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Key descriptors for **forage grasses**

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THE INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE
and
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
on behalf of
THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES
FOR FOOD AND AGRICULTURE

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The International Livestock Research Institute (ILRI) is One CGIAR research centre, a global research partnership for a food-secure future. CGIAR science is dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources and ecosystem services. ILRI's mission is to improve food and nutritional security and to reduce poverty in developing countries through research for efficient, safe and sustainable use of livestock—ensuring better lives through livestock. ILRI is co-hosted by Kenya and Ethiopia and has 14 offices across Asia and Africa.

The ILRI Forage Genebank was established in 1983 with the objective to conserve, make available and promote use of forage biodiversity, in compliance with international obligations, for current and future generations. It currently holds a diverse forage collection comprising 18 641 accessions of 1 350 species.

The objectives of the FAO International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) are the conservation and sustainable use of all plant genetic resources for food and agriculture (PGRFA) and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity (CBD), for sustainable agriculture and food security.

Articles 5 and 6 of the ITPGRFA guide countries in promoting the conservation and sustainable use of PGRFA. An essential component of Article 5 – Conservation, Exploration, Collection, Characterization, Evaluation and Documentation of PGRFA – is the characterization and evaluation of crops and their potentially useful traits needed to develop new crop varieties. Article 5 also highlights the importance of adopting a complementary approach between *in situ* and *ex situ* conservation.

The ITPGRFA also stresses, through Article 17 on the Global Information System, the importance of collecting and making publicly available information on scientific, technical and environmental matters related to PGRFA.

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PREFACE

The *Key descriptors for forage grasses* consist of an initial minimum set of characterization and evaluation descriptors for some species of the family Poaceae. This strategic set aims at facilitating access to and utilization of various tropical grass species and it does not exclude the addition of other descriptors later.

This work has been done jointly with the International Livestock Research Institute (ILRI) and the FAO International Treaty on Plant Genetic Resources for Food and Agriculture. The list was based on a preliminary list of descriptors developed by ILRI. While focussing on descriptors for tropical grasses, it expands upon the original descriptors published for temperate and tropical grasses in 1985 (IBPGR/CEC). In addition, internet searches were carried out looking for the most updated information on relevant characteristics and traits. The original list was subsequently integrated with evaluation traits. Special attention was given to the inclusion of descriptors relevant to germplasm utilization and biotic and abiotic stresses of particular importance in the context of emerging adverse weather events, which are expected to intensify under current and future climate challenges.

The key set of access and utilization descriptors was defined through an online survey, in which 35 experts from 19 different organizations and universities from 14 countries participated. Survey results were subsequently validated in consultation with a Core Advisory Group (see "Contributors") led by Alice Muchugi and Jean Hanson from ILRI.

The strategic set of data standards is designed to facilitate access to and utilization of plant genetic resources for food and agriculture. Together with passport information (Alercia, A. *et al.*, 2015), descriptors are critical to the effective sharing of characterization and evaluation data and to the efficient use of plant genetic resources for food and agriculture.

INTRODUCTION

Grasses are the most widely used feed resource for livestock in the tropics from natural grassland and planted pastures. Grasses can be directly grazed, cut and carried for stall feeding or cut and dried for hay to use during the dry season. Their stoloniferous, spreading and deep-rooted nature supports soil stabilization and prevents soil erosion. Grasses have wide economic importance in the tropics and are an important component of extensive grazing and silvopastoral systems in Latin America and intensive cut and carry systems in Sub-Saharan Africa and southeast Asia. Tropical turf grasses are widely used for amenity areas and public parks in both the tropics and subtropics.

