

Descriptors for Tropical Forage Legume
Egyptian clover/Berseem
Trifolium alexandrinum L.

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Indian Grassland and Fodder Research Institute (IGFRI), Jhansi, a national Institute under the administrative control of Indian Council of Agricultural Research (ICAR), New Delhi is mandated to conduct basic, strategic, applied and adaptive research; development and training in forage production and its utilization.

The Institute has highly experienced and internationally trained human resources engaged in need-based, participatory and multi-disciplinary research. With more than 45 years of experience in forage research and development, IGFRI today stands as the premier R&D institution in south Asia for sustainable agriculture through quality forage production for improved animal productivity.

Since its establishment in 1962, it has been instrumental in fostering research, training and extension programmes on all aspects of forage production and utilization through inter-disciplinary approach. It has three Regional stations to cater to forage related location specific R&D needs of humid tropics (at Dharwad, Karnataka), semi-arid and arid (at Avikanagar, Rajasthan) and temperate at Srinagar (J&K)/ Palampur (Himachal Pradesh) ecosystems.

Forage plant genetic resources is one of the core areas of research at IGFRI, Jhansi. IGFRI is maintaining more than 5500 forage germplasm in its medium term conservation module (MTS) and most of them are also kept in National Gene Bank at National Bureau of Plant Genetic Resources (NBPGR), New Delhi. IGFRI is one of the largest forage germplasm holders at the national and international level. The cultivated tropical forage legumes occupy a significant place in IGFRI research and it holds more than 1000 accessions in various forage legumes which include *Trifolium alexandrinum* (*berseem*), *T. resupinatum* (*Shaftal*), *Trifolium species* (clovers), *Vigna unguiculata* (Cowpea), *Stylosanthes* sp (Stylos), *Desmanthus* sp., *Indigofera* sp., *Lablab purpureus* (*Dolichos*), etc.

IGFRI has so far published a series of evaluation catalogues in different forage crops namely, Cowpea (*Vigna unguiculata*), Maize (*Zea mays*), Stylos (*Stylosanthes* sp.), Siratro (*Macroptelium atropurpureum*), Oats (*Avena sativa*), *Berseem* (*Trifolium alexandrinum*), Teosinte (*Zea diploperennis*), etc.

Being the national institute on forage crops, IGFRI envisaged publishing descriptors in forage crops especially the tropical perennial/ annual forage crops in which IPGRI/ Biodiversity international (formerly IPGRI/IBPGR) has so far not paid desired attention. This descriptor list is the first in the series of cultivated forage legume, which will be immensely useful to the forage workers through out the world.

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Preface

Descriptors for Egyptian clover (*Berseem*) is the first descriptor list on this very important tropical forage legume cultivated in India, Pakistan, Turkey, Egypt and other Mediterranean countries. Despite being a very important fodder crop especially in Indian sub-continent and Egypt, no descriptor list has been developed by any agency. Although IPGRI descriptor is available on white clover (*Trifolium repens*), because of many distinctive features it cannot be applied as such to Berseem or Egyptian clover.

IGFRI, Jhansi is holding approximately 600 accessions of Egyptian clover (*Trifolium alexandrinum*) which have been evaluated through morphological, nutritive parameters, isozyme banding pattern, molecular markers. For this crop, we have also developed 'DUS testing guidelines' Berseem as well as 'breeder and nucleus seed production manual'.

This descriptor list is largely based on IBPGR/IPGRI/ Biodiversity International catalogue on forage legume, white clover (*Trifolium repens*) with modifications to suit to this crop. The descriptor list was developed based on the rich experience of IGFRI, Jhansi in forage genetic resource collection, evaluation, conservation and documentation.

Four types of descriptors have been considered important – Passport, Management, Environment and site, and characterization/ evaluation. The number of descriptors selected may vary based on individual experience and local needs/ capacity.

An attempt has been made to provide the descriptor list in an international format as adopted by Biodiversity International which is the leading organization in providing a universally accepted 'language' for plant genetic resources data. The adoption of this scheme for data encoding, will produce a rapid, reliable, and efficient means for information storage, retrieval and communication, and will assist with the use of germplasm. It is therefore recommended that information should be produced by closely following the descriptor list with regard to ordering and numbering the descriptors, using the descriptors specified and using the descriptor states recommended.

This descriptor list is intended to be comprehensive for the descriptors that it contains. This approach assists with the standardization of descriptor definitions. However, it is assumed that curators/scientists will be able to characterize accessions of their collections using all descriptors given. Descriptors should be used when they are useful to curators for the management and maintenance of the collection and/or to the users of plant genetic resources. However, highly discriminating descriptors are highlighted in the text to facilitate the selection of descriptors and are listed in Annex I.

Any suggestions for further improvement on the 'Descriptors for Egyptian clover (*Berseem*)' will be highly appreciated.

Authors

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We are highly thankful to IBPGR/IPGRI/Biodiversity International whose descriptors on various crops especially on white clover, *Medicago*, forage legumes have formed the backbone of this descriptor.

