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Short Communication

Character association studies for traits of economic importance in okra

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Okra (*Abelmoschus esculentus* (L) Moench) belongs to family Malvaceae with 2n = 130 chromosomes. It is one of the most important vegetable crops, which is grown throughout the tropical and subtropical parts of the world. Being a day neutral plant, it is cultivated in every season in one or other parts of the country. The improvement in genetic make-up i.e. growing habit of the plant increases the harvest index and improvement in resistance to insect-pest and diseases ultimately increase the yield. There are good prospects and possibilities for the further increase in productivity and production of okra. Increase in genetic yield potential gives a boost to okra production. Some biometrical techniques like variability, correlation and path analysis provide relative contribution of various yield related traits. Genotypic and phenotypic coefficients of variance suck out the association between yield and yield contributing traits in okra. If the association is positive and significant, simultaneous important and association is possible and significant. As the correlation measures the mutual relationship between different traits of a plant, it helps to determine the best yield contributing traits. Path analysis deals with a close system of variables that are linearly related. It specifies the causes and generally measures their relative importance. Path analysis split the correlation coefficient in to the measured of direct and indirect effect and determines direct and indirect contribution of various characters towards the yield.

The experimental material comprised of thirty five genotypes of okra. All genotypes were sown at spacing 30 x 15 in randomized block design with three replication at All India coordinated Research project on vegetable crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra state during summer 2015. All the cultural practices and plant protection measures were adopted as per recommended practices for better crop establishment. The biometric observations were recorded on five randomly selected plants of each genotypes in all the replications on thirteen important characters like plant height, days to 50% flowering, number of nodes/plant, number of lobes/leaf, number of branches/plant, number of ridges/fruit, inter-modal length, node at which first flower appear, length of fruit, diameter of fruit, average weight of fruit, number of fruits/plant and yield/plant. The data collected were subjected to standard analysis of variance as per method suggested by Panse and Sukhatme (1985) . Genotypic correlation coefficients of the biometric observations were estimated according to the method suggested by Aljibouri et al. (1958) and phenotypic correlation coefficients according to the method of Steel and Torrie (1960). Path coefficient analysis was carried out using the method of Dewey and Lu (1959).

The mean sum of square was highly significant for all traits, indicating the presence of wide variability in the present genotypes of okra. (Table 1).Fruit yield (q/ha) showed widest range (63.02 - 370.04) at edible stage was recorded in genotype EC-0305717 and IC-034124 respectively with mean value of 179.52. Maximum fruit yield / plant (kg) was recorded by IC-034124 (255.20g) while minimum in EC-0305717 (41.75g) with man value 114.13. Plant height ranged from 28.95 – 162.10 (IC-33332 and IC-045811). Days to 50% flowering ranged from 53.50 - 63.50 (IC-117292 and EC-0305717). Number of nodes per plant ranged from 10.0-23.50 (IC-0257803and IC-045811). Length of fruit also registered considerable variability, which ranged from 3.65cm (IC-0090202) to 14.45 (IC-13424), maximum diameter of fruit was recorded in EC-0280757 and minimum in IC-117262 . The maximum number of branches/ plant was recorded in EC-305625 and minimum in IC-0090202. The maximum average weight of fruit recorded in IC-117059 and minimum in EC-305625

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In general, phenotypic coefficients of variance were higher than their respective genotypic coefficient of variance for all the trails (Table 1), indicating considerable effects of environment on their expression. In the present investigation, genotypes were found to possess a high to moderate phenotypic variance for various characters as revealed by PCV. Phenotypic coefficient of variance varied from 4.57 (days to 50% flowering) to 43.55 (fruit yield/plot). The PCV expressed in the form of percentage were high for fruit yield / plot followed by fruit yield/ha, yield per plant, number of branches/plant, average weight of fruit, number of ridges/fruit, number of fruits/plant and length of fruit. As the estimate of phenotypic variability cannot differentiate between the effect of genetic and environmental effects, so the study of genetic variability is effective in partioning out the real genetic differences. Higher the GCV, more the enhances of improvement in that characters. In the present experiment, GCV were comparatively high for fruit yield/plot followed by yield/ ha, yield/plant, number of branches/plant, average fruit weight, number of fruits/plant, fruit length, internodal length and number of nodes/plant. GCV was less than corresponding PCV, indicating the role in the expression of traits under the observation.