Grasses belong to the plant family Poaceae and many of the important forage grass genera have similar morphology, making it possible to suggest a common set of descriptors that can be used for describing diversity within multiple species. Despite similarities, grasses show diversity in morphology, productivity, feed quality and their response to drought and cold, even within the same species. These general forage grass descriptors are limited to tropical species with specific examples from A*ndropogon gayanus*, *Bothriochloa pertusa*, *Cenchrus ciliaris*, *Cenchrus clandestinus*, *Cenchrus purpureus*, *Chloris gayana*, *Cynodon dactylon*, *Cynodon nlemfuensis*, *Digitaria eriantha*, *Megathrysus maximus*, *Melinis minutiflora*, *Panicum coloratum*, *Paspalum dilatatum*, *Paspalum plicatulum*, *Setaria sphacelata*, *Sorghum x almum*, *Tripsacum laxum*, *Urochloa brizantha*, *Urochloa decumbens* and *Urochloa ruziziensis*. These are all grasses that are already being adopted by smallholder farmers worldwide.

This descriptor list which follows the international standardized documentation system for the characterization and study of genetic resources (Alercia, 2011), is expected to support studies focusing on genetic and morphological diversity of grass accessions, conservation of genetic resources, domestication and to increase production and use of its products. With such a wide range of grass species currently used for livestock production, these descriptors will only act as general guidelines for use where species specific descriptors may be lacking.

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FORAGE GRASSES DESCRIPTORS

Descriptors are used for studying diversity in key characteristics of accessions within a species. They should be used when they are useful to users, either collection curators for the management and maintenance of their germplasm material or to all other users of plant genetic resources for promoting their sustainable use. As far as possible, environmentally stable descriptors should be selected but some important plant traits show genotype x environment (GxE) interaction. Rather than avoid these important use traits, such as plant height, yield and nutritive value, it is suggested that comparisons between accessions should only be made using representative data generated with the same methodology from plantings on the same date in the same site and season. To this end, highly discriminating descriptors are listed below to facilitate selection of those best suited to user's needs and highlighted throughout the text along with their relevant definition.

MINIMUM SET OF CHARACTERIZATION AND EVALUATION DESCRIPTORS

This is an initial, key set of characterization and evaluation descriptors for a group from the family Poaceae, namely A*ndropogon gayanus, Bothriochloa pertusa, Cenchrus ciliaris, Cenchrus clandestinus, Cenchrus purpureus, Chloris gayana, Cynodon dactylon, Cynodon nlemfuensis, Digitaria eriantha, Megathrysus maximus, Melinis minutiflora, Panicum coloratum, Paspalum dilatatum, Paspalum plicatulum, Setaria sphacelata, Sorghum x almum, Tripsacum laxum, Urochloa brizantha, Urochloa decumbens* and *Urochloa ruziziensis*. The strategic set aims at facilitating access to and utilization of these species and is useful in assisting researchers to describe and utilize accessions more easily. While these descriptors have been developed for the five species above, they should also prove useful for describing other similar forage grasses.

Descriptor number	Descriptor name
1.	Plant height (cm)
2.	Plant growth habit
4.	Presence of stolon
5.	Presence of rhizome
6.	Number of tillers
7.	Leaf length (cm)
8.	Leaf width (cm)
10.	Leaf hairiness
12.	Type of inflorescence
13.	Inflorescence compactness
14.	Inflorescence length
15.	Days to flowering
16.	Caryopsis (seedcoat) colour
17.	100-Seed weight (g)

18. Herbage yield (kg/ha DW)
19. Shattering of inflorescence (%)
20. Herbage protein content (%)
21. Neutral detergent fibre (NDF) content (% DW)
22. Acid detergent fibre (ADF) content (% DW)
23. Percentage of leaf (%)
30. Susceptibility to drought
31. Susceptibility to low temperature
32. Susceptibility to soil acidity
35. Susceptibility to grazing/defoliation

CHARACTERIZATION

Measure/count each descriptor on 10 randomly selected plants or plant parts and report as a mean, with standard deviation, if relevant, for the accession. For all colour descriptors the use of the Royal Horticultural Society (RHS) Colour Chart codes is recommended. If these are not available, the colour codes as suggested throughout the text can be used.

1. **Plant height** (cm)

Measured from ground to the top of the plant foliage at maturity. This may be expressed as short to tall compared to a mean measurement for the species planted on the same date in the same site and season.

