

## Assessment of Phenotypic Variations in Ten Finger Millet (*Eleusine coracana*(L) Gaertn) Landraces Germplasm Collected From Northern Nigeria

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**Abstract:** Germplasm identification and characterization is an important link between conservation and utilization of plant genetic resources. The present study was conducted to assess the phenotypic variation/diversity of 10 germplasm accessions of Finger millet (*Eleusine coracana* (L) Gaertn) from diverse locations in the geographic region of Northern Nigeria during the 2008, 2009 and 2010 cropping seasons. Randomised Complete Block Design (RCBD) was used for the study and field data were analysed based on phenotypic characters. Phenotypes were found to express significant diversity for plant height, 1000seed weight, leaf length and number of tillers. The results were analysed using ANOVA model and showed that plant height in accession Ex-Kwi was significantly different from all the other nine accessions while the highest leaf length which was recorded in Ex-Riyom was significantly different ( $p < 0.05$ ) from accession Ex-Dantse. Similarly, significant variations were observed in the number and length of fingers, and 1000seed weight across all the accessions. Cluster analyses revealed six distinct groups, with one landrace forming an independent colony. Our results suggest a high phenotypic variability, which could exist among the selected morphological traits.

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### 1. Introduction

In Nigeria, The Finger Millet plant is diverse and is popularly used without restriction in our different multi-ethnic, multi-cultural and multi-religious groups. In various regions of the world it is referred to as tamba (Nigeria), Ragi (India), Mandua Winbi (Swahili) bulo (Uganda), kurakan (Sri Lanka), fingerhirse (German) (Dewet, 1976). Epidemiological evidence showed that the plant is widespread and well adopted to diverse regions of the world. In East Africa, the plant is known to originate from Ethiopia and then spread by geographic spatial pattern to Southern African countries such as Namibia and Botswana. The plant is also well known and grows well in Asian countries such as India and China, Middle East (Gupta, *et al*, 2010).

Germplasm identification in finger millet plant is an important link between conservation and utilization of plant genetic resources. The usefulness of germplasm in the study of plant genetic resources could play an important role in the generation of new hybrids and high yielding crop varieties with disease resistant traits to cope with adverse challenges associated with biotic and abiotic stress, (Murray, *et al*. 2008).

The problem of erosion of genetic diversity of finger millet plant in Nigeria because of large-scale farming activities, urbanization and preferential land

uses causes leaching, and may destroy our natural vegetation. This eventually erodes finger millet beyond the reach of rural farmers (Fakrudin, *et al*, 2004). Our study is conducted to assess the phenotypic properties of Nigerian finger millet plant. The phenotypic characterization could also reveal the genetic relatedness within these species. This will be useful in the conservation of new species and understanding of the genetic diversity of the finger millet plant. Our findings may provide information on the plant taxonomy as well as ecology of the finger millet plant.

### 2. Methodology

#### 2.1 Sampling Methods

Field survey was conducted between November 2007 and February 2008. The 10 finger millet (seeds) were randomly collected from local farmers in consultation with the Agricultural Development Programme (ADP) in five states (Bauchi, Gombe, Nasarawa, Plateau and Kaduna) and the Federal Capital Territory (FCT) Abuja, Nigeria.

#### 2.2 Experimental Design

The Randomized Complete Block Design (RCBD) was used to plant the finger millet seeds in the three cropping seasons in 2008, 2009 and 2010 in accordance with standard agricultural practices. Each

plot consisted of 2m X 3m (6m<sup>2</sup>). Plant to plant spacing was maintained at 10cm in both locations. A basal dose of NPK was applied 4 weeks after planting in both locations. Fertilizer was applied at 100kg N (Nitrogen) 60kg K<sub>2</sub>O (Potassium) and 40kg, P<sub>2</sub>O<sub>5</sub> (Phosphorus) in both locations. Weeding was done at six weeks after planting in both locations. This field experiment was repeated in the two locations in the 2009 and 2010 cropping seasons and data were collected for all the seasons.

