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COMPARATIVE MORPHO-ANATOMY OF TWO SEDGES (*Cyperus cyperoides* (L.) Kuntze and *Cyperus rotundus* L.)

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ABSTRACT

The research investigated the comparative morpho-anatomy of two sedges (Cyperus cyperoides (L.) Kuntze and Cyperus rotundus L.), members of the family Cyperaceae. They are perennial herbs and the former commonly known as commonflat sedge and the latter nut sedge or purple nutsedge.The epidermal peels were obtained by standard methods. The samples were fixed in formaldehyde, glacial acetic acid, 70% alcohol in the ratio of 1:1:18, dehydrated in alcohol solutions of 50%, 70%, 90%, absolute and sectioned, stained in 2% aqueous solution of Safranin O, counter stained in Alcian blue, mounted in glycerine.The result on epidermal studies showcased both kidney and dumbbell-shaped guard cells, graminaceous stomata which is amphistomatic for both species. The anatomical studies revealed scattered vascular bundies in ground tissues of stems, bulliform cells at adaxial foliar organs. The pith sections have large pith and a single row of barrel shaped endodermis prominently pronounced. The research findings here would assist in improving upon already existing knowledge about C. cyperoides and C rotundus.

Keywords: Anatomy, Comparative, Cyperaceae**,** *Cyperus***,** Morphology,

INTRODUCTION

Members of Cyperaceae are monocotyledonous graminoid flowering plants grouped as sedges, and they resemble grasses and rushes; contained about 113 genera and 5,732 species (Milne and Milne, 1975).Cyperaceae is the third largest of families in monocots (Lunkai *et al*., 2010). Consisting of about 600 species and *Cyperus* L. is the second largest genus in Cyperaceae (Kukenthal 1936; Rad & Sonboli 2008). They are widely distributed with centres of diversity occurring in Tropical Asia andTropical South America (Hipp, 2007). One unique attribute of sedges is their triangularcross section and spirally arrange leaves in three ranks, unlike grasses that havealternate leaves forming two ranks.*Cyperus rotundus* is considered to have originated in India but some believed that the origins are more widespread, including northern and eastern Australia (Parsons and Cuthberson, 1992), and the recorded occurrence in 92 countries also assumed their existence in countries of the tropics and subtropics (Holm *et al*.,1977). However, the most widely accepted distribution range considers *C. rotundus* as native to Africa and Eurasia (USDA-ARS, 2014).*Cyperus rotundus*is a C4 plant with kranz anatomy which supposedly made it increasingly

competitive due to high temperature and light intensity (Black *et al.*, 1969). *Cyperus rotundus* has low shade tolerance and one of the most invasive sedges (Holm *et al.*, 1977); based on countries,*Cyperus rotundus* also known as purple nutsedge, is a perennial weed.*Cyperus rotundus* is one of the most invasive weed known, found both in the tropical and temperate zones. In literature, it is believed to occur as a weed in over 90 countries, and infests over 50 crops worldwide (*Omezine and Harzallah-Skhili, 2009). It is a disturbing weed of farm lands* (Martin and Pol, 2009). There are aerenchymatous cells, bulliform cells, large meta xylem vessels and thick leaf which enabled *C. rotundus* get adapted to environmental conditions in agricultural fields, dryland salinity, salt marshes, and desert and semi-desert climates; its ecological success is due to plasticity in structural and functional features: bulliform cells, large meta xylem vessels, storage parenchyma, stomatal complexes and thick leaf which enabled *C. rotundus* in particular get adapted to varying environmental conditions be it in the tropics, sub tropics, desert and temperate regions as also supported by Mumtaz *et al*. (2019)storage parenchyma, wide xylem vessels for conduction of solutes, sclerenchyma and stomatal features for minimizing water loss (Mumtaz *et al*., 2019).Measured angles of keel for adaxial and abaxial surfaces for*C. cyperoides* less than 90^0 and more than 90^0 for *C. rotundus* (Mallick and Ghosh, 2018). Members of the genus *Cyperus* are increasingly becoming known for their great importance as food, medicine and industrial materials such as biogas production etc. Proper identification using taxonomic lines of evidence is relevant. Hence, the objectiveinvestigated the comparative morpho-anatomy of two sedges (*Cyperus cyperoides* (L.) Kuntze and *Cyperus rotundus* L.).

