

**STUDIES IN CYPERACEAE. XIV. ENDOMORPHIC EVIDENCES  
FOR PLACING CYPERUS HYALINUS UNDER THE NEW  
SUBGENUS QUEENSLANDIELLA**

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## ABSTRACT

Detailed morphological and anatomical investigations of *Cyperus hyalinus* Vahl were undertaken and based on the data accumulated *Queenslandiella* Domin was accorded a new status as *Cyperus* L. subgen. *Queenslandiella* (Domin) Govindarajalu on a par with subgen. *Cyperus*, *Mariscus*, *Kyllinga* and *Pycreus* of the genus *Cyperus*.

## ABSTRAK

Penelitian morfologi dan anatomi *Cyperus hyalinus* Vahl secara mendalam telah diadakan dan berdasarkan data-data yang terkumpul maka marga *Queenslandiella* Domin diberi status baru sebagai *Cyperus* L. subgen. *Queenslandiella* (Domin) Govindarajalu setingkat dengan anak-anak marga *Cyperus*, *Mariscus*, *Kyllinga* dan *Pycreus* daripada marga *Cyperus*.

## INTRODUCTION

*Cyperus hyalinus* Vahl is one of the common cyperaceous taxa growing in paddy fields, wet and dry habitats of tropical E. Africa, India, Ceylon, Laccadive Islands, Malesia (Moluccas, Lesser Sunda Islands, Madura), Mascarene Islands and Australia. Nevertheless its taxonomic status under different genera or subgenera remains unsettled till today. By taking into consideration the occurrence of distichous glumes, compressed spikelets, distigmaty and laterally compressed nuts in *C. hyalinus*, Clarke (Fl. Br. Ind. 6: 591. 1893) has synonymized this species with *Pycreus pumilus* (Nees) Clarke. Domin (*in* Bibl. Bot. Heft 85: 415. 1915) has treated *C. hyalinus* as a synonym of *Queenslandiella mira* Domin which has been since reversed and synonymized with *C. hyalinus* and

placed under the genus *Cyperus* and its subgenera by later authors as follows: *Mariscus* Kükenthal (Pflanzenr. Heft 101: 498. 1936), the genus *Cyperus* itself (Koyama in J. Fac. Sci. Univ. Tokyo III, 8(3): 72. 1961) and *Kyllinga* (Kern, Fl. Males. 7: 655. 1974). Metcalfe (1971) following Domin has upheld *Queenslandiella mira* as a distinct taxon in his work on the anatomy of this family. It appears from the foregoing that there has been not only confusion and difference of opinion regarding the placement of this taxon, but also it reflects a difficult situation in which the application of mere conventional exomorphological criteria has not helped us so far in solving this problem. Therefore an attempt is made to exploit the endomorphological data towards solving this problem. As there are certain discrepancies observed in the available taxonomic description of this species with reference to the Indian samples, a revised account is also given here.

#### MATERIALS AND METHODS

The methods used by the author for the anatomical study of the cyperaceous taxa (Govindarajalu 1966, 1969a, 1969b, 1974) have been adopted in this work also. The following materials available in the Herbarium of the Presidency College, Madras (PCM) were used for the present investigation: *Govindarajalu 5252, 5256*, Presidency College campus, Madras; *Govindarajalu 5435*, Gingee, N. Arcot Dt.; *Rajasekaran 7096*, Ponnuthu, Ramanathapuram Dt.; *Sundram 17A*, Periakulam, Madurai Dt.

#### OBSERVATIONS

##### Morphological description

Annuals with a characteristic smell of fenugreek (when dry). Culms few to many, tufted, triquetrous, smooth, ribbed, sulcate, 4—14 cm high by 0.8—1 mm diam. Leaves many, flat, acuminate, scabrid on the margin towards top, distinctly keeled, longer than the culms, 10—25 cm long by 1—3 mm wide. Sheaths dull brown, membranous, sometimes 1—2 lowermost ones with or without reduced blades. Inflorescence simple or compound spike, open. Involucral bracts 3—6, obliquely erect or spreading, longer than the inflorescence, exactly resembling leaves, up to 20 cm long and 1—3 mm broad. Rays 3—5(—7), each consisting of 5—12 spikelets, often unequal in length, (0.5—)1—3 cm long. Rhachis membranously 4 winged. Spikelet alternately or suboppositely arranged in a spicate manner, spreading at right angles to the rhachis, oblong-elliptic ovate, strongly compressed, brown, 8—12 flowered, entirely

