CORRELATION AND PATH ANALYSIS FOR GROWTH, EARLINESS, YIELD AND QUALITY PARAMETERS IN CHILLI (*Capsicum annuum* L.)

Rinchan Dolkar*, M. B. Madalageri and G. Manjunath[1]

Department of Vegetable Science, University of Horticultural Sciences,, Bagalkot - 587 103 (Karnataka)
[1]*Deptt. of Plant Pathology, College of Horticulture, Bagalkot, Karnataka, India*
*E-mail: drinchan2012@gmail.com

ABSTRACT : Character association and path analysis in twelve advanced breeding lines of chilli was studied for 16 important traits. The phenotypic and genotypic association of fruit yield was significantly positive with per cent fruit set, number of fruits/plant, number of secondary branches/plant, plant height, fruit weight, total fruit chlorophyll content, pericarp weight and number of primary branches at both genotypic and phenotypic level. However, days to first flowering and days to 50 per cent flowering showed negative and significant correlation with total yield. The genotypic and phenotypic path coefficient revealed that total green chilli yield had high direct positive effect from number of fruit / plant and pericarp weight. So selection done based on number of fruits/plant and pericarp weight would be rewarding.

Chilli (*Capsicum annuum* L.) is one of the most important vegetable crops grown throughout India. It is grown for export as well as for domestic market. In India, chilli is grown in area of 792.1 thousand hectares with a production of 1223.4 thousand metric tonnes and with the productivity of 1.5 tonnes/ha (Anon, 2). In any crop improvement program, it is a prerequisite to assess critically the interrelationship for yield and quality and its contributing characters. Yield is the result of the expression and association of several plant growth components. The study of relationships among quantitative traits is important for assessing the feasibility of joint selection of two or more traits. Correlation coefficient analysis measures the mutual relationship between various characters and it determines the component traits on which selection can be relied upon which a effect the improvement. Assessing the direct and indirect effects of each component towards yield through path coefficient analysis would help in identifying the reliable characters contributing to yield. The present investigation was conducted to determine the nature and degree of association among the characters and their direct and indirect effect on green chilli yield.

MATERIALS AND METHODS

Twelve advanced breeding lines of chilli (*Capsicum annuum* L.) collected from different sources (Table 1) were evaluated at the College of Horticulture, Udayangiri, Bagalkot, Karnataka, during Kharif 2013-14. Geographic position of the experimental site lies in Northern dry zone (Zone-3) of Karnataka State at 14°47' North latitude, 75°21' East longitude and at an altitude of 612.05 metres above the mean sea level. The mean monthly minimum and maximum temperature varied between 13–26°C and 27–36°C, respectively during the cropping season. The accessions were evaluated in randomized block design with three replications for each treatment or a genotype in each replication was represented by single row of 4.50 m length at spacing of 45 cm. The rows were spaced at 90 cm apart and all the recommended agronomic package of practices were followed. Three plants in each experimental plot were randomly selected by avoiding border plants. The selected plants were tagged for taking observations on various growth (at 90 days after transplanting) and green chilli yield parameters. The average of three plants was computed and observations recorded on plant height, number of primary branches, number of secondary branches, days to first flowering, days to 50 % flowering, per cent fruit set, fruit weight, pericarp weight, number of fruits per plant, fruits yield per plant, ascorbic acid content, total chlorophyll content, β-carotene content, seedling vigour index-I, seedling vigour index-II and speed of germination. Correlation coefficients were computed using the method suggested by Al-Jibouri *et al.* (1). The direct and indirect effects of components characters on yield were estimated through path analysis technique (Wright, 12).

RESULTS AND DISCUSSION

A complex association exists among different plant characters and characters themselves do not

exist in isolation. These characters are often correlated with each other, either due to pleiotrophy or due to genetic linkage. For rational approach towards the improvement of yield, selection will be more rewarding when it is based on the components of yield. Association of yield component with yield thus assume special importance as the basis of indirect selection. In the present investigation the genotypic and phenotypic correlation coefficients were worked out for 16 characters as presented in Tables 2 and 3.