MATERALS AND METHODS

Geographic Location

The location of the parent plant studied was University of Port Harcourt, Port Harcourt, Rivers State, Nigeria.

Morphological Studies

The meter rule was used to ascertain the plant height from the root-collar to theterminal bud while leaf length from the leaf tip to the petiole base. The leaf width ismeasured across the leaf lamina, from one margin to another at the widest region.The epidermal studieswere done following standard method as given by Cutler (1977).Slides with good preparations were photo-micro graphed using Song Digital Camera on Monocular Microscope.

Anatomical Study

The plants were harvested from the wild for the secondary anatomy. The harvestedstems, leaves, petioles, flowers, fruits and roots were dehydrated in alcohol solutions following the methods of (Johansen, 1940) and free hand sections according to the method of Wahua (2020). Microphotographswere taken from good preparations using Sony camera of 7.2 Mega pixels having 2.411LCD monitor and High sensitivity ISO 1250.

RESULT

Morphological Studies

Cyperus cyperoides and *Cyperus rotundus* are sedges resembling grasses and rushes but leaves of *C. cyperoides* are shorter, narrower, flat, and linearthan those of *Cyperus rotundus* which are cylindrical and rounded. The differences and similarities are shown in Table 1, Plates 1 and 2.

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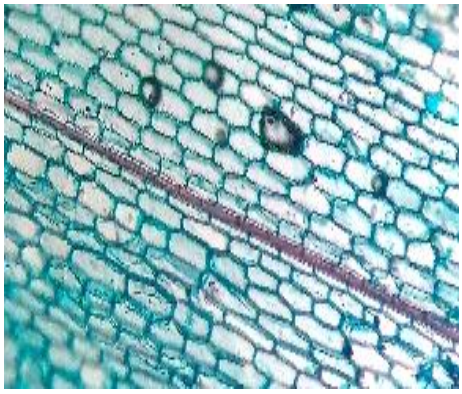
Plate 1: *Cyperus cyperoides*(L.) Kuntze; Plate 2: *Cyperus rotundus* L.

Table 1: Comparative morphology of*C. cyperoides*and*C. rotundus*

Features	*Cyperus cyperoides*	*Cyperus rotundus*
Ecological habitat	Damp grassy places or marshy land	Invasive weed wastelands and in crop fields and evasive
Plant height	Grows up to 45 ± 20 cm in height	40 ± 15 cm in height
Leaf	Glabrous, linear, bluish green up to 30 ± 6 cm long, blade acute, margins finely scabrous	Glabrous, linear, yellowish green up to 20 ± 10 cm long, 7 mm wide and emerge from a sheath around the shoot base.
Leaf sheath	Closed and Disposed tristically at base of stem. Both sides hairless.	Purple sheaths
Stem base	Dense tufted, trigonous, with basal leaves and short underground rhizomatous system.	Smooth with swollen bases.
Inflorescence	Simple umbel,	Smaller, more compact Compound umbel, terminal, open umbel subtended by several leafy bracts.
Spikes	In groups of small cylindrical head	Oblong to cylindrical, 1.2 ± 0.3 cm in length
Spikelets	Compressed 1 to 4 flowers protected by glumes with pointed apex.	3-8 reddish-brown to purplish-brown, flattened spikelets, each containing up to 30 glumes, 3.5-4 mm long.
Matured spikelets	small greenish or reddish one or two-flowered spikelet	Linear with acute tip, curved and sinuous.
Glumes	Imbricate in 2 rows	2.3 ± 0.5 mm in length
Achene	trigonous slightly arched longitudinally	3-angled achene, dark brown or black.
Rhizomes	Woody, and of swollen stem base	Rhizomes are wiry, dark and persistent, connecting a network of daughter shoots and tubers.
Root	Fasciculate and numerous	Fibrous

Epidermal Studies

Epidermal cells were of irregular shaped graminaceous structure. Their epidermal cells were observed in opposite direction with virtually no stomata found on the adaxial foliar layersat right angle to the vein-islets (Plates 3 and 4).



