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RESEARCH ARTICLE

CORRELATION AND PATH COEFFICIENT ANALYSES OF SEED YIELD AND YIELD COMPONENTS IN OKRA (*Abelmoschus esculentus* (L) MOENCH)

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Abstract

The study was conducted at Modibbo Adama University of Technology, Yola and Shelleng LGA, Adamawa State, Nigeria during the year 2011. A line x tester analysis was made to identify the correlation and path coefficients analysis in Okra. Eight lines/females (SH1, SH2, SH3, SH4, GR1, GR2, GR3 and GR4) and Two testers/males (Paysan and Clemson) were crossed to develop 16 F1 hybrids. These genotypes were evaluated along with parents in RCBD with three replications. Analysis of variance and other genetic analyses such as genotypic and phenotypic coefficient of variation and path coefficient analyses were performed. The results obtained showed highly significant variation in all the genotype except days to 50% flowering, and characters measured such as number of pods per plant (54.365**), number of branches per plant (8.2063**), number of leaves per plant (45.891**), days to pod formation, pod length (6.6526**), pod width (54.306**), seed index (20.787**), number of seeds per pod (2.4373**), plant height at 50% flowering (2543.5**), pod yield (45.395**), seed yield (427.73**), seed size (0.0144**) and internodes distance (0.6602**). Genotypic coefficient of correlation showed more significant relationship between the pair of characters, meaning that, these characters are more related genotypically. Path coefficient analysis revealed that Seed size had positive and highly significant genotypic association with seed yield (0.709**) and also with high positive direct effect on seed yield (0.703), this suggests that the two attributes have a strong influence on seed yield. Number of seeds per pod had the highest significant correlation effect on seed yield (0.846**) as well as highest negative direct effect with seed yield (-1.00) indicating that selection of number of seeds per pod will increase seed yield.

Introduction

The ultimate goals of an okra breeder is to develop high yielding varieties (pod and seed yield), though selection and breeding, utilizing available genetic resources. The final product of okra plant i.e. pod and seed yield are the outcome of inter play between genetic and non-genetic component and due to complex nature of the interaction selection. The cultivated okra (*Abelmoschus esculentus* (L.) Moench) is an important vegetable crop throughout tropical and subtropical regions of Asia and Africa (Bisht and Bhat, 2006). It originated in tropical Africa (Purseglove, 1974); also it presumably originated in tropical Asia (Grubben, 1977). The genus *Abelmoschus* originated in South-East Asia. *Abelmoschus esculentus,* however, is a cultigen of uncertain origin. It is widespread in tropical,

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subtropical and warm temperate region, but is particularly popular in West Africa, India, the Philippines, Thailand and Brazil (PROTA, 2004). The center of origin of okra remains unclear, but centers of genetic diversity include West Africa, India and Southern Asia (Hamon and Van Stolen, 1989). Phenotypic ally diverse genotypes, presumably of diverse origins, are regarded to be more effective in obtaining promising crosses (Duzyaman and Vural, 2002). It was found that dominance gene effect was also found indicating the presence of both additive and dominance genetic variation in fruit length. Singh (1982) reported that pod length in okra is affected by both additive and dominance genes indicating the presence of both additive and dominance genes. Pod yield and several yields contributing characters lack stability due to strong environmental influence, suggesting the need for breeding for specific environmental (Ariyo, 1990). Diversity in pod shape/size and flowering behavior account for most of the variation between the genotypes of WCA origin (Duzyaman,1997) and scope for further gain in pod yield per plant is limited because of low phenotypic and genotypic variation (Ariyo, 1990). The inheritance of fruit length in okra was obtained as partial dominance (Stino *et al,* 1970; Partap et al, 1980), additive gene effect (Thaker *et al.*1983) and both additive and dominance gene action (Singh, 1982). Over dominance was also observed in fruit length suggesting that hybrid vigor can be exploited in okra for increasing yield (Sharma and Mahajan, 1978). The yield was influenced directly and/or indirectly by pod weight and pod length suggesting that these traits would be most useful as selection criteria in breeding for yield improvement (Patel and Dalal, 1994; Duzyaman and Vural, 2003).In as much as determination of the correlation coefficient of yield with its components is undoubtedly helpful to breeders in selecting suitable plant types based on simultaneous selection of two or more characters, a better approach of character association is the path-coefficient analysis (Wright, 1968). It is beneficial as anti ulcer, comparable to a standard growth misopropol with good result. Its alkaline pH could also contribute to its effect in gastro-intestinal ulcer by neutralizing the digestive acids (Wamanda, 2007). The objectives of this work therefore are; to investigate inter-relationship of yield attributes of okra with view to identifying the traits that contribute significantly to its yield by correlation and path coefficient analysis.