Table 1: Details of chilli accessions used in the experiment and their source of collection.

Code	Genotype name	Source
G1	DCA-136	HRS, Devihosur.
G2	DCA-192	HRS, Devihosur.
G3	DCA-199	HRS, Devihosur.
G4	DCA-223-1	HRS, Devihosur.
G5	Assam chilli	HRS, Devihosur.
G6	ByadagiKaddi	HRS, Devihosur.
G7	EC-28-DPS-06-07-01	COH, Bagalkot
G8	GC-07-03	COH, Bagalkot
G9	CH-1	COH, Bagalkot
G10	HC-07-05	COH, Bagalkot
G11	GC-07-02	COH, Bagalkot
G12	HC-0714	COH, Bagalkot

The estimates of phenotypic and genotypic correlation coefficient revealed that the genotypic correlation was higher than the corresponding phenotypic correlation for all the character combinations establishing predominant role of heritable factors.

Among the growth parameters, the phenotypic and genotypic associations of fruit yield were significantly positive with number of secondary branches, plant height and number of primary branches. Therefore, it is logical to attempt for selecting genotypes performing well for growth contributing characters which would simultaneously help in improvement of yield. These results are in conformity with those of Ganeshreddy *et al.* (5) for plant height and number of secondary branches and Smitha and Basavaraj (10) for stem thickness. Among the

Table 2 : Genotypic correlation coefficients among growth, earliness, yield and quality parameters in green chilli (*Capsicum annuum* L.).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1.000	0.345*	0.702**	-0.010	-0.388*	0.641**	0.541**	0.613**	0.412*	0.423*	0.057	0.032	0.031	0.187	0.195	0.573**
2		1.000	0.968**	0.497**	0.053	0.593**	-0.196	-0.136	0.831**	-0.052	0.503	0.029	-0.296	-0.002	-0.201	0.324*
3			1.000	0.293	-0.124	0.803**	0.149	0.204	0.880**	0.148	0.544*	-0.020	-0.131	-0.015	-0.097	0.635**
4				1.000	0.738**	-0.201	-0.472**	-0.387*	0.310	-0.056	0.220	0.449*	-0.382	-0.298	-0.646**	-0.349*
5					1.000	-0.499**	-0.475**	-0.383*	-0.007	0.012	0.064	0.155	-0.521	-0.290	-0.605**	-0.503**
6						1.000	0.408*	0.411*	0.782**	0.232	0.569*	-0.024	0.190	0.241	0.206	0.932**
7							1.000	0.982**	-0.094	0.763**	-0.296	0.241	0.489**	0.433**	0.338*	0.569**
8								1.000	-0.075	0.848**	-0.311	0.217	0.483**	0.498**	0.302	0.536**
9									1.000	-0.096	0.868**	-0.042	-0.230	-0.179	-0.200	0.676**
10										1.000	-0.348*	0.308	0.489**	0.521	0.202	0.280
11											1.000	-0.181	-0.389*	-0.347*	-0.288	0.555**
12												1.000	0.379*	0.179	-0.088	-0.239
13													1.000	0.654**	0.773**	0.225
14														1.000	0.694**	0.192
15															1.000	0.213
16																1.000

Critical *r* value = 0.423 at 1 per cent, and 0.329 at 5 per cent
* and ** indicate significant at 5 and 1 per cent probability level, respectively

1. Plant height
2. Number of primary branches
3. Number of secondary branches
4. Days to first flowering
5. Days to 50 % flowering
6. Fruit set (%)
7. Fruit weight
8. Pericarp weight
9. Number of fruits per plant
10. Ascorbic acid content
11. Total chlorophyll content
12. β-Carotene content
13. Seedling vigour index-I
14. Seedling vigour index-II
15. Speed of germination
16. Total yield

