

# Taxonomic inventory of grasses on the basis of morphological attributes from Thal desert, Pakistan

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**Abstract**— Grasses constitute a natural homogenous group of plants belonging to the family Poaceae (Gramineae). Undoubtedly, Poaceae forms the most fascinating families of flowering plants, with a wide range of diversity and plays a significant role in the lives of human beings and animals. Thal Desert of Pakistan has rich diversity in grasses and various habitats are available for their growth, and these grasses are less exploited as far as taxonomy is concerned. In this study, morphological analysis of 29 grass species belonging to 10 different tribes was carried out. These Species were distinguished at tribe level and at individual level by apparent morphological features such as height, leaf blade appearance, inflorescence type, ligule, glumes, lemma, palea, number of awn extensions etc. *Arundo donex* belonging to tribe Arundineae has lacerate membranous ligule which is a unique characteristic from other members of same tribe. Tribe Aristideae members have trifid awn extension. *Enneapogon shimpranus*, member of tribe Pappophoreae has 9 awned lemma. These different morphological characteristics of grasses help in discriminating between closely resembling species of Poaceae and can be used in further taxonomic studies carried out on these species.

**Index Terms**— Thal desert, Poaceae, taxonomy, morphological features, inflorescence types

## 1 Introduction

Grasses belong to family Poaceae which is among the largest family of flowering plants. Grasses are classified into about 50 tribes, 660 genera and 10,000 species (Lowe, 1989). According to Clayton and Renvoize (1986) there are 10,000 species belonging to 651 genera in the world and they assigned numbers to identified grass species based upon their phylogentic status. (Good, 1953).

Grasses are considered valuable since advancement of human civilized life. The practice of growing cereal grasses for food dates back to the time of ancient civilization (Mitra and Mukherjee, 2005). Grasses are among the most versatile group of plants which used for multiple purposes. Their value to humanity is as old as the human civilization, They occupy 23 percent of the forest area of the world and are of the utmost value to human beings and animals as food (Singh, 2008). They are considered highly nutritious as they are

taken as food and high protein and starch content provide energy to body (Mensah, 1990).

Besides being the staple food, grasses are also ecologically significant. They are present in all types of climatic conditions such as subalpinic, xerophytic and aquatic ecosystems and helps in building texture of soils. Grasses continuously add humus into soil fulfilling the nutrient requirement and increase primary production (Clayton & Renvoize, 1986).

Grasses are grouped taxonomically with reference to a diverse range of morphological attributes, particularly those of the spikelet and the floret but also in accordance to a variety of variable microtaxonomic features (Kellog, 2006).

The grass family, Poaceae, is noted for its diverse number of characteristics and complexity and so it is complicated to classify the grasses based only on apparent morphological characters (Srivastava, 1978). Grasses being evolutionarily advanced exhibit morphological reduction and monotony in morphological characters, hence gross morphological characters are not very helpful in proper identification of plants and the aid of micromorphological characters is also required (Ullah et al., 2011).

As grasses have lot of economic importance so they are being studied in different areas of Pakistan taxonomically. But Thal area of Khushab is quite unexploited in this regard,

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although because of its sandy soil, harsh environment and low rain fall, unique species grow there. So there was need to document the species belonging to Poaceae family in the area as they are basic source of fodder for cattle. This study is a step for analyzing the grasses of Thal from taxonomic point of view which would serve as the reference point for future experimentation on grasses of this area.

## 2 MATERIALS AND METHODS

### 2.1 COLLECTION OF PLANT MATERIAL

Several field trips were conducted during different seasons of the year in various resource based sites i.e Garout chowk , Tehsil Joharabad, Tehsil Khushab of District Khushab, Thal desert or collection of plant material. Each trip was well planned and executed effectively. Ten to fifteen specimens of each plant species were collected. During collection it was planned to collect specimen of different sizes, age, and habitats for each species to ensure the authentic macro and micro morphological data. Field data on locality, habit, habitat, plant height, branching pattern, flowering period, anther color, and ethno botanical uses was recorded in the field note book. The plant specimens were properly pressed, dried and preserved according to standard procedure as described by the Judd et al., (2002). Plants were properly mounted on standard size herbarium sheets. Name of genus and species with authority and family, locality, name of collector and identifier, and ecological remarks were recorded on label. The voucher specimens for each of the samples studied have been deposited in the Herbarium of PMAS Arid Agriculture University Rawalpindi.

### 2.2 MORPHOLOGICAL STUDY

For morphological studies, 10 to 15 specimens per species were studied under the binocular light microscope. Observations and measurements were made 3-6 times to ensure the readings and taking their means. The parts of the plants were measured with hard ruler or for finer details, under a dissecting microscope. Magnifiers of 5X, 10X, 20X were also used for observation of various parts. The morphological characters were reconfirmed by using Flora of Pakistan Poaceae No 143(Cope, 1982), Flora of China; Vol 22, Flora of British India Flora of North America, Flora of Europea, Manual of the Grasses of United States, Grasses Genera of the, Grasses of Burma, Ceylon, India, and Pakistan and Grasses of Saudi Arabia.

