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MORPHOLOGICAL AND ANATOMICAL STUDIES ON PANNEER NAVAL *(Syzygium aqueum)*

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ABSTRACT

Syzygium aqueum **is a tropical fruit crop belonging to the family Myrtaceae and commonly called as water rose apple. Various parts of the plant have been used for the treatment of fever; detoxify the liver, headaches, digestive issues, diabetes, lower cholesterol, skin conditions and prevention against certain types of cancers. The plant specimen for the present study was collected from Achanputhur village in 2022. In identifying a plant species, morphological and anatomical characteristics of vegetative organs such as root and stem are needed to have well identified the botanical taxonomy of the specimen .The results of this study indicate that transverse section of root showed more or less a circular outline and consists of periderm, cortex, phloem and xylem. Phloem occurs in several thin patches around well-developed xylem. Centrally pith made of compact parenchymatous cells. T.S. of stem showed the vascular strand consists of external phloem, xylem and internal phloem, traversed by narrow rays. There are numerous cells with phenolic content, calcium oxalate prismatic crystals.**

It is inferred from the results that morphological and anatomical evaluation may be useful in the identification of *Syzygium aqueum* which may act as reference information and produce a solid basis for proper identification, authentication, collection and investigation of this plant material. Further, it will be helpful for identifying the plants and prevent it from the adulterants and lead to a scope for further investigations and maintaining the quality, reproducibility and efficacy of natural drugs.

(Key words: *Syzygium aqueum,* anatomical, phenol, calcium oxalate , morphological)

INTRODUCTION

Geographically, India has about 2.4% of the total land area of the world but it accounts for~8% in terms of total number of species found over the world. The majority of the species are occurring in certain biologically rich zones of tropical forests. India is a mega-biodiversity country accounting around 47000 species of plants and fungi and 89 000 animal species (Khoshoo, 1995; Anonymous, 1999). Tamil Nadu has a geographical area of 1,30,058 km^2, which constitutes about 4 per cent of the country's total area.

Myrtaceae is considered the ninth largest flowering plant family; it includes trees and shrubs distributed mostly in South America, Australia and Tropical Asia. Myrtaceae include nearly 5950 species belonging to 150 genera (Christenhusz and Byng, 2016). Many taxa are cultivated as ornamentals and for the manufacture of timber, oil, gum, tannin, resin, spices, and fruits. The family is characterized by entire leaves containing oil glands, semi inferior to inferior ovary and numerous stomata. Most of the plants of *Myrtaceae* are either evergreen shrubs or woody trees.

Syzygium aqueum is a tropical fruit crop belonging to the family Myrtaceae and native to Philippines, Indonesia and Malaysia. In India, it is most likely to occur in moist deciduous forests up to an altitude of 1500 m. It generally grows in the warmer parts like Andhra Pradesh, Assam, Karnataka, Kerala, Orissa, Maharashtra, West Bengal, Punjab, Rajasthan and Tamilnadu. Fruits, leaves and bark of Watery Rose Apple fruit has many medicinal uses like fever treatment, detoxify the liver, headaches, digestive issues, diabetes, lower cholesterol, skin conditions and prevention against certain types of cancers .

The Watery Rose Apple fruit is rich in fibers, calcium, magnesium, potassium, and Vitamin C though very low in proteins. It has high antioxidant activity and betacarotenecontent. It is very low calorie fruit due to high water content and very low fat content. Nutrient composition of Watery Rose Apple fruit pr 100^{-1} g of edible portion was initially reported by (Dignan, *et al*., 1994; Tee, *et al.,* 1997) and volatile constituents by Wong *et al*. (1997). The present study aimed to introduce external and an internal description of root and stem to determine its taxonomic importance. Morphological and anatomical data has proved to be very useful in discerning evolutionary trends and interrelationships of taxa at and above the species level and at higher taxonomic categories. They are most useful in determining relationship between different genera, families, orders and other taxonomic categories.

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MATERIALS AND METHODS

The plant specimens for the present study, *Syzygium aqueum* (Burm. f) Alston). was collected from Achanputhur village, Tenkasi district of family Myrtaceae during the study period 2022. The voucher specimens of this species of *Syzygium* was deposited in Department of Botany, Sri Parasakthi College for Women, Courtallam for future reference.