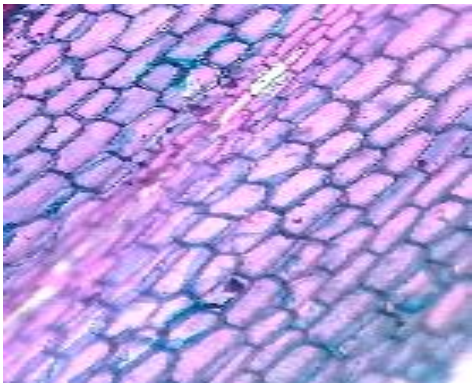
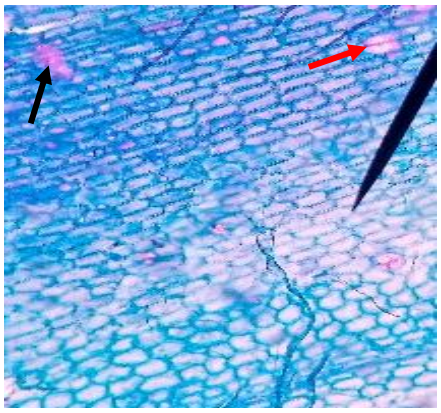


Plate 3: Adaxial surface of *C. cyperoides*; Plate 4: Upper Epidermal surface of *C. rotundus* The cells lined up by vein-islets are more rectangular and organized in *C. cyperoides* than those of *C. rotundus.*

The abaxial foliar surfaces of *C. cyperoides* and those of *C. rotundus* have numerous stomata but more on the latter than on the former. The cells lining the vein-islets are larger than those of the rest of epidermal cells in *C. rotundus* while the reverse is the case with *C. cyperoides* (Plates 5 and 6).



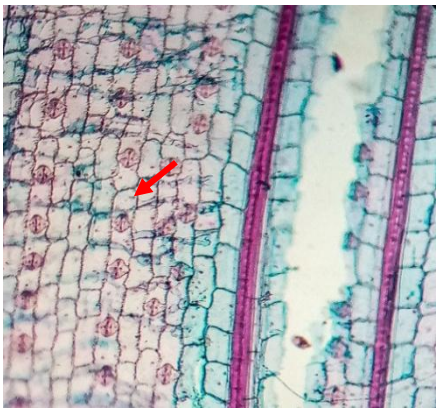


Plate 5: Abaxial surface of *C. cyperoides*; Plate 6: Lower foliar surface of *C. rotundus* Black arrow showed club headed trichome, red arrows is pointing stomata which is basically paracytic and gramenacous in structure.

Anatomical Studies

Sections made from the mid-rib, leaf lamina, stem and roots respectively, showcased similarities and differences between the species. Bulliform cells are larger in *C. cyperoides* than those of *C. rotundus*(Table 2;Plates 7 to 16).

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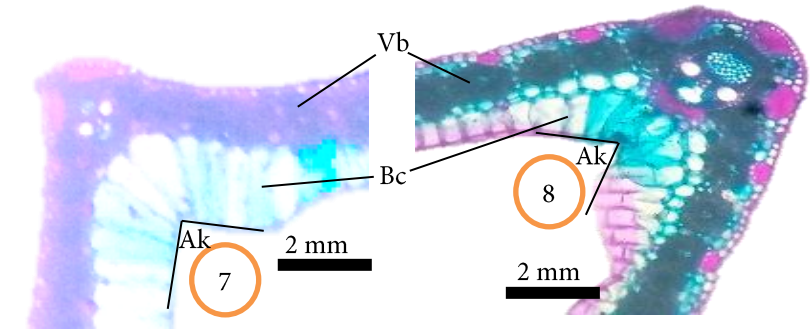