We are also thankful to our learned and experienced reviewers Dr. Bhag Mal, Dr. J.L. Kariahloo and Dr. S.N.Zadoo in the field of forage crops and plant genetic resources who have contributed significantly in the improvement, editing of this document with their constructive suggestions and views.

We are also thankful to the forage workers in the country and abroad, whose experience and interactions have helped in crystallizing the ideas of developing descriptors.

Introduction

The genus *Trifolium* commonly called clovers comprises 237 annual and perennial species out of which 25 are agriculturally important as cultivated and pasture crops. The genus has wide range of variability for habit (annual, biennial and perennial), habitat (tropical, subtropical and temperate) and tolerance to biotic and abiotic stresses. The important perennial pasture clover *T. repens* (white clover), *T. hybridum* (alsike clover), *T. pratense* (red clover) and *T. ambiguum* (caucasian clover) are widely distributed in the temperate and sub temperate regions of the world while the annual types such as *T. resupinatum* (Persian clover), *T. subterraneum* (subterranean clover) and *T. alexandrinum* (Egyptian clover or *berseem*) are commonly cultivated as winter annuals in the tropical and subtropical regions. *T. alexandrinum* or Egyptian clover, popularly known as *berseem* (name derived from Arabic name 'Bersym' or 'Berzum') is believed to be indigenous to Egypt. Based on the branching behaviour and regeneration potential, three ecotypes of *berseem* i.e., Mescavi, Fahli and Saidi are reported from Egypt.

Egyptian clover (*Trifolium alexandrinum*) is one of the most important winter forage legumes in India, Pakistan, Turkey, Egypt and countries of Mediterranean region. The crop is reported to be highly self-incompatible in its place of origin but in India it is believed to be self fertile. However, in a recent report, the crop has shown wide diversity for self fertility and population with self compatible and self pollinating, self compatible requiring tripping, Self incompatible types with broad genetic base and self incompatible types with narrow genetic base. In India, it occupies 2 m ha. The merit of the crop lies in its multicut nature (4–6 cuts), long duration of green fodder availability (November to April), high green fodder yield (85 t/ha), good forage quality (20% crude protein), and digestibility (up to 65%) and high palatability.

The significance of this forage species lies in the development of milk industry. It is a potent milk producer in the lactating buffaloes, Sahiwal cows and cross bred cattle's as compared to other forage crops alone or in combination. Of the two Egyptian biotypes of Berseem 'Mescavi and Fahli' introduced in India during 1903, the former proved to be highly adaptable and productive as fodder crop for large scale cultivation. Most of the present day cultivars are derivatives of Mescavi. The phenomenal success of *berseem* in India is also due to its high nitrogen fixing ability resulting in substantial improvement in soil fertility.

Important varieties developed in India are Mescavi, Wardan, BL-1, BL-10, BL-22, JB-2, BL-2, UPB-110, Bundel Berseem -2 (JHB 146), Bundel Berseem -3 (JHTB 96-4), HFB 478 etc.

Definitions and Use of the Descriptors

Passport descriptors

These provide the basic parameters that should be observed when the accession is originally collected. The information can be used for the general management of the accession (including registration at the genebank and other identification information)

Management descriptors

These provide the basis for the management of accessions in the gene bank and assist with the multiplication and regeneration.

Environment and site descriptors

These describe the environmental and site-specific parameters that are important for characterization and evaluation trials. Site descriptors for germplasm collections are also included here.

Characterization/Evaluation descriptors

These enable an easy and quick discrimination between phenotypes. Some of them are generally highly heritable, can be easily seen by the eye and are equally expressed in all environments. However, the expression of many of the descriptors depends on the environment; consequently, special experimental designs and techniques are needed to assess them. Their assessment may also require complex biochemical or molecular characterization methods. These types of descriptors include characters such as yield, agronomic performance, stress susceptibilities and biochemical and cytological traits. They are generally the important traits in crop improvement. However, additionally, some other traits may be used which are thought desirable by users of the particular crop.

General Guidelines for evaluation

Following internationally accepted norms for the scoring, coding and recording of descriptor states should be followed:

- (a) The Système International d'Unités (SI) is used;
- (b) The units to be applied are given in square brackets following the descriptor name;
- (c) Standard colour charts, e.g. Royal Horticultural Society Colour Chart is strongly recommended for all colour characters (the precise chart used should be specified in the section where it is used);

- (e) Quantitative characters, i.e. those that are continuously variable, should preferably be measured quantitatively. Alternatively, in cases where it is difficult to measure quantitatively, it is acceptable to score instead on a 1–5 scale, where
1. Very low
 2. Low
 3. Medium
 4. High
 5. Very high
- (f) Absence/presence of characters can be scored as
- 0 Absent
 - 1 Present
- (g) Stages: this refers to the stage of development when the descriptor is recorded.
- (h) Dates should be expressed numerically in the format DD-MM-YYYY, where DD 2 digits to represent the day MM 2 digits to represent the month YYYY 4 digits to represent the year
- (i) Leaf descriptors: unless otherwise specified, all descriptors for leaves and their components (leaflets, petiole, sheath, margin and blade) are recorded on the third leaf from top.

