Gashua Journal of Irrigation and Desertification Studies
Available online at www.gjidsfugashua.org.ng
Maiden Edition: Vol 1, Nos. 1 & 2

CORRELATION AND PATH ANALYSIS IN GROUNDNUT (*Arachis hypogaea* L.) VARIETIES AS INFLUENCED BY POULTRY MANURE AND WEED CONTROL TREATMENTS IN IRRIGATED CONDITION AT KADAWA

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Abstract

In order to identify characters that contribute to yield of groundnut (*Arachis hypogaea* L.) varieties under the influence of poultry manure and weed control treatments in irrigated condition, field trials were conducted during the 2012/2013 and 2013/2014 dry seasons at the Irrigation Research Farm of the Institute for Agricultural Research, located in the Sudan savanna ecological zone of Nigeria. The treatments consisted of three levels of poultry manure (0, 1.5 and 3 t ha^{-1}), five weed control treatments (54 g a.i. ha^{-1}, 108 g a.i ha^{-1} and 162 g a.i ha^{-1} of Haloxyfop-R-methyl ester, weedy check, and two hoe weeding at 3 and 6 WAS) on three varieties of groundnut (SAMNUT 23, SAMNUT 22 and SAMNUT 11). The treatments were laid out in a split plot design with factorial combination of the weed control treatments and poultry manure rates occupying the main plot, while the varieties were allocated to the subplots. The strength of relationship between growth and yield characters was studied using correlation coefficient analysis. The direct, indirect, individual and combined contributions of growth and yield components to total pod yield were determined using path analysis. The results showed that pod yield was positively and highly correlated with number of branches, numbers of pods, pod weight, 100-kernel weight but was negatively correlated with haulm yield. Pod weight had the highest direct contribution which was followed by 100-kernel weight, number of pods, number of branches, plant height and canopy spread in that order, while number of leaves had the lowest direct contribution. The highest percent individual contribution was from pod weight followed by 100-kernel weight, number of pods, number of branches, plant height, canopy spread and number of leaves in that order. The combined effect of pod weight and 100-kernel weight gave the highest combined contribution while the combined contribution of number of branches and number of pod ranked second. The least combined contribution was from number of leaves and number of pods and plant height and canopy spread that resulted in negative values. This study has confirmed that all the growth and yield characters considered made significant contribution to pod yield and thus constitute important characters when breeding for high yielding groundnut varieties.

Keywords: *Correlation, path analysis, direct contribution, percentage contribution.*

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the most important oil seed crop in the world (Mukhtar, 2009). Groundnut plays an important role in the diets of rural populations, particularly children, because of its high contents of protein and carbohydrate. It is also rich in calcium, potassium, phosphorus, magnesium and vitamin E (Mukhtar, 2009). Protein meal, a by-product of oil extraction, is an important ingredient in livestock feed. Groundnut haulm is nutritious and widely used for feeding livestock. The shells are used as fuel by some local oil factories or they are sometimes spread on the field as a soil amendment (Mukhtar, 2009).

Estimation of simple correlation between various agronomical characters may provide good information necessary for groundnut production, when selection is based on two or more traits simultaneously (Mukhtar, 2009). Sadek *et al.* (2006) and Babaji *et al*. (2005 and 2007) reported that information obtained from correlation coefficients for these characters could also be useful as indicator of the more important parameters under consideration. They further observed that association among traits might be measured by genotypic or phenotypic coefficients of correlation depending on the types of studied material and the kind of experimental design.

Path analysis was first described by Wright (1921, 1934) as a means of describing the influence of independent factors on dependent factors while also calculating the simple correlation between pairs of dependent factors. Path analysis techniques partitions correlation into direct and indirect effects and differentiate between correlation and causation (Wright, 1934). In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Dewey and Lu, 1959, Milligan *et al.*, 1990 and Adekpe, 2005).The correlation of economic yield components with yield and the partitioning of the correlation coefficient into its components of direct and indirect effect have been extensively studied in groundnut (Abdu El-Aal *et al*., 2006, Karikari *et al.,* 2003 and Mukhtar, 2009). Mukhtar e*t al.* (2013) concluded that plant height was the most critical growth parameter for determining yield of groundnut under irrigation.

