Synopsis To The Thesis

Morpho-Anatomical studies of some wild Grasses of Gujarat

Submitted to

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Grasses comes from Old High German word *"gras"* – generally used to describe any suitable for livestock grazing and they evolved in late cretaceous era (Stromberg, 2011; Prasad et al., 2011). Grasses and their values have been recognized since time immemorial as the present day cereal crops are the cultivated varieties of their wild ancestors. Use of grasses, as food resources or as fodder has led to extensive breeding programs and improvement in pasture land. In India concept of scientific pasture management has not been properly planned, despite the fact that India has one of the largest livestock populations in the world, with an estimated 520 million heads. Grasses are very important group of plants not only to human beings but also to animals. Grass species are most of the world's major food crops, including wheat, barley, oats, rice, maize, millets, sugarcane and pasture species.

The grass family, scientifically known as Poaceae or Gramineae is a 5^{th} largest family after Asteraceae, Leguminosae, Orchidaceae and Rubiaceae of flowering plants in the world (Tzevlev and Michaelova, 1989). The family Gramineae distinguished by characteristic morphological features including sheathing, ligulate leaves with distinctive epidermal features and flowers in spikelets, glumes, palea, lemma and caryopses. The grasses are not closely related to other families of monocotyledons.

Grasslands (also called greenswards) are one of the most important natural resources and ecologically productive land (Trivedi et. al., 2007). They occupy approximately 25% (33 x lo6 km^2) of the land surface of the earth (Shantz, 1954). Current estimates of the global extent of grasslands range from 16% (Whittaker and Likens, 1973, 1975) to 30% (Ajtay et al., 1979). The difference between the estimates of the potential extent of grasslands and the current extent provides an indication of the degree to which humans have, and are, modifying this ecosystem type.

Morphology of the grass plant can be conceptualized as a hierarchical arrangement of structural subunits or modules (Briske, 1991; White, 1984). The perennial grass plant is a collection of tillers that arise from a single crown and are of the same genotype as the primary tiller. Each tiller is composed of a series of phytomers differentiated from a common apical meristem (Langer, 1979; Robson et al., 1988). Although there is debate as to what constitutes a phytomer (Clark and Fisher, 1987), it is usually defined as a leaf blade and sheath, the internode, the node, and the associated axillary bud below the point of sheath attachment (Briske, 1991).

Seedling of grasses is difficult to identify, because they were have vegetative features only and grasses mainly identify when they become mature. So concentrate on the vegetative characters in seedling stage. In the present study characteristic features of the grass seedlings have been analysed. McAlpine (1890) reported identification of grasses by their leaves. The first attempts to study the grasses in their flowerless and anatomical characters were by Jenssen (1983) as rightly indicated by Ward (1901). Carrier (1917) compiled a key for 48 common grasses in Eastern United States and it proved of more practical value for the field work than other available key. Later on Henning (1930), Whyte (1930), Burr & Turner (1933), Hitchcock (1936), Undersnder *et al* (1996), Prosser (2009), Bradley *et al* (2010) identified grasses at their mature stage before flowering on the basis of the vegetative characters. Nowosad *et al* (1942) bulletin on the identification of certain native and naturalized hay and pasture grasses and Phillips (1962), field manual on the identification of grasses describes the identification of few grasses of North Eastern part of Canada by their vegetative characters.

Caroypsis is grass fruit, in that the pericarp is bonded to the seed wall. In grass caroypses, the pericarp and testa are adherent and must be studied to gether (Nesbitt, 2006). The distinctiveness extends to the caroypses with their abundant starchy endosperm and laterally placed embryos. Hilum is present on ventral surface because it is point of attachment of the funiculus to inner ovary wall. Terrel and Peterson (1993) studied on caryopsis morphology of tribe Triticeae. The purpose of their study was to evaluate the morphological structure of the caryopses within the Triticeae. And they conclude that the tribe Triticeae can be divided into two major subtribes and one monogeneric tribe. For the family Gramineae, attempts have been made for the tribe Chlorideae, for lead to address phylogenetic relationship, mainly on the basis of morphological and molecular data (Hilu and Wright, 1982; Hilu and Alice, 2001). Liu et al (2005) studied on 58 species representing 45 genera of tribe Chlorideae and revealed that Chlorideae allows recognition of three major types of caryopsis on the basis of differences in ventral surface and hilum morphology.

Another very important aspect of taxonomic important in grasses is its anatomy characteristic.