The difference between GCV and PCV was more in case of number of branches per plant followed by node at which first flower appear. The large difference between GCV and PCV indicated that environment affects a large extent influence the trait having high GCV possessed better potential for further gain and improvement. A similar finding was reported by Kumar et al. (2012). Burton and De Vane (1952) has suggested that GCV together with heritability estimates would give the best option expected for the selection. Heritability estimates were high (above 90%) for plant height, number of nodes/plant, number of ridges/fruit, length of fruit, diameter of fruit, average weight of fruit, number of fruits/plant and yield/plant. Moderate heritability (70-90%) for days to 50% flowering, number of branches per plant, internodal length, yield per plot and per hectare suggested that the environmental effects constitute major portion of the total phenotypic variation and hence direct selection for these characters will be less effective. High heritability for the characters controlled by polygene might be useful to plant breeder for making effective selection. Johnson et al. (1955) reported that heritability estimates along with genetic advance is more useful than the resultant effect for selecting best genotypes, as if suggests the presence of additive gene effects. High estimates of genetic advance were recorded for fruit yield/ha, yield/plant, average fruit weight and plant height.

The information on heritability alone may be misleading but when used in combination with genetic advance, the utility of heritability estimate will be more effective. High genetic advance with high heritability was observed for number of ridges per fruit followed by plant height, yield/ plant and yield/ha. It indicated that additive gene effects were more important than these characters, so the improvement in these traits would be more efficiently done through selection in the present material. Depending upon variability, heritability and genetic advance estimates, it could be predicted that improvement by direct selection on the basis of number of fruits/ plant, number branches per plant and length of fruit. These finding are also similar with those Bendale et al. (2003), Osekita et al. (2000) and Kumar et al. (2012). The data presented in Table 2 indicated that the plant height exhibited positive significant genotypic and phenotypic correlation with number of nodes/ plant, intermodal length, and number of fruit/plant. This mean

Table 1: Parameters of genetic variability in 35 genotypes of okra

S. No.	Characters	Range	General mean	GCV	PCV	Heritability (%) in b.s.	Genetic advance	GA as % of mean
1	Plant height (cm)	28.95-162.10	93.25	26.81	27.28	96.65	50.63	54.30
2	Days to 50 % flowering	53.50-63.50	57.38	3.92	4.57	73.48	3.97	6.92
3	Number of nodes/ plant	10.00-23.50	16.08	18.66	19.20	94.42	6.00	37.34
4	Number of lobes on leaves	3.0-5.0	4.88	6.61	9.64	46.97	0.45	9.32
5	Number of branches/ plant	0.5-3.5	2.44	33.81	36.86	84.15	1.56	63.89
6	Number of ridges/ fruit	5.0-10.0	5.77	24.17	24.18	100.00	2.87	49.79
7	Internodal length (cm)	2.35-8.50	5.72	19.44	21.05	85.30	2.11	36.98
8	Node to 1st flower	3.0-4.5	3.84	6.53	10.59	38.07	0.31	8.30
9	Length of the fruit (cm)	3.65-14.45	9.20	23.17	23.33	98.62	4.36	47.39
10	Diameter of fruits (cm)	1.29-2.16	1.61	14.14	14.19	99.23	0.46	29.00
11	Average weight of fruit (g)	5.25-20.10	9.96	31.14	31.85	95.61	6.24	62.73
12	Number of fruits/plant	6.55-19.10	11.91	24.51	25.44	92.75	5.79	48.61
13	Fruit yield/ plant (g)	44.80-255.20	114.13	41.76	42.82	95.08	95.72	83.87
14	Fruit yield/ plot (kg)	3.403-19.982	9.68	40.77	43.55	87.61	7.61	78.60
15	Fruit yield (q/ha)	63.02-370.04	179.52	40.68	43.46	87.62	140.83	78.45

