SIGNIFICANT DIFFERENCES MORPHOLOGICAL CHARACTERS OF POACEAE AND CYPERACEAE FAMILIES

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Abstract

The grass family Poaceae and Sedges family Cyperaceae are belonging to order Poales. (APG IV, 2016) and very similar in features. But these two families are so differing from each other by individual morphological characters. Grass belongs to family Poaceae (Gramineae) and the largest family in monocotyledonous gramineous flowering plants. The name of family Poaceae is derived from types genus *Poa* L. Family Cyperaceae is the third largest family of monocotyledonous gramineous flowering plants and type genus is *Cyperus.* Grass taxonomy is very different and difficult from other flowering plants. Grass floret is spikelet and individual spikelet possess each substances bract (glumes, lodicule) and various modified inflorescences types and underground organs. These reproductive and vegetative morphological characters of Poaceae is more advance evolution trends features than Cyperaceae. This feature agreed in evolutionary trends of morphological characters and APG IV 2016 system. Family Cyperaceae is one spiculose flower and these organized into spikelet (glumes, perianth). Spikelet further arranged into higher order spicate, paniculate or umbellate inflorescence (anthela). Flowers of both families may be perfect or imperfect, usually monoecious. In this research highlights the quite different characters of very similar morphological unit features of grass and sedges and then verify primitive and advance comparison characters between Poaceae and Cyperaceae with systematics science record in region, Myanmar.

Keywords Taxonomy, differences, grass, sedges, morphology, evolution

Introduction

The English word “grass” probably come from the Old Height German word grass (Bor 1960). Grass family Poaceae is widely adaptation in various habitats. Grasses are usually herbaceous, which indicates that they produce a seed, do not develop woody tissue, and die down at the end of a growing season. They are annual or perennial and monocotyledonous leaf sprouts from the seed fruit called grain (caryopsis) which feeds much of the world and they often have jointed, slender, sheathing (wrapping) leaves on alternately arranged in the stem(culm). Grasses can be large, giant grass bamboo, sugarcane, corn, or small like annual bluegrass. Though the grain is valued by humans, grasses have green leaves and stems not digestible for humans that are the main food source for animals. Some grain is fed to livestock but the leaves and stems are the mainstay of animals feed and can be used for building materials, medicines, and biomass fuels. The word Cyperus derived from the Greek word “Kyperas”. English name “Sedge” is “Sword-man ‘'with linear leaves and parallel venation, Stebbins (1956). Cyperaceae is a largely widespread and most suited to damp habitats with a preference for waterlogged often acids soil rich in humus. Cyperaceae grow in wetland, artificial marshes or swamps created for anthropogenic discharge such as wastewater, strong water ran off of sewage treatment in various parts of the world and it serve ecosystem services especially they can play in a particular role in the maintaining and improvement of water quality, Baker (1965). Cyperaceae leaves are three - ranked, meaning that, they arise as through off the points of tringle’s three-ranked condition. It is partially obvious in three- way sedges and their seed are achene. The study species were collected in some area of Kachin State, especially the Mohnyin University Campus and Mohnyin Distinct during vegetative and reproductive time from 2021, December to 2022, May. The survey area located in Group of Ywa-tthit-kone village, Mohnyin Township, Mohnyin Distinct in Kachin State, Myanmar. It is situated in 24° 47' 03" N and 96° 23' 21"E and above the

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elevation nearly about 6000 feet. The morphological characters of grasses comprise vegetative organs of culm (stem), underground organs, nodes, branching and prophyllum, leaves (sheath; blade, ligule) and reproductive organs of (inflorescences; spike, raceme, panicle; true panicle, false panicle, pseudospike and flower or spikelet (glumes, lemma and palea, lodicule, awned), seed (caryopsis). Family Poaceae are divided into 5 Subfamilies, Bambusoideae, Oryzoideae, Pooideae, Chloridoideae and Panicoideae based on the morphological characters of spikelet (flowers) and vegetative structure (Hafliger and Scholz's1981).

