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Genetic Diversity among Nigeria '*Maiwa Type*' of Pearl Millet Germplasm

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Keywords: pearl millet, maiwa, germplasm, staygree, phenotyping.

I. Introduction

Pearl millet [*Pennisetum glaucum (L.) R. Br.*], is one of the most important staple cereals for over 40 millions subsistence farmers living in the most marginal agricultural lands of Northern Nigeria, due to its high tolerance to drought, high temperatures, saline and marginal soils, and high capacity to buffer variable environmental conditions (Haussmann et al., 2012). Improving production of pearl millet while maintaining its production stability is crucial for food security for poor African smallholder farmers cropping under rain-fed farming systems (Pucher et, al., 2015). It is endowed with enormous genetic variability for various morphological traits, yield components, adaptation and quality traits accumulated over a long century which is gradually getting eroded due to climate change (Shah et, al., 2012, Upadhyaya and Reddy, 2009). Selection by farmers over a long period of time for adaption to local growing conditions and for local taste, plant type, etc are very valuable source of wide range of characters and represent the greatest reservoir of useful traits of any source which so far have been exploited only to a limited extent (Rai et, al,. 1999; Niangado 2001) and in a very unsystematic manner. For plant breeding effort to be successful there should be continuing and expanding supply of plant germplasm materials with sufficient variability to explore for improvement. Characterization of pearl millet germplasm is imperative for categorization of germplasm and identification of the desirable genotypes for introgression into breeding programs. The present study was undertaken for initial morphological and phonological characterization of unexploited '*maiwa'* or stay-green pearl millet accession in geographical gaps of Nigeria, so as to group them into maturity cycles, plant height, yield potentials, etc., to ensure high precision in future genotyping and phenotying through the application of biotechnological tools.

II. Methodology

a) Collection Routes

A total of 109 geographical gaps in 65 districts from 16 states (Figure1) were purposively selected to reflect areas where millet is predominantly grown using multi-stage sampling procedure, between October to November, 2011. These collection sites were grouped into three routes for effective coverage as follows:

Route 1 : Gombe, Benue, Taraba and Adamawa States

Route 2 : Zamfara, Kano, Katsina, Bauchi, Sokoto, Jigawa, Yobe and Kebbi States

Route 3 : Nasarawa, Jos and Kaduna States. Consequently, two teams were constituted for collection convenience in the three routes.

b) Sampling Technique

A total of 50 – 100 millet panicle samples were collected on-farm per village, spaced 5 – 10 km apart. However, more than 1 sample was occasionally taken per site based on distinct panicle features. Grains from one-third middle portion of each panicle were then sampled into a sampling bag and then labeled. In addition, robust panicles were collected from the lots in order to determine the edaphic characteristics of the cultivars.

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c) Sample Descriptors/Catalogue

Farmers were interviewed on the spot using a 15-point structured questionnaire (logbook) for standard gene-bank cataloguing as follows:

1. Collection date
2. Collection serial number
3. Cultivar name
4. Days to Maturity
5. Disease
6. Insect
7. Distinct traits
8. Donor name
9. Agro-ecology
10. State
11. Local Government Area
12. District
13. Village
14. Lat.^{0}
15. Long.^{0}

173 samples collected within Lat 7-13^{o}N and Long 4-12^{o}E, from119 geographical gaps in 63 districts across 14 states of Northern Nigeria.

d) Field evaluation

126 maiwa landrace accessions from the 2011 collections were evaluated on 2-row plot on 5m length spaced 0.75m inter-row and 50cm intra-row at Dadinkowa Gombe State of Nigeria. Data were taken for Downy mildew severity, stem borer, *striga* count, days to 50%flowering, plant height, panicle length, panicle weight and grain yield which was subjected to statistical analysis using SAS 9.3. Mean values were determined for all the studied quantitative traits. Pairwise Euclidean distance of genotypes was computed on all traits taken together, and the resulting matrices were used to synthesize dendrograms by unweighted pair- group method with arithmetic means (UPGMA) cluster analysis. Mean values per accession were used and standardized prior to analysis.

III. Result and Discussion

Variation for all parameters except for *striga* was observed among the studied accessions of *maiwa* pearl millet as presented on Table 1. Days to 50% heading serve as a useful criterion determining the maturity range of the genotypes. Performance of the genotypes for this trait depicted considerable variation. Means for days to 50% flowering among the germplasm lines ranged from 75 129 days. Variation for downy mildew resistance depicted by severity index (IS%) score had minimum score of 0% with Maximum score of 50%. Mean values from descriptive statistics showed SI% of 1.00 suggesting genotypes showed high level of resistance to downy mildew infestation. Differences for plant height and panicle length varied from 168-377cm and from 17-113cm for plant height and panicle length respectively. Highly significant variation were observed for panicle circumferences ranging from 5-13cm with mean value of 7.6cm. Result from the data analysis revealed significant variability among the genotypes ranging from 0-1150g/plot with mean yield of 446.75g/plot suggesting the need to improve on this traditionally valued crop considering its low performance for yield in comparison to gero types with higher as a result of its genetic improvement for OPVs and hybrids.

