Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences 7 (5): 510-513, 2008
ISSN 1682-3974

Genetic Analysis of Quantitative Traits in Ten Cultivars of Okra-*Abelmoschus esculentus* (Linn.) Moench

[1]O.S. Osekita and [2]B.O. Akinyele
[1]Ministry of Agriculture, Fisheries and Forest Resources, Alagbaka,
P.M.B. 713, Akure, Nigeria
[2]Department of Crop, Soil and Pest Management, Federal University of Technology,
P.M.B. 704, Akure, Nigeria

Abstract: Ten quantitative traits of 10 genotypes of okra (*Abelmoschus esculentus*) were investigated with a view to identifying the high yielding potential of the cultivars and to determining the extent of association among their contributing traits. The plant materials used are labeled according to their genotypes as follows: NH47-4, MHae 474, FEae 98, FEak, Agk98, Agkae, Aklc, Ilae, Ijae2000 and Alae- B. Using the Randomized Complete Block Design (RCBD) with three replications, the ten genotypes of okra were grown (one seed per hill) at the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria during the rainy season of 2002 and 2003. At the appropriate stages of growth, the following traits were investigated: days to flowering, height at flowering, number of pods per plant, pod length, pod width, number of branches per pant, days to maturity, number of seeds per pod, weight of hundred seeds and final plant height. Data collected were subjected to analysis of variance (ANOVA) and phenotypic and genotypic correlation analyses computed. Results show that there is a strong relationship between pod length and pod width with the juxtaposition of number of seeds per pod. Hence, selection programme based on these traits are most likely to bring about further improvement in the yield of okra under rainfed conditions.

Key words: Genetic analysis, quantitative traits, genotypes, *Abelmoschus esculentus*

INTRODUCTION

Plant breeding is the act of cultivating plants with the aim of producing new ones with desirable traits. According to Michael (1995), it is the act of developing, from the pre-existing ones, better plant with the aim of satisfying the needs of man. Plant breeding revolves around continuous efforts to develop genotypes that have greater economic value in terms of yield (Akinwale, 2007). In effecting improvement in yield, selection of superior genotypes is based on the outward appearance (phenotype) which is subject to variation due to fluctuating environmental factors. Under similar environmental conditions, any progress in a breeding programme depends on the magnitude of genetic variability in a population and the extent to which the desirable traits are heritable (heritability). Therefore, it is necessary to evaluate the genetic stocks acclimatized to local conditions (Osekita and Akinyele, 2008).

Plant breeders are expected to choose the kind of cultural conditions in which to evaluate their materials. The issue involves questions of genotype-environment interactions and the choices vary between conditions of deliberate stress and the most optimum growing conditions available (Akinwale, 2007; Osekita and Akinyele, 2008). Usually, most breeding programmes involve stress and optimum conditions at different stages of growth and for different traits.

Okra- *Abelmoschus esculentus* (L.) Moench-belongs to the family Malvaceae. It is a fast growing annual and the immature pods are used as a common vegetable (Ariyo, 1993; Martin, 1982; Osekita and Ariyo, 2000). It is widely cultivated in Nigeria for its fresh pod which is appreciated as ingredients of soup and stew. Therefore, increased production of high yielding varieties to meet the demand for this crop is only possible through breeding. The aim of this study is to identify the high yielding potential of the cultivars and to determine the extent of association among the contributing traits.

MATERIALS AND METHODS

In a Randomized Complete Block Design (RCBD) with three replications, 10 genotypes of okra were grown at the Teaching and Research Farm of the Federal University of Technology, Akure, Nigeria during the rainy season of 2002, 2003. One seed was planted per

Corresponding Author: B.O. Akinyele, Department of Crop, Soil and Pest Management, Federal University of Technology, P.M.B. 704, Akure, Nigeria

hill and each row was 6.0 m long. The spacing between rows was 0.6 m while it was 0.30 m within the row. Data were collected from 10 quantitative traits, namely days to flowering (DF), height at flowering (HF), number of pods per plant (NP), pod length (PL), kod width (KW), number of branches per plant (NB), days to maturity (DM), number of seeds per pod (NS), weight of a hundred seeds (WH) and final plant height (FH). Data collected were then subjected to analysis of variance (ANOVA) according to the method of Steel and Torrie (1980). Phenotypic and Genotypic correlation analysis were computed according to the method of Miller *et al.* (1958).