2. **Plant growth habit**

Recorded at plant maturity. See Figure 1.

1 Erect
2 Decumbent
3 Procumbent
99 Other (e.g., semi-erect)

Figure 1. Plant growth habit (Fish, L. *et al.*, 2015)

3. Stem hairiness

Record the hairiness of the surface of a mature stem when first inflorescences are forming in the plot.

0 Glabrous
1 Hairy
2 Bristled
99 Other

4. Presence of stolon

See Figure 2.

0 Absent
1 Present

5. Presence of rhizome

See Figure 2.

0 Absent
1 Present

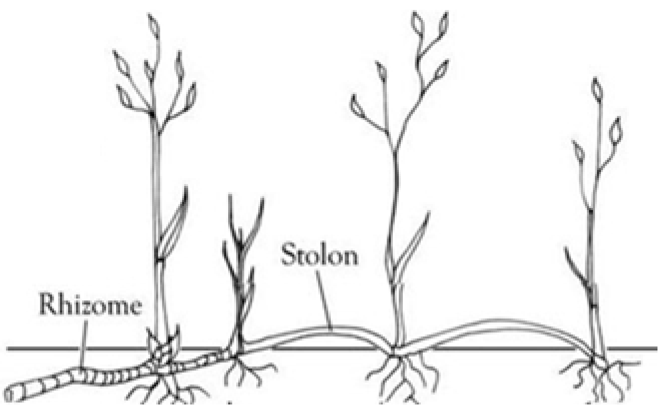

Figure 2. Stolon and rhizome (Kamal, M. I. *et al.*, 2018)

6. Number of tillers per plant

Recorded at plant maturity.

7. Leaf length (cm)

Length of leaf from ligule to tip of a mature vegetative leaf measured when first inflorescences are forming in the plot.

8. Leaf width (cm)

Record width at the widest point of a mature vegetative leaf measured when first inflorescences are forming in the plot.

9. Leaf colour

Record the predominant primary colour.

1 Grey
2 Green
3 Yellow
4 Purple
5 Red
6 Blue
7 Brown
99 Other

10. Leaf hairiness

Record the hairiness when first inflorescences are forming in the plot on a mature leaf.

0 Glabrous
1 Moderately hairy
2 Hairy

11. Leaf margin

Record the predominant leaf margin of a mature leaf when first inflorescences are forming in the plot.

1 Entire
2 Dentate
3 Serrate
4 Ciliate
99 Other

12. Type of inflorescence

Recorded on a mature inflorescence. See Figure 3.

1 Panicle
2 Spike
3 Umbel
4 Raceme
99 Other

1 2 3 4

Figure 3. Type of inflorescence (adapted from Fish, L. *et al.*, 2015)

13. Inflorescence compactness

Recorded at 50% flowering.

3 Loose
5 Medium
7 Compact

14. Inflorescence length (cm)

Record the length from the lowest spikelet to the tip of a mature inflorescence at 50% flowering.

15. Days to flowering

Number of days from sowing/planting until first inflorescences are forming in the plot for first year after establishment and days from cutting until first inflorescences are forming in the plot for evaluation in subsequent years. Recorded for plants with the same planting/cutting date at the same location in the same year.

16. Caryopsis (seedcoat) colour

Record the predominant primary colour.

1 White
2 Grey
3 Green
4 Yellow
5 Red
6 Brown
7 Blue
8 Purple
9 Black
99 Other

17. 100-Seed weight (g)

Record the weight of 100 randomly selected mature caryopses taking replicates to obtain a mean. This can be expressed as 100 or 1000 seed weight for smaller caryopses.