Genus Meloncanna in tribe Bambuceae of Sub-family Bambusoideae, genus Oryza in tribe Oryzeae of Sub-family Oryzoideae, genus Arundinella in tribe Arundinellae of Sub-family Pooideae, genus Chloris in tribe Chlorideae of Sub- family Chloridoideae, genus Pennisetum in tribe Paniceae of Sub-family Panicoideae in family Poaceae were recorded. The habit, leaves position, inflorescence variation types and more complexity spikelet structures are advance morphological characters of Poaceae than Cyperaceae in evolutionary trends. In Cyperaceae, vegetative organs; culm (stem), underground organs, leaves(trifoliate) involucre bract, reproductive organ; inflorescence (anthela) (Corymb, capitulum and spike), flower (spikelet, glume and perianth, seed (achene) are unit characters. Family Cyperaceae divided into 4 Sub-families are Sub-family Cyperoideae, Scripoideae, Rhynchoporoideae and Caricoideae (Halfliger and Scholz's1981). Genera of Actinoscripus, Pycerus Eleocharis, Lipocarpha in tribe Cypereae of Sub-family Cyperoideae and genus Scleria in tribe Sclerieae of Sub-family Caricoideae. This research highlights distinct differences morphological characters and evolutionary trends of family Poaceae and Cyperaceae under Order Poales in graminoids clade.

Materials and Methods

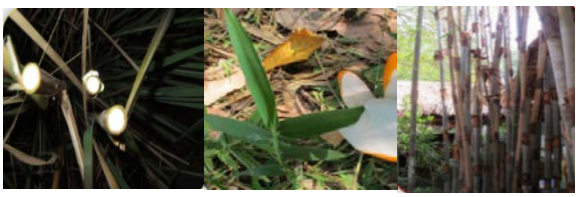
Collection Procedure and Classification, Identification, Verification and Evolutionary Trends

Specimens were collected from some areas of Mohnyin University Campus and Mohnyin Distinct during from 2021, December to 2022, May. The morphological characters of grass and sedges were classified according to Hafliger and Scholz's classification (1981) that based upon the morphological characters. The identification, verification and evolutionary trends were done by using keys, principles of many author citations; Rhind, 1945; Stebbins, 1956; Bor, 1960; Dassanayake et.al, 1968; Hafliger and schalz, 1981; Hundley and Chit Ko Ko, 1987; Willis, 2002, APG IV,2016.

Results

Morphology of Grass and Sedges

Culm Structure of Grass



Culm Structure of Sedges

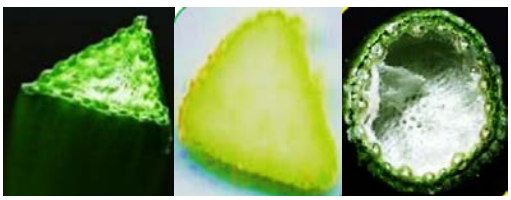


Figure (1) Terete to flattered and giant culm in Poaceae Triangular to terete culm in Cyperaceae

Structure of Grass Spikelet

The spikelet is the unit of inflorescences. It can be differentiated into 1 to 2 flowered and 1 to many flowered spikelet with articulation. The spikelet may be terete, flattened, gibbus and rounded shape. Spikelet comprises glumes. The basally outer 2 glumes are lower empty glume and upper empty glume. The flowering glumes; outer lemma and inner palea arrange the above of empty glumes and this joint portion called rachilla. All glumes may be various modified characters etc. texture, nerved, silky hairs, bristles and awns.

Figure (2) Habits

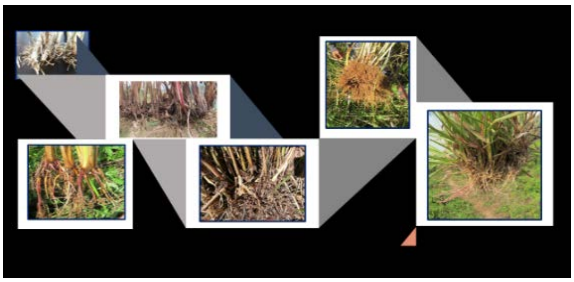


Figure (3) Various Underground Parts

Figure (4) Inflorescences, Spikelet

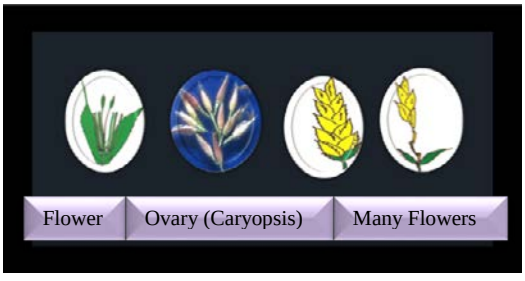


Figure (5)

