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DESCRIPTORS for PEARL MILLET

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INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES
(IBPGR)

and

INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS
(ICRISAT)

Pearl Millet Descriptors

IBPGR Secretariat
Rome, 1981

The International Board for Plant Genetic Resources (IBPGR) and the International Crops Research Institute for the Semi-Arid Tropics(ICRISAT) are autonomous, international, scientific organizations under the aegis of the Consultative Group on International Agricultural Research (CGIAR).

The basic function of the IBPGR, as defined by the Consultative Group, is to promote an international network of genetic resources centres to further the collection, conservation, documentation, evaluation and use of plant germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world.

The objectives of ICRISAT are to develop improved farming practices and better varieties of major food crops in order to improve the welfare of the poorest population of the semi-arid tropics, estimated to number about 500 million. ICRISAT reaches the target groups through cooperation with national programmes that are, at present, predominantly in India, but which, increasingly, are elsewhere in the semi-arid tropics.

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PREFACE

The Advisory Committee on Sorghum and Millets Genetic Resources, co-sponsored by the IBPGR and ICRISAT, was charged with the development of a list of descriptors for pearl millet (*Pennisetum americanum* (L.) Leeke). The work was completed in stages, drawing heavily on a preliminary list prepared by Dr. S. Appa Rao and Mr. D.J. Andrews and a later revised list by Messrs. Rao, Andrews and M.H. Mengesha.

A sub-committee was convened by the IBPGR in March 1980 and this met at FAO, Rome. The participants at the meeting of the sub-committee are shown in the Appendix. Subsequently a revised list was circulated to the Advisory Committee and other experts who ensured that the final list represented a consensus of users' opinions.

ICRISAT and the IBPGR recommend this list for documentation and exchange purposes. It should be noted that IBPGR and ICRISAT endorse the descriptors and descriptor states; the suggested coding for descriptor states, although representing a consensus of the experts, should not be regarded as the only definitive scheme.

Any suggestions for modifications will be welcomed by ICRISAT and the IBPGR Secretariat.

DESCRIPTOR LIST FOR PEARL MILLET

The following definitions are now used in genetic resources documentation.

(i) passport data (accession identifiers and information recorded by collectors);

(ii) characterization (consists of recording those characters which are highly heritable, can be easily seen by the eye and are expressed in all environments);

(iii) preliminary evaluation (consists of recording a limited number of additional agronomic traits thought desirable by a consensus of users of the particular crop).

Characterization and preliminary evaluation will be the responsibility of the genebank, while further evaluation should be carried out in collaboration with other specialists. The data from further evaluation should be fed back to the genebank for permanent maintenance in a data file.

Many descriptors which are continuously variable are recorded on a 1-9 scale. The authors of this list have sometimes described only a selection of the states, e.g. 3, 5 and 7 for such descriptors. Where this has occurred the full range of codes is available for use by extension of the codes given or by interpolation between them - e.g. EARLY VIGOUR (4.4) could also be coded as:

1 Very low
or
6 Intermediate to high

When a characteristic shows substantial variation, a mean value will be recorded with a suffix 'V' for variable.

PASSPORT DATA

1. ACCESSION DATA

1.1 IP NUMBER

Each accession in a pearl millet germplasm bank will be identified by its IP number. This unique number, once assigned, can never be re-assigned to another accession, even when an accession becomes extinct. To avoid duplication, the IBPGR Advisory Committee on Sorghum and Millets authorized ICRISAT to assign this number.

1.2 OTHER NUMBER

Any number assigned by Institutes other than ICRISAT such as "J" number from Jamnagar, NEP number from ALAD

1.3 OTHER NUMBER

- same as 1.2 -

1.4 OTHER NUMBER

- same as 1.2 -

1.5 COMMON/LOCAL NAME AND ETHNIC GROUP

The name given by the farmers to a particular landrace in a region and the name of the ethnic group

1.6 PEDIGREE

Names or codes assigned by crop scientists to a particular accession with parents and breeding synopsis

1.7 DATE OF LAST MULTIPLICATION OR REGENERATION

Month and year of last harvest expressed numerically in four digits, e.g. May 1981 to be expressed 0581

2. COLLECTION DATA

2.1 COLLECTING ORGANIZATION

Name of the organization carrying out the expedition

2.2 COLLECTION SPONSOR

Name of the organization sponsoring collection

2.3 COLLECTOR NAME

Name(s) of the collector(s)

2.4 COLLECTOR NUMBER

Number assigned by the collector(s) at the time of collection. This is alpha-numeric; comprising a two or three letter abbreviation of collector(s) name(s) followed by a number not exceeding five digits, e.g. SAD 00697

2.5 DATE COLLECTED

The date on which a particular accession was collected expressed numerically in six digits, e.g. 5 April 1981 to be expressed as 050481

2.6 DONOR NAME

Name of the person, institution or organization donating a particular accession

2.7 SAMPLE SOURCE

Source from which a sample was obtained

FF	Farmer's field
FS	Farmer's seed sample
TF	Threshing floor
MS	Market sample
IN	Institution
OS	Other source

2.8 ACCESSION TYPE

AO Authentic indigenous accession, unselected original seed

CN Authentic indigenous accession, unselected, seed increased by cluster bagging "N" times

AN Authentic indigenous accession, un-selected, seed increased by selfing "N" times

