

---

Descriptors for  
**Barley**

(*Hordeum vulgare* L.)



International Plant Genetic Resources Institute  
  
**IPGRI**

---

Descriptors for  
**Barley**  
(*Hordeum vulgare* L.)

The International Plant Genetic Resources Institute (IPGRI) is an autonomous international scientific organization operating under the aegis of the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI works in partnership with other organizations, undertaking research, training, and the provision of scientific and technical advice and information and has a particularly strong programme link with the Food and Agriculture Organization of the United Nations.

The international status of IPGRI is conferred under an Establishment Agreement which, by December 1993 had been signed by the Governments of Belgium, Bolivia, Cameroon, Chile, China, Cyprus, Denmark, Egypt, Greece, Hungary, India, Iran, Italy, Jordan, Kenya, Pakistan, Poland, Portugal, Romania, Russia, Senegal, Switzerland, Syria, Turkey and Uganda. IPGRI, the legal successor to the International Board for Plant Genetic Resources (IBPGR), became operational when its Headquarters Agreement with the Italian Republic was ratified by Italian Parliament in December 1993.

Financial support for the core programme of IPGRI is provided by the Governments of Australia, Austria, Belgium, Canada, China, Denmark, France, Germany, India, Italy, Japan, the Republic of Korea, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK, the USA, and the World Bank

#### Citation

IPGRI. 1994. *Descriptors for barley* (*Hordeum vulgare L.*). International Plant Genetic Resources Institute, Rome, Italy

ISBN 92-9043-222-5

IPGRI  
Via delle Sette Chiese 142  
00145 Rome  
Italy

Copyright. International Plant Genetic Resources Institute, 1994

# CONTENTS

PREFACE	v
DEFINITIONS AND USE OF THE DESCRIPTORS	1
PASSPORT	5
1. Accession descriptors	5
2. Collecting descriptors	7
MANAGEMENT	12
3. Seed management descriptors	12
4. Multiplication/regeneration descriptors	13
ENVIRONMENT AND SITE	15
5. Site descriptors	15
6. Environment descriptors	17
CHARACTERIZATION	29
7. Plant descriptors	29
EVALUATION	38
8. Plant descriptors	38
9. Abiotic stress susceptibility	38
10. Biotic stress susceptibility	39
11. Alloenzyme composition and zymotype	41
12. Cytological characters and identified genes	42
REFERENCES	43
CONTRIBUTORS	44
ACKNOWLEDGEMENTS	45



## PREFACE

Descriptors for barley (*Hordeum vulgare* L.) is a revision of the original IPGRI 'Barley Descriptors' (1982). An updated and slightly modified list was prepared by J.D. Franckowiak and T. Konishi, as recommended by the International Workshop on Barley Genetic Resources held 20-21 July, 1991, in conjunction with the Sixth International Barley Genetics Symposium, Helsingborg, Sweden. A draft version prepared in the IPGRI internationally accepted format for descriptor lists was subsequently sent to a number of experts for their comments and amendments. A full list of the names and addresses of those involved is given in 'Contributors'. The descriptors from the 1982 list are cross-referenced with the current list with the descriptor numbers in parentheses beside the current descriptor.

IPGRI encourages the collection of data for descriptors on the first four categories of this list: *Passport, Management, Environment and site*, and *Characterization*; and endorses data in these categories as those that should be available for any one accession. However, the number of each of the site and environment descriptor types used will depend on the crop and their importance to the crop's description. Descriptors listed under *Evaluation* allow for a more detailed description of the accession's characters, but generally require replicated site and time trials.

Although the suggested coding should not be regarded as the definitive scheme, this format has the full backing of IPGRI and is promoted worldwide. This descriptor list is intended to be comprehensive for the descriptors that it contains. This approach assists with the standardization of descriptor definitions. IPGRI does not, however assume that each curator will characterize accessions of their collection utilizing all descriptors given. Those descriptors known to be highly discriminating descriptors are given in bold and marked with an asterisk. Descriptors should be used when they are useful to the curator for the management and maintenance of the collection and/or to the users of the plant genetic resources.

This descriptor list provides an international format and thereby produces a universally understood 'language' for plant genetic resources data. The adoption of this scheme for data encoding, or at least the production of a transformation method to convert other schemes to the IPGRI format, will produce a rapid, reliable, and efficient means for information storage, retrieval, and communication, and will assist with the utilization of germplasm. It is recommended, therefore, that information should be produced by closely following the descriptor list with regard to: ordering and numbering descriptors; using the descriptors specified; and using the descriptor states recommended.

Any suggestions on this descriptor list will be appreciated by IPGRI.



## DEFINITIONS AND USE OF THE DESCRIPTORS

IPGRI now uses the following definitions for genetic resources data management:

- (i) **Passport** descriptors: These provide the basic information used for the general management of the accession (including the registration at the genebank and other identification information) and describe parameters that should be observed when the accession is originally collected
- (ii) **Management** descriptors: These provide the basis for the management of accessions in the genebank and assist with their multiplication and regeneration
- (iii) **Environment and site** descriptors: These describe the environmental and site specific parameters that are important when characterization and evaluation trials are held. They can be important for the interpretation of the results of these trials. Germplasm collecting site descriptors are also included here
- (iv) **Characterization** descriptors: These enable an easy and quick discrimination between phenotypes. They are generally highly heritable, can be easily seen by the eye and are equally expressed in all environments. In addition, these may include a limited number of additional traits thought desirable by a consensus of users of the particular crop
- (v) **Evaluation** descriptors: Many descriptors in this category are susceptible to environmental differences but are generally useful in crop improvement. In addition, others may involve biochemical or molecular characterization. They include yield, agronomic performance, stress susceptibilities and biochemical and cytological traits

Characterization will normally be the responsibility of genebank curators, while evaluation will typically be carried out elsewhere (possibly by a multidisciplinary team of scientists). The evaluation data should be fed back to the genebank which will maintain a data file.

Minimum descriptors highly discriminating are in bold and marked with an asterisk.

The following internationally accepted norms for the scoring, coding, and recording of descriptor states should be followed as indicated below:

- (a) the *Système International d'Unités* (SI system) is used. The units to be applied are given in square brackets following the descriptor name;
- (b) standard colour charts, e.g. Royal Horticultural Society Colour Chart, Methuen Handbook of Colour, or Munsell Color Chart for Plant Tissues, are strongly recommended for all ungraded colour characters (the precise chart used should be specified in the section where it is used);



## 2 DESCRIPTORS FOR BARLEY

- (c) many quantitative characters which are continuously variable are recorded on a 1-9 scale, where:

1	Very low
2	Very low to low
3	Low
4	Low to intermediate
5	Intermediate
6	Intermediate to high
7	High
8	High to very high
9	Very high

is the expression of a character. 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. in Section 10 (Biotic stress susceptibility) 1 = very low susceptibility and 9 = very high susceptibility;

- (d) (i) when a descriptor is scored using a 1-9 scale, such as in (c), '0' would be scored when the character is not expressed; and (ii) when a descriptor is inapplicable. In the following example, '0' will be recorded if an accession does not form awns:

### Lemma awn barbs

3	Smooth (few barbs at tip)
5	Intermediate (small barbs on upper half)
7	Rough

- (e) absence/presence of characters are scored as in the following example:

### Presence/absence of terminal leaflet

0	Absent
1 (or +)	Present

- (f) blanks are used for information not yet available;
- (g) for accessions which are not generally uniform for a descriptor (e.g. mixed collection, genetic segregation), the mean and standard deviation could be reported where the descriptor is continuous, or where the descriptor is discontinuous up to three codes in the order of frequency could be recorded; or other publicized methods can be utilized, such as van Hintum (1993), that clearly states a method for scoring heterogeneous accessions;

(h) dates should be expressed numerically in the format DDMMYYYY, where

DD	-	2 digits to represent the day
MM	-	2 digits to represent the month
YYYY	-	4 digits to represent the year

#### 4 DESCRIPTORS FOR BARLEY

# PASSPORT

## 1. ACCESSION DESCRIPTORS

### 1.1 ACCESSION NUMBER (1.1)

This number serves as a unique identifier for accessions and is assigned when an accession is entered into the collection. Once assigned this number should never be reassigned to another accession in the collection. Even if an accession is lost, its assigned number is still not available for re-use. Letters should be used before the number to identify the genebank or national system (e.g. IDG indicates an accession comes from the genebank at Bari, Italy; CGN indicates an accession comes from the genebank at Wageningen, The Netherlands; PI indicates an accession within the USA system)

### 1.2 DONOR NAME (1.2)

Name of institution or individual responsible for donating the germplasm

### 1.3 DONOR NUMBER (1.3)

Number assigned to accession by the donor

### 1.4 OTHER NUMBER(S) ASSOCIATED WITH THE ACCESSION (1.4)

Any other identification number known to exist in other collections for this accession, e.g. USDA Plant Inventory number (not COLLECTING NUMBER, see 2.2). Other numbers can be added as 1.4.3, etc.

