Key access and utilization descriptors for sorghum genetic resources

This list consists of an initial set of characterization and evaluation descriptors for sorghum [*Sorghum bicolor* (L.) Moench] genetic resources utilization. This strategic set of descriptors, together with passport data, will become the basis for the global accession level information portal being developed by Bioversity International with the financial support of the Global Crop Diversity Trust (GCDT). It will facilitate access to and utilization of sorghum accessions held in genebanks and does not preclude the addition of further descriptors, should data subsequently become available.

Based on the comprehensive list 'Descriptors for Sorghum [*Sorghum bicolor* (L.) Moench]' published by ICRISAT and IBPGR (now Bioversity International) in 1993, the list was subsequently compared with a number of sources such as UPOV technical guidelines for Sorghum (*Sorghum bicolor* L.) (1989); 'Descriptors for SORGHUM' (USDA, ARS, GRIN); 'Characterization of ICRISAT-Bred Sorghum Hybrid Parents (Set I)'[1] (ICRISAT, 2006); as well as the list of traits provided by the National Institute of Agrobiological Sciences (NIAS). The initial list also builds on the results of the Global Public Goods Activity 4.2.1.1 led by Dr Hari D. Upadhyaya (ICRISAT), particularly with regards to those descriptors highlighted as the most important diagnostic and breeding traits, and also on the Descriptors Draft for Sorghum, which was revised by a Committee formed at the Expert Consultation Meeting for Developing a Strategy for the Global Conservation of Sorghum Genetic Resources held at ICRISAT in 2007. It was further refined during a crop-specific consultation meeting held at the National Bureau of Plant Genetic Resources (NBPGR, India) in June 2009.

A worldwide distribution of experts was involved in an online survey to define a first priority set of descriptors to describe, to access and to utilize sorghum genetic resources. This key set was afterwards validated by a Core Advisory Group (see 'Contributors') led by Dr Jeff Dahlberg of the United Sorghum Checkoff Program and Dr Hari D. Upadhyaya of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), together with sorghum leading organizations such as NBPGR, USDA and the Directorate of Sorghum Research (formerly National Research Centre for Sorghum), amongst others.

Biotic and abiotic stresses included in the list were chosen because of their wide geographic occurrence and significant economic impact at a global level.

Numbers in parentheses on the right-hand side are the corresponding descriptor numbers listed in the 1993 publication. Descriptors with numbers ending in 'letters' are either modified or are new descriptors that were added during the development of the list below.

1 International Sorghum and Millets Newsletter, No. 47, Special issue

Race and Group name (1.5.5/6)

(As per Dahlberg, 2000)

1 Bicolor
- 10 Bicolor
- 11 Dochna
- 12 Nervosum
- 13 Nervosum-kaoliang
- 14 Nervosum-broomcorn
- 15 Sudanense

2 Guinea
- 20 Guineense
- 21 Conspicuum
- 22 Margaritiferum
- 23 Roxburghii

3 Caudatum
- 30 Caudatum
- 31 Caudatum-nigricans
- 32 Nigricans
- 33 Sumac
- 34 Nigricans-feterita
- 35 Dobbs
- 36 Caudatum-kaura
- 37 Zerazera

4 Kafir
- 40 Caffrorum

5 Durra
- 50 Durra
- 51 Nandyal
- 52 Cernuum

6 Guinea-bicolor
- 60 Guinea-bicolor
- 61 Dochna-honey
- 62 Dochna-roxburghii

7 Caudatum-bicolor
- 70 Caudatum-bicolor
- 71 Caudatum-dochna
- 72 Nigricans-bicolor
- 73 Dochna-nigricans

8 Kafir-bicolor
- 80 Bicolor-kafir
- 81 Caffrorum-bicolor
- 82 Dochna-kafir

9 Durra-bicolor
- 90 Durra-bicolor
- 91 Dochna-durra
- 92 Durra-dochna
- 93 Subglabrescens
- 94 Subglabrescens-milo
- 95 Milo-kaura

