DUS DESCRIPTORS BASED CHARACTERIZATION OF MAIZE (*Zea mays* L.) INBRED LINES

ABSTRACT:

DUS testing is one of the important criteria to test inbred lines for distinctness, uniformity and stability. Effective plant breeding programme requires a basic understanding of the existence of genetic variability in a population. Characterization and evaluation of variability is prerequisite for the efficient use of genetic material. Maize is one of the economic crops of global importance. Hence, in the present investigation, morphological characterization of thirty-two maize inbred lines was carried out as per the DUS descriptors. Out of the twenty-seven traits under study, fourteen were found dimorphic and six characters were with trimorphic expression, indicating that all the traits were informative with respect to trait expression cum characterization. Presence of wide variation among the thirty-two maize inbreds would aid in selection of inbreds with desirable characters for further breeding programme.

Keywords: Maize, DUS, Characterization, Morphological, Inbred lines

Introduction:

Maize (*Zea mays* L.) is the world's third most widely grown cereal crop and is known as "queen of cereals". It is commercially valued economic crop, majorly used in poultry and cereal food industries, provides raw materials for starch, gluten, corn oil, corn syrup, sugar, corn meal and com flour and occupies an important place in Indian agriculture. This emphasizes the demand of maize in India and there is an urging need to develop high yielding single cross hybrids. Therefore, knowledge on genetic diversity of inbred lines would help the breeder in planning crosses for superior hybrid development.

Morphological data plays an important role in management of genetic resources that are conserved in ex-situ gene-banks. Many tools are available to study the relationship among the cultivars, including various types of molecular markers; however, morphological characterization is the first step in the description and classification of germplasm.

Characterization of morphological variability facilitates identification of accessions with desirable characteristics such as earliness, disease resistance and improved ear trait etc.

Hence, grouping of lines aids in avoidance of duplication in sampling populations for identification of varieties and hybrids.

The morphological characters are very important indicators to determine the off types in the seed production programme and guides in maintainance of the genetic purity. Protection of Plant Varieties and Farmers Right Authority insists on characterization and registration of extant, farmers and new varieties as a part of national and botanical asset. DUS testing is one of the important criteria to test inbred lines for distinctness, uniformity and stability. DUS Testing of cultivars is one of the requirements for granting Plant Breeders Rights (PBR) and it is conducted according to national guidelines prepared on the basis of UPOV guidelines. Maize inbred lines represent a fundamental resource for studies in genetics and breeding and are used extensively in hybrid corn production.

Keeping in view the importance of aforesaid aspects, the present investigation was undertaken to characterize the thirty-two maize inbreds based on DUS descriptors.

Material and methods:

The field experiment was conducted during *kharif*, 2020 at Agricultural Research Station, Tornala, Siddipet district of Telangana state. The seed material was selected during field day at Winter Nursery Centre, ICAR-IIMR, Rajendranagar, Hyderabad during 2019-20 and purified & used for DUS characterization during *kharif*, 2020. A total of thirty two maize inbred lines were sown in 4 rows of 6 m length by adopting a spacing of 75 cm between rows and 20 cm between plants with in a row in Randomized Block Design replicated thrice. All the necessary precautions were taken to maintain uniform plant population of each genotype per replication. All the recommended package of practices were adopted besides providing necessary prophylactic plant protection measures to raise a good crop.

Morphological characterization of thirty-two maize inbred lines was carried out using twenty-seven DUS characters. Visual observations were recorded on single plant basis on thirty randomly selected plants in each genotype at appropriate growth stages (Rakshith et al., 2005) on eighteen qualitative characters *viz*., leaf: angle between blade and stem, altitude of blade and anthocyanin colouration of sheath, stem: anthocyanin colouration of brace roots, tassel: anthocyanin colouration at base of glume, anthocyanin colouration of glumes, anthocyanin colouration of anthers, density of spikelets, angle between main axis and lateral branches, altitude of lateral branches, ear: time of silk emergence, anthocyanin colouration of silks, shape, type of grain, colour of top of grain and anthocyanin colouration of glumes of cob and kernel: row arrangement and shape. While the data on time of anthesis (50 % plants) and time of silking (50 % plants) was noted on plot basis.