#### 1.4.1 Other number 1

#### 1.4.2 Other number 2

### 1.5 SCIENTIFIC NAME (1.5)

#### 1.5.1 Genus

#### 1.5.2 Species

#### 1.5.3 Subspecies

#### 1.5.4 Botanical variety

## 6 DESCRIPTORS FOR BARLEY

### 1.6 PEDIGREE (1.6)

Parentage or nomenclature, and designations assigned to breeders' material

#### 1.6.1 Pedigree/mother line

#### 1.6.2 Literature citations

### 1.7 CULTIVAR NAME (1.6)

Either a registered or other formal cultivar designation given to the accession

#### 1.7.1 Cultivar name

#### 1.7.2 Year of release of the cultivar/year of registration

#### 1.7.3 Other designations assigned to breeder's material

#### 1.7.4 Literature citations

### 1.8 PRINCIPAL ATTRIBUTE

The most useful characteristics of the accession

### 1.9 ACQUISITION DATE (1.7)

Date on which the accession entered the collection (in the format DDMMYYYY)

### 1.10 ACCESSION SIZE (1.9)

Approximate number or weight of seeds of an accession in the genebank

### 1.11 TYPE OF MAINTENANCE

- 1 Vegetative
- 2 Seed
- 3 Vegetative and seed
- 4 Tissue culture

## 2. COLLECTING DESCRIPTORS

### 2.1 COLLECTING INSTITUTE(S) (2.2)

Institute(s) and people collecting/sponsoring the sample collection

### 2.2 COLLECTING NUMBER (2.1)

Original number assigned by the collector(s) of the sample, normally composed of the name or initials of the collector(s) followed by a number. This item is essential for identifying duplicates held in different collections and should be unique and always accompany subsamples wherever they are sent

### 2.3 SITE NUMBER

Number assigned to the physical site by the collector

### 2.4 COLLECTING DATE OF ORIGINAL SAMPLE (2.3)

(in the format DDMMYYYY)

### 2.5 COUNTRY OF COLLECTING (2.4)

Name of the country in which the sample was collected or was bred. Use the three letter abbreviations from the *International Standard (ISO) Codes for the representation of names of countries*, No. 3166, 1988. Copies of these are available from Beuth Verlag GmbH, Burggrafenstrasse 6, D-10772 Berlin 30, Germany; Tel. 30-2601-2320; Fax 30-2601-1231, Tlx. 1-84-273-din-d

### 2.6 PROVINCE/STATE (2.5)

Name of the primary administrative subdivision of the country in which the sample was collected

### 2.7 DEPARTMENT/COUNTY

Name of the secondary administrative subdivision (within a Province/State) of the country in which the sample was collected

### 2.8 LOCATION OF COLLECTING SITE (2.6)

Distance in kilometers and direction from the nearest town, village or map grid reference point (e.g. CURITIBA 7S means 7 km south of Curitiba)

## 8 DESCRIPTORS FOR BARLEY

### 2.9 LATITUDE OF COLLECTING SITE (2.7)

Degrees and minutes followed by N (North) or S (South) (e.g. 01030S)

### 2.10 LONGITUDE OF COLLECTING SITE (2.8)

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W)

### 2.11 ELEVATION OF COLLECTING SITE [m] (2.9)

Altitude above sea level

### 2.12 TYPE OF SAMPLE

Form of sample collected. If different types of material were collected from the same source, each sample type should be designated with a unique collecting number and a corresponding unique accession number

- 1 Vegetative
- 2 Seed
- 3 Pollen
- 4 Tissue culture

### 2.13 COLLECTING SOURCE (2.10)

- 1 Wild habitat
- 2 Farm land
- 3 Farm store
- 4 Backyard
- 5 Market
- 6 Institute
- 7 Threshing yard
- 8 Others (specify in the descriptor COLLECTOR'S NOTES, 2.33)

### 2.14 STATUS OF SAMPLE (2.11)

- 1 Wild
- 2 Weedy
- 3 Landrace
- 4 Advanced cultivar
- 5 Breeding/research material
- 6 Population/composite cross
- 7 Genetic or cytogenetic stock
- 8 Other (specify in the descriptor COLLECTOR'S NOTES, 2.33)

2.15 NUMBER OF PLANTS SAMPLED (2.13)

2.16 NUMBER OF SPIKES COLLECTED

2.17 WEIGHT OF SEED COLLECTED [g]

2.18 MAIN COMPANION SPECIES AT COLLECTING SITE

Was (were) companion species collected?

0 No  
+ Yes

2.19 CROPPING SYSTEM

1 Monoculture  
2 Intercropped (specify crop(s) in the descriptor COLLECTOR'S  
NOTES, 2.33)

2.20 PLANT POPULATION DENSITY

3 Low  
5 Medium  
7 High

2.21 GENETIC EROSION

Estimate of the rate at which genetic erosion of the species is occurring in the region of collecting

3 Slow  
5 Intermediate  
7 Rapid

2.22 LOCAL/VERNACULAR NAME (2.12)

Name given by farmer to crop and cultivar/landrace/weed. State language and dialect if the ethnic group is not provided

2.23 ETHNIC GROUP

Name of the tribe of the farmer donating the sample or of the people living in the area of collecting



## 10 DESCRIPTORS FOR BARLEY

### 2.24 PRIMARY GRAIN USAGE

- 1 Human food
- 2 Livestock feed
- 3 Alcoholic beverages
- 4 Other (specify in the descriptor COLLECTOR'S NOTES, 2.33)

### 2.25 PRIMARY FODDER USAGE

- 1 Grazing
- 2 Dried hay
- 3 Straw for bedding
- 4 Fuel
- 5 Green mature or conservation
- 6 Other (specify in the descriptor COLLECTOR'S NOTES, 2.33)

### 2.26 COLLECTING SOURCE ENVIRONMENT

Descriptors for Collecting Source Environment (2.26.1 - 2.26.26) are given in Section 6. These are numbered in Section 6 in the following manner 6.1.1 - 6.1.26, but should be used for this section. This has been done in order to reduce the repetition of descriptors in Sections 2 and 5

### 2.27 CULTURAL PRACTICES

#### 2.27.1 Sowing date

(in the format DDMMYYYY)

#### 2.27.2 Harvest date

(in the format DDMMYYYY)

#### 2.27.3 Irrigation

Specify amount, frequency, and method of application

## 2.28 PHOTOGRAPH (2.14)

Was a photograph taken of the accession or habitat at the time of collecting? If so, provide an identification number in the descriptor COLLECTOR'S NOTES, 2.33

0 No  
+ Yes

## 2.29 HERBARIUM SPECIMEN

Was a herbarium specimen collected? If so, provide an identification number in the descriptor COLLECTOR'S NOTES, 2.33

0 No  
+ Yes

## 2.30 ASSOCIATED FLORA

Other dominant crop species, found at and around the collecting site

## 2.31 PREVAILING STRESSES

Information on associated biotic and abiotic stresses and the accession's reaction. Indicate if disease indexing was done at the time of collecting

## 2.32 FREQUENCY OF ACCESSION AT COLLECTING SITE

1 Rare  
3 Occasional  
5 Frequent  
7 Abundant  
9 Very abundant

## 2.33 COLLECTOR'S NOTES

Additional information recorded by the collector or any specific information on any state in any of the above descriptors