Following morphological characters were observed;

#### 2.2.1 Vegetative Characters:

- a) **Habit:** Annual or perennial, erect, prostrate, decumbent or trailing, single or caespitose etc.
- b) **Stem and Culm:** Plant height, number of culms, number of nodes, branching and pubescence of culms, texture of internodes, stem color and outline etc.
- c) **Leaf:** Shape, length, and width position and arrangements, pubescence, color, apex, base and margins, and feature of adaxial and abaxial surfaces of leaf blades.

**Shaeth:** pubescence, color, whether open or not, keeled or not, and features of margins.

**Ligule:** shape, size, whether membranous, ciliate, ciliate fringe, or a line of hairs.

#### 2.2.2 Reproductive Characters

a) **Inflorescence:** Panicle, raceme, spike etc, shape, length and width, terminal or axillary, length and arrangements of inflorescence branches, texture and pubescence of rhachis.

b) **Spikelets:** Shape, length, width, color, whether pedicellate or sessile and single or in group etc.

c) **Glumes:** Shape, length, width, texture, color, pubescences, keels, veins, and apex of lower and upper glumes.

d) **Lemmas:** Shape, length, width, texture, color, pubescences, keels, veins, and awns of lower and upper lemmas.

e) **Paleas:** Shape, length, width, texture, color, pubescences, keels, veins of paleas.

f) **Stamens:** Number, size, color etc.

g) **Carpels:** Shape and size of ovary, numbers of styles and stigmas and color of stigma hairs.

h) **Caryopsis:** shape length, width, breadth, color, pubescence etc.

### 3. RESULTS

#### 3.1 Tribe wise Classification of the 29 Grasses collected from Thal desert.

1. **Tribe Arundineae**
  1. *Arundo donax* L.
2. **Tribe Aristideae**
  2. *Aristida adscensionis* L.
  3. *A. funiculata* Trin. & Rupr.
3. **Tribe Chlorideae**
  4. *Cynodon dactylon* (Linn.) Pers.
4. **Tribe Eragrostideae**
  5. *Dactyloctenium aegyptium* (L.) W
  6. *Desmostachya bipinnata* (Linn.) Stapf.
  7. *Eleusine indica* (L.) Gaertn.
  8. *Leptochloa chinensis* (Linn.) Nees
  9. *Ochthochloa compressa* (Forssk.)
5. **Tribe Pappophoreae**
  10. *Enneapogon shimpranus*
6. **Tribe Andropogoneae**
  11. *Cymbopogon javarancusa* (Jones) Schult.
  12. *Dichanthium annulatum* (Forssk.)
  13. *Imperata cylindrica* (Linn.)Raeu
  14. *Saccharum ravennae* (Linn.) Murr.
  15. *Saccharum spontaneum* Linn.
  16. *Sorghum halepense* (Linn.) Pers.
7. **Tribe Paniceae**
  17. *Brachiaria ramosa* (Linn.) Stapf.
  18. *Cenchrus biflorus* Roxb.
  19. *Cenchrus ciliaris* Linn
  20. *Cenchrus pennisetiformis* hochst. & Steud. Ex Steud
  21. *Cenchrus setigerus* Vahl
  22. *Digitaria sanguinalis* (Linn.)
  23. *Setaria intermedia* Roem. & Schult.
  24. *Setaria verticellata* (Linn.) P. Beauv
8. **Tribe Aveneae**
  25. *Avena fatua* L.
  26. *Phalaris minor* Retz.
  27. *Polypogon fugax* Nees ex Steud.
10. **Tribe Bromeae**
  28. *Bromus pectinatus* Thunb.
11. **Tribe Poeae**
  29. *Poa annua* Linn

#### 3.2 MORPHOLOGICAL DESCRIPTION

##### 3.2.1 *Arundo donax* L.

Perennial habit, rhizomatus, erect culm, 100cm to 250 cm in length. leaf blades lanceolate in shape, rounded at lower side, pointed at tip, with a glabrous surface. Leaf size ranging from 23-51 cm

lengthwise and 2-6 mm in width. Lacerate Membranous ligule, 0.5- 0.7 mm lengthwise. Inflorescence: panicle 17-29cm in length, Spikelets ranging in size from 10-15 mm. Glumes unequal, lanceolate in shape, 3 veined, dark purple or brown in colour. upper glume longer in size as

compared to lower glume. Upper glume 6-10mm long while lower glume ranges from 4.5 -8mm in length. Floret size ranges from 2-3 mm. Lemmas lanceolate, long hairs arising from base, 3 nerved, 4-6 mm in length. Palea shorter than lemma, 2-5 mm in length. Anthers of orangish yellow colour with size of 1.5-2 mm. Caryopsis 4-5 mm, oblong in shape.

