GENETIC VARIATION AND HERITABILITY STUDIES IN SOME OKRA (*ABELMOSCHUS SPP*) VARIETIES

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Abstract
A study on Genetic variation and heritability estimates in 52 okra varieties was conducted at the Teaching and Research Farm, Federal University of Agriculture, Makurdi (07^o 41'N, 08^{o}37'E, 106.4m asl). The aim of the study was to assess the level of genetic divergence and heritability of quantitative traits of some okra varieties in 2018 rainy season in a randomized complete block design (RCBD) with three replicates. Data recorded on thirteen quantitative traits included plant height (PH), number of branches/plant (NB/P), number of leaves/plant (NL/P), days to flowering (DFF), days to 50% flowering (D50%F), days to harvestable pods (DHP), number of pods/plant (NP/P), pod length (PL), pod girth (PG), pod weight (PW), number of seeds/pod (NS/P), hundred seed weight (100SW) and pod yield/plant (PY/P). The result showed significant differences ($p<0.05$) in all the traits studied. Wide range of variability were recorded for PY/P (88.33 – 774g), followed by PH (64.00 – 242.00cm), DFF (42.00 – 109 days) and D50%F (45.00 – 112 days). Broad sense heritability (H_{bs}) ranged from moderate (54.00%) in 100SW (g) to very high value (100.00%) in PH (cm).

Keywords: **Genetic variation, heritability, okra, quantitative traits, varieties**

Introduction

Okra (*Abelmoschus spp*) is an economically important vegetable belonging to the *Malvaceae* family. It is grown in the tropics and the subtropical areas of the world. Okra is propagated by seed and is sensitive to frost and low temperature (below 15^{o}C). The crop is widely distributed in Africa, Asia, Southern Europe, the Mediterranean and all of America (Oyelade *et al.*, 2003). Okra grow well under a hot humid climate and best plant growth and fruiting is observed around 25 ^{o}C average temperature with high relative humidity (65-85%) (Dhankhar and Mishra, 2014). It is a multipurpose crop due to various uses of the fresh leaves, buds, flowers, pods and stem, pods and seeds (Schippers, 2000). In 2008, the five topmost okra producing countries were Iraq, Nigeria, Togo, Sudan and India (Faostat, 2010). Nigeria, however ranks third in okra with regards to fruit vegetable based on production and consumption, succeeding pepper and tomato (Ibeawuchi, 2007). The immature okra fruits are cooked as vegetable. The fruits are fairly good in nutritive value and 100g consumable portion contain 10.4 dry matter, 3100 calories energy,1.8g protein, 90mg calcium, 0.1mg carotene among several others (Gruben, 1977). Although okra has a multidirectional importance and utilisation, technology development regarding variety development and crop management practices are very limited (Tesfa and Yosef, 2016).

For a successful breeding programme, the evaluation of germplasm is a prerequisite on which the future line of action is based. The value of germplasm collection depends not only on the number of accessions it possessed but also on the genetic variability present in those accessions for yield and yield components. Yield and its components are generally polygenic in nature and subjected to different amount of non-heritable variation (Lush,1940). Thus, in any selection programme emphasis on yield and its component characters lies solely on their heritability and genetic advance. The improvement in plant breeding scheme leans on high genetic differences in the population and the magnitude of inheritance of favourable attributes (Olawuyi *et al.*, 2015, Bello *et al.*, 2014b). High heritability alone is not enough to make efficient selection unless the information is accompanied by substantial amount of genetic variation (Johnson *et al.*, 1955). Therefore, knowledge of nature and magnitude of genetic variability present in the germplasm and the degree of transmission of the economic traits is of greater help in selecting parents for planning a suitable breeding strategy. The existing variability in okra has been exploited in various breeding programme, which resulted in the development and release of a good number of varieties of the crop. However, the released varieties cannot be consistent in performance due to genetic drift and susceptibility to pests and disease. This demands continuous development and replacement of current varieties by new and high yielding varieties with acceptable pod yield and quality in Okra. The present study was therefore, carried out to determine the status of genetic variability and the degree of transmission of yield components in okra with the view of devising a breeding strategy for its selection for further improvement.

