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RESEARCH ARTICLE

Studies on interrelationship and path co-efficient analysis on the basis of fruit yield in eggplant (*Solanum melongena* L.)

■ **Kailash Ram and P. Singh**

SUMMARY

The genotypic and phenotypic correlation and path co-efficient in nineteen genetically diverse genotypes of eggplant were studied at Vegetable Research Station (C S Azad University and Technology, Kanpur) during *Kharif* season. Studies on relationship at genotypic level revealed positive and strong correlation of yield per plant, number of branches per plant, width of fruit, plant spread and fruit weight in parents, F_1s and F_2s, whereas significant and positive association of yield per plant with number of fruits per plant were observed in parents, F_1s and F_2s at phenotypic level. Path co-efficient analysis indicate that number of fruits per plant had highest direct/desirable effect on yield per plant followed by fruit weight in both F_1 and F_2 at genotypic and phenotypic level and days to flowering in F_1 and F_2 only at genotypic level. The highest positive direct effect on yield per plant was observed by most of the yield contributing characters, *i. e*., days to marketable maturity and number of branches per plant *via* number of fruits per plant, length of fruit and width of fruit, and plant spread *via* number of fruits per plant in F_1 and F_2 generations at both genotypic and phenotypic levels.

Key Words : Eggplant, Correlation, Path co-efficient, Character association

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Eggplant (*Solanum melongena* L., 2n=24) belonging to family Solanaceae is one of the most important vegetable crops grown round the year all over the country. It is liked by both poor and rich people. As regards nutritive value, it has about 92.7% moisture, 24% calories, 1.4% protein, 4% carbohydrates, 0.3% minerals, 0.3% fat and 1.3% fibres. Vitamin C content is around 6mg/100mg, vitamin A 24AU and 12mg vitamin C (Chen and Li,1996). The amino acid contents are higher in green and low in purple varieties. Bajaj *et al*. (1979) reported that on an average, the oblong fruited brinjal cultivars are rich in total water-soluble sugars, whereas the long-fruited cultivars contain large amount of free reducing sugars, anthocyanin, phenols

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glycoalkaloids, dry matter and amide proteins. A higher anthocyanin content and low glycoalkaloid content are considered essential. It is further observed that, on an average, the round types of brinjal have higher polyphenol oxidase activity and glycoalkaloid content than long types. Bitterness in brinjal is due to presence of glycoalkaloids. In addition to its nutritional value, it also has medicinal value. White varieties are treated to be good for diabetic patients. It has also been found to be an appetizer cardic tonic and beneficial *Vata* and *Kapha* (Choudhary,1976). It can also cure toothache if fried brinjal fruit in til oil is use to cure toothache (Chen and Li, 1996). It has also recommended as an excellent remedy for those suffering from liver complaints.

Estimation of correlation co-efficient among the yield contributing characters is necessary to understanding the direction of selection and maximize yield in the shortest period. Path coefficient provides an efficient way of entangling direct and indirect causes of association of selection and measures the relative importance of each causal factor. Yield is a composite character and depend upon a number of ascribes. For an effective selection, it is essential to have the association of various attributes with yield and yield contributing characters. Several workers have done remarkable studies on this aspect. The relative contribution of causal factors can not be measured by simple correlation hence would not be useful to the final yield. While the component traits are inter-dependent, they much affect their direct correlation with yield and resultant limit the reliability of selection indices grounded upon correlation co-efficients. The path co-efficient analysis allows the detachment of direct effects from indirect effects *via* other related traits by dividing the genotypic correlation co-efficients. Therefore, the present study was conducted to calculate the genotypic and phenotypic correlations to determine the direct effects of component characters on yield in eggplant.