## MANAGEMENT

### 3. SEED MANAGEMENT DESCRIPTORS

- |      |   |                 |
|------|---|-----------------|
| 3.1  | ACCESSION NUMBER  | (Passport 1.1)  |
| 3.2  | POPULATION IDENTIFICATION   | (Passport 2.2)  |
|      | Collecting number, pedigree, cultivar name, etc. depending on the population type |                 |
| 3.3  | STORAGE ADDRESS   |                 |
|      | (Building, room, shelf numbers/location in medium- and/or long-term storage)      |                 |
| 3.4  | STORAGE DATE  |                 |
|      | (in the format DDMMYYYY)  |                 |
| 3.5  | GERMINATION AT STORAGE (INITIAL) [%]  |                 |
| 3.6  | DATE OF LAST GERMINATION TEST   |                 |
|      | (in the format DDMMYYYY)  |                 |
| 3.7  | GERMINATION AT THE LAST TEST [%]  |                 |
| 3.8  | DATE OF NEXT TEST   |                 |
|      | Date when the accession should next be tested (estimate) (in the format DDMMYYYY) |                 |
| 3.9  | MOISTURE CONTENT AT HARVEST [%]   |                 |
| 3.10 | MOISTURE CONTENT AT STORAGE (INITIAL) [%]   |                 |
| 3.11 | AMOUNT OF SEED IN STORAGE(S) [g or number]  | (Passport 1.10) |
| 3.12 | DUPLICATION AT OTHER LOCATION(S)  | (Passport 1.4)  |

#### **4. MULTIPLICATION/REGENERATION DESCRIPTORS**

4.1 ACCESSION NUMBER (Passport 1.1)

4.2 POPULATION IDENTIFICATION (Passport 2.2)

Collecting number, pedigree, cultivar name, etc. depending on the population type

4.3 FIELD PLOT NUMBER

4.4 MULTIPLICATION/REGENERATION SITE LOCATION

4.5 COLLABORATOR

4.6 SOWING DATE

(in the format DDMMYYYY)

4.7 TRANSPLANTING DATE

(in the format DDMMYYYY)

4.8 SOWING DENSITY

4.9 CULTURAL PRACTICES

4.10 FERTILIZER APPLICATION

4.11 GERMINATION IN THE FIELD [%]

4.12 SEEDLING VIGOUR

Assessed 18 days after emergence

4.13 NUMBER OF PLANTS ESTABLISHED

4.14 HARVEST DATE

(in the format DDMMYYYY)

## 14 DESCRIPTORS FOR BARLEY

For descriptors 4.15-4.17 only applicable for composite crosses

4.15 NUMBER OF PLANTS POLLINATED

4.16 POLLINATION METHOD

100 or more flowers are preferred

- 1 Selfing
- 2 Chain cross
- 3 Pair crossing
- 4 Bulk pollen
- 5 Isolation
- 6 Cluster bagging

4.17 NUMBER OF POLLINATED SPIKES REPRESENTED IN STORE(S)

4.18 AGRONOMIC EVALUATION

4.19 NUMBER OF TIMES ACCESSION REGENERATED (1.10)

4.20 PREVIOUS MULTIPLICATION AND/OR REGENERATION

4.20.1 Location

4.20.2 Sowing date (1.8)

(in the format DDMMYYYY)

4.20.3 Plot number

4.21 NUMBER OF PLANTS USED IN EACH REGENERATION/MULTIPLICATION

4.22 SPECIAL MULTIPLICATION REQUIREMENTS

4.22.1 Cytological

4.22.2 Environmental

4.22.3 Isolation

4.22.4 Gene identification

## ENVIRONMENT AND SITE

### 5. SITE DESCRIPTORS

- 5.1 COUNTRY OF CHARACTERIZATION AND/OR EVALUATION (3.1, 5.1)

(See instructions in COUNTRY OF COLLECTING, 2.5)

- 5.2 SITE (RESEARCH INSTITUTE) (3.2, 5.2)

5.2.1 Latitude

Degrees and minutes followed by N (North) or S (South) (e.g. 01030S)

5.2.2 Longitude

Degrees and minutes followed by E (East) or W (West) (e.g. 07625W)

5.2.3 Elevation [m]

Altitude above sea level

5.2.4 Name of farm or institute

- 5.3 EVALUATOR'S NAME AND ADDRESS (3.3, 5.3)

- 5.4 SOWING DATE (3.4, 5.4)

(in the format DDMMYYYY)

- 5.5 HARVEST DATE (3.5, 5.5)

(in the format DDMMYYYY)

- 5.6 STANDARD CULTIVARS USED

The applied characteristics to be scored require standardization by comparison with recognized cultivars (e.g. *Hordeum vulgare* cv. Betzes). The standard cultivars used will be constant at a given site or group of sites; however, specific traits may require other standards

## 16 DESCRIPTORS FOR BARLEY

### 5.7 EVALUATION ENVIRONMENT

Environment in which characterization/evaluation was carried out

- 1 Field
- 2 Screenhouse
- 3 Glasshouse
- 4 Laboratory
- 5 Other (specify in the descriptor NOTES, 5.16)

### 5.8 PERCENTAGE SEED GERMINATION [%]

Specify number of days over which germination is measured

### 5.9 PERCENTAGE FIELD ESTABLISHMENT [%]

### 5.10 NUMBER OF DAYS TO 50% GERMINATION

### 5.11 SOWING SITE IN FIELD

Give block, strip and/or row/plot numbers as applicable

### 5.12 FIELD SPACING

5.12.1 Distance between plants in a row [cm]

5.12.2 Distance between rows [cm]

### 5.13 ENVIRONMENTAL CHARACTERISTICS OF THE SITE

Descriptors for the Environmental characteristics of site (5.13.1 - 5.13.26) are given in Section 6. These are numbered in Section 6 in the following manner 6.1.1 - 6.1.26, but should be used for this section. This has been done in order to reduce the repetition of descriptors in Sections 2 and 5

### 5.14 FERTILIZER

(Specify types, doses, frequency of each, and method of application)

### 5.15 PLANT PROTECTION

(Specify pesticides used, doses, frequency of each, and method of application)

## 5.16 NOTES

Any other site-specific information

## 6. ENVIRONMENT DESCRIPTORS

### 6.1 COLLECTING AND/OR CHARACTERIZATION/EVALUATION SITE ENVIRONMENT

#### 6.1.1 Topography

This refers to the differences in elevation of the land surface on a broad scale

The reference is:

FAO, 1990. In: *Guidelines For Soil Profile Description*, 3rd Edition (Revised), Rome, p.70

1	Flat	0	-	0.5%
2	Almost flat	0.6	-	2.9%
3	Gently undulating	3	-	5.9%
4	Undulating	6	-	10.9%
5	Rolling	11	-	15.9%
6	Hilly	16	-	30%
7	Steeply dissected	>30%, moderate range of elevation		
8	Mountainous	>30%, great range of elevation (>300 m)		
9	Other (specify in the appropriate Section's NOTES)			

#### 6.1.2 Higher level landform (General physiographic features)

The landform refers to the shape of the land surface in the area in which the collecting site is located (Adapted from *FAO, 1990*)

- 1 Plain
- 2 Basin
- 3 Valley
- 4 Plateau
- 5 Upland
- 6 Hill
- 7 Mountain



6.1.3 Second level landform (Adapted from *FAO, 1990*)

- |                    |  |
|--------------------|--|
| 1 Alluvial plain   | (A plain formed from the deposition of alluvium usually adjacent to a river that periodically overflows (aggraded valley plain, river plain, wash plain, waste plain))   |
| 2 Coastal plain    |  |
| 3 Lacustrine plain |  |
| 4 Glacial plain    |  |
| 5 Peneplain        | (Base-leveled plain) (Any land surface changed almost to a plain by subaerial erosion)   |
| 6 Pediment         | (A piedmont slope formed from a combination of processes which are mainly erosional; the surface is chiefly bare rock but may have a covering veneer of alluvium or gravel (conoplain, piedmont interstream flat)) |
| 7 Volcano          |  |
| 8 Dunefield        |  |
| 9 Delta            |  |
| 10 Tidal flat      | (A marshy, sandy, or muddy nearly horizontal coastal flatland which is alternately covered and exposed as the tide rises and falls)  |
| 11 Playa           | (A small, generally sandy land area at the mouth of a stream or along the shore of a bay)  |
| 12 Cay             | (A flat coral island)  |
| 13 Other           | (Specify in the appropriate Section's NOTES)   |

6.1.4 Land element and position

Description of the geomorphology of the immediate surroundings of the collecting site (Adapted from *FAO, 1990*). See Fig. 1