Passport Descriptors

1. Accession descriptors

- 1.1 Institute code or Institute name** - Name of the institute, place and country should be given. Alternatively, Code of the institute (as per FAO website http://apps3.fao.org/views/institute_query.htm?i_I=EN) may also be mentioned where the accession is maintained.
 - 1.1.1 Site where maintained** - Name of institution in which collection is maintained.
- 1.2 Accession number** - The number provided by National Bureau of Plant Genetic Resources, New Delhi should be given. For indigenous collections, IC number and for exotic collections, EC number should be provided.
- 1.3 Donor name** - Name of institution or individual responsible for donating the germplasm.
- 1.4 Donor accession number** - Number assigned to an accession by the donor.
- 1.5 Other identification number(s) associated with the accession** - Any other identification (numbers) known to exist in other collections for this accession.
- 1.6 Scientific name**
 - 1.6.1 Genus** - Genus name for taxon. Initial uppercase letter required.
 - 1.6.2 Species** - Specific epithet portion of the scientific name in lowercase letters. The abbreviation 'sp.' is used if the species is unknown.
 - 1.6.2.1 Species authority** - Provide the authority for the species name.
 - 1.6.3 Subtaxa** - Subtaxa can be used to store any additional taxonomic identifier.
 - 1.6.3.1 Rank name** - The rank of the subtaxon name. Use the following abbreviations: 'subsp.' (for subspecies); 'convar.' (for convariety); 'var.' (for botanical variety); 'f.' (for form).
 - 1.6.3.2 Subtaxon name** - The infraspecific epithet of the scientific name
 - 1.6.3.3 Subtaxon authority** - Provide the subtaxon authority at the most detailed taxonomic level.
- 1.7 Common crop name** - Name of the crop in colloquial language.
 - 1.7.1 Genetic origin** - Genetic origin of the accession
 - 1.7.2 Accession name** - Registered or any other name given to the accession.
- 1.8 Acquisition date [DD-MM-YYYY]** - Date on which the accession entered the gene bank collection
- 1.9 Notes** - Any other information on the particular accession

Collection Descriptors

2. Collecting descriptors

- 2.1 Collecting institute code and name** - Name of the institute, code, place and country should be given. If the holding institute has collected the material, the collecting institute name should be the same as holding institute code.

- 2.2 Collecting number** - Original number assigned by the collector(s) of the sample. It will help in identifying duplicates held in different collections.
- 2.3 Collecting date of original sample** [DD-MM-YYYY] - Collecting date of sample, where DD is the date, MM is the month and YYYY is the year.
- 2.4 Country of origin** – Name of the country in which the sample was collected.
- 2.5 State** - Name of the primary administrative subdivision of the country in which the sample was collected.
- 2.6 District** - Name of the secondary administrative subdivision (within a province/state) of the country in which the sample was collected.
- 2.7 Village / city / place** - Location of collecting site - Location that describes where the accession was collected.
- 2.8 Latitude of collecting site** - Degrees, minutes and seconds followed by N or S.
- 2.9 Longitude of collecting site** - Degrees, minutes and seconds followed by E or W.
- 2.10 Elevation of collecting site** - Altitude of the collecting place in meter above sea level.
- 2.11 Collecting source**
- 1 Wild habitat - Forest, Grassland, wastelands/ degraded lands
 - 2 Farm or cultivated habitat – cultivated Field, Orchard, Garden, Fallow land, Pasture, threshing yard
 - 3 Market - Town, Village, Urban area (around city), other exchange system
 - 4 Institute/research organization
 - 99 Other – specify in descriptor 2.22 collector’s note
- 2.12 Breeding institute name and code** - Institute code or name of the institute that has bred the material.
- 2.13 Type of sample** - Type of sample collected
- 1 Seed
 - 2 Vegetative samples (seedlings, *etc*)
 - 99 Other – specify in descriptor 2.22 collector’s note
- 2.14 Biological status of accession**
- 1 Wild
 - 2 Weedy
 - 3 Landrace
 - 4 Breeding line/research material (advance breeding line, mutant/genetic stock)
 - 5 Advanced/improved cultivar
 - 6 Released varieties
 - 99 Other – specify in descriptor 2.22 collector’s note
- 2.15 Local/vernacular name** – Name given by the farmer to the crop and cultivar/landrace/wild form
- 2.16 Use of samples collected** –
- 1 Food
 - 2 Forage
 - 3 Medicinal
 - 4 Religious
 - 99 Other – specify in descriptor 2.22 collector’s note

2.17 Plant population density - Visual assessment of plants in the area

- 1 Rare - Few individual plants only
- 2 Occasional (1-5 % cover)
- 3 Frequent (5-25% cover)
- 4 Abundant (25% cover)

2.18 Associated soil and *Rhizobium* – Collected or not

- 1 Collected
- 2 Not collected

2.19 Cropping system

- 1 Mono culture
- 2 Mixed with other crops
- 3 Intercropping pattern

2.20 Special characteristics – if any

2.21 Prevailing stresses - Information on main associated biotic (pests and diseases) and abiotic (drought) stresses at the time of collection.

