



Taxonomic Perspective of Grasses; a Potential Resource of Cholistan Desert, Pakistan

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Abstract

Poaceae is the fourth largest family of flowering plants. The present study provides an enumeration of grasses taxa of Cholistan desert with their local name, distribution, taxonomic investigation and their voucher specimens. A total of 34 grasses were identified belonging to 23 genera, 9 tribes and 3 subfamilies from the study area. The study revealed that the area harbors high plant diversity. This taxonomic study will help in classification and identification of grasses. It is very essential to identify such important grasses and develop a strategy for their conservation. These grasses play a significant role in the management of various human essentials and ailments in the study area. Awareness was thus needed to be raised among local people on sustainable management and utilization of plant resources of the area.

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Introduction

Poaceae is the fourth largest family among the flowering plants and containing about 60 tribes, 793 genera and 10, 000 species throughout the world (Clayton and Renvoize, 1989; Watson and Dallwitz, 1994). Poaceae represented by 26 tribes, 158 genera and 492 species in flora of Pakistan (Cope, 1982). Grasses occurs in a diversity of habitats from tropics to Antarctica but their abundance is greatest in the temperate regions. The adaptability of many species has enabled them to thrive under the most varied conditions; some of them are aquatic and others are characteristic of extremely arid and desert places. Grasses believe a greater importance in areas like a tropical/subtropical ecology and an agrarian economy but grasses have not been given sufficient attention in the floristic and taxonomic record of the region. Some earliest researchers have made only an inventory or floristic lists but lacking of the specific grasses taxonomic studies (Arshad and Rao, 1994; Arshad and Akbar, 2002; Wariss, 2012; Wariss *et al.*; 2013). There is an essential need to study the systematic description and classification of the grasses of Cholistan desert. In the present study, an updated account of grasses from the cholistan desert documented, in order to identify the plant species and provide baseline information for future studies.

Materials and methods

The comprehensive field surveys have been done to explore the grasses at regular intervals during 2009-2011. Field information's like micro-habitats, habit, associated plant species, status of plant, flower colour and flowering season has been recorded. The collected specimens were examined and microscopic studies have been done at the Cholistan Institute of Desert Studies, The Islamia University of Bahawalpur and Centre for Biodiversity and Conservation, Shah Abdul Latif University, Khairpur (Mir's) Sind, Pakistan. Grasses were identified and described with most recent techniques and with the help of various floras, illustrations and monographs (Ahmad, 1954; Cope, 1982; Jaffari, 1966; Stewart, 1972; Matthew, 1981-83; Bhandari, 1978; Chaudhary, 1989; Shetty and Singh, 1987 & 1991).

The collected specimens were dried, preserved and deposited in the herbarium of Cholistan Institute of Desert Studies, The Islamia University of Bahawalpur for future reference.

Results and discussion

In the current study, a total of 34 plant species belonging to 23 genera, 9 tribes and 3 subfamilies of Poaceae from the study area have been recorded. The keys to subfamilies, tribes, genera and species having more than one in number are given before their taxonomic description in an alphabetical order respectively. Each species enumerated as with its botanical name, local name, description, flowering period, distribution and specimens examined with the name of herbarium and voucher number given in parenthesis (Herb CIDS as Herbarium of Cholistan Institute of Desert Studies).

Key to sub-families

1. + Lemma 5-many nerved.
- 2 - Lemma 3-nerved.

A. Chloridoideae

2. + Spikelets 2-flowered, the lower floret male or sterile, rarely bisexual, the upper always bisexual.

B. Panicoideae

- Spikelets 1-many flowered, all the florets bisexual.

C. Pooideae

1. Sub-family A. Chloridoideae

In Cholistan desert sub-family Chloridoideae represented with 6 tribes distinguished by the diagnostic characteristics.

Key to tribes

1. + Spikelets containing 1 fertile floret with or without 1 or 2 male or borne florets below it or more. 3
- Spikelets containing 2 or more fertile florets, rarely 1 but this succeeded by several sterile lemmas reduce to a clavate mass. 2
2. + Lemma 1-3 nerved, if 5-nerved then the lowermost lemmas empty and resembling the glumes.
- d. Eragrostideae
- Lemma 9-11 nerved.

a. Aeluropodeae

3. + Inflorescence an open or contracted panicle.

4

- Inflorescence 1-sided spikes or many-sided cylindrical spike or false spike. 5

4. + Lemmas bearing 3-branched awn.

b. Aristideae

- Lemmas usually awnless; glumes and lemmas similar in texture,

the former often shorter; grain with loose pericarp. e. Sporoboleae

5. + Inflorescence a many sided cylindrical spike or false spikes. f. Zoysieae

- Inflorescence of racemes or spikes, these solitary, digitate or

scattered along an axis.

c. Chlorideae

a. Aeluropodeae

Aeluropodeae represented by only one genus in Cholistan desert.

1. *Aeluropus lagopoides* (Linn.) Trin. ex Thw., Cope in Nasir and Ali, Fl. Pak. 143: 63 (1982).

A rhizomatous perennial; stem crowded, resembling stolons, giving off branchlets at the nodes but not the roots, arising from a thick root-stock with stout root fibers; culms 5-15 cm high, erect or creeping at the base. Leaf-blades narrow lanceolate, acuminate, flate or convolute, subulate, spreading, sparsely ciliate; up to 4 cm long, 2-3 mm broad, rigid, pungent, margins scabrid; ligule a minutely hairy ridge. Inflorescence a panicle of a globose, elliptic or oblong head of densely crowded spikelets, up to 2 cm long, 1-1.5 cm broad. Spikelets densely crowded in hairy spikes or together, 4-8-flowered, elliptic-oblong, 2.5-3.5 mm long, 2-2.5 mm wide; sessile, villous with soft hairs, pale-green or white. Glumes elliptic, unequal, villous, the lower 1-3-nerved, c. 1.5 mm long, the upper 3-5-nerved, c. 2 mm long; lemmas broadly elliptic, apiculate, 9-nerved, 2.4-2.8 mm long, villous; lowest lemmas sometimes empty; anthers 1.5 mm long. Grain 0.6 mm long, ovoid-oblong, dorsally compressed.

Flowering period: September-December

Distribution: Northern Africa from Morocco to Somalia; Sicily and Cyprus through the Middle East to Central Asia and India and Pakistan (Cope, 1982).

(Sind, Baluchistan & Punjab, Cholistan desert; Jano Wali, Derawar Fort, Dodhlan Plantation, Shadi Wali Dahar)

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 33 (HERB. CIDS).

b. Aristideae

It is represented by two genera and 4 species in Cholistan desert.

Key to genera

1. + Central awn-branch glabrous.

1. *Aristida*

- Central awn-branch plumose.

2. *Stipagrostis*

1. *Aristida* Linn.

A genus of about 260 species in areas of poor dry soils with low rainfall; 7 species occur in Pakistan (Cope, 1982) and in Cholistan desert represented by 3 species.

Key to species

1. + Lemma or column not articulated at its summit.

1. *Aristida adscensionis*

- Lemma or column articulated at the summit and breaking cleanly across when mature.

2

2. + Lower glumes always longer than the upper, base of the callus pointed.

2. *Aristida funiculata*

- Lower glume shorter than the upper, base of the callus forked.

3. *Aristida hystricula*

1. *Aristida adscensionis* Linn., Cope in Nasir and Ali, Fl. Pak. 143: 41-43 (1982).

Local Name: Lumb

An annual, forming erect or sprawling tufts 10-50 cm high, culms erect or ascending from a shortly decumbent base, densely tufted, slender, simple or branched, smooth. Leaf-blades linear, up to 5-10 cm long and 2-3 mm broad, filiform, convoluted, smooth, scabridulous at margins, sheath smooth rounded auricles; ligule a ridge of short fine hairs, 3 mm long hairs.