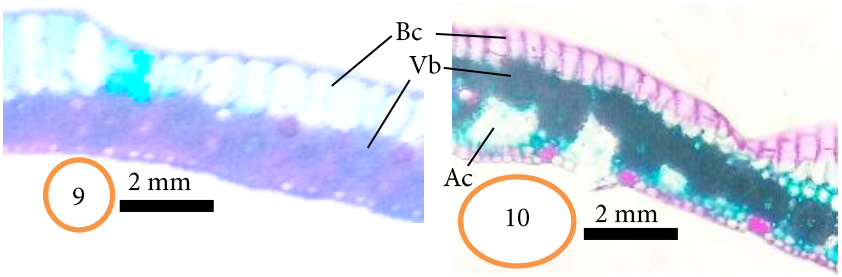

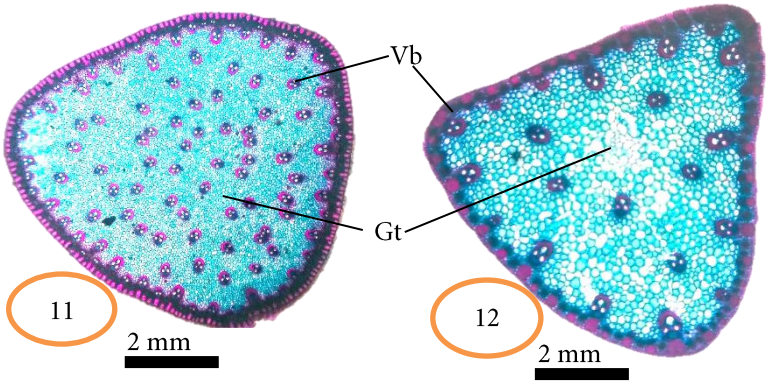

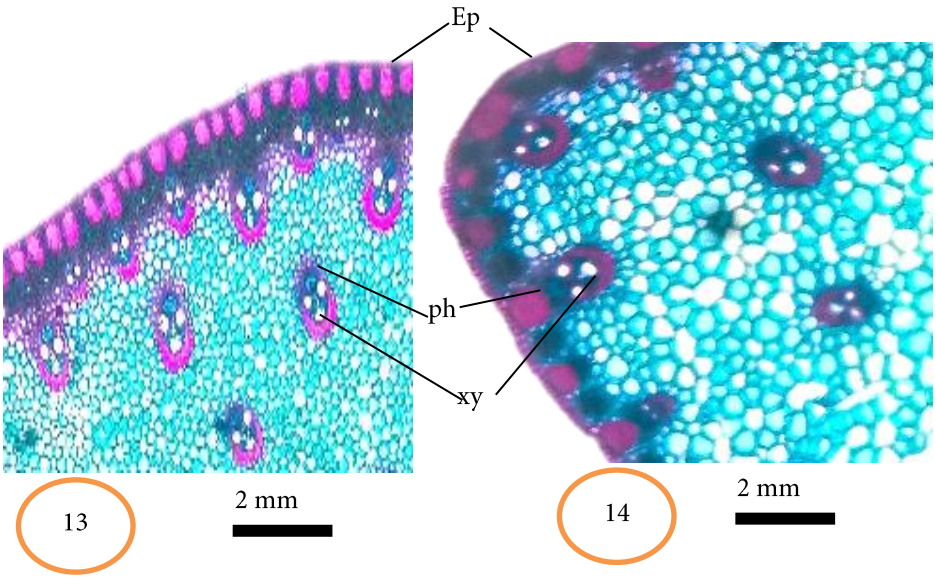

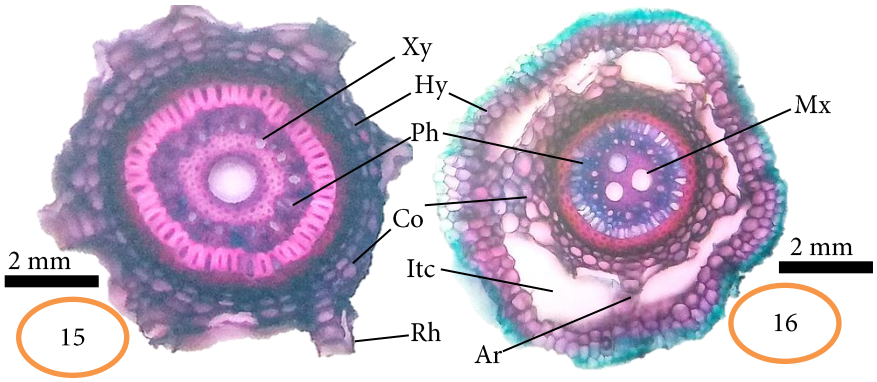

Plate7: Anatomy of Mid-rib of *C. cyperoides* (T.S.); Plate 8: Anatomy of Mid-rib of *C. rotundus* (T.S.)
Plate 9: Section of leaf lamina *of C. cyperoides*; Plate 10: Section of leaf laminaof *C. rotundus*;
Plate 11: Stem anatomy of *C. cyperoides* (T.S.); Plate 12: Stem anatomy of *C. rotundus* (T.S.)
Plate 13: Magnified portion of stem *C. cyperoides*; Plate 14: Magnified portion ofstemof *C. rotundus*
Plate 15: Root anatomy of *C. cyperoides* (T.S.); Plate 16: Root anatomy of *C. rotundus* (T.S.), Ep - Epidermis
Bc – Bulliform cells, Vb – vascular bundles, Gt – Ground tissues, Ac – air chamber, Ph – phloem, Xy – xylem, Co - cortex, Hy – hypodermis, Itc – intercellular spaces, Ar – aerenchyma, Mx – metaxylem, Rh – root hair, Ak – Angle of the keel.

Table 2: Anatomical properties of *C. cyperoides* and *C. rotundus*

Characteristics	*C. cyperoides*	*C. rotundus*
Ground tissues of stem	Scattered vascular bundles very numerous	Scattered vascular bundles not numerous
Hypodermis	3 to 6 rows of Sclerenchymatous cells	3 to 6 rows of Sclerenchymatous cells
Shape of section	Rounded to triangular	Triangular
Angle of keel (foliar surfaces)	Less than 90^0	More than 90^0
Nature of vascular bundle	Closed	Closed
Mid rib adaxial foliar mesophyll	Lined with tightly packed bulliform cells, with central ones biggest.	Lined with tightly packed bulliform cells, with mid ones biggest.
Mid –rib abaxial mesophyll	Air chamber not very prominently pronounced.	More air chambers, very prominently pronounced
Phloem tissues	Towards the palisade mesophyll	Towards the palisade mesophyll
Xylem tissues	Towards the spongy mesophyll	Towards the spongy mesophyll