Data on seven quantitative traits such as, leaf: width of blade, tasssel: length of main axis above lowest side branch (cm), plant: length upto flag leaf (cm), ear: length without husk (cm), ear: diameter without husk (cm), number of rows of grains (no.) and 1000 kernel weight (g) were recorded on five randomly selected plants in each plot.

Results and Discussion:

In the present study, thirty two maize inbreds were characterized by using twenty seven DUS characters including twenty qualitative and seven quantitative traits as per the norms of national DUS test guide lines. The maize inbreds under study showed wide range of variability with respect to different traits studied. The frequency distribution of all the characters under study is presented (Table 1).

For leaf characters like angle between blade and stem, maximum frequency of 81% showed small angle and rest (19%) was observed for "wide" state of expression indicating that these inbreds are good water harvesters and could be best used under rainfed conditions. This result is in confirmed with the findings of Gull *et al*., whereas attitude of leaf blade showed maximum frequency (66%) for "straight" state of expression, this is very useful in increasing the plant population per acre, there by results in higher yield levels. Anthocyanin coloration of brace roots and anthocyanin coloration of silks was observed at a frequency of 69% and 53 % respectively remaining 31 % showed absence of anthocyanin coloration of brace roots and 47 % showed absence of anthocyanin coloration of silks (Fig 2).

Anthocyanin colouration of tassels of different character showed maximum frequency for "absent" state, similar results were observed by Saha *et al.* This presence of coloration is a useful tool for identification of parental lines in the crossing programme. The density of spikelets on tassels showed maximum frequency (84%) for"dense" state indicated more pollen count on the tassels for maximum inbreds. This is very useful parameter of inbred to used as parental line as it provides pollen for more number of days. Time of anthesis and silk emergence was found late for all genotypes having frequency of 100 % for each character. This parameter will indirectly indicates higher yield levels. The anthesis silking interval(ASI) was found short for maximum genotypes revealedless pollen loss and effective pollination.

All the germplasm lines were registered absence of anthocyanin coloration of leaf sheath. Angle between main axis & lateral branches and attitude of lateral branches of tassel were observed 100 % narrow and straight state of expression. All the inbred lines were grouped into three categories based on length of main axis of tassel, 13 % were showed short, 84 % were showed medium and 3 % were observed long state of expression. This high medium state of expression will indicates more of pollen production. Regarding plant length of inbred lines maximum 88 % showed short height, it is amicable for used as female parent in the crossing programme. Twenty nine inbred lines (91%) were having narrow leaf blade which were less than 8cm and three inbred line (9%) were having medium width of leaf blade which is 8-9cm. This is very useful for cultivation of these lines in the dryland agriculture as transpirational are very less.

The trait ear length without husk recorded with maximum frequency of 69% for "medium"state and the diameter of cobs without husk showed 100% for large state of expression. As length and diameter is directly proportional to production and productivity. The shape of ear was registered wide variability for states of expression like conical (6%), conico-cylinderical (85 %) and cylinderical of 9 % state of expression.Number of rows of grains of ear was also observed wide variability for states of expression with maximum of medium state of expression with 56 %. This parameter is also in directly proportional to production and productivity of crop.

Type of grain of ear showed two categories with 97% of flint type and 3% of semi flint type. The color of top grain was registered wide variability for states of expression like orange (91%), yellow with cap (3 %) and yellow of 6 % state of expression. This orange grain type is more preferable by the consumers and at industrial level also. Anthocyanin coloration of glumes of cob was noticed maximun of 97 % of white color and 3 % of light purple color.

All inbred lines were classified into two categorieswith 31 inbred lines were having straight row arrangement of kernels and only 1 inbred line is having irregular row arrangement of kernels. The shape of kernel was showed wide variability for states of expression like maximum of round (56 %), indented (16 %) and toothed (28 %). The results are in close conformity withthe findings of Gull et al. (2020). Thousand kernel weight also showed variability for all states with highest frequency (75%) recorded in small state.