Material and Methods

This study was conducted in Yola and Shelleng Local Government Areas of Adamawa state, in the year 2011 cropping season. The tropical climate of the state has rainy season which commences from April and ends in October. The average monthly rainfall for the state during the wet season is 79mm in the northern and 101mm in the southern parts. The average minimum temperature is 15.2C and the maximum is 39.70C (Gambo, 2002). The location of Shelleng Local Government area (about 111km south of the state capital, Yola) has been described (Chimbekujwo *et al*., 2006 and Apuno *et al*., 2011) as lying between latitude $09^0\ 49^1 – 10^0\ 4^1$ and longitude $12^0\ 37^1 – 13^0$ E. Yola is located at Latitude $9^o\ 14^1$ N and Longitude $12^o\ 32^1$ E and has altitude of 200m above sea level and lies within the Sudan Savanna ecological zone of Nigeria (Adebayo, 1999 and Bello *et al*., 2006). 2 varieties and 8 cultivars were evaluated in a replicated field trial in Yola and Shelleng. The 10 parental varieties and cultivars were sown in a RCBD with three replications. Each plot was made up of 30 plants, sown in five rows of six plots each, with 40cm spacing between plants and 40cm between rows. Each plot within each replication was separated by 0.5m paths while the replication was separated by 1.0m path. At maturity, ten plants in the middle rows were sampled. The following characters were measured for the sampled plants at maturity: Days to 50% flowering, number of pods per plant, number of branches per plant, number of leaves per plant, days to pod formation, pod length (cm), pod width (cm) , seed index (weight of 100 seeds in grams per plot), number of seeds per pod, plant height at 50% flowering, pod yield (weight of 10 pods in grams per plot), seed yield (weight of total seed in grams per plant), seed size (the diameter of seed in mm) and internodes distance (cm).

A total of 18 post-partum anoestrus buffaloes belonging to villages around the college of Veterinary Science and Animal Husbandry, Mhow

Result and Discussion

The present research work was carried out to determine the correlation and path coefficients effect of parents and F1's hybrid for planning efficient breeding programme. The mean square values from the analysis of variance (ANOVA) of parents and their hybrid (lines and testers) for all the characters measured are presented in Table 1. Location was found to have significant ($P<0.01$) effect for all the characters measured. Replication is shown to have significant ($P<0.01$; $P<0.05$) effect for the four characters. For treatments (parents and crosses), significant ($P<0.01$) difference was observed for all the characters measured except days to 50% flowering which shown no significant difference. Treatment x Location were found to have significant