2.22 Collector's notes - Additional information recorded by the collector or any specific information on any state in any of the above descriptors.

Management Descriptors

3. Management descriptors

3.1 Accession number

3.2 Population identification - Collecting number, pedigree, cultivar name etc. depending on population type

3.3 Seed storage location identifier - (Building, room, shelf number/location in medium and / or long term storage)

3.4 Storage date (DD-MM-YYYY)

3.5 Seed germination at storage - Initial (%)

3.6 Date of last seed germination test (DD-MM-YYYY)

3.7 Seed germination at last test [%]

3.8 Date of next seed germination test (DD-MM-YYYY) – Estimated date when the accession should next be tested.

3.9 Seed moisture content at harvest [%]

3.10 Seed moisture content at storage – initial [%]

3.11 Type of stored plant material

- 1 Seed
- 2 Vegetative
- 3 Tissue
- 4 Pollen
- 99 Other - specify in descriptor 3.16 notes

3.12 Amount of seed in storage [g or number]

3.13 Duplication at other location(s)

3.14 *In vitro* conservation

3.15 Cryopreservation

3.16 Notes – Any additional information may be specified here.

Multiplication/Regeneration Descriptors

4. Multiplication/regeneration descriptors

4.1 Accession number

4.2 Population identification

4.3 Field plot number

4.4 Multiplication/regeneration site locations

4.5 Collaborator

4.6 Propagation method

- 1 Seed
- 2 Cutting
- 3 Tissue culture
- 99 Others (specify in descriptor 4.13 notes)

4.7 Sowing/planting date (DD-MM-YYYY)

4.8 Cultural practices

4.8.1 Distance between plants [cm]

4.8.2 Distance between rows [cm]

4.8.3 Irrigation – specify amount, frequency and method used.

4.8.4 Fertilizer application – specify type, dose, frequency and method of application

4.9 Plant/seedling vigour – Assess 45 days after emergence

- 3 Low
- 5 Medium
- 7 High

4.10 Number of plants established

4.11 Previous multiplication/regeneration

4.11.1 Location

4.11.2 Sowing /planting date [DD-MM-YYYY]

4.11.3 Plot number

4.12 Number of times accession regenerated

4.13 Notes

Environment and Site Descriptors

5. Characterization and/or evaluation site and site environment descriptors

5.1 Country of characterization and/or evaluation

5.2 Site (research institute)

5.2.1 Latitude

- 5.2.2 **Longitude**
- 5.2.3 **Elevation [m asl]**
- 5.2.4 **Name and address of farm or institute/station/centre**
- 5.3 **Sowing date [DD-MM-YYYY]**
- 5.4 **Harvest date [DD-MM-YYYY]**
- 5.5 **Evaluator's name and address**
- 5.6 **Evaluation environment** - Environment in which characterization/evaluation /screening was carried out
 - 1 Field (F)
 - 2 Nursery or greenhouse (N)
 - 3 Laboratory (L)
 - 4 Phytotron (P)
 - 99 Other (specify in descriptor 5.12 notes)
- 5.7 **Field spacing**
 - 5.7.1 **Distance between plants in a row [cm]**
 - 5.7.2 **Distance between rows [cm]**
- 5.8 **Seed germination [%]**
- 5.9 **Fertilizer** – Specify fertilizer used, doses, frequency and method of application
- 5.10 **Plant protection** – Specify pesticide used, doses, frequency and method of application
- 5.11 **Site environment**
 - 5.11.1 **Topography**
 - 1 Flat
 - 2 Gently undulating
 - 3 Undulating
 - 4 Hilly
 - 5 Mountainous
 - 99 Other (specify in descriptor 5.12 notes)
 - 5.11.2 **Land element and position-** Description of the geomorphology of the immediate surroundings of the site –
 - 1 Plain level
 - 2 Upper slope
 - 3 Mid slope
 - 4 Lower slope
 - 5 Valley
 - 6 Valley floor
 - 7 Ridge
 - 8 Mangrove
 - 9 Terrace
 - 10 Floodplain
 - 11 Rounded summit
 - 12 Summit
 - 99 Other (specify in descriptor 5.12 notes)
 - 5.11.3 **Slope [°]** - Estimated slope of the collecting site
 - 5.11.4 **Ecological zone** – Forest, transition zone, alpine, arid, semi-arid, tropical, temperate, desert, semi-desert etc.