### 3.2.2 *Aristida adscensionis* L.

Annual grass, rhizomatous, tufted culms branched 2-58 cm in height. Linear leaf blades, flat or folded, scabrous surface, 3.5-16.5 cm in length, 1-1.6 mm in width. Ligule a hairy fringe with very long hair, 0.5 mm in size. Leaf sheath glaucous. Panicle 13-20 cm in length, Spikelets purple or light green in colour, lanceolate. 3.8-7.9 mm in length with awn extensions. Glumes unequal, lanceolate, tip toothed, brown in colour. Upper glume 1 nerved, 5.5-8.5 mm in length while lower glume 4.8-6.2 mm in length. Keeled lemma present with 3 awn extensions. Lemma size 4.6-7.9 mm, awn length unequal, middle one longer in size than lateral ones. Middle awn 12-18.5 cm in length while lateral ones are 8.2-17 cm in length. Palea thin, membranous, obtuse 0.4-0.8 mm in length. Lodicules elliptical, membranous 1.5-1.7 mm in size. Anthers 1.5-2mm in length. Caryopsis 4.5-5.6 mm in length. (Plate 2a)

### 3.2.3 *A. funiculata* Trin. & Rupr.

Annual grass, tufted culms, 12-36 cm in length. Leaf blades flat 4-10 cm in length, 2-3.5 mm in width. Ligule a ciliated fringe 0.3-0.4 mm in length. Panicle linear, about 8-12 cm in length. Spikelets brownish green in colour, Glumes linear, membranous, finely attenuate, unequal, lanceolate, membranous, Upper glume 6.5-7 mm in length, lower 5-6 mm in length. Lemma cylindrical, scabrid surface, 2-3.5 mm in length. Awns extensions present, trifid, unequal, middle one 3-5.5 mm in length. Caryopsis hard, brownish, 3.5-4 mm in length.

### 3.2.4 *Cynodon dactylon* (Linn.) Pers.

Perennial grass, prostrate and spreading, rhizomatous or stoloniferous culms creeping at the base and upright at later stages 8-43 cm in length, glabrous surface. Leaf blade flate, scabrous margins, glabrous 2-5.5 cm lengthwise and 1.1-1.4 mm in width. Leaf sheaths glabrous with membranous margins. Hairy ligule a short ciliate rim, 0.3-0.4 mm in size. Inflorescence: digitate having 4-5 spikes. Spikelets 1.5-4 cm in length, 0.8-2 mm in width. One floret in each spikelet, jointed with rachis, floret 1.6-2.1 mm in length, greenish or violet in color. Glumes unequal, upper glume 1.6-2.8 mm in length, lower 1.3-2.4mm in length, both lanceolate and 1 nerved. Lemma pubescent, 3

nerved, ovate or lanceolate in shape, awnless, 1.6-1.9 mm in length. Palea shorter than lemma, about 1.3 mm in length, 2 keeled. Anthers 0.8 mm in length, caryopsis oblong in shape, 1.2-1.8 mm in size.

### 3.2.5 *Dactyloctenium aegyptium* (Linn.) Willd

Annual grass, culms 25-46 cm in length, ganiculately ascending, rooting at lower nodes. Leaf blades flat with hispid margins, 3-14.5 cm in length, 2.5-5 mm in width. Ligule ciliated fringe, 0.8-1.3 mm in length. Inflorescence digitate, 4-6 spikes, 1.5-3.5 cm lengthwise. Spikelets 1.5-3 mm long, ovate, 3 florets present. Glumes equal, lanceolate, 1 nerved, keeled, 2-2.5 mm lengthwise. Upper glume with an awn extension about 1 mm in length. Lemmas 1.5-2 mm in length, lanceolate, 3 nerved, Palea shorter than lemma, hyaline, keeled. Anthers 0.5 mm in length. Caryopsis obovate in shape, 1 mm in length.

### 3.2.6 *Desmostachya bipinnata* (Linn.) Stapf.

Tall perennial grass, rhizomatous, culms 100-120 cm in height, Leaf blades stiff, flat, 18-56 cm in length, 3-8.5 mm in width. Lacerate membranous ligule 0.5mm in length. Inflorescence: Panicle with clustered spikes 0.8-2.9 mm in length. Spikelets ovate to oblong, 1-2.6 mm in length. Glumes lanceolate, both 1 nerved, unequal in size. Upper glume larger than lower 0.5-1.4 mm in size, lower glume about half as long as upper glume. Lemmas 1-3 nerved, coriaceous, 1.5 mm in length. 2 keeled membranous palea, almost equal in length to lemma. Anthers 0.4-0.8 mm in length. Caryopsis ovoid in shape and about 1 mm in length.

### 3.2.7 *Eleusine indica* (Linn.) Gaertn

Annual grass, tufted culms 21-37 cm tall. Leaf blades linear with a smooth surface, ranging in size from 11-19 cm in length and 2-5 mm in width. Membranous ligule with rough margins, 0.5-0.6 mm in length. Inflorescence digitate, number of spikes usually 3-5, rarely 3. Spikes ranging in length from 2.5 to 7 cm. 4-7 florets present in 1 spikelet. Elleptical spikes with yellowish green colour. Glumes acute, unequal, Upper 1 nerved, scabrid margins 1.9-2.1 mm in length and 0.6- 1 mm in width, Lower glume 3 nerved, 1.5-1.9 mm in length. Lanceolate lemmas with acute tip, 1.2-1.7 mm in length, palea nearly same size as palea. Elleptical caryopsis about 1.5-2.1 mm.