(P<0.01) effect on number of pod per plant, number branches per plant and number of leaves per plant while internodes distance shown significant effect at P<0.05. Thus indicating that there is variability between the varieties and cultivars studied. Similar results were obtained by Martinello *et al* (2001). This implies that these population okra genotypes would respond to selection. However, selections based on the characters which show no significant differences in there mean squares values will bring no progress genetically. Generally, the genotypic correlation showed more significant relationship between the pairs than the phenotypic correlations (Table 2). This suggests that the characters are more related genotypically than phenotypically. From the results observed in this study, it is interesting to note that most of the characters showed highly significant positive or negative correlation with seed index, seed yield, seed size, pod width, number of seeds per pod and pod yield. This is an indication that these characters influence yield, directly. This is exhibited in the number of seeds per pod which had highly positive and significant relationship with seed yield. This also indicates that any increase in number of seeds per pod will lead to high seed yield. On the other hand, pod length showed highly negative correlation with seed yield suggesting that any increase in pod length will cause reduction in seed yield, while a decrease in pod length will inversely increase seed yield. Selection for number of branches per plant will be very rewarding in the improvement of number of leaves per plant, days to pod formation, pod length, pod width, seed index, number of seeds per pod, seed yield and seed size. Singh and Chaudhary (1985), however, argued that selection for characters that exhibit genotypic and phenotypic, positive and significant relationship will automatically increase yield. Path coefficient analysis was developed to study the relationship between two characters through their direct and by the way of indirect influence of the other characters. Genotypic correlations were partitioned into direct and indirect effects on seed yield. The data analysis across locations (Table: 3) revealed that number of seeds per pod had the highest significant correlation effect on seed yield (0.846**) as well as highest negative direct effect with seed yield (-1.00) indicating that selection for number of seeds per pod will increase seed yield. Singh and Chaudhary (1985) also reported that, if the correlation coefficient is positive but the direct effect is negative or negligible, the indirect effects might be the causal factor of correlation. Similar result was also obtained by Kumar and Reddy (1982) and, Sumathi and Muraldaharan (2007) in groundnut. Seed size had positive and highly significant genotypic association with seed yield (0.709**) and also with high positive and direct effect on seed yield (0.703), indicating that the high direct effects were the major contributors to the high positive and significant correlation between these two characters. Pod yield had positive and highly significant genotypic correlation with seed yield (0.745**), however, positive weak direct effect of these characters on seed yield (0.055). This might be as result of indirect negative influence of most of the characters through days to 50% flowering, number of pods per plant, number of branches per plant, number of seeds per pod and internodes distance. Pod width had positive and highly significant genotypic correlation with seed yield (686**) but moderate positive direct effects on seed yield (0.143). This might be as a result of indirect negative influence of most of the characters through days to 50% flowering, number of pods per plant and number of seeds per pod, indicating that the direct effects were the major contributors to the high positive and significant correlation between the two characters. Pod length had negative and highly significant genotypic correlation with seed yield (-0.545**) and moderate negative direct effect on seed yield (-0.615). This might be as a result of indirect negative influence. In view of this, selecting for these characters might not be beneficial for yield improvement. This is so because these characters exhibited low (positive or negative) non –significant correlation with yield. Haidar and Khan (1998) also reported similar results. Kaul *et al.* (1978) observed that seed yield per plant followed by number of primary branches per plant had maximum direct effect on pod yield per plant. Wright (1968) reported that in as much as determination of the correlation coefficient of yield with its components is undoubtedly helpful to breeders in selecting suitable plant types based on simultaneous selection of two or more characters, a better approach of character association is the path coefficient analysis. Whereas correlation is simply a measurement of mutual association, without regards to causation, path-coefficient analysis specifies the causes and measures their relative importance. Kumar and Reddy (1982) observed that number of pods per plant had the highest direct effect on seed yield followed by plant height, number of primary branches and days to flowering. Ariyo *et al.* (1987) reported that edible pod weight had the highest positive direct effect on pod yield with its largest indirect effect through reduction on edible pod width.

Table 1: Mean Square Value from the analysis of variance for all characters measured across locations

Source	DF	DTF	NPP	NBPP	NLPP	DTPF	PL	PW	SI	NSPP	PHAF	PY	SY	SS	ID
Loc	1	1025.6**	1863**	156.00**	568.87**	15.391**	143.71**	158.89**	50.411**	12587**	713.09**	51841**	4333.4**	0.3577**	8.4049**
Rep(loc)	4	0.0449	32.949	3.1658**	8.5631	0.2051	2.8089*	1.1096	0.2803	79.866	7.0836	621.54*	60.633	0.0015	0.3469*
Trt	25	14.492	54.365**	8.2063**	45.891**	6.6526**	54.306**	20.787**	2.4373**	2543.5**	45.395**	3268.5**	427.73**	0.0144**	0.6602**
Error	100	0.2182	34.839	0.6112	4.4936	0.5185	0.9247	0.8672	0.2254	108.76	6.6303	207.07	45.472	0.0018	0.1352

*' ** Significant at 5% and 1% level of probability, respectively.

Table 2: Genotypic (Upper right) and Phenotypic (Lower left) Correlation between Yield and Yield Component across locations