MATERIALS AND METHODS

This study took place at the Teaching and Research Farm of the Federal University of Agriculture, Makurdi (07^{0}41'N, 08^{0}37'E, at 106.4m asl). The Okra varieties used for the research were collected from the National Centre for Genetic Resources and Biotechnology (NAGRAB) Ibadan, and some farmers in Benue, Nasarawa, Plateau, Kebbi and Borno States of Nigeria which were code named according to their locations of collection. Fifty-two (52) Okra accessions were used for the study. These experimental materials were laid out in a Randomized Complete Block Design (RCBD) with three replications in the 2018 cropping season. A spacing of 60cm by 40cm inter and intra row spacing were employed with a distance of O.5m and 1m between plots and blocks, respectively. Two seeds were planted per hole and later thinned to one seedling per hole. Weeding was done manually and insect pests were controlled using cypermethrine at the rate of 4mls/litre of water. Data were recorded on five (5) plants randomly selected in the middle ridges in each plot. The quantitative traits measured included plant height (PH), number of branches/plant (NB/P), number of leaves/plant (NL/P), days to flowering (DFF), days to 50% flowering (D50%F), days to harvestable pods (DHP), number of pods/plant (NP/P), pod length (PL), pod girth (PG), pod weight (PW), number of seeds/pod (NS/P), hundred seed weight (100SW) and pod yield/plant (PY/P).

Means of the collected data were computed and subjected to analysis of variance to estimate level of variability among the okra varieties and significant treatment means were separated using least significant difference (Obi, 2002). Genetic parameters such as phenotypic, genotypic, environmental, phenotypic coefficient of variation, genotypic coefficient of variation, Broad sense heritability and Genetic advance were computed. The phenotypic variation for each trait was partitioned into genetic and non-genetic factors and estimated according to Johnson *et al*. (1955) and Uguru (2005) as:

$Vp=MSg/r$, $Vg=(MSg-MSe)/r$, $Ve=MSe$

Where: Vp, Vg, Ve are phenotypic variance, genotypic variance and environmental variance, respectively. The phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and the environmental coefficient of variation (ECV) were computed according to the method suggested by Allard (1960) and Burton (1952); thus:

$PCV=(Vp/X) \times 100$

$GCV=(Vg/X) \times 100$

ECV=(Ve/) x *100*
Where X = the grand mean for each of the studied trait.
Broad sense heritability *(H_{bs})* was calculated according to Burton and Devane (1953) and Allard (1960) as the ratio of the genotypic variance (V*g*) to the phenotypic variance (V*p*).
$H_{bs} = Vg/Vp = Vg/(Vg+Ve)$
Where Vg, Vp and *Ve* are the genetic, phenotypic and environmental components of variance, respectively. Genetic advance was estimated according to Johnson (1956).
GA=Vg/Vp x k where k is the selection differential (at 5% =2.06), Vg=genotypic variance, Vp= square root of phenotypic variance.
Genotypic variance as percentage of mean (GAM) is determined from Genetic advance (GA) expressed as percentage of the population mean.

RESULTS AND DISCUSSION

The mean performance of the okra varieties assessed (Table 1) revealed highly significant differences (p<0.05) among the 52 Okra genotypes for the 13 quantitative traits studied. The result on the simple measures of variability such as means and ranges of mean values also showed sufficient variation for all the parameters studied (Table 2). Wide ranges of variability were recorded for pod yield per plant (88.33 – 774.00g), followed by plant height (64.00 – 242cm), days to first flowering (42.00 – 109days) and days to fifty percent flowering (45 – 112 days). The coefficient of variation was higher for number of leaves/plant (25.40), pod yield (10.30) and number of pods per plant (8.30) indicating the presence of higher variability in the varieties for these traits and thus offering greater scope for selecting desirable genotypes. Findings from this work are in agreement with the reports of earlier workers (Thirapathi *et al.*, 2012; Singh *et al.*, 2006; Bashir and Bello, 2017) in Okra.

