CORRELATION AND PATH ANALYSIS FOR SOME CHARACTERS CONTRIBUTING TO GRAIN YIELD IN SORGHUM

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ABSTRACT

The grain yield and other yield contributing characters were studied in three generations (C0, C1, C2) of a random mating population of sorghum Y2 composite, using recurrent mass selection method to improve the grain yield.. The grain yield was positively and significantly (P = 0.05) - correlated with panicle length (r = 0.629), plant height (r = 0.514) and 1000 grain weight (r = 0.514). Plant height was significantly and positively correlated with panicle length and 1000 grain weight (r = 0.578 and 0.593). panicle length and panicle width are also positively and significantly correlated (r = 0.530). Path analysis showed that panicle length had a large positive direct effect on grain yield while 1000 grain weight and plant height had low positive direct effect. Panicle width had a negative direct effect on grain yield. The indirect contribution of plant height and panicle width via panicle length were positive.

INTRODUCTION

Sorghum (*Sorghum bicolor*) (L.) moench) is an important food and feed crop cultivated in both rainy and dry seasons in the savannah ecological zones of Nigeria. Grain yield of sorghum is the multiplicative and product of many factors which influence it singly or jointly. Knowledge on the correlation of characters alone would be misleading as grain yield is a complex character. Hence, it is necessary for a plant breeder to look more closely at the nature of the associations among characters which he wants to improve.

Path coefficient analysis, which has been defined as a standardized partial regression coefficient in to direct and indirect components. Wright (1921), Deway and Lu (1959), and Franker *et al.* (1961) demonstrated the usefulness of path – coefficient analysis in plant breeding. The objectives of this investigation were to study: (1) the association of yield contributing characters among themselves and with grain yield: and (11) the direct and indirect effects of the characters on yield through path coefficient analysis.

MATERIAL AND METHODS

The present investigation was conducted with two advanced YZ composite populations of sorghum obtained from, a random-mating population which was being improved for yield using recurrent mass selection. After two cycles of selections, the three generations (C0, C1, C2) were evaluate Samaru and Mokwa. A randomize complete Block Design (RCBD) was used with four replications. The plot comprised of six (6) rows, each row was 5m long , and 0.75m X 0.30m inter and intra-row spacing were used.The plots were over planted and later thinned down to two seedlings per stand after three weeks, thus maintaining 40 plants per row. This resulted in a plant population of about 80,000 plants per hectare.

Prior to ridging and sowing, 32kg/ha of P_2O_5 (SSP) was applied, while split application of nitrogen fertilizer (NPK 27:13:13) was done at 32kg/ha (basal) and 32kg/ha (Urea 36:0:0) (top dressing) 3 weeks after thinning. Target plants were those in the central two rows of each plot and observation were made on these plants only. Data were recorded at harvest on plant height, panicle length, panicle width, 1000 grain weight and grain yield per ha As suggested by Wright (1921, 1960, 1968 and Deway and Lu 1959). Path coefficient analysis was used to partition the complex correlation of the characters into direct and indirect causes, which influence yield, taking the yield as the effect and all the other characters as possible causes.

RESULT AND DISCUSSION

The range, mean and coefficient of variability for all the characters are presented in Table 1. The maximum genotypic coefficient of variability was in the grain yield and panicle width. In all cases, the phenotypic coefficient of variability was higher than the genotype coefficient of variability. Yield component such as 1000 grain weight, plant height and panicle had almost similar values of phenotypic and genotypic coefficient of variability. Similarly they have low SE, thus indicating that these characters are less influenced by the environment, hence, these characters are amendable to considerable improvement through selection. On the contrary, grain yield and panicle width seem to be quite sensitive to environmental changes .Estimates of coefficient of variability for plant height, grain yield, panicle width and panicle length are in conformity with those reported by Lukhele and Obilana, (1984).

The phenotypic correlation coefficients computed among 5 agronomic characters (Table 2) revealed that all the correlation coefficients were positive: Grain yield had the highest and significant (p = 0.05) correlation with panicle length (r = 0.629), followed by plant height (r = 0.514) and 1000 grain weight (r = 0.514). Panicle width with 1000 grain weight was not significantly correlated grain yield and plant height: while panicle length and 1000 grain weight were also and not significantly correlated. The implication of these results is that an increase in plant height and panicle length could result in corresponding increases in 1000 grain weight and total grain yield improving one character will have a direct progressive and corresponding effects on the character in association. This is in agreement with findings of Thombre and Patil (1985) in sorghum population, Nwasike *et al.*, (1987) in millet, and Obilana (1977) in maize.

