PRINCIPAL COMPONENT ANALYSIS IN SOME ACCESSIONS OF SORGHUM (*Sorghum bicolor* (L.)Moench)

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ABSTRACT

The study was carried out to evaluate nineteen accessions of sorghum grown for two consecutive cropping seasons of 2015 and 2016 at the Teaching and Research Farm of Crop Production Department, Federal University of Technology, Minna, Niger-State. The experiment was to characterize 19 sorghum accessions based on their morpho-agronomic traits andto understand the direct and indirect contributions of different traits towards the grain yield. A randomized complete block design with three replications was used for the experiment. Data on the various morpho-agronomical traits were collected and subjected to individual and combined analysis of variance (ANOVA). Highly significant differences among accessions were found for all characters. The principal components revealed variations among the characters studied as the first three components explained 71.5 % and 68.5 % of the cumulative variations for the two years; the remaining two components explained 16 % and 16.4 % of the variation. The most outstanding performance accessions for grain weight are: AKV11 (Kaura), AKV9 (Shawimpe) and AKV14 (Farafara), which could be used for Sorghum improvement programme and recommend for farmers in the Southern Guinea Zones of Nigeria.

Keywords: Accessions, Sorghum, Morpho-agronomic, Principal Component, Variations

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is an important staple food crops and provide bulk of raw materials for the livestock and many agro-allied industries in the world (Ahmed *et al.*, 2012) It had been reported that, area under sorghum cultivation in Sub- Sahara Africa has steadily increased over the years but the average yield trends are downwards (Olembo*et al.*, 2010). There are collections of sorghum genotypes in some research institutes and most of these collections lack information on its morphology- agronomic traits that could be used by researchers to improve sorghum production in Nigeria. However, breeding for high yield crops require information on the nature and magnitude of variation in the available materials and the relationship of yield with other agronomic characters (Ahmed *et al.*, 2012)For any progress in plant breeding, there is the need to study the genetic variability which cannot be easily quantified. Genetic improvement for quantitative traits depends on the nature and amount of variability present in any genetic stock and the extent to which the desirable traits are heritable (Sami *et al.*, 2013). Therefore, there is the need to characterize as much as possible sorghum genotypes available in Nigeria to identify traits for yield against future sorghum improvements for better food production and security The aim and objective of the trial was to estimate the extent of genetic variability for yield and its component traits among some selected sorghum accessions and to understand the direct and indirect Contributions of different traits towards the grain yield.

MATERIALS AND METHODS

Description of the study Area

The trial was conducted in 2015 and 2016 rainy seasons at the Teaching and Research Farm of Crop Production Department, Federal University of Technology, Gidankwano campus Minna, Niger state. The site is located in the Southern Guinea Savanna of Nigeria, with Global Positioning System (GPS) co-ordinates of (Latitude 9.52335N, and Longitude 6.44791E). Minna is located in the Southern Guinea Savanna agro-ecological zone of Nigeria with a mean annual rainfall of 1200mm (Adeboye *et al.*, 2011). The rainfall which has its peaks in September and it usually begins in April and ends in the first week of October. The temperature ranges between 35 and 37.5°C, with relative humidity between 60 and 80 % in the month of July and 40 and 60 % in January.

Experimental Design and Field Layout:

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three (3) replications. The gross plot size was 4m by 2m (8m^2); 5 ridges of 2m long each. The net plot size was 2.4m by 2m (4.8m^2); 3 ridges of 2m long each. Gross plots were separated by a distance of 0.5m each while a distance of 1m separated one replication from the other.

Cultural Practices

The total land area of 658m^2 was measured, ploughed, harrowed mechanically and was ridged manually. Three to four seeds were sown per hill and each stand was later thinned to one plant per stand. NPK fertilizer was applied at the rate of 60 kg N ha^{-1}, 30 kg ha^{-1} of phosphorus (P_2O_5) and 10kgha^{-1} Potassium (K_2O) at 3 weeks and Nitrogen was split at 6 weeks after sowing (WAS). In each year, 1.5L/ha of Atrazine was applied as pre emergence, followed by supplementary hoe weeding at 6 WAS and ridge remoulding at 9 WAS, respectively. Harvesting was done manually.

Data collected were subjected to analysis of variance (ANOVA) using SAS 9.1.3 software statistical package. The means were separated by Student- Newman-Keuls (SNK) test at 5% level of significant.

Principal Component analysis for quantitative traits evaluated during 2015 cropping season in Minna Southern Guinea of Nigeria

Table 2 showed the principal component analysis (PCA) for quantitative traits during the cropping season of 2015. The first PCA was characterized by positive loadings of all the variables and explained by 39.5 % of the total variation. The second PCA was characterized and loaded by 1000 seed weight, grain yield, leaf length, number of leaves/plant, plant height and panicle width. This component contributed 18.1 % of the variation. The third PCA was loaded with leaf width, grain yield, width, leaf length, and days to 95 % maturity and panicle length. This component contributed 13.9 % of the total variation. The fourth component was characterized and loaded positively with plant height, leaf width, number of nodes, and number of leaves/plant. This contributed 10 % of the total variation. The fifth PCA was loaded with panicle width, number of nodes and grain yield. This component contributed 6 % of the total variation.

