CONCLUSION

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Following are the conclusions derived from the present study.

- Total 55 genera and 100 species of grasses have been collected from Panchmahal and Dahod districts the study area of the present work. Poaceae has been divided into two groups: Panicoideae and Pooideae (G. L. Shah). Among collected species 47 genera belonged to Panicoideae from distributed in the different tribes i.e Tribe Maydeae (2 genera), tribe Andropogoneae (22 genera) and tribe Paniceae (13 genera). From group Pooideae 18 genera, distributed into tribes Ischaneae, Aristideae, Perotideae, Sporoboleae, Zoysieae with single genera, tribe Chlorideae with 6 and tribe Eragrostideae with 7 genera were collected. Apart from grasses, 108 other associated angiosperm species including trees, shrubs, herbs have also been listed.
- Seventeen talukas were covered under Panchmahal and Dahod districts for the collection of grass species. Species *Apluda mutica, Bothriochloa pertusa, Cymbopogon martini, Dicanthium annulatum, themeda triandra, Brachiaria eruciformis, Brachiaria reptans, Digitaria ciliaris, Echinochloa colona, Panicum trypheron, Aristida adscensionis, Aristida funiculata, Cynodon dactylon, Eleusine indica, Eragrostis tenella* and *Sporobolus diander* were found to be common in all the talukas.
- A list of dominating species in the two districts has been listed. Panchmahal districts has 14 dominating species which includes *Apluda mutica, Cymbopogon martini, Themeda triandra, Cynodon dactylon, Dactyloctenium aegyptim, Eleusine indica, Bothriochloa pertusa, Capillepedium hugleii, Aristida adscendionsis, Eragrostis tenela, Sporobolus diander, Echinochloa colona* etc. while Dahod has 11 dominating species which includes *Dicanthium annulatum, Sehima nervosum, Apluda mutica, Chrysopogon fulvus, Eleusine indica, Heteropogon contortus, Dactyloctenium aegyptium, Eragrostis tenella, Sporobolus diander,* etc.
- Study area could be categorized into three different habitats: dry soil area, moist area and stony or rocky area. From the studied species, 7 species have been collected from stony area, 16 species from moist area and all the other species from dry soil areas. *Oropetium* and *Eragrostiella bachyphylla* was located in the crevices of rocks and *Cenchrus ciliaris* was found at the edges of rock while *Imperata* and *Saccharum* are found in moist places. From the diversity point of view Panchmahal district showed more diversity of grass species. Especially in Bandheli grassland which showed three of habitats. Species *Apluda mutica, Cymbopogon martini, Themeda triandra, Cynodon dactylon, Dactyloctenium aegyptium, Eleusine indica* were dominating species. *Oropetium villosulum* and *Eragrostiella bachyaphylla* were found restricted to be Bandheli grassland. *Rottbelia exaltata* was found only at Kalitalai.

- *Heteropogon contortus* var. *geninus* sub var. *typicus*, *Heteropogon contortus* var. *geninus* sub var. *hispidissimus* collected from Dahod distirct and *Oropetium villosulum* collected from Panchmahal distirct, reported first time in Gujarat.
- Grasses are widely used as good fodders for cattles. Out of 100 species only 6 species were unpalatable, 8 species were low palatable, 34 species were moderately palatable and 24 species were highly palatable species. Some of the palatable grasses like *Dicanthium annulatum* and *Apluda mutica* were found growing abundantly in both districts. Highly palatable grass species *Cenchrus ciliaris*, *Iselima laxum* and *Sehima* sp. was found growing restricted to Bandheli grassland, Kharoda and Rampura grasslands.
- Socioeconomic survey has revealed multiple ethno botanical uses of grasses growing in the study area. The present investigation revealed the significance of grass species used by the tribals and villages of Baria and Godhra forest divisions. The present findings will contribute to understand the community structure, composition of wild species of grasses in these grasslands. The indigenous knowledge and uses of the plants of a particular area have to be analyzed to develop appropriate management measures (exsitu and insitu conservation) for best utilization of natural resource.
- Morphological characters of grass plant were observed and have been described for all the studied species. Photographs of habit, inflorescence and magnified view of inflorescence of each species have been given for all the species which would be helpful in identifing the plant easily. Documentation along with relevant photographs of identifying features has not been recorded for the 100 species studied.
- A seedling is helpful in assessing the natural regeneration of an ecosystem and is of great importance to the forest planners. For the perfect identification of especially the grasses flowering condition is needed. Majority of these grasses are cosmopolitan and thus this information will be of wide use. Terms used to describe a grass seedling have been depicted with help of photographs. Different diagnostic features of the seedling such as growth habit, type of vernation, node, internode, leaf lamina, leaf tip, leaf sheath, ligule, auricle and collar have been used for their identification and described for the species along with photograps. One of the main characteristic features used is the morphological characters of the foliar ligule which are relatively vital to demarcate the different taxa. The ligule traits applied has successfully alienated intimately related species belonging to same tribe. It also helps in correlating between taxa and closely associated genera facilitating in the identification of the species, in the absence of other reproductive characters right from the seedling stage. The description and photographs will enable a user to successfully and very easily identify these species in the field