SN Initially authentic accession; now sub-divided on a few characters such as head and grain characters, seed increased "N" times

PN Germplasm pool constituted after mixing different landrace accessions of the same population, e.g. different accessions of "Zongo" are mixed to constitute the "Zongo" population, and seed increased "N" times

IN Inbred line selfed "N" times

EB Experimental accession, breeder's line

UN Unknown, even after attempts were made to identify the type of accession, no information was available

2.9 STATUS AT THE TIME OF COLLECTION

CV Cultivated

CS Mostly cultivated types in which shibras 1/ occur occasionally

IF Intermediate between wild and cultivated, shibras

WS Wild species

2.10 COUNTRY OF ORIGIN

Country from where the accession was first collected. Use the three letter abbreviations supported by the statistical office of the United Nations. Copies of these abbreviations are available from the IBPGR Secretariat

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1/ A natural cross between the cultivated and wild Pennisetum

2.11 STATE/PROVINCE

2.12 COLLECTION SITE

Number of kilometres and direction from the nearest village or other permanent landmark on the map

2.13 ALTITUDE

Elevation above mean sea level recorded in metres at which a particular accession was collected

2.14 LATITUDE

Latitude of the collection site expressed in degrees and minutes with suffix N or S for north or south respectively, e.g. 12°45' N

2.15 LONGITUDE

Longitude of the collection site expressed in degrees and minutes with suffix E or W for east or west respectively, e.g. 09°20' E

2.16 CLIMATE

Climate of the locality from where the particular germplasm accession was collected. Troll's classification system for world climates based on broad rainfall groups in relation to potential evapo-transpiration will be used. A humid month is defined as a month with mean rainfall exceeding potential evapo-transpiration. The climate codes are:

V1 Tropical rainy climates with rainy season of 9½ to 12 humid months and without short interruptions. Evergreen tropical rain forests and half-deciduous transition woods

V2 Tropical humid-summer climates with 7 to 9½ humid months; rain-green forests and humid grass-savannahs

V2A Tropical winter-humid climates with 7 to 9½ humid months; half deciduous transition woods

V3 Wet-dry tropical climates with 4½ to 7 humid months; rain-green dry wood and dry savannah

V4 Tropical dry climates with 2 to 4½ humid months; tropical thorn-succulent wood and savannah

V4A Tropical dry climates with humid months in winter

V5 Tropical semi-desert and desert climates with less than 2 humid months; tropical semi-desert and deserts

2.17 RAINFALL

Classified into four types based on the annual rainfall recorded in millimetres

1 less than 450 mm
2 451 - 650 mm
3 651 - 900 mm
4 above 900 mm

2.18 CULTURAL PRACTICES

1 Irrigated
2 Rainfed
3 Flooded
4 Transplanted

2.19 CROPPING SYSTEM

1 Sole crop
2 Inter-crop

2.20 SOIL

1 Sandy, sand and loam
2 Loam and silt loam
3 Clay loam, clay and silt
4 Highly organic
5 Other (specify)

2.21 TOPOGRAPHY

1 Swamp
2 Flood plain
3 Plain level
4 Undulating
5 Hilly
6 Hilly dissected
7 Steeply dissected
8 Mountainous
9 Other (specify)

2.22 REMARKS

Additional textual information provided by the collector(s) and not covered elsewhere

CHARACTERIZATION

3. MORPHOLOGICAL DATA

DESCRIPTORS AND CODE	Growth stage (for recording)
3.1 STEM THICKNESS	At harvest
The thickness of the stem in millimetres (without leaf sheaths) between 3rd and 4th node from the top	
3.2 SPIKE SHAPE	At maturity

See Figure 1

CYL Cylindrical: spike thickness more or less uniform throughout its length

CON Conical: spike thickness maximum at the base, gradually tapering toward the apex

SPL Spindle: spike thickness maximum in the middle, gradually tapering toward both ends