The traits dendrogram (Figure 2) showed that 3 clusters were formed at dissimilarity coefficient of 2.7. The first cluster consists of 26 genotypes which majority are materials from Adamawa and Taraba states which geographic similarity and at boundary with each other. The second cluster consists of 30 genotypes drawn mostly from Sokoto and Kebbi state showing local similarity among the two states as that of Adamawa and Taraba. The 3rd cluster consist of 70 genotypes with majority drawn from Bauchi state followed by Jigawa and few representations from Kano states.

Result from this cluster analysis revealed that materials Adamawa-Taraba, Sokoto-Kebbi and Bauchi are major *maiwa* millet farmers considering the distribution of the genotypes derived from this states in other locations. This also suggests that there are movement of materials across the different agro-ecologies other than from the origin of cultivation.

Table1 : Descriptive statistic on the performance of pearl millet (*maiwa* type) at Dadinkowa during 2012 cropping season

Variables	Mean	Std Error	Minimum	Maximum
Number of hills/row	5	0.1002476	1	7
Downy mildew severity (%)	1	0.3059489	0	50
Striga count at harvest	0	-	0	0
Days to 50% flowering (days)	104	7.0851912	75	129
Plant height (cm)	283.2	1.9666687	168	377
Panicle length (cm)	51.4	1.0753987	17	113
Panicle circumference (cm)	7.6	0.0622953	5	13
Number of panicles @ harvest	18	0.5366185	1	45
Panicle weight/plot (g)	907.25	31.3889824	50	2500
Grain weight/plot (g)	446.75	16.0194404	0	1150
Panicle compactness (score)	2	0.0482837	1	3

IV. Conclusion

Variation for all parameters except for *striga* was observed among the studied accessions of *maiwa* pearl millet Cluster analysis for the traits depicted three clusters suggesting dissimilarity among genotypes although there are movements of materials across states within the *maiwa* millet growing areas as evidenced by genotypes from different states clustering together. The genetic potential of the genotypes can be exploited in future pearl millet breeding programs.