- 5.11.5 Soil drainage** – Poor, Moderate, Good, Excessive etc.
 - 5.11.6 Soil salinity** – Indicate the EC level of the soil.
 - 5.11.7 Soil pH** - Actual pH value of the soil.
 - 5.11.8 Root depth [cm]** - Indicate the root depth at which the soil pH is being measured.
 - 5.11.9 Soil texture classes**
 - 1 Sand
 - 2 Loam
 - 3 Clay
 - 4 Silt
 - 5 Clay loam
 - 6 Sandy loam
 - 7 Sandy clay
 - 8 Silt clay
 - 99 Others (specify in descriptor 5.12 notes)
 - 5.11.10 Soil taxonomic classification** - Indicate class (*e.g.* Alfisols, Spodosols, Vertisols, *etc.*).
 - 5.11.11 Climate of the site**- Should be assessed as close to the site as possible.
 - 5.11.11.1 Temperature [°C]** - Provide either the monthly or the annual mean.
 - 5.11.11.2 Rainfall [mm]** - Provide either the monthly or the annual mean.
 - 5.11.12 Relative humidity**
 - 5.11.12.1 Indicate diurnal range [%]**
 - 5.11.12.2 Indicate seasonal range [%]**
- 5.12 Notes** - Specify any additional information.

Characterization and Evaluation Descriptors

- 6. Plant descriptors** – For all quantitative descriptors (metric traits), record the average of at least ten plants measurements per accession. Most of the observations should be made at the maximum growth stage (50% flowering) unless otherwise specified.
 - 6.1 Growth characters**
 - 6.1.1 Population uniformity** – Homogeneous, Heterogeneous (specify)
 - 6.1.2 Life cycle**
 - 1 Annual
 - 2 Biennial
 - 3 Perennial
 - 4 Others (please specify)
 - 6.1.3 Hypocotyl: anthocyanin colouration** - Observed in 20-25 days-old seedlings
 - 0 Absent
 - 1 Very weak
 - 3 Weak
 - 5 Medium
 - 7 Strong

6.1.4 Seedling vigour height [cm] – Observed in 20-25 days old seedlings. The seedlings can be characterized as follows:

- 1 Poor
- 2 Medium
- 3 Vigorous

6.1.5 Growth habit - Record at 50% flowering stage [Fig. 1]

- 1 Erect
- 2 Semi-erect
- 3 Spreading
- 4 Procumbent
- 99 Other (specify in descriptors notes)

6.2 Stem characters

6.2.1 Plant height [cm] - Measured from ground level to the base of the peduncle on five representative plants.

6.2.2 Stem thickness [mm] - Measured at the third internode from the base of the main stem, record average of five representative plants.

6.2.3 Internode length [cm] – Measured between third and fourth internode from top.

6.2.4 Stem colour - Colour observed on the stem.

- 1 Yellow
- 2 Green
- 3 Purple
- 4 Light purple
- 5 Purple lines

6.2.5 Stem node colour –Colour of the outer surface of the nodes.

- 1 Light green
- 2 Green
- 3 Purple
- 4 Others (specify)

6.3 Leaf characters

6.3.1 Leaflet shape

- 1 Round
- 2 Oval
- 3 Obovate
- 4 Cordate
- 5 Lancelolate

6.3.2 Leaflet apex shape

- 1 Truncate
- 2 Rounded
- 3 Acute

6.3.3 Leaflet margin

- 1 Entire
- 2 Fairly serrate
- 3 Distinctly serrate

- 6.3.4 Leaflet: anthocyanin colouration**
- 0 Absent
 - 1 On tips only
 - 2 On margins only
 - 3 In blotches
 - 4 Even (uniform purple)
- 6.3.5 Leaflet surface colour**
- 1 Light green
 - 2 Medium green
 - 3 Dark green
- 6.3.6 Leaflet pubescence** - Assess both visually and by touch, rubbing fingers over the leaflet surface from the tip downwards.
- 1 Glabrous (smooth)
 - 2 Scanty hairiness glabrous
 - 3 Medium hairy
 - 4 Dense hairy
- 6.3.7 Leaflet margin pubescence** - Assess pubescence of leaf margins.
- 1 Glabrous (no hairs)
 - 2 Hairy or ciliated
- 6.3.8 Leaflet length [cm]** - Measure the length of middle leaflet of third leaf from top on the main branch on ten representative plants.
- 6.3.9 Leaflet width [cm]** - Measure at the widest portion of middle leaflet of third leaf from top on the main branch on ten representative plants.
- 6.3.10 Stipule length [mm]** - Measured on the third leaf from top on the main branch.
- 6.3.11 Stipule margin hairiness** [Fig. 2]
- 0 Absent
 - 1 Present
- 6.3.12 Stipule pubescence** - Visual assessment using hand lens [Fig. 3]
- 1 Glabrous
 - 2 Partially hirsute: hairs covering less than 50% of the stipule
 - 3 Mostly hirsute: hairs covering more than 50% of the stipule
- 6.3.13 Stipule colour**
- 1 Whitish
 - 2 Yellowish green
 - 3 Green
 - 4 Green with purplish tinge
- 6.3.14 Petiole length [cm]** - Measure length of petiole of third leaf from top on the main branch on ten representative plants.
- 6.3.15 Petiole hairiness**
- 0 Glabrous
 - 1 Lax
 - 2 Medium
 - 3 Dense

6.3.16 Petiole colour

- 1 Green
- 2 Dark green
- 3 Purple
- 4 Green with purplish tinge
- 99 Others (specify)