GCV = Genetic coefficient of variation, PCV = Phenotypic coefficient of variation

Table 2: Estimates of Genotypic (G) and Phenotypic (P) correlation of 12 characters in okra

S. No.	Characters		Plant height (cm)	Days to 50 % flowering	Number of nodes/ plant	Number of lobes / leaf	Number of branches/ plant	Number of ridges / Fruit	Internodal length (cm)	Node at which 1[St] flower appear	Length of fruit (cm)	Diameter of fruits (cm)	Average weight of fruit (g)	Number of fruits /plant	Fruit yield / plant (g)
1	Plant height	G	1.0	-0.5298**	0.7037**	-0.0532	0.0232	-0.4491**	0.6885**	0.4449**	0.0912	-0.1712	-0.0791	0.6868**	0.2486*
	(cm)	P	1.0	-0.4278 **	0.6719 **	-0.0916	0.0302	-0.4415 **	0.6656 **	0.2760 *	0.0921	-0.1689	-0.0700	0.6660 **	0.2512*
2	Days to 50 %	G		1.0	-0.4254**	0.2245	0.2234	0.3008*	-0.3574**	-0.0558	-0.1414	-0.1176	-0.0643	-0.4296**	-0.2851*
	flowering	P		1.0	-0.3437 **	0.1557	0.2233	0.2578 *	-0.2809 *	-0.0878	-0.1193	-0.0889	-0.0725	-0.3544 **	-0.2498*
3	Number of nodes	G			1.0	-0.02	0.1880	-0.3781**	-0.0094	0.0162	0.1361*	-0.0763	0.0498*	1.0117**	0.5757**
	/plant	P			1.0	0.0069	0.1745	-0.3674 **	-0.0773	-0.0110	0.1260*	-0.0733	0.0330*	0.9657 **	0.5511**
4	Number of lobes	G				1.0	0.5263**	0.2015	-0.0657	-0.2281	-0.0968	0.0185	0.0100	-0.079	-0.0531
	on leaves	P				1.0	0.2615 *	0.1381	-0.1245	-0.0965	-0.0717	0.0154	0.0264	-0.0604	-0.0052
5	Number of	G					1.0	0.1415	-0.1387	-0.0122	-0.0334	-0.0591	0.0138*	0.2033*	0.1590
	branches/ plant	P					1.0	0.1298	-0.1252	-0.0436	-0.0215	-0.0508	0.0148*	0.1653*	0.1365
6	Number of ridges	G						1.0	-0.2038	-0.1896	-0.3126**	0.3093**	0.0988	-0.3722**	-0.1107
	/ fruit	P						1.0	-0.1882	-0.117	-0.3104 **	0.3081 **	0.0966	-0.3585 **	-0.1079
7	Internodal length	G							1.0	0.6917**	-0.0049	-0.0741	-0.0648	-0.0489	-0.1388
	(cm)	P							1.0	0.4498 **	0.0067	-0.0721	-0.0303	-0.0454	-0.1116
8	Node at which 1[St]	G								1.0	-0.0548	0.2159	0.1015	0.0133	0.0774
	flower appear	P								1.0	-0.0440	0.1477	0.0848	0.0550	0.0831
9	Length of the fruit	G									1.0	-0.3057*	0.4314**	0.1913	0.5081**
	(cm)	P									1.0	-0.3027 *	0.4281 **	0.1713	0.4922**
10	Diameter of fruits	G										1.0	0.5341**	-0.0708	0.3719*
	(cm)	P										1.0	0.5200 **	-0.0728	0.3590*
11	Average weight of	G											1.0	0.0562*	0.8187**
	fruit	P											1.0	0.0599*	0.8135**
12	Number of fruits	G												1.0	0.5878**
	/plant	P												1.0	0.5941**