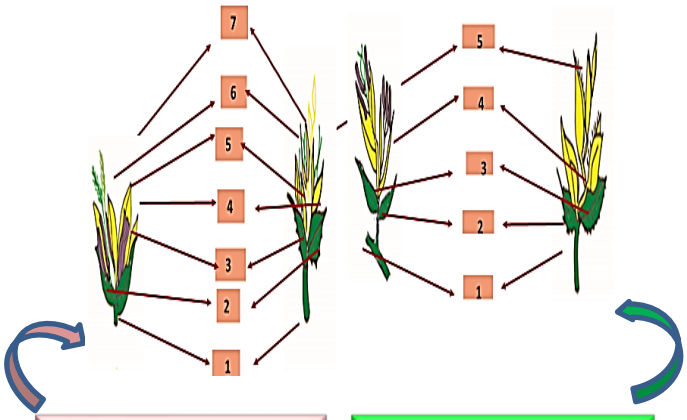


Figure (6) 2-flower spikelet,
1. Pedicel, 2. Lower glume, 3. Upper glume, 4. Lower lemma, 5. Lower palea, 6. Upper lemma, 7. Upper palea

More than 2 flower spikelet
1. pedicel, 2. Lower glume, 3. Upper glume, 4. Lowest lemma, 5. Upper most lemma

Spikelet Structure of Sedges

Cyperaceae spikelet (flowers) are protected by only one empty glume sometime two empty glumes and one flowering glume (sometime present perianth (scales or bristles). In multi-floral spikelet, these glumes may be two - ranked or spirally arranged, depend on the species. The spikelet may be either flattened or circular in crossing - section. In the primitive form, the spikelet axis is not articulated; the glumes are shed in an ascending sequence. In the advanced form the spikelet axis in articulated below each flower or glumes are united to the spikelet axis.

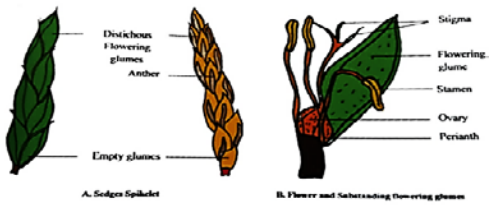


Figure (7) structure of sedges spikelet

Figure (8) Various Habits

Figure (9) Various Underground Parts

Figure (10) Inflorescences, Spikelet

Figure (11) Ovary (Achene)

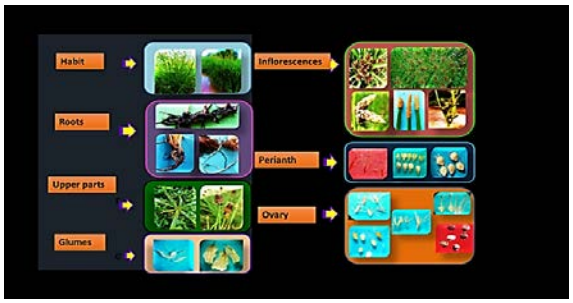


Figure (12) Sedges Morphological Characters

1. Family - Poaceae (Gramineae)
   Scientific Name - *Meloncanna arundina* Darkison (Tribe Bambuseae)
   Sub-family - Bambusoideae
   Myanmar Name - Kayan -wa- gale, Ta- been- daing- gale

Figure (13) 1. Habit, 2. Foliage leaf and branching, 3. Culm sheath; ligule and culm blade

An evergreen tufted moderate sized bamboo, singly from the rhizomes at distance, culm yellowish-green, culm surface puberulous. Culm up to 5 m high, 2.0 - 5.0 cm in diameter, wall up to 2.0 mm thick. Culm-sheath yellowish-green, shining cylindric, rounded and inflated, culm blade subulate acuminate, numerous branches at each node. Foliage leaf auricles with long hairs, branching is densely equally branchlets from node.