- |                |                          |   |
|----------------|--------------------------|---|
| 1 Plain level  | 12 Caldera               | 23 Beach  |
| 2 Escarpment   | 13 Open depression       | 24 Beachridge   |
| 3 Interfluv    | 14 Closed depression     | 25 Rounded summit   |
| 4 Valley       | 15 Dune                  | 26 Summit   |
| 5 Valley floor | 16 Longitudinal dune     | 27 Coral atoll  |
| 6 Channel      | 17 Interdunal depression | 28 Drainage line (bottom position in flat or almost flat terrain) |
| 7 Levee        | 18 Mangrove              | 29 Coral reef   |
| 8 Terrace      | 19 Upper slope           | 30 Other (specify in the appropriate Section's NOTES)             |
| 9 Floodplain   | 20 Mid slope             |   |
| 10 Lagoon      | 21 Lower slope           |   |
| 11 Pan         | 22 Ridge                 |   |

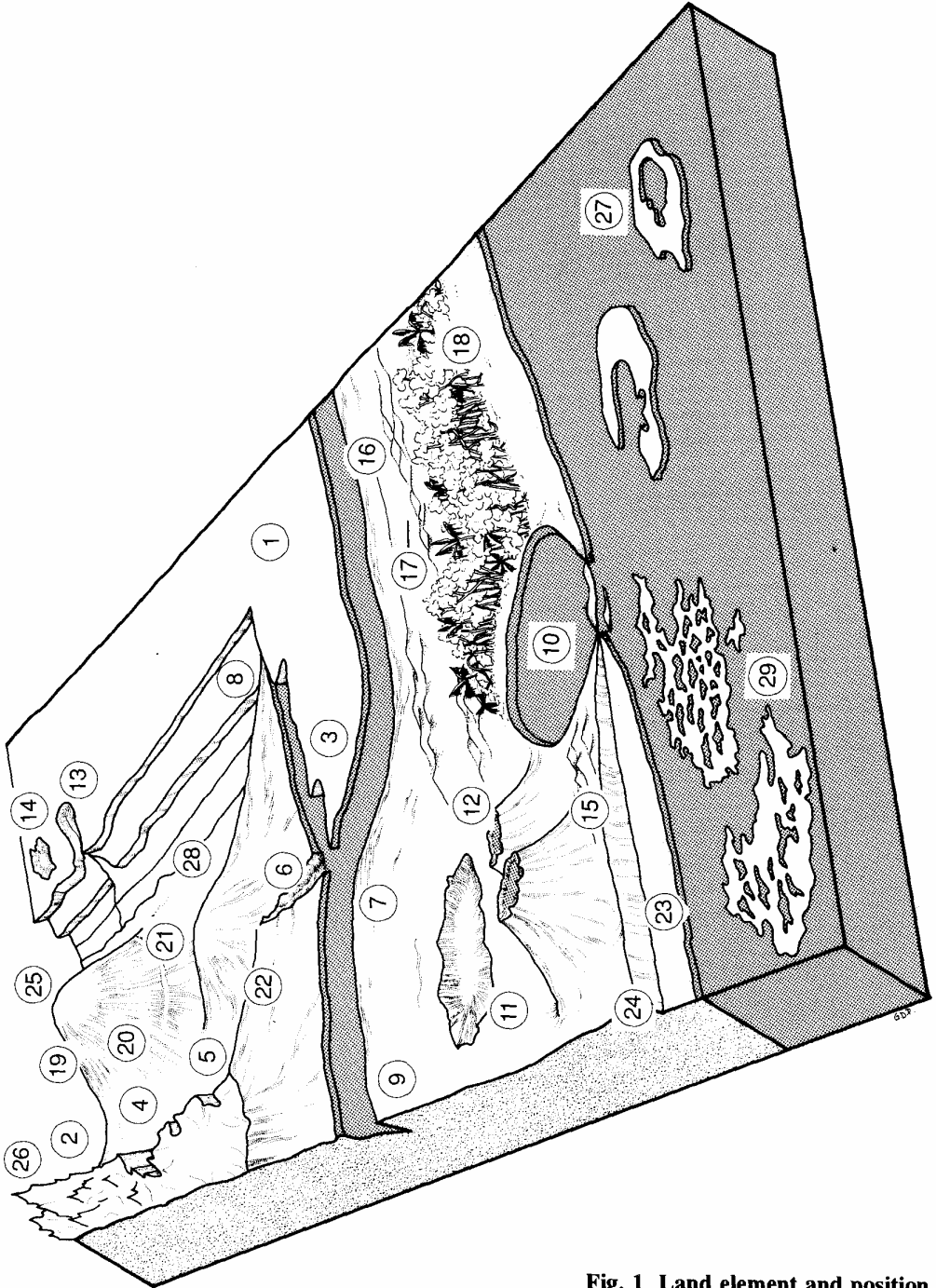


Fig. 1 Land element and position

6.1.5 Slope [°]

Estimated slope of the collecting site

6.1.6 Slope form

It refers to the general shape of the slope in both the vertical and horizontal directions (*FAO, 1990*)

- 1 Straight
- 2 Concave
- 3 Convex
- 4 Terraced
- 5 Complex (Irregular)

6.1.7 Slope aspect

The direction that the slope on which the accession was collected faces. Describe the direction with symbols N, S, E, W (e.g. a slope that faces a southwestern direction has an aspect of SW)

6.1.8 Crop agriculture (*FAO, 1990*)

6.1.8.1 Annual field cropping

- 1 Shifting cultivation
- 2 Fallow system cultivation
- 3 Ley system cultivation
- 4 Rainfed arable cultivation
- 5 Wet rice cultivation
- 6 Irrigated cultivation

6.1.8.2 Perennial field cropping

- 1 Non-irrigated cultivation
- 2 Irrigated cultivation

6.1.8.3 Tree and shrub cropping

- 1 Non-irrigated tree crop cultivation
- 2 Irrigated tree crop cultivation
- 3 Non-irrigated shrub crop cultivation
- 4 Irrigated shrub crop cultivation

6.1.9 Overall vegetation surrounding and at collecting site (FAO, 1990)

- |   |           |  |
|---|-----------|--|
| 1 | Grassland | (grasses, subordinate forbs, no woody species)   |
| 2 | Forbland  | (herbaceous plants predominant)  |
| 3 | Forest    | (continuous tree layer, crowns overlapping, large number of tree and shrub species in distinct layers) |
| 4 | Woodland  | (continuous tree layer, crowns usually not touching, understorey may be present)                       |
| 5 | Shrubland | (continuous layer of shrubs, crowns touching)  |
| 6 | Savanna   | (grasses with a discontinuous layer of trees or shrubs)  |

6.1.10 Soil parent material (Adapted from FAO, 1990)

Two lists of examples of parent material and rock are given below. The reliability of the geological information and the knowledge of the local lithology will determine whether a general or a specific definition of the parent material can be given. Saprolite is used if the *in situ* weathered material is thoroughly decomposed, clay-rich but still showing rock structure. Alluvial deposits and colluvium derived from a single rock type may be further specified by that rock type

6.1.10.1 Unconsolidated material

- 1 Aeolian deposits (unspecified)
- 2 Aeolian sand
- 3 Littoral deposits
- 4 Lagoonal deposits
- 5 Marine deposits
- 6 Lacustrine deposits
- 7 Fluvial deposits
- 8 Alluvial deposits
- 9 Unconsolidated (unspecified)
- 10 Volcanic ash
- 11 Loess
- 12 Pyroclastic deposits
- 13 Glacial deposits
- 14 Organic deposits
- 15 Colluvial deposits
- 16 *In situ* weathered
- 17 Saprolite