6.4 Inflorescence characters

6.4.1 Number of days to flowering initiation – Days taken to flowering initiation from date of seeding.

6.4.2 Date of flowering initiation – [DD-MM-YYYY] – Date of flowering initiation.

6.4.3 Number of days to 50% flowering – Days taken to flowering in 50% population (branches of all plants).

6.4.4 Date of 50% flowering – [DD-MM-YYYY] Date on which 50% populations are in flowering.

6.4.5 Number of days to maturity – Number of days taken from seeding to maturity.

6.4.6 Petal colour of florets

- 1 White
- 2 Light Pink
- 3 Pink
- 4 Red
- 99 Others specify

6.4.7 Peduncle length [cm] – Measure length of peduncle on ten representative well developed heads

6.4.8 Peduncle hairiness [Fig. 4]

- 0 Glabrous
- 1 Lax
- 2 Medium
- 3 Dense

6.4.9 Peduncle pigmentation

- 0 No pigmentation
- 1 Light purple pigmentation
- 2 Medium purple pigmentation
- 3 High purple pigmentation

6.4.10 Number of flowers/ head – Count the number of flowers in ten well developed heads.

6.4.11 Head diameter [cm] - Measure the diameter at widest parts in ten well developed heads.

6.4.12 Head length [cm] - Length of head measured from the base to the tip in ten well developed heads.

6.4.13 Head apex shape

- 1 Round
- 2 Conical
- 3 Tapering
- 4 Elongated
- 99 Others (specify)

6.4.14 Number of whorls per inflorescence – Count the number of flower whorls in the main head on ten representative plants.

6.4.15 Inflorescence number per plant - Record the number of inflorescence per plant on ten representative plants.

6.5 Seed characters

6.5.1 Number of seeds per inflorescence – Count seeds from ten inflorescences

6.5.2 Seed yield per plant – All seeds from individual plant be weighed

6.5.3 Seed length [mm]

6.5.4 Seed width [mm]

6.5.5 Seed shape

- 1 Round
- 2 Elliptical
- 3 Spindle-shaped
- 99 Others (specify)

6.5.6 Seed colour

- 1 Yellow
- 2 Light brown
- 3 Brown
- 4 Variable purple
- 5 Purple
- 99 Others (specify)

6.5.7 1000 seed weight (g) – Record weight of 1000 seed after removing all the appendages after harvest and dried to 10% moisture level.

6.6 Forage characters

6.6.1 Herbage yield (g/plant) – harvesting of plants to be done from 10 cm above ground level

6.6.1.1 First cut green herbage yield (g/plant) - Green herbage yield recorded after 45 days of crop growth.

6.6.1.2 Second cut green herbage yield (g/plant) - Green herbage yield recorded after 30 days of first regrowth.

6.6.1.3 Third cut green herbage yield (g/plant) - Green herbage yield recorded after 30 days of second regrowth.

6.6.1.4 Fourth cut green herbage yield (g/plant) - Green herbage yield recorded after 30 days of third regrowth.

6.6.1.5 Fifth cut green herbage yield (g/plant) - Green herbage yield recorded at 50% flowering stage.

6.6.1.6 First cut dry herbage yield (g/plant) - Green herbage yield from first cut dried in oven at 60oC till constant weight.

6.6.1.7 Second cut dry herbage yield (g/plant) - Green herbage yield from second cut dried in oven at 60oC till constant weight.

6.6.1.8 Third cut dry herbage yield (g/plant) - Green herbage yield from third cut dried in oven at 60oC till constant weight.

6.6.1.9 Fourth cut dry herbage yield (g/plant) - Green herbage yield from fourth cut dried in oven at 60oC till constant weight.

6.6.1.10 Fifth cut dry herbage yield (g/plant) - Green herbage yield from fifth cut dried in oven at 60oC till constant weight.

6.6.2 Leaf / stem ratio - Record at 50% flowering by dividing dry leaf weight by dry stem weight.

6.6.3 Nutritive parameter descriptors - Estimated at 50% flowering stage - Indicate the method and reference followed.

6.6.3.1 Crude protein (%) - Estimate the Crude protein on dry weight basis using nitrogen estimation method by Kjeldahl or other methods.

6.6.3.2 Neutral Detergent Fibre (%) - Estimate the extent of neutral detergent fibres.

6.6.3.3 Acid detergent fibre (%) - Estimate the extent of acid detergent fibre from harvested sample.

6.6.3.4 *In vitro* Dry Matter Digestibility (IVDMD%) - Estimate IVDMD from harvested sample .

6.6.3.5 Lignin (%) - Estimate the lignin content from harvested sample.

6.6.3.6 Organic matter (%) - Estimate the organic matter content from harvested sample.

6.6.3.7 Hemicellulose (%) - Estimate the hemicellulose content from harvested sample.

6.6.3.8 Cellulose (%) - Estimate the cellulose content from harvested sample.

7. Abiotic stress susceptibility – scored under artificial and/or natural conditions which should be clearly specified. These are to be recorded on a susceptibility scale of 1 to 5.