MATERIAL AND METHODS

The present investigation entitled "Line x tester analysis for combining ability in eggplant (*Solanum melongena* L.)" was conducted during *Kharif* season of 2001-02, 2002-03 and 2003-04 at Vegetable Research Station, Kalyanpur, C. S. Azad University of Agricultural and Technology, Kanpur. The experimental materials comprised fifteen lines, *viz.*, KS 219, KS 247, KS 253, KS 262, KS 228, KS 233, KS 250, KS 263, KS 235, KS 227, ACC 5114, ACC 8204, ACC 8206, ACC 8207, ACC 2623 and four testers, *viz.*, T 3, AB 1, KS 224 and DBR 8 and their F_1 hybrids derived by crossing the fifteen lines used as female parent with each of the four testers used as male parent in line x tester fashion. These genotypes were planted in Randomized Block Design with three replications at the spacing of 60 cm between row to row and plant to plant. All the recommended cultural practices were followed to raise a healthy crop. Observations were recorded on five randomly selected plants from each parent and F_1s, and 10 plants in F_2s in each replication. For the data observation, ten characters were considered *viz.* days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, length of fruit(cm), fruit width (cm), fruit weight (g), plant spread (cm) and yield per plant (kg). The simple correlation between different characters at genotypic and phenotypic levels were estimated according to Al-Jibouri *et al*. (1958). For the path co-efficient analysis, Dewey and Lu (1959) method was followed. Seed yield is not independent variable and characters, directly as well as indirectly. The variation in seed yield unexplained by the ten causes was presumed to be contributed by a residual factor effect (x) which is uncorrelated with other factors. Path co-efficients were estimated by solving the following simultaneous equation indicating the primary relationship between correlation and path co-efficient.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Correlation co-efficient:

The knowledge of correlation between yield and its components may give variable indications regarding the components on which selection pressure could most profitably be exercised in order to obtain an increase in yielding ability (Grafius, 1964). Understanding of then genotypic correlation between characters is of theoretical interest because a genotypic correlation may be derived from genetic linkage, pleiotropy or developmentally induced relationship between components that are indirectly the consequence of gene interaction. The significance of genotypic associations could not be tested as no suitable statis tical test is available (Nasar *et al.,* 1973), yet their magnitude is considered in relation to the corresponding phenotypic estimates. In this study, in general, genotypic correlation co-efficients were higher than phenotypic correlation co-efficients suggesting inherent relationship in different genotype. This is not unusual in eggplant and has earlier been reported by Prabhu (1974), Singh and Khanna (1978) and Sharma *et al.* (2002). At genotypic level, the co-efficient of correlations of yield per plant were consistently strong and positive with number of fruits per plant, number of branches per plant, width of fruit, plant spread and fruit weight in parents, F_1s and F_2s; length of fruit in F_1 and F_2 and days flowering and days to marketable maturity in F_1 only. It is interesting to not that yield per plant had either weak or negative association with plant height in all the populations and days to flowering and length of fruit in parent only. Further, the significant and positive association of yield per plant with number of fruits per plant in all the three populations; plant spread in parent and F_1; number of branches per plant and fruit weight in F_1 and F_2 and width of fruit and length of fruit only in F_1 progenies while plant height in F_1 and F_2 exhibited negative and significant correlation with yield at phenotypic level indicate the role of environment for these associations. Significant and negative association of yield with plant height indicated better yield from dwarf plant type. These finding concorded well with the earlier results of Mohanty (1999), Negi *et al.* (1999), Singh and Singh

Table 1: Estimates of genotypic and phenotypic correlation for ten characters among parents, F_1s and F_2s in eggplant