The path diagram (Figure 1) revealed that the grain yield was directly influenced by 1000 grain weight

(0.1386), panicle width (-0.2119), panicle length (0.5770) and plant height (0.1645), while the residual factors 0.5119 and panicle width was positively low and non- significantly correlated with grain yield (0.185), but path analysis showed that the direct effect was negative (-0.2119). The positive phenotypic correlation was because of its positive indirect effect through plant height, panicle length and 1000 grain weight . Hence, these characters should be considered simultaneously for selection and improvement. Panicle length and grain yield showed a high positive significant correlation (r = 0.629) and had the largest direct effect on grain yield (0.5770). This negligible difference between correlation and direct effect showed a true relationship between panicle length and grain yield, thus, a direct selection through this character will be effective. The path coefficient analysis showed that 1000 grain weight and plant heignt increase the grain yield through the panicle length.

The residual effect (R) determines how best the causal factors account for the variability of the dependent factor. In this study R = 0.51196, therefore the variables (plant height, panicle length, panicle width and 1000 grain weight) explain only about 49% of the variability in grain yield. This residual effect (R) is lower than that of Ado *et al.*, (1988) in sunflower (0.67) but higher than that reported by Zaria *et al.* (1995) in cowpea (0.37). This suggests the inclusion of more yield components not considered in this study.

The phenotypic correlation as well as the path coefficient analysis do not always present similar pictures of the major causal forces determining the final expression of grain yield. From the materials studied, a greater selection efficiency could be obtained by formulating selection indices based on panicle length, and indirectly, plant height and 1000 grain weight.

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Table 1: Range mean and coefficient of variability for yield and yield component in sorghum.

Character	Range	Mean	Coefficient of variation (%)	
			Phenotype	Genotype
Plant Height (cm)	124.86-244.86	212.10±15.4	0.92	0.19
Panicle length (cm)	22.25-36.25	32.39±1.75	5.85	5.18
Panicle Width (cm)	6.30-12.17	9.30±1.20	18.45	13.60
1000 grain weight (gm)	16.31-35.56	27.70±1.90	6.69	6.04
Grain yield (kg/ha)	338.89-4977.78	2127.78±505.56	21.93	18.85

Table 2: Phenotypic correlations of yield and yield components in sorghum.

Character	Range	Mean	Coefficient of variation (%)	
			Phenotype	Genotype
Plant Height (cm)				
Panicle length (cm)	0.687*			
Panicle Width (cm)	0.336	0.530*		
1000 grain weight (gm)	0.593*	0.490	0.134	
Grain yield (kg/ha)	0.514*	0.629*	0.185	0.514*

* = significant at 0.05 level of probability

Table 3: Path coefficient analysis showing direct and indirect effects of yield and yield component in sorghum

Cause and effect	Correlation	Cause and effect	Correlation
Plant height vs yield	0.514	Panicle weight vs yield.	0.185
Direct effect	0.1643	Direct effect p_{35}	-0.2119
Indirect via panic length $P_{25}\ r_{12}$	0.3387	Indirect via plant height $p_{15}\ r_{31}$	0.0552
Indirect via panicle width $p_{35}\ r_{13}$	-0.3387	Indirect via panicle length $p_{25}\ r_{32}$	0.3231
Indirect via 1000 grain weight $p_{45}\ r_{15}$	0.0822	Indirect via 1000 grain weight $p_{45}\ r_{34}$	0.0552
Total	0.514	Total	0.18499
Cause and effect	**Correlation**	**Cause and effect**	**Correlation**
Plant height vs yield	0.629	Panicle weight vs yield.	0.514
Direct effect	0.5770	Direct effect p_{35}	0.1386
Indirect via panic length $P_{25}\ r_{12}$	0.0964	Indirect via plant height $p_{15}\ r_{31}$	0.09743
Indirect via panicle width $p_{35}\ r_{23}$	-0.1123	Indirect via panicle length $p_{25}\ r_{32}$	0.30696
Indirect via 1000 grain weight $p_{45}\ r_{15}$	0.0679	Indirect via 1000 grain weight $p_{45}\ r_{34}$	-0.02894
Total	0.6290	Total	0.51405

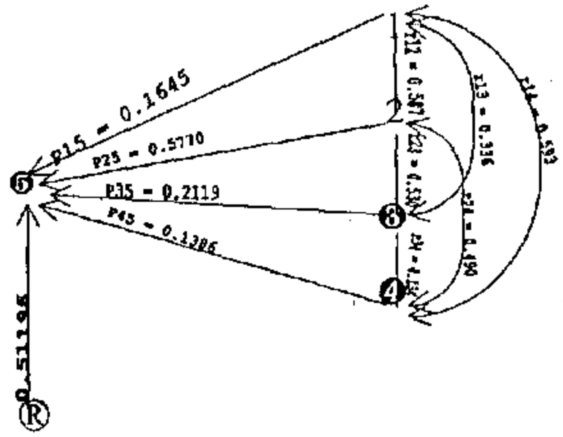

Fig. 1: Diagrammatic representation of factors (path-coefficient analysis) influencing grain yield in sorghum
(1) Plant height (2) Panicle length (3) Panicle width (4) 1000 grain weight (5) Grain yield ,(6) Residual factor
Double arrowed lines denote mutual association as measured by correlation coefficients, while single arrowed lines denote direct influence and measured by the path coefficient analysis.