- 1 Very low or no visible sign of susceptibility
- 2 Low
- 3 Medium
- 4 High
- 5 Very High

7.1 Cold

7.2 Drought

7.3 Salt stress

7.3.1 Salinity

7.3.2 Alkalinity

7.4 Flood or submergence

7.5 Mineral deficiency

- 1 Nitrogen
- 2 Phosphorus
- 3 Potassium
- 4 Boron
- 5 Zinc
- 6 Copper
- 99 Others (Specify in 7.6 notes)

7.6 Notes – Specify any additional information.

8. Biotic stress sensitivity -In each case, state the origin of the infestation or infection (natural, field inoculation or laboratory) Record such information on a susceptibility scale from 1 to 5.

- 1 Very low or no visible sign of susceptibility
- 2 Low
- 3 Medium
- 4 High
- 5 Very High

8.1 Diseases caused by fungi – Mention causal organism and common name of disease

8.2 Diseases caused by bacteria – Mention causal organism and common name of disease

8.3 Diseases caused by viruses and mycoplasma-like organisms - Mention causal organism and common name of disease

8.4 Insects - Mention causal organism and common name of the insect-pest

8.5 Notes - Specify here any additional information.

9. Biochemical markers - Specify methods used and cite reference(s).

10. Molecular markers - Specify methods used and cite reference(s).

11. Cytological characters

11.1 Chromosome number - Determined from pollen mother cells taken at booting stage or from the root tip of germinating seedlings.

11.2 Ploidy level - Indicate the ploidy level of the accession with reference to the basic chromosome number

11.3 Other cytological characters- Please give details

List of Highly Discriminating Descriptors

- 6.2.5 Stem node colour
- 6.3.1 Leaflet shape
- 6.3.2 Leaflet apex shape
- 6.3.3 Leaflet margin
- 6.3.4 Leaflet: anthocyanin colouration
- 6.3.6 Leaflet: pubescence
- 6.3.7 Leaflet margin: pubescence
- 6.3.12 Stipule pubescence
- 6.4.3 Number of days to 50% flowering
- 6.4.5 Number of days to maturity
- 6.4.6 Petal colour of florets
- 6.4.8 Peduncle hairiness
- 6.4.13 Head apex shape
- 6.5.1 Average number of seeds/ inflorescence
- 6.5.6 Seed colour
- 6.5.7 1000 seed weight

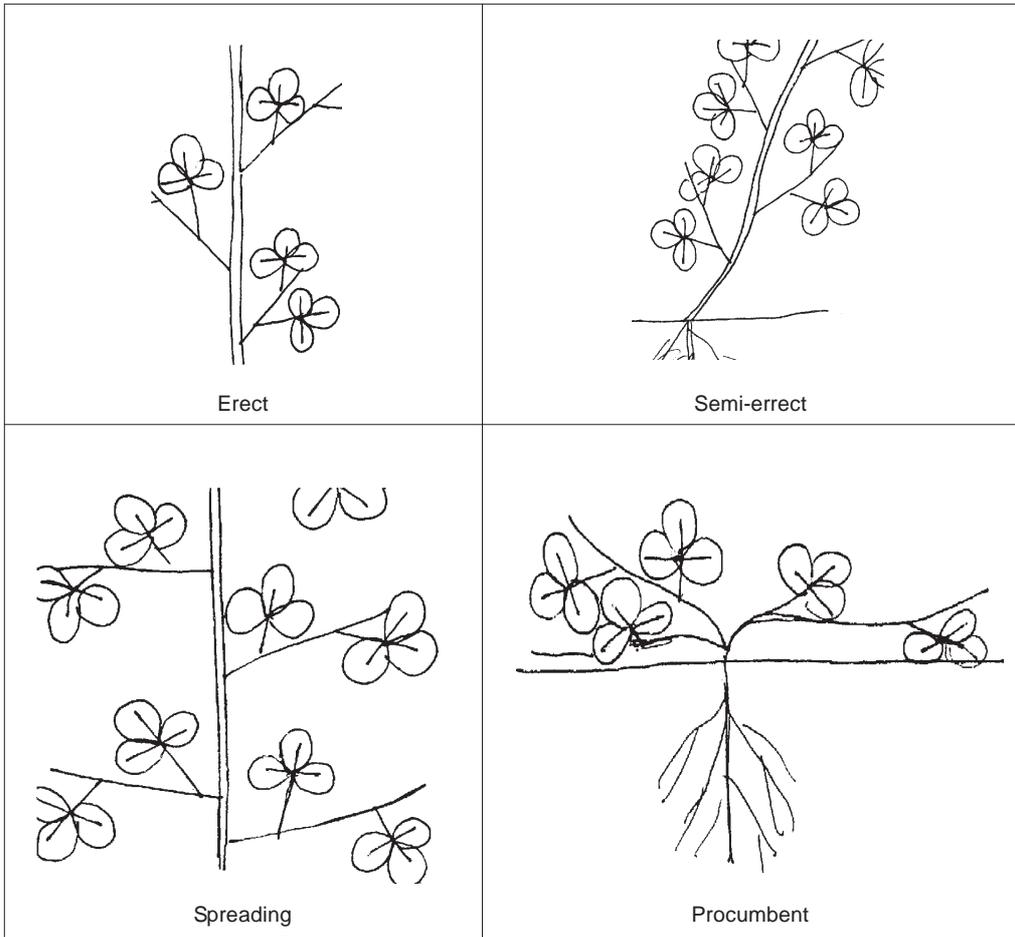


Fig. 1: Growth habit [6.1.5]