environment. Identification of these seedlings would be very easy as it would match with the documented features. Identifying the seedling with the help of photographs is always more authentic rather than with the help of diagrams. The contents include photographs of seedlings of each species where features used in identification are clearly exposed. A key and easy-to-use pictorial field guide for identifying the common grass seedlings have been developed. The key is also supplemented with dendrogram. The diagnostic features of the seedlings represented will be a useful tool in the field of forestry, agriculture, taxonomy and other related scientific studies.

- Characteristic features of caryopses serve as an important feature of identification. In the present work, the morphometric and micromorphological study of the caryopses has been conducted. A topographical character of caryopsis has been carried out by light microscopy and Scanning electron microscopy. For the light microscopical study characters observed includes shape, colour, texture, compression, dorsal/lateral striations, ventral groove, scutellum shape, embryo type, embryo class, hilum visibility, hilum type and hilum shape. Moprhometric characterization has been also done for caryopses. The parameters measured includes length, breadth, thickness, L:B ratio, T:B ratio, length and breadth of embryo, embryo %, length and breadth of hilum, hilum %. All these characteristic features observed were adapted from Nestbitt (2006).
- SEM studies were carried out for dorsal, ventral, lateral, embryo and hilum surface. A great variation in surface sculpturing was reported. Generally reticulate pattern with either undulating or straight wall was present. Three different types of undulation '∩' shaped, '**Ω**' shaped or 'ʌ' shaped could be observed. As very important character for identifying. *Dactyloctenium* and *Eleusine* was the presence of ridges and furrows on caryopses surface. *Eragrostis tremula* typically showed special globular slime glands cells. Topographically the observed characteristic features helped in differentiating species of same genera. Based on the micromorphological features a dichotomous key was prepared for all studied species.
- Anatomical studies on Caryopsis has not been worked out in detailed so far. Few characteristic features like course of vascularisation, presence or absence of epiblast, presence or absence of cleft and arrangements of embryonic leaves in cross section have been adapted from Reeder (1957). Other than these, pericarp, angle of embryo with respect to anterior-posterior position of caryopses, coleoptiles, plumule, mesocotyl, coleorhiza, types of epiblast, scutellum, angle of vascularisation, endosperm, type of starch grains, types of aleurone layer also taken in consideration for the study. Other significant diagnostic features were observed for the first time in caryopses anatomy. This includes (i) Embryo placed at different angles with respect to anterior-posterior position of caryopsis. Based on this feature, angle of embryo with