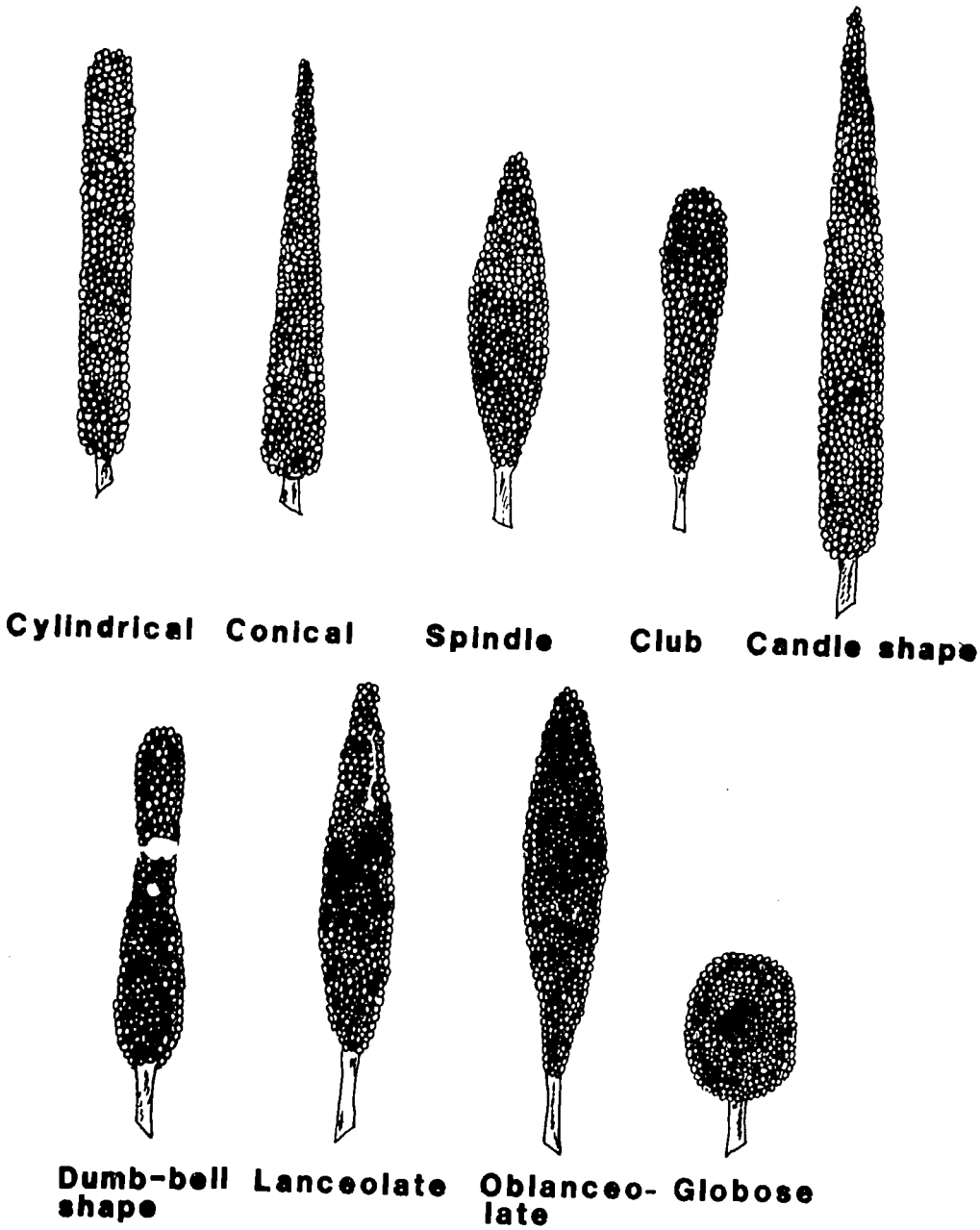

Figure 1. Spike Shape

Growth stage

CLB Club: maximum thickness of the spike at the apex, gradually tapering toward base

CDL Candle shape: intermediate between cylindrical and conical. About 3/4 length of the spike is cylindrical, gradually tapering toward the apex

DBL Dumb-bell: the characteristic spike of the Souna type from Mali. Maximum spike thickness is at the base, gradually tapering to 2/3 of the spike and then increasing slightly

LNC Lanceolate: intermediate between spindle and conical. Maximum spike thickness is near the middle which tapers more toward the apex than base

OBL Oblanceolate: the opposite of lanceolate, maximum spike thickness is near the middle which tapers more toward the base

GLB Globose: almost spherical, spike length not more than twice the diameter

3.3 SPIKELET SHATTERING/THRASHING At maturity

1 Spontaneous shattering
2 Shattering at touch
3 Non-shattering and free thrashing
4 Non-shattering and difficult to thrash

3.4 BRISTLE LENGTH At dough stage

1 Bristles below the level of the apex of seed
5 Bristle length between 0 and 2 centimetres above the seed
7 Bristles longer then 2 centimetres above the seed