RESULTS AND DISCUSSION

Data analysis to test for genotypic differences among the 10 genotypes showed that there were highly significant differences among the genotypes for 80% of the traits considered. Also, there was significant block effect for plant height at flowering, number of pods per plant and final plant height. Table 1 shows the mean performance of the 10 genotypes while Table 2 shows ANOVA for 10 agronomic traits in the 10 okra genotypes.

The highest coefficient of variation was shown by number of branches per plant, followed by number of seeds per pod and number of pods per plant. The least values were shown by the developmental traits and closely followed by the fruit characters. The Phenotypic Coefficient of Variation (PCV) was generally higher than the Genotypic Coefficient of Variation (GCV) for 80% of the traits. The GCV is highest in the number of pods per plant, which, invariably, is slightly higher than corresponding PCV. The heritability estimates varied from 22% in height at flowering to 99% in number of seeds per pod and shows moderate to high in number of branches per plant (70%), days to maturity (71%), days to flowering (82%) pod length (98%) and number of seeds per pod (99%). These are summarized in Table 3.

In most cases, phenotypic and genotypic correlation coefficients closely agreed, whereas in others, the differences were large. The genotypic and phenotypic correlation coefficients of height at flowering and number of seeds per pod were slightly different from each other. A similar case was shown by plant height at flowering and pod length; weight of hundred seeds and days to flowering, number of pods per plant, pod length and number of branches per plant. Phenotypic correlations differed significantly from the corresponding genotypic correlations in a number of cases. Days to flowering shows very high phenotypic correlations with height at flowering, number of pods per plant, pod length, pod width, number of branches per plant and final plant height. Height at flowering expressed negative association with number of pods per plant, number of branches per plant, days to maturity and weight of hundred seeds. Negative genotypic effects or correlations were shown in number of pods per plant with number of branches per plant, days to maturity, number of seeds per pod and final plant height. The association between pod length and pod width was highly significant. Height at flowering had negative but highly significant difference with number of branches per plant. Weight of hundred seeds correlates significantly with days to flowering, number of pods per plant, pod length, pod width, number of branches per plant and days to maturity.

Table 1: Mean performance of the 10 okra genotypes

Traits genotypes	Days to flowering	Plant height at flowering (cm)	No of branches	Pod length per plant	Pod width (cm)	No. of pods (cm)	Days to maturity	No. of seeds per pod	Hundred seed weight (g) per plant	Final plant height (cm)
NH47-4	31.07	40.87	1.70	9.11	3.05	3.30	54.05	91.20	6.01	49.45
MHae 474	28.22	63.44	1.67	9.89	3.40	5.55	47.90	104.87	6.16	74.81
FEae 98	36.37	49.69	1.32	7.83	3.06	4.17	65.33	100.32	5.98	79.36
FEak	44.87	65.60	1.40	6.43	2.82	3.98	74.58	84.63	6.27	91.27
Agk 98	35.93	45.17	1.30	5.55	2.49	3.37	66.67	84.18	4.73	85.32
Agkae	42.72	63.65	1.20	6.64	3.49	4.68	71.12	109.38	6.10	95.12
Aklc	52.87	54.34	1.17	4.57	2.68	3.32	82.87	85.70	5.76	92.90
Ilae	61.23	71.66	2.15	7.34	2.28	3.62	91.63	71.32	4.13	106.17
Ijae2000	43.13	46.57	1.23	5.88	2.63	4.47	73.13	77.28	6.99	85.22
Alae-B	34.00	43.97	1.50	5.92	3.01	5.67	64.00	91.70	7.60	86.44

Table 2: Analysis of variance for 10 agronomic traits in okra showing mean squares only

Source	Degree of freedom	Days to flowering	Plant height at flowering (cm)	No. of branches per plant	Pod width (cm)	Pod length (cm)
Blocks	2	0.485	21.45**	0.005	0.100	0.010
Genotypes	9	310.620**	327.62**	0.277*	8.163**	0.447
Error	41	0.315	4.44	0.006	0.076	0.000
Blocks	2	0.205**	-479.92**	7.850	0.020	42.610**
Genotype	9	2.330**	489.16**	433.120**	2.940	687.290**
Error	41	-0.189	-104.84	100.310	0.023	27.850

*Significant at 5% level of probability; **Significant at 1% level of probability

Table 3: Phenotypic Coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV) and heritability estimates of 10 traits in 10 okra genotypes