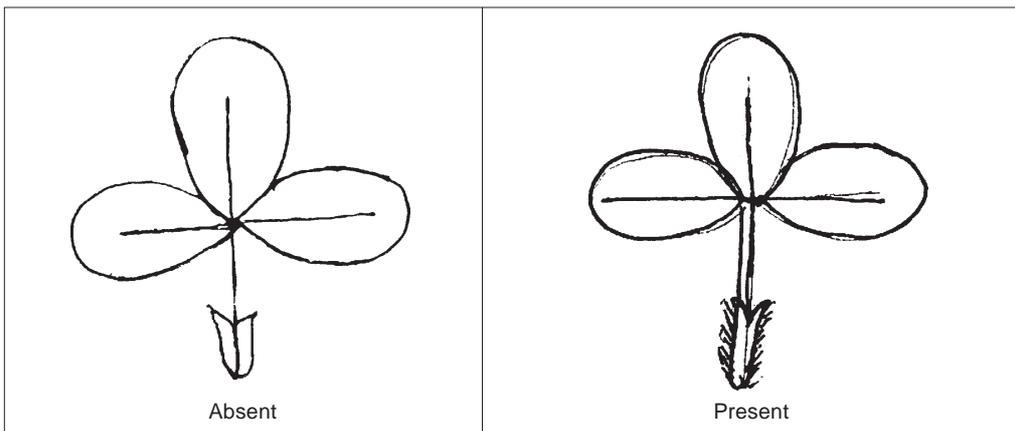


Fig. 2: Stipule margin hairiness [6.3.11]

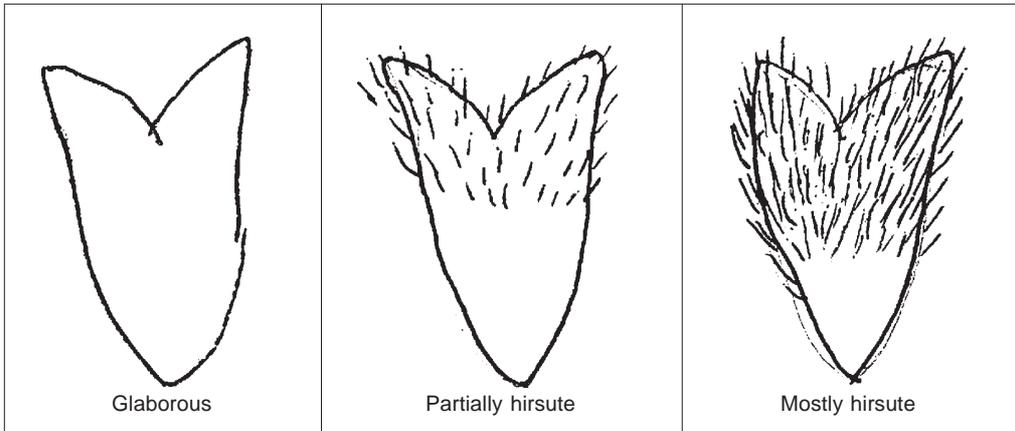


Fig. 3: Stipule pubescence [6.3.12]

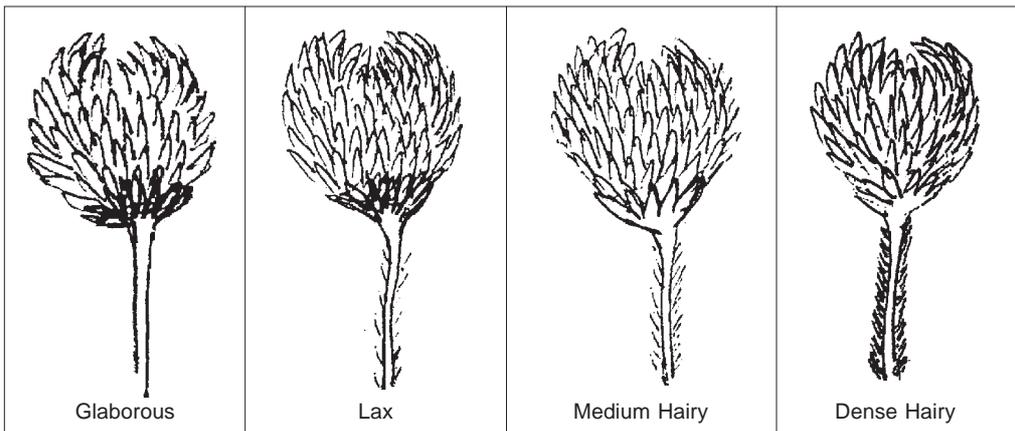


Fig. 4: Peduncle hairness [6.4.8]