Anatomical studies of grasses have provided some important diagnostic features in coastal and inter-coastal parts (Metcalfe, 1960; Ogundipe and Olatunji, 1992; Keshavarzi et al, 2002). Metcalfe (1960) work on “Anatomy of the monocotyledons, I. Gramineae” and several

papers have appeared, those dealing with the anatomy of grasses and anatomical peculiarities such as root, culm and leaf anatomy and epidermal characteristics etc. have been used in grass systematic at generic and specific level. He described the anatomy of 206 genera and 413 species based on his own observations. After that, in addition the literature has been compiled with author's own results thus bringing the total number of genera that have been treated up to 345. That means out of 898 genera 345 genera worked out by Metcalfe (1960).

For the culm anatomy features like incomplete bundle sheath which is forming an arc external to the vascular bundles, Kranz arc, radial chlorenchyma, culm outline and chloroplast shape and position are suggested to be useful for inferring phylogenies (Siqueiros and Herrera, 1996).

Caryopsis simply consists of embryo and endodermis surrounded by several different structural layers which are contributed by the flower of the parent plant. The growth of the endosperm causes expansion, modification and compaction of their enveloping layers. This study, may contribute to dormancy in several species (Thornton 1966a, 1966b; Rost, 1971) and is also known to contain nutritionally important materials in certain food grains.Few representative studies those done on barley (Mann and Harlan, 1915), corn (Kiesselbach, 1949; Wolf et al. 1952), Indian millets (Narayanaswami 1953, 1955a, 1955b, 1955c, 1956), Johanson grass (Harrington and Crocker, 1923), sorghum (Sanders, 1955), sugar cane (Artschwager, Brandes and Starrett, 1929) and other Poaceae (Guerin, 1899). Anatomy of mature seed coat is remarkable similar in almost similar. The coat is continuous around the entire caryopsis except at the point where it is connected to the axis of the inflorescence. The outer most layer is covered by the thick cuticle layer. The pericarp, derived from the ovary of the flower, may be a thin membrane, or it may be composed of one or several cell layers.

MAIN OBJECTIVES OF THE RESEARCH WORK

- Study the diversity of grass species in Panchmahal and Dahod districts of Gujarat.
- Collection, identification and preparation of herbarium of the collected species.
- Socioeconomic survey of Baria and Godhra forest divisions to identify economic value of the collected species.
- Characterization of grass seedlings for identification of the species.

- Characterize the anatomical features in vegetative parts of the grass species
    (a) Culm
    (b) Leaf
- Characterization of grass caryopses
    (a) Morphological and micromorphological
    (b)Anatomical

SUMMARY OF RESULTS

DIVERSITY OF GRASS SPECIES IN PANCHMAHAL AND DAHOD DISTRICTS OF GUJARAT:

Panchmahal district is bounded by state of Rajasthan and the Sabarkantha district of Gujarat state in North, Dahod district in East, Baroda district in South and Baroda, Kheda and Sabarkantha districts in West. The Western and South Western parts are generally flat lying between 120 m to 210 m. above mean sea level. A series of hills comprise the South Eastern part of the area which are the extreme Western limit of Vindhyan mountains. The Northern and Eastern parts of the area are undulating and occasionally interrupted by hills of 300 to 500 m. height. which are the Southern extensions of Aravallis.

Dahod district is bounded by state of Rajasthan in North, State of Madhya Pradesh and Rajasthan in East, State of Madhya Pradesh and Baroda district in South and Panchmahals districts in West. This district is cover the hilly portion in the northern and eastern part of the distirct and the undulating, easy and flat plains in the west and the south-western part of the district and lying between 120 m to 210 m above the sea level.

For the collection of grass species field visits were conducted during the year 2009 – 2012. Especially from the month of June to February frequent field visits were arranged, at a regular interval of 10 - 15 days. Different Talukas and forest ranges of Panchmahal and Dahod districts were visited at a regular period for the collection of grass species. During the field visits the grasses which are collected were identified by using different floras with the help of binocular stero microscope.

Total 100 different grass species were selected from the different grasslands and forest area of the studied districts.

Collected species are pressed for the herbarium. The specimens were spread gently between newspapers. Long samples were folded in "V" or "N" shape and then pressed. Unnecessary overlapping leaves and other parts were removed. These specimens were kept in a wooden press and tightly screwed (Jones and Luchsinger, 1986). After that specimens kept for drying by changing filter papers at regular interval. After drying specimens mounted on herbarium sheets.