deciduous, acute, 6—6.5 X 2—2.5 mm. Rhachilla conspicuously flexuous, broadly winged, excavated, disarticulating at the base leaving a button like stub. Glumes broadly ovate, membranous, acute, sometimes excurved, strongly 3 nerved in each half, densely distichous, distinctly mucronate, prominently carinate, 2.8—3 (incl. mucro) X 2 mm; carina 3—5 nerved, strong, scabrid, excurrent into mucro; cells large, somewhat isodiametric, vertically straight and curving towards margin; mucro 0.5—0.6 mm long, excurved or straight. Stamens 2; anther oblong, apiculate, yellow, 0.4 mm long. Style glabrous, flat, slender, 0.5—0.75 mm long; stigma 2, slender, glabrous, as long as or longer than the style (up to 1.2 mm long). Islet biconvex, laterally compressed, suborbicular to broadly obovate, usually asymmetric, depressed or emarginate at apex, usually non apiculate, brown to dark brown with outer surface granulate, 1.2—1.5 x 0.8—1 mm.

#### Anatomical description

Leaf — *Abaxial surface*. Intercostal cells variable in size, thin-walled; walls moderately sinuous; stomata paracytic (L. 36—40  $\mu$ m; 40—44  $\mu$ m); subsidiary cells triangular (Fig. 1 A); interstomatal cells short with concave ends; silica cells rather elongated, thin-walled, each cell containing 2—3 cone shaped silica bodies surrounded by satellites (Fig. 1 C) occurring in a single sometimes in two continuous rows.

*Adaxial surface*. Cells elongated, hexagonal, thin-walled; walls conspicuously sinuous; stomata wanting.

*T.S. lamina*. Shape flanged V-shaped, asymmetrical with a median furrow and rounded keel (Fig. 1B, F). Margin rounded. Adaxial epidermal cells larger than those of the abaxial; adaxial and abaxial epidermal cells papillate in certain places. Cuticle thick on either surface but thicker over the bulliform cells (Fig. 1F). Bulliform cells 4—5 in number and not differentiated from the neighbouring epidermal cells (Fig. 1F). Stomata slightly raised, restricted only to the abaxial surface; guard cells with prominent outer ledge; substomatal chamber very narrow. Vascular bundles 61 in number, arranged unequally in each half of lamina (34 and 26 in each half respectively + 1 median bundles); vascular bundles of two different sizes, not regularly alternating with each other (Fig. 1B); the smaller bundles belonging to Type I and the large ones to Type IIIB (Cheadle & Uhl 1948a); metaxylem vessel member rounded in transectional view (Diameter 16—20  $\mu$ m). Metaphloem belonging to "regular type" (Cheadle & Uhl 1948b). Assimilatory tissue radiating. Bundle sheaths two layered, both complete; outer fibrous and inner parenchymatous. Submarginal adaxial, abaxial and midrib lateral sclerenchyma strands (Ht. 24—40  $\mu$ m; W. 40—100  $\mu$ m) pulviniform (Fig. 1B, F); abaxial strands in the remaining parts (Ht. 16—20  $\mu$ m; W. 32—36  $\mu$ m) trapezoid (Fig. 1D). Tannin idioblasts abundant.

