ASSOCIATION ANALYSIS OF YIELD AND YIELD PARAMETERS IN BRINJAL (*SOLANUM MELONGENA* L.)

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Abstract

Studies on correlation & Path coefficient analysis carried out in 21 genotypes of brinjal (*Solanum melongena* L.) revealed that the fruit yield per plant was positively and significantly correlated with number of pickings ($r_p = 0.456$, $r_g = 0.468$), fruit volume ($r_p = 0.371$, $r_g = 0.381$), number of fruits per plant ($r_p = 0.371$, $r_g = 0.368$) and average fruit weight ($r_p = 0.246$, $r_g = 0.247$), but negative and significant association was found with days to 50% flowering ($r_p = -0.395$, $r_g = -0.422$) indicating that early flowering and early picking (first picking) might be associated with increasing the number of fruits per plant. Path coefficient analysis indicated that by average fruit weight (1.481), number of pickings (1.149), flowers per cluster (0.396), number of fruits per plant (0.389), plant height at 50% flowering (0.379), fruit volume (0.284), days to 50% flowering (0.203) and leaf area (0.194) positive direct effect to fruit yield per plant. Negative direct effect of fruit diameter (-0.533), fruits per cluster (-0.309) and plant height at last picking (-0.206) and fruit setting percentage (-0.188) were as component characters towards influencing fruit yield of brinjal genotypes suitable for hills in Garhwal Himalayas.

Key words : Correlation, path analysis, yield components, brinjal.

Introduction

The correlation coefficients are worked out to describe the degree of association between independent and dependent variables. The phenotypic correlation indicate the extent of observed relationship between two characters and these include both heredity and the environmental influences, while genotypic correlation coefficient provides a real association between two characters and are highly useful in selection (Johnson *et al*., 1955). The genotypic correlation coefficients (r_g) in general were higher than their corresponding phenotypic correlation coefficient (r_p) for most of the character pairs, indicating a strong inherent association between the characters in brinjal (Singh and Singh, 1981; Kalda *et al*., 1996 and Senapati *et al*., 2009). Path coefficient analysis measures the direct influence of one variable upon another and permits the separation of correlation coefficients into components of direct and indirect effects. This gives clear picture of direct and indirect effects of the various traits on fruit yield of plant.

Materials and Methods

The experiment was carried out during the *kharif* season of 2013 at Vegetable Research Block of Department of Vegetable Science, Uttarakhand University of Horticulture and Forestry, Ranichauri Campus (30° 18' N latitude and 78° 24' E longitude at an elevation of 2000 m), Tehri Garhwal, Uttarakhand. Seeds of twenty one genotypes were (Arka Shirish, Utkal Madhuri, DBL-329, Uttara, JBGR-1, Azad T-3, Azad B-3, Utkal Keshri, Punjab Nagini, Swarna Avilamb, Pusa Shyamal, GOB-1, CH-10-45, NDB-3, Annamalai, Brinjal Local Long, Pant Samrat, Mukta Keshri, PR-5, Swarna Shoba and Utkal Tarni) sown in different rows on a raised bed nursery followed by normal nursery practices. The experiment was laid out in randomized block design with three replications at the spacing of 60 cm between rows and 45 cm between plant to plant. All the recommended cultural practices measures were followed data were recorded for 16 characters.

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Results and Discussion

In present investigation, phenotypic and genotypic correlation coefficients were worked out for sixteen traits in all possible combination (table 1).

Fruit yield per plant was significantly and positively correlated at both phenotypic and genotypic levels with number of pickings, fruit volume, number of fruits per plant and average fruit weight. It indicated that for improvement of fruit yield per plant in brinjal selection should be practiced keeping in the view fruit volume, fruit weight and number of fruits per plant. Similar results on correlation of fruit yield per plant have been also reported by Kushwah and Bandhyopadhya (2005) with number of pickings, Panja *et al*. (2013) with fruit volume, Dahatonde *et al*. (2010) and Ahmed *et al*. (2013) with number of fruits per plant and Nalini *et al*. (2009) and Muniappan *et al*. (2010) with average fruit weight. Significant negative correlation at both phenotypic and genotypic levels of fruit yield per plant was observed with days to 50% flowering. Negative correlation between fruit yield per plant and days to 50% flowering indicated that late flowering genotypes could not be high yielding particularly in temperate hill conditions during *kharif* season as late bearing genotypes would readily be prone to low temperature in late *Kharif*. Therefore, early flowering and fruiting type genotypes should be selected for *Kharif* cultivation in temperate hills of Uttarakhand so that the crop may get prolonged high temperature period to explore it their full potentiality of fruiting. Similar results on correlation of fruit yield was also reported by Mishra *et al*. (2002) in capsicum; Kamani *et al*. (2008) and Shinde *et al*. (2012) in brinjal with days to 50% flowering.