Macroscopical study

The plants were collected and subjected to study morphological and taxonomical characteristics by using a student's dissection microscope. The details were described in technical terms using "Flora of the presidency of Madras" (Gamble, 1935), " Flora of Tamil Nadu Carnatic" (Mathew, 1983) and "Flora of Tamilnadu' (Henry *et al .,* 1987). Morphological assessment was done by physical observations and measurement of physiognomic features of their fresh leaf, flower and fruits specimens.

·**Microscopical study**

Anatomical features were analyzed (Johansen, 1940) based on transversal sections of root and stem were obtained by free hand sectioning. They were stained with safranin and TBO, mounted in glycerin and covered with a cover slip. The structures were analyzed and photomicrographed in a Stereo Nikon SM2800N with a digital camera attached. Micro morphological features of the flowers were studied using Nikon Eclipse – NI model stereomicroscope.

RESULTS AND DISCUSSION

I. Macroscopical study (Plate-1)

Systematic position- Class- Dicotyledons; Subclass- Polypetalae; Series - Calyciflorae; Order- Myrtales; Family - Myrtaceae; Genus- Syzygium; Species- S. aqueum; Synonym- Eugenia alba Roxb , Euginea aquea Burm.f ; English- Water apple, Rose apple, Java apple, Bell fruit, Chambakka; Tamil - Panneer Naval ; Malayalam- Jambakka; Hindi – Gulabjamun

Description: Habit: Small evergreen tree with a dense, spreading crown (Fig.1 and 2).

Trunk: Trunk is short with branching occuring at about 1 m. Bark is brown and cracked.

Leaves: Leaves are elliptic (5 - 12 cm long, 2.5 – 5.2 cm wide) with very short petioles. According to Oliveira *et al.* (2011) secondary venation pattern, ultimate marginal venation in arches, and reticulate tertiary venation were common characters occurrences in most of the species under Myrtaceae family. Ultimate marginal venation in arches was observed in all species analyzed, although more prominent in *S. aqueum* and *S. samarangense* (Fig. 1and 2).

Inflorescences: Terminal and axillary, 3-7-flowered (Fig.3).

Flowers : Flowers are 2.5 cm long and 1 cm wide, greenish-white, shortly pedicelled. The bisexual flowers carry a large number of long stamens that give the flowers a fluffy appearance; calyx tube is 1.5-2 cm long, 6 mm wide, turbinate-clavate; lobes 4, unequal; Corolla 4, 1.2 cm long, 8 mm wide, rounded, obtuse and free; Anthers are dithecous and dorsifixed. They have a subtle fragrance. Ovary is inferior with axile placentation; Style single, up to 17 mm long ; stigma single. Most species of Myrtaceae have flowers with mostly inferior ovaries (Schmid, 1972). Some sepecies of Myrtaceae that have axile placentation (Lughadha and Proença, 1996) (Fig.3-8).

Fruits: Fruits are pear-shaped berries (5 cm long). The apex has a shallow cavity that is partially covered by 4 fleshy sepals. The skin is shiny, thin and waxy, while the flesh is white, juicy and crisp. Fruits have 1 - 6 small rounded seeds (Fig. 9).

Propagation: It is propagated by cuttings, budding and grafting.

Flowering and fruiting : Occurs in February–March and fruits mature during May–June.

II. Microscopical study

T.S. of root (Plate 2)

Transverse section of root shows more or less a circular outline and following tissue was observed these include periderm, cortex, phloem and xylem. Periderm is further divided into cork and phellogen, cork is three to five layer, cells are tangentially elongated filled with brown matter (Fig. 1). Phellogen is four layers present immediately below the cork which are tangentially elongated. Cortex is several layers with polygonal parenchyma cells. Phloem occurs in several thin patches around well-developed xylem. Xylem occupies one third of the transverse section which is divided by rows of medullary rays (Fig.2). Medullary ray cells are radially elongated. As the protoxylem elements face towards the periphery, the root is called as exarch. Secondary xylem consists of vessels, fibres and parenchyma. Centrally pith made of compact parenchymatous cells.

The following reports were also supported our findings with Anatomy of aerial and terrestrial roots of *Syzygium cumini* Skeels with special reference to an adaptive strategy (Singh and Misra, 2015). The aerial roots differed from terrestrial roots by its ephemeral nature, reddish pink to brownish colour with plenty of lenticels, lysigenous cavity and polyarch condition. Origin and occurrence of aerial roots had plenty of lenticels, lysigenous cavity in cortex and periderm indicated high adaptive strategy under stress ecosystem for survival and sustainable growth.

