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# Identification of maize (*Zea mays* L.) inbreds by using agro-morphometric traits

**Priyanka Kumari, Manigopa Chakraborty, Sudhir Kumar, SB Chaudhary, Krishna Prasad and Rameshwar Prasad Sah**

**Abstract**
Morphological characterization of forty fivemaize (*Zea Mays* L.) inbreds which is procured from BAU Maize project, Ranchi and NBPGR, Ranchi was carried out using DUS characters. Field experiments were conducted to study the experimental materials for tolerance to moisture stress i.e. excessive and normal moistures condition at Research Farm at different locations of BAU, Kanke, Ranchi during, rabi 2019-20, Geographically, the area is located between 23º17' N latitude and 85º19' E longitude at an altitude of 625 m above mean sea level. The study was conducted at Visual observations were recorded on single plant basis on five randomly selected plants in each inbreds at appropriate growth stages as per descriptor of IIMR, Ludhiana. Data on Leaf angle between blade and stem, Leaf attitude of blade, Leaf Width blade (leaf of upper ear), Leaf color, Leaf orientation, stem: Anthocyanin colour of brace roots, Anthocyanin coloration of anther, Anthocyanin colouration excluding glumes, Anthocyanin colouration at base of glumes, Density of anthers, Tassel angle, Tassel length, Shape of cob, kernel row arrangement were recorded on five randomly selected plant sin each plot under both the condition under normal condition and under moisture stress condition. All the qualitative traits were recorded as per the standard procedures.

**Keywords:** Maize (*Zea mays* L.), characterization, DUS rate, national bureau of plant genetics resources NBPGR

## Introduction
Maize (2n=20) is one of the most important cereal crops in the world, providing a staple food, and being used as source of income for many populations in developing countries including India. Characterization of morphological variability allows breeders to identify accessions with desirable characteristics such as earliness, improved ear morphology etc and avoid duplication of accessions in germplasm collection. Traditionally, numerous morphological traits have been used to describe inbred lines and hybrid cultivars of Maize (*Zea mays* L.). Protection of Plant varieties and Farmers Right authority insists on characterization and registration of extant, farmers and new as a part of national and botanical asset. Pinnisch *et al.*, (2012) [5] also indicated that, inbred lines serve as the seed parent to estimate the profitability of commercial maize genotypes.

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 (International Union for the Protection of New Varieties of Plants) guidelines. The system accepted and in operation in a large number of countries is as provided by (International Union for the Protection of New Varieties of Plants) UPOV. Information is, thus, generated on the basis of internationally accepted and followed norms, thereby providing a basis for appropriate comparison of materials identified under the national agricultural research system (NARS) alongside materials from other sources. Morpho-agronomical characters have been used to study the genetic diversity in maize (Beyene *et al.*, 2005) [2]. The traits used in assessing crop variety for DUS have been carefully selected taking into account the plastic-ity of morphological characteristics and thus the efficient for comparing varieties. However the characterization of germplasms provides a baseline information regarding the morphological and agronomic traits (Ngwadla, X. 2002) [1]. Hence studies were initiated to develop parental characteristics as per the guidelines of PPV and FRA for the domestic inbreds of Birsa Agricultural University (BAU) and the inbred of National Bureau of Plant Genetics Resources (NBPGR) which will help in selection of inbreds for specific breeding program.

## Materials and Methods

The seeds of forty five (Table 1 & 2) maize inbred lines were sown at Birsa Agricultural university Experimental field in randomised block design with two replications per variety with a row to row and plant to plant distance of 60 cm and 20 cm in two condition one is under irrigated condition another is on the non-irrigated condition respectively. As the main goal was a practical characterisation of maize inbreds a set of fourteen descriptors (Table 1) were used. Data for morphological traits were collected on randomly selected plants per replication.