respect to caryopses has been measured and it could be classified into three categories: less than 130°, between 130° – upto 160° and between 160° – upto 190° (ii) previous studies reports only presence or absence of epiblast in the different species studied according to which in group Panicoideae all the members showed absence of epiblast except *Chionachnae koengii*. while in group Pooideae all members showed presence of epiblast except *Ischanae globosa* from tribe Ischaneae, *Aristida adscensionsis, Aristida funiculata* from Aristideae and *Melanocenchris* and *Oropetium* from tribe Chlorideae. In the present study five different types of epiblast could be identified and categorised. This was found to be an important diagnostic feature for identification of grass species (iii) Different authors have categorised the type of scutellum into two main categories: sickle shaped and V shaped but in the present study based on the shape and further on the angle which forms the different shapes, scutellum could be broadly divided into three main categories: V shaped, U shaped and Δ shaped. Further 18 different types of V shaped scutellum, 5 different types of U shaped scutellum and 6 different types of Δ shaped scutellum were observed and categorized. Among the studied species 48 studied species have 'V' shaped scutellum, 39 species have 'U' shaped scutellum and 13 species have Δ shaped scutellum. Based on above characters, identification key was prepared which help to identify caryopses on the basis of anatomical features. (iv) angle of vascularisation was also studied in detail and the grass species could be divided into four different categories.

- In caryopses anatomy, quantitative features like cross section size of caryopses, seed coat thickness, aleurone cell size, occupied % of endosperm, thickness of endosperm, occupied % of embryo, thickness of embryo, number of starch grains per endospermic cell were also observed. Species belonging to the same genera could be identified distinctly. On the basis of embryo anatomy caryopses has been divided into six categories by Reeder (1957). According to this the grass species could be categorised into:

  1. All Panicoideae members belonged to True panicoids except *Chionachnae koengii* which belonged to Oryzoid-olyroid group.
  2. Most of the members of Pooideae group belonged to Chloridoid-Eragrostoid group except *Chloris montana, Chloris virgata, Sachoenefeldia gracilis* belongs to Bambusoid and *Aristida sp., Melanocenchris jaquemontii, Orepetium villosum* belonged to Arundinoi-Danthonioid group.

  Based on above characters, dichotomous key has been prepared.

- Culm anatomy of the different grass species has been described. Culm anatomy of grasses has been described by only few authors. These authors have merely described the anatomy of the studied species. In the present study characteristic features of identification are represented with photographs. Both

qualitative and quantitative features have been taken into consideration. Qualitative features includes shape in cross section, epidermis, hypodermis, ground tissue, type of sclerenchyma, I° and II°IVBs, III°PVB, kranz anatomy, shape of kranz arc, shape of kranz cell, chloroplast type, mesotme while quantitative features include features like cross sectional area, number of vascular bundles, size of vascular bundles, size of metaxylem, number of kranz cells were considered in study. Also based on the presence or absence of kranz anatomy, the studied species have been divided into two categories. 39 species show presence of kranz anatomy while 61 species showed absence of kranz anatomy. It is further categoried on the basis of presence of sclerenchyma either in form of cylinder or girder. Kranz arc, radial cholrenchyma, culm outline and chloroplast shape and position, are some of the culm anatomical features suggested to be useful for inferring phylogenies. Based on all above characters a dichotomous key was prepared.

- Leaf is a important part of plant, which structurally varies depending on the environment. A major characteristic feature of leaf lamina has been characterized according to Ellis (1976). These characters include outline of lamina, presence or absence of ribs and furrows, keel structure, epidermis, mesophyll structure, position of vascular bundles in leaf blade, shapes of 1st order, 2nd order, 3rd order vascular bundles, relationship of vascular elements, structure of vascular bundles, characterization of vascular bundle sheath, sclerenchyma structure at abaxial, adaxial and at margin of leaf lamina, types of bulliform cells, colourless cells, presence and absence of mestome. Significant variations were observed in the different tissue systems which comprised the leaf lamina. Also leaf sheath and ligule anatomy of the 100 species have been described. To describe the different species the features have been adapted as per that of the leaf lamina (i.e. Ellis, 1976). Ligule anatomy has not been studied in detail. For the ligule anatomy shape of ligule, attachment of it with leaf sheath and leaf lamina, number of layers of mesophyll between adaxial and abaxial epidermis like features studied. Structurally there was not much of variation observed in ligule anatomy. Present study shows that ligule anatomy is very simple in structure; sometimes abaxial surface shows prickles or sclerenchyma cells. By using anatomical characters of leaf lamina, leaf sheath and ligule, a dichotomous key is prepared.
- On the basis of vegetative morphological and anatomical features the 100 grass species studied can be identified by the different keys prepared and presented in the present work. The present work will be useful for researchers and agronomist in the field of agriculture and pasture management.