### 2.3 Phenotypic Assessments

Morphological traits such as plant height, plant width, leaf length, leaf width, number of fingers, finger length and finger width were determined and recorded in accordance with standard finger millet descriptors (IBPGR/ICRISAT, 1985). The number of days to flowering was recorded for each plot as a whole and the remaining characters were recorded on 10 randomly chosen plants per plot. The number of fingers per panicle and number of productive tillers per plant were recorded. Mature panicles or fingers were harvested, sundried and weighed to record panicle yield, and then threshed to measure grain yield. This experiment was repeated in the 2009 and 2010 cropping seasons in both locations using the same treatments and conditions.

## 3. Results

### 3.1 Phenotypic Properties of Finger Millet

Table 1 shows the pooled means of morphological traits of finger millet accessions planted in Northern Nigeria for the three cropping seasons. Plant height varied from 54.66cm in Ex-Dantse to 64.96cm in Ex-Biliri with a mean value of 59.79cm across the ten accessions. Plant width varied from 9.77cm in Ex-Andaha to 12.30cm in Ex-Tafawa Balewa with a mean of 11.07cm across all the accessions. Leaf length varied from 49.02cm in Ex-Dantse to 58.20cm in Ex-Riyom with a mean of 53.53cm across the ten accessions. Leaf width varied from 1.30cm in Ex-Tafawa Balewa to 1.94cm in Ex-Kwi and a mean of 1.51cm across all the accessions. Number of fingers varied from 73.5 in Ex-Dantse to 171.5cm in Ex-Kwi and a mean of 105.1 across the ten accessions. Finger length varied from 44.90cm in Ex-Gwagwalada to 99.25cm in Ex-Andaha with a mean of 64.80cm across the ten accessions while the finger width ranged from 2.1cm in Ex-Gura to 2.7cm in Ex-Riyom with a mean of 2.39cm across all the accessions. Number of ears varied from 16.5 in Ex-Gwagwalada to 25.5 in Ex-Kwi with a mean value of 20.15 across the accessions while 1000 seed weight varied from 150.9g in Ex-Gwagwalada to 275g in Ex-Andaha with a mean value of 200.09g across the ten accessions.

The lowest similarity was observed between Ex-Andaha and Ex-Gwagwalada (Fig.1). The dendrogram showed the highest genetic similarity between the germplasms Ex-Biliri, Ex-Bum and Ex-Dantse. The population is divided into two germplasm which included a smaller subgroup comprising of Ex-Kwi and Ex-Andaha. The other subgroup contains germplasm of Ex-Gwagwalada and Ex-Gura; Ex-Tafawa Balewa and Ex-Kwakwi; Ex-Riyom, Ex-Bum, Ex-Biliri and Ex-Dantse. Phenotypic relatedness was observed between Ex-Riyom, Ex-Bum Ex-Biliri and Ex-Dantse and maximum closeness was observed in Ex-Dantse, Ex-Biliri and Ex-Bum, Ex-Riyom, Ex-Tafawa Balewa and Ex-Kwakwi. Phenotypically, Ex-Tafawa Balewa, Ex-Kwakwi, Ex-Riyom, Ex-Bum, Ex-Biliri and Ex-Dantse could constitute a species where the morphological differences amongst them are narrow or close.

## 4. Discussion

Results of our assessments of 10 finger millet landraces using 9 morphological traits showed significant variations across all the 10 landraces of finger millet plant within the three cropping seasons (2008, 2009 and 2010) respectively. Our results agree with the earlier findings of Upadhyaya, et al., (2007) and Mnyenyembe and Gupta, (1998).

Evaluation of the phenotypic characters for the different accessions showed that the phenotype could have genetic diversity for plant height, 1000seed weight, leaf length and tillers than all the other traits assessed in this trial.

Table 2 shows the genetic variability existing in the ten accessions used in this trial. Our research concurs with Shahryani *et al.*, (2011), Garavandi and Kabrizi, (2010), who established genetic diversity for plant height, 1000seed weight, spikelet in bread wheat genotypes and similar crops. Kempana and Thirumalachar (1968), and Abraham *et al.* (1989) also found significant variation for grain yield and number of productive tillers per plant. Josh and Mehra (1989) reported significant genetic variation for days to flowering and other parameters as plant height, finger length, and number of fingers and phenotypic relatedness in finger millet accessions.