2.Family - Poaceae (Gramineae)
Sub-family - Oryzoideae (Tribe Oryzeae)
Scientific Name - *Oryza sativa* L.
Myanmar Name - Sa-ba

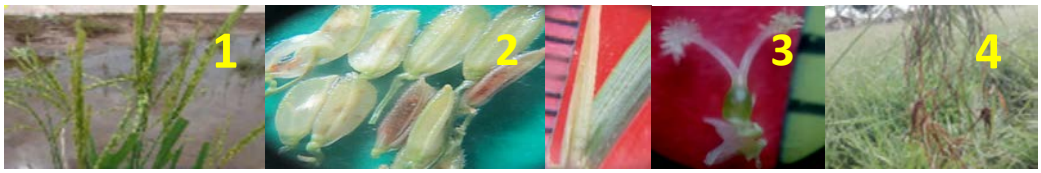


Figure (14) 1. Habit,2. Spikelet, 3. Ligule, 4. Ovary, Roots

Annual. Culm 40-50 cm high, terete. Leaf-sheath lanceolate; ligule membranous, acute, leaf blade linear. Inflorescence opens panicle, rachis scabrous joint of rachis and pedicel silky hairs. Spikelet solitary, lanceolate-oblong, light green to yellowish green, 7.0-8.0 x 2.0-2.5 mm, laterally compressed, pedicel 1.5-3.5 mm long, scabrous, rachilla disarticulating below the glume,1-flowered, bisexual, mature floret with 1-grain. Lower glume narrow-elliptic, Upper glume narrow elliptic. Lemma lanceolate-oblong, chartaceous, margins revolute. Palea lanceolate-oblong, chartaceous, cuspidate at the apex, margins revolute; lodicule 2; stamens 6, oblong, filament slender, ovary ovoid, style 2, stigma 2, plumose.

3.Family - Poaceae (Gramineae)
Sub-family - Oryzoideae (Tribe Oryzeae)
Scientific Name - *Oryza grandiglumis* (Doell) Prodhl.
Myanmar Name - Sa-ba

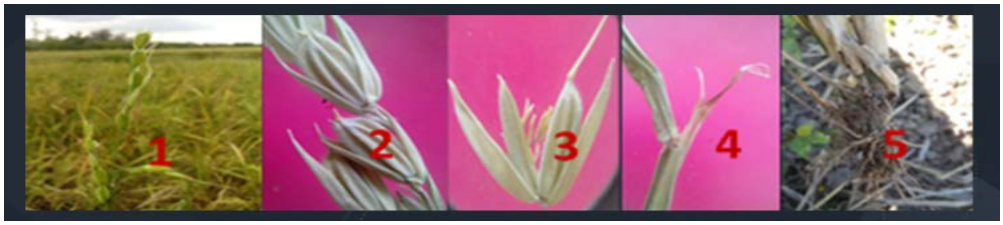


Figure (15) 1. Habit, 2, 3. Spikelet,4. Ligule, 5. Roots

Annual. Culm 60-70 cm high, terete, fibrous roots. Leaf sheath lanceolate, ligule membranous, leaf blade linear. Inflorescence opens panicle, peduncle straight, rachis scabrous, joint of rachis and pedicel with distinct hairs. Spikelet solitary, lanceolate-oblong, light green to yellowish green, 7-10 mm x 3.5- 4.5 mm, laterally compressed, acuminate at the apex, awned, persistent, pedicellate, pedicel 4-7 mm long, scabrous, rachilla disarticulating below the glume, 1-flowered, bisexual, glume equal, as long as the lemma and palea of same texture. Lower glume linear-lanceolate, 8.0-9.0, margins revolute. Upper glume linear-lanceolate, 8.0-9.0 x 2.0-2.2 mm, chartaceous. Lemma ovate-lanceolate, 7.0-7.5 x 4.0-5.0 mm, awn 2.5-3.5 cm long, scabrous, whitish, base of awn with dense hairs, 5-nerved, both margins and back scaberulous, margins revolute. Palea ovate-lanceolate, margins revolute; lodicule 2, distinct; stamens 6, oblong, filament slender, ovary ellipsoid, style 2, stigma 2, plumose.

4.Family - Poaceae (Gramineae)
Sub-family - Pooideae (Tribe Arundinellae)
Scientific Name - *Arundinella pumila* (Hochst) Steut
Myanmar Name - Kaing

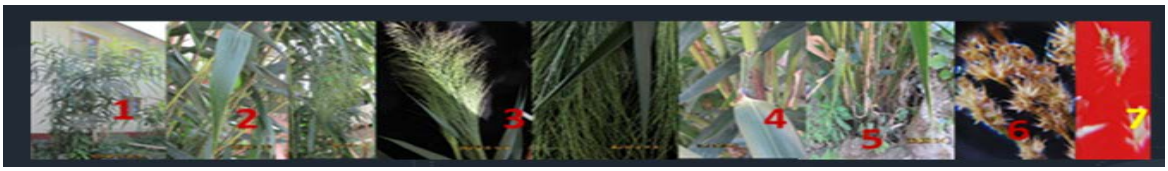


Figure (16) 1. Habit, 2. Leaf blades, 3. Inflorescences, 4. Rhizome, 6. Spikelet, 7.