Groundnut pod yields from farmers' field are low, averaging 1,000 kg ha^{-1} which is about one-third the potential yield of 3000 kg $ha^{-1.}$ This large gap between actual and potential yields is due to several factors, including non-availability of seeds of improved varieties for a particular ecology, poor soil fertility, inappropriate crop management practices, pests and diseases (Ahmed *et al.,* 2010). Therefore, there is the need to study the correlation between pod yield with other growth and yield characters and the partitioning of the correlation coefficient into its components of direct and indirect effect in other to identify parameters that need to be selected in varietal development. The objective of this work is to study correlation and path analysis in groundnut varieties as influenced by poultry manure and weed control treatments under irrigation.

MATERIALS AND METHODS

Field trials were conducted during the 2012/2013 and 2013/2014 dry seasons at the Irrigation Research Farm of the Institute for Agricultural Research, Kadawa (Latitude, 11° 39 $'$ N, Longitude 08° 27$'$ E, 500 meter above sea level) located in the Sudan Savanna ecological zone of Nigeria. The treatments consisted of three levels of poultry manure (0, 1.5 and 3 t ha^{-1}), five weed control methods (54 g a.i.ha^{-1}, 108 g a.i ha^{-1} and 162 g a.i ha^{-1} of Haloxyfop-R-methyl ester, weedy check, and two hoe weeding at 3 and 6 WAS) and three varieties of groundnut (SAMNUT 23, SAMNUT 22 and SAMNUT 11). The treatments were laid out in a split plot design with factorial combinations of the weed control methods and poultry manure rates occupying the main plot while the varieties were allocated to the subplots. The land was harrowed twice and ridged to obtain a fine tilth. It was then marked out into 45 plots with 1.0m spacing between blocks and 0.5m spacing between plots. The treatments were replicated three times throughout the period of experimentation. The gross and net plot sizes were 18.0 m^2 (4.5 m x 4 m) and 6.0 m^2 (1.5 m x 4 m), respectively. There were 6 ridges in gross plot and 2 ridges in net plot. Poultry manure was applied three weeks before sowing. It was uniformly spread on the ridge and lightly worked into soils with hoe. The groundnut seed was sown at a spacing of 75cm x 23cm. One kernel was sown per hole. Haloxyfop –R- Methyl ester was applied at 3 weeks after sowing (WAS). Irrigation was carried out using furrow method and water was supplied at 10 days intervals, and was stopped a week before harvesting each variety, although the amount of water used to irrigate was not quantified. Assessment of vegetative characters was done at 12 WAS. Five plants were randomly selected and tagged in each plot for sampling. Number of branches per plant was obtained by physical counting of the total number of branches of five tagged plants and the mean obtained. Number of leaves was obtained by actual counting of the total number of leaves of five tagged plants and the mean obtained. In measuring the shoot dry weight, two plants were randomly selected in each gross plot. The shoot sample was packed in an electronic oven at 70^0C for 48 hours as suggested by Sharma and Mehta (1991). Dried shoot weight was measured using E2000 electronic mettler balance and the mean of dry matter per plant was recorded on per plot basis. Plant height was measured *in situ* using a meter rule from the ground level to the terminal leaflet. Canopy spread was measured by taking the diameter of the open canopy using a meter rule and the mean obtained was recorded on per plot basis. Assessment of yield component was carried out at harvest. Number of pods per plant was determined by counting the total number of pods from the five randomly selected plants in each plot, and mean number per plant was computed. Weight of pods per plant was determined by measuring the weight of the entire pods from the five randomly selected plants in each plot using E2000 electronic mettler balance and the mean weight per plant computed. A total of 100 kernels were randomly counted from each net plot, weighed and the value was recorded as 100 kernel weight. The haulm yield per net plot weighed was extrapolated to per hectare and the value obtained was recorded as haulm yield per ha. Data collected were subjected to Analysis of Variance (ANOVA) using general linear model GLM of the Statistical Analysis System package (SAS, 2003) and the means were separated using Duncan's Multiple Range Test (Duncan, 1955). The strength of relationship between growth and yield characters was studied using correlation coefficient analysis (Little and Hills, 1978 and Babaji *et al.*, 2005 and 2007).The direct, indirect, individual and combined contributions of growth and yield components to total pod yield were determined using path analysis (Dewey and Lu, 1959 Babaji *et al.*, 2005 and 2007).