**Table 1:** The seeds of Maize (*Zea Mays*) accession procured from NBPGR (National Bureau of Plant Genetic Resources) Ranchi

| S. No. | Collector No. | I.C. NO. | S. No. | Collector No. | I.C NO. |
|---|---|---|---|---|---|
| 1. | SKB/PM-5 | IC624140 | 9. | SKB/PM-17 | IC624151 |
| 2. | SKB/PM-6 | IC624141 | 10. | SKB/PM-19 | IC624153 |
| 3. | SKB/PM-7 | IC624142 | 11. | SKB/PM-21 | IC624154 |
| 4. | SKB/PM-10 | IC624145 | 12. | SKB/PM-28 | IC624157 |
| 5. | SKB/PM-11 | IC624146 | 13. | SKB/PM-31 | IC624158 |
| 6. | SKB/PM-12 | IC624147 | 14. | SKB/PM-35 | IC624159 |
| 7. | SKB/PM-14 | IC624148 | 15. | SKB/PM-36 | IC624160 |
| 8. | SKB/PM-16 | IC624150 | 16. | SKB/PM-39 | IC624161 |
| 17. | SKB/PM-46 | IC624164 | 24. | SKB/PM-73 | IC624175 |
| 18. | SKB/PM-47 | IC624165 | 25. | SKB/PM-75 | IC624176 |
| 19. | SKB/PM-48 | IC624166 | 26. | SKB/PM-76 | IC624177 |
| 20. | SKB/PM-56 | IC624169 | 27. | SKB/PM-77 | IC624178 |
| 21. | SKB/PM-58 | IC624170 | 28. | SKB/PM-78 | IC624179 |
| 22. | SKB/PM-66 | IC624173 | 29. | SKB/PM-79 | IC624180 |
| 23. | SKB/PM-71 | IC624174 | 30. | SKB/PM-83 | IC624181 |

**Table 2:** The seeds of the Maize (*Zea Mays*) inbred line procured from the Maize Research Scheme of Plant Breeding and Genetics department of BAU Kanke, Ranchi

| S. No. | Inbred lines | Accession number | S. No. | Inbred lines | Accession number |
|---|---|---|---|---|---|
| 1. | 96 Rohyo | BAUIM-1 | 9. | HKI-193-1 | IC470149 |
| 2. | Suwan | BAUIM-2 | 10. | HKI-1532 | IC563958 |
| 3. | 55Dholi | BAUIM-3 | 11. | HKI-335 | IC405279 |
| 4. | B1105TE | BAUIM-4 | 12. | P1M1PV1 | IC622967 |
| 5. | 95IOWA | BAUIM-5 | 13. | P1M1PV2 | IC622968 |
| 6. | BQPM-2 | IC45673 | 14. | LM13 | IC527290 |
| 7. | CM425 | IC67543 | 15. | LM14 | IC527291 |
| 8. | CML169 | IC643215 | | | |

**Table 3:** DUS traits and the state of expression which were recorded are as presented in the below

| Sl. No. | Name of the traits | States | scale | Stage of observation | Type of assessment |
|---|---|---|---|---|---|
| 1. | Leaf angle between blade and stem | Small<br>Wide<br>Medium | 3<br>7<br>5 | 61 DAS | VG |
| 2. | Leaf attitude of blade | Straight<br>Drooping<br>Strongly curved | 1<br>9<br>3 | 61 DAS | VG |
| 3. | Leaf Width blade (leaf of upper ear) | Narrow (<8 cm)<br>Medium(8-9 cm)<br>Broad (> 9 cm) | 3<br>5<br>7 | 75 DAS | MS |
| 4. | Leaf color | Light green<br>Green<br>Dark green | 1<br>2<br>3 | 61 DAS | VG |
| 5. | Leaf orientation | Present<br>Absent | 1<br>2 | 61 DAS | VG |
| 6. | Stem: Anthocyanin colour of brace roots | Absent<br>Present | 9<br>1 | 75 DAS | VG |
| 7. | Anthocyanin coloration of anther | Absent<br>Present | 9<br>1 | 75 DAS | VG |
| 8. | Anthocyanin colouration excluding glumes | Absent<br>Present | 9<br>1 | 75 DAS | VG |
| 9. | Anthocyanin colouration at base of glumes | Absent<br>Present | 9<br>1 | 75 DAS | VG |
| 10. | Density | Dense<br>Sparse | 7<br>3 | 75 DAS | VG |
| 11. | Tassel angle | Narrow<br>Wide | 3<br>7 | 75 DAS | VG |
| 12. | Tassel length | Short | 3 | 75 DAS | VG |

| | | | | | |
|---|---|---|---|---|---|
| | | Medium<br>Long | 5<br>7 | | |
| 13. | Shape of cob | Conical<br>Conic cylindrical<br>Cylindrical | 1<br>2<br>3 | 75 DAS | VG |
| 14 | Kernel row arrangement (middle of ear) | Straight<br>spiral<br>irregular | 1<br>2<br>3 | 75 DAS | VG |