Traits	Mean	PCV (%)	GCV (%)	H (%)	SE (±)	F-values for genotypes	CV(%)
Days to flowering	61.23	47.40	18.17	0.82	0.06	0.330*	06.32
Height of flowering	71.66	47.24	18.25	0.22	0.01	0.740**	26.86
Number of pods/plant	03.61	19.05	19.91	0.60	0.13	303.200**	45.56
Pod length (cm)	07.34	47.16	18.45	0.98	0.35	0.930**	10.26
Pod width (cm)	02.28	47.48	18.63	0.46	1.01	0.130	11.15
Number of branches/plant	02.15	47.52	18.64	0.70	0.14	0.050	76.98
Days to maturity	91.63	47.52	18.55	0.71	0.08	0.040	02.86
Number of seeds/pod	71.32	19.92	18.29	0.99	8.27	31.160**	47.13
100 (seed weight	04.13	46.91	18.64	0.57	0.79	1.560**	07.15
final plant height (cm)	106.17	46.92	18.56	0.41	0.01	1.540**	30.21

*p = 0.05; **p = 0.01

Table 4: Genotypic correlation coefficient and phenotypic correlation coefficients for pairs of traits in 10 okra genotypes

Traits	HF (cm)	NP	PL (cm)	PW (cm)	NB	DM	NS	HW (g)	FH (cm)
DF	0.0896	0.0150	-0.0117	0.0880	-0.0370	0.1108*	0.2173**	0.1891**	-0.0376
	(0.4999)	(0.9102)	(0.9297)	(0.5076)	(0.7808)	(0.4033)	(0.098)3)	(0.151)4	(0.7773)
HF (cm)		-0.1104)*	0.1768**	0.3160**	-0.1878**	-0.0991	0.1735**	-0.1293	0.0441
		(0.4052)	(0.1804)	(0.0148)	(0.1543)	(0.4552)	(0.1889)	(0.3290)	(0.7402)
NP			0.0220	0.0474	-0.0346)	-0.0431)	-0.0696)	0.1883**	-0.0520)
			(0.8688)	(0.7215)	(0.7947)	(0.7456)	(0.6004)	(0.1533)	(0.6949)
PL (cm)				0.4732**	0.0719	0.0779	0.0761	0.1607**	0.4707**
				(0.0002)	(0.5886)	(0.5574)	(0.5665)	(0.2239)	(0.0002)
PW (cm)					0.1216*	0.1124	0.0411	0.1404**	0.3212*
					(0.3591)	(0.3965)	(0.7573)	(0.2890)	(0.0131)
NB						0.1532**	-0.1041	0.1624**	0.1421
						(0.2468)	(0.4328)	(0.2191)	(0.2830)
DM							0.1006	0.1335**	0.1083
							(0.4484)	(0.3133)	(0.4144)
NS								0.0714	0.2059**
								(0.5908)	(0.1177)
HW									0.0270
									(0.8390)

*p = 0.05; **p = 0.01. Phenotypic correlation coefficients in parenthesis; Days to flowering (DF), height at flowering (HF), number of pods/plant (NP), Pod length (PL), Pod width (W), number of branches/plant (NB), days to maturity (DM), number of seeds/pod (NS), hundred seed weight (HW) and final plant height (FH)

There is also a strong association between final height, pod length, pod width and number of seeds per pod. All these observations are shown in Table 4.

The estimates of mean sum of squares were highly significant for genotype in the analysis of variance for almost all the traits studied. This is an indication of the diversity of the genotypes (Table 1). The mean performance of the genotypes for all the traits showed variable results (Table 2).

The two genotypes that had longer number of days to flowering as shown by the mean performance are Aklc and Ilae. They may be crossed with the early flowering genotypes if improvement is directed at the trait.

The two genotypes, therefore, have longer days to maturity as a result of the longer vegetative growth phase, which they have to undergo before flowering. The potentials for all the genotypes to have more pods per plant would be enhanced if fresh pods were harvested promptly to give room for more branches to be formed. This will, in turn, enhance the overall yield of the genotypes.

Table 3 reveals variability in both the reproductive and vegetative traits of the 10 okra genotypes. This indicates that the total reproductive and vegetative performance of the cultivars is influenced by the environment. The lowest coefficients of variation were recorded for days to maturity and days to flowering. This is an indication of a measure of productivity. It also suggests numerical classification and that the various okra varieties could be discriminated. This is supported by the findings of Osekita and Ariyo (2000), Ariyo (1989), Sneath and Sokal (1973) and Ariyo and Odulaja (1991).

The conspicuously higher differences between the phenotypic coefficient of variation and genotypic coefficient of variation is largely due to the strong influence of the environment during the developmental stages of the crop. The interaction of the genotypes with the environment in utilization of the natural phenomenal necessitated the wide difference except in a few traits like number of pods per plant and number of seeds per pod which are often regarded as the major components of yield.