RESULTS AND DISCUSSION

Correlation Matrix between Yield and Some Growth and Yield Characters

Pod yield was positively and highly correlated with number of branches, numbers of pods, pod weight, 100-kernel weight but was negatively correlated with haulm yield. Number of branches was positively and highly correlated with number of leaves, canopy spread and haulm yield. Number of leaves was positively and highly correlated with shoot dry weight, canopy spread and haulm yield. Shoot dry weight was positively and highly correlated with canopy spread and haulm yield. Canopy spread was positively and highly correlated with number of pods and haulm yield. In 2012/2013 dry season, number of pod was positive and highly correlated with to 100-kernel weight while in 2013/2014 dry season number of pods was positively and highly correlated with pod weight. Pod weight was positively and highly correlated with 100-kernel weight but negatively and highly correlated with haulm yield. The correlation value between 100-kernel weight and haulm yield was highly negatively correlated as shown in Tables 1 and 2.

Path Analysis

Direct and indirect contribution

The partitioning of the total correlation in to direct and indirect effects of some growth and yield characters on pod yield of groundnut were positive throughout the period under consideration. Pod weight had the highest direct contribution which was followed by 100-kernel weight, number of pods, number of branches, plant height and canopy spread in that order, while number of leaves had the lowest direct contribution as shown in Tables 3.

Percent contribution

The percent individual and combined contribution of some growth and yield characters on pod yield is shown in Table 4. In 2012/2013 and 2013/2014 dry seasons, the highest percent individual contribution was from pod weight followed by 100-kernel weight, number of pods, number of branches, plant height, canopy spread and number of leaves in that order. The combined effect of pod weight and 100-kernel weight gave the highest combined contribution while the combined contribution of number of branches and number of pods ranked second. The least combined contribution was from number of leaves and number of pods and plant height and canopy spread that resulted in negative values.

The percent total individual contributions were 32.23% and 7.99% in 2012/2013 dry season and 2013/2014 dry season, respectively. The total combined contributions were 51.86% in 2012/2013 dry season and 62.51% in 2013/2014 dry season. The total contribution from both the individual and the combined were 84.10% in 2012/2013 dry season and 70.51% in 2013/2014 dry season. The residuals, which were the un- accounted contributions from other characters to yield, were 15.91% in 2012/2013 dry season and 29.49% in 2013/2014 dry season. The significant and positive correlations between pod yield and growth characters indicated the importance of good vegetative development as being necessary for high yields. This is in conformity with the work of Wright (1934) who noted a highly significant positive relationship between pod yield and vegetative characters. The positive significant relationship between pod yield and yield characters indicates that these characters are important yield indices (Mukhtar, *et al.*, 2013, Babaji *et al.*, 2005 and Babaji *et al.,* 2007). All the direct and indirect effects were positive throughout the period under consideration. This suggests that these characters are important in pod yield and the higher the direct or indirect effect the most critical the determinant in pod yield and thus constitute important characters that the breeders should consider when breeding for high yielding varieties.

CONCLUSION

Based on the results of this work, it can be concluded that all the growth and yield characters considered in this work made significant contribution to pod yield and thus constitute important characters when breeding for high yielding varieties.

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Table 1: Correlation matrix among some growth and yield characters of groundnut during the 2012/2013 dry season at Kadawa

	Pod yield	Number of branches	Number of leaves	Shoot dry weight	Plant height	Canopy spread	No of pods	Pod weight	100-kernel weight	Haulm yield
Pod yield	1									
Number of branches	0.71**	1								
Number of leaves	0.18	0.57**	1							
Shoot dry weight	-0.19	0.17	0.39**	1						
Plant height	0.33**	-0.21*	0.13	0.16	1					
Canopy spread	0.22*	0.30**	0.85**	0.44**	-0.01	1				
No of pods	0.51**	0.08	0.06	0.04	0.11	0.54**	1			
Pod weight	0.80**	0.04	0.11	0.14	0.09	0.13	0.22*	1		
100 kernel weight	0.83**	0.13	0.04	0.07	0.02	0.17	0.28**	0.74**	1	
Haulm yield	-0.35**	0.72*	0.46**	0.77**	0.05	0.43**	0.02	-0.27**	-0.36**	1

r at 5% =0.195, r at 1% =0.254, *= significant at 5% level of significant and ** = significant at 1% level of significant

Table 2: Correlation matrix among some growth and yield characters of groundnut during the 2013/2014 dry season at Kadawa