### 3.2.8 *Octochloa compressa* (Forssk.) Hilu.

Perennial grass, stoloniferous, culms 17-24 cm in height, prostrate or ganiculately ascending. Leaf blades linear with a glaucous surface, 1.3-4.5 cm in size, 1.2-1.6 mm in width. Ciliated ligule, 0.5 mm in size. Glabrous leaf sheath with ciliated base. Inflorescence: Digitate 2-4 spikes. Spikes 4-18 cm in length, spikelets 3.5-4.7 mm in length. 2-5

florets in one spikelet. Glumes lanceolate in shape, purple in color, unequal in size. Upper glume 3 nerved, 2.5-3.3 mm in length, lower glume 1-3 nerved, 1.7-2.4 mm in length. Lemmas lanceolate, coriaceous, ciliated margins, 2.6-3.8 mm in length. Palea 2 keeled, boat shaped, Anthers 0.4-0.6 mm in length, Style 0.2-0.5 mm. Caryopsis 0.9-1.2 mm in length.

### 3.9 *Leptochloa chinensis* (Linn.) Nees

Annual grass, culms erect, geniculately ascending, 20-50 cm tall. Leaf blade, linear, flat, with scabrous margins, 15-23 cm in length, and 4-5.5 mm in width. Ligule a hairy fringe, 0.8-1.5 mm in length, leaf sheath glaucous. Inflorescence elliptical, green to purplish, racemes scattered along the central axis. Spikelets 3-5 flowered, elliptical to oblong in shape, 1.7-2.5 mm in length. Glumes unequal, 1 nerved, Lanceolate or often ovate in shape, Upper 0.7-1.2 mm in length, lower 0.5-1mm in length. Lemma oblong in shape, 3 nerved, ciliated surface, 0.6-0.9 mm in length. Ellepsoidal caryopsis, dark green or brown in colour, 0.5-0.7 mm in length.

### 3.2.10 *Enneapogon shimpranus* (Hochst. ex A. Rich) Renvoize

Perennial grass. Culms 22-40 cm tall. Leaf blades hairy, size ranging from 2.5-9 cm in length and 3-3.5 mm in width. Hairy ligule, 0.3 mm in length. Inflorescence: panicle 7.9-11cm in length, pale green or light purple in colour. Usually 3 florets in a single spikelets. Glumes hairy at the margins, glabrous at the pointed tip, both 7 nerved, Upper glume 4-6.5 mm in length while lower glume 4.5mm long. Keeled, pubescent keel, lemma membranous, 9 nerved, 3.5-4 mm in length, palea 2mm in length, Lemma has 9 awn extension ranging in size from 4.3-8.7. Floret size 2.3-3.9 mm. Anthers 0.3-0.7 mm in size. Caryopsis 0.6-0.8 mm, shiny with dark brown colouration.

### 3.2.11 *Cymbopogon jwarancusa* (Jones.)Schult

Perennial grass, rhizomatous, culms tufted at the base, geniculately ascending 32-90 cm in height. Leaf blades green or brownish in colour, glaucous surface, 5-30 cm in length, 0.5-4 mm in width. Leaf sheath, whitish in appearance, glabrous, flat or coiled. Membranous ligule 1-2.5 mm in length. Panicle, spatheolate, elliptical spatheoles. Paired spikelets, one pedicelled other sessile, ciliated pedicels. Sessile spikelet, female, 3-4.7 mm in length. Upper glume 3.2-5 mm in length, boat shaped, membranous. Lower glume concave on the back, 2.9-4.5 mm in length, both glumes 4 nerved. Membranous, 1 nerved upper lemma, 2.5-3.3 mm in length having an awn extension 4-10 mm in length. Pedicelled spikelet, male, lanceolate or ovate in shape, ciliated at base, 4.5-5.6 mm in

length. Glumes unequal, greenish or reddish, lanceolate, membranous, upper glume 1 nerved, 3.8-4.7 mm in length. Lower glume 3-5 nerved, 3.5-4.6 mm in length. Upper lemma oblong with acute apex, hyaline, 2.5-3.4mm in length, anthers 1.5-2mm in size.

### 3.2.12 *Dicanthium annulatum* (Forssk.)Stapf

Perennial grass, upright culms 20-87 cm in length. leaf blades 13-24 cm in length and 2.3-5.4 mm in width, glaucous at margins, pubescent at base. Ligule membranous, 0.7-1.7 mm in length. Leaf sheath glabrous. Inflorescence: digitate or sub digitate, peduncled raceme, 4-7 mm in length. Spikelets green or purple in colour 2.9 mm in length. Glumes unequal, upper 1 nerved, 2.9mm in length and lower 7 nerved, 2 mm in length. Lemma 1 nerved, 1.9-2.1mm in length. Awn present, 7-16.5 mm in length. Anthers, whitish or violet, 1mm in length. Stigma black 1.7 mm in size, Style 0.9 mm in size. Caryopsis 0.9-1.9 mm in length, oblong in shape.

### 3.2.13 *Imperata cylindrica* (Linn.)Raeu

Perennial grass, rhizomatous, upright culms 15-52 cm tall. Leaf blades flat, 4-19.5 cm in length and 2.5-13 mm in width. Membranous ligule 1.3-1.9 mm in size. Glabrous leaf sheath. Inflorescence: Panicle, cylindrical, spatheolate. Spikelets in pair, pedicelled, oblong in shape, ranging in size from 2.2-3.5 mm in length, clumps of white hair arising from base of spikelets. Glumes equal, 5 nerved, lanceolate in shape, 2-3.5 mm in length. Hyaline lemma 1.6-2.4 mm in length. Anthers 1.8-2.5 mm in length, yellow orange in colour. style and stigma equal in size about 2 mm.