The phenotypic coefficient of variation (PCV) and Genotypic coefficient of variation (GCV) values were classified as low (< 10.00%), moderate (10.00 – 20.00%) and high (> 20.00%) as suggested by Sivasubramanian and Menon (1973). Thus, for all the traits studied; the phenotypic variances and the phenotypic coefficient of variations (PCV) were generally higher than their correspondent Genotypic variances and Genotypic coefficient of variations (GCV), respectively (Table 3). It was noted that the estimates of PCV were of high magnitude (< 20%) for number of pods per plant (60.52%), pod yield (57.08%), number of branches/plant (54.28%), plant height (38.91%), number of leaves/plant (27.83%) pods weight (26.68%), Days to flowering (26.49%), Days to harvestable pods (23.14%), and days to 50% flowering (22.79%); while it was lowest for hundred seed weight (9.98%).

The estimates of GCV were also high for number of pods/plant (59.96%), pod yield/plant (56.15%), number of branches/plant (47.96%), plant height (38.88%), Pod weight (26.36%), Days of harvestable pods (22.75%), days to fifty percent flowering (22.36%) and days to first flowering (26.12%). It was however, also lowest for hundred seed weight (7.34%).

The estimates of GCV and PCV are of greater use in determining the variability present in the research material (Thirupathi *et al.*, 2012). The higher magnitude of PCV compared to the estimate of GCV for all the traits studied (Table2) indicates that the apparent variations were not only due to genotype but also due to the environment and selection for these traits sometimes may be misleading (Manggoel and Uguru, 2012). The environmental effect could be due to heterogeneity in soil fertility status and other unpredictable factors (Khandelwal, 1994, Chandra *et al*, 1996). However, the close correspondence between the Genotypic and Phenotypic coefficient of variations for most of the parameters studied indicates that the environmental influence is quite low. High and low magnitude of genotypic and phenotypic coefficient of variations have been reported by several researchers (Mehta *et al*. 2006, Thirupathi *et al*, 2012, Singh *et al*, 2006) for number of branches/plants, pod yield/plant and Marketable yield/plant in okra. The estimates of broad sense heritability were of high magnitude (> 60.00%) for all the studied traits except for hundred seed weight (54.00%). As described by Robinson *et al*, (1955), heritability is categorized as low (0 – 30%), moderate (31 – 60%) and high (>60%). Broad sense heritability in this study therefore, ranged from moderate in hundred seed weight (54%) to very high value (100%) in plant height.

Johnson *et al*, (1955) categorized Genetic advance as percentage of mean (GAM) as high (> 20%), Moderate (10 ≤ 20%) and Low (0 ≤10%). Based on this categorization, number of pods per plant (83.16%), pod yield/plant (77.33%), number of branches/plant (59.32%), plant height (54.40%), number of leaves/plant (37.48%), pod weight (36.47%), days to first flowering (36.05%), days to harvestable pods (31.31%), days to 50% flowering (30.73%) and pod length (23.15%) in this study recorded genetic advance of greater than 20% (Table 3). Pod girth (14.98%) and number of seeds/pod (20.59%) were moderate; while hundred seed weight (7.49%) was lowest. Genetic advance above 20% implied the predominance of additive genetic effects for these traits. The high estimates of heritability coupled with high genetic advance in this study offered sufficient information on each character, indicating a genotypic response to selection (Sibsakar *et al.*, 2012, Bashir and Bello 2017) as exemplified by pod yield/plant, number of pods/plants, number of branches/plant and plant height.

CONCLUSION

In conclusion, it is evidently clear from the analysis of variance that the Okra accessions used in this study possessed a considerable genetic variability as all the characters revealed considerable variation in the observed traits. The estimates of means, range, coefficient of variation, heritability and genetic advance as percentage of mean also showed considerably high variation in most traits. This broad spectrum of variation exhibited for the economically important traits will provide breeders a good scope for genetic improvement.

REFERENCES

Bashir, O. Bello and D. Aminu (2017) Genetic relationship among Okra (*Abelmosclus esculentus (L.) Moench)* cultivars in Nigeria. Acta agriculture slovenica, 109-2, pp.251 – 260.