Panicle 5-20 cm long, occasionally lax on one side of the rachis, interrupted, subsecund, branches single or 2-nate, sometimes narrow and dense, rachis; filiform, smooth, pedicel capillary. Spikelets erect, green or brown on drying; glumes unequal, linear-lanceolate to lanceolate, scaberulous on the keel, translucent with a greenish on the middle outside, emarginate and mucronate or acute but never awned, the upper 5-8 mm long, 2-4 mm broad, the lower 2-5 mm broad; lemma 5-13(17) mm long, sometimes no longer than the glumes but usually exceeding the upper by 1-2 mm or more, laterally compressed, convolute, scabrid on the keel or sometimes generally scaberulous on the upper part, passing into the awn without constriction or articulation; callus 0.5 mm long, pointed hairy at base, awn trifid, not articulate; central branch of the awn 5-20 mm long, the laterals little shorter.

Flowering & fruiting period: August-November

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Gilgit& Kashmir); throughout the tropics (Cope, 1982) & Cholistan Desert; Deen Garh, Mooj Garh, Shadi Wali Dahar, Derawar Fort, Khipli, Fort Morot.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 95 (HERB. CIDS).

2. *Aristida funiculata* Trin. & Rupr., Cope in Nasir and Ali, Fl. Pak. 143: 45-46 (1982).

Local Name: Lumb

Annual with wiry culms up to 26.5 cm tall grass, stems many, geniculately ascending. Leaf-blades 8.5 cm long, up to 2 mm broad, flat or convoluted, ciliate at base with long, white hairs in axils; sheaths glabrous, ligule a small, ciliate membrane. Panicle linear up to 8.5 cm long, up to 5 flower. Spikelets green, tinged with brown; glumes linear, membranous, the lower (11-) 13-22 mm long, the upper 10-20 mm long, both finely attenuate; lemma, cylindrical, about 4 mm long, scabrid above, articulated at the apex; callus about 2 mm long, conical, pungent; column 2-3.5 cm long, the base as

wide as the summit of the lemma, straight for a short distance, there after strongly twisted; awn-branches subequal, 2.5-4.5 cm long (Figure, 13).

Flowering & fruiting period: August-November.

Distribution: Tropical East Africa, through Arabia to the Middle East, India & Pakistan (Sind, Baluchistan, Punjab & Kashmir, (Cope, 1982). Cholistan desert; DeenGarh, MoojGarh, Fort Morot, Derawar Fort, Channan Peer, Bijnot & Shadi Wali Dahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 96 (HERB. CIDS).

3. *Aristida hystriacula* Edgew, Cope in Nasir and Ali, Fl. Pak. 143: 46-47 (1982).

Local Name: Lumb

An annual, tufted, small plant; culms erect, 5-18 cm tall, stem many from the base, densely tufted, glabrous at nodes. Leaves convolute, curved, 2-4 cm long, 1 mm broad, glabrous, sheath 1-2 cm long; ligule a small line of hairs; 3 mm long. Panicle 3-5 cm long, narrow, few-flowered, erect, capillary, slender. Spikelets green or tinged with purple, linear-lanceolate; glumes unequal; lower glume smaller, lanceolate, translucent, purple lines, 4 mm long, bifid at the apex with an awn up to 1 mm long in the sinus; upper glume large, 10 mm long, linear-lanceolate, tinged with purple and green lines, bifid at the apex with an awn up to 1.5 mm long in the sinus; lemma 2.5-3.5 mm long, terete, convolute, hispidulous, articulated at the summit; callus 0.5 mm long, oblong, 2-toothed; column of awn twisted, strongly, 10-50 mm long; lateral branches about two-thirds the length of the central. central branch of the awn up to 3.5 cm long.

Flowering period: August-November.

Distribution: Known only from Pakistan (Sind), but likely to occur in North West India (Cope, 1982) & Cholistan desert; Lakhan Check Post, Derawar Fort, KalyPahar.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 83 (HERB. CIDS).

1. *Stipagrostis plumosa* (Linn.) Munro ex T. Anderss., Cope in Nasir and Ali, Fl. Pak. 143: 50-51 (1982).

A densely tufted, perennial grass, up to 26.5 cm tall; lowest sheaths and internodes covered with wool. Leaf-blades filiform, rolled, up to 8-5 cm long, smooth, pungent, curved, sometimes forming a semi-circle or complete circle. Panicle 8.5 cm long, ± contracted. Spikelets pallid; glumes glabrous, unequal, the lower 9-5 mm long, the upper 13 mm long; lemma 4 mm long, smooth, gradually passing into the awn; callus 1-1.5 mm long, acute, bearded, the hairs increasing in length upward; column of awn 4.5 mm long, glabrous; central branch of the awn 3-5 cm long, plumose in the upper two-thirds but with an excurrent naked tip; lateral branches naked, up to 15 mm long. Seeds brownish, oblong, 2 mm long.

Flowering period: August-November.

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Gilgit & Kashmir); Mediterranean region and the Middle East (Cope, 1982). (Cholistan desert; Deen Garh, Derawar Fort, Shadi Wali Dahar, Mooj Garh, Fort Morot, Haider Wali).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 39 (HERB. CIDS).

c. Chlorideae

This tribe represented by two genera and two species in Cholistan desert.

Key to genera

- 1. + Lemmas without awns.
1. *Cynodon*
- Lemmas with long-awned.
2. *Schoenefeldia*

1. *Cynodon dactylon* (Linn.) Pers., Cope in Nasir and Ali, Fl. Pak. 143: 117 (1982).

Local Name: Khabbar, Talla

A perennial stoloniferous grass, sward-forming, with slender underground rhizomes, stems rise to long, spreadingly widely, slender, up to 40 cm high. Leaf-blades often short and narrow, 2-12 cm long, 2-4 mm wide, glaucous, scaberulous, with or without scattered hairs, auricles and orifices bearded; ligule a short ciliate rim about 0.3 mm long. Racemes usually 4-5.5, 2-5.5 cm long in a single whorl. Spikelets 2-2.5 mm long; glumes lanceolate, 1-nerved; lemma silky-pubescent on the keel with simple hairs, lateral nerves often glabrous; palea glabrous, scaberulous on the keels; anthers more than 1 mm long; caryopsis usually turgid. Grain oblong, 1 mm long.

Flowering period: Throughout the year.

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK & Kashmir, (Cope, 1982). Cholistan Desert; Kaly Pahar, Mansoor Check Post, Dodhlan Plantation, Shadi Wali Dahar); tropical and warm temperate regions throughout the world.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 111 (HERB. CIDS).

1. *Schoenefeldia gracilis* Kunth, Cope in Nasir and Ali, Fl. Pak. 143: 115-116 (1982).

Annual; erect or geniculately ascending, tufted, glabrous, 10-80 cm tall grass. Stem simple, filiform. Leaves linear, glabrous, scaberulous on both margins from sheath base, pilose towards the base, 3-10 cm long, 2-3 mm broad, acuminate apex. Ligule of a few hairs. Inflorescence a solitary, paired or digitate slender 1-sided spikes. Spikes 1-4, 3-20 cm long, straight or slightly flexuous, golden yellow, slender, the rachis 0.4-0.6 mm wide. Spikelets 1-flowered; 5-8 cm long, glumes shortly aristate, the lower floral glume 2-3.5 mm long, sessile, ovate, 1-nerved, hairy; base bearded, tip minutely notched, the upper 3-5 mm long; lemma 2-2.5 mm long, with a scaberulous awn 2-4 cm long. The palea narrow, keels ciliate. Grain 1.7 mm long, linear, very slender.

Flowering period: August-November

Distribution: Tropical Africa, Arabia, India and Pakistan (Cope, 1982). Cholistan desert; Biodiversity Park, Derawar Fort, Khir sir).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 74 (HERB. CIDS).

d. Eragrostideae

In Pakistan Eragrostideae represented with 16 genera and 33 species (Cope, 1982); in Cholistan desert represented by 3 genera and 7 species.