Conclusion:

Frequency distribution of traits for DUS characterization of corn inbreds indicated that wide variation existed among different genotypes which could be better utilized in the selection of inbreds based on their specific requirement for further breeding programmes. The diversity among the different inbredscould be utilized for cultivar improvement and germplasmconservation programs aimed at improving productivityof corn.

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Fig. 1: DUS characterization of maize inbred lines

Anthocyanin coloration of anthers: Absent

Anthocyanin coloration of anthers: Present

Anthocyanin coloration at base of glume: Absent

Anthocyanin coloration at base of glume: Present

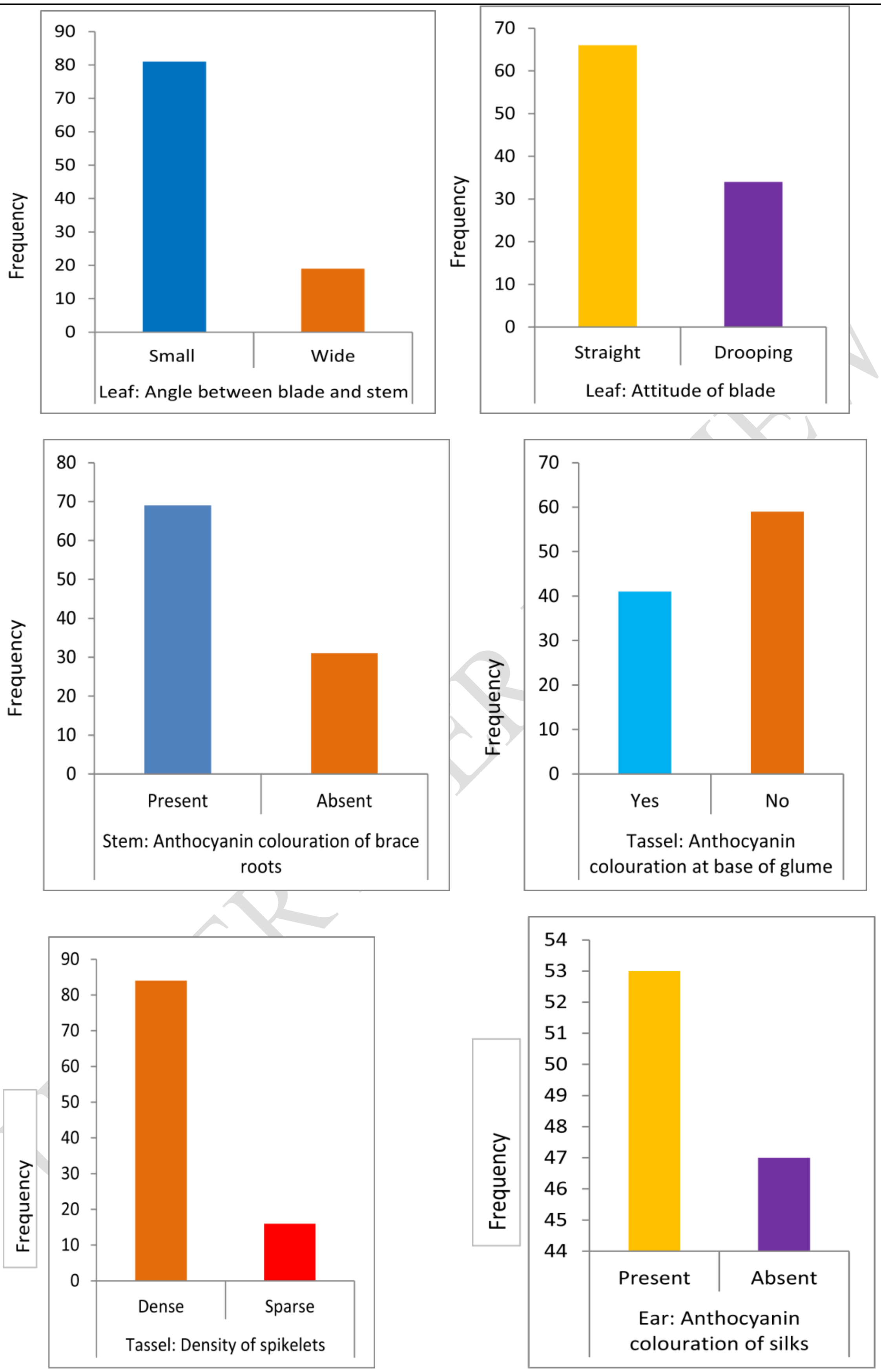
Anthocyanin colouration of brace roots: Absent