Growth stage

At maturity

3.5 SEED COVERING

See Figure 2

3 Exposed
5 Intermediate
7 Enclosed

Figure 2. Seed Covering

3.6 SEED SHAPE

See Figure 3

OB Obovate
LN Lanceolate
EL Elliptical
HG Hexagonal
GB Globular

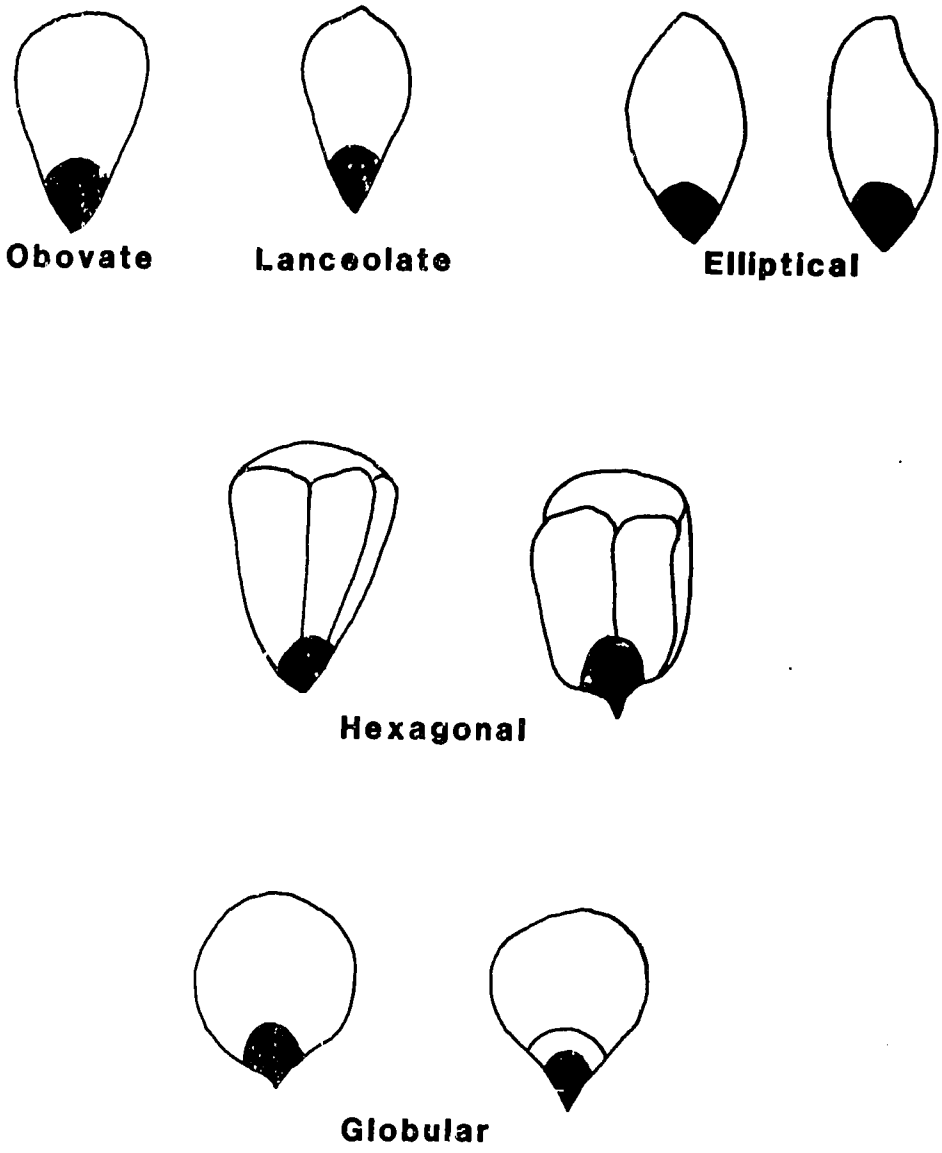

Figure 3. Seed Shape

Growth stage

3.7 SEED COLOUR

Seed colour scored after threshing.
For standard colour identification refer to Munsell colour chart

IV Ivory
CM Cream
YE Yellow
GR Gray
DG Deep gray
GB Gray brown
BR Brown
PU Purple
PB Purplish black

PRELIMINARY EVALUATION

4. AGRONOMIC EVALUATION DATA

4.1 SITE OF EVALUATION

The name of the site where evaluation was done

4.2 DATE OF PLANTING

The day, month and year on which the accession was planted, e.g. 15 June, 1981 as 150681

4.3 PLANT DENSITY

Estimated number of plants per m^2 — At maturity

4.4 EARLY VIGOUR — 18 days after emergence

Recorded after thinning to avoid the effect of plant number

3 Low
5 Intermediate
7 High

Growth stage

4.5 TILLERING

4.5.1 Tillering attitude — At head emergence

3 [1] Erect (cylindrical)
5 Intermediate
7 Spreading

4.5.2 Total tillers — At maturity

The total number of mature and immature spikes at the time of harvest. Any culm, including the main stem, having a spike is considered as a tiller

4.5.3 Productive tillers — At maturity

The number of spikes which bear seed at the time of harvest and therefore contribute to yield. Immature spikes are not counted

4.5.4 Nodal tillers — At maturity

0 None
3 Few
7 Many

4.6 DAYS TO FLOWERING — At flowering

Number of days from field emergence to when 50 per cent of the plants flowered. Stigma emergence on the main spike is considered as flowering

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1/ ICRISAT uses E,I,S for the coding

Growth stage

4.7 FLOWERING RANGE — At flowering

SF Short, continuous flowering, duration less than 7 days

LF Long, continuous flowering, duration more than 7 days

DF Discontinuous flowering, two or more groups flowering

4.8 SYNCHRONY OF EAR MATURITY — At harvest

N Non-synchronous
S Synchronous

4.9 RESTORATION RESPONSE (Cytoplasmic male sterility A-1 type) — At harvest

1 Non-restoration (maintainer)
2 Partial restoration (all plants shed poor pollen)
3 Complete restoration
4 Segregating for restoration

4.10 GREEN FODDER YIELD POTENTIAL — At flowering

Consider tillering, leafiness and bulk

3 Poor
5 Intermediate
7 Good

4.11 PLANT HEIGHT — At dough stage

Measured in centimetres from the ground level to the tip of the spike

4.12 EAR EXSERTION — At maturity

Observations taken on the primary tiller in centimetres. It is recorded as the

Growth stage

distance between the ligule of the flag leaf and the base of the spike

NEN Negative exsertion, N centimetres

PEN Positive exsertion, N centimetres

4.13 SPIKE **At dough stage**

4.13.1 Spike length

Measured in centimetres from the base to the tip of the spike on the primary tiller

