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Studies on Correlation and Path Coefficient Analysis in Okra [*Abelmoschus esculents* (L.) Moench]

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ABSTRACT

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The present investigations entitled “Studies on correlation and path coefficient analysis in okra (*Abelmoschus esculentus* (L.) Moench)” were carried out at the Horticulture Research Farm-I of the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University Vidya Vihar Rae Bareilly Road Lucknow- 226025 Uttar Pradesh, India during the rainy season 2018. The present study involved evaluation of seventeen genotypes of okra. The observations on various attributes recorded revealed that the maximum total fruit yield per plant had exhibited highly significant and positive correlation with number of fruits per plant, was observed at phenotypic level with number of fruits per plant followed by plant height. High magnitude of positive direct effect on total fruit yield per plant followed by fruit circumference, TSS, acidity and fruit length. While highest negative direct effect was shown by leaves per plant.

Introduction

Okra [*Abelmoschus esculents* (L.) Moench $2n = 2x=130$] is one of the important members of the family Malvaceae and is well-known by many regional names as lady’s finger in England, Gumbo in USA, Bhindi in Pakistan and India. Okra is an African word and is native to northern Africa including the area of Ethiopia and Sudan. It is a summer and rainy season crop and is widely cultivated from tropics to sub tropics (Kochar, 1986). Okra (*Abelmoschus esculentus* L.) is probably an

amphidiploid (allo-tetraploid) derived from *Abelmoschus tuberculatus* ($2n = 58$), a wild species from India, and a species (*Abelmoschus ficulneus* (L.) Wight with $2n = 72$ chromosomes. The highest chromosome number $2n=196$ reported in *Abelmoschus manihot* var. *Caillei* (Singh and Bhatnagar, 1975, Siemonsma, 1982a, 1982b). Okra plants are characterized by indeterminate growth. Okra is a herbaceous, annual, 1-2 m tall, stem erect, green or with reddish tinge, leaves alternate, broadly cordate, palmately 3-7 lobed, hirsute and serrate. The flower

structure combines hermaphroditism and self-compatibility. Flowers are solitary, auxiliary with about 2 cm long peduncle, epicalyx up to 10, narrow hairy bracteoles which fall before the reaches maturity, calyx split longitudinally as flowers opens, petals 5, yellow with crimson spot on claw, 5-7 cm long, staminal column united to the base of petals with numerous stamens, ovary superior, stigma 5-9 deep red. The style is surrounded by a staminal column which may bear more than 100 anthers. The pollen may come in contact with the stigmas through a lengthening of the staminal column or through insect foraging. Thus, the flowers of okra are self-fertile. The pollen grain is large with many pores, and every pore a potential tube source; therefore, many tubes can develop from one pollen grain (Purewal and Randhawa 1947). Fruit is capsule, light green or sometimes red in colour pyramidal-oblong, beaked, longitudinally furrowed, 10-30 cm long, dehiscing longitudinally when ripe. Seeds green to dark brown, rounded with numerous stamens, ovary superior, stigma 5-9 deep red. The style is surrounded by a staminal column which may bear more than 100 anthers.

Materials and Methods

The present investigations entitled “Studies on correlation and path coefficient analysis in okra (*Abelmoschus esculentus* (L.) Moench)” were carried out at the Horticulture Research Farm-I of the Department of Horticulture, School of Agricultural Sciences and Technology, Babasaheb Bhimrao Ambedkar University Vidya Vihar Rae Bareilly road Lucknow- 226025(U.P.), India during the rainy season 2018. The experiment was laid out in an RBD randomized block design with three replications. The present study involved evaluation of 17 genotypes of okra like Arka Anamika, Kashi Lila, Arka Abhaya, Pusa Sawani, Kashi Satdhari, Kashi Vibhuti, Kashi

Pragti, Kashi Meghali, Kashi Vardan, Kashi Mohini, Kasha Kranti, Prabhani Kranti, Punjab -7, Punjab Padmini, D-1-875, HRB-55 and Pusa Makhmali. Observations were recorded on five plants from each genotype in each replication. *Viz*, germination percent, days to 50% flowering, plant height, stem diameter, no. of branches per plant, leaves per plant, fruit length, fruits circumference (cm), average fruit weight, no. of fruits per plant, acidity, TSS, ascorbic acid, moisture percent and total fruit yield per plant. Statistical analysis of data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme.