Phenotypic path coefficient analysis

Path coefficient analysis at phenotypic level (table 2) exhibited that maximum direct positive effect on fruit yield per plant was registered by average fruit weight (1.481), number of pickings (1.149), flowers per cluster (0.396), number of fruits per plant (0.389), plant height at 50% flowering (0.379), fruit volume (0.284), days to 50% flowering (0.203) and leaf area (0.194). High positive direct effect on fruit yield per plant in brinjal have also been reported by Nayak and Nagre (2013) for average fruit weight, Nayak and Nagre (2013) for flowers per cluster, Dahatonde *et al*. (2010) for number of fruits per plant, Senapati *et al*. (2009) for days to 50% flowering, Chattopadhyay *et al*. (2011) for plant height at 50% flowering, Panja *et al*. (2013) for fruit volume and Dixit (2000) and Kushwah and Bandhyopadhya (2007) for leaf area.

The direct selection for these characters would be beneficial for crop improvement since most of these characters also showed positive coefficient of correlation with fruit yield per plant. The residual effect of phenotypic path coefficient analysis was 29.87% that indicated that almost 70.13% variability in fruit yield per plant was explainable through the selected components.

Genotypic path coefficient analysis

A perusal of genotypic path coefficient analysis (table 1) showed that average fruit weight had maximum direct positive effect (1.980) on fruit yield per plant followed by number of pickings (1.791), plant height at 50% flowering (1.020), days to 50% flowering (0.576), flowers per cluster (0.386), fruit volume (0.319), leaf area (0.274) and number of fruits per plant (0.246).

High positive direct effect on fruit yield per plant in brinjal have also been reported by Shinde *et al*. (2012) and Nayak and Nagre (2013) for average fruit weight, Nayak and Nagre (2013) and Rekha and Celine (2013) for plant height at 50% flowering, Muniappan *et al*. (2010) for days to 50% flowering, Nalini *et al*. (2009) for flowers per cluster, Panja *et al*. (2013) for fruit volume, Kushwah and Bandhyopadhya (2007) for leaf area, Muniappan *et al*. (2010); Shinde *et al*. (2012) and Rekha and Celine (2013) for number of fruits per plant. The direct selection for these characters would be beneficial for crop improvement since most of these characters also showed positive coefficient of correlation with fruit yield per plant. The residual factor for genotypic path coefficient analysis in this study was obtained 0.2408, which indicate 75.92% of viability among genotypes for fruit yield per plant was explainable through selected components and only 24.08% of variability for fruit yield had not been covered.

Conclusion

On the basis of correlation and path analysis studies, it was concluded that the selection of genotypes to improve fruit yield per plant, should be imposed primarily for number of fruits per plant, average fruit weight, fruit volume and fruit diameter on individual plant. While, other characters *viz*., days to 50% flowering, plant height at 50% flowering, number of pickings and dry matter content should be considered as second most important characters. Other characters, however, did not show any significant association with fruit yield in brinjal for improving population for fruit yield in low temperature prone mid to high altitudes of western Himalayas. The residual effect of both genotypic and phenotypic path coefficients suggested that more number of characters should be in-corporate to account the entire variability of brinjal crop in high-hills of Uttarakhand.

Table 1: Estimates of phenotypic & genotypic correlation coefficients between different characters in brinjal (*Solanum melongena* L.).