Tuladhar and Nii (2017) reported T.S. of root of wax apple and guava grown under normal, drought and water-logged conditions were observed under fluorescent microscopy after staining with berberine, anniline blue and saffranin, or with phloroglucinol under optical microscope. Polyderm layers in roots increased significantly under drought stress condition indicating that polyderm formation

was affected by environmental stress. Similar to lignin dramatically accumulation in cortex cell walls in the roots of *Myrica rubra* Sieb. et Zucc. under drought condition and crescent-like lignin thickenings were observed in roots of wax apple and guava. Under drought stress, accumulation of lignin was first observed in cortex cell wall in young new roots and later, as roots matured, in polyderm layers.

T.S. of stem (Plate-3)

The stem is circular in transverse section. Outermost layer is known as epidermis. It is single layered and covered with cuticle (Fig.1). The cells are compactly arranged without any intercellular spaces. The cortex is lie below the epidermis. The outer three or four layers of ground tissue are collenchymatous; the remaining ground tissue is parenchymatous; the cells are angular, compact and thin walled. The vascular strand consists of external phloem, xylem and internal phloem, traversed by narrow rays. The phloem includes sieve elements, phloem rays and phloem parenchyma (Fig.2). In the secondary xylem, the vessels occur in radial chain. The xylem fibers are highly thick walled and lignified and the cell lumen is reduced. There are numerous cells with phenolic content, calcium oxalate prismatic crystals (Fig.4). Centrally pith made of compact parenchymatous cells.

Concordant result was also observed by Sudhakar *et al.* (2012). They observed the diagnostic characters of stem like presence of rod-shaped calcium oxalate crystals in some cells of the cork region of stem and fruit of *Syzygium alternifolium*. Wangkhem *et al.* (2020) studied comparative wood anatomical properties of genus *Syzygium* (Family Myrtaceae) from Manipur, India. They studied the anatomical and physical characteristics of five *Syzygium* species, namely *Syzygium cumini, Syzygium fruticosum, Syzygium jambos, Syzygium nervosum* and *Syzygium praecox* and also saw intra and inter- species variation among them. Crystals in the ray of *S.nervosum* and *S. fruticosum* and silica bodies in axial parenchyma of *S.jambos* were also observed.

Our results are in accordance with the study of Reynertson *et al.* (2008). They reported the presence of anti-radicle phenolic constituents in a number of edible Myrtaceae fruits which included myricetin. In reference to the stem, the structural organization in *E. pyriformis* matched the description by Metcalfe and Chalk (1950) for the Myrtaceae and *Eugenia*, consisting of peripheral phellogen, external phloem, xylem and internal phloem forming continuous cylinders traversed by narrow rays, stone cells, phenolic compounds, calcium oxalate crystals and tracheary elements with small lumen.

Anatomical characters of stem is quadrangular, vascular tissue is a continuous bicollateral cylinder in all species. Pith presenting the centre of stem composed of parenchymatous storage cells of isodimetric to polyhederal thin layered cells with more or less large inter-cellular spaces. Cells are rich of druses crystals (Al-Edany and Al-Saadi, 2012). Calcium oxalate crystals have been reported in practically all the Myrtaceae studied (Cardoso *et al.,* 2009 ; Soh and Parnell, 2011).

Based on the results of the study, it can be inferred that morphological and anatomical characters should be considered together to identify *Syzygium aqueum* such as T.S. of root showed more or less a circular outline and consists of periderm, cortex, phloem and xylem. Phloem occurs in several thin patches around well-developed xylem. Centrally pith made of compact parenchymatous cells. T.S. of stem showed the vascular strand consists of external phloem, xylem and internal phloem, traversed by narrow rays. There are numerous cells with phenolic content, calcium oxalate prismatic crystals. This is the first report of anatomical studies in this species.

Morphological and anatomical evaluation may be useful in the identification of *Syzygium aqueum* which may act as reference information and produce a solid basis for proper identification, authentication, collection and investigation of this plant material. Further, it will be helpful for identifying the plants and prevent it from the adulterants and lead to a scope for further investigations and maintaining the quality, reproducibility and efficacy of natural drugs.