This is in line with the findings of Moghaddam *et al.* (1998). In this study, days to maturity, final plant height, pod width, number of branches per plant, weight of hundred seeds and number of pods per plant exhibited moderate to high estimates for genotypic correlation coefficients. The heritability estimates reported for height at flowering, final plant height and pod width were usually low. This means that the genotypes cannot be improved through direct selection for these traits. This is at variance with the conclusion of Osekita and Ariyo (2000). Intermediate estimates of heritability (0.57) and (0.60) observed for weight of hundred seeds and number of pods respectively suggest the possibility of improving the genotypes through direct selection for pod yield.

The association observed between pod length and pod width was positively correlated and highly significant, indicating that there is a strong relationship between pod length and its width with the juxtaposition of number of seeds per pod. This is corroborated by Akinyele and Osekita (2006). The negative association between two traits is an indication that, it will be difficult to exercise simultaneous selection for the traits in the development of a variety (Newell and Eberhart, 1961). Therefore, the negative genotypic correlation coefficient of height at flowering with number of pods per plant and number of branches per plant shows that there is no strong relationship between height at flowering and the two other traits. Hence, considerable height at flowering may not necessarily result in offshoot of more branches or translate to more fruit formation. The contributions of days to maturity and days to flowering were, respectively, negatively and positively correlated with number of pods per plant as it is expected that late maturing genotypes under rainfed conditions will experience moisture stress during flowering and pod formation thereby considerably reducing the number of pods per plant (Henry and Krishna, 1990). In light of the foregoing factors, it is arguable that selection programme based on number of pods per plant, pod length, pod width, number of branches per plant and days to maturity will bring about further improvement in the yield of okra under rainfed conditions.

REFERENCES

Akinwale, G., 2007. Genetic variability for root yield and its components in cassava (*Manihot esculenta* Crantz). M. Tech. Thesis, Federal University of Technology, Akure, Nigeria, pp: 65.

Akinyele, B.O. and O.S. Osekita, 2006. Correlation and path coefficient analyses of seed yield attributes in okra (*Abelmoschus esculentus* (L.) Moench). Afr. J. Biotechnol., 14: 1330-1336.

Ariyo, O.J., 1989. Variation and heritability of fifteen characters on okra (*Abelmoschus esculentus* (L.) Moench). Trop. Agric. (Trinidad and Tobago), 67: 215-216.

Ariyo, Q.J. and A. Odulaja, 1991. Numerical analysis of variation among accessions of okra (*Abelmoschus esculentus* (L.) Moench), Malvaceae. Ann. Bot., 67: 527-531.

Ariyo, O.J., 1993. Genetic diversity in West African okra (*Abelmoschus caillei*) (A. Chev.) Stevels-Multivariate analysis of morphological and agronomic characteristics. Genet. Res. Crop. Evol., 40: 22-32.

Henry, A. and G.V. Krishna, 1990. Correlation and path coefficient analysis in pigeon pea. Madras Agric. J., 77: 440-442.

Martin, F.W., 1982. A second edible okra species and its hybrids with common okra. Ann. Bot., 50: 277-283.

Michael, R., 1995. Longman Dictionary of Contemporary English. 3rd Edn., Longman Group Ltd., England, pp: 1668.

Miller, P.A., J.C. Williams, H.F. Robinson and R.E. Comstock, 1958. Estimates of genetic and environmental variances and covariances in inland cotton and their implications in selection. Agron. J., 50: 126-131.

Moghaddam, M., B. Ehdaie and J.G. Waines, 1998. Genetic variation for and interrelationships among agronomic traits in land races of breadwheat from South Western Iran. J. Genet. Breed., 52: 73-81.

Newell, L.C. and S.A. Eberhart, 1961. Clone and progeny evaluation in the improvement of switch grass (*Panicum virgatum*). Crop Sci., 1: 117-121.

Osekita , O.S. and O.J. Ariyo, 2000. Variation and inter character association in the segregating of populations arising from two cases of okra (*Abelmoschus esculentus* (L.) Moench). Moor J., 1: 76-78.

Sneath, P.H.A. and R. Sokal, 1973. Numerical Taxonomy. 2nd Edn. W.H. Freeman San, Fransisco, pp: 573.

Steel, E.G.O. and J.H. Torrie, 1980. Principles and Procedure of Statistic. A Biometrical Approach. 2nd Edn. McGraw- Hill Book Co. Inc., New York, pp: 597.