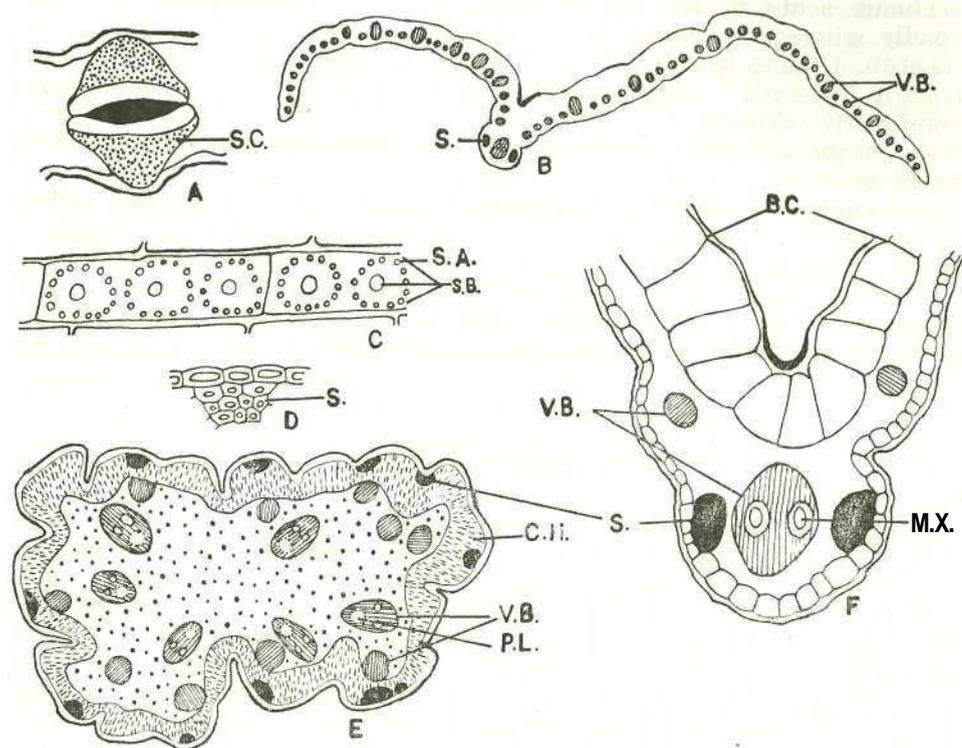


Fig. 1. *Cyperus hyalinus* Vahl. A. Stoma from lamina, surface view x 490; B. T.S. leaf x 32; C. Silica cells from lamina, surface view x 490; D. Sclerenchyma strand in T.S. from <sup>abaxial surface</sup> of leaf x 205; E. T.S. culm x 54; F. Laminal keel in T.S. x 205 (key to lettering:- B.C. bulliform cells; CH. chlorenchyma; M.X. metaxylem vessel; P.L. protoxylem lacuna; S. sclerenchyma strand; SA. satellite; S.B. silica-body; S.C. subsidiary cell; V.B. vascular bundle).

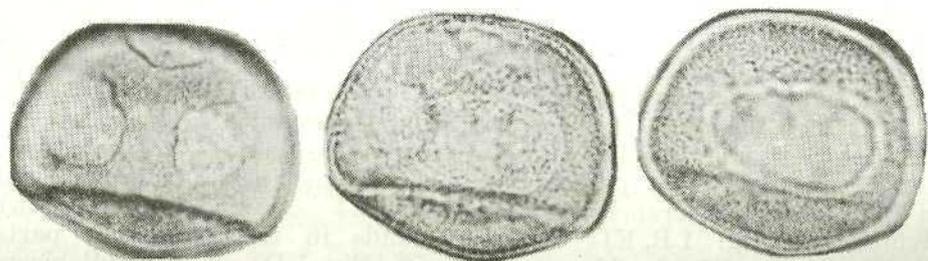


Fig. 2. *Cyperus hyalinus* Vahl. Different views of pollen grain x 1000.

Culm — *Epidermis, surface view*. Cells elongated with moderately thick sinuous walls. Silica cells overlying the peripheral strands long, or short, broad, moderately thick-walled, each cell containing 2–4 cone shaped silica bodies surrounded by satellites; silica cells occurring in a single discontinuous row. Stomata (L. 36–40  $\mu\text{m}$ ; W. 24  $\mu\text{m}$ ) thin-walled; subsidiary cells low dome shaped; interstomatal cells long with concave ends.

*T.S. culm*. Diameter of culm examined 1.1 mm. Outline subcircular with ridges and furrows (Fig. 1E). Cuticle moderately thick. Cortex chlorenchymatous. Air cavities absent. Sclerenchyma strands (Ht. 28–40 mm; W. 48–64  $\mu\text{m}$ ) pulviniform (rounded) with smooth sides. Vascular bundles 16 in number and of two different sizes, arranged in two rings: outer ring consisting of 10 smaller bundles (Type I) and inner ring of 6 large bundles (Type II) and the latter containing protoxylem lacunae. Bundle sheaths single layered, sclerenchymatous, complete; crescentiform sclerenchymatous inner cap (2–3 layered) present in all the bundles. Central ground tissue parenchymatous. Tannin idioblasts not seen.

Root — *T.S. root*. Diameter of the root examined 0.24 mm. Exodermis: cells exceedingly thick-walled. Cortex very narrow characterized by air-cavities. Endodermis: cells uniformly thickened all around. Pericycle consisting of thick-walled cells with very narrow lumen. Metaxylem element large, central, solitary. Protoxylem units 7 in number alternating with as many metaphloem units, each one of the latter containing a single large sieve tube element and 2–3 companion cells. Ground tissue sclerenchymatous.