PLATE 1
Habit and flower morphology of *Syzygium aqueum*

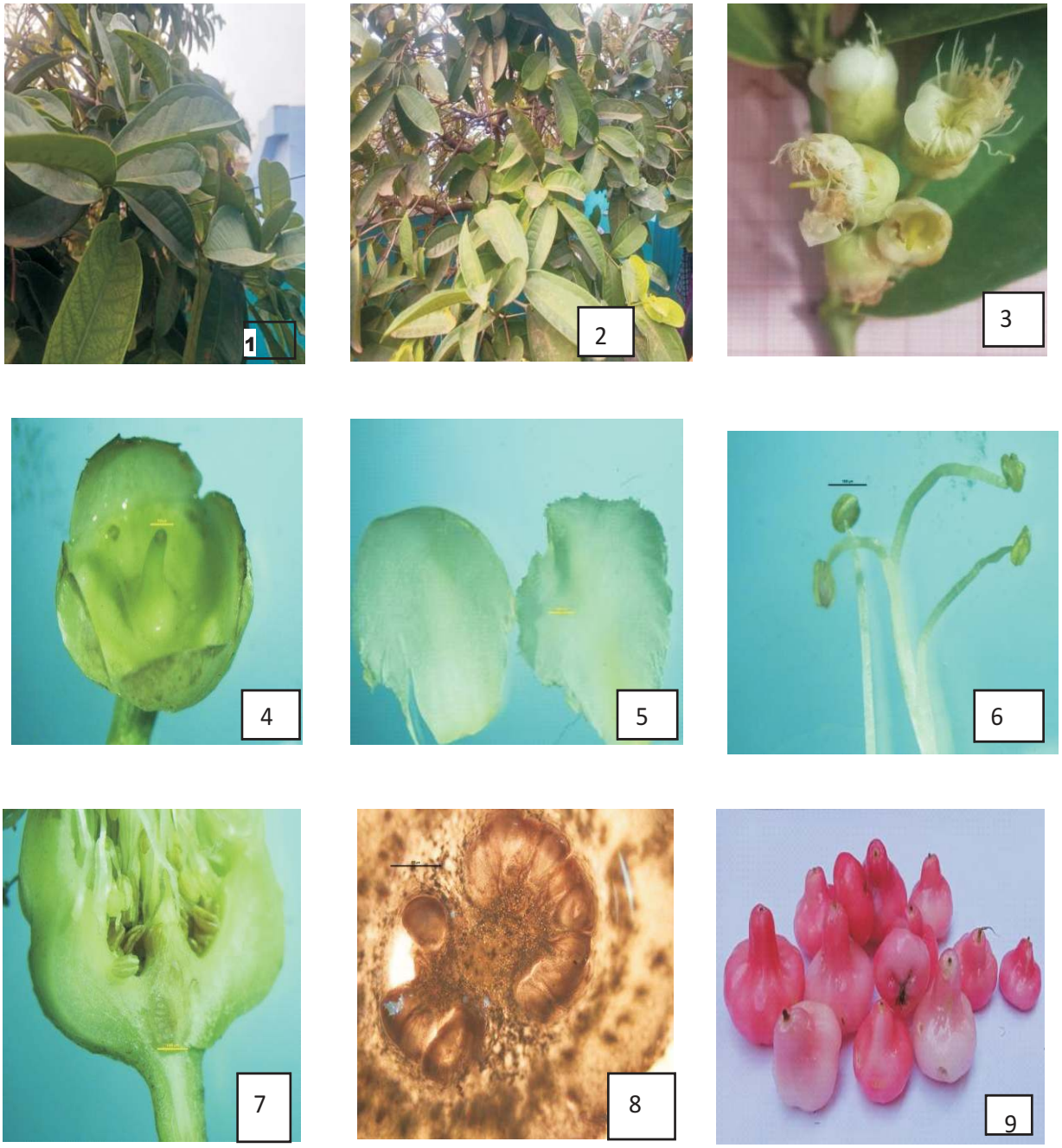
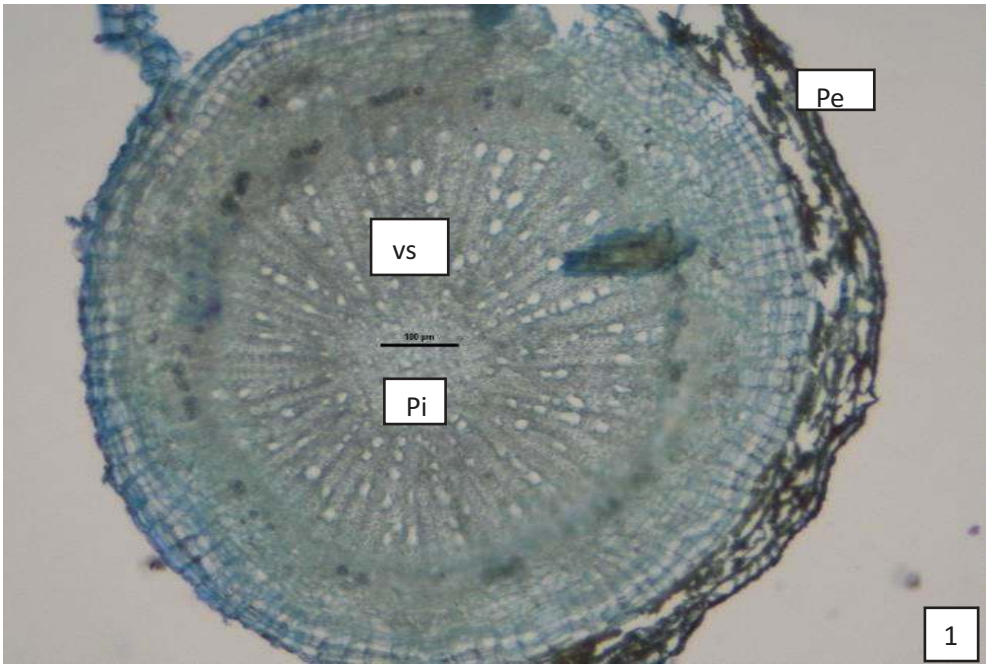