Strongly reed like tall culm, rhizome system, inflorescences very large open plumose panicle, spikelet cluster, very small, bristle numerous, florets 4 - 6, lowest to middle floret perfect, the upper most neuter, inflorescences are used for cleaning material.

5.Family - Poaceae (Gramineae)
Sub-family - Chlorodoideae (Tribe Chlorideae)
Scientific Name - *Chloris Pilosa* Schmach
Myanmar Name - Unknown

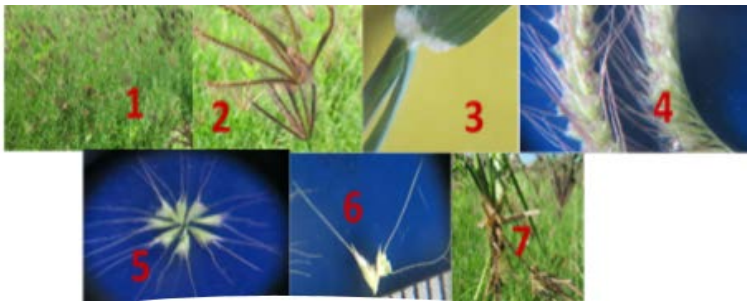


Figure (17) 1. Habit, 2. Inflorescence, 3. Ligule, 4. Spike, 5. Spikelet, 6. Floret, 7. Roots

Perennial. Culm 60.0-70.0 cm high, scabrous. Leaf sheath scabrous on the margins, ligule membranous fringe, leaf blade linear. Inflorescence spike-liked raceme, Spikelet paired or tried, 6-flowered, 3-awned. Lower glume narrowly linear. Upper glume narrowly linear, lower lemma ovate, awned, 3-nerved, awn 5.1 mm long, hair on the apex, light green color; lower palea ovate, 1.0-1.2 x 0.7-0.9 mm, membranous, acute at the apex, nerve less, upper floret ovate, awned, awn 5.1 mm long, 3-nerved; upper palea, awned, awn 4.8-5.5 mm long, ovary ovoid, 0.5 mm long, style 2, 0.5 mm long, stigma 2, 1.0 mm long, brown color, plumose.

6.Family - Poaceae (Gramineae)
Sub-family - Panicoideae (Tribe Paniceae)
Scientific Name - *Pennisetum parpareum* L.
Myanmar Name - Myet -Ya

Figure (18) 1. Habit, 2. Inflorescence, 3. Ligule, 4. Spikelet, 5. Floret

Perennial, erect, tufted. Culm 60-120 cm high, Leaf-sheath glabrous; ligule hairy ring; leaf blade linear-lanceolate, Inflorescences spike-like dense cylindrical or false panicle, peduncle and rachis scabrous. Spikelet paired; one sessile and one pedicellate, spikelet subtended by involucres bristles, spikelet falling with the involucres. Sessile spikelet linear-lanceolate, 2-flowered. Lower floret staminate and upper bisexual, awn less. Pedicellate spikelet linear-lanceolate, 2-flowered. Both florets staminate.

7.Family	-	Cyperaceae
Sub-family	-	Cyperoideae (tribe Cypereae)
Scientific Name	-	*Actinoscripus grossus* (L.F.) Goetah & D.A.Simpson
Myanmar Name	-	unknown

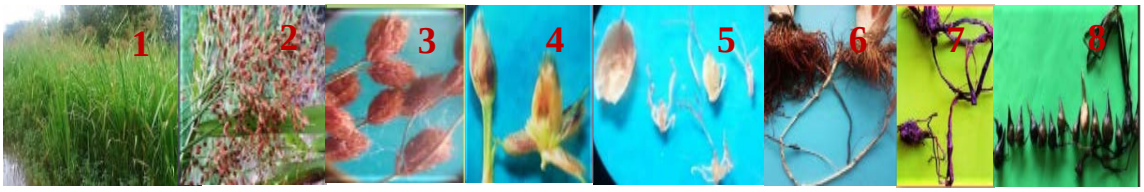


Figure (19) 1. Habit, 2. Inflorescences, 3. Spikelet, 4. Floret,. 5. Flowering glume, 6. Ovary with perianth, 7, 8. Stoloniferous with bulb