## Result and Discussion

The state of expressions and frequency distribution of these forty five Maize (*Zea Mays* L.) Inbreds for various DUS characters is given below in Table 4.

**Table 4:** The state of expressions and frequency distribution of these forty five Maize (*Zea Mays* L.) Inbreds for various DUS characters

| Sl. No. | Name of the traits | States of expression | Number of inbreds | | Frequency distribution under irrigated condition (%) | Frequency distribution under non-irrigated condition (%) |
|---|---|---|---|---|---|---|
| | | | Irrigated | Non-irrigated | | |
| 1. | Leaf angle between blade and stem | Small | 25 | 33 | 55.55 | 72.12 |
| | | Wide | 11 | 10 | 24.45 | 23.44 |
| | | Medium | 9 | 2 | 20 | 4.44 |
| 2. | Leaf attitude of blade | Straight | 27 | 24 | 60 | 53.33 |
| | | Drooping | 12 | 20 | 27.57 | 44.44 |
| | | Very strongly curved | 6 | 1 | 13.33 | 2.23 |
| 3. | Leaf Width blade (leaf of upper ear) | Narrow (<8 cm) | 9 | 22 | 20 | 48.88 |
| | | Medium(8-9cm) | 12 | 8 | 26.66 | 17.77 |
| | | Broad (> 9cm) | 24 | 14 | 53.34 | 31.12 |
| | | wide | | 1 | | 2.24 |
| 4. | Leaf color | Light green | 11 | 8 | 24.45 | 17.78 |
| | | Green | 24 | 28 | 53.34 | 62.22 |
| | | Dark green | 10 | 9 | 22.21 | 20 |
| 5. | Leaf orientation | Present | 27 | 32 | 60 | 71.12 |
| | | Absent | 18 | 13 | 40 | 28.88 |
| 6. | Stem: Anthocyanin colour of brace roots | Absent | 14 | 35 | 31.12 | 77.78 |
| | | Present | 31 | 10 | 68.88 | 22.22 |
| 7. | Anthocyanin coloration of anther | Absent | 34 | 32 | 75.55 | 71.12 |
| | | Present | 11 | 13 | 24.45 | 28.88 |
| 8. | Anthocyanin colouration excluding glumes | Absent | 33 | 34 | 73.33 | 75.55 |
| | | Present | 12 | 11 | 26.67 | 24.45 |
| 9. | Anthocyanin colouration at base of glumes | Absent | 28 | 12 | 62.22 | 26.66 |
| | | Present | 17 | 33 | 37.78 | 73.34 |
| 10. | Density of anthers | Dense | 31 | 14 | 68.88 | 31.12 |
| | | Sparse | 14 | 31 | 31.12 | 68.88 |
| 11. | Tassel angle | Narrow | 28 | 30 | 62.22 | 66.66 |
| | | Wide | 17 | 15 | 37.78 | 33.34 |
| 12. | Tassel length | Short | 10 | 30 | 22.22 | 66.66 |
| | | Medium | 29 | 10 | 64.44 | 22.22 |
| | | Long | 6 | 5 | 13.34 | 11.12 |
| 13. | Shape of cob | Conical | 18 | 16 | 40 | 35.55 |
| | | Conicocylindrical | 6 | 8 | 13.34 | 17.78 |
| | | cyliderical | 21 | 21 | 46.66 | 46.66 |
| 14 | Kernel row arrangement | straight | 13 | 13 | 28.88 | 28.88 |
| | | spiral | 15 | 14 | 33.33 | 31.12 |
| | | irregular | 17 | 18 | 37.79 | 40 |