## 22 DESCRIPTORS FOR BARLEY

### 6.1.10.2 Rock type

- |    |                                    |    |                      |
|----|------------------------------------|----|----------------------|
| 1  | Acid igneous/<br>metamorphic rock  | 15 | Sedimentary rock     |
| 2  | Granite                            | 16 | Limestone            |
| 3  | Gneiss                             | 17 | Dolomite             |
| 4  | Granite/Gneiss                     | 18 | Sandstone            |
| 5  | Quartzite                          | 19 | Quartzitic sandstone |
| 6  | Schist                             | 20 | Shale                |
| 7  | Andesite                           | 21 | Marl                 |
| 8  | Diorite                            | 22 | Travertine           |
| 9  | Basic igneous/<br>metamorphic rock | 23 | Conglomerate         |
| 10 | Ultra basic rock                   | 24 | Siltstone            |
| 11 | Gabbro                             | 25 | Tuff                 |
| 12 | Basalt                             | 26 | Pyroclastic rock     |
| 13 | Dolerite                           | 27 | Evaporite            |
| 14 | Volcanic rock                      | 28 | Gypsum rock          |
|    |                                    | 29 | Not known            |

### 6.1.11 Stoniness/rockiness/hardpan/cementation

- 1 Tillage unaffected
- 2 Tillage affected
- 3 Tillage difficult
- 4 Tillage impossible
- 5 Essentially paved

### 6.1.12 Soil drainage (Adapted from *FAO, 1990*)

- 1 Very poorly drained
- 3 Poorly drained
- 5 Moderately drained
- 7 Well drained
- 9 Excessively drained

6.1.13 Flooding (*FAO, 1990*)

Flooding or temporary inundation is described according to its estimated frequency, duration and depth. Information may be obtained from records of past flooding or from local enquiry. The frequency and duration classes should give an indication of the average occurrence of inundation

6.1.14 Soil depth to groundwater table  
(Adapted from *FAO, 1990*)

The depth to the groundwater table, if present, as well as an estimate of the approximate annual fluctuation, should be given. The maximum rise of the groundwater table can be inferred approximately from changes in profile colour in many, but not all, soils

- |   |        |   |         |
|---|--------|---|---------|
| 1 | (0     | - | 25 cm)  |
| 2 | (25.1  | - | 50 cm)  |
| 3 | (50.1  | - | 100 cm) |
| 4 | (100.1 | - | 150 cm) |
| 5 | (>150  |   | cm)     |

6.1.15 Quality of the groundwater (*FAO, 1990*)

- 1 Saline
- 2 Brackish
- 3 Fresh
- 4 Polluted
- 5 Oxygenated
- 6 Stagnating

6.1.16 Soil salinity

- 1 (<160 ppm dissolved salts)
- 2 (161-240 ppm)
- 3 (241-480 ppm)
- 4 (>480 ppm)

6.1.17 Soil moisture (FAO, 1990)

Moisture conditions prevailing in the soil at the time of collecting should be given together with the depth. Attention should be paid to unusual moisture conditions caused by inseasonal weather, prolonged exposure of the profile, flooding, etc.

- 3 Dry
- 5 Slightly moist
- 7 Moist
- 9 Wet

6.1.18 Soil matrix colour (Adapted from FAO, 1990)

The colour of the soil matrix material in the root zone around the accession is recorded in the moist condition (or both dry and moist condition, if possible) using the notation for hue, value and chroma as given in the Munsell Soil Color Charts (Munsell, 1975). If there is no dominant soil matrix colour, the horizon is described as mottled and two or more colours are given and should be registered under uniform conditions. Early morning and late evening readings are not accurate. Provide depth of measurement [cm]. If colour chart is not available, the following categories may be used

- |                   |                    |
|-------------------|--------------------|
| 1 White           | 9 Yellow           |
| 2 Red             | 10 Reddish yellow  |
| 3 Reddish         | 11 Greenish, green |
| 4 Yellowish red   | 12 Grey            |
| 5 Brown           | 13 Greyish         |
| 6 Brownish        | 14 Blue            |
| 7 Reddish brown   | 15 Bluish-black    |
| 8 Yellowish brown | 16 Black           |

6.1.19 Soil pH

Actual value of the soil within the following root depths around the accession

- 6.1.19.1 pH at 10-15 cm
- 6.1.19.2 pH at 30-60 cm
- 6.1.19.3 pH at 60-90 cm

#### 6.1.20 Soil organic matter content

- 1 Nil (as on arid zones)
- 3 Low (as in long-term cultivation in a tropical setting)
- 5 Medium (as in recently cultivated but not yet much depleted)
- 7 High (as in never cultivated, and in recently cleared from forest)
- 9 Peaty

#### 6.1.21 Rock fragments

Large rock and mineral fragments (>2 mm) are described according to abundance (Adapted from *FAO, 1990*)

- |   |        |   |      |
|---|--------|---|------|
| 1 | (0     | - | 2%)  |
| 2 | (2.1   | - | 5%)  |
| 3 | (5.1   | - | 15%) |
| 4 | (15.1  | - | 40%) |
| 5 | (40.1  | - | 80%) |
| 6 | (>80%) |   |      |

#### 6.1.22 Soil texture classes (Adapted from *FAO, 1990*)

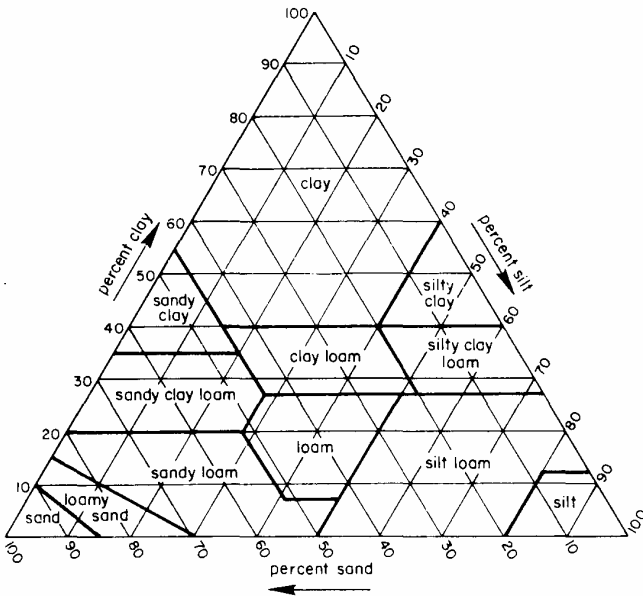
For convenience in determining the texture classes of the following list and the particle size classes are given for each of the fine earth fraction below.  
See Fig. 2

- |                    |                         |
|--------------------|-------------------------|
| 1 Clay             | 12 Coarse sandy loam    |
| 2 Loam             | 13 Loamy sand           |
| 3 Clay loam        | 14 Loamy very fine sand |
| 4 Silt             | 15 Loamy fine sand      |
| 5 Silty clay       | 16 Loamy coarse sand    |
| 6 Silty clay loam  | 17 Very fine sand       |
| 7 Silt loam        | 18 Fine sand            |
| 8 Sandy clay       | 19 Medium sand          |
| 9 Sandy clay loam  | 20 Coarse sand          |
| 10 Sandy loam      | 21 Sand, unsorted       |
| 11 Fine sandy loam | 22 Sand, unspecified    |



Soil particle size classes (Adapted from *FAO, 1990*)

1	Clay		<	2 $\mu\text{m}$
2	Fine silt	3	-	20 $\mu\text{m}$
3	Coarse silt	21	-	63 $\mu\text{m}$
4	Very fine sand	64	-	125 $\mu\text{m}$
5	Fine sand	126	-	200 $\mu\text{m}$
6	Medium sand	201	-	630 $\mu\text{m}$
7	Coarse sand	631	-	1250 $\mu\text{m}$
8	Very coarse sand	1251	-	2000 $\mu\text{m}$



**Fig. 2 Soil texture classes**

**6.1.23 Soil taxonomic classification**

As detailed a classification as possible should be given. This may be taken from a soil survey map. State class (e.g., Alfisols, Spodosols, Vertisols etc.)