4.13.2 Spike thickness **At dough stage**

Maximum diameter of the spike, excluding bristles, measured in millimetres

4.13.3 Spike density **At maturity**

3 Loose
5 Intermediate
7 Compact

4.14 SEED

4.14.1 Seed weight per spike **Post-harvest**

Weight of the seed in grams at 12 per cent moisture content

4.14.2 Seed weight **Post-harvest**

Weight of 1000 seeds in grams at 12 per cent moisture content

4.14.3 Seed volume **Post-harvest**

Volume of 1000 seeds expressed in cubic centimetres using alcohol

Growth stage

4.15 ENDOSPERM TEXTURE — Post harvest

3 Mostly corneous
5 Partly corneous
7 Mostly starchy

4.16 YELLOW ENDOSPERM — Post-harvest

0 1/ Absent
+ Present

4.17 YIELD POTENTIAL — At maturity

Consider spike number, size and density, seed number and size compared with a standard check

3 Low
5 Intermediate
7 High

4.18 OVER-ALL PLANT ASPECT — At maturity

Over-all agronomic desirability of accession

3 Poor
5 Intermediate
7 Good

4.19 LODGING SUSCEPTIBILITY — At maturity

3 Low
5 Intermediate
7 High

1/ ICRISAT uses A and P for the coding

		Growth stage
4.20	SENSITIVITY TO PHOTOPERIOD	At flowering

In respect of flowering being influenced by length of day

3 Highly sensitive
5 Partly sensitive
7 Insensitive

FURTHER CHARACTERIZATION AND EVALUATION

5. FURTHER CHARACTERIZATION

5.1 SITE OF EVALUATION

The name of the site where evaluation was done

5.2 DATE OF PLANTING

The day, month and year on which the accession was planted, e.g. 8 June 1981 as 080681

5.3 LEAF

5.3.1 Length — At head emergence

The measurement in centimetres from ligule to tip of the leaf on the 4th node below the head on the main tiller

5.3.2 Width — At head emergence

The measurement in millimetres taken at the widest point of the leaf on the 4th node of the main tiller

		Growth stage
5.3.3	Attitude	At head emergence
	1 Erect 5 Intermediate 9 Pendant	
5.3.4	Colour	At head emergence
	1 Light green 5 Green 7 Dark green	
5.3.5	Sheath length	At head emergence
	The measurement in centimetres taken from the node to the base of the ligule of the leaf on the 4th node below the head of the main stem	
5.3.6	Sheath pigmentation	At dough stage
	1 Green 5 Red 7 Purple	
5.3.7	Blade pigmentation	At dough stage
	1 Green 5 Red 7 Purple	
5.3.8	Sheath pubescence	At head emergence
	1 Glabrous 5 Sparsely hairy 7 Densely hairy	
5.3.9	Senescence	At maturity
	3 Slow 5 Intermediate 7 Fast	

		Growth stage
5.3.10	Separation	At dough stage

The distance (in centimetres) between two successive (3rd and 5th) leaf blades, ligule to ligule divided by two

5.3.11	Number	At maturity

3 Low
5 Intermediate
7 High

5.4 STEM

5.4.1	Internode length	At harvest

The distance (in centimetres) between 3rd and 4th node

5.4.2	Stalk juiciness	At dough stage

0 1/ Absent
\+ Present

5.4.3	Juice quality	At dough stage

3 Insipid
5 Intermediate
7 Sweet

5.4.4	Node pigmentation	At dough stage

3 Light
5 Intermediate
7 Dark

1/ ICRISAT uses A and P for the coding

		Growth stage
5.4.5	Internode pigmentation	At dough stage

3 Light
5 Intermediate
7 Dark

5.4.6	Node pubescence	At flowering

0 1/ Absent
+ Present

5.4.7	Internode pubescence	At flowering

0 1/ Absent
+ Present

5.5 RACHIS

5.5.1	Rachis diameter	At maturity

A measurement in millimetres taken at mid-point of the rachis

5.5.2	Rachis pubescence	At maturity

3 Sparse
5 Intermediate
7 Dense

5.5.3	Rachis tip	At maturity

E Exposed
C Covered

5.6 INVOLUCRE

5.6.1	Stalk length	At maturity

A measurement in millimetres of the involucre stalk at mid-point of the rachis

1/ ICRISAT uses A and P for the coding

		Growth stage
5.6.2	Number of fertile spikelets per involucre	At maturity
	Average number recorded at the middle of the spike	
5.6.3	Bristle colour	At dough stage
	3 Green 5 Tan (Brown) 7 Red	
5.6.4	Bristle ornamentation	At maturity
	See Figure 4	
	1 Scabrous (rough) 2 Ciliate (with fine hairs) 3 Plumose (feathery)	