Bello, O.B., O.J Olawuyi, Ige, S.A, J. Mahsmood, M.S. Afolabi, M.A Azeez and S.Y. Abdulmaliq (2014b) Yield performance and adaptation of early and intermediate drought tolerance maize cultivars in Guinea Savanna of Nigeria. *Sarhad Journal of Agriculture* 30(1) 53-66.

Chandra D; K.P Singh and P.K. Panda (1996). Genetic variability, correlation and path analysis in Okra *(Abelmoschus esculentus (L) moench)*. Environment and Ecology 14:315 – 319.

Dhankhar,B.S.and Dhankhar,S,K (2002).Correlation and Path analysis in Okra (*Abelmoschus esculentus (L.) Moench),Harvana J. Hort. Sci., 31(3& 4):294.*

FAOSTAT (2010) Economic and Social Department,the statistics Division. Major Food and Agricultural commodities and producers. Retrieved from http://faostat.fao.org/site/339/default.aspx.

Grubben, G.J.H.,O.A. Denton, Messiaen, R.R. Schippers, R.H., Lemmens, M.J. and Oyen, L.P.A. (2004). Plant Resources of Tropical Africa2: PROTA Vegetables. PROTA Foundation/Backhuys Publishers ICTA. Wageningen, Netherlands.pp25-30.

Iheawuchi, I. K. (2007).Intercropping a food production strategy for resource poor farmers. *Nature science*, 5 (1), 46-49.

Johnson, H.W, H.F. Robinson and R.E Comstock (1955) Estimation of Genetics and Environmental variability in soybeans. *Agronomy Journal*, 47,314-318.

Lush, J.L (1940) Intersire correlations and regression of offspring on dams as a method of estimating heritability of characters. *Proceedings of American Society of Animal Breeding*, 33: 293-301.

Megawal,P.R and Khandelwal, R.C (1994).*Studies on Coefficient of Variation and heritable components of some quantitative characters in Okra (Abelmoschus esculentus L.moench) Progressive Horticulture.26:57-61*

Mehta, D.R, Dhaduk, L.K and K.D Patel (2006).Genetic variability, correlation and path analysis studies in okra *(Abelmoschus esculentus (L) Moench).Agricultural Science Digest*, 26(1) 15 – 18.

Olawuyi, O.J; O.B. Bello, C.V Ntube and A.O Akanmu (2015) Progress from selection of some maize cultivars response to drought in the derived savanna of Nigeria. AGRIVITA, 37(1), 8 – 17.

Oyelade, O.J, B.I.O Ade-Omowaye and V.F. Adeomi, (2003). Influence of variety on protein, fat contents and some physical characteristics of Okra seeds. *J. Food Eng;* 57: 111 – 114.

Robinson H.F; R.E Comstock and P.H Harvey (1955).Estimates of heritability and the degree of dominance in maize. *Agronomy Journal*, 41, 353 – 359.

Schippers, R.R (2000). *African Indigenous vegetables: an over view of the cultivated species*. University of Greenwich, Natural Resources Institute London, United Kingdom

Sibsankar, D.C, Arup, B.C Sankhendu, D. Subrata and H. Pranab (2012). Genetic parameters and path analysis of yield and its components in Okra at different sowing in the genetic plains of Eastern India. *African Journal of Biotechnology*, 11 (95), 16132 – 16141.

Singh, B.Pal,A.K and Singh, S. (2006).Genetic variability and correlation analysis in Okra *(Albelmoschus esculentus (L) moench)*. Indian Journal of Horticulture 63(3): 63 – 66.

Sivasubramanian, S. and Menon, M. (1973).Heterosis and inbreeding depression in Rice. *Madras Agricultural journal*, 60:1139.

Tesfa B. and Yosef A. (2016).Characterization of Okra *(Abelmoschus esculentus (L) Moench)* Germplasms collected from Western Ethiopia. *International Journal of Research in Agriculture and Forestry*. Vol. 3. Issue 2. PP 11 – 17

Thirupathi, R.M; B.K Hari, M. Ganash, R.K Chandrasekhar, H. Begum, R.B. Puru-Shothama and G. Narshimulu (2012). Genetic variability analysis for the selection of elite cultivars based on pod yield and quality from the germplasm of okra *(Abelmoschus esculentus(L) moench). Journal of Agricultural Technology,* 8, 639-655.