Character	DF	DMM	PH	NBP	NFP	LF	WF	FW	PS
DF	Parents	0.881	0.117	0.103	-0.269	-0.018	0.028	0.328	0.328
	F_1s	0.887	0.019	0.448	0.297	-0.034	0.269	0.248	0.382
	F_2s	0.902	0.011	0.303	0.220	0.148	0.318	-0.047	0.083
DMM	0.834**	Parents	0.337	0.158	-0.541	0.127	-0.080	0.262	0.302
	0.782**	F_1s	0.053	0.400	0.205	-0.094	0.232	0.208	0.356
	0.827**	F_2s	0.101	0.459	0.283	0.286	0.402	0.034	0.190
PH	0.083	0.356	Parents	0.634	-0.346	0.739	0.293	0.151	0.213
	0.013	0.030	F_1s	-0.032	-0.388	0.175	-0.144	0.061	-0002
	0.027	0.069	F_2s	-0.111	-0.308	-0.006	0.215	-0.080	-0.127
NBP	0.024	0.073	0.401	Parents	0.269	0.733	0.557	0.022	0.601
	0.327*	0.295*	-0.069	F_1s	0.940	0.614	0.938	0.614	0.505
	0.147	0.175	0.010	F_2s	0.863	0.400	0.393	0.389	0.452
NFP	-0.208	-0.449	-0.276	0.229	Parents	-0.510	0.254	-0.112	0.386
	0.217	0.194	-0.343**	0.730**	F_1s	0.433	0.737	0.395	0.261
	0.125	0.160	-0.206	0.620**	F_2s	0.323	0.353	0.138	0.250
LF	-0.003	0.022	0.336	0.120	-0.179	Parents	-0.181	0.575	-0.015
	-0.041	-0.049	0.107	0.160	0.063	F_1s	0.676	0.574	0.419
	0.087	0.128	0.038	0.138	-0.031	F_2s	0.902	0.905	0.632
WF	0.050	0.010	0.178	-0.027	0.005	0.634**	Parents	0.490	0.535
	0.126	0.096	-0.053	0.270*	0.209	0.765**	F_1s	0.659	0.404
	0.079	0.106	0.093	0.097	-0.093	0.856**	F_2s	0.441	0.860
FW	0.316*	0.226	0.136	0.102	-0.046	0.351	0.293	Parents	0.276
	0.181	0.163	0.047	0.353**	0.199	0.443**	0.460**	F_1s	0.504
	-0.021	0.026	-0.51	0.053	-0.076	0.557**	0.507**	F_2s	0.383
PS	0.324	0.275	0.193	0.366**	0.310*	0.023	0.141	0.241	Parents
	0.292*	0.308*	0.002	0.337**	0.221	0.238	0.237	0.425**	F_1s
	0.027	0.115	-0.109	0.228	0.165	0.291*	0.207	0.303*	F_2s
YP	0.056	-0.241	-0.285	0.251	0.813**	0.000	0.152	0.351	0.474**
	0.225	0.160	-0.282*	0.710**	0.822**	0.255*	0.381**	0.518**	0.389**
	0.021	0.058	-0.301*	0.544**	0.768**	0.200	0.144	0.280*	0.232

* and ** indicate significance of values at P=0.05 and 0.01, respectively
Upper diagonal indicated genotypic correlation co-efficient   Lower diagonal indicated phenotypic correlation co-efficient

(2001) and Sharma *et al*. (2002) for different traits. When relationship among the component traits were reviewed, it was found that the genotypic level days to flowering has strong positive association with days to marketable maturity and number of branches per plant in all the three populations; fruit yield and plant spread in parent and F_1, number of branches per plant and width of fruit in F_1 and F_2, plant height in parent and length of fruit in F_2 population. Days to marketable maturity showed high positive association with number of branches per plant and plant spread in all the three populations, fruit weight in parent and F_1, width of fruit and number of fruits per plant in F_1s and F_2s, plant height and length of fruit in parents and F_2 generation. Plant

Table 2: Direct and indirect effect of different characters on yield per plant at genotypic and phenotypic level in eggplant

