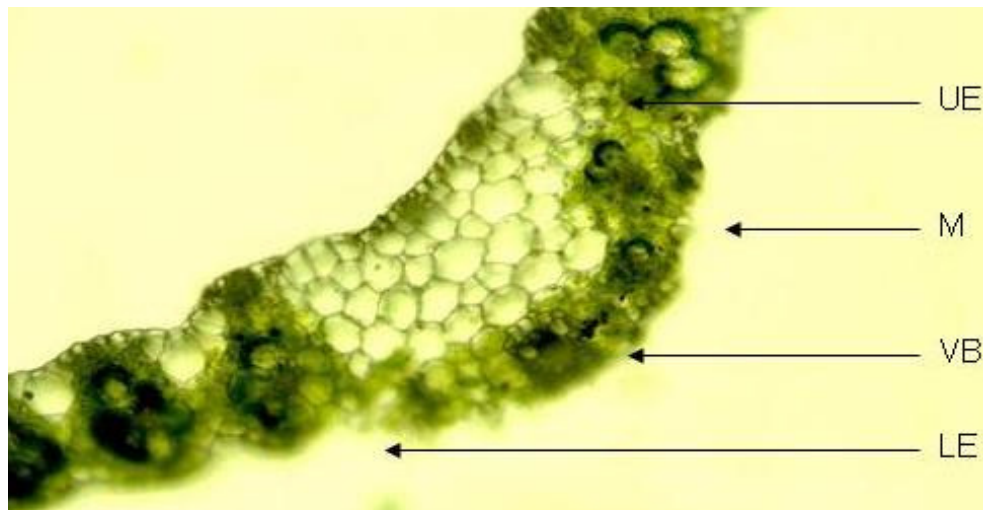


Figure 10. Transverse section of leaf (UE, upper epidermis; M, mesophyll tissue; VB, vascular bundle; LE, lower epidermis).

equatorial view.

Generally, these are small in size and monad type is about 23.986 μm in diameter (Table 2). Apertural form of pollens is monocolpate type and position is proximal. Ectexine or sexine is columnar, exine ornamentation is depression type and reticulate subtype (Figures 12, 13a

and 13b).

DISCUSSION

Some morphological characters of *B. mutica* are very

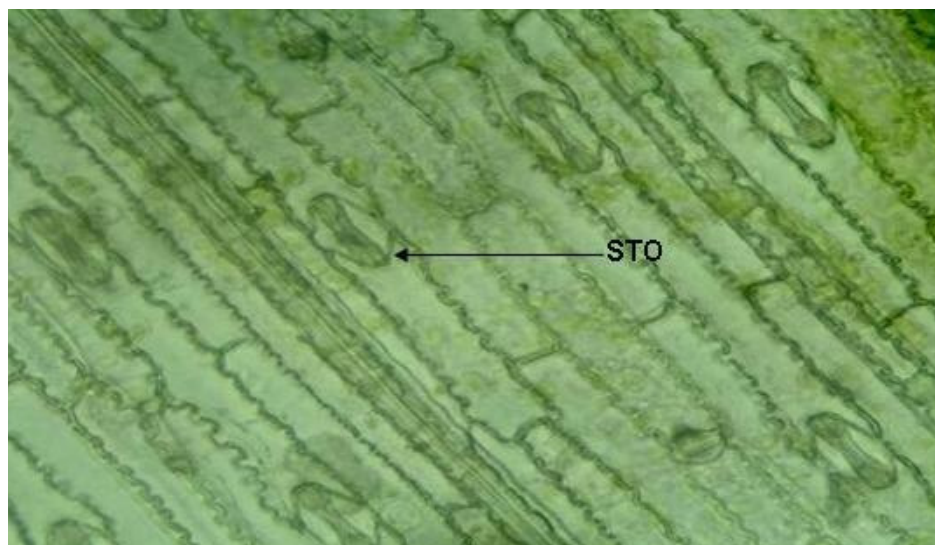


Figure 11. Leaf epidermis [Sto, stomata (paracytic type)].

