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Correlation and Path Analysis between Sorghum Yield to Growth and Yield Characters

U.L Arunah[1] U. F. Chiezey[1] L. Aliyu[1] and A. Ahmed[1.2]
1. Department Agronomy, Ahmadu Bello University, Zaria, Nigeria
2. Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria

Abstract
Mutual association between characters of two sorghum varieties (ICSV III and SAMSORG 14) was determined using correlation coefficient of two years experiment. The percent contribution of growth and yield components to yield was also determined with path coefficient analysis. In both years and the average over the years, a positive and highly significant correlation was observed between sorghum yield and plant height, leaf area index and total dry matter. Likewise, sorghum yield also had a positive and highly significant interaction with panicle weight and 1000- grain weight. The highest individual contribution was made by leaf area index, followed by plant height. Total dry matter, panicle length and weight also contributed positively to the final yield. The highest combined percent contribution to yield resulted from plant height via leaf area index. This was followed by contribution from plant height via panicle weight, panicle length via leaf area index respectively. In improving sorghum yield emphasis on breeding should be on its height, leaf area index and panicle length.
Keywords: Sorghum, correlation, growth, regression and yield.

Introduction
Sorghum is known to be highly versatile, hardy and very dependable in yields under adverse conditions. The crop requires a long night for panicle initiation which also reflects on its performance. These are in turn affected by production factors such as fertilizer, seeds rate, moisture level etc. the association among these characters can provide useful information about crop response to treatments and ways of improving the yield. The relationship between parameters has often been determining using correlation analysis to determine the type and strength of these associations (Aliyu *et al*., 1991, Aliyu *et al*., 2000). The direct and indirect contribution of growth and yield components to yield has also played an important role in yield determination. This may be useful in effective selection of characters that will improvement yield. The technique was first described by Wright (1918) and the mathematical implication of the method and its basic features are documented in the literature (Li 1956; Turner and Stevens, 1959; Wright 1960). The objective of this paper is to describe the association between various sorghum growth characters, yield components with the purpose of identifying those that could contribute to yield.

Materials and methods
Field experiments were conducted during the rainy seasons of 2002 and 2003 at the research farm of the Institute for Agricultural Research, Samaru, Nigeria (11^{o} 11^{l} N, 07^{0} 38^{l} E). treatments consisted of two sorghum varieties (ICSV III and SAMSORG 14), three nitrogen levels using urea at 0: 40 and 80 kg N ha^{-1} and three poultry manure levels (0, 1 and 2 t ha^{-1}) which were factorially combined and laid out in a Randomize Complete Block Design (RCBD) replicated three times. The gross and net plot size were 24 and 12 m^2 respectively. Data were recorded on plant height, LAI, total dry matter, panicle length and weight, 1000- grain weight and grain yield. Correlation coefficient and multiple regression was calculated from the means of the treatment across replications and years.
Correlation coefficient between a pair of character was computed using the formular given by Steel and Torrie (1984). In order to get the direct and indirect effects of the characters on grain yield, path coefficient was obtained in accordance with the method of Dewey and Lu (1959).

Results and discussions
The correlation between sorghum and plant height, LAI, TDM, panicle length and weight, and 1000- grain weight were observed to be positive and highly significant in both years and average over the years except, where significant correlation was observed between yield and TDM in average over the years (Table 1). The could be due to the increase in sorghum height, which might have led to increase in LAI as a result of increase in photosynthetic ability of the plant that helped in assimilate production. Assimilates formed might have been translocated to the TDM thus, helped in increasing the sorghum panicle length and weight that was observed in the strong relation with yield. The LAI also had a positive and highly significant relation with other growth and yield attributes. Likewise, other yield components had a positive relation between themselves and with growth characters. Since LAI is a measure of the photosynthetic capacity per unit area of ground, increase in LAI might had led to increased in assimilate formation, thus helped in increasing other growth and yield attributes. This

suggests that this growth and yield attributes of sorghum are important in yield determination. Kamoshita *et al*., 1998 and Utzurrum *et al*., 1998 reported significant relation between sorghum yield to growth and yield attributes.