Character			DF	DMM	PH	NBP	NFP	LF	WF	FW	PS	YP
DF	G	F1	0.160	-0.211	-0.211	-0.104	0.292	0.007	0.038	0.081	0.069	0.32
		F_2	0.193	-0.392	-0.001	0.095	0.153	0.029	-0.032	-0.010	-0.007	0.028
	P	F_1	0.060	-0.095	-0.001	0.031	0.141	0.000	0.008	0.054	0.027	0.225
		F_2	-0.047	-0.032	-0.004	0.013	0.091	0.000	0.007	-0.006	-0.001	0.021
DMM		F_1	0.142	-0.249	0.006	-0.93	0.202	0.019	0.032	0.068	0.064	0.192
		F_2	0.174	-0.434	-0.006	0.144	0.196	0.056	-0.040	0.007	-0.016	0.082
	P	F_1	0.047	-0.122	-0.002	0.028	0.127	0.000	0.006	0.049	0.028	0.160
		F_2	-0.039	-0.039	-0.010	0.016	0.116	0.000	0.009	0.008	-0.003	0.058
	G	F_1	0.003	-0.013	0.116	0.007	-0.382	-0.035	-0.020	0.020	0.000	-0.304
PH		F_2	0.002	-0.044	-0.055	-0.035	-0.214	-0.001	-0.022	-0.017	0.011	-0.375
	P	F_1	0.001	-0.004	-0.061	-0.006	-0.223	0.000	-0.003	0.014	0.000	-0.282*
		F_2	-0.001	-0.003	-0.144	0.001	-0.150	0.000	0.008	-0.015	0.002	-0.301**
NBP	G	F_1	0.072	-0.100	-0.004	-0.232	0.926	-0.121	0.131	0.200	0.091	0.965
		F_2	0.058	-0.199	0.006	0.314	0.599	0.079	-0.039	0.085	-0.038	0.864
	P	F_1	0.020	-0.036	0.004	0.094	0.475	0.000	0.016	0.106	0.031	0.710**
		F_2	-0.007	-0.007	-0.001	0.089	0.452	0.000	0.008	0.015	-0.005	0.544**
NFP	G	F_1	0.048	-0.051	-0.045	-0.218	0.985	-0.085	0.103	0.129	0.047	0.912
		F_2	0.043	-0.123	0.017	0.271	0.694	0.063	-0.035	0.030	-0.021	0.939
	P	F_1	0.013	-0.024	0.021	0.068	0.651	0.000	0.012	0.060	0.020	0822**
		F_2	0.006	-0.006	0.030	0.055	0.728	0.000	-0.008	-0.022	-0.004	0.768**
LF	G	F_1	-0.006	0.023	0.020	-0.142	0.427	-0.197	0.094	0.187	0.076	0.483
		F_2	0.029	-0.124	0.000	0.126	0.224	0.197	-0.090	0.198	-0.053	0.505
	P	F_1	-0.002	0.006	-0.007	0.015	0.041	0.002	0.046	0.133	0.022	0.255*
		F_2	-0.004	-0.005	-0.006	0.012	-0.023	0.000	0.071	0.160	-0.007	0.200
WF	G	F_1	0.043	-0.058	-0.017	-0.218	0.726	-0.133	0.140	0.215	0.073	0.772
		F_2	0.061	-0.175	-0.012	0.124	0.245	0.177	-0.100	0.315	-0.072	0.563
	P	F_1	0.008	-0.012	0.003	0.025	0.136	0.001	0.060	0.138	0.022	0.381**
		F_2	-0.004	-0.004	-0.013	0.009	-0.068	0.000	0.083	0.146	-0.005	0.144
FW	G	F_1	0.040	-0.052	0.007	-0.142	0.389	-0.113	0.092	0.326	0.091	0.38
		F_2	-0.009	-0.015	0.004	0.122	0.096	0.178	-0.145	0.219	-0.032	0.419
	P	F_1	0.011	-0.020	-0.003	0.033	0.130	0.001	0.027	0.300	0.039	0.518**
		F_2	0.001	-0.001	0.007	0.005	-0.055	0.000	0.042	0.287	-0.007	0.280*
PS	G	F_1	0.061	-0.089	0.000	-0.117	0.257	-0.082	0.156	0.164	0.180	0.431
		F_2	0.016	-0.082	0.007	0.142	0.173	0.124	-0.086	0.984	-0.084	0.293
	P	F_1	0.018	-0.038	0.000	0.032	0.144	0.000	0.014	0.127	0.092	0.389**
		F_2	-0.001	-0.004	0.016	0.020	0.120	0.000	0.017	0.087	-0.022	0.232