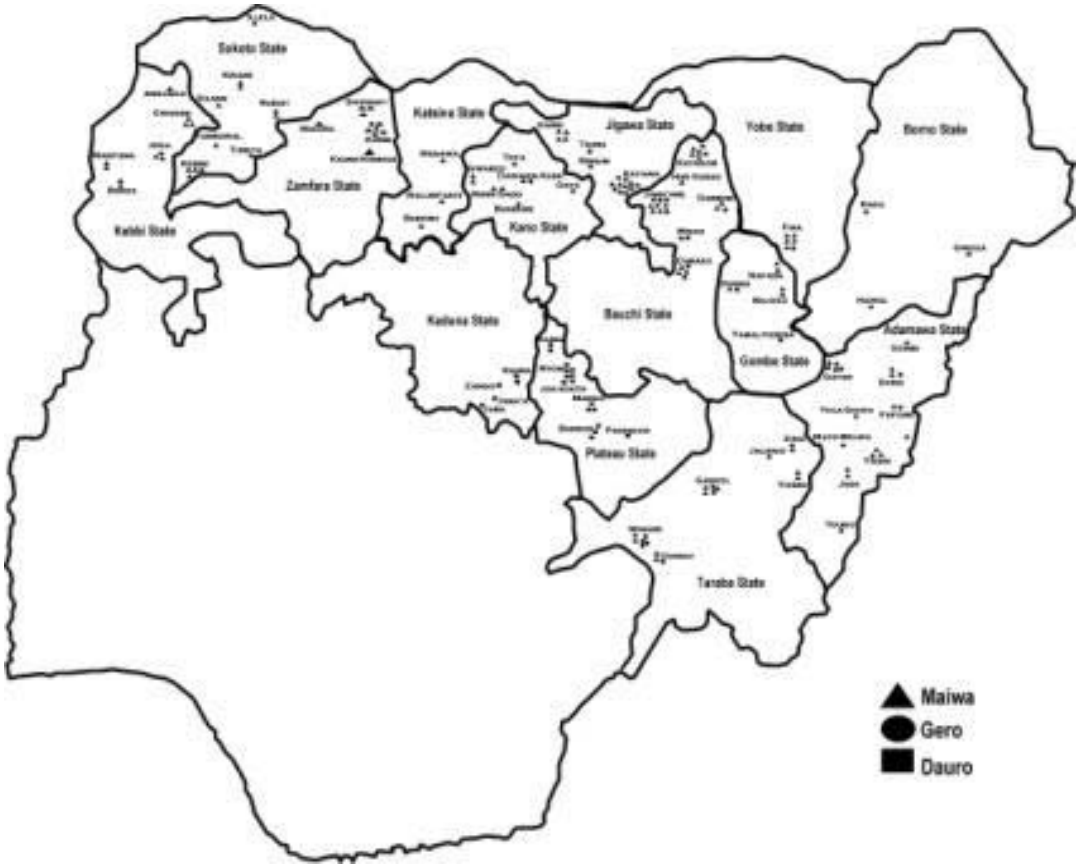

Figure 1 : Geographical districts for *maiwa* pearl millet collection

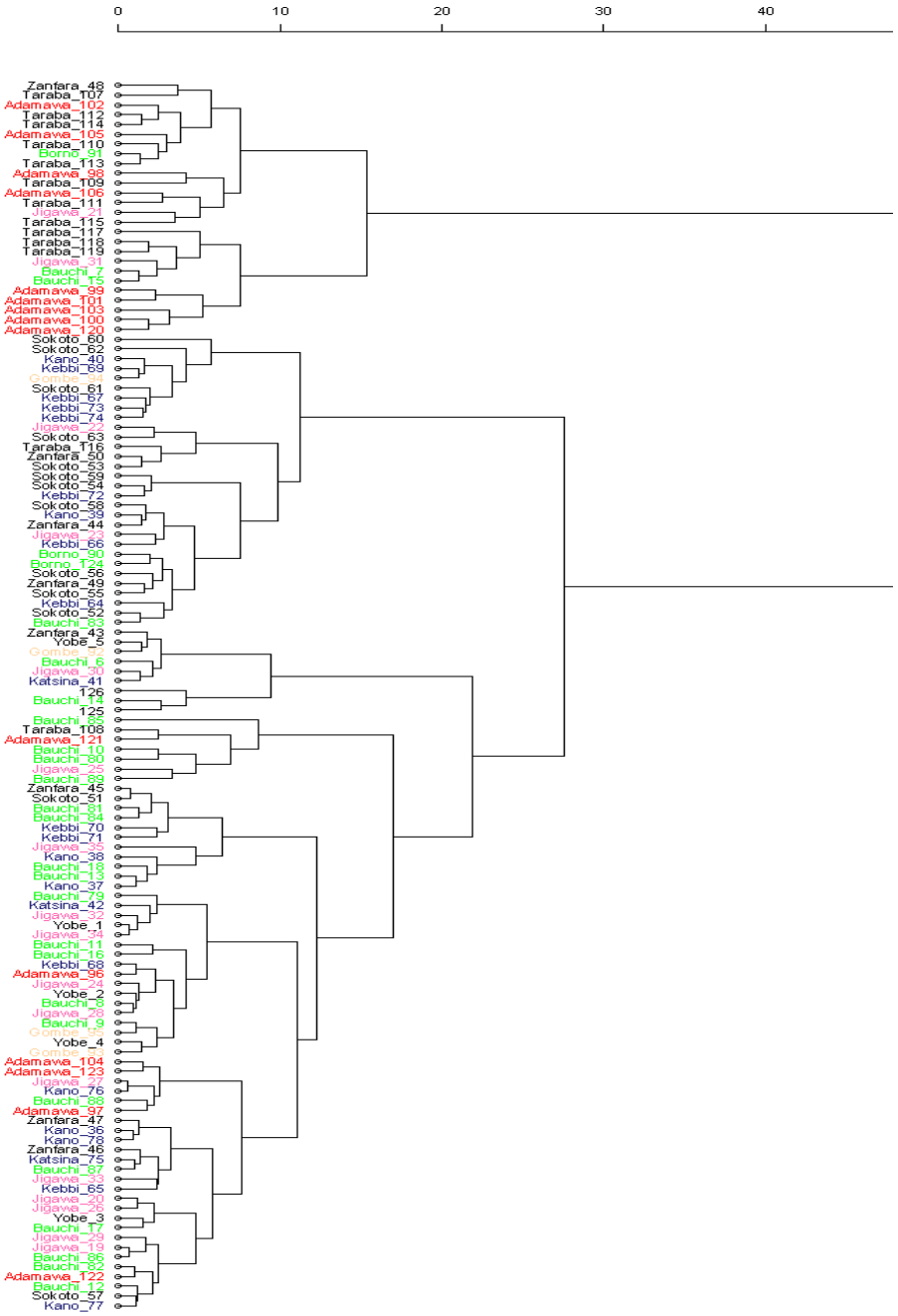

Figure 2 : Cluster analysis

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