### 3.2.14 *Saccharum ravennae* (Linn.) Murr.

Tall perennial grass, culms 2-4 cm in length. leaf blades flat, glaucous with a thick mid rib, 40-100 cm in length and 5-15 mm in width. Membranous ligule, 3-8 mm in length. Inflorescence; panicle 15-45 cm in length. Glumes present, almost equal in length i.e 2.5-3 mm in length. Upper glume glabrous, 1 nerved, Lower glume membranous, 2 nerved. Floret size ranges from 1.3-1.7 mm. Upper lemma membranous, lanceolate with acute apex, 1.4mm with an awn extension which is 2.5-4.5 mm long. Lower lemma slightly shorter than upper lemma, 1.5-2 mm in length, Anthers whitish, 1mm in length.

### 3.2.15 *Saccharum spontaneum* Linn.

Tall Perennial grass, rhizomatous, culms 70-130 cm tall. Leaf blades glaucous 10-50 cm in length and 4-7 mm in width. Membranous ligule, 0.9-1.2 mm in length. Inflorescence: panicle 20-27.5 cm in length. Hairy peduncle, white long hair present on inflorescence. Upper and lower glumes



equal in length, glabrous, margins hairy, tip membranous. Upper lemma lanceolate, 1.5-2.1 mm in length, lower lemma 1.1-1.3 mm in length. Anthers dark orange, 0.9-1.2 mm in length. Caryopsis ovoid, shiny nearly 1 mm long.

### 3.2.16 *Sorghum halepense* (L.) Pers.

Perennial, rhizomatus grass, slender, erect culms, height 70 cm-2 m. Leaf blades 14.5-33 cm in length and 0.8-1.2 mm in width, lanceolate in shape, scabrous surface, membranous ligule, sheath glabrous. Inflorescence: panicle, pyramidal arrangement of branchlets, 18-27 cm in length and 2-17 cm in width. Branchlets having two types of spikelets, sessile and pedicelled. Sessile spikelets elliptical or ovate, 3-3.5 mm in length, hairy, brownish in colour. Upper glume 2-3.5 mm in length, 5-7 nerved, lower glume about the same length as upper glume, 10 nerved, minute hair at margins. Upper lemma acute, 2 lobed having an awn extension 8-10 mm in length. Both lemmas membranous, upper 3-3.5 mm in length while lower lemma 2.5 mm in size. Palea ranging in size from 2-2.7 mm. Anthers 1.5-1.8 mm in length, orange yellow in colour.

### 3.2.17 *Brachiaria ramosa* (Linn.) Griseb.

Annual grass, culms height 10-45 cm in length, leaf blades 4-11.5 cm in length, 6-15 mm in width, lanceolate with scabrid margins, ligule 1 mm in length, leaf sheath glabrous from both upper and lower side. Inflorescence: panicle 1.5-3.7 cm in length, triquetrous racemes emerging, spikelets cylindrical 2-3.5 mm in length and 1.5-1.8 mm in width, glabrous. Glumes size unequal, upper glume, 7 nerved, pubescent, 2.5-3 mm and lower glume 5-7 nerved, 1.5-2.5 mm in length. Upper lemma 3 nerved, 2 mm in length, lower lemma 5 nerved equal in length with upper lemma, palea hyaline, membranous, 1.7 mm in length. Anthers green in colour, 0.5 mm in length. Brown stigma, 0.4 mm in length. Elliptical caryopsis green, 0.9 mm in size.

### 3.2.18 *Cenchrus biflorus* Roxb.

Annual grass, erect culms ranging in height from 20-40 cm. Leaf blades 2-9 cm in length, 2.5-6 mm in width, smooth surface, wavy margins. Ligule covered with minute hair. Sheath smooth on upper side, hairy on lower side. Inflorescence: panicle, 3-12 cm in length, ovoid involucre, spiny with sticky bristles. Inner bristles larger than outer bristles connate to form a disc enclosing the 3 spikelets. Spikelets ovate, equal in length, 5 nerved, 2-2.5 mm in length. 5 nerved, ovate lemma with pointed end, 1.3-1.8 mm in length. Caryopsis 1.3 mm in length, ovate to elepsoidal in shape.

### 3.2.19 *Cenchrus ciliaris* Linn.

Perennial grass, culms height 6-20 cm.