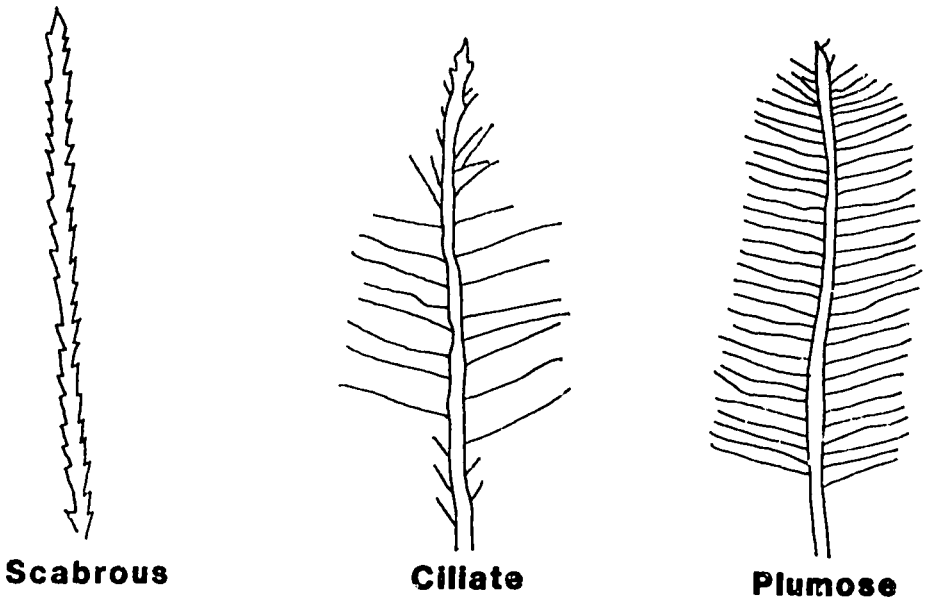


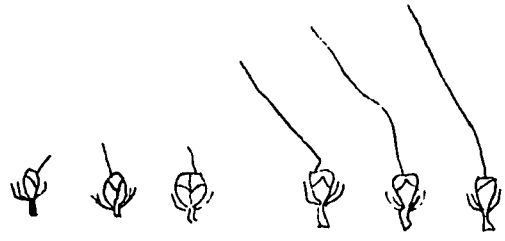
Figure 4. Bristle Colour

Growth stage

5.6.5 Type of aristation — At maturity

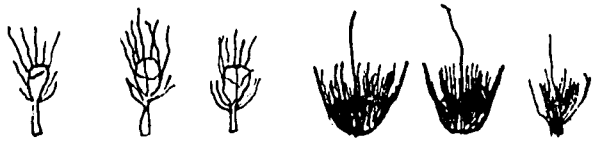
See Figure 5

1 Mono-aristation - short
3 Mono-aristation - long
5 Poly-aristation - sparse
7 Poly-aristation - dense



Mono-aristation

short **long**



Poly-aristation

sparse **dense**

Figure 5. Types of Aristation

Growth stage

5.7 SPIKELET

5.7.1 Glume colour — At dough stage

3 Light
5 Intermediate
7 Dark

5.7.2 Anther colour — Before anther dehiscence

1 Cream
3 Cream yellow
5 Yellow
7 Brown
9 Purple

5.7.3 Stigma pigmentation — At flowering

1 1/ Absent
2 Present

5.7.4 Florets per spikelet — At stigma emergence

Number and types of florets per spikelet at mid-point of the rachis (with dissection of the florets)

1 One perfect floret only
3 Two florets: one perfect
5 Two florets: one perfect + one male
7 Two florets: 2 perfect
9 More than two perfect florets

1/ ICRISAT uses A and P for the coding

		Growth stage
5.8	SEED	
5.8.1	Apex shape	Post-harvest
	1 Non-mucronate 2 Mucronate	
5.8.2	Surface	Post-harvest
	S Smooth W Wrinkled	

6. FURTHER EVALUATION

6.1	GRAIN QUALITY	
6.1.1	Protein content	Post-harvest
	Per cent of dry matter	
6.1.2	Lysine content	Post-harvest
	Per cent of dry matter	
6.1.3	Methionine content	Post-harvest
	Per cent of dry matter	
6.1.4	Tryptophane content	Post-harvest
	Per cent of dry matter	
6.2	DROUGHT TOLERANCE	
	3 Low tolerance 5 Medium tolerance 7 High tolerance	

6.3 RHIZOSPHERE NITROGENASE ACTIVITY

3 [1] Low
5 Intermediate
7 High

6.4 TEMPERATURE TOLERANCE

3 Low tolerance
5 Medium tolerance
7 High tolerance

6.5 SALINITY TOLERANCE

3 Low tolerance
5 Medium tolerance
7 High tolerance

6.6 ENZYME AND PROTEIN PATTERN

(Future task)

6.7 STRIGA RESISTANCE

6.7.1 *Striga asiatica* (L.) O. Kuntze

3 Low
5 Medium
7 High

6.7.2 *Striga hermonthica* Benth.

3 Low
5 Medium
7 High

1/ ICRISAT uses L, M and H for the coding

Growth stage

7. DISEASE SUSCEPTIBILITY EVALUATION DATA

Disease susceptibility scores should only be made from designed trials with check varieties

7.1 SITE OF EVALUATION

The name of the site where evaluation was done

7.2 DATE OF PLANTING

The day, month and year on which the accession was planted for evaluation, i.e. 15 June 1981 as 150681

7.3 DOWNY MILDEW (*Sclerospora graminicola* (Sacc.) Schroet.) — At dough stage

1 No symptoms
2 Symptoms on nodal tillers only
3 Symptoms on main tiller but still more than 50% heads normal
4 Symptoms on so many main tillers that there are less than 50% normal tillers
5 Symptoms on so many main stems and tillers that there are no productive heads. (Plants may have died at an earlier stage leaving clumps of straw or gaps)

7.4 ERGOT (*Claviceps fusiformis* (Lev.)) — At dough stage

Record mean per cent infected florets from ten heads with the aid of the standard drawings. (See Figure 6)