	Pod yield	Number of branches	Number of leaves	Shoot dry weight	Plant height	Canopy spread	No of pods	Pod weight	100-kernal weight	Haulm yield
Pod yield	1									
Number of branches	0.45**	1								
Number of leaves	0.30**	0.54**	1							
Shoot dry weight	-0.03	0.22*	0.35**	1						
Plant height	0.13	-0.04	0.12	0.13	1					
Canopy spread	0.14	0.40**	0.32**	0.29**	-0.16	1				
No of pods	0.27**	0.13	0.24*	0.08	0.17	0.26**	1			
Pod weight	0.35**	0.14	0.02	0.06	0.07	0.11	0.38**	1		
100 kernel weight	0.39**	0.07	0.08	0.08	0.12	0.13	0.24*	0.47**	1	
Haulm yield	-0.48**	0.52**	0.51**	0.40**	0.03	0.22*	0.01	-0.34**	-0.29**	1

r at 5% =0.195, r at 1% =0.254, *= significant at 5% level of significant and ** = significant at 1% level of significant

Table 3: The direct and indirect effects of some growth and yield characters on pod yield of groundnut at Kadawa during the 2012/2013 and 2013/ 2014 dry seasons.

2012/2013

characters	Number of branches	Number of leaves	Plant height	Canopy spread	No of pods	Pod weight	100 kernel weight	Total correlation
Number of branches	**0.13**	0.15	0.05	0.09	0.12	0.04	0.13	0.71
Number of leaves	0.05	**0.03**	0.02	0.02	0.03	0.01	0.02	0.18
Plant height	0.02	0.09	**0.10**	0.02	0.05	0.02	0.03	0.33
Canopy spread	0.01	0.03	0.01	**0.06**	0.09	0.01	0.01	0.22
No of pods	0.13	0.01	0.04	0.04	**0.19**	0.03	0.07	0.51
Pod weight	0.04	0.04	0.05	0.02	0.05	**0.42**	0.18	0.80
100 kernel weight	0.10	0.06	0.10	0.07	0.05	0.17	**0.28**	0.83

2013/2014

characters	Number of branches	Number of leaves	Plant height	Canopy spread	No of pods	Pod weight	100 kernel weight	Total correlation
Number of branches	**0.10**	0.09	0.03	0.06	0.07	0.02	0.08	0.45
Number of leaves	0.10	**0.02**	0.03	0.04	0.05	0.02	0.04	0.30
Plant height	0.01	0.01	**0.07**	0.01	0.01	0.01	0.01	0.13
Canopy spread	0.01	0.02	0.01	**0.03**	0.05	0.01	0.01	0.14
No of pods	0.06	0.01	0.02	0.02	**0.12**	0.01	0.03	0.27
Weight of pods	0.02	0.02	0.02	0.01	0.02	**0.18**	0.08	0.35
100 kernel weight	0.05	0.03	0.05	0.03	0.02	0.08	**0.13**	0.39

Figures highlighted represent direct effect

Table 4: Percent individual and combined contribution of some growth and yield characters to pod yield of groundnut and their residual effect at Kadawa during the 2012/2013and 2013/2014 dry seasons.

Growth and yield characters		
Individual Contribution	**2012**	**2013**
No of branches	1.69	1.00
No of leaves	0.09	0.04
Plant height	1.0	0.49
Canopy spread	0.36	0.09
No of pods	3.61	1.44
Pod weight	17.64	3.24
100 kernel weight	7.84	1.69
Sub total	**32.23**	**7.99**
Combined contributions		
No of branches and no of leaves	3.18	4.29
No of branches and plant height	0.08	0.07
No of branches and canopy spread	0.22	0.24
No of branches and No of pods	5.62	4.97
No of branches and pod weight	0.43	0.38
No of branches and 100 kernel weight	0.26	0.60
No of leaves and plant height	0.02	0.03
No of leaves and canopy spread	1.14	1.11
No of leaves and No of pods	-0.002	-0.004
No of leaves and pod weight	0.06	0.07
No of leaves and 100 kernel weight	0.02	0.05
Plant height and canopy spread	-0.001	-0.006
Plant height and No of pods	0.05	0.0475
Plant height and pod weight	0.04	0.035
Plant height and 100 kernel weight	0.07	0.0575
Canopy spread and No of pods	0.09	0.2975
Canopy spread and pod weight	0.03	0.0275
Canopy spread and 100 kernel weight	0.30	0.245
No of pods and pod weight	0.66	0.515
No of pods and 100 kernel weight	0.19	0.2375
Pod weight and 100 kernel weight	39.40	49.26
Sub total	**51.86**	**62.51**
Total	**84.10**	**70.51**
Residual	**15.91**	**29.49**