Leaf blades 3-25 cm in length and 2-6 mm in width, flat, with scabrous margins. Leaf sheath glabrous. Membranous ligule. Inflorescence: panicle, 5-10 cm in length, cylindrical in shape, dark purple or light green in colour. Spikelets covered by elongated involucre with long hairy projections (bristles). Inner bristle longer in size than the spikelet. Two spikelets in 1 involucre, spikelets ovate to lanceolate, 2.5-3.5 mm in length. Glumes unequal, 1-3 nerved, ovate with acute apices, upper glume 2-3 mm in length, while lower glume 1.5-2.2 mm in length. Floret enclosed by lemma ovate in shape. Upper lemma 2-3.5 mm in length, 5 nerved. Membranous, hyaline palea, 1.6-1.8 mm in length. Size of anthers 0.6 mm, ovoid in shape, brown in colour. Pistil 1.5-1.7 mm in length. Style size 1.3-1.6 mm and stigma 1.3 mm in length. Hard caryopsis, shiny, blackish brown, about 1 mm in length.

### 3.2.20 *Cenchrus pennisetiformis* Hochst. & Steud. Ex Steud

Annual grass, culms 5-45 cm tall, erect. Leaf blades flat, 5-15 cm in length, 3-6 mm in width. Ligule membranous. Leaf sheath smooth. Elongate involucre, 3-11 mm in length. 2-3 spikelets enclosed in one cupulate involucre, inner bristles shorter than spikelet. Spikelet size 4-6.5 mm in length, ovate in shape. Glumes both ovate with acute apices, 1 nerved, equal, almost 5 mm in length. 5 nerved, coriaceous lemma, ovate in shape, 2-2.5 mm in size.

### 3.2.21 *Cenchrus setigerus* Vahl

Perennial grass, culms height 15-40 cm in length. Leaf blades 2.5-10 cm in length and 1.5-2.5 mm in width. Membranous ligule. Sheath glabrous with scabrid margins. Inflorescence: panicle, 2-6.5 cm in length, cylindrical, scabrous appearance, cup shaped involucre, inner bristles connate to form a cup. Inner bristles longer than outer bristles. 3 spikelets in a single involucre. Spikelets 2.5-4.5 mm in length. Lanceolate, glumes ovoid and pointed, unequal, both 1 nerved. Upper glume 1.5-2.3 mm in length, lower glume 1-1.3 mm in length. Lemma enclosing the floret, 5 nerved, 1-1.9 mm in length. Palea membranous, hyaline, also 5 nerved, more than half length of lemma. Stigma 2-2.3 mm in length. Anthers orange or violet in colour. Caryopsis shiny, brown, 0.9-1.2 mm in length.

### 3.2.22 *Digitaria sanguinalis* (Linn.) Scop.

Annual grass, culms prostrate, erect upwards. Leaf blades lanceolate, scabrous surface, 3.5-12.3 cm in length, 2-3 cm in width, membranous ligule, 2.3 mm in length. Inflorescence: digitate having 3-5 racemes, raceme 6-12.5 cm in length, triquetrous, ovate

spikelets 2-2.7mm in length. Both short pedicel and long pedicel spikelets arranged in pairs, glumes unequal, 3 nerved, upper glume 1.5-2.5mm long. Lower glume 0.5-0.7mm in length. Upper and lower lemma are equal in length with the spikelet, 3 nerved. Caryopsis ovoid with dark brown coloration 1.1-2.2 mm in size.

### 3.2.23 *Setaria intermedia* Roem. & Schult.

Annual grass, prostrate at the base with extremity curving upwards, rooting at the nodes. Culms 30-45 cm in length. Leaf blades linear, scabrous at margins, ciliated surface, 4-16 cm in length, 3-7 mm in width. Ligule, a ciliated fringe 1.8 mm in length. Inflorescence: Panicle, 3.5-8.6 cm in length, lanceolate in shape with a scabrid rachis. Elliptical spikelet 1.8-2.3 mm in length and 0.5 mm in width. Glumes unequal, ovate in shape. Upper glume 1.5-2 mm in length, lower one ranging in length from 0.7-1.3 mm, 3 nerved. Upper lemma 3 nerved, lower five nerved 1.5-2 mm in length. Upper palea ovate lower boat shaped and 2 keeled. Elliptical caryopsis about 1.5 mm in size.

### 3.2.24 *Setaria verticellata* (Linn.) P. Beauv.

Annual grass, erect, culms 20-50 cm tall. Leaf blades lanceolate, scabrid margins, Leaf blade size 6-15cm in length, 2-10 mm in width. Leaf sheaths glabrous. Ligule lacerate membranous, 1-2.5 mm in length. Inflorescence: panicle, purplish green in colour, 3-10 cm in length, hispid on rachis. Spikelets with bristles at the base, 2-3 mm in length, Spikelets oblong to ellipsoidal in shape, about 2 mm in length. Glumes equal in size, about 1.5-2 mm in length, upper glume one nerved while lower 3-5 nerved. Lemma membranous, 0.9-1.2 mm in length enclosing palea half of its length. Anthers light yellow or whitish, about 0.5 mm in length. Stigma black, 0.3 mm in length. Caryopsis yellowish green, hard, 0.9 mm in length.

### 3.2.25 *Avena fatua* Linn.

Annual grass, culms 28-42 cm tall, erect or geniculately ascending. Leaf blades 4-15.5 cm in length, glabrous, scabrid at margins. Membranous ligule 1.9-2.4 mm in length. Leaf sheath glaucous. Inflorescence: Loose pendulous panicle 10-14 cm in length. Spikelets 17-24.5 mm in size. Glumes unequal, lanceolate, acute, 7 nerved. Upper 16-19.5 mm and lower 13.5-16.5 mm in size. Florets are marked by a horse shoe shaped scar at the base. Lemmas lanceolate, 7 nerved, ciliated, fringed with stiff hair, 2 toothed at apex, brown at lower side and greenish towards the tip provided with a 19-26.5 mm awn extension. Two keeled palea about half the length of lemma. Caryopsis, 4.5-5.6 mm in size.