### Pollen description

The pollen grains which are known as pseudomonads in this family are pyriform and tenuixinous; exine 1.8–2  $\mu\text{m}$  thick, semitectate; the perforations in the tectum is more or less fine; intine thin beneath the apertures and remains thick elsewhere; apertures 3 lateral (Fig. 2 A) and 1 basal (Fig. 2 B, C), circular-elliptical, often ragged, the basal apertures more readily discernible than the lateral ones; membrane areolate.

### DISCUSSION

The anatomical description of *Cyperus hyalinus* as given above clearly indicates a certain number of differences from that of its putative congeners under which this taxon has been accommodated by different authors. The anatomical details by which *C. hyalinus* differs from the following taxa respectively are enumerated as follows:

*Cyperus*.— Leaf: 1. absence of marginal prickles, crystals and air-cavities; 2. presence of adaxial groove; 3. poorly differentiated

bulliform cells.— Culm: 1. presence of fewer vascular bundles not penetrating towards centre; 2. vascular bundles not embedded in chlorenchyma; 3. subepidermal sclerenchyma strands fewer in number; 4. absence of air-cavities and 5. absence of radiating chlorenchyma around vascular bundles.

*Kyllinga*.— Leaf: 1. absence of marginal prickles, hypodermis and adaxial sclerenchyma strands; 2. occurrence of lesser number of silica bodies (2—3) per cell; 3. bulliform cells not well developed and differentiated; 4. presence of only one vascular bundle in the midrib; 5. vascular bundles not exhibiting any special pattern of distribution.— Culm: 1. absence of radiating chlorenchyma around the vascular bundles; 2. vascular bundles situated at inner boundary of chlorenchyma large and vascular bundles more closely spaced; 3. subepidermal sclerenchyma strands few and far between and being uniformly pulviniform throughout.

*Mariscus*.— Leaf: 1. absence of marginal prickles and air-cavities; 2. vascular bundles not showing any special pattern of distribution.— Culm: 1. transectional outline subcircular with ribs and furrows; 2. vascular bundles not reaching the centre; 3. subepidermal sclerenchyma strands few and far between and uniformly pulviniform throughout.

*Pycneus*.— Leaf: 1. transectional outline of lamina flanged 'V' shaped; 2. absence of air-cavities; 3. secretory cells abundant.— Culm: 1. cortex chlorenchymatous; 2. absence of radiating chlorenchyma around the vascular bundles; 3. solid ground tissue in the centre; 4. sclerenchyma strands few and peripheral appearing independent of vascular bundles and somewhat irregular in distribution.

When the anatomical differences between *C. hyalinus* on the one hand and all the above mentioned taxa on the other are found to be of qualitative nature and at the same time are so many in number, it is pertinent to consider this as a distinct taxon which deserves to be placed under a separate subgenus.

From the scanty palynological information available at present for the Cyperaceae as a whole, this family is well known for its stenopalynous character. Therefore it is not possible to expect that the pollen morphological characters will throw any light on a problem of this kind, and the pollen characters of *C. hyalinus* is not an exception in the sense that they resemble to a greater or lesser extent those of subgen. *Cyperus*, *Kyllinga*, *Mariscus* and *Pycneus* in some respects or the other.

Kiikenthal (I.e.) has treated *C. hyalinus* under *Cyperus* subgen. *Mariscus* sect. *Aristati* Kunth in spite of the distigmatic condition coupled with laterally compressed nuts, whereas all the remaining taxa