Table 1: Mean Performance of the 52 Okra Accessions Studied

S/N	ACC.	PHT	NOL	NOB	DTF	DTFF	DHP	NPP	PL	PG	NSP	PWT	100SWT	PY
1.	293	224.67	31.33	2.33	79.66		104.67	5.33	9.00	2.00	118.69	25.43	7.00	135.33
2.	297	111.00	39.33	4.67	51.00	67.33	67.61	8.67	9.67	9.67	2.13	39.33	6.33	380.67
3.	298	238.33	40.33	4.00	101.33	102.67	109.33	6.00	8.00	2.03	114.00	25..33	7.00	152.00
4.	301	100.67	62.00	11.00	64.33	67.33	71.67	8.33	9.67	2.00	87.00	33.80	6.00	306.67
5.	302	210.67	30.37	3.00	77.33	85.67	87.00	4.67	7.00	2.00	113.33	22.33	5.67	111.67
6.	303	219.67	18.00	1.00	58.33	66.67	70.33	6.67	12.67	2.03	111.33	48.80	7.33	325.00
7.	304	129.33	54.00	12.00	97.67	100.00	107.67	27.67	7.00	1.80	83.67	13.67	6.33	377.67
8.	322	84.00	48.00	6.33	71.67	75.67	77.00	7.00	7.00	2.26	133.33	28.67	6.67	200.00
9.	326	75.00	34.00	3.67	94.00	97.33	105.00	5.33	7.33	1.50	97.67	17.13	6.61	91.33
10.	328-B	182.00	36.33	8.33	107.00	108.33	118.33	27.00	9.00	2.00	89.67	36.33	6.00	774.00
11.	332	242.33	37.00	4.00	100.00	105.67	110.00	5.67	8.33	2.10	117.00	23.00	7.00	130.00
12.	333	148.33	64.33	9.00	86.00	98.67	99.33	14.33	9.67	1.93	86.67	26.73	7.00	417.67
13.	335.	195.00	37.33	5.67	74.33	84.33	95.33	7.00	8.00	2.16	122.67	31.86	7.33	222.67
14.	342.A	87.67	42.33	3.67	58.00	69.00	69.67	7.00	8.67	1.73	111.67	29.46	6.33	206.7
15.	342.B	162.67	17.33	1.00	43.67	47.67	53.67	9.00	8.67	1.63	106.33	25.67	6.33	232.33
16.	343.A	239.33	27.33	1.67	100.33	103.33	109.00	8.00	8.00	1.67	147.33	16.33	7.00	133.33
17.	345	215.33	43.00	6.33	72.33	76.67	78.67	8.00	8,00	1.86	133.67	31.67	7.00	255.67
18.	346-A	133.33	40.67	5.67	80.33	87.33	102.33	6.67	7.00	2.00	111.33	19.10	7.00	130.00
19.	346-B	138.33	36.33	3.33	75.33	79.67	86.67	7.67	7.00	2.00	127.33	26.67	6.67	206.67
20.	348	135.33	37.33	2.33	97.00	104.00	118.67	5.67	7.00	1.67	107.67	15.33	6.33	88.33
21.	349	118.00	31.33	5.00	52.67	64.67	65.00	6.33	9.33	2.06	114.67	34.67	6.67`	222.33
22.	350	225.00	41.00	8.33	90.33	103.33	105.67	6.33	8.00	2.10	118.67	21.67	7.33	136.67
23.	356-A	84.00	47.33	8.33	60.33	69.00	71.33	6.67	9.67	1.96	112.67	35.33	6.33	218.00
24.	356-B	77.67	31.67	4.00	69.33	70.33	71.33	7.00	9.67	2.00	111.33	42.00	6.67	294.33
25.	359	152.00	40.67	6.33	57.67	64.33	67.00	15.00	10.33	1.96	122.33	39.33	5.67	590.00
26.	361	125.00	39.67	6.00	109.33	112.33	119.00	17.67	9.33	2.50	94.00	33.67	6.00	364.33
27.	371	170.67	39.33	4.33	71.33	75.33	83.00	8.00	9.00	1.95	124.33	32.00	6.67	258.67

Table 1: Contd.