Table 3: Phenotypic correlation coefficients among growth, earliness, yield and quality parameters in chilli (*Capsicum annuum* L.).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**1.000**	0.275	0.662**	−0.034	−0.375	0.614**	0.509**	0.582**	0.393*	0.403*	0.040	0.025	0.296	0.180	0.178	0.547**
2		**1.000**	0.859**	0.468**	0.058	0.538**	0.175	−0.127	0.758**	0.050	0.458**	0.039	−0.251	0.006	−0.163	0.297
3			**1.000**	0.285	−0.128	0.792**	0.145	0.199	0.876**	0.146	0.542*	−0.02	−0.123	−0.018	−0.101	0.632**
4				**1.000**	0.734**	−0.204	−0.467**	−0.382	0.305	-0.052	0.218	0.432**	−0.367	−0.294	−0.636**	−0.345*
5					**1.000**	−0.496**	−0.469**	−0.381*	−0.009	0.013	0.064	0.163	0.505**	−0.274	−0.597**	−0.501*
6						**1.000**	0.403*	0.410*	0.778**	0.230	0.561**	−0.038	0.189	0.232	0.213	0.923**
7							**1.000**	0.979**	−0.093	0.756**	0.294	0.231	0.474**	0.431**	0.335*	0.565**
8								**1.000**	−0.073	0.838**	0.310	0.202	0.463**	0.489**	0.302	0.535**
9									**1.000**	−0.096	0.864**	−0.043	−0.228	−0.180	−0.197	0.676**
10										**1.000**	−0.345*	0.295	0.481**	0.519**	0.200	0.277
11											**1.000**	−0.178	−0.371*	−0.340*	−0.285	0.551**
12												**1.000**	0.343*	0.187	−0.096	−0.021
13													**1.000**	0.638**	0.745**	0.213
14														**1.000**	0.678**	0.187
15															**1.000**	0.211
16																**1.000**

Critical *r* value= 0.423 at 1 per cent and 0.329 at 5 per cent, * and ** indicate significant at 5 and 1 per cent probability level, respectively

1. Plant height
2. Number of primary branches
3. Number of secondary branches
4. Days to first flowering
5. Days to 50 % flowering
6. Fruit set (%)
7. Fruit weight
8. Pericarp weight
9. Number of fruits per plant
10. Ascorbic acid content
11. Total chlorophyll content
12. β-Carotene content
13. Seedling vigour index-I
14. Seedling vigour index-II
15. Speed of germination
16. Total yield

earliness parameters, days to first flowering and days to fifty per cent flowering had significant negative association with total yield. Krishna *et al.* (8) and had also recorded the similar type of results with days to first flowering and Sharma *et al.* (9) and Chattopadhyay *et al.* (3) for days to 50 per cent flowering. Among the yield parameters per cent fruit, number of fruits per plant, fruit weight and pericarp weight had significant positive association with the yield. These results are in agreement with Smitha and Basavaraj (10), Krishna *et al.* (8), Ganeshreddy *et al.* (5), Tembhurne *et al.* (11). With regard to fruit quality parameters, total chlorophyll content had highly significant and positive association with yield. Chattopadhyay *et al.* (3) also reported positive association of chlorophyll content with yield. Therefore, the selection of fruit with high chlorophyll content would also result in improvement of total yield. However, in the present study, contrary to the general belief, the seed quality parameter had no association with the yield which needs further investigation.

Path analysis (Table 4 and 5) revealed that number of fruits per plant and pericarp weight had the highest positive direct effect on yield per plant indicating their true positive and significant association with total yield. Chaudhary *et al.* (4), Karad *et al.* (7), Ganeshreddy *et al.* (3), Islam and Singh (6), Sharma *et al.* (9), Chattopadhyay *et al.* (3) for number of fruits per plant and pericarp weight also reported the similar results. Therefore, direct selection for these traits would be rewarding for improvement of total yield. Plant height, fruit weight, total fruit chlorophyll content and number of primary branches had highly significant positive correlation with total yield. But, they had low to negligible direct positive effects indicating that their association with the yield was not strong and true.