1 No symptoms
2 Less than 5% of grain become sclerotic
3 6-10% of grain become sclerotic
4 11-20% of grain become sclerotic
5 More than 20% of grain become sclerotic

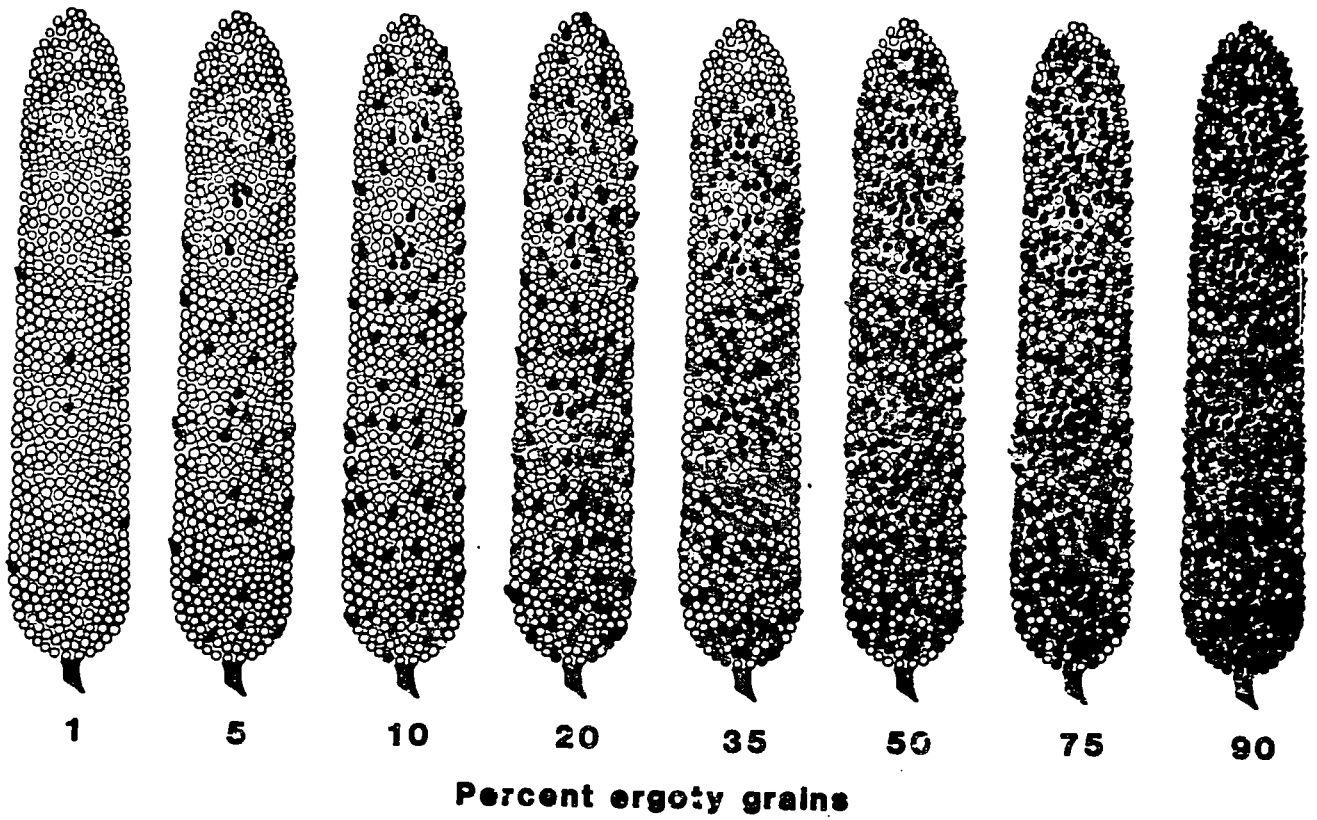


Figure 6. Ergot

Growth stage

7.5 SMUT — At dough stage
(*Tolyposporium penicillariae* (Bref.))

Record the mean per cent infected florets on 10 bagged/inoculated heads with the aid of the standard drawings. (See Figure 7)

1 No symptoms
2 Less than 5% of grain become smut sori
3 6-10% of grain become smut sori
4 11-20% of grain become smut sori
5 More than 20% of grain become smut sori

7.6 RUST — At flowering
(*Puccinia pennisoti* Zimm.)

Assess the top four leaves at 50% flowering and indicate whether infection also occurs on the sheaths by using an additional suffix, S if necessary

1 No symptoms
2 Few scattered pustules
3 Pustules up to 10% of leaf surface
4 Pustules covering 11-25% of leaf surface
5 Pustules covering more than 25% of leaf surface