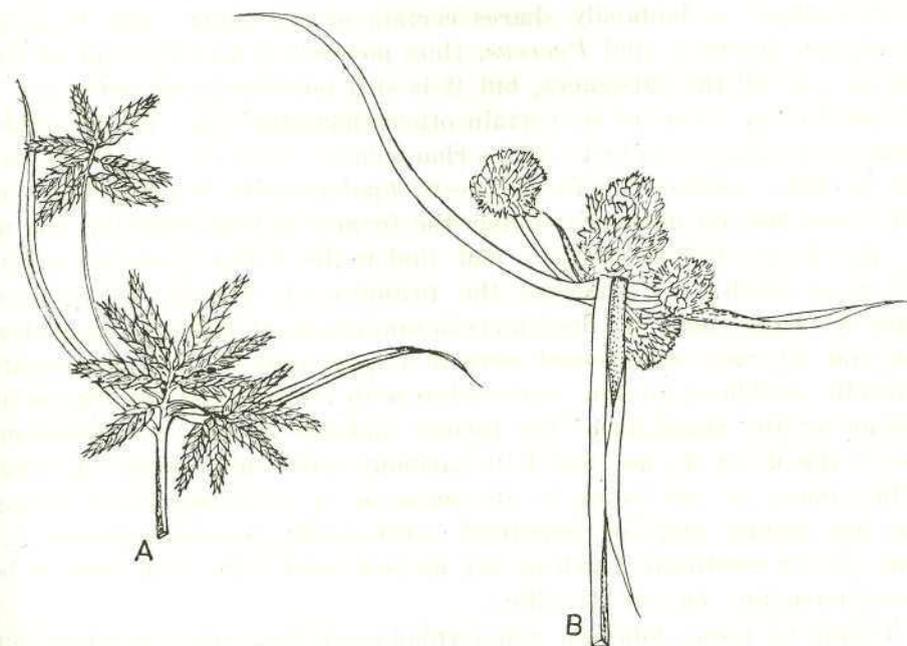


Fig. 3. A. Inflorescence of *C. hyalinus*; B. Inflorescence of *C. transitorius* Kiikenth. (both diagrammatic).

in this section possess trifid styles and trigonous nuts. On the other hand, Kern (I.e.) has placed this taxon under *Cyperus* subgen. *Kyllinga* sect. *Queenslandiella* (Domin) Kern. The basis for treating this taxon under these two different subgenera stems from the occurrence of deciduous nature of the rhachilla in *C. hyalinus* which is supposed to be the basic feature in circumscribing both the subgenera *Kyllinga* and *Mariscus*. Kern has offered additional justification in favour of its inclusion under the subgenus *Kyllinga* by stating that the shape and the structure of the glumes in both *Kyllinga* and *C. hyalinus* are similar, and that the open type of anthela which is characteristically seen in the latter is also encountered at least in a few species of the subgenus *Kyllinga* (though not common) as in *Cyperus* (subgen. *Kyllinga*) *transitorius* Kiikenth. Although the inflorescence of *C. transitorius* is said to be open and hence comparable with and similar to that of *C. hyalinus* so as to include the latter under the subgen. *Kyllinga*, the so called anthelate condition seen in *C. transitorius* and in *C. hyalinus* appears to be totally different from each other (compare Kiikenthal, I.e. Fig. 61 D and 3 B with Fig. 3 A).

*C. hyalinus* undoubtedly shares certain of the exomorphic features of *Kyllinga*, *Mariscus* and *Pycneus*, thus possessing an amalgam of the characters of all the subgenera, but it is still possible to differentiate it satisfactorily by virtue of its certain other characteristics. For example, should the deciduous condition of the rhachilla be taken into consideration, there is every justification to include *C. hyalinus* either under *Kyllinga* or *Mariscus* but its placement under the former is precluded because of the open type of inflorescence and under the latter because of the distigmatic condition. Likewise the presence of strongly compressed condition of the spikelets, distichous arrangement of the glumes, distigmaty and laterally compressed nuts in *C. hyalinus* appear to indicate a phenetic semblance to and relationship with *Pycneus* but the deciduous condition of the rhachilla of the former and the contrasting persistent state in the latter do not stand in harmony with each other. Another tell tale mark of this taxon is the emission of a characteristic strong odour resembling that of fenugreek (*Trigonella foenum-graecum* L.) in the siccate condition which as far as is known is not reported to be present from any one of its allies.

Taking all these endo- and exomorphological facts into consideration, it therefore appears not only logical to remove *C. hyalinus* from all the subgenera to which this taxon has been assigned but also prudence to establish a separate subgenus of its own on a par with other subgenera recognized under the genus *Cyperus*. This procedure will certainly facilitate easy recognition and at the same time the homogeneity of each subgenus will also be preserved. Therefore to accommodate *C. hyalinus* the new subgenus *Queenslandiella* is proposed as follows:

*Cyperus* L. subgen. *Queenslandiella* (Domin) Govindarajalu, *stat. nov.*

*Queenslandiella* Domin in *Bibl. Bot.* Heft 85: 415. 1915 (basionym).— *Cyperus* L. subgen. *Kyllinga* (Rottb.) Valck. *Sur. sect. Queenslandiella* (Domin) Kern, *Fl. Males.* 7: 654. 1974.

*Mariseopsis* Cherm. in *Bull. Mus. Paris* 25: 60. 1919.

This subgenus is characterized morphologically by open type of inflorescence, deciduous rhachilla, compressed spikelets, distichous glumes, distigmaty, laterally compressed nuts and fenugreek odour.

TYPE SPECIES : *Queenslandiella mira* Domin.

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