Upadhyaya *et al.* (2007) reported large phenotypic diversity in pearl millet germplasm especially in terms of days to flowering, plant height, total tillers and 1000-seed weight, which was also observed in this work. Our findings also indicated that at the three-year trials in both Keffi and Gwagwalada locations, there were accessions that could flower as early as 60 days and others as late as 120 days. Similarly, phenotypic variations were observed in plant diameter, leaf length, number of

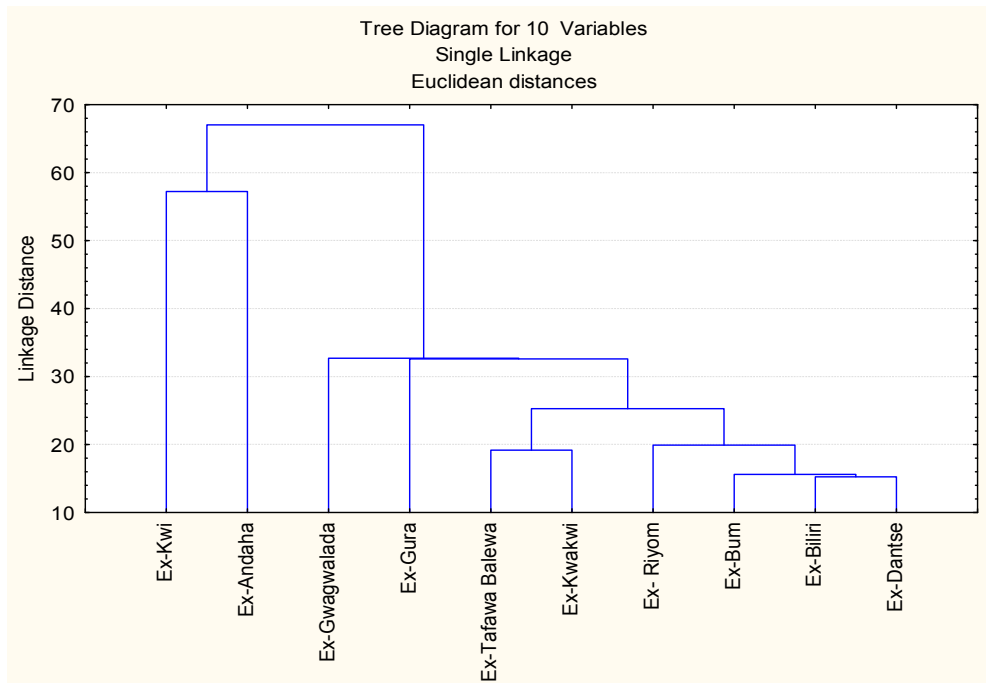
fingers, number of ears and 1000seed weight. This exhibition of significant genetic diversity observed in this report agrees with the work of Garavandi and Kabrizi, (2010) and Shahryari, *et al.*, (2011) who reported genetic biodiversity for plant height, 1000 seed weight, seed number, spikelet etc in bread wheat genotypes.

**5. Conclusion**

The objectives of our research have been greatly achieved. We were able to demonstrate the morphological traits of finger millet and to determine the phylogenetic diversity of the plant using cluster analysis. These results have clearly established the possibility of genetic variation and could be useful at ascertaining evolutionary diversion whenever mutation occurs. Further studies should involve the identification of specific primers, which could identify loci responsible for this diversity.