6.1.24 Water availability

- 1 Rainfed
- 2 Irrigated
- 3 Flooded
- 4 River banks
- 5 Sea coast
- 6 Other (specify in the appropriate Section's NOTES)

6.1.25 Soil fertility

- 3 Low
- 5 Moderate
- 7 High

6.1.26 Climate of collecting site

Should be assessed as close to the collecting as possible

6.1.26.1 Temperature range [°C]

Provide either the diurnal (mean, maximum, minimum) or the seasonal (mean, maximum, minimum)

6.1.26.2 Rainfall range [mm]

Annual average (state number of recorded years)

6.1.26.3 Wind [km s<sup>-1</sup>]

Annual average (state number of years recorded)

6.1.26.3.1 Frequency of typhoons or hurricane force winds6.1.26.3.2 Date of most recent typhoons or hurricane force winds

(in the format DDMMYYYY)

6.1.26.3.3 Annual maximum wind velocity [km s<sup>-1</sup>]

## 28 DESCRIPTORS FOR BARLEY

### 6.1.26.4 Frost

6.1.26.4.1 Date of most recent frost  
(in the format DDMMYYYY)

6.1.26.4.2 Lowest temperature  
Specify seasonal average and minimum survived

6.1.26.4.3 Duration of temperature below freezing

### 6.1.26.5 Relative humidity

6.1.26.5.1 Relative humidity diurnal range [%]

6.1.26.5.2 Relative humidity seasonal range [%]

### 6.1.26.6 Light

3 Shady  
7 Sunny

6.1.27 Other (specify in the appropriate Section's NOTES)

## CHARACTERIZATION

### 7. PLANT DESCRIPTORS

#### 7.1 VEGETATIVE

##### \* 7.1.1 Growth class (seasonality) (4.1.1)

- 1 Winter
- 2 Facultative (intermediate)
- 3 Spring

##### 7.1.2 Growth habit

(Subject to environmental factors). See Fig. 3

- 3 Prostrate
- 5 Intermediate
- 7 Erect



Fig. 3 Growth habit

##### \* 7.1.3 Plant height [cm] (4.1.2)

At maturity, measured from the ground level to the top of spike excluding awns

\* 7.1.4 Stem pigmentation (immature)

- 1 Green
- 2 Purple (basal only)
- 3 Purple (half or more)

7.1.5 Auricle pigmentation

(Very subject to environmental factors)

- 1 Green
- 2 Pale purple
- 3 Purple
- 4 Dark purple

7.2 INFLORESCENCE AND FRUIT

7.2.1 Photoperiod sensitivity

- 1 Very low or no visible sign of sensitivity
- 3 Low sensitivity
- 5 Intermediate
- 7 High sensitivity

7.2.2 Days to flowering (4.2.1)

From sowing to when 50% of plants have started flowering. However, in dryland areas when planting in dry soils, it is counted from the first day of rainfall or irrigation, which is sufficient for germination. (Highly dependant on temperature-photoperiod interactions)

\* 7.2.3 Row number/lateral florets (4.2.2)

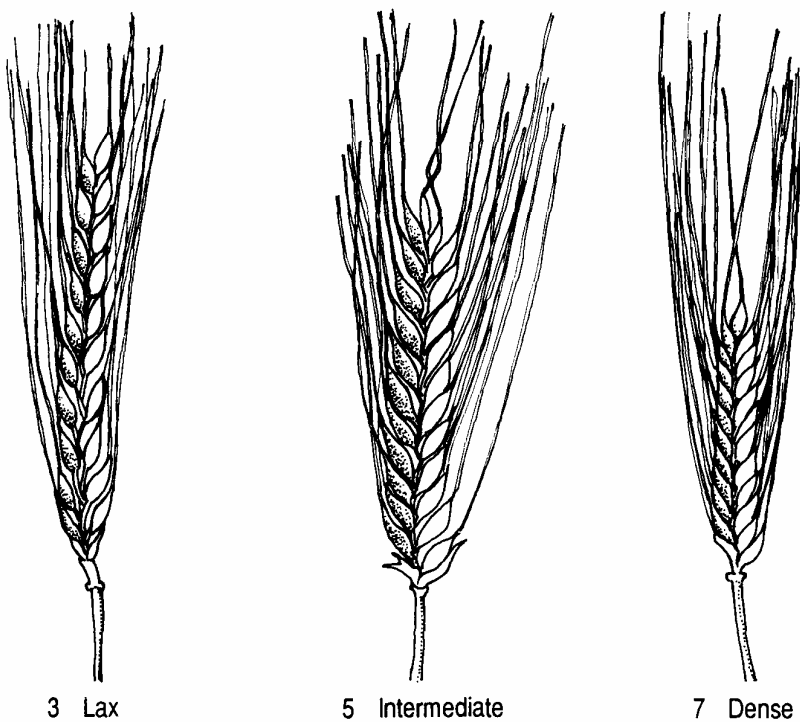
- 1 Two rowed, large or small sterile lateral florets
- 2 Two rowed, deficient
- 3 Irregular, variable lateral florets development
- 4 Six rowed, awnless or awnleted lateral florets
- 5 Six rowed, long awns on lateral florets
- 6 Other (specify in the NOTES descriptor, 7.4)

\* 7.2.4 Spike density

(4.2.3)

A subjective observation. See Fig. 4

- 3 Lax
- 5 Intermediate
- 7 Dense



**Fig. 4 Spike density**

7.2.5 Number of spikelet groups (triplets) per spike

(4.2.4)

An average of five typical spikes selected from a growing accession. (Trait subject to fertility and photoperiod factors)

\* 7.2.6 Lemma awn/hood

(4.2.5)

See Fig. 5

- 1 Awnless
- 2 Awnleted
- 3 Awned
- 4 Sessile hoods
- 5 Elevated hoods

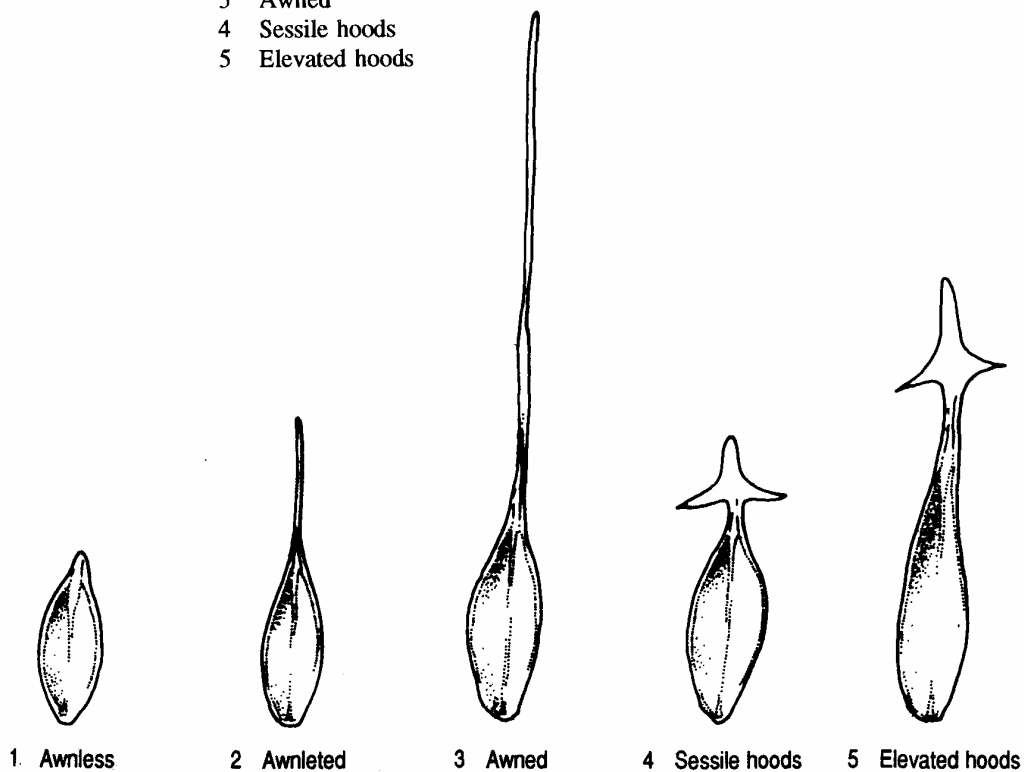


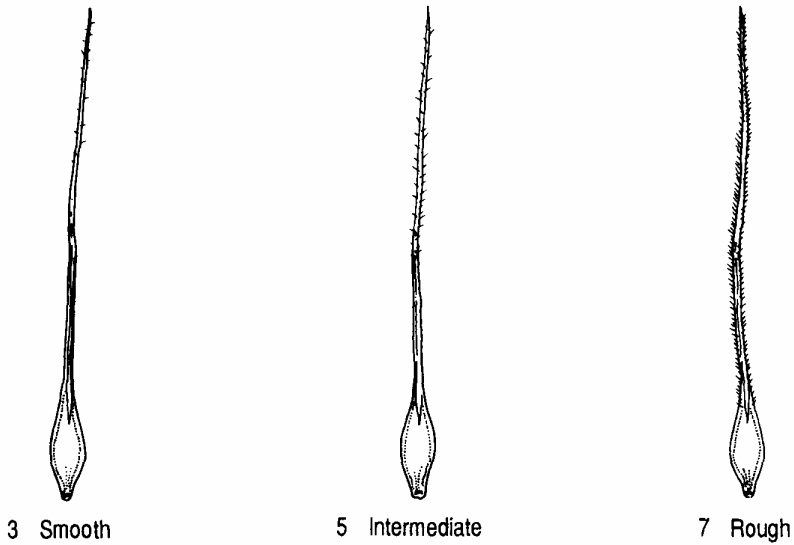
Fig. 5 Lemma awn/hood

\* 7.2.7 Lemma awn barbs

(4.2.6)