Characters		Plant height at 50% flowering (cm)	Number of branches per plant	Leaf area (cm²)	Flowers per cluster	Fruits per cluster	Fruit setting percentage (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm³)	Number of fruits per plant	Average fruit weight (g)	Plant height at last picking (cm)	Dry matter content (%)	Number of pickings	Fruit yield per plant (Kg)
Days to 50% flowering	P	-0.559**	-0.150	0.332**	0.167	-0.072	-0.462**	-0.433**	0.175	-0.053	-0.462**	0.036	-0.426**	0.440*	-0.391**	-0.395**
	G	-0.623**	-0.176	0.367**	0.182	-0.072	-0.492**	-0.464**	0.199	-0.061	-0.496**	0.037	-0.482**	0.503**	-0.426**	-0.422**
Plant height at 50% flowering(cm)	P		0.097	-0.131	-0.235	-0.075	0.340**	0.463**	-0.146	-0.064	0.032	0.108	0.854**	-0.388**	0.007	0.199
	G		0.102	-0.146	-0.241*	-0.074	0.381**	0.498**	-0.149	-0.064	0.036	0.113	0.873**	-0.424**	0.007	0.218
Number of branches /plant	P			0.089	0.174	0.044	-0.170	0.016	-0.096	-0.099	0.316*	-0.190	0.026	0.367**	0.230	0.196
	G			0.082	0.182	0.050	-0.180	0.011	-0.097	-0.101	0.335*	-0.201	0.032	0.411**	0.254*	0.201
Leaf area (cm²)	P				0.086	-0.092	-0.194	-0.114	-0.094	-0.328**	-0.248*	-0.068	0.073	0.236	-0.206	-0.199
	G				0.088	-0.093	-0.195	-0.125	-0.095	-0.330**	-0.251*	-0.068	0.075	0.244*	-0.207	-0.207
Flowers per cluster	P					0.821**	-0.205	0.306*	-0.447**	-0.475**	0.466**	-0.653**	-0.322**	-0.078	0.317*	-0.100
	G					0.828**	-0.202	0.3098*	-0.462**	-0.487**	0.484**	-0.668**	-0.334**	-0.080	0.324*	-0.100
Fruits per cluster	P						0.351**	0.501**	-0.534**	-0.524**	0.663**	-0.651**	-0.125	-0.132	0.522**	-0.037
	G						0.354**	0.514**	-0.550**	-0.544**	0.692**	-0.670**	-0.128	-0.149	0.544**	-0.037
Fruit setting percentage (%)	P							0.381**	-0.196	-0.151	0.348**	-0.091	0.408**	-0.123	0.409**	0.085
	G							0.405**	-0.200	-0.166	0.358**	-0.092	0.440**	-0.148	0.431**	0.085
Fruit length (cm)	P								-0.260*	-0.115	0.368**	-0.344**	0.390**	-0.145	0.470**	0.190
	G								-0.270*	-0.116	0.379**	-0.355**	0.411**	-0.152	0.486**	0.193
Fruit diameter (cm)	P									0.822**	-0.497**	0.705**	-0.191	0.321*	-0.317*	0.192
	G									0.837**	-0.505**	0.715**	-0.205	0.335*	-0.323*	0.202
Fruit volume (cm³)	P										-0.313*	0.549**	-0.141	0.194	-0.076	0.371**
	G										-0.316*	0.552**	-0.144	0.195	-0.077	0.381**
Number of fruits per plant	P											-0.643**	-0.019	-0.135	0.835**	0.361**
	G											-0.648**	-0.015	-0.144	0.851**	0.378**
Average fruit weight(g)	P												0.142	0.041	-0.628**	0.246*
	G												0.145	0.044	-0.636**	0.247*
Plant height at last picking (cm)	P													-0.203	0.035	0.202
	G													-0.220	0.031	0.218
Dry matter content (%)	P														0.095	0.003
	G														0.097	0.010
Number of pickings	P															0.456**
	G															0.468***

*Significant at 5% level,   ** Significant at 1% level.

Table 2 : Path coefficient analysis showing the direct and indirect effect of 16 characters on fruit yield per plant in brinjal at genotypic & phenotypic level.