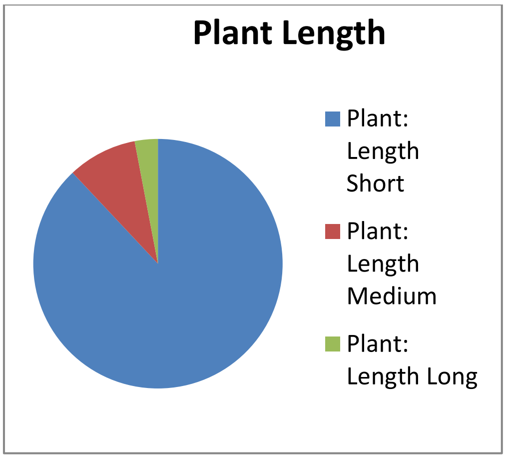
Anthocyanin colouration of brace roots: Present

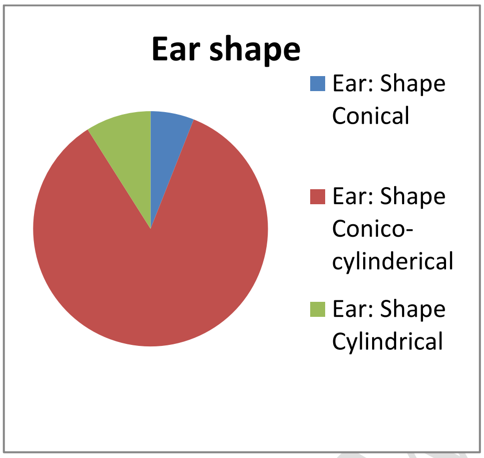

Colouration of glumes of cob: White

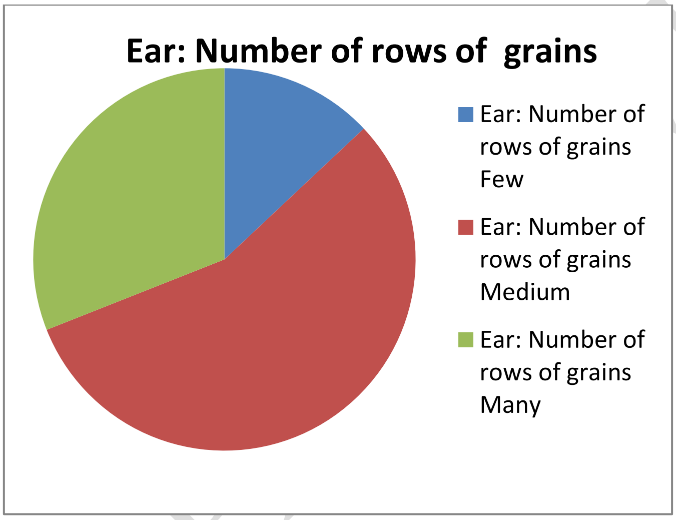

Colouration of glumes of cob: Purple

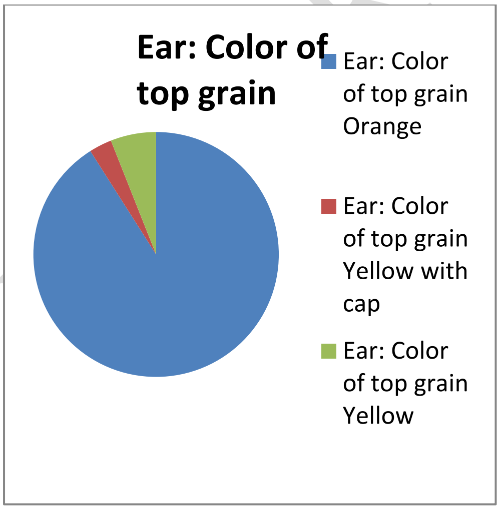
Fig.2. Graphical representation of Morphological characteristics of maize inbred lines
inbred line