See Fig. 6

- 3 Smooth (few barbs at tip)
- 5 Intermediate (small barbs on upper half)
- 7 Rough



**Fig. 6 Lemma awn barbs**

**7.2.8 Glume and glume awn (outer glumes)**

See Fig. 7

- 1 Length of glume and awn shorter than kernel
- 2 Length of glume and awn as long as kernel
- 3 Glume plus awn longer than kernel
- 4 Glume plus awn nearly twice as long as kernel
- 5 Lemma-like
- 6 Other (specify in the descriptor NOTES, 7.4)

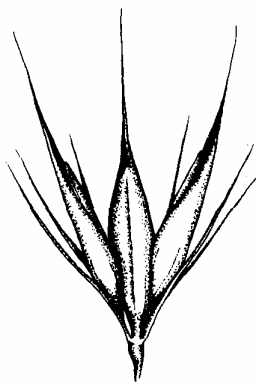
**\* 7.2.9 Glume colour**

- 1 White
- 2 Yellow
- 3 Brown
- 4 Black

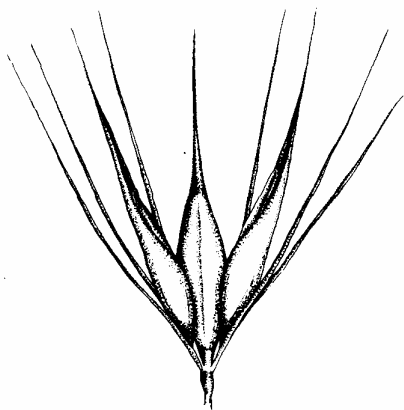




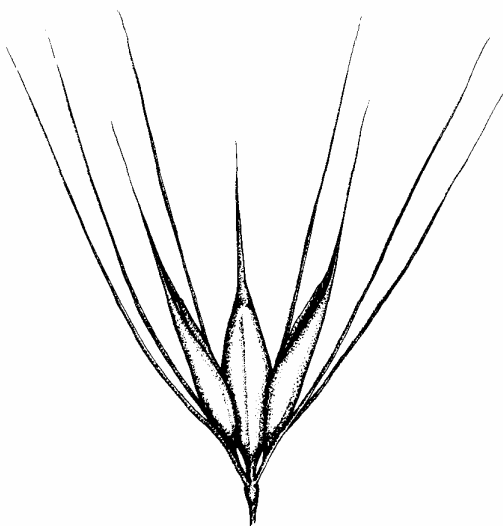
1 Length of glume and awn shorter than kernel



2 Length of glume and awn as long as kernel



3 Glume plus awn longer than kernel



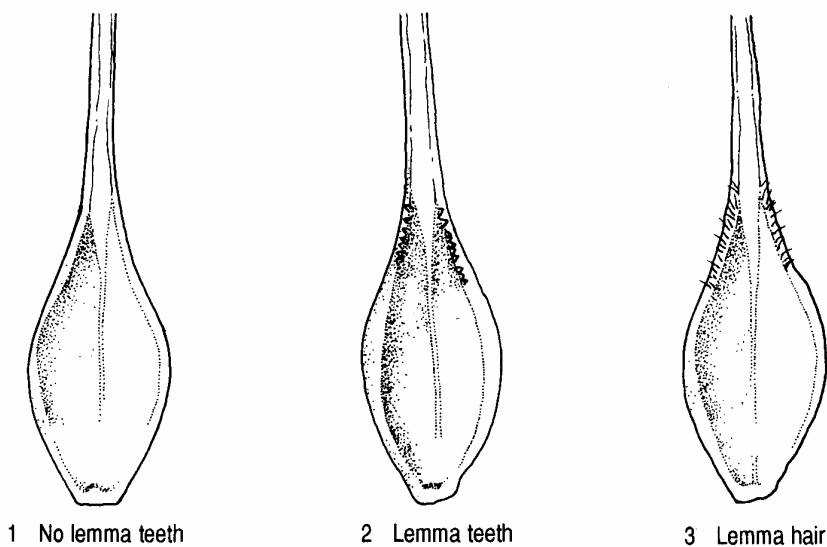
4 Glume plus awn nearly twice as long as kernel

**Fig. 7 Glume and glume awn**

7.2.10 Lemma type

See Fig. 8

- 1 No lemma teeth
- 2 Lemma teeth (barbs on lateral nerves)
- 3 Lemma hair



**Fig. 8 Lemma type**

**7.2.11 Awn colour**

Recorded on fresh seeds

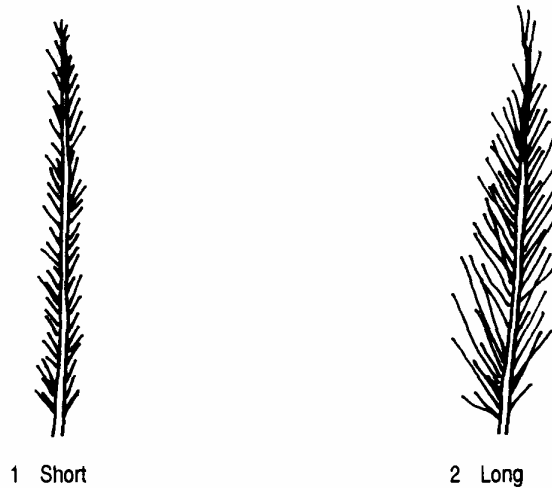
- 1 Amber/white
- 2 Yellow
- 3 Brown
- 4 Reddish
- 5 Black
- 6 Other (specify in the descriptor NOTES, 7.4)

**\* 7.2.12 Length of rachilla hairs**

(4.2.7)

See Fig. 9

- 1 Short
- 2 Long



**Fig. 9 Length of rachilla hairs**

7.3 SEED (Grain)

\* **7.3.1 Kernel covering** (4.3.1)

Whether or not the lemma and palea adhere to the caryopsis

- 1 Naked grain
- 2 Semi-covered grain
- 3 Covered grain

7.3.2 **Kernel plumpness** [%]

Percentage of kernels remaining on a 2.38 mm slotted screen

\* **7.3.3 Lemma colour** (4.3.2)

- 1 Amber (=normal)
- 2 Tan/red
- 3 Purple
- 4 Black/grey
- 5 Other (specify in the NOTES descriptor, 7.4)

7.3.4 Grain (pericarp) colour (4.3.3)

- 1 White
- 2 Tan/red
- 3 Purple
- 4 Black
- 5 Other (specify in the NOTES descriptor, 7.4)

\* 7.3.5 Aleurone colour

(Although this trait is difficult to observe, it is used for market type classification in several countries)

- 1 White
- 2 Blue

\* 7.3.6 1000-kernel weight [g] (6.3.1)

(Even though this trait is environment dependent, most growouts will occur in favorable environments). Converted from weighing a lot of 250 kernels or more

7.4 NOTES

Any additional information, especially in the category of 'other' under various descriptors above, may be specified here

## EVALUATION

### 8. PLANT DESCRIPTORS

#### 8.1 SEED (Grain)

##### 8.1.1 Protein content [%] (6.3.2)

Measured as percentage dry weight (seed moisture equal to or less than 12%).  
Indicating the conversion factors used as either N x 6.25 or N x 5.6

##### 8.1.2 Lysine/protein ratio [%] (6.3.3)

Percentage lysine per unit of protein (absolute)