Key to genera

1. + Lemmas usually entire at the apex. Acute or acuminate,

Sometimes mucronate; cleistogamous spikelets not developed

in the axils of the leaf-sheaths.

2

- Lemmas usually emerginate or 2-4-toothed or lobed at the apex,

rarely entire but then hairy along the nerves, frequently

mucronate or awned.

3. *Ochthochloa*

2. + Spikelets in open, contracted or spike-like panicles. 2. *Eragrostis*

- Spikelets sessile or very shortly pedicelled, loosely to densely

imbricate in digitate or racemosely arranged spikes or

spike-like racemes, very rarely insolitary spikes.

1. *Dactyloctenium*

1. *Dactyloctenium aegyptium*(Linn.) Willd.,Cope in Nasir and Ali, Fl. Pak. 143: 106-107 (1982).

Local Name: Madhana Ghaa

Annual, ascending or prostrate; stems 20-40 cm high, rooting at the lower nodes, frequently shortly stoloniferous and mat-forming, less often erect, glabrous. Leaves linear, tapering to a fine point, flat, hairy, ciliate with bulbous-based hairs; ligule a small, ciliolate line. Leaf-blades flat, 3-25 cm long, 2.5-7.5 mm broad, papillose-hispid especially along the margins.

Inflorescence composed of 3-9 linear to narrowly oblong spikes, 1.2-3.5 cm long. Spikelets 3-4-flowered, broadly ovate, 3-4 mm long; glumes subequal, 1-2.2 mm long, the lower lanceolate, with a thick scabrid keel, the upper elliptic to narrowly obovate, keel smooth; lemmas narrowly ovate, 2.5-4 mm long, the keel gibbous, concave and scabrid above the middle and often extended into a stout cusp or mucro up to 1 mm long; palea-keels winged or wingless; anthers 0.25-0.8 mm long. Grains, obovate to obtriangular, very rugose, c. 1 mm long.

Flowering & fruiting period: August-November

Distribution: Pakistan (Sind, Punjab, KPK, Kashmir (Cope, 1982) & Cholistan desert; Bijnot, Kaly Pahar, Mansoor Check Post); widely distributed in tropical and warm temperate regions of the Old World; introduced in America.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 66 (HERB. CIDS).

3. *Eragrostis* Wolf

A genus of ± 300 species, mainly in the tropics and subtropics, particularly as ruderal and pioneer species; about 14 species are recorded from Pakistan (Cope, 1982) & 4 species present in Cholistan desert.

Key to species

1. + Spikelets breaking up from the base.

2

- Spikelets breaking up from the apex.

3

2. + Leaves with raised crateriform glands along with margin, grain broadly oblong,

0.7-0.8 mm long.

4. *Eragrostis minor*

- Leaves eglandular, grain elliptic oblong, 0.6-1 mm long. 1. *Eragrostis barrelieri*

3. + Lemma oblong-elliptic.

2. *Eragrostis ciliaris*

- Lemma broadly ovate.

3. *Eragrostis japonica*

1. *Eragrostis barrelieri* Day., Cope in Nasir and Ali, Fl. Pak. 143: 97-98 (1982).

A loosely tufted; culms 15-30 cm tall, ascending or loosely prostrate, branched grass. Leaf-blades flat or convolute, up to 3 cm long and 2 mm broad; eglandular, pubescent, mostly glabrous, somewhat glaucous. Panicle terminal and axillary, oblong-lanceolate, 3-20 cm long, usually open, stiffly branched, with glands on branchlets and pedicels. Spikelets 5-30-flowered, narrowly oblong, 5-18 mm long, 1-2 mm broad, yellowish green or tinged with grey or purple, breaking up from the base, the rhachilla persistent; glumes unequal, lanceolate, the lower 0.9-1.3 mm long, the upper 1.5-2 mm long, acute; lemmas broadly ovate-oblong, 1.5-2.5 mm long, the lateral nerves distinct, obtuse; palea scabrid on the keels, persistent; stamens 3; anthers c. 0.2 mm long. Caryopsis, dark brown, elliptic-oblong, 0.5-1 mm long.

Flowering period: August-November

Distribution: Pakistan (Baluchistan, KPK, Mediterranean region to the Middle East; tropical Africa; introduced in South Africa (Cope, 1982). (Cholistan desert; Kaly Pahar, Mooj Garh, Deen Garh, Channan Peer, Shadi Wali Dahar)

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 12 (HERB. CIDS).

2. *Eragrostis ciliaris* (Linn.) R. Br., Cope in Nasir and Ali, Fl. Pak. 143: 86 (1982).

A glabrous annual, tufted, 5-30 cm tall, geniculately ascending above, slender, glabrous, smooth, stem terete. Leaves linear, flat, tapering to a fine point; 4.5 cm long, 2 mm broad; sheaths striate, bearded with long hairs at the mouth, ligule a fringe of short hairs. Panicles 2.5 cm long, apparently spike-like, but lobed or interrupted, densely clustered, appearing hairy from the long cilia of palea, branches very short, glabrous, divided from base; pedicels very short, glabrous. Spikelets 6-12-flowered, densely crowded, compressed, pale or slightly purplish, ovate, 2-3 mm long, breaking up from the apex, the rhachilla fragile; glumes lanceolate, subequal, 0.5-1.2 mm long, acute; lemmas oblong-elliptic, 0.7-1.5 mm long, the keels

bearing a few short stiff hairs, otherwise smooth, broadly obtuse, more or less obscurely mucronate; palea keels tuberculate-ciliate, the hairs 0.5-0.7 mm long; anthers 2, 0.2 mm long. Grain ovoid, c. 0.5 mm long.

Flowering period: August-November

Distribution: Pakistan (Sind, Baluchistan & Punjab, tropical and South Africa, extending through Arabia and the Mascarene Islands to India; tropical America (Cope, 1982). (Cholistan desert; Thandi Khoi, Mooj Garh, Deen Garh, Shadi Wali Dahar, Dodhlan Plantation).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 13 (HERB. CIDS).

3. *Eragrostis japonica* (Thunb.) Trin., Cope in Nasir and Ali, Fl. Pak. 143: 88-89 (1982).

Annual, tufted grass; 10-90 cm tall, prostrate mostly erect. Leaf-blades flat, up to 30 cm long and 1.5-2.5 mm wide; ligule membranous, 0.3-0.6 mm long, truncate, fimbriate. Panicle linear, 4-40 cm long; branches ascending or spreading and the panicle lanceolate to narrow ovate, 3-12 cm long, bare towards the base, the spikelets shortly pedicelled. Spikelets 4-14-flowered, breaking up from the apex, ovate-oblong, 1.3-3 mm long, the rhachilla fragile; glumes unequal, narrowly ovate to broadly oblong-elliptic, 0.4-0.5 mm long, acute to obtuse; lemmas broadly ovate, 0.7-1 mm long, obtuse; stamens 2, anthers 2, 0.2 mm long. Grain, 0.3-0.5 mm long, ellipsoid.

Flowering period: August-November

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Kashmir & through-out South and Southeast Asia to tropical and South Africa and Australia (Cope, 1982). (Cholistan desert; Bijnot, Lakan Check Post, Thandi Khoi).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 68 (HERB. CIDS).

4. *Eragrostis minor* Host, Cope in Nasir and Ali, Fl. Pak. 143: 95-96 (1982).