Herbs, perennial, rhizomes with stolon long and slender ending in small tubers(bulb), aquatic. Culm about 300 cm in length, compressed trigonous, erect, cespitose, scabrous, greyish green, culm base bulbous and reddish brown near to rhizome. Leaves 3 - 4; leaf sheath 3 - 5 cm long, reddish brown in color, spongy, glabrous, ligulate; leaf blade flat, margins scabrous, recurved. Involucre bracts 4 - 6, linear, flat, margin scabrous on the upper part, surfaces glabrous, yellowish green spreading. Inflorescence terminal large, corymbiform, decompound anthela; many rays; spike ovoid to globose 20 - 30 spikelet; spikelet ovoid to globose, terete, many flowered, reddish brown. Flower bisexual, acropetally deciduous, arranged in spiral. Empty glume absent. Flowering glume 1, ovate to broadly ovate, boat shaped. Perianth 3. Stamens 3; filaments slender; anthers connective present beyond anthers., apiculate, verrucose, pale yellow; style about 1.0 mm long, slender, glabrous, caducous, style and ovary flattened; obovoid to sub-ellipsoid, compressed trigonous, cuneate at the base not dilated, persistent, stigma 3.

8.Family	-	Cyperaceae
Sub-family	-	Cyperoideae (tribe Cypereae)
Scientific Name	-	*Eleocharis acutangular* (Roxb.) Schult
Myanmar Name	-	unknown

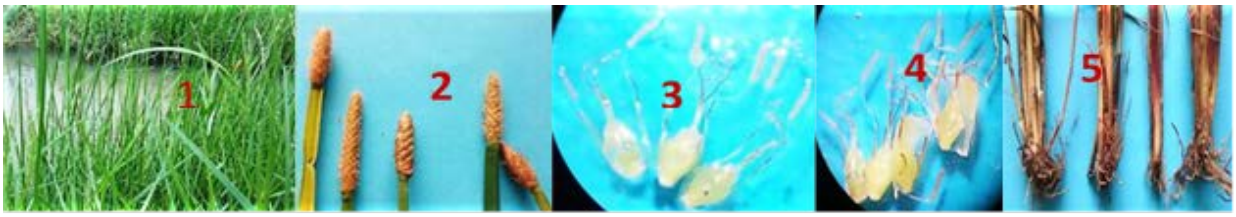


Figure (20) 1. Habit, 2. Inflorescence, 3. Ovary with perianth, 4. Flowering glumes, 5. Roots

Herbs, perennial, fibrous roots, aquatic. Culm 40 - 75 cm in length, narrowly trigonous, erect, stout, spongy, smooth, light-green. Leaves 2 - 3, leaf sheath 5.0 - 10.0 cm in length, membranous, lower portion of basal sheath brownish, leaf blade is minute, acute at the apex, membranous, pale green. Involucre bract absent. Inflorescence cylindrical terminal spike, broader than the culm, without ray or ray let; spike single globose-oblong; spikelet terete, apex acuminate, with many flowered. Flower bisexual, loosely imbricate, closely appressed to main

axis, acropetally deciduous. Perianth absent. Empty glume absent. Flowering glume broadly ovate, strongly persistent. Stamens 2, filaments later produced perianth appendage; anthers, linear, shortly apiculate, ovary, broadly obovoid, turgidly and biconvex, glabrous but shallowly pitted in longitudinal rows, pale yellow; style about 0.8 mm long, flat, style base subulate deltoids, reddish brown, persistent; stigma 3, recurved.

9.Family - Cyperaceae
Sub-family - Cyperoideae (tribe Cypereae)
Scientific Name - *Pycerus flavidus* (Rertzius) T.Koyama
Myanmar Name - unknown

Figure (21) 1. Habit, 2. Inflorescence, 3. Spikelet, 4. Floret, 5. Ovary with perianths, 6. Stoloniferous roots