10 Guinea-caudatum
- 100 Caudatum-guineense
- 101 Nigricans-guineense

11 Guinea-kafir
- 110 Caffrorum-roxburghii
- 111 Roxburghii-shallu

12 Guinea-durra
- 120 Durra-roxburghii
- 121 Membranaceum
- 122 Durra-membranaceum

13 Kafir-caudatum
- 130 Caudatum-kafir
- 131 Caffrorum-birdproof
- 132 Caffrorum-darso
- 133 Caffrorum-feterita

14 Durra-caudatum
- 140 Caudatum-durra
- 141 Nigricans-durra
- 142 Durra-nigricans
- 143 Durra-feterita/Kaura

15 Kafir-durra
- 150 Durra-kafir
- 151 Caffrorum-durra

16 Perennial wild
- 160 S. halepense
- 161 S. propinquum

17 Annual wild
- 170 S. bicolor ssp. drummondii

18 S. bicolor ssp. verticilliforum
- 180 verticilliforum
- 181 arundinaceum
- 182 virgatum
- 183 aethiopicum

19 Unclassified

20 Breeding material
- 200 Unclassified

21 Mixed

Plant height [cm] (4.1.1)
From the ground (base of plant) to the tip of the panicle at 50% flowering. Mean of 10 randomly selected plants

Stalk juiciness (4.1.3)
0 Not juicy
1 Slightly juicy
3 Juicy

Fodder yield (4.1.a)
3 Low
5 Medium
7 High

Days to 50% flowering (4.2.1)
From planting date until 50% of the plants have started flowering

Planting date [YYYYMMDD] (5.4)
When planting is done (if moisture is sufficient) or when irrigation is done after planting

Flowering behaviour (4.2.a)
If grown under long days
0 Absent
3 Early
7 Late

Inflorescence compactness and shape (4.2.2)
1 Very lax panicle (typical of wild sorghums)
2 Very loose erect primary branches
3 Very loose drooping primary branches
4 Loose erect primary branches
5 Loose drooping primary branches
6 Semi-loose erect primary branches
7 Semi-loose drooping primary branches
8 Semi-compact elliptic
9 Semi-compact oval
10 Compact elliptic
11 Compact oval
12 Half broom corn
13 Broomcorn
99 Other (specify in the descriptor **Notes**)

Grain covering (4.2.4)
Amount of grain covered by glumes at maturity. Involuted grain is found when the grain has completely twisted inside of the glumes and is fully exposed such as in the Guinea race

1 25% grain covered
2 50% grain covered
3 75% grain covered
4 Grain fully covered
5 Glumes longer than grain
6 Involuted

Shattering (4.2.6)
Observed at maturity

3 Low
5 Intermediate
7 High

Grain colour (4.3.1)
Phenotypic colour of the grain

1 White
2 Chalky white
3 Straw
4 Grey
5 Light red
6 Red
7 Yellow
8 Light brown
9 Brown
10 Black
11 Purple
12 Variegated (when streaks of red or white appear in the grain)
13 Reddish brown
14 Mixed (when there are mixed grain colours in the grain)

100-seed weight [g] (4.3.3)
Measured at 12% moisture content

Pigmented testa (Grain sub-coat) (4.3.5)
Tannins are not present without the presence of a pigmented testa

0 Absent ($b_1b_1b_2b_2$ or B_1-b_2b_2 or $b_1b_1B_2$-)
1 Present (B_1-B_2-)

Endosperm texture (4.3.8)

1 Completely corneous
2 Mostly corneous
3 Intermediate-partly corneous
4 Mostly starchy (floury)
5 Completely starchy (floury)

Genotypic pericarp colour (4.3.a)

Genetically, there are three pericarp colours in sorghum

1 White (R-yy or rryy)
2 Lemon Yellow (rrY-)
3 Red (R-Y-)

Seedling vigour (6.1.1)