XTERS	DTF	NPPP	NBPP	NLPP	DTPF	PL	PW	SI	NSPP	PHAF	PY	SY	SS	ID
DTF		-0.395*	-0.307	-0.356	0.507*	0.172	-0.142	-0.290	0.02	-0.077	-0.030	-0.184	-0.380	0.130
NPPP	-0.181		0.682**	0.807**	-0.372	0.136	0.228	0.512**	0.322	-0.147	0.100	0.293	0.812**	0.351
NBPP	-0.238	0.494**		0.723**	-0.582**	-0.441**	0.406*	0.527**	0.419*	-0.228	0.380	0.446**	0.456**	-0.17
NLPP	-0.279	0.617**	0.573**		-0.544**	-0.447**	0.312	0.637**	0.375	-0.139	0.293	0.473**	0.356	0.272
DTPF	0.419*	-0.138	-0.406*	-0.329		0.224	-0.299	-0.322	-0.005	-0.100	-0.424**	-0.294	-0.371	0.058
PL	0.161	0.042	-0.361	-0.207	0.157		-0.208	-0.077	-0.367	0.022	-0.338	-0.545**	-0.021	0.302
PW	-0.129	0.145	0.284	0.246	-0.194	-0.143		0.622**	0.688**	0.129	0.639**	0.686**	0.559**	0.164
SI	-0.228	0.286	0.391*	0.353	-0.24	-0.054	0.446**		0.664**	-0.117	0.546**	0.844**	0.773**	0.345
NSPP	0.023	0.039	0.29	0.226	-0.005	-0.299	0.556**	0.446**		-0.105	0.817**	0.846**	0.589**	0.030
PHAF	-0.045	0.054	0.019	-0.046	-0.037	-0.021	0.087	0.011	-0.046		-0.005	-0.313	-0.032	0.476**
PY	-0.104	-0.006	0.25	0.184	0.052	-0.255	0.461**	0.356	0.659**	-0.001		0.745**	0.510**	0.206
SY	-0.099	0.145	0.243	0.289	-0.175	-0.126	0.467**	0.450**	0.707**	-0.188	0.590**		0.776**	0.075
SS	-0.193	0.266	0.335	0.309	-0.242	-0.024	0.361	0.938**	0.361	0.079	0.317	0.398**		0.335
ID	0.249	0.296	0.126	0.177	0.102	0.166	0.068	0.159	0.036	0.401*	0.072	0.001	0.178	

*' ** Significant at 5% and 1% level of probability, respectively. G= Genotypic correlation and P= Phenotypic correlation

Table 3: Direct and Indirect Effect of Yield Components of Yield per plant based on Path coefficient analysis of Okra across locations

XTER	DTF	NPPP	NBPP	NLPP	DTPF	PL	PW	SI	NSPP	PHAF	PY	SS	ID	Genotypic
DTF	**0.240**	0.050	0.161	-0.035	-0.050	-0.106	-0.020	-0.156	-0.002	0.022	-0.002	-0.267	-0.019	-0.184
NPPP	-0.095	**-0.127**	-0.358	0.079	0.037	-0.084	0.033	0.275	-0.032	0.042	0.006	0.571	-0.053	0.293
NBPP	-0.074	-0.087	**-0.525**	0.071	0.058	0.271	0.058	0.283	-0.042	0.065	0.021	0.321	0.026	0.446**
NLPP	-0.085	-0.102	-0.379	**0.098**	0.054	0.275	0.045	0.342	-0.038	0.039	0.016	0.250	-0.041	0.473**
DTPF	0.122	0.047	0.306	-0.053	**-0.099**	-0.138	-0.043	-0.173	0.001	0.029	-0.023	-0.261	-0.009	-0.294
PL	0.041	-0.017	0.232	-0.044	-0.022	**-0.615**	-0.029	-0.041	0.037	-0.006	-0.018	-0.015	-0.046	-0.545**
PW	-0.034	-0.029	-0.213	0.031	0.029	0.128	**0.143**	0.334	-0.069	-0.037	0.035	0.393	-0.025	0.686**
SI	-0.069	-0.065	-0.277	0.062	0.032	0.047	0.089	**0.537**	-0.066	0.033	0.030	0.543	-0.052	0.844**
NSPP	0.005	-0.041	-0.219	0.037	0.001	0.226	0.098	0.357	**-0.100**	0.030	0.045	0.414	-0.005	0.846**
PHAF	-0.018	0.019	0.119	-0.014	0.009	-0.014	0.018	-0.062	0.011	**-0.286**	-0.0003	-0.023	-0.072	-0.313
PY	-0.007	-0.013	-0.199	0.029	0.042	0.208	0.091	0.293	-0.082	0.001	**0.055**	0.358	-0.031	0.745**
SS	-0.091	-0.103	-0.239	0.035	0.037	0.013	0.079	0.415	-0.059	0.009	0.028	**0.703**	-0.118	0.709**
ID	0.031	-0.045	0.089	0.027	-0.006	-0.186	0.023	0.185	-0.003	-0.136	0.011	0.053	**-0.152**	-0.109

Bold figures denote direct effects, while light figures denote indirect effects.

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