Annual; culms 5-30 cm high, ascending, densely tufted. Leaf-blades flat, up to 12 cm long and 5 mm wide, mostly glabrous and usually with raised crateriform glands along the margin; ligule a pubescent ridge. Panicle ovate, 4-20 cm long, fairly dense to open, stiffly branched with short pedicels, usually with glands on pedicels and branchlets. Spikelets 6-16 flowered, narrowly oblong or almost linear, 3-9 mm long, 1.5-2 mm broad, yellowish green, leaden grey or purplish, breaking up from the base; glumes subequal, ovate, boat-shaped, 1-1.5 mm long, 1-3-nerved, often glandular on the keel, acute; lemmas broadly ovate to subrotund, 1.5-2 mm long, chartaceous, often glandular on the keel, the lateral nerves distinct, obtuse; palea 1 mm long, keels scabrid, persistent; anthers 3, 0.3 mm long. Grains, dark brown, broadly oblong, 0.5-0.7 mm long.

Flowering period: August-November

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Gilgit & Kashmir); warm temperate and subtropical regions of the Old World; occasionally found as an introduction in the tropics and the New World (Cope, 1982).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 14 (HERB. CIDS).

1. *Ochthochloa compressa* (Forssk.) Hilu, Cope in Nasir and Ali, Fl. Pak. 143: 81-82 (1982).

Local Name: Chimber, Ghandheel

A perennial stoloniferous, glabrous, terete, swallowing node formation, woolly, stem prostrate or geniculately ascending, up to 30-50 cm high. Leaves linear, lanceolate, acuminate, rigid, distant, flat, recurved, upper short, sheath glabrous; ligule a hairy line. Spikes 1.5-4.5 cm long, clustered at the top of the culm, digitate. Spikelets 4-8-flowered, imbricate, subsessile or shortly pedicellate, 4.5-8 mm long. Lower involucral glume 2-3 mm long, ovate, acute, membranous; upper involucral glume 3-4.5 mm long, lanceolate, aristate, coriaceous. Floral glumes 5 mm long, ovate, acute, apiculate, 3-nerved; lemmas 3 nerved, 3.8-5.4 mm long, acute or shortly awn-pointed. Pericarp free from the seed (Figure, 57).

Flowering period: August-December or (Throughout the year)

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK (Cope, 1982) & Cholistan desert; Deen Garh, Mir Garh, Mooj Garh, Dodhlan Plantation, Channan Peer, Derawar Fort, Shadi Wali Dahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 86 (HERB. CIDS).

e. 5 Sporoboleae

In Pakistan represented with 4 genera and 15 species (Cope, 1982) and in Cholistan desert represented by 1 species.

1. *Sporobolus ioclados* (Nees ex Trin.) Nees, Cope in Nasir and Ali, Fl. Pak. 143: 141 (1982).

A stoloniferous, tufted, perennial, roots covered with thick felt of hairs, rigid, geniculately ascending, spreading by means of stolons; 10-80(100) cm high. Leaves flat, convolute, scabridulous above, margins serrulate or cartilaginous and usually bearing stiff hairs, 20-25 cm long, 0.5-3.4 cm broad, sheath of the vegetative shoots often keeled; ligule a fringe of hairs, 2-3 mm long. Panicle capillary, spreading, 4-20(25) cm long; primary branches in 4-6 whorls, with side branches 3-5 mm long from the upper two-thirds to three-quarters, sometimes reddish. Spikelets 1.5-2.2 mm long, smooth or scabridulous, grey-green to pallid, rarely purplish; glumes 3; lower involucral glume oblong, 0.2-0.8 mm long, 1-nerved, obtuse; upper glume oblong-elliptic; lemma similar to the upper glume; anthers 3, 0.7-1 mm long. Caryopsis 0.6-1 mm long, ellipsoid (Figure, 71).

Flowering period: August-December

Distribution: Pakistan (Punjab & throughout Africa and in India (Cope, 1982). Cholistan desert; Channan Peer, Shadi Wali Dahar, Dodhlan Plantation, Thandi Khoi).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 89 (HERB. CIDS).

f. 6 Zoysieae

It is represented with 12 genera in tropics; 3 genera and 4 species in Pakistan (Cope, 1982). In Cholistan desert by 2 genera and 3 species.

Key to genera

1. + Clusters of spikelets pedunculate; glumes tuberculate. 1. *Leptothrium*

- Clusters of spikelets sessile on the main axis; glumes adorned

with rows of hooked spines.

2. *Tragus*

1. *Leptothrium senegalense* (Kunth) W.D. Clayton, Cope in Nasir and Ali, Fl. Pak. 143: 151-153 (1982).

A rigid with few, leafy, ascending branching short lived, annual grass; culms 10-40 cm high, thin, wily, ascending. Leaf-blades narrow, flat or often rolled, 2-10 cm long, 1-3 mm wide. Inflorescence 2-17 cm long, the clusters more or less distant upon its wavy main axis, brightly coloured with purple and light green; peduncle cuneate, flattened, 1-5 mm long, ciliate with hooked hairs on the margins, the spikelets paired and side by side on its truncate tip. First spikelet: lower glume narrowly lanceolate, 2.5-7 mm long, coriaceous, flattened, sharply recurved, the margins ciliate; upper glume oblong to narrowly oblong in side-view, 3-5.5 mm long, densely tuberculate and often spinulose, pectinate with hooked spines near one margin, rostrate at the tip: lemma 1.6 mm long, elliptic, hyaline. Second spikelet, when present: lower glume narrowly lanceolate, 2.5-4 mm long, loosely clasping the upper glume, tuberculate-spinulose; upper glume lanceolate in side-view, 3-5 mm long, tuberculate-spinulose, prostrate above with a crest of hooked prickles; lemma 1.5 mm long.

Flowering period: August-November

Distribution: Pakistan & Tropical East Africa and Senegal (Cope, 1982). Cholistan desert; Deen Garh, Mooj Garh, Khipli, Forot Morot, Bijnot, Shadi Wali Dahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 38 (HERB. CIDS).

2. *Tragus* Hallers

Cope in Nasir and Ali, Fl. Pak. 143: 149 (1982).

A genus of 7 weedy species found throughout the tropics; 2 species occur in Pakistan (Cope, 1982); represented by 2 species in Cholistan desert.

Key to species

1. + Spikelets separated by a distinct internode; upper glume 2-3 mm long,

its prickles often bulbous.

1. *Tragus berteronianus*

- Spikelets arising at almost the same level; upper glume 2.5-4 mm long,

its prickles never bulbous.

2. *Tragus roxburghii*

1. *Tragus berteronianus* Schult., Cope in Nasir and Ali, Fl. Pak. 143: 149-150 (1982).

A small tufted annual, prostrate at the base and often rooting at nodes, finally ascending, erect, 5-15 cm tall. Leaf blade flate, lanceolate-cordate, 1-3 cm long, 2-4 mm wide acuminate, bearing white, spinulose hairs along the margins; leaf-sheath striate. Spike cylindrical, 2-5 cm long, 4-5 mm thick, subtended by the uppermost inflated leaf-sheath enclosing the base of the spike. Spikelet 2-3 mm long in clusters of 2-3 falling of together on the common pedicel. Lower spikelet 2-3 mm long; upper glume 5-nerved, the prickles turgid to bulbous in their lower half and hooked at the tip.

Flowering period: August-November

Distribution: Pakistan & throughout Africa and the warmer parts of America; also in Arabia, Afghanistan and China (Cope, 1982). (Cholistan desert; Kaly Pahar, Mooj Garh, Toba Shah Sultan).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 40 (HERB. CIDS).

2. *Tragus roxburghii* Panigrahi, Cope in Nasir and Ali, Fl. Pak. 143: 150-151 (1982).