Results and Discussion

The phenotypic and genotypic correlation coefficients estimated among the eleven characters in present investigation are presented in Table 1 and 2 respectively. Phenotypic coefficient of correlation was higher than corresponding genotypic coefficient of correlation for all traits. Germination percent showed highly significant and positive correlation with plant height ($r_p=0.63^{**}$) followed by acidity ($r_p=0.55$), fruit length ($r_p=0.53^{**}$), whereas non-significant positive correlation with days to 50% flowering ($r_p=0.3936$) followed by moisture ($r_p=0.38$), and negative correlation with fruit circumference ($r_p=-0.40$) was significant. Days to 50 % flowering showed highly significant positive correlation with plant height ($r_p=0.49^*$), followed by fruit length ($r_p=0.43^*$) whereas it is non-significant positive correlation with number of branches per plant ($r_p=0.39$) followed by moisture ($r_p=0.24$) and non-significant negative correlation with average fruit weight ($r_p=-0.6051$) followed by stem diameter ($r_p=-0.4842$).

Table.1 Estimates of phenotypic correlation coefficients among 15 characters in okra

Characters	Germination Percent	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	No of Branches per plant	Leaves per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (g)	No. of fruits per plant	Acidity	TSS	Ascorbic Acid	Moisture percent	Total fruit yield per Plant
Germination Percent	1.00	0.39	0.63**	-0.64**	-0.26	0.20	0.53*	-0.40	-0.37	0.12	0.55**	-0.20	-0.10	0.38	0.19
Days to 50% flowering		1.00	0.49*	-0.48*	0.39	-0.22	0.43*	-0.28	-0.61	-0.09	0.13	0.32	-0.15	0.24	0.00
Plant Height (cm)			1.00	-0.54*	-0.28	-0.08	0.41	-0.03	-0.06	0.40	0.60**	-0.05	0.04	0.09	0.43*
Stem diameter (cm)				1.00	0.03	0.01	-0.12	0.41*	0.34	-0.01	-0.52*	0.04	0.14	-0.42*	0.07
No. of Branches per plant					1.00	-0.35	-0.26	-0.37	-0.41	-0.14	-0.11	0.47*	-0.12	0.32	-0.22
Leaves per plant						1.00	0.43*	-0.06	0.15	0.13	0.10	-0.25	-0.55**	-0.16	0.33
Fruit length (cm)							1.00	-0.15	-0.14	0.02	0.04	-0.21	-0.39	-0.35	0.40
Fruit circumference (cm)								1.00	0.50*	0.19	-0.13	-0.28	0.11	-0.29	0.16
Average fruit weight (gm)									1.00	0.32	-0.13	-0.47*	0.08	-0.46*	0.40
No. of fruits per plant										1.00	0.45*	0.24	-0.04	-0.08	0.89**
Acidity											1.00	0.10	-0.25	0.49*	0.30
TSS												1.00	-0.14	0.24	0.10
Ascorbic Acid													1.00	0.04	-0.22
Moisture percent														1.00	-0.34

* Significant at 5% probability level

** Significant at 1% probability level

Table.2 Estimates of genotypic correlation coefficients among 15 characters in okra