The correlation analysis was able to establish the type and magnitude of the relationships between the characters. However, it was not unable to provide an exact picture of the relative importance of each causal factor nor did it show the sole and combined contributions of the characters to yield. The percent contribution became useful as a tool of unraveling the individual and combined causes of association. The individual and combined percent contribution in 2002 and 2003, and average over the years are presented in Table 2. All the parameters positively contributed to the yield, however, there was no consistence in highest contributor in both years. In the average over the years, LAI contributed more to the grain yield than other parameters. And in the combined contributor, plant height via LAI contributed more to yield. This was followed by plant height via panicle length and panicle length via LAI. The higher individual contribution from LAI shows the importance photosynthetic ability of a plant as an index of assimilates production for yield. The combined contribution from plant height and panicle length might be due to the importance of these parameters to yield. Ibrahim (1995) also observed higher contribution of these parameters to sorghum yield.

Conclusion

The greatest contributions to yield were observed on LAI, plant height and panicle length. These are parameters that should be worked on for crop improvement, to achieve better yield in sorghum production.

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Table 1: Correlation coefficient between growth and yield components of sorghum during 2002, 2003 rainy season and average over the years (Mean).

	Plant height	LAI	TDM	Panicle length	Panicle weight	1000-G/weight	Yield
2002							
Plant height	1.000						
LAI	0.820**	1.000					
TDM	0.776**	0.8599**	1.000				
Panicle length	0.881**	0.787**	0.778**	1.000			
Panicle weight	0.750**	0.736**	0.673**	0.710**	1.000		
1000- grain weight	0.783**	0.762**	0.728**	0.777**	0.742**	1.000	
Yield	0.84**	0.857**	0.830**	0.825**	0.736**	0.780**	1.000
2003							
Plant height	1.000						
LAI	0.784**	1.000					
TDM	0.891**	0.823**	1.000				
Panicle length	0.930**	0.792**	0.905**	1.000			
Panicle weight	0.859**	0.854**	0.922**	0.902**	1.000		
1000- grain weight	0.803**	0.834**	0.827**	0.846**	0.911**	1.000	
Yield	0.868**	0.828**	0.847**	0.873**	0.895**	0.891**	1.000
Mean							
Plant height	1.000						
LAI	0.636**	1.000					
TDM	0.781**	0.490**	1.000				
Panicle length	0.857**	0.753**	0.664**	1.000			
Panicle weight	0.805*	0.614**	0.762**	0.741**	1.000		
1000- grain weight	0.795*	0.652*	0.689**	0.773**	0.803**	1.000	
Yield	0.840**	0.765**	0.717*	0.843**	0.782**	0.811**	1.000

* = significant at 5 % level **= significant at 10 % level

Table 2: percent contribution of some growth and yield components to sorghum yield in 2002, 2003 rainy seasons and average over the years (Mean).

	2002	2003	Mean
Individual and direct contribution			
Plant height	5.2	24.8	7.26
Total dry matter/ plant	4.72	5.13	1.33
Leaf area index	8.16	2.97	8.47
Panicle length / plant	2.63	0.03	4.43
Panicle weight / plant	0.80	27.36	2.04
Combined contribution			
Plant height and Total dry matter / plant	7.86	-19.88	4.86
Plant height and Panicle length / plant	6.66	1.04	9.72
Plant height and Panicle weight / plant	3.13	44.28	6.19
Plant height and Leaf area index	10.92	13.31	9.97
Total dry matter / plant and Panicle length / plant	5.49	-0.46	3.23
Total dry matter / plant and Panicle weight / plant	2.62	-21.84	2.51
Total dry matter / plant and Leaf area index	10.66	-6.42	2.29
Panicle length / plant and Panicle weight / plant	2.06	1.07	4.46
Panicle length / plant and Leaf area index	7.30	0.31	9.23
Panicle weight / plant and Leaf area index	3.77	15.40	5.10
Residual	17.75	13.42	18.90
Total	100.00	100.00	100.00