EVALUATION

All evaluation descriptors are environmentally influenced and therefore care needs to be taken when collecting evaluation data. To present reliable and reproducible information about characters that have significant GxE interaction, it is encouraged that measurements for these descriptors are taken from a carefully managed trial where the planting date, agronomic treatments, environmental conditions (soil characters and fertility, rainfall, temperature), season, age of plants and physiological stage at time of measurement and plant treatments after harvest are the same for all accessions and are fully described and documented. All nutritional traits reported should be from comparable samples using analyses done according to standard accredited methods from the same laboratory. Data on drought tolerance must be collected from a drought stress trial. While data from different seasons and locations may be presented to better represent environmental adaptation of the accession, it is not advisable to use them for comparison among accessions. Data are reported as means with standard deviation, for the accession.

18. Herbage yield (kg/ha DW)

Record the dry matter weight of quadrats cut when first inflorescences are forming in the plot at 5-10 cm above ground (as relevant for the species) using representative samples that are dried and converted to kg dry matter/ha. Indicate season, plant age and physiological stage (e.g. vegetative/ flowering) at harvesting as results will change as the plant ages.

19. Shattering of inflorescence (%)

Percentage of spikelets remaining on the inflorescence at full maturity.

3 Low
5 Medium
7 High

20. Herbage protein content (%)

Recorded from representative samples taken from quadrats. Analytical assessment determined on a dried ground sub-sample of the whole plant. Indicate season, plant age and physiological stage (e.g., vegetative/ flowering) at harvesting as results will change as the plant ages.

21. Neutral detergent fibre (NDF) content (% DW)

Recorded from representative samples taken from quadrats. Analytical assessment determined on a dried ground sub-sample of the whole plant. Indicate plant age and physiological stage (e.g., vegetative/ flowering) at harvesting as results will change as the plant ages.

22. Acid detergent fibre (ADF) content (% DW)

Recorded from representative samples taken from quadrats. Analytical assessment determined on a dried ground sub-sample of the whole plant. Indicate plant age and physiological stage (e.g., vegetative/ flowering) at harvesting as results will change as the plant ages.

23. Percentage of leaf (%)

Percentage of leaf on the entire plant, including all tillers, measured/ observed on a mature plant when first inflorescences are forming in the plot.

BIOTIC STRESS SUSCEPTIBILITY

Scored as percentage infection from a specific trial to induce disease or insect infestation, under conditions which are clearly specified. In each case, it is important to state the origin of the infestation or infection, i.e., natural, field inoculation, laboratory. Given the general nature of these descriptors covering a large number of grass species, an indicative list of common pathogens and insect pests are provided. Users should select those with economic impact or add additional ones relevant for the grass species being characterized and the production environment. Record such information in descriptor 36. NOTES. These are coded on a susceptibility scale from 1 to 9:

3 Low
5 Intermediate
7 High

	Causal organism	Common name
24.	***Puccinia coronata***	**Crown rust**
25.	***Magnaporte grisea***	**Leaf spot**
	Drechslera dictyoides	
26.	***Ustilago* spp.**	**Smut**
27.	**Phytoplasma**	**Stunt**
28.	***Deois flavopicta Mahanarva* sp.**	**Spittle bug**
29.	***Tetranynchus urticae***	**Spider mite**

ABIOTIC STRESS SUSCEPTIBILITY

Scored as percentage survival from a specific trial to induce stress, under conditions which are clearly specified. Drought trials are often performed under greenhouse conditions or rain-out shelters.

30. Susceptibility to drought (%)
Record the percentage of plants showing drought symptoms under stress conditions.

31. Susceptibility to low temperature (%)
Record the percentage of plants showing damage under low temperature. Record the temperature causing stress.

32. Susceptibility to soil acidity (%)
Record the percentage of plants showing symptoms of poor adaptation.

33. Susceptibility to salinity (%)
Record the percentage of plants showing symptoms of poor adaptation.

34. Susceptibility to waterlogging (%)
Record the percentage of plants showing symptoms of poor adaptation.

35. Susceptibility to grazing/defoliation (%)
Record the percentage of plants showing symptoms of poor adaptation to grazing or defoliation by cutting.

36. NOTES
Specify here any other additional information. Add any additional traits that are important to describe the diversity among accessions within this species.

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