**Table1: Pooled Means of Morphological traits of finger millet Accessions grown in northern Nigeria in the three cropping seasons.**

| Accession        | Plant Height (cm) | Plant width (cm) | Leaf Length (cm) | Leaf width (cm) | Number of Fingers | Finger length (cm) | Finger width (cm) | Number of Ears | Seed Weight (1000g) |
|------------------|-------------------|------------------|------------------|-----------------|-------------------|--------------------|-------------------|----------------|---------------------|
| Ex-Dantse        | 54.66             | 10.68            | 49.02            | 1.43            | 73.50             | 61.30              | 2.60              | 20.00          | 175.70              |
| Ex-Riyom         | 60.33             | 12.00            | 58.20            | 1.45            | 79.50             | 79.35              | 2.70              | 19.50          | 185.75              |
| Ex-Bum           | 56.33             | 11.06            | 55.36            | 1.38            | 81.50             | 60.95              | 2.20              | 21.50          | 190.75              |
| Ex-Gura          | 59.16             | 11.52            | 50.96            | 1.67            | 132.00            | 64.65              | 2.10              | 19.00          | 183.40              |
| Ex-Kwakwi        | 58.28             | 10.42            | 55               | 1.57            | 115.50            | 61.15              | 2.30              | 20.00          | 210.95              |
| Ex-Tafawa Balewa | 59.05             | 12.30            | 54.29            | 1.30            | 102.50            | 51.65              | 2.20              | 21.00          | 200.80              |
| Ex-Biliri        | 64.96             | 11.78            | 54.32            | 1.38            | 77.50             | 54.00              | 2.40              | 19.00          | 180.90              |
| Ex-Gwagwalada    | 60.47             | 10.15            | 53.16            | 1.50            | 85.00             | 44.90              | 2.60              | 16.50          | 150.90              |
| Ex-Andaha        | 58.26             | 9.77             | 50.24            | 1.57            | 132.50            | 99.25              | 2.30              | 22.50          | 275.85              |
| Ex-Kwi           | 62.50             | 11.39            | 54.15            | 1.94            | 171.50            | 70.90              | 2.50              | 25.50          | 245.75              |
| TOTAL            | 567.9             | 110.74           | 535.3            | 15.50           | 1051.00           | 648.10             | 23.90             | 201.50         | 2000.0              |
| MEAN             | 59.79             | 11.07            | 53.53            | 1.51            | 105.10            | 64.80              | 2.39              | 20.15          | 200.09              |
| S.E.             | 3.38              | 0.32             | 3.37             | 0.106           | 3.97              | 5.26               | 0.07              | 1.88           | 3.38                |
| LSD(0.05)        | 6.48              | 0.48             | 7.61             | 0.184           | 13.61             | 7.77               | 0.09              | 2.69           | 32.54               |
| CV (%)           | 11.54             | 6.85             | 6.05             | 3.064           | 4.63              | 0.77               | 0.08              | 1.69           | 16.55               |



**Fig 1: Dendrogram of morphological characters showing the linkages among ten accessions of finger millet grown in Northern Nigeria for the three cropping seasons.**

**Table 2: Range of variation for important morphological characters in finger millet accessions grown in Keffi and Gwagwalada, Northern Nigeria, for the 3 cropping seasons**

| Parameter              | MIN   | MAX    | MEAN        | VARIANCE |
|------------------------|-------|--------|-------------|----------|
| Time to flower (days)  | 60    | 120    | 97.67       | 11.43    |
| Plant height (cm)      | 54.66 | 64.96  | 59.67±3.38  | 6.85     |
| Plant diameter (cm)    | 9.77  | 12.30  | 11.07±0.32  | 6.08     |
| Leaf length (cm)       | 49.00 | 55.30  | 53.50±3.37  | 6.05     |
| Leaf diameter(cm)      | 1.30  | 1.94   | 1.51±0.11   | 3.06     |
| Number of fingers      | 73.50 | 171.5  | 105.1±3.97  | 4.63     |
| Length of fingers (cm) | 44.90 | 99.25  | 64.80±5.26  | 0.77     |
| Finger diameter (cm)   | 2.1   | 2.7    | 2.39±0.07   | 0.08     |
| Number of ears         | 16.5  | 25.5   | 20.15±1.88  | 1.69     |
| 1000seed weight (g)    | 150.9 | 275.85 | 200.09±3.38 | 16.55    |

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