##### \* 8.1.3 Specific gravity (Test Weight) [kg m<sup>-3</sup>]

Mass of harvested grain of a known volume

- 1 Light (<-1σ)
- 2 Medium (±1σ)
- 3 Heavy (>1σ)

### 9. ABIOTIC STRESS SUSCEPTIBILITY

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on a susceptibility scale from 1 to 9 viz.:

- 1 Very low or no visible sign of susceptibility
- 3 Low
- 5 Intermediate
- 7 High
- 9 Very high

#### 9.1 LOW TEMPERATURE (7.1)

Damage caused by cold to aerial parts of plants (not associated with death of plants in the winter)

##### 9.1.1 Reproductive susceptibility

Measured as reduction in seed set at low temperatures or after frost

- 9.2 HIGH TEMPERATURE (7.2)
- 9.3 DROUGHT (7.3)
- 9.4 HIGH SOIL MOISTURE (7.4)
- 9.5 WINTER KILL (7.5)
- Susceptibility to cold stress measured as a loss of plants in spring (as related to check)
- 9.6 SALINITY (7.6)
- 9.7 ACIDITY/ALUMINIUM TOXICITY (7.7)
- 9.8 LODGING
- 9.9 AWN RETENTION
- 9.10 SHATTERING PRIOR TO HARVEST
- 9.11 SPROUTING (7.8)

Tendency of grains to sprout in the ear before harvest as a result of late rainfall

## 10. BIOTIC STRESS SUSCEPTIBILITY

In each case, it is important to state the origin of the infestation or infection, i.e. natural, field inoculation, laboratory. Record such information in the NOTES descriptor, 10.5. Indicate the age of plant when damage is observed.

These are coded on a susceptibility scale from 1 to 9 viz.:

- 1 Very low or no visible sign of susceptibility
- 3 Low
- 5 Intermediate
- 7 High
- 9 Very high

### 10.1 INSECTS

Causal organism	Disease or common name
10.1.1 <u>Mayetiola destructor</u>	Hessian fly

Causal organism	Disease or common name
10.1.2 <u>Oulema melanopus</u>	Cereal leaf beetle
10.1.3 <u>Schizaphis graminum</u>	Greenbug
10.1.4 <u>Diuraphis noxia</u>	Russian wheat aphid
10.1.5 <u>Macrosiphum avenae</u>	English grain aphid
10.1.6 <u>Nematodes</u> (parasitic)	
10.2 FUNGI	
10.2.1 <u>Puccinia striiformis</u> f. sp. <u>hordei</u>	Yellow rust
10.2.2 <u>Puccinia graminis</u> f. sp. <u>tritici</u>	Black rust
* 10.2.3 <u>Puccinia hordei</u>	Brown rust, Dwarf leaf rust
10.2.4 <u>Erysiphe graminis</u> f. sp. <u>hordei</u>	Powdery mildew
10.2.5 <u>Rynchosporium secalis</u>	Scald
10.2.6 <u>Pyrenophora graminea</u>	Barley stripe
10.2.7 <u>Pyrenophora teres</u>	Net blotch
10.2.8 <u>Cochliobolus sativus</u>	Spot blotch
10.2.9 <u>Ustilago nuda</u>	Loose smut
10.2.10 <u>Ustilago hordei</u>	Covered smut
10.2.11 <u>Helminthosporium sativum</u> <u>Fusarium</u> spp.	Common root rot
10.2.12 <u>Fusarium graminearum</u>	Scab or head blight
10.2.13 <u>Septoria passerinii</u>	Septoria leaf blotch

Causal organism	Disease or common name
10.2.14 <u><i>Septoria avenae</i> f. sp. <i>triticea</i></u>	Speckled leaf blotch
10.2.15 <u><i>Septoria nodorum</i></u>	Glume blotch
10.3 BACTERIA	
10.3.1 <u><i>Xanthomonas campestris</i> pv. <i>translucens</i></u>	Bacterial leaf streak
10.3.2 <u><i>Pseudomonas syringae</i> pv. <i>syringae</i></u>	Bacterial kernel blight
10.4 VIRUS	
10.4.1 <u>Barley yellow dwarf virus</u> (BYDV)	
10.4.2 <u>Barley yellow mosaic virus</u> (BaYMV)	
10.4.3 <u>Barley stripe mosaic virus</u> (BSMV)	
10.4.4 <u>Barley mild mosaic virus</u> (BaMMV)	
10.5 NOTES	

Specify here any additional information or response to other biotic stresses

## 11. ALLOENZYME COMPOSITION AND ZYMOTYPE

### 11.1 BIOCHEMICAL MARKERS

#### 11.1.1 Isozyme

Gene symbols based on nomenclature recommended by the International Barley Genetic Symposium

#### 11.1.2 Other biochemical markers (specify)

### 11.2 MOLECULAR MARKERS

#### 11.2.1 Restriction fragment length polymorphism (RFLP)

#### 11.2.2 Random amplified polymorphic DNA (RAPD)



11.2.3 Specific amplicon polymorphism (SAP)

11.2.4 Other molecular markers (specify)

## 12. CYTOLOGICAL CHARACTERS AND IDENTIFIED GENES

### 12.1 GENETIC STOCK

12.1.1 Marker allele

Specific gene present following the system of nomenclature used in the *Barley Genetic Newsletter*

12.1.2 Mutant stock

Specific trait present based on nomenclature used in the *Barley Genetic Newsletter*

12.1.3 Near-isogenic line

12.1.4 Other (specific cytogenetic stocks in descriptor 12.4)

### 12.2 OTHER GENES PRESENT

Gene symbols of other morphological markers present

### 12.3 ANEUPLOID OR POLYPLOID STOCK

### 12.4 STRUCTURAL REARRANGEMENT

12.4.1 Translocation

12.4.2 Inversion

12.4.3 Duplication

12.4.4 Deletion

12.4.5 Other structural change (specify)

### 12.5 COMPOSITE CROSS

## REFERENCES

- FAO (1990). In: *Guidelines For Soil Profile Description*, 3rd Edition (Revised). Food and Agriculture Organization of the United Nations, International Soil Reference Information Centre. Land and Water Development Division. Rome, p.70
- Royal Horticultural Society, 1966, c. 1986. *R.H.S. colour chart*, [ed. 1, 2]. Royal Horticultural Society, London.
- van Hintum, Th. J.L. (1993). In: *A computer compatible system for scoring heterogeneous populations*. Genetic Resources and Crop Evolution **40**: 133-136.

## CONTRIBUTORS

### *Authors*

**Dr. J.D. Franckowiak**  
Professor  
North Dakota State University  
College of Agriculture  
Crop and Weed Sciences Department  
P.O. Box 5051  
Fargo, North Dakota 58105-5051  
USA

**Dr. T. Konishi**  
Professor  
Institute of Genetic Resources  
Faculty of Agriculture  
Kyushu University  
Fukuoka 812  
Japan

### *Reviewers*

**Dr. Roland von Bothmer**  
Dept. of Crop Genetics and Breeding  
The Swedish University of  
Agricultural Sciences  
S-268 00 Svalöv  
Sweden

**Dr. Richard J. Cross**  
NE Crop Germplasm Resource Center  
DSIR Crop Research  
Private Bag  
Christchurch  
New Zealand

**Dr. Andreas Hadjichristodoulou**  
Agricultural Research Institute  
P.O. Box 2016  
Nicosia  
Cyprus

**Dr. A.A. Jaradat**  
IPGRI WANA Group  
c/o ICARDA  
P.O. Box 5466  
Aleppo  
Syria

**Dr. J. Helms Jørgensen**  
Risø National Laboratory  
P.O. Box 49  
DK-4000 Roskilde  
Denmark

**Dr. Theo J.L. Van Hintum**  
Center for Genetic Resources  
of the Netherlands  
P.O. Box 224  
6700 AE Wageningen  
The Netherlands

**Dr. Michael C. MacKay**  
Australian Winter Cereals Collection  
RMB 944  
Tamworth NS 2340  
Australia

## ACKNOWLEDGEMENTS

IPGRI wishes to place on record their sincere thanks to the numerous barley workers around the world who have contributed to the development of the *Descriptors for barley* directly or indirectly.

Ms. Adriana Alercia prepared the text for publication. Illustrations were drawn by Mrs. Pina di Pilla. Mr. Paul Stapleton managed the production of the publication. Scientific direction was provided by Dr. Mark Perry.