A small prostrate, spreading annual; stem leafy with many, 3-20 cm long, ascending from a prostrate base, rooting from the nodes, often matted. Leaves narrowly ovate to ovate-lanceolate, acuminate, flat or undulate, rigid, very glaucous, smooth, with

pectinately setose margins, amplexicaule at base; sheaths 1-2 cm long; ligule a slender, ciliate rim. Leaf-blades 0.5-5 cm long, 1-4 mm wide. Inflorescence 1-4 cm long, cylindrical, often loosely so; clusters straight or slightly gaping at the tip, consisting of 2 subequal and subopposite spikelets. Spikelets 2.5-4 mm long; upper glume 5-nerved, the prickles terete in their lower half and hooked at the tip. Glumes 2 or 3; lower glume very minute, hyaline, compressed; upper glume 3 mm long, curved, involute, strongly 3-5 ribbed, thin and pubescent between the ribs; margins scabridulous and membranous; floral glumes solitary, 2 mm long, oblong, lanceolate, apiculate 3-nerved; palea as long as the glume, hyaline, 2-nerved, subacute. Caryopsis oblong, linear, 1.2 mm long, pale-brown.

Flowering period: March-June

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK & Kashmir); South-east Asia and East Africa (Cope, 1982 & Cholistan desert; Kaly Pahar, Mooj Garh, Toba Shah Sultan, Derawar Fort, Maroot Fort, Shadi Wali Dahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 113 (HERB. CIDS).

B. Sub-family Panicoideae

In Cholistan desert represented with 2 tribes Andropogoneae and Paniceae.

Key to tribes

1. + Spikelets typically paired with 1 sessile and the other pedicelled,

those of each other pair usually dissimilar, rarely with the spikelets all alike;

glumes as long as the spikelets and enclosing the florets;

upper lemma often with a geniculate awn.

a. Andropogoneae

- Spikelets solitary, rarely paired with the spikelets all alike;

glumes usually membranous, the lower mostly smaller or sometimes suppressed;

upper lemma papery to polished and stony, usually awnless.

b. Paniceae

a. Andropogoneae

This tribe represented with genera ± 87; throughout the tropics, extending into warm temperate regions; 36 genera and 67 species in Pakistan (Cope, 1982). In Cholistan desert represented by 4 genera and 5 species.

Key to genera

1. + Lemma hyaline; awnless.
2
- Lemma awned.

2. *Dicanthium*

2. + Callus very short, truncate.
3
- Callus obtuse, compressed.

1. *Cymbopogon*

3. + Inflorescence a single raceme, terminal on culm or from axillary branches;
ligule a line of hairs.

3. *Lasiurus*

- Inflorescence a narrow often speciform panicle or large plumose often
silvery with many racemes;

4. *Saccharum*

1. *Cymbopogon jwarancusa* (Jones) Schult., Cope in Nasir and Ali, Fl. Pak. 143: 328-329 (1982).

2.

Local Name: Kittrun, Khavi

A densely tufted, erect or geniculately ascending, up to 150 cm high, with aromatic roots, perennial grass. Stems, persistent, finally loose and open sheaths. Leaves flat, leaf-blades up to 30 cm long and 5 mm wide, whitish, narrowly linear, attenuate to a filiform tip; basal sheaths glabrous, flat or coiled; ligule membranous, 0.5-4 mm long. Panicle long, narrow, 10-40 cm long, erect; spatheoles lanceolate to narrowly elliptic, becoming reddish, 1.5-2.5 cm long. Racemes 13-22 mm long, lowest pedicel not swollen; internodes and pedicels densely ciliate along the margins. Sessile spikelet 4.5-5.5 mm long; lanceolate, lower glume flat or concave between the keels; upper lemma deeply bifid, with an awn 7-10 mm long.

Pedicelled spikelets equally or rather longer than the sessile, lanceolate, purplish; lower glume 7-9 nerved (Figure, 34).

Flowering period: March-June

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Gilgit, Kashmir & India (mainly in the west) and Nepal (Cope, 1982). Cholistan desert; Kaly Pahar, Deen Garh, Mooj Garh, Channan Peer, Dodhlan Plantation, Fort Morot).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 65 (HERB. CIDS).

1. *Dichanthium annulatum* (Forssk.) Stapf, Cope in Nasir and Ali, Fl. Pak. 143: 280-283 (1982).

Perennial; culms 25-100 cm high, geniculately ascending. Leaf-blades 3-30 cm long, 2-7 mm wide. Inflorescence composed of (1-) 2-15 subdigitate shortly peduncled racemes, the peduncles glabrous; racemes 3-7 cm long, the spikelet subimbricate with 0-6 smaller homogamous pairs at the base; internodes and pedicels solid. Sessile spikelet narrowly oblong, 2-6 mm long; lower glume firmly cartilaginous, slightly concave, pubescent to villous below the middle with long bulbous-based hairs on the margins above, obtuse to subacute; awn 8-25 mm long.

Flowering period: Almost throughout the year.

Distribution: Pakistan (Sind, Baluchistan, Punjab, N.W.FY. & Kashmir); Kenya, Tanzania and Senegal, through the Middle East to Indonesia; introduced to southern Africa, Tropical America and Australia (Cope, 1982). (Cholistan desert: Dodhlan Plantation).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 146 (HERB. CIDS)

1. *Lasiurus scindicus* Henr., Cope in Nasir and Ali, Fl. Pak. 143: 342-343 (1982).

Local Name: Gorkha, Sewan

Perennial; stems often woody at base, up to 37 cm high, simple or suffruticose, erect from a thick woody rhizome covered with firm, imbricate, often silky cataphylls, these often decaying into stiff parallel fibres.

Leaf-blades firm, flat or convolute, up to 15 cm long and 5 mm broad, unicellular hairs at both margins of the leaf base, glaucous. Racemes up to 7 mm long, silky vinous from internodes, pedicels and glumes. Sessile spikelet 8 mm long; internode 6 mm long, lower glume 8 mm long, 3.5 mm broad, lanceolate, caudate at apex, spreadingly horizontally at maturity. Lower glume 6 mm long, 3.5 mm broad, ovate-lanceolate, villous at both margins, caudate at apex. Pedicelled spikelet usually 6 mm long, the pedicel free. Lemma 5 mm long, 1.5 mm broad; ovate-lanceolate, nerved, acuminate apex, hyaline. Palea 4 mm long, 1 mm broad, ovate, acuminate at apex, 2-keeled.

Flowering period: March-June

Distribution: Northwest India westwards to Iraq; tropical Arabia; Egypt: Ethiopia, Somalia, Mali and Pakistan (Sind, Baluchistan, KPK, Punjab (Cope, 1982) & Cholistan desert; Derawar Fort, Shadi Wali Dahar, Channan Peer, Bijnoot, Lakhan Check Post, Kaly Pahar, Mooj Garh, Deen Garh, Fort Morot, & Dudhlan Plantation)

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 85 (HERB. CIDS).

4. *Saccharum* Linn.

A genus of 35-40 species throughout the tropics, extending to warm temperate regions; 9 species occur in Pakistan, one of them cultivated (Cope, 1982). Represented with 2 species in Cholistan desert.

Key to species

1. + Leaf-blades up to 90 cm long, racemes 2-4 cm long,

shorter than the supporting tissue.

1. *Saccharum bengalense*

- Leaf-blades 0.5-2 m long, racemes 3-15 cm long, usually much longer than the supporting branches.

2. *Saccharum spontaneum*

1. *Saccharum bengalense* Retz., Cope in Nasir and Ali, Fl. Pak. 143: 264-265 (1982).

Local Name: Sarkanda, kana, kany

A robust, tall tufted, perennial; culms 2-4 m high. Leaves linear, Leaf-blades 60-90(1 m) cm long, 3-10 mm wide, margins scabrid; flat or channelled,

the midrib occupying the greater part of the width, glaucous; ligule a runcate, ciliate rim. Panicle 20-75 cm long, white-villous, peduncle glabrous; racemes 2-4 cm long, considerably shorter than the supporting branches, the internodes and pedicels hirsute with hairs c. 7 mm long. Spikelets in pairs; heteromorphous, one sessile and the other pedicelled, 3.8-5.5 mm long, the callus bearded with whitish or greyish hairs up to 2.5 mm long; glumes equal, membranous, lower glume of sessile spikelet hairy on the back, the upper glume glabrous, both glumes of pedicelled spikelet hairy, the hairs at least 4 mm long, often up to 9 mm; lower lemma empty, oblong-elliptic, hairy on the back; upper lemma ovate-lanceolate, ciliate on the margins, acute or very shortly awned, the awn not visible beyond the glumes. Pedicelled spikelets glumes villous.