Observed 15 days after emergence

3 Low
5 Intermediate
7 High

Lodging susceptibility (6.1.2)

Indicate if root or stalk

3 Low
5 Intermediate
7 High

Senescence rating [%] (6.1.3)

Death of leaves and stalk at grain maturity

1 Very slightly senescent (10%)
3 Slightly senescent (25%)
5 Intermediate (about half of leaves dead) (50%)
7 Mostly senescent (75%)
9 Completely senescent (leaves and stalk dead)

Desirability rating (6.1.4)

Overall agronomic desirability (use and yield potential) of the total plant as observed visually

1 Very good
2 Good
3 Average
4 Poor
5 Very poor

Photosensitivity (6.2.1)

Recorded on the basis of rainy season (long days): post-rainy season (short days) ratios of plant height (4.1.1) and days to flowering (4.2.1) above

1 Insensitive
2 Partially sensitive
3 Very sensitive

Inflorescence exsertion (6.2.4)

1 Slightly exserted (<2 cm but ligule of flag leaf definitively below inflorescence base)
2 Exserted (2-10 cm between ligule and inflorescence base)
3 Well-exserted (>10 cm between ligule and inflorescence base)
4 Peduncle recurved (inflorescence below ligule and clearly exposed splitting the leaf sheath)

Inflorescence length [cm] (6.2.5)

From base of inflorescence (head) to tip. Mean of five randomly selected plants

Restoration response (Milo source) (6.2.7)

The reaction of the F_1 plant when a male sterile (A line) is pollinated with the accession

1 Maintainer
2 Partial maintainer/restorer
3 Restorer

Male sterile cytoplasm system (6.2.8)

There are four major distinct cytoplasmic-genetic systems

1 A_1
2 A_2
3 A_3
4 A_4
5 Other (specify in the descriptor **Notes**)

Pollen shed (6.2.a)

Visual score (early morning) when the panicle is lightly tapped. Observed at 50% flowering. Mean of five randomly selected plants

3 Low
5 Intermediate
7 High

Grain yield (6.3.a)

Overall estimation of the grain yield for the accession based upon the particular growing conditions in which it was accessed

3 Low
5 Medium
7 High

ABIOTIC STRESSES

Reaction to low temperature (7.1)

Pollen susceptibility (7.1.a)
Measured as reduction in pollen production at low temperatures (10ºC to 15ºC)

Seedling susceptibility (7.1.1)
Measured as reduction in seed germination at low temperatures (10ºC to 15ºC)

Reproductive susceptibility (7.1.2)
Measured as reduction in seed set at low temperatures (10ºC to 15ºC)

Reaction to drought (7.3)

Pre-anthesis drought reaction (7.3.a)
Measured as plants stressed prior to flowering. Plant symptoms include leaf rolling, leaf erectness, leaf bleaching, leaf firing, delayed flowering, poor panicle exsertion, saddle effect, panicle/floret blasting, and reduced panicle size. Ratings may be on individual symptoms or a combination of symptoms

Post-anthesis drought reaction (stay-green ability) (7.3.b)
Measured as plants stressed post-flowering. Plant symptoms include premature leaf and plant death, stalk collapse and lodging, charcoal rot (*Macrophomina phaseolina*) infestation, and reduced seed size

BIOTIC STRESSES

Sorghum shoot fly *(Atherigona soccata)* (8.1.1)

Spotted stem borer *(Chilo partellus)* (8.1.2)

Sorghum midge (*Stenodiplosis sorghicola*) (8.1.5)

Anthracnose *(Colletotrichum graminicola)* (8.2.3)

Grain moulds (*Curvularia lunata*; *Fusarium* spp.) (8.2.4)

NOTES

Any additional information may be specified here, particularly that referring to the category '99=Other' present in some of the descriptors above.

CONTRIBUTORS

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