Plant Length
Plant: Length Short
Plant: Length Medium
Plant: Length Long


Ear shape
Ear: Shape Conical
Ear: Shape Conico-cylinderical
Ear: Shape Cylindrical


Ear: Number of rows of grains
Ear: Number of rows of grains Few
Ear: Number of rows of grains Medium
Ear: Number of rows of grains Many


Ear: Color of top grain
Ear: Color of top grain Orange
Ear: Color of top grain Yellow with cap
Ear: Color of top grain Yellow

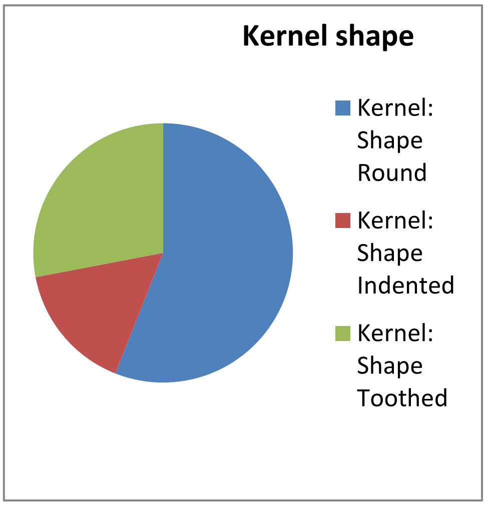

Kernel shape
Kernel: Shape Round
Kernel: Shape Indented
Kernel: Shape Toothed

Table 1. Frequency distribution of germplasm of maize for various DUS characters

S. No	Character	State of expression	Number of genotypes	Frequency distribution (%)
1	Leaf: Angle between blade and stem	Small	26	81
		Wide	6	19
2	Leaf: Attitude of blade	Straight	21	66
		Drooping	11	34
3	Stem: Anthocyanin colouration of brace roots	Present	22	69
		Absent	10	31
4	Tassel: Time of anthesis	Late	32	100
5	Tassel: Anthocyanin colouration at base of glume	Yes	13	41
		No	19	59
6	Tassel: Anthocyanin colouration of glumes excluding base	Yes	14	44
		No	18	56
7	Tassel: Anthocyanin colouration of anthers	Yes	6	19
		No	26	81
8	Tassel: Density of spikelets	Dense	27	84
		Sparse	5	16
9	Tassel: Angle between main axis and lateral branches	Narrow	32	100
10	Tassel: Attitude of lateral branches	Straight	32	100
11	Ear: Time of silk emergence	Late	32	100
12	Ear: Anthocyanin colouration of silks	Present	17	53
		Absent	15	47
13	Leaf: Anthocyanin colouration of sheath	Absent	32	100
14	Tassel: Length of main axis	Short	4	13
		Medium	27	84
		Long	1	3
15	Plant: Length	Short	28	88
		Medium	3	9
		Long	1	3
17	Leaf: Width of blade	Narrow	29	91
		Medium	3	9
18	Ear: Length without husk (cm)	Short	10	31
		Medium	22	69
19	Ear: Diameter without husk (cm)	Large	32	100
20	Ear: Shape	Conical	2	6
		Conico-cylinderical	27	85

		Cylindrical	3	9
21	Ear: Number of rows of grains	Few	4	13
		Medium	18	56
		Many	10	31
22	Ear: Type of grain	Flint	31	97
		Semi flint	1	3
23	Ear: Color of top grain	Orange	29	91
		Yellow with cap	1	3
		Yellow	2	6
24	Ear: Anthocyanin coloration of glumes of cob	White	31	97
		Light purple	1	3
25	Kernel: Row arrangement	Straight	31	97
		Irregular	1	3
26	Kernel: Shape	Round	18	56
		Indented	5	16
		Toothed	9	28
27	Kernel: 1000 kernel weight (g.)	Small	24	75
		Medium	8	25