### 3.2.26 *Phalaris minor* Retz.

Annual, 23-56 cm long culms, prostrate at

base with extremity curving upwards. Leaf blades rough surface, 2-3 cm in length, 0.4-0.6 mm in width, rough surface. Membranous ligule 0.5-2 mm in length. glabrous on upper side, leaf sheath membranous at margins. Inflorescence: Panicle, pale green or light green in colour. Spikelets 6-8 mm, yellowish green in colour, Glumes equal with dentate margins, pointed, winged, awnless 5.4-7.6 mm in length. Lemma hyaline, 2.4-3.1 mm in length, ciliated at tips and margins, 5 nerved. Palea smaller than lemma, lanceolate in shape. Anthers white or light yellow in colour, 1.2 mm in length. Style 1.7 mm in length, stigmas 1.3 mm in length. Ovate caryopsis, brown in colour, pubescent and shiny 2-2.5 mm in length.

### 3.2.27 *Polypogon fugax* Nees ex Steud

Annuals, Culms 22-65 cm tall, Prostrate at the base with extremity curving upward, leaf blades linear, 1.5-13 cm long, 1.2-9 cm broad, smooth or with scabrid margins. Ligule membranous 1-3.5 mm long. Panicle light green or greenish yellow in colour, cylindrical with ovate or oblong shape. Spikelets 1.2-2 mm in length. Unequal glumes, ovate, grooved at the tip, margins slightly hairy with long, fine, straight awn 3 mm long. Glaucous lemma and palea, Lemma 1.5-2.5 mm in length, palea 1.3-2.2 mm, toothed at tip. Anthers whitish or pale in colour, 0.1-0.5 mm long. Caryopsis spheroidal or oval, 0.25-0.3 mm long.

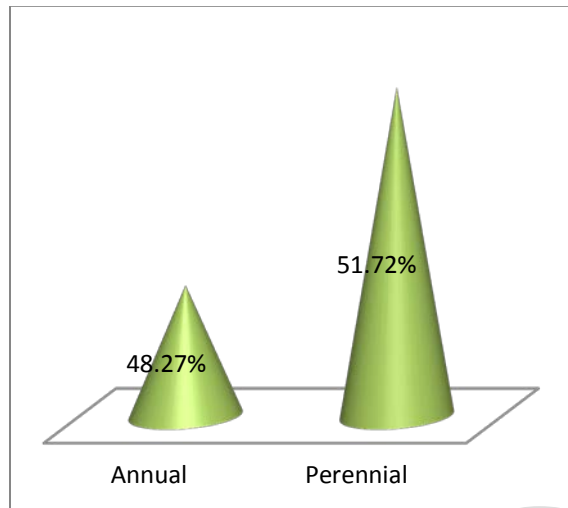
### 3.2.28 *Bromus pectinatus* Thunb.

Annual grass, culms height 10-30 cm. Leaf blades with ciliated surface, 4-15cm in length and 1.5-2.5 mm in width. Leaf sheath glaucous. membranous ligule, about 2 mm in length. Inflorescence: panicle 6-17 cm in length with 4-10 cm long racemes. Spikelets lanceolate, having 4-5 florets, 1-2 cm in length with pedicel. Glumes unequal, first glume lanceolate in shape, 5-7 mm in length, 5-7 nerved, while 2nd glume 3-5 mm in length, scabrid, narrower than the upper glume. Pubescent, lanceolate lemma, toothed at apex, 6-8 mm in length, 7 nerved, having an awn extension, 7-12 mm in length. Pubescent, keeled palea, 5-8 mm in length. Anthers 1.3-1.9 mm in length.

### 3.2.29 *Poa annua* Linn.

Annual or short span perennial grass. Culms 5-20 cm in length, erect, geniculately ascending, rooting from nodes. Leaf blades flat, folded at younger stages, glabrous surface, scabrid margins, 2.5-9 cm in length, 1-2 mm in width. Membranous ligule 1-1.8 mm in length. Leaf sheath with glaucous or glabrous surface. Inflorescence panicle, pyramidal 3-8 mm in length. Spikelets 2.8-5.6mm in length, lanceolate, pale green in colour, 3 florets inside. Glumes unequal, lanceolate or ovate, upper glume 3 nerved, 2.5-3

mm in length. While lower glume 1 nerved, 2-2.7 mm in length. Lemma oblong in shape 3 nerved, glabrous in surface, ciliated base, 2-3 mm in length, no awn extension present. Palea half the size of lemma. Anthers 0.5 mm in length. Caryopsis 0.5-1.2 mm in length.