A wide spectrum of variation was found in the frequency distribution of inbreds for various characters under normal and drought condition. For leaf characters angle between blade and stem under irrigated condition and non-irrigated condition maximum frequency of (55.55%) and (72.22%) as found for “small” state of expression while minimum frequency (4.44) found for “medium” state of expression under non-irrigated condition. Maximum percentage of inbreds (60%) and (53.33%) was found to be “Straight” for leaf attitude of blade under irrigated condition and non-irrigated condition while minimum frequency (2.23) found for “very strongly curved” state of expression under non-irrigated condition. For leaf width blade maximum frequency (53.33%) found for “broad” state of expression under irrigated condition while in non-irrigated condition maximum frequency (48.88%) found for “narrow” state of expression. For leaf color maximum frequency (60%) found for “green” state of expression under non-irrigated condition while under irrigated condition maximum frequency (53.34%) found for “green” state of expression. For leaf orientation maximum frequency (71.12%) found for “present” state of expression under non-irrigated condition. For stem: Anthocyanincolour of brace roots maximum frequency(77.78%) found for “absent” state of expression under non-irrigated condition while in irrigated condition maximum frequency (68.888%) found for “present” state of expression. For anther traits like

Anthocyanin colouration excluding glumes maximum frequency (77.78%) found for “absent” state of expression under non-irrigated condition while in irrigated condition maximum frequency (68.888%) found for “present” state of expression. Anthocyanin colouration at base of glumes maximum frequency (73.34%) found for “present” state of expression under non-irrigated condition while under irrigated condition maximum frequency (62.22%) found for “absent” state of expression. For density of anthers maximum frequency(68.88%) found for “dense” state of expression under irrigated condition while under irrigated condition same frequency (68.888%) found for “sparse” state of expression. For tassel angle maximum frequency (66.66%) found for “narrow” state of expression under non-irrigated condition while under irrigated condition maximum frequency (62.22%) found for “narrow” state of expression. For tassel length maximum frequency (66.66%) found for “short” state of expression under non-irrigated condition while under irrigated condition maximum frequency (64.44%) found for “medium” state of expression. For shape of cob maximum frequency (46.66%) found for “cylinderical” state of expression under non-irrigated condition while under irrigated condition maximum frequency (46.66%) found for same that is “cylinderical” state of expression. For kernel row arrangement there is found slight variation between under irrigated and non-irrigated condition equal frequency found for “straight” state of expression while maximum frequency found (40%) and (37.79%) for irregular state of expression under non-irrigated condition and irrigated condition.

**Images of qualitative traits are given**

a b

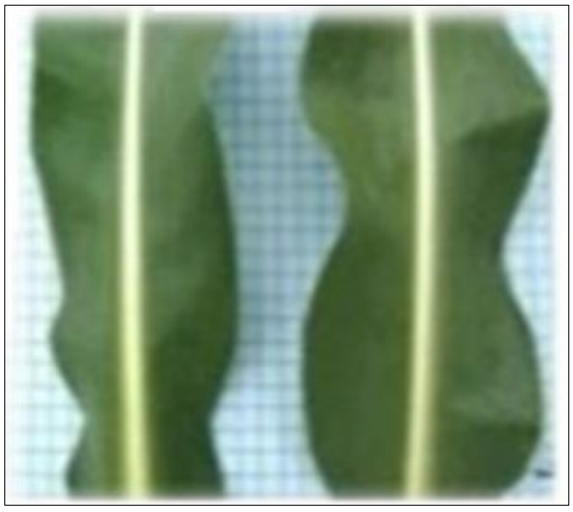
Tassel volume: Sparse (A) and Dense (B)

(C) Stem: Anthocyanin colour of brace roots- Absent

(D) Anthocyanin coloration - Absent

(E) Anthocyanin coloration- Present

(F) Stem: Anthocyanin colour of brace roots- Absent



(G) Width of leaf

(H) Irregular kernel row arrangement

(I) Straight kernel row arrangement and conical shape of cob

(J) Irregular kernel row arrangement

(K) Spiral kernel row arrangement

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