Characters	Germination Percent	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	No of Branches per plant	Leaves per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (g)	No. of fruits per plant	Acidity	TSS	Ascorbic Acid	Moisture percent	Total fruit yield per plant
Germination Percent	1.00	0.56**	1.10**	-1.13**	-0.38	-0.15	1.24**	-1.00**	-0.94**	0.22	-0.81**	-0.36	-0.18	0.69**	0.34
Days to 50% flowering		1.00	0.54*	-0.54*	0.69*	0.74**	0.59**	-0.41*	-0.97**	-0.12	-0.31	0.56*	-0.15	0.25	0.01
Plant height (cm)			1.00	-0.56**	-0.38	0.24	0.54*	-0.08	-0.05	0.46*	-0.94**	-0.07	0.03	0.10	0.44*
Stem diameter (cm)				1.00	0.00	0.01	-0.12	0.47*	0.49*	-0.03	0.79**	0.01	0.23	-0.48*	0.06
No. of Branches per plant					1.00	0.83**	-0.48*	-0.49*	-0.98**	-0.21	0.55**	0.73**	-0.27	0.48*	-0.31
Leaves per plant						1.00	-1.14**	0.35	-0.05	-0.18	0.29	0.78**	1.15**	0.84**	-0.72**
Fruit length (cm)							1.00	-0.30	-0.05	-0.05	0.14	-0.42*	-0.68**	-0.45*	0.49*
Fruit circumference (cm)								1.00	0.93**	0.17	0.49*	-0.45*	0.14	-0.41*	0.19
Average fruit weight (gm)									1.00	0.61**	0.07	-0.94**	0.36	-1.01**	0.59**
No. of fruits per plant										1.00	-0.74**	0.26	-0.01	-0.05	0.94**
Acidity											1.00	-0.14	0.69**	-0.80**	-0.45*
TSS												1.00	-0.30	0.33	0.11
Ascorbic Acid													1.00	0.08	-0.26
Moisture percent														1.00	-0.38

Table.3 Direct and indirect effects of 15 characters on total fruit yield/plant (kg) at phenotypic level in okra

Characters	Germination Percent	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	No. of Branches per plant	Leaves per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (gm)	No. of fruits per plant	Acidity	TSS	Ascorbic Acid	Moisture percent	Total fruit yield per plant
Germination Percent	0.397	0.001	-0.007	-0.011	-0.064	0.031	0.140	-0.053	-0.158	0.072	-0.004	-0.061	-0.006	-0.089	0.19
Days to 50% flowering	0.156	0.003	-0.006	-0.008	0.097	-0.034	0.113	-0.038	-0.258	-0.054	-0.001	0.098	-0.009	-0.055	0.00
Plant height (cm)	0.249	0.001	-0.012	-0.009	-0.071	-0.012	0.109	-0.004	-0.025	0.244	-0.005	-0.015	0.002	-0.021	0.43*
Stem diameter (cm)	-0.252	-0.001	0.006	0.017	0.008	0.001	-0.030	0.055	0.144	-0.005	0.004	0.012	0.008	0.099	0.07
No. of Branches per plant	-0.102	0.001	0.003	0.001	0.250	-0.054	-0.069	-0.049	-0.173	-0.087	0.001	0.142	-0.007	-0.076	-0.22
Leaves per plant	0.079	-0.001	0.001	0.000	-0.087	0.154	0.114	-0.008	0.063	0.082	-0.001	-0.074	-0.032	0.038	0.33
Fruit length (cm)	0.211	0.001	-0.005	-0.002	-0.066	0.067	0.263	-0.021	-0.061	0.014	0.000	-0.063	-0.023	0.082	0.40
Fruit circumference (cm)	-0.157	-0.001	0.000	0.007	-0.092	-0.009	-0.040	0.133	0.215	0.117	0.001	-0.084	0.006	0.068	0.16
Average fruit weight (g)	-0.147	-0.002	0.001	0.006	-0.101	0.023	-0.038	0.067	0.426	0.192	0.001	-0.140	0.005	0.107	0.40
No. of fruits per plant	0.047	0.000	-0.005	0.000	-0.036	0.021	0.006	0.026	0.135	0.608	-0.004	0.073	-0.003	0.019	0.89**
Acidity	0.217	0.000	-0.007	-0.009	-0.028	0.015	0.010	-0.017	-0.054	0.276	-0.008	0.029	-0.015	-0.115	0.30
TSS	-0.080	0.001	0.001	0.001	0.119	-0.038	-0.055	-0.037	-0.198	0.148	-0.001	0.300	-0.008	-0.055	0.10
Ascorbic Acid	-0.039	0.000	0.000	0.002	-0.030	-0.084	-0.102	0.015	0.036	-0.027	0.002	-0.043	0.058	-0.009	-0.22
Moisture percent	0.151	0.001	-0.001	-0.007	0.081	-0.025	-0.091	-0.039	-0.194	-0.048	-0.004	0.071	0.002	-0.235	-0.34