Herbs, annual, stoloniferous roots. Leaves 3-5, leaf sheath about 3.0 cm long, membranous, reddish brown, glabrous; leaf blade, linear, flat, margins scabrous, surfaces glabrous, apex acute, recurved, brightly green. Involucre bract 2-4, linear, erect, rigid spreading, yellowish green, margin scabrous on the upper part, surfaces glabrous. Inflorescence simple or compound congested anthela; 7 - 13 rays; congested into a single or head like cluster of spikes; spikelet spreading, and forming a globose spike, each with 8 -14 flowered, greenish yellow. Flower bisexual, acropetally deciduous, distichous. Empty glume1.Flowering glum 1, broadly ovate. Perianth 2 – 3, slightly flat. Stamens 2; filaments minute, later produced perianth appendages; anthers about 1.0 mm long, yellow, connective present beyond anthers. Ovary about 1.0 x 1.0 mm, ob.-ovoid, biconvex, slightly compressed, minutely apiculate, cuneate at the base, distinctly verrucose; style about 1.0 mm long, slender, glabrous, style base not dilated, persistent, pale brown; stigma 2.

10. Family - Cyperaceae
Sub-family - Cyperoideae (tribe Cypereae)
Scientific Name - *Lipocarpha chinensis* Osbeck
Myanmar Name - unknown

Figure (22) 1. Habit, 2. Inflorescence, 3. Spike, 4. Spikelet, 5. Ovary, 6. Fibrous roots

Herbs, annual, fibrous roots, aquatic. Culm about 27.0 - 30.0 cm in length, angular, concave both sides, erect, slender, cespitose, smooth, greenish, glabrous. Leaves 5-7; sheath closely compressed to the culm, greenish -brown; ligule membranous, Involucre bract 6, very narrowly linear, Inflorescences compound very narrowly spike anthela, broader than the culm. Spike densely; each spike with 2-5 spikelet, ellipsoid, spikelet terete, 11- flowers. Flower bisexual, spirally arranged, empty glume 3, lanceolate, middle nerved to form awned, perianth 1, persistent. Stamen 1, flattened, ovary narrowly linear, stigma 2, strongly recurved, fimbriate.

11. Family - Cyperaceae
Sub-family - Caricoideae (tribe Sclerieae)
Scientific Name - *Scleria biflora* Roxb
Myanmar Name - unknown

Figure (23) 1. Habit, 2. Inflorescence, 3. Spike, 4. Spikelet, 5. Floret, 6. Ovary, 7. Root

Herbs, annuals, fibrous roots, terrestrial. Culm 25.0 – 60.0 cm in length, greyish green. Leaves ranked weak cauline, sheath tubular, sheaths 3 sided, loosely surrounding the culm. Involucre bracts about 15.0 x 1.0 cm, sheathing with brown pubescence, branchlets setaceous much longer than spikelet, but not over topping the total inflorescence. Inflorescence spike like raceme, with 2 - 3 brunches, narrow, elongate, peduncles slightly excreted from bract sheath; smooth peduncles. Flower mostly unisexual, male and female or male and some bisexual; 1 or 2 in a cluster narrowly ovoid; mostly unisexual; female spikelet 4 or 5 glumes and 1 female flower; male spikelet with 7 - 9 or more glumes and male flower. Empty glume absent. Perianth absent. Stamens 2 - 3; filaments slender; anthers short. Ovary spherical, surface reticulate, purplish brown, apex with a purple tip or stipitate, short gynophore or cupula, stigma 2, purplish brown.