Roots	Concentric arrangement, no intercellular spaces	Concentric arrangement with intercellular spaces at cortex
Foliar Leaf blade mid-section	V-shaped	Flanged V-/W-shaped
Foliar vascular bundles	less than 50	More than 50
Stem vascular bundles	More numerous	Less numerous
Foliar air chamber	Absent	Present

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Aerenchyma of root	Absent	Present
Vascular bundle sheath	Present	Present
Bulliform cells in leaf	Dissimilar to rest of epidermis	Dissimilar to rest of epidermis
Foliar leaf sclerenchyma	Formed strand above and below Vascular bundles	Formed strand above and below Vascular bundles

DISCUSSION

Cyperus cyperoides and *C. rotundus* have bundle sheaths which were very evident as also reported by Black *et al.* (1969) who also mentioned them to be C4 plants. There are bulliform cells, large meta xylem vessels, storage parenchyma, stomatal complexes and thick leaf which enabled *C. rotundus* in particular get adapted to varying environmental conditions be it in the tropics, sub tropics, desert and temperate regions as also supported by Mumtaz *et al*. (2019); the same applied to *C. cyperoides.* Stem vascular bundles are more numerous than those of *C. rotundus.*The angles of keel differ for both species as also supported by Mallick and Ghosh (2018).

CONCLUSION

*Cyperus cyperoides*and *Cyperus rotundus* on morphological basis, easier to differentiate during flowering season, though the color of the leaves slightly varies. Anatomically, their roots show clear variation, aerenchyma prominently pronounced in *C. rotundus* than as in *C. cyperoides.* Areas of further work may include: Histological properties, DNA barcodes and Cytological characteristics among others.

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