Residual effect (F_1) Genotypic = 0.057 and Phenotypic = 0.173 Residual effect (F_2) Genotypic= -0.023 and Phenotypic = 0.265

height exhibited positive relationship with number of branches per plant, plant spread and fruit weight in parents, length of fruit in parents and F_1 and width of fruit in parent and F_1. Number of branches per plant showed positive and high magnitude of association with number of fruits per plant, width of fruit, length of fruit and plant spread in all the three populations and with fruit weight in F_1 and F_2. Width of fruit and plant spread in all the three populations and length of fruit and fruit weight in F_1 and F_2 exhibited comparatively strong and positive association with number of fruits per plant. The length of fruit has positive correlation with fruit weight in all the three populations and width of fruit and plant spread in F_1s and F_2s. The strong and positive association was also observed between width of fruit and plant spread, fruit weight; fruit weight and plant spread in all the populations. At phenotypic level, positive and significant associations were recorded by days to flowering with days to marketable maturity in all the three populations, with number of branches per plant and plant spread in F_1s and F_2s, and fruit weight in parents. Days to marketable maturity showed significant positive association with plant spread in parents and F_1s, with number of fruits per plant in F_1 and F_2, with fruit weight and width of fruit in F_1, while number of branches per plant had positive and significant association with plant spread in parents. Length of fruit showed positive and significant association with width of fruit in all the populations, with fruit weight in F_1s and F_2s and with plant spread only in F_2. Width of fruit had significant positive association with fruit weight in F_1 and F_2, while fruit weight also showed positive and significant association with plant spread. Such association of days to flowering and days to marketable maturity with different traits confined the said notions as it is expected that late maturity types would get more period for vegetable development resulting in taller plant height and a greater number of branches per plant towards higher yield. Similar finding on association ship with different traits were also reported by Negi *et al*. (1999), Sharma *et al*. (2002); Singh and Kumar (2004); Patharia *et al*. (2005); Nair and Mehta (2007); Jadhao (2009); Muniappan *et al*. (2010); Karak *et al.* (2012) and Shinde *et al*. (2012).

Path co-efficient :

The result path co-efficient analysis reviled that having higher positive direct effect, number of fruits per plant was most important character followed by fruit weight in F_1 and F_2 at both genotypic and phenotypic level, while at genotypic level, days to flowering in F_1 and F_2 width of fruit and plant height in parents and number of branches per plant and length of fruit in F_2 generation exhibited high positive direct effect on yield per plant. Days to marketable maturity in F_1 and F_2, number of branches per plant and length of fruit in F_1, and width of fruit in F_2 had direct negative effect on yield per plant at genotypic level, whereas days to marketable maturity in F_1 and plant height in F_2 generation also showed negative direct effect on yield per plant at phenotypic level. The negative direct effect on plant height and negative indirect effects via other traits contributed to negative correlation of plant height with yield per plant and this resulted higher yield from dwarf plant types. Traits, days to marketable maturity, number of branches per plant and plant spread via number of fruits per plant; length of fruit and width of fruit via fruit weight in F_1 and F_2 at genotypic and phenotypic level had high indirect effect on yield per plant. The higher magnitude of indirect effect on yield per plant was recorded by days to flowering via number of fruits per plant, days to marketable maturity via days to flowering; length of fruit and width of fruit via number of fruits per plant; and plant spread via fruit weight in F_1 and F_2 only at genotypic level. This information may be utilized to improve the yield in eggplant through direct selection for these traits. The earlier workers, *viz*., Mohanty (1999) and Mohanty (2001); Singh and Kumar (2004); Naliyadhara *et al*. (2007); Mishra *et al*. (2007); Bansal and Mehta (2008); Muniappan *et al*. (2010); Singh *et al*. (2011); Thangamani and Jansirani (2012) and Shinde *et al*. (2014) reported similar results with respect to different traits.

Conclusion:

Correlation studies provide information the nature and extent of association between any two pairs of matric traits. This, it could be possible to bring about genetic upgradation in one trait by selection of the other trait. It can be concluded that for getting higher yield, selection should be emphasized on dwarf plant height, a greater number of branches per plant, number of fruits per plant and fruit weight in this crop. However, as regards to character plant height, medium tall plant height should be taken into consideration rather than much taller or dwarf. Selection based on these characters can be effective to developing high yielding eggplant varieties.

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