Flowering period: September-November

Distribution: Pakistan (Sind, Punjab, KPK and North and Northwest India, Afghanistan. (Cope, 1982). Cholistan desert; ThandiKhoi, Fort Morot, Toba Shah Sultan, Derawar Fort, Dudhlan Plantation.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 87 (HERB. CIDS).

2. *Saccharum spontaneum* Linn., Cope in Nasir and Ali, Fl. Pak. 143: 263-264 (1982).

Local Name: Kahn, Sachi Sir

A stout, rhizomatous perennial; culms 2-3.5 m high or more. Stem c. 1.5 cm in diam., solid above, fistular below, polished, silky below panicles and minutely silky below upper leaf-insertions. Leaves erect, 0.5-2 m long, up to 6.5 mm wide, gradually tapered towards the base into a narrow wing on either side of the petiole, midrib white, margins scabrid, glaucous, often villous above base, sheath longer than internodes, villous at mouth minutely pubescent at base, adpressed hairs, sulcate, ligule ovate or deltoid, membranous often fimbriate, minutely silky dorsally, ciliate. Panicle 25-40 cm long, conical-oblong, peduncle usually hairy; racemes 3-15 cm long, usually much longer than the supporting branches, reddish or purplish, callus hair closely adpressed to branches of panicle internodes and pedicels hirsute.

Spikelets all alike, in pairs, 2.5-6 mm long, the callus bearded with silky white hairs 2-3 times as long as the spikelet; glumes 4; lower glume lanceolate, subulate, acuminate, upper glume as much long, lanceolate, keeled obscurely, 1-nerved; lower lemma lanceolate elliptic, ciliate on the margins; upper lemma very narrow, very shortly awned.

Flowering period: September-November

Distribution: Pakistan (Sind, Punjab, KPK, Gilgit & Kashmir); widely distributed in the warmer regions of the Old World (Cope, 1982).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 88 (HERB. CIDS).

b. Paniceae

The tribe Paniceae represented by genera ± 86; throughout the tropics, extending into warm temperate regions; 15 genera and 73 species in Pakistan (Cope, 1982). In Cholistan desert represented by 6 genera and 10 species.

Key to genera

1. + Spikelets, or some of them, subtended by 1-many bristles or spines. 5
 - Spikelets not subtended by bristles. 2
2. + Inflorescence consisting of 1-sided spikes or racemes, these either digitate
 - or scattered along a central axis, rarely solitary; the racemes sometimes with
 - short secondary branchlets or with the spikelets long-pedicelled and distant. 3
 - Inflorescence an open or spike-like panicle, occasionally condensed
 - about the primary branches.
5. *Panicum*
3. + Upper lemma coriaceous to crustaceous, with narrow inrolled margins
 - clasping only the edge of the palea. 4
 - Upper lemma characeous to cartilaginous.
3. *Digitaria*

4. + Racemes mostly 4-rowed, the spikelets in clusters of 2 or more;

spikelets gibbous, plano-convex, cuspidate to awned; upper lemma acute,

muticous; upper palea acute, with reflexed tip.

4. *Echinochloa*

- Racemes mostly 1-2 rowed; the spikelets single or paired. 1. *Brachiaria*

5. + Involucral bristles free throughout, filiform.

6. *Pennisetum*

- Involucral bristles flattened and connate below, commonly forming a cup.

2. *Cenchrus*

1. *Brachiaria ramosa* (Linn.) Stapf, Cope in Nasir and Ali, Fl. Pak. 143: 207-208 (1982).

Annual, loosely tufted 10-50 cm high culms. Stems fasciculate, erect or ascending from a frequently prostrate and rooting base, terete, glabrous, or softly pubescent upward and on nodes. Leaves broadly linear or linear-lanceolate, 3-6 cm long, 3-7 mm broad, pubescent, sheath finely striate, scabrid on margins; line of short hairs forming a ligule, somewhat thin. Inflorescence of 5-many racemes borne on an axis 5-10 cm long; racemes slender, 1-5 cm long, simple or the longest with branchlets at the base, bearing mostly paired loosely contiguous spikelets appressed to the triquetrous rachis; pedicels filiform, shorter than the spikelets, 1-2 mm long. Spikelets alternate, ovoid, subacute or apiculate, elliptic to broadly elliptic, 2.5-3.5 mm long, glabrous or pubescent, with or without a stipe up to 0.5 mm long; glumes unequal, lower glume a third to half the length of the spikelet, broad, ovate, obtuse or subacute, clasping at base, 1.5 mm long, 1 mm broad; upper glume membranous, glabrous, or finely pubescent, 3 mm long, 1.5 mm broad, 7-nerved; lower lemma membranous, or rarely the latter coriaceous; upper lemma 2 mm long, subacute to acute, rugose. Grain flat or slightly depressed on both sides, broadly-elliptic.

Flowering period: March-June

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, & Kashmir); Senegal to Yemen and southwards to Malawi, Rhodesia and South Africa; tropical Asia (Cope, 1982).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 84 (HERB. CIDS).

2. *Cenchrus* Linn.

A genus of 22 species in tropical and warm temperate regions, mainly in Africa and America; 5 species occur in Pakistan (Cope, 1982). In Cholistan desert this genus is represented by 4 species.

Key to species

1. + One of the inner bristles longer and stouter than the rest and united at the base.

2. *Cenchrus ciliaris*

- None of the inner bristles longer and stouter than the rest;

all ± similar in texture and length.

2

2. + Bristles retrose scaberulous, tenaciously prickly. 1. *Cenchrus biflorus*

- Bristles antrorse scaberulous, not prickly.

3

3. + Bristles long, plumose, up to 10-2 mm in length; the lower

one-third of the margins densely ciliate.

3. *Cenchrus prieurii*

- Bristles short, 2-4 mm long, the margins usually glabrous,

sometimes shortly puberulous.

4. *Cenchrus setigerus*

1. *Cenchrus biflorus* Roxb., Cope in Nasir and Ali, Fl. Pak. 143: 243-244 (1982).

Local Name: Bhurra, Leedha

A tufted annual, glabrous; 5-30 cm high culms, ascending, branched from base, slender. Leaves linear-lanceolate, 2-25 cm long, 2.6 mm broad; finely scabrid on both sides or smooth below and scabrid upwards, finely acuminate; sheath glabrous;

ligule a densely ciliate rim. Panicle 2-15 cm long; involucre ovoid, 4-11 mm long; inner spines flattened, connate at the base to form an ovoid or diamond-shaped disc 2-4 mm across, bearing 1-3 shallow grooves on the outer face, ciliate below, retrorsely barbellate and mostly pungent at the tip; outer spines numerous, acicular, shorter than the inner, commonly divergent, rarely suppressed. Spikelets 1-3 per burr, 3.5-6 mm long. Glumes 4, thinly membranous, acute; lower glume 2 mm long, lanceolate, acute; the upper 3 mm long, ovate, 1-5-nerved often mucronate, 3-5-nerved often mucronate, barren; upper glume long as lower, 5-nerved. Grain 2-2.5 mm long, elliptic or elliptic-oblong, rugose.

Flowering period: August-December

Distribution: Pakistan (Sind, Punjab) Kashmir, tropical Africa, extending through Arabia to India. (Cope, 1982). Cholistan desert; Mooj Garh, Deen Garh, Fort Morot, Channan Peer, Bijnot, Dudhlan Plantation, Derawar Fort.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 34 (HERB. CIDS).

2. *Cenchrus ciliaris* Linn., Cope in Nasir and Ali, Fl. Pak. 143: 241-242 (1982).