Principal Component analysis for quantitative traits evaluated during 2016 cropping seas... Minna, Southern Guinea of Nigeria

Table 3 showed the principal component analysis (PCA) for quantitative traits during the ... season of 2016. The first PCA was characterized by positive loadings of all the variables and ... 36.9 % of the total variation. The second PCA was characterized and loaded by 1000 seed w... grain yield, leaf length, plant height, number of leaves/plant and panicle width. This com... contributed 18.2 % of the variation. The third PCA was loaded with leaf width, grain yield, ... width, leaf length, and days to 95 % maturity. This component contributed 13.4 % of the total v... The fourth component was characterized and loaded positively with plant height, numb... leaves/plant, panicle width and number of nodes and leaf width. This contributed 9.9 % of the ... variation. The fifth PCA was loaded with number of nodes, leaf width, panicle width, grain yield ... number of leaves/plant. This component contributed

Table 2. Eigen Vectors for Principal Component axes using quantitative and agronomic traits of the nineteen Sorghum accessions (2015)

Parameters	Prin1	Prin2	Prin3	Prin4	Prin5
Plant Height (cm)	0.231059	0.114663	-0.314577	0.627066	-0.27355
Number of Leaves/Plant	0.383955	0.144548	-0.154417	0.013241	-0.22133
Leaf Length (cm)	0.336704	0.300658	0.198331	-0.161576	-0.29602
Leaf Width (cm)	0.042894	-0.041528	0.544648	0.614788	-0.12676
Number of Nodes	0.180767	-0.091703	-0.564442	0.239203	0.49515
Days to 50 % Flowering	0.448152	-0.208581	-0.006731	-0.011626	-0.10294
Days to 95 % Maturity	0.381361	-0.318956	0.076927	-0.204507	-0.12237
Panicle Length (cm)	0.363262	-0.341687	0.041459	-0.240069	0.02023
Panicle Width (cm)	0.363124	0.075397	0.206811	0.087675	0.53212
Grain Yield (g)	0.177749	0.503067	0.307668	-0.044992	0.42408
1000 Seed Weight	0.098056	0.587094	-0.278412	-0.189795	-0.19539
% variation	**39.5**	**18.1**	**13.9**	**10**	**6**
CV	**39.5**	**57.6**	**71.5**	**81.5**	**87.5**

Table 3. Eigen Vectors for Principal Component axes using quantitative and agronomic traits of the nineteen Sorghum accessions (2016)

Parameters	Prin1	Prin2	Prin3	Prin4	Prin5
Plant Height (cm)	0.007403	0.210968	-0.04331	0.816244	-0.47388
Number of Leaves/Plant	0.361305	0.175293	-0.184071	0.073351	0.008683
Leaf Length (cm)	0.355934	0.285237	0.1599	-0.275947	-0.146274
Leaf Width (cm)	0.06055	-0.032117	0.666535	0.181222	0.381821
Number of Nodes	0.16261	-0.007425	-0.562489	0.243137	0.653076
Days to 50 % Flowering	0.464115	-0.17938	-0.025179	0.063686	-0.14606
Days to 95 % Maturity	0.413747	-0.293023	0.014001	-0.128614	-0.20870
Panicle Length (cm)	0.3813	-0.346044	-0.047281	-0.066413	-0.1066
Panicle Width (cm)	0.369939	0.062181	0.155974	0.246857	0.2691
Grain Yield (g)	0.186932	0.509983	0.280525	-0.008434	0.1495
1000 Seed Weight	0.093957	0.583595	-0.268186	-0.272479	-0.102
% variation	**36.9**	**18.2**	**13.4**	**9.9**	**6.5**
CV	**36.9**	**55.1**	**68.5**	**78.4**	**84.9**

DISCUSSION

Crop improvement activities through breeding are aimed at boosting the genetic potential for yield. Selection based on yield alone is not effective. Therefore breeders select for high yield indirectly through yield association and highly heritable characters after eliminating environmental components of phenotypic variation (Tadele and Assefa, (2012). Effort to improve a character by selection would be futile unless a major portion of variation is heritable. The amount of variation existing in a population is of great importance for any successful application of selection procedure used for crop improvement (Mba*et al.*, 2012). The information on phenotypic coefficient of variation and heritability will be helpful at predicting the possible genetic advance by selection for the character. Knowledge of principal component, direct and indirect contributions of yield components and path analysis would assist in setting up selection indices. There were high significant differences in most of the characters investigated which indicated the presence of wide range of variability, and in agreement with (Khandelwal*et al.*, 2015) that reported similar result of high significant differences in the characters of 224 genotypes investigated. Jain and Patel (2016) studied 32 sorghum genotypes for yield and yield component traits reported existence of diversity in nine quantitative traits among the genotypes. The phenotypic coefficient of variability (PCV) was higher than genotypic coefficient of variability (GCV) for most of the traits investigated except for grain yield that both PCV and GCV maintain the same values. High (PCV %) and (GCV %) were observed in some of the characters studied.(Khandelwal*et al.*, 2015) studied 224 genotypes of sorghum for genetic parameters and characters association among yield components, the result revealed that phenotypic coefficients of variation (PCV) were higher than genotypic coefficients of variation (GCV) for all the traits investigated. The estimate of heritability alone may not indicate the response to selection therefore; the heritability estimate appeared to be more meaningful when accompanied by estimate of genetic advance. High heritability was observed for plant height, leaf length and grain yield. For grain yield similar high broad sense heritability was reported by Jain and Patel (2012)who also found similar high heritability investigated in 102 land races of forage sorghum for plant height, number of leaves per plant, leaf length and fodder yield

The principal component (PC) summarized most of the variables among the nineteen accessions into five and is a reliable method in identifying few key traits contributing to the largest variation and could be a reliable method in predicting the important traits influencing clustering of different accessions.

The PC analysis in this present study provided an opportunity in the classification of accessions and identification of the subset of accessions having difference between yield and yield component

CONCLUSION

The information about components of variance, broad sense heritability, genetic advance, principal component analysis in respect of sorghum yield and yield contributing traits obtained could be used as guide for the improvement of sorghum. It can also help farmers to select productive and profitable accessions. The most outstanding performance accessions for grain weight are AKV11 (kaura), followed by AKV9 (shawimpe) and AKV14 (farefare).

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