Figure1 & 2. Habit of *Syzygium aqueum;* 3- A twig contain mature flower *of Syzygium aqueum*; 4- Calyx with Gynoecium; 5- Corolla; 6- Androecium; 7- L.S.of flower ; 8- C.S. of ovary; 9- fruits of *Syzygium aqueum*

Plate 2

T.S.of root



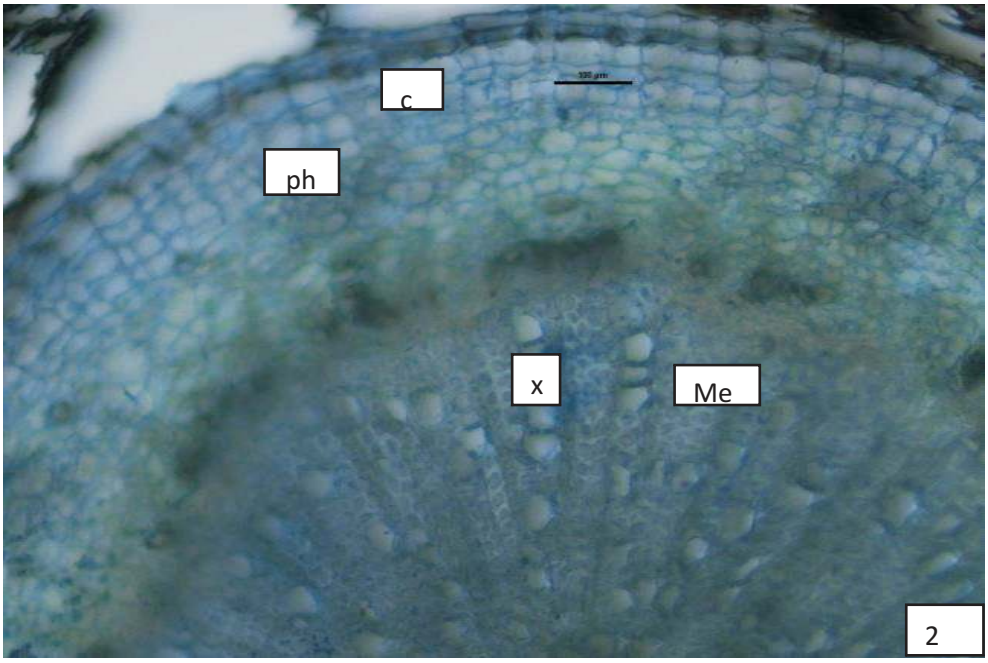
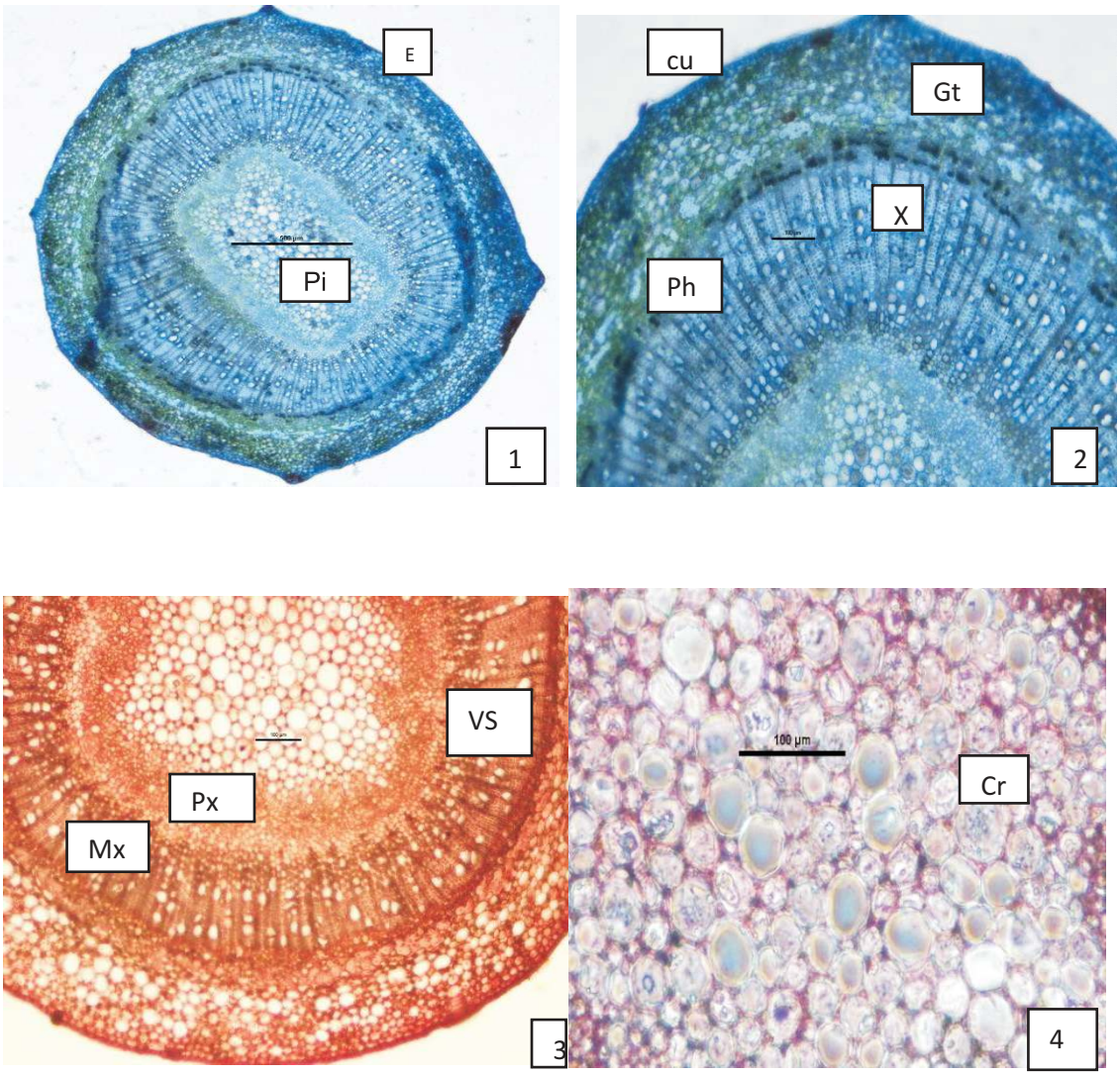


Figure-1. T.S. of root; 2 .T.S. of root- enlarged view
(Pe-Periderm; VS- Vascular bundle ; Ph- Phloem; Pi- Pith ; C- cortex; X-Xylem; Me-Medullary ray)

Plate 3

T.S. of Stem



Pi

Figure-1.T.S. of stem; 2&3 T.S. of stem-enlarged view; 4. Calcium oxalate crystals in cortex region (E-Epidermis; Cu- cuticle; Gt- ground tissue; VS- Vascular bundle ; Ph- Phloem; Pi- Pith ; X-Xylem; Px- Proto xylem; Mx- Meta xylem; Cr- Calcium oxalate crystals)

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