Table.4 Direct and indirect effects of 15 characters on total fruit yield/plant (kg) at genotypic level in okra

Characters	Germination Percent	Days to 50% flowering	Plant height (cm)	Stem diameter (cm)	No. of Branches per plant	Leaves per plant	Fruit length (cm)	Fruit circumference (cm)	Average fruit weight (gm)	No. of fruits per plant	Acidity	TSS	Ascorbic Acid	Moisture percent	Total fruit yield per plant
Germination Percent	0.611	-0.163	-1.286	1.052	0.389	0.008	1.126	-1.254	0.593	0.388	-0.849	-0.435	-0.029	0.195	0.34
Days to 50% flowering	0.342	-0.291	-0.626	0.505	-0.705	-0.041	0.537	-0.509	0.614	-0.208	-0.327	0.672	-0.025	0.071	0.01
Plant height (cm)	0.674	-0.156	-1.165	0.525	0.388	-0.013	0.491	-0.096	0.034	0.799	-0.979	0.089	0.006	0.027	0.44*
Stem diameter (cm)	-0.691	0.158	0.658	-0.930	0.004	0.000	-0.106	0.592	-0.312	0.051	0.827	0.011	0.038	-0.136	0.06
No. of Branches per plant	-0.233	-0.201	0.443	0.004	-1.020	-0.046	-0.439	-0.609	0.619	0.368	0.578	0.871	-0.045	0.136	-0.31
Leaves per plant	-0.092	-0.216	-0.284	-0.006	-0.851	-0.055	-1.030	0.435	0.031	0.309	0.300	0.934	0.191	0.237	-0.72**
Fruit length (cm)	0.758	-0.172	-0.630	0.108	0.494	0.063	0.908	-0.379	0.034	0.095	0.149	0.503	-0.114	-0.128	0.49*
Fruit circumference (cm)	-0.612	0.119	0.090	-0.441	0.497	-0.019	-0.275	1.250	-0.590	0.292	0.516	0.544	0.023	-0.115	0.19
Average fruit weight (gm)	-0.572	0.282	0.062	-0.459	0.999	0.003	-0.049	1.166	-0.633	1.063	0.074	1.124	0.060	-0.283	0.59**
No. of fruits per plant	0.135	0.035	-0.531	0.027	0.214	0.010	-0.049	0.208	-0.384	1.753	-0.768	0.310	-0.002	-0.015	0.94**
Acidity	-0.497	0.091	1.093	-0.737	-0.565	-0.016	0.130	0.618	-0.045	1.290	1.044	0.165	0.114	-0.226	-0.45*
TSS	-0.222	-0.163	0.086	-0.008	-0.741	-0.043	-0.380	-0.567	0.593	0.453	-0.144	1.200	-0.050	0.093	0.11
Ascorbic Acid	-0.108	0.044	-0.040	-0.215	0.275	-0.063	-0.622	0.170	-0.227	0.022	0.721	0.363	0.166	0.022	-0.26
Moisture percent	0.423	-0.073	-0.113	0.450	-0.492	-0.047	-0.412	-0.510	0.638	0.095	-0.838	0.396	0.013	0.281	-0.38