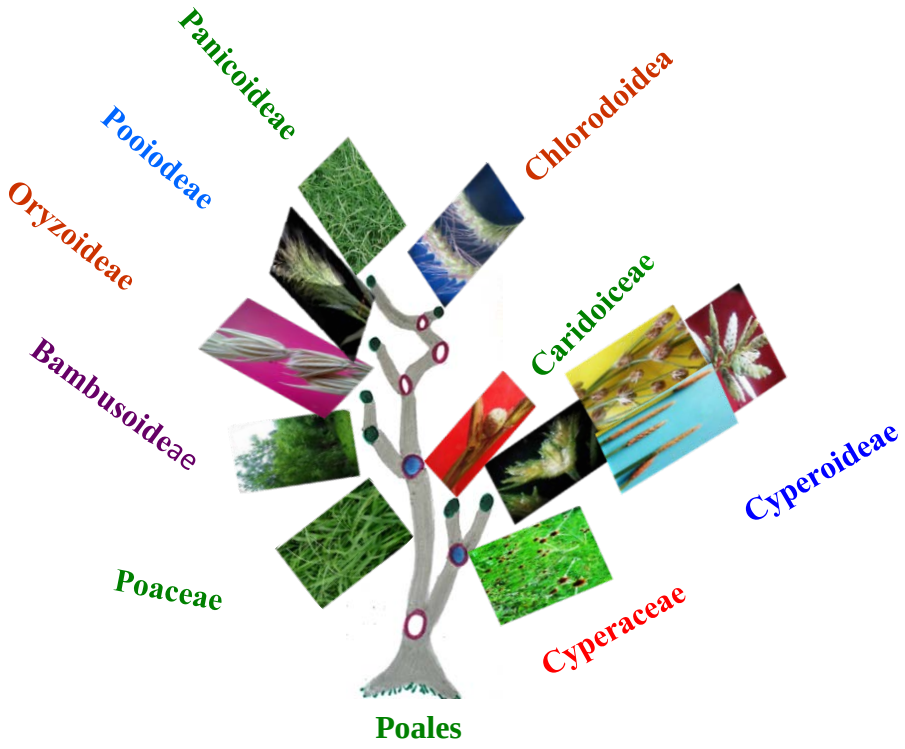


Figure (24) Evolutionary trends of Poaceae and Cyperaceae under clade Order Poales

Useful of Wild Grasses and Wild Sedge Species for Daily Household Materials

Figure (25) *Arundinella pumila* (Hochst) Steut, the whole plant is used for broom

Figure (26) *Eleocharis acutangular* (Roxb.) Schult. Culm fiber makes hat and roof materials for house

Discussion and Conclusion

According to cladistic analysis of APG IV (2016), family Cyperaceae stands more primitive evolutionary trends and it distance 6 families far from family Poaceae under clade of Order Poales by their morphological and molecular data. Poaceae is one of the largest and most so difficult morphological features among the flowering plants and the most economic important family and very widely adaptable status on various environmental conditions than other families. Cyperaceae is growing preferable in wet and swamp aquatic areas and some species is very useful for various point of humanity and economic status *(Actinoscripus*; tuber for food and *Eleocharis*; used for fiber). Poaceae is identified and classified by vegetative characters in genus *Meloncanna arundina* Darkison, tribe Bambusaceae in Sub- family Bambusoideae, this is more evolutionary advance characters than family Cyperaceae. Bamboo floret's stamens is six, Bor (1960).*Oryza sativa* L. and *Oryza grandiglumis* (Doell) Prodhl in tribe Oryzeae of Sub-

family Oryzoideae are six stamens , lemma and palea textures are strongly rigid and cover the sexual organs this is closely related evolutionary primitive features with Bambusoideae and differ from other Sub- families of Poaceae and Cyperaceae, and agree with principles evolutionary status of Baker (1965*). Arundinella pumoila* (Hochst) Steut tribe Arundinellae in Sub- family Pooideae is reed like primitive culm but broadly advance open panicle inflorescence and its advance evolutionary features, Baker (1965), Hafliger and Schole (1981). *Chloris Pilosa* Schmach in tribe Chlorideae of Sub-family Chloridoideae with rarely 3- awned structure. It is so great advance character spikelet from other species for distribution of floret characters in family Poaceae. *Pennisetum parpareum* L. in tribe Paniceae of Sub- family Panicoideae is densely bristles spikelet advance modified character and readily distributed than other recorded 10 species, this characters agree with phylogenetic principles of Baker (1965), Dassanayake et. al (1968). In family Cyperaceae, genera of *Actinoscripus grossus* (L.F.) Goetah & D.A.Simpson in tribe Cypereae of Sub-family Cyperoideae) and *Scleria biflora* Roxb in tribe Sclerieae of Sub - family Caricoideae possess tuber (bulb) advance modified underground organs and *Scleria* is very rare spherical ovary from other species of family Cyperaceae. In tribe Cypereae; *Pycerus flavidus* (Rertzius) T.Koyama possess concave ovary with 3 persistent hyaline perianths and *Eleocharis acutangular* (Roxb.) Schult is narrowly slender culm and reduce involucre bract is modified features for adaptation of evolution trends. *Lipocarpha chinensis* Osbeck is so difference characters of star shape anthela and this is own distinct primitive features for reproductive status, this is agreed with concepts of evolutionary trends of Stebbin (1965). Moreover, the simplicity to complexity of both two families; Poaceae and Cyperaceae are integration of some features but so quite differences morphological features in evolution under Order Poales in graminoids clade of monocotyledonous gramineous flowering plants. This research highlights and supports the future outcome researches for graminoids clade's evolutionary trends of systematics science record in region, Myanmar.

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