Characters	G/P	Days to 50% flowering	Plant height at 50% flowering (cm)	Number of branches per plant	Leaf area (cm²)	Flowers per cluster	Fruits per cluster	Fruit setting percentage (%)	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (cm³)	Number of fruits per plant	Average fruit weight (g)	Plant height at last picking (cm)	Dry matter content (%)	Number of pickings	Genotypic correlation (rg) with fruit yield per plant
Days to 50% flowering	G	**0.576**	-0.359	-0.101	0.211	0.105	-0.041	-0.283	-0.267	0.114	-0.035	-0.285	0.021	-0.278	0.289	-0.245	-0.422
	P	**0.203**	-0.113	-0.03	0.067	0.034	-0.014	-0.094	-0.088	0.035	-0.01	-0.094	0.007	-0.086	0.089	-0.079	-0.395
Plant height at 50% flowering (cm)	G	-0.635	**1.020**	0.104	-0.149	-0.246	-0.075	0.389	0.508	-0.152	-0.066	0.037	0.116	0.891	-0.432	0.007	0.218
	P	-0.212	**0.379**	0.036	-0.05	-0.089	-0.028	0.128	0.175	-0.055	-0.0243	0.012	0.041	0.323	-0.147	0.002	0.199
Number of branches / plant	G	0.01	-0.006	**-0.061**	-0.005	-0.011	-0.003	0.011	0	0.006	0.006	-0.02	0.012	-0.002	-0.025	-0.015	0.201
	P	0.002	-0.001	**-0.018**	-0.001	-0.003	0	0.003	0	0.001	0.0018	-0.005	0.003	0	-0.006	-0.004	0.196
Leaf area (cm²)	G	0.1	-0.04	0.022	**0.274**	0.024	-0.025	-0.053	-0.034	-0.026	-0.09	-0.069	-0.018	0.02	0.067	-0.056	-0.207
	P	0.064	-0.025	0.017	**0.194**	0.016	-0.017	-0.037	-0.022	-0.018	-0.0638	-0.048	-0.013	0.014	0.046	-0.04	-0.199
Flowers per cluster	G	0.07	-0.093	0.07	0.034	**0.386**	0.32	-0.078	0.119	-0.178	-0.188	0.187	-0.258	-0.129	-0.031	0.125	-0.1
	P	0.066	-0.093	0.069	0.034	**0.396**	0.325	-0.081	0.121	-0.177	-0.1884	0.185	-0.259	-0.128	-0.031	0.125	-0.1
Fruits per cluster	G	0.024	0.024	-0.016	0.031	-0.276	**-0.333**	-0.118	-0.171	0.183	0.181	-0.23	0.223	0.042	0.049	-0.181	-0.037
	P	0.022	0.023	-0.013	0.028	-0.254	**-0.309**	-0.108	-0.155	0.165	0.1625	-0.205	0.201	0.038	0.041	-0.161	-0.037
Fruit setting percentage (%)	G	0.137	-0.106	0.05	0.054	0.056	-0.098	**-0.278**	-0.113	0.055	0.046	-0.099	0.025	-0.122	0.041	-0.12	0.085
	P	0.087	-0.064	0.032	0.036	0.038	-0.066	**-0.188**	-0.071	0.037	0.0284	-0.065	0.017	-0.076	0.023	-0.077	0.085
Fruit length (cm)	G	0.021	-0.02	0	0.005	-0.014	-0.023	-0.018	**-0.045**	0.012	0.005	-0.017	0.016	-0.018	0.007	-0.022	0.193
	P	-0.01	0.011	0	-0.002	0.007	0.011	0.009	**0.023**	-0.006	-0.0027	0.008	-0.008	0.009	-0.003	0.011	0.19
Fruit diameter (cm)	G	-0.179	0.135	0.088	0.086	0.417	0.497	0.18	0.243	**-0.902**	-0.755	0.456	-0.645	0.185	-0.303	0.291	0.202
	P	-0.093	0.077	0.051	0.05	0.238	0.284	0.104	0.139	**-0.533**	-0.438	0.265	-0.376	0.102	-0.171	0.169	0.192
Fruit volume (cm³)	G	-0.019	-0.02	-0.032	-0.105	-0.155	-0.174	-0.053	-0.037	0.267	**0.319**	-0.101	0.176	-0.046	0.062	-0.024	0.381
	P	-0.015	-0.018	-0.028	-0.093	-0.135	-0.149	-0.043	-0.032	0.233	**0.284**	-0.089	0.156	-0.04	0.055	-0.021	0.371
Number of fruits per plant	G	-0.122	0.009	0.082	-0.062	0.119	0.17	0.088	0.093	-0.124	-0.078	**0.246**	-0.159	-0.003	-0.035	0.21	0.378
	P	-0.18	0.012	0.123	-0.096	0.181	0.258	0.135	0.143	-0.193	-0.122	**0.389**	-0.25	-0.007	-0.052	0.325	0.368
Average fruit weight(g)	G	0.075	0.225	-0.398	-0.136	-1.324	-1.328	-0.183	-0.704	1.417	1.095	-1.283	**1.98**	0.288	0.088	-1.259	0.247
	P	0.054	0.16	-0.282	-0.101	-0.968	-0.964	-0.135	-0.509	1.045	0.814	-0.952	**1.481**	0.21	0.062	-0.93	0.246
Plant height at last picking (cm)	G	0.331	-0.599	-0.022	-0.052	0.229	0.088	-0.302	-0.282	0.141	0.099	0.01	-0.099	**-0.686**	0.151	-0.021	0.218
	P	0.088	-0.176	-0.005	-0.015	0.066	0.025	-0.084	-0.08	0.039	0.029	0.004	-0.029	**-0.206**	0.042	-0.007	0.202
Dry matter content (%)	G	-0.047	0.04	-0.038	-0.023	0.007	0.014	0.014	0.014	-0.031	-0.018	0.013	-0.004	0.02	**-0.094**	-0.009	0.01
	P	-0.023	0.02	-0.019	-0.012	0.004	0.007	0.006	0.007	-0.016	-0.01	0.007	-0.002	0.01	**-0.052**	-0.005	0.003
Number of pickings	G	-0.763	0.013	0.455	-0.371	0.581	0.976	0.772	0.87	-0.579	-0.138	1.525	-1.139	0.056	0.174	**1.791**	0.468
	P	-0.449	0.008	0.264	-0.237	0.365	0.6	0.47	0.54	-0.365	-0.088	0.961	-0.722	0.04	0.109	**1.149**	0.456

Residual factor = 0.2408   Diagonal bold values are direct effects

Residual factor = 0.2987   Diagonal bold values are direct effects.

rg = genotypic correlation coefficient

rp = phenotypic correlation coefficient

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