Plant height showed highly significant positive correlation acidity ($r_p=0.60^{**}$) followed by total fruit yield per plant ($r_p=0.43^*$), moisture percent ($r_p=0.09$), significant negative correlation with leaves per plant ($r_p=-0.08$), whereas it is non-significant positive correlation with fruit length ($r_p=0.41$) followed by number of fruit per plant ($r_p=0.40$) and negative non-significant correlation with stem diameter ($r_p=-0.54^*$) followed by number of branches per plant ($r_p=-0.28$). Stem diameter showed highly significant positive correlation with fruit circumference ($r_p=0.41^*$), whereas it is significant negative correlation with acidity ($r_p=-0.52^*$) followed by moisture percent ($r_p=-0.42^*$) and it is non-significant positive correlation with average fruit weight ($r_p=0.34$), followed by ascorbic acid ($r_p=0.14$). Number of branches per plant showed highly significant positive correlation with TSS ($r_p=0.47^*$), whereas it is significant negative correlation with average fruit weight ($r_p=-0.41$) followed by fruit circumference ($r_p=-0.37$), leaves per plant ($r_p=-0.35$) and it is non-significant positive correlation with moisture percent ($r_p=0.32$). Leaves per plant showed significant positive correlation with fruit length ($r_p=0.2196^*$), whereas it is significant negative correlation with ascorbic acid ($r_p=-0.55^{**}$) and it is non-significant positive correlation with total fruit yield per plant ($r_p=0.33$), followed by average fruit weight ($r_p=0.15$). Fruit length showed significant positive correlation with total fruit yield per plant ($r_p=0.40$) whereas it is significant negative correlation with ascorbic acid ($r_p=-0.39$) followed by moisture percent ($r_p=-0.35$) and it is non-significant positive correlation with average fruit length ($r_p=0.1665$), followed by number of fruit per plant ($r_p=0.0936$), average fruit weight ($r_p=0.0040$). Fruit circumference showed significant and positive correlation with average fruit weight ($r_p=0.50^*$), and whereas it is non-significant positive correlation with

number of fruits per plant ($r_p=0.19$) followed by total fruit yield per plant ($r_p=0.16$), and negative correlation with moisture percent ($r_p=-0.29$) followed by TSS ($r_p=-0.28$). Average fruit weight showed significant negative correlation with acidity ($r_p=-0.47^*$) followed by percent ($r_p=-0.46^*$) whereas it is non-significant positive correlation with total fruit yield per plant ($r_p=0.40$) followed by number of fruits per plant ($r_p=0.32$). Number of fruits per plant showed highly significant positive correlation with total fruit yield per plant ($r_p=0.89^{**}$) followed by acidity ($r_p=0.45^*$). Whereas it is non-significant positive correlation with TSS ($r_p=0.24$), negative correlation with moisture percent ($r_p=-0.08$) followed by ascorbic acid ($r_p=-0.04$). Acidity showed highly significant and positive correlation with moisture ($r_p=0.49^*$) whereas it is non-significant positive correlation with total fruit yield per plant ($r_p=0.30$) and negative correlation with ascorbic acid ($r_p=-0.25$). TSS showed non-significant positive correlation with moisture percent ($r_p=0.24$), negative correlation with ascorbic acid ($r_p=-0.14$). Ascorbic acid showed significant positive correlation with moisture ($r_p=0.04$), negative correlation with total fruit yield per plant ($r_p=-0.22$). Moisture percent showed non-significant negative correlation with total fruit yield per plant ($r_p=-0.34$) and the path coefficient analysis estimated at phenotypic level and genotypic was presented in Table 3 and Table 4 respectively. Number of fruits per plant (1.753) showed highest positive direct effect on total fruit yield per plant followed by fruit circumference (1.250), TSS (1.200), acidity (1.044) and fruit length (0.908). While highest negative direct effect was shown by leaves per plant (-0.55). The highest positive indirect effect on total fruit yield per plant were exhibited by number of fruits per plant (0.94^{**}) followed by average fruit weight (0.59^{**}), fruit length (0.49^{*}) and plant height (0.44^{**}) all character except germination

percent (0.01) showed low positive indirect effect. Leaves per plant (-0.72**) showed negative indirect effect on total fruit yield per plant via acidity (-0.45*) and moisture percent (-0.38) and it is also showed negative indirect effect via number of branches per plant, ascorbic acid and TSS.

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