28.	372	74.00	29.00	4.33	100.33	102.67	107.33	5.33	6.00	2.03	87.00	18.67	6.00	364.33
29.	376	123.33	30.33	3.33	107.00	110.00	116.33	16.67	10.67	2.00	111.00	22.33	7.00	372.00
30.	380	219.00	34.33	3.67	77.33	81.33	85.00	5.33	7.33	1.70	99.00	18.67	7.00	99.00
31.	394	71.00	25.33	3.67	52.00	60.00	64.67	6.67	9.67	2.06	94.33	36.00	5.67	240.00
32.	396	218.67	29.67	3.17	51.00	59.33	62.67	10.00	11.00	2.03	103.67	40.67	6.00	426.67
33.	452	215.67	36.33	3.00	94.00	102.67	107.67	5.00	8.00	1.96	131.67	19.67	6.00	99.00
34.	454	67.00	35.33	4.67	99.67	102.00	110.00	7.67	8.33	1.83	105.67	30.00	7.00	231.00
35.	463	154.00	23.67	2.33	47.33	54.33	57.33	6.33	10.67	1.86	83.00	30.33	7.00	192.33
36.	466	81.33	36.00	5.33	66.00	71.00	75.00	5.67	9.00	1.90	98.67	28.67	6.67	162.33
37.	467	85.33	23.33	2.67	58.00	69.33	70.67	5.00	12.0	1.90	96.00	35.00	6.00	176.00
38.	469	89.00	28.00	2.33	75.67	79.33	79.33	5.00	8.33	1.93	100.33	31.67	6.00	158.33
39.	490	240.00	31.00	3.33	79.00	82.67	87.67	5.33	8.00	1.83	128.67	24.33	7.33	131.00
40.	507	166.00	25.00	3.00	74.00	80.00	83.00	4.33	10.33	2.06	97.00	36.67	5.67	159.00
41.	514	207.33	34.33	4.67	83.67	99.00	100.33	4.00	7.33	2.03	102.33	25.33	6.67	101.33
42.	650	98.33	39.00	7.00	47.00	49.67	55.67	6.33	9.00	2.00	103.00	29.33	6.33	185.67
43.	Abuja	141.33	23.67	4.00	55.00	75.00	75.69	5.33	9.00	2.00	128.33	32.33	6.00	176.33
44.	Awe	79.67	49.67	7.67	52.00	62.00	62.67	11.00	10.33	1.10	88.33	31.67	6.00	350.67
45.	Bassa	174.67	32.67	2.67	73.00	80.00	86.33	9.33	9.67	2.13	70.33	29.00	6.33	273.00
46.	Bius	78.00	43.37	6.33	64.67	72.00	73.00	5.00	9.67	2.03	128.33	33.33	6.33	163.00
47.	Jos	80.33	38.67	5.67	49.67	68.00	68.67	4.33	9.67	1.93	106.67	32.67	6.00	142.00
48.	Lafia	135.00	45.00	7.00	61.00	70.67	82.67	15.33	9.00	2.30	77.33	30.67	5.00	470.00
49.	Makurdi	147.67	42.33	5.00	62.00	66.67	70.67	6.67	11.33	2.40	118.00	46.33	6.33	309.00
50.	Oju	176.33	37.33	4.33	107.33	108.33	115	4.33	9.00	2.83	118.00	38.67	6.00	168.00
51.	Yawuri	64.00	36.67	6.33	66.00	68.00	72.00	7.33	10.333	1.67	114.33	29.00	5.67	124.67
52	Zuru	69.33	12.67	1.00	42.00	45.00	49.67	11.67	14.67	1.40	110.00	34.33	6.67	408.33
LSD.		3.23	3.155	1.965	5.303	5.731	5.863	1.114	0.785	0.21	2.835	1.965	0.72	39.831

PH=Plant height (cm), NL/p=number of leaves/plant, NB/P=number of branches/plant, DFF=days to first flowering, D50%F=days to fifty percent flowering, DHP=days to harvestable pods, NPP/P=number of pods/plant, PL=Pod length, PG=Pod girth, PWT=Pod weight, NSP/P=number of seeds/pod, HSWT=hundred seed weight, PY=Pod Yield.