#### 4 DISCUSSION

Being a valid scientific discipline plant morphology aims to explain the form, structure and development of plants (Pochynok, 2012). Only one sp of tribe Arundineae *Arundo donax* L. was collected from Thal desert, Dist. Khushab. Height of *Arundo donax* L. reaches to 2.5m in length and leaves are recorded about half meter in length. Ligule is lacerate membranous, it is an important distinguishing character in case of *Arundo donax* as stated earlier by (Ahmad, 2009). Inflorescence is panicle with spikelets 10-15mm long. Glumes and lemmas are 3 nerved, lanceolate.

Apparently type of lemma and awns is important characteristic in identifying *Aristida* species. Both the species of *Aristida* genus has trifid awns. middle one greater in length than side ones, which is a significant feature in delimiting the sp.

The distinguishing features of *Cynodon dactylon* belonging to tribe chlorideae are presence of a hairy ligule with ciliate rim, 0.3-0.4mm in size, digitate inflorescence. Lanceolate, 1 nerved glumes enclosing the florets and 3 nerved awnless lanceolate lemma.

*Desmostachya bipinnata* is the tallest grass of Eragrostideae tribe collected from Thal desert, culms reaching in length from 1 to 1.2m. *Dactyloctenium aegyptium* and *Ochthochloa*

Fig 1: Percentage of annual and perennial grass species collected from Thal Desert

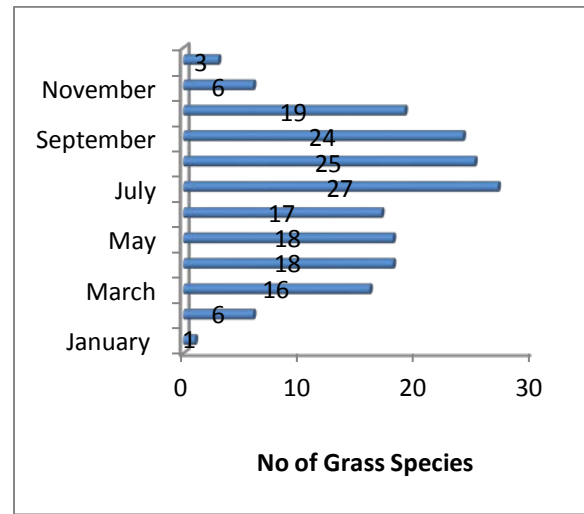


Fig 2: Occurrence of Grass species in months of the year

*compressahas* ligule a ciliated fringe while *Desmostachya bipinnata* and *Eleusine indica* has lacerate membranous ligule. Inflorescence is panicle in *Desmostachya* while in all other, digitate inflorescence present comprising 3-5 spikes in *Eleusine*, 2-4 in *Ochthochloa*, 4-6 spikes in *Dactyloctenium* sp.

*Enneapogon shimpranus* of tribe Pappophoreae is a perennial grass distinguished from others by having a 9 nerved lemma and 9 awns extending from it. It is an important feature for identification of this genus. Earlier this character was observed by Ahmad (2009) in *Enneapogon persicus*.

*Saccharum spontaneum* and *Saccharum ravennae* are tallest grasses in species of Andropogoneae collected from Thal desert. Inflorescence panicle in all species *C. jwarancusa* has spatheolate panicle, *S. halipanse* has pyramidal arrangement of panicle and *Dicanthium annulatum* digitate or sub digitate inflorescence present. *Imperata cylindrica* is recognized by its woolly cylindrical panicle, *Saccharum spontaneum* has white hairy panicle while inflorescence of *Saccharum ravennae* is yellowish in colour. *C. jwarancusa* is highly aromatic, aroma comes from its roots and when leaves are crushed, so it could easily be identified. Ligule in all species collected is membranous type.



Variation exist in culm length of species of *Cenchrus* genus. (Hooker, 1897; Shaheen et al., 2011). In present study, they vary in length from 5-45cm. All *Cenchrus* sp. studied posses membranous ligule, In *Cenchrus setigerus* Vahl and *C. biflorus* 3 spikelets present, In *C. ciliaris* 2 spikelets present and in *C. pennisetiformis* 2-4 spikelets are observed. However a variability in number of spikelets is earlier suggested by Shaheen et al. (2011). Variation in colour of spikelets also exist among these species. In *Cenchrus ciliaris* 1-3 nerved glumes are present while in all other species studied 1 nerved glumes present. 5 nerved lemmas are sort of consistent feature of genus *Cenchrus*. In *S. intermedia* ligule is a ciliated fringe while in *S. verticellata* ligule is lacerate membranous.

*Avena fatua* has stems 28-47cm high, main distinguishing features are floret marked by a horse shoe shaped scar which according to Hubberd (1978) is a mark of point of detachment of spikelet. *Phalaris minor* is distinguished by membranous ligule, Panicle inflorescence, glumes unequal with dentate margins, lemma having ciliated surface without an awn extension. *Polypogon fugax* having the marked differences of genus *Polypogon*. Ligule membranous so far largest in genera of this tribe collected from Thal desert reaching to a length of 3.5mm.

## CONCLUSION

Morphological parameters are quite important in identifying a species taxonomically. Species of Thal desert were distinguished at tribe level and at individual level by apparent morphological features such as height, leaf blade appearance, inflorescence type, ligule, glumes, lemma, palea, number of awn extensions etc. These characteristics would be helpful in future studies on these grasses.

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