*, ** Denotes significance at 5% and 1% levels, respectivel

performance of okra plant in terms of fruit yield and should be selected for as component of yield. The negative significant association of plant height with days to 50% flowering, indicate that performance of crop plant in terms of final yield will be reduced because considerable height at flowering favours production of more fruits than shorter heights. The association of days to 50% flowering with number of branches per plant showed non significant but positive association. The negative and significant correlation of days to 50% flowering with internodal length shows that varieties with shorter days to flowering tend to produce more yield. The number of nodes per plant showed significant positive correlation with length of fruit, number of fruits/ plant and yield/plant, it shows that as node increases the number of fruit increases and finally yield/plant. Significant and positive correlation of number of branches/plant with number of fruit/plant indicates that more the branches, more the fruit yield/plant indicate that more the branches, more the fruit yield/plant. The internodal length was non significant but negatively correlated with number of fruits/plant and yield/plant indicate, the internodal length decreases, number of fruits and yield/plant increases. These results are inconformity with those reported by Ariyo et al. (1987), and Akinyele and Osekita (2006). The length of fruit have significant positive correlation with average weight of fruit and yield/plant indicate that length increases, average weight of fruit and finally yield/plant increases. Similarly the fruit diameter has also positively significant correlation was observed with average weight of fruit and yield/plant. The number of fruit/plant has strong positive correlation with yield/plant indicate this character should be improved through selection. Although some character that exercise negative correlation with one another will be difficult to select for characterization of desirable traits, those with negative association but non significant correlation will be disregarded in selection for crop improvement (Ariyo et al. 1987; Henry and Krishna 1990, and Newall and

Table 3: Direct and indirect effect of various yield and yield components in okra

S. No.	Characters		Plant height (cm)	Days to 50 % flowering	Number of nodes/ plant	Number of lobes / leaf	Number of branches/ plant	Number of ridges / Fruit	Internodal length (cm)	Node at which 1[St] flower appear	Length of fruit (cm)	Diameter of fruits (cm)	Average weight of fruit (g)	Number of fruits /plant
1	Plant height (cm)	G	**-0.5758**	0.0153	0.2998	0.0017	0.0014	0.0024	0.2160	0.0094	0.0144	-0.0100	-0.0510	0.3250
2	Days to 50 % flowering	G	0.3050	**-0.0289**	-0.1812	-0.0071	0.0135	-0.0016	-0.1121	-0.0012	-0.0223	-0.0069	-0.0414	-0.2033
3	Number of nodes/ plant	G	-0.4052	0.0123	**0.4260**	0.0006	0.0114	0.0020	-0.0029	0.0003	0.0214	-0.0045	0.0321	0.4787
4	Number of lobes on leaves	G	0.0306	-0.0065	-0.0085	**-0.0314**	0.0318	-0.0011	-0.0206	-0.0048	-0.0152	0.0011	0.0064	-0.0374
5	Number of branches/ plant	G	-0.0134	-0.0064	0.0801	-0.0165	**0.0605**	-0.0008	-0.0435	-0.0003	-0.0053	-0.0034	0.0089	0.0962
6	Number of ridges/ fruit	G	0.2586	-0.0087	-0.1610	-0.0063	0.0086	**-0.0053**	-0.0639	-0.0040	-0.0493	0.0180	0.0636	-0.1762
7	Internodal length (cm)	G	-0.3964	0.0103	-0.0040	0.0021	-0.0084	0.0011	**0.3137**	0.0147	-0.0008	-0.0043	-0.0417	-0.0231
8	Node to 1[st] flower	G	-0.2562	0.0016	0.0069	0.0072	-0.0007	0.0010	0.2170	**0.0212**	-0.0086	0.0126	0.0654	0.0063
9	Length of the fruit (cm)	G	-0.0525	0.0041	0.0580	0.0030	-0.0020	0.0017	-0.0015	-0.0012	**0.1576**	-0.0178	0.2780	0.0905
10	Diameter of fruits (cm)	G	0.0986	0.0034	-0.0325	-0.0006	-0.0036	-0.0017	-0.0232	0.0046	-0.0482	**0.0583**	0.3441	-0.0335
11	Average weight of fruit (g)	G	0.0455	0.0019	0.0212	-0.0003	0.0008	-0.0005	-0.0203	0.0021	0.0680	0.0311	**0.6443**	0.0266
12	Number of fruits/plant	G	-0.3955	0.0124	0.4309	0.0025	0.0123	0.0020	-0.0153	0.0003	0.0301	-0.0041	0.0362	**0.4732**