Local Name: Dhaman, Dhraman

A perennial, tufted, from woody rootstock, 10-150 cm high culms, ascending, wiry or sometimes almost woody, branches solitary or fascicled; lower internodes glabrous or scanty hairy, smooth or scabrid towards the inflorescence. Leaves linear, 3-20 cm long, 2-8 mm broad; tapering to a fine point, glabrous or loosely base with fine, stiff, usually tubercle-based hairs, flat or convolute when dry; sheaths glabrous or scabridulous, shorter or longer than internodes; ligule a densely ciliate rim. Panicle cylindrical to ovoid, 2-10 cm long, 10-20 mm wide, grey, purple or straw-coloured, the rachis angular and puberulous; involucre elongate, 6-16 mm long; inner bristles greatly exceeding the spikelets, one of them longer and stouter than the rest, at least the longest somewhat flattened at the base,

connate only at the base to form a disc 0.5-1.5 mm in diameter (or sometimes connate for up to 0.5 mm above the rim of the disc), sparsely or densely ciliate below, grooved on the face or not, filiform above, flexuous, often wavy, antrorsely scaberulous; outer bristles filiform. Spikelets 2-4 per burr, 2-5.5 mm long, acutely lanceolate; glumes distinct, acute, the lower as long as the spikelet. Glumes 4, ovate, acute or acuminate; lower glume 2 mm long, ovate-lanceolate, 1-nerved; upper glume 2.5 mm long, ovate, acuminate, 1-3-nerved. Grain 2 mm long, oblong, truncate, dorsally compressed.

Flowering & fruiting period: August-December

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK and throughout Africa, extending through Arabia and the Middle East to India; widely introduced else-where in the Old World. (Cope, 1982). Cholistan desert; Mooj Garh, Fort Morot, Dodhlan Plantation, Derawar Fort, Channan Peer, Bijnot.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 35 (HERB. CIDS).

3. *Cenchrus prieurii* (Kunth) Maire, Cope in Nasir and Ali, Fl. Pak. 143: 244-245 (1982).

Local Name: Dhaman, Dhraman

Annual 12-50 cm high culms; geniculately ascending, terete, slender, branched from base up to middle, glabrous. Leaves linear, 5-7 cm long, 3-5 mm broad; finely acute, flat, sheath scabridulous, glabrous, lower longer; the upper shorter than internodes; ligule a densely ciliate rim. Panicle cylindrical, 5-9 cm long, the rachis flexuous and scabrid; involucre elongate, 15-27 mm long; inner bristles greatly exceeding the spikelets, flattened and connate only at the base, forming a shallow oval or diamond-shaped disc, densely ciliate below, the outer surface with one or two shallow grooves, filiform and flexuous above, antrorsely scaberulous; outer bristles filiform. Spikelets 1 or 2 per burr, about 4.3 mm long, acutely lanceolate; lower glume short, up to 0.8 mm long, or absent; upper glume a little shorter than the spikelet. Grain 2-2.5 mm long, dorsally compressed, elliptic-oblong.

Flowering & fruiting period: August-December
Distribution: Pakistan, northern Africa, Arabia and

India (Cope, 1982). (Cholistan desert; Mooj Garh, Derawar Fort, Shadi Wali Dahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 36 (HERB. CIDS).

4. *Cenchrus setigerus* Vahl, Cope in Nasir and Ali, Fl. Pak. 143: 245 (1982).

Local Name: Dhaman, Dhraman

A perennial, forming a stout root-stock; 5-80 cm high culms, geniculately ascending, glabrous or rarely pilose at knotted nodes, scabridulous just beneath the inflorescence. Leaves linear or narrowly linear-lanceolate; 2-20 cm long, 2-7 mm broad, scabridulous on both surfaces or smooth below, sparsely hairy on the upper surface towards the base with long, sheath compressed, ciliate on margins; ligule a shortly ciliate rim. Panicle 2-12 cm long; involucre cup-shaped, 3-7 mm long; inner spines short, flattened, connate for a quarter to half their length to form a cup, glabrous or obscurely puberulous and grooved on the face, occasionally sparsely ciliate on the margins, green to dark purple, antrorsely scaberulous, narrowly triangular at the tip; outer spines few, short, often suppressed, rarely almost as long as the inner. Spikelets 1-3 per burr, 3-5 mm long. Glumes 4, acute, ovate, 1-nerved; outer glume 2.5 mm long; inner glume 3 mm long, 5-nerved; palea 2.5 mm long, oblong, obtuse. Grain 2 mm long, oblong, smooth, shining, pale-brown.

Flowering & fruiting period: August-December

Distribution: Pakistan (Sind, Punjab, KPK) & tropical East Africa, through Arabia to India; introduced in several tropical countries (Cope, 1982). Cholistan desert; Channan Peer, Shadi Wali Dahar, Fort Morot.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 37 (HERB. CIDS).

3. *Digitaria sanguinalis* (Linn.) Scop., Cope in Nasir and Ali, Fl. Pak. 143: 231-232 (1982).

An annual decumbent with culms 20-30(40) cm high or sometimes more, geniculately ascending grass. Leaf-blades linear-lanceolate, 3-30 cm long, 3-8 mm wide. Inflorescence composed of 2-16 racemes; digitate, or subdigitate racemes stiff, whorls, 3-20 cm long, the spikelets binate and overlapping by about two-thirds their length on a winged rachis with triquetrous midrib; pedicels triquetrous, scabrid, obtuse or slightly expanded at the tip. Spikelets elliptic to ovate-elliptic, 2.3-3.5 mm long, acute; lower glume minute, 0.2 mm long; upper glume 3-nerved, a third to half as long as the spikelet; lower lemma as long as the spikelet, 7-nerved, the nerves evenly spaced, scaberulous on the nerves with minute siliceous spines, appressed pubescent; fruit grey or light brown, lanceolate.

Flowering period: August-November

Distribution: Pakistan (Baluchistan, Punjab, KPK, Gilgit, Kashmir) & warm temperate regions throughout the World, penetrating into the tropics (Cope, 1982). (Cholistan desert; Derawar Fort, Dodhlan Plantation, Deen Garh).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 112 (HERB. CIDS).

1. *Echinochloa colona* (Linn.) Link, Cope in Nasir and Ali, Fl. Pak. 143: 196-197 (1982).

Local Name: Sawank, Swankri

A slender, erect or ascending-prostrate, annual grass; culms 10-30 cm high, erect or ascending, smooth dull green or partly purplish, nodes softly hairy. Leaves narrowly lanceolate, acuminate, flat, glabrous; sheath c. 5 cm long, striate, keeled, pubescent; ligule a short fringe of hairs; Leaf-blades 5-18 cm long, 2-6 mm broad, occasionally marked with purple bars. Inflorescence typically linear, 1-12 cm long, the racemes neatly 4-rowed, seldom over 2.5 cm long, simple.

Spikelets ovate-elliptic to subglobose, acute or subcuspidate, pubescent, second, sessile, 3-5- seriate, 1.5-3 mm long, pubescent; glumes 4; lower glume 1.2 mm long, membranous, 5-nerved; upper glume 1.6-2 mm long, ovate-cuspidate, 5-nerved; lower lemma acute to cuspidate; upper lemma 2-2.5 mm long. Grain plano convex, broadly elliptic.

Flowering period: August-November

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Kashmir) & through-out the tropics and subtropics (Cope, 1982). Cholistan desert; Bijnot, Derawar Fort.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 67 (HERB. CIDS).

5. *Panicum* Linn.

A genus of about 600 species in tropical and warm temperate regions; 15 species are recorded from Pakistan of which 7 are probably native, 3 are established aliens and 5 are found only in cultivation (Cope, 1982). In Cholistan desert represented by 2 species.