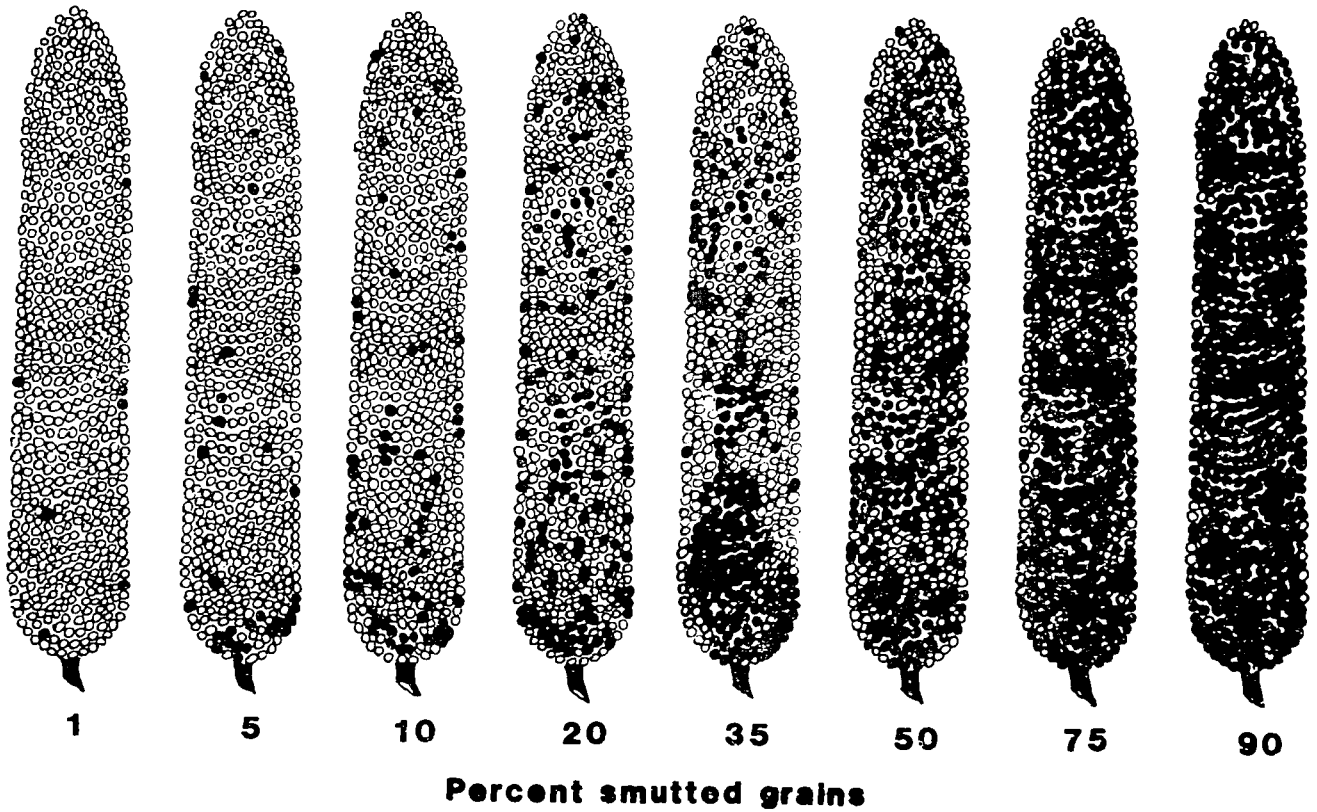


Figure 7. Smut

8. PEST SUSCEPTIBILITY EVALUATION DATA

Pest susceptibility scores should only be made from designated trails with relevant check varieties.

Insect damage scores are recorded on a 1 to 9 scale, where:

3 Damage less than that shown by the check
5 Damage approximately equal to that shown by the check
7 Damage greater than that shown by the check

8.1 SITE OF EVALUATION

The name of the site where evaluation was done

8.2 DATE OF PLANTING

The day, month and year on which the accession was planted for evaluation i.e. 20 July 1981 as 200781

8.3 WHITE GRUBS

8.3.1 *Holotrichia* sp.

8.3.2 Other (Specify)

8.4 SHOOT FLY

8.4.1 *Atherigona approximata*

8.4.2 Other (Specify)

8.5 STEM BORERS

8.5.1 *Chilo partellus*

8.5.2 *Sesamia inferens*

8.5.3 *Acigona ignefusalis*

8.5.4 Otner (specify)

8.6 HAIRY CATERPILLARS

8.6.1 *Amsacta* sp.

8.6.2 *Estigmene lactinea*

8.6.3 Other (specify)

8.7 ARMY WORMS

8.7.1 *Mythimna* sp.

8.7.2 *Spodoptera exempta*

8.7.3 *Spodoptera frugiperda*

8.7.4 Other (specify)

8.8 CUT WORMS

8.8.1 *Agrotis* sp.

8.8.2 Other (specify)

8.9 GRASS HOPPERS

8.10 APHIDS

8.10.1 *Rhopalosiphum maidis*

8.10.2 *Schizaphis graminum*

8.10.3 Other (specify)

8.11 LEAF EATING WEEVILS/BEETLES

8.11.1 *Myllocerus* sp.

8.11.2 *Tanymecus indicus*

8.11.3 Oulema downsei

8.11.4 Other (specify)

8.12 MIDGE

8.12.1 Geromyia penniseti

8.13 HEAD BUGS

8.13.1 Calocoris angustatus

8.13.2 Dysdercus sp.

8.13.3 Other (specify)

8.14 HEAD CATERPILLARS

8.14.1 Masalia sp.

8.14.2 Heliothis armigera

8.14.3 Cryptoblabes gnidiella

8.14.4 Raghuva sp.

8.14.5 Other (specify)

8.15 BLISTER BEETLES

8.15.1 Mylabris pustulata

8.15.2 Psalydolytta sp.

8.16 THRIPS

8.16.1 Haplothrips sp.

8.16.2 Thrips sp.

8.17 BIRDS

APPENDIX

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