R Square =0.9882 Residual effect= 0.1088

Eberhart 1961). The data regarding direct and indirect effects was presented in Table 3 revealed that high positive direct effects of average weight of fruit followed by number of fruits per plant and number of nodes/ plant. On fruit yield indicated that, with other variables held constant, on increase in fruit weight and fruit number/plant might increase yield/plant. Although number of branches/plant had least direct effects on fruit yield, its indirect effects via number of fruits/plant and number of nodes/plant were high there by counterbalancing the low direct effect of number of branches/plant.pod diameter had appreciable direct effect on fruit yield with high indirect effect via average weight of fruit. This shows that increase in fruit diameter will results in increase in yield/[plant. Similar findings are reported by Dhall et al. (2003).

References

Akinyele BO and Osekita OS (2006) Correlation and path analyses of seed yield attributes in okra *(A. esculentus* (L.) Moench). African J. Biotechnology, vol. 5 (14) : 1330-1336.

Aljibouri HA, Miller PA and Robinson HF (1958) Genotype and environmental variances and covariance’s in an upland cotton cross of interspecific origin Agron. J. 50:663-636.

Ariyo OJ, Aken’ova ME and Fatokun CA (1987) Plant character correlation and path analysis of pod yield in okra (Abelmoschus esculentus) Euphytical 36 (1987) 677-686.

Bendale VW, Kadam SR, Bhave SG, Mehta JL.and Pethe UB (2003) Genetic diversity studies in okra [*Abelmoschus esculentus* (L.) Moench]. J. Crop Res. in India, **4** (3);395-399.

Burton GW and De Vane EH (1952) Estimating heritability in tall fenscue (*Festeca arundina* Ceae) from replicated clonal material. Agron. J., **45** :478-481

Dhall RK, Arora SK and Rani M (2003) Studies on variability, heritability and genetic advance of advance generations in okra [*A. esculentus* (L.) Moench]. J. Res. Punjab agric. Univ., **40** (1):54-58.

Dewey DR and Lu KD (1959) A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 51: 515-518.

Henry A and Krishna GV (1990) Correlation and path coefficient analysis in pigeon pea. Madras Agric J. 77 (9-12) : 443-446.

Johnson HW. Robinson HE and Comstock RE (1955) Estimation of genetic and environmental variability in soybean. Agron. J., **47** (7): 314-318.

Kumar SA, Yadav YC and Singh R (2012) Genetic variabiltity, heritability , genetic advance, correlation and path analysis in okra. Hort Flora Res. Spectrum, (1) 2 : 139-144.

Newall LC and Eberhart SA (1961) Clone and progeny evaluation in the improvement of switch grass (Panicum vigatum). Crop Sci. 1.117-121.

Osekita OS, Ariyo OJ and Kehinde OB (2000) Variation and inter character association in segregating F3 population from two crosses of okra. J.Agri.Res. 1(1): 32-36.

Panse VG and Sukhatme PV (1985) Statistical Methods for Agril. Workers, ICAR, New Delhi.

Steel EGD and Torrie JH (1960) Principles and procedure of statistic. A Biometrical appraoach 2nd ed. pp. 597.

Waldia RS, Katasra DS, Dahiya BN (1979) Correlations and path analysis of yield components in Gossypium arboretum. Indian J. Agric. Sci. 49(1):32-34.