Table 2: Mean, Standard Deviation, coefficient of variation and Range of values for Okra accessions

Traits	Means	SE Means	St. Dev.	CV	Min.	Max.
PH	143.88	4.44	57.55	1.40	64.00	242.00
NB/P	4.76	0.77	9.95	5.40	1.00	12.00
NL/P	35.95	0.20	2.57	25.40	12.00	64.00
DFF	73.95	1.58	19.46	4.40	42.00	109.00
D50%F	81.81	1.47	18.29	4.40	45.00	112.00
DHP	85.37	1.58	19.62	4.20	49.00	119.00
NPP	8.32	0.42	5.00	8.30	4.00	27.00
PL	9.04	0.12	1.63	5.40	6.00	14.00
PG	1.97	0.02	0.25	6.60	1.40	2.00
PWT	29.65	0.61	7.86	4.10	13.67	48.80
NSP/P	108.46	1.38	16.03	1.60	70.33	147.33
HSWT	6.44	0.05	0.64	6.90	5.00	7.00
PY	239.66	14.20	135.92	10.30	88.33	774.00

PH=Plant height (cm), NL/p=number of leaves/plant, NB/P=number of branches/plant, DFF=days to first flowering, D50%F=days to fifty percent flowering, DHP=days to harvestable pods, NPP/P=number of pods/plant, PL=Pod length, PG=Pod girth, PWT=Pod weight, NSP/P=number of seeds/pod, HSWT=hundred seed weight, PY=Pod Yield.

TABLE 3: Genetic Parameters of the 52 Okra Accessions

Traits	Means	MS	GV	PV	EV	GCV (%)	PCV (%)	H^2 (%)	GA	GAM(%)
PHT	148.88	10056.9**	3350.97	3354.95	3.98	38.88	38.91	100	80.05	54.40
NOL.	35.95	292.685**	96.3	100.09	3.8	27.3	27.3	96	55.15	37.48
NOB	4.77	17.19**	5.23	6.7	1.47	47.96	54.28	78	87.29	59.32
DFF	73.95	1130.16**	373.14	383.87	10.73	26.12	26.49	97	53.05	36.05
DTFF	80.81	992.39**	326.62	339.15	12.53	22.36	22.79	96	45.21	30.73
DHP	85.37	1144.34**	377.08	390.19	13.11	22.75	23.14	97	46.06	31.31
PP	8.32	75.12**	24.88	25.35	0.47	59.96	60.52	98	122.36	83.16
PL	9.05	7.61**	2.46	2.7	0.24	17.32	18.15	91	34.05	23.15
PG	1.98	0.16**	0.05	0.06	0.02	11.03	12.84	74	19.5	14.98
PWT	29.65	184.73*	61.09	62.56	1.47	26.36	26.68	98	53.66	36.47
SPP	108.46	775.24**	257.39	260.46	3.07	14.79	14.88	99	30.29	20.59
HSWT	6.44	0.86*	0.22	0.41	0.19	7.34	9.98	54	11.11	7.49
PY	239.66	54927.8**	18107.6	18712.6	605	56.15	57.08	97	113.78	77.33

PH=Plant height, NL=number of leaves/plant, NB=number of branches/plant, DFF=days to first flowering, D50%F=days to fifty percent flowering, DHP=days to harvestable pods, PP=number of pods/plant, PL=Pod length, PG=Pod girth, PWT=Pod weight, SPP=number of seeds/pod, HSWT=hundred seed weight, PY=Pod Yield, GA =Genetic advance, GAM =Genetic advance as percentage of means.