Table 2. Important palynological characters of *Brachiaria mutica* (Forsskil) Stapf.

Number of character observe	Character	<i>Brachiaria mutica</i>
1	Shape of the pollen	Circular, oblate spheroidal
2	Number of apertures	Monoaperturate
3	Morphology	Ectexine columnar and retipliate exine
4	Pollen size	$\pm 23.986 \mu\text{m}$
5	Pollen association	Monad type



Figure 12. Pollen of *Brachiaria mutica*.

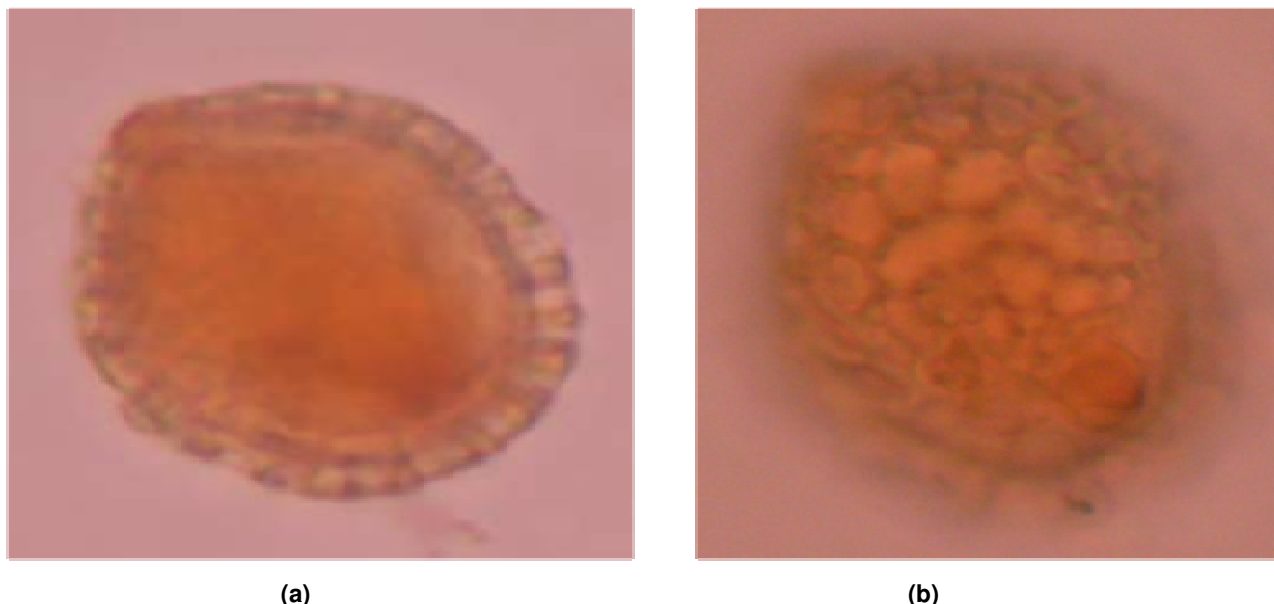


Figure 13. Pollen of *Brachiaria mutica* after acetolysis showing different ornamentation.

attractive. These characters can be used for identification purpose. Morphologically, this plant is a creeper, stoloniferous with solid internodes and swollen nodes.

Long pubescent sheath is present. Leaves are simple with acute apex and scabrous margin. Glumes has obtuse apex and relatively short inflorescence, stamens has broad anther and short filament while the carpel has long style and reddish stigma. Anatomically, it has single layer root epidermis with thick cuticle. Exodermis is present just beneath the epidermis, while vascular bundle is polyarch and radial with exarch xylem. The stem chlorenchymatous layer is present just beneath the stem epidermis. Vascular bundles are scattered in ground tissue with endarch xylem. Leaves have abundant paracytic type of stomata. Important palynological characters are small, oblate spheroidal, monad type; monocolpate pollen with columnar ectexine and retipliate exine which are also use in identification purpose.

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