SOCIOECONOMIC SURVEY OF BARIA AND GODHRA FOREST DIVISIONS:

For the socioeconomic survey field visits were arranged at an interval of one month beginning from June 2009 to January 2010 in all the representative localities (Raval, Baria, Muslim, Nayak, Vadand, Brahmin, Rathva, Patel, Navi, Vanzara, Malivad, Adivasi, Savarn) of the area. The growth period of grasses was at its peak during September to December, during which the field visits were conducted at an interval of 15 days. Grasses and legumes associated to these grasses were collected during the field trips.

The availability of green fodder is the most important single factor responsible for the success of animal husbandry. Most of the tribal in these areas are farmers and are almost completely dependent on the forest resources. The grasslands nearby these villages are in the custody of the forest department and so they work as laborers in these grasslands for harvesting these grasses. The main occupations of the villagers are to grow *Zea mays* and *Paspalum scorbiculatum.* When the production of grasses in the grasslands is more than the requirement of the villagers, these are sold in the nearby markets. During the monsoon period, the growth of natural grasses is appreciable and plenty of grasses are available. Species like *Dichanthium annulatum, Bothriochloa pertusa, Sehima nervosum, Sehima sulcatum, Chrysopogon fulvus* are highly palatable grasses and are frequently used.

CHARACTERIZATION OF GRASS SPECIES SEEDLINGS:

The seedling study was carried out both in field and in laboratory.

(1) In field: Seedlings of grasses were collected as the new emergents and (2) In laboratory: Total 45-50 seeds were grown in earthern pots and seedlings were raised till the emergence of four to five leaves. Randomly selected seedlings were evaluated for their characteristic features and photographed by Digital camera (DSC-T20). The information included in the morphological data was used to prepare a morphological key. The morphological features were grouped and a

dichotomous key was constructed on the basis of the most conspicuous morphological features observed in the field collected samples.

The combination of identifying features considered in the study stands solely for a particualr species and therefore the key is an important tool for foresters and researchers where the species can be identified at early age of development itself. Photographs with written description will help the forester to compare the seedling sample for authentic identification. Mostly the person who deals with pasture management needs more knowledge about the seedlings. By using this knowledge they can eliminate the unwanted species which will help in increasing the productivity of desired species. It is helpful for researchers actively involved in this field.

ANATOMICAL FEATURES OF VEGETATIVE PARTS

For anatomical study grass species collected from the field were thoroughly washed and the different parts were separated and fixed in FAA and processed further for sectioning. 12 - 15 µm sections were obtained on Rotary microtome and slides were prepared for staining. Prepared slides were stained with Saffranin and Fast green and mounted in DPX (Di thalate xylene).

Sections of leaf parts and culm were taken and permanent slides were prepared. Microscopically characteristic features were noted down. Anatomical variations have been identifed in the different parts of the leaf and the culm which could distinctly differentiate the different grass species.

CHARACTERIZATION OF GRASS CARYOPSES:

Morphological and micromorphological:

Mature caryopses were obtained by cleaning the spikelets. Mature caryopsis were manually separated from the spikelets and used for the light and scanning electron microscopic studies. 15-20 dried caryopses were examined for each species. For light microscopic observations and measurements mature, dry seeds were examined under Stereo Microscope (Olympus microscope-SZ2-ILST) and the diagnostic features were observed and photographed.

All the morphometric dimensions are an average of 50 readings. Scanning electron microscopic studies were conducted by mounting seed samples on carbon conducting tape mounted on brass stubs. Based on the characteristic features a key to the identification of the different species has been prepared.

Caryopses surface of the Gramineae represent highly variable types of the surface sculpturing which can be a tool for identifying charactes for the taxa even at the species level and

sometime it works as diagnostic significance for the species (Brissson and Peterson, 1976). In the present study characteristic features of the caryopses differed from species to species.

Anatomical:

Mature spikelets were collected and stored in polythene bags and brought to the laboratory. Caryopses were carefully separated out from the glumes with the help of dissecting microscope (especially the smaller ones). The collected grass caryopses were immersed in distilled water for 15 – 20 days with few drops of formalin to prevent microbial attack, depending upon the nature of the caryopses for the softening. Soaked caryopses were then fixed in FAA and processed further to obtain sections. The trimmed paraffin blocks were exposed and immersed with exposed surface of sample in 50% glycerine for 20 – 25 days to soften the tissue. 12 - 15 µm sections were obtained on Rotary microtome and stained with Toludene blue and mounted in DPX (Di thalate xylene). Anatomical variations could be prominently observed in the different portions of the caryopses which characterized them for an easy identification.

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