Key to species

1. + Spikelets elliptic; lower lemma 7-9-nerved.
 1. *Panicum antidotale*
 - Spikelets ovoid; lower lemma 9-11-nerved.
 2. *Panicum turgidum*

1. *Panicum antidotale* Retz., Cope in Nasir and Ali, Fl. Pak. 143: 171-172 (1982).

Local Name: Murrat, Bansi Ghaa

A tall, with creeping woody rootstock, perennial grass; culms 30-140 cm high, woody, solid, erect or ascending, usually branched, the lower internodes often pruinose. Leaves linear, rigid, tapering from the rounded base to a fine point, 6-28 cm long, 4-14 mm wide, flat, glabrous, sheath; 3-7 cm long, smooth, striate; ligule short, membranous or imbricate. Panicle, effuse, pyramidal to broadly oblong or ovate, 12-30 cm long, varying from copiously, branched fascicled, filiform, spreading and drooping. Spikelets elliptic, 2-3 mm long, glabrous, acute; lower glume broadly ovate,

membranous with broad hyaline margins, half to two-thirds as long as the spikelet, rarely less, 3-5-nerved, acute; glumes 4; lower glume 1.5 mm long, ovate, 3-nerved; upper glume 2.2 mm long, hyaline margins, 7-9 nerved; lower lemma 7-9-nerved, its palea almost as long; upper lemma pallid, shining, smooth on back, yellowish-white.

Flowering period: Throughout the year

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Kashmir) & tropical Africa; Arabia, through Iran and Afghanistan to India (Cope, 1982). Cholistan desert; DeenGarh, Shadi Wali Dahar, Dodhlan Plantation.

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 139 (HERB. CIDS).

2. *Panicum turgidum* Forssk., Cope in Nasir and Ali, Fl. Pak. 143: 167-169 (1982).

Local Name: Murrat, Bansi Ghaa

A perennial, glaucous suffruticose, up to 50-80 cm tall, forming bushes, stem erect or ascending woody at base with nodes swollen, terete, usually dichotomously branched at the nodes, sometimes also forming fastigiate tufts of branches. Leaves few, 4-14 cm long, 2-5 mm broad; linear-lanceolate, acuminate, terete, smooth, sheath 3-7 cm long; glabrous, glaucous, stiff and pungent; ligule a dense, ciliate rim. Panicle subpyramidal, terminal, branching at first erect, later more or less spreading, up to 15 cm long, rachis angular, grooved, glabrous. Spikelets 3-4 mm long, 2-mm broad, glabrous, solitary or three, glaucous, ovoid, acuminate, turgid and often widely gaping at anthesis, pedicels suberete, scabridulous, short or long copular lips. Lower glume 4 mm long, 2 mm broad, ovate-lanceolate, 7-nerved; upper glume 5 mm long, 2 mm broad, 5-9-nerved; lower lemma 4-5 mm long, 9-11-nerved, its palea almost as long; upper lemma pallid or yellowish, smooth and shining. Grain 3.2 mm long, elliptic, apiculate, convex on both sides.

Flowering period: August-December

Distribution: Pakistan (Sind, Baluchistan) & from Somalia westward through Ethiopia and the Sudan to Morocco, and eastwards from Egypt through Arabia (Cope, 1982). (Cholistan desert; Kaly Pahar, Mooj Garh, Mansoor Check Post).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 15 (HERB. CIDS).

1. *Pennisetum divisum* (Gmel.) Henr., Cope in Nasir and Ali, Fl. Pak. 143: 239-240 (1982).

A perennial grass, with short woody rootstock; culms woody, branched throughout, suffruticosely branched throughout, erect or ascending, 1-1.5 m high or more. Leaf-blades rigid, 7.5 cm long, 1-1.5 mm broad, tightly convolute, pungent, glaucous, equalling or considerably shorter than the sheath; sheaths inflated slightly, persistent at the nodes. Panicle oblong, cylindrical scaberulous; 4-11 cm long; rachis with shallow angular ribs below the cupular scars; single sessile spikelet enclosing by involucre, the base with a short oblong stipe 0.5-1 mm long; bristles glabrous or inner obscurely ciliate, the longest 7-20 mm long. Spikelets narrowly lanceolate, acute to acuminate, 6.5-8.5 mm long; lower glume 1/2 to 3/4 the length of the spikelet, 1(-3)-nerved; upper glume nearly as long as the spikelet, acute or acuminate; lemmas similar, as long as the spikelet, lanceolate-acuminate.

Flowering period: Throughout the year

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK & North Africa; Middle East; India (Cope, 1982). (Cholistan desert; Yazman road 22 km Bahawalpur).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 114 (HERB. CIDS).

C. Sub-family Pooideae

The sub-family Pooideae represented with Aveneae tribe in Cholistan desert.

The tribe Aveneae represented with c. 65 genera, mainly in temperate regions of both hemispheres, extending to mountainous regions of the tropics; 17 genera and 55 species in Pakistan. In Cholistan desert 2 genera and 2 species present.

Key to genera

- | | | | |
|--------------------|---|--------------------|-------------|
| 1. | + | Spikelets | 3-flowered. |
| 1. <i>Phalaris</i> | | | |
| - | | Spikelets strictly | 1 flowered. |
| . <i>Polypogon</i> | | | |

1. *Phalaris minor* Retz., Cope in Nasir and Ali, Fl. Pak. 143: 494 (1982).

A branched, erect or ascending annual. Culms 5-60 cm high, glabrous. Leaves linear-lanceolate, 4-10 cm long, 2-7 mm broad; apex acuminate, glabrous, margins puberulous; sheath convolute; ligule a transparent sheath forming about 4 mm long undulated margins around the culms. Panicle 1-5 cm long, 1-1.5 cm broad, ovate-oblong. Glumes both same, 4-5 mm long, upper glume shiny, 3-nerved, ovate-apex large acuminate, 6 mm long, 2-3 mm broad. Lemma and palea shining, pubescent, 3 mm long; sterile floret, glabrous, 1-1.8 mm long; fertile floret broadly lanceolate-ovate, 2.5-4 mm long, grey-brown and shiny at maturity, pubescent. Grain 2 mm long, dark-brown.

Flowering period: March-June

Distribution: Pakistan (Baluchistan, Punjab, KPK, Kashmir & throughout the world, but apparently native only in the Mediterranean region and eastwards to Baluchistan and the Northwest Himalayas (Cope, 1982). (Cholistan desert; Derawar Fort, Kaly Pahar).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 97 (HERB. CIDS).

2. *Polypogon monspeliensis* (Linn.) Desf., Cope in Nasir and Ali, Fl. Pak. 143: 467-468 (1982).

Local Name: Dumbi Citi

A tufted erect or geniculately ascending, annual grass; culms 6-60 cm high, stout, glabrous; leaves linear, lanceolate, subacute, scabridulous on margins, 5-13 cm long, 2-6 mm broad; ligule oblong, membranous rim, 2.5-12 mm long.

Panicle pale yellowish green, silky, ovate to oblong, cylindrical or lobed, 1.5-13 cm long, 1-3 cm broad. Spikelets 2-3 mm long; minutely pubescent, shortly pedicelled; glumes variable, ovate-oblong, scabridulous on margins, keeled, slightly notched at the apex, with a fine straight awn 4-7 mm long; lower glume 1.3 mm long, oblong, glabrous, 2-fid, lemma about half the length of the glumes, smooth, awnless or with an awn up to 2 mm long; palea oblong, the tip notched.

Flowering period: March-June

Distribution: Pakistan (Sind, Baluchistan, Punjab, KPK, Gilgit, Kashmir) tropical and South Africa; Mediterranean region northwards to the British Isles and eastwards to India and China; introduced and naturalised in most warm temperate countries (Cope, 1982). (Cholistan desert; Derawar Fort, Kaly Pahar, Dodhlan Plantation).

Specimens examined: Cholistan Desert: Hafiz Muhammad Wariss, 98 (HERB. CIDS).

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