Table 4: Genotypic path coefficient analysis among growth, earliness, yield and quality parameters in green chill (*Capsicum annuum* L.).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	r G
1	**-0.001**	-0.005	-0.223	0.005	-0.020	-0.085	-0.024	0.460	0.543	-0.127	-0.002	0.001	0.069	0.021	-0.044	0.573**
2	-0.000	**-0.016**	-0.307	-0.260	0.002	-0.079	0.009	-0.103	1.093	0.015	-0.017	0.001	-0.060	-0.000	0.046	0.324*
3	-0.001	-0.016	**-0.317**	-0.153	-0.006	-0.107	-0.006	0.156	1.158	-0.044	-0.018	-0.001	-0.026	-0.001	0.022	0.635**
4	0.000	-0.008	-0.093	**-0.523**	0.039	0.020	0.021	-0.295	0.407	0.017	-0.007	0.028	-0.077	-0.034	0.148	-0.349*
5	0.000	-0.000	0.039	-0.386	**0.053**	0.066	0.021	-0.292	-0.009	-0.003	-0.002	0.009	-0.105	-0.033	0.139	-0.503**
6	0.000	-0.009	-0.254	0.105	-0.026	**-0.133**	-0.018	0.313	1.028	-0.070	-0.019	-0.001	0.038	0.028	-0.047	0.932**
7	0.000	0.003	-0.047	0.247	-0.025	-0.054	**-0.045**	0.749	-0.124	-0.230	0.010	0.015	0.099	0.050	-0.078	0.569**
8	-0.000	0.002	-0.065	0.202	-0.020	-0.054	-0.045	**0.762**	-0.099	-0.256	0.010	0.013	0.098	0.057	-0.069	0.536**
9	-0.000	-0.013	-0.279	-0.162	-0.000	-0.104	0.004	-0.057	**1.315**	0.029	-0.030	-0.002	-0.046	-0.020	0.046	0.676**
10	0.000	0.000	-0.047	0.029	0.000	-0.031	-0.030	0.646	-0.126	**-0.301**	0.012	0.019	0.099	0.060	-0.046	0.281
11	-0.000	-0.008	-0.172	-0.115	0.003	-0.076	0.013	-0.237	1.142	0.105	**-0.034**	-0.011	-0.078	-0.040	0.066	0.555*
12	0.000	-0.000	0.006	-0.235	0.008	0.003	-0.011	0.165	-0.055	-0.093	0.006	**0.063**	0.077	0.020	0.020	-0.023
13	-0.000	0.004	0.041	0.200	-0.028	-0.025	-0.022	0.368	-0.303	-0.147	0.013	0.024	**0.202**	0.076	-0.178	0.226
14	-0.003	0.000	0.004	0.156	-0.015	-0.032	-0.019	0.380	-0.235	-0.157	0.012	0.011	0.132	**0.116**	-0.160	0.190
15	-0.000	0.003	0.030	0.338	-0.032	-0.027	-0.015	0.230	-0.264	-0.061	0.010	-0.005	0.156	0.080	**-0.230**	0.214

Residual= -1.01; Bold diagonal figures indicate direct effect; rG = Genotypic correlation coefficient of total yield

* and ** indicate significant at 5 and 1 per cent probability level, respectively

1. Plant height
2. Number of primary branches
3. Number of secondary branches
4. Days to first flowering
5. Days to 50 % flowering
6. Fruit set (%)
7. Fruit weight
8. Pericarp weight
9. Number of fruits per plant
10. Ascorbic acid content
11. Total chlorophyll content
12. β-Carotene content
13. Seedling vigour index-I
14. Seedling vigour index-II
15. Speed of germination
16. Total yield

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Table 5: Phenotypic path coefficient analysis among growth, earliness, yield and quality parameters in green chilli (*Capsicum annuum*.L).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	rP
1	0.582	0.108	0.257	0.042	-0.152	-0.140	0.665	-0.820	-0.186	0.095	0.043	0.008	0.086	0.048	-0.089	0.547**
2	0.161	0.393	0.333	-0.573	0.024	-0.122	-0.229	0.179	-0.359	-0.012	0.483	0.012	-0.073	0.002	0.081	0.297
3	0.386	0.337	0.387	-0.349	-0.052	-0.180	0.190	-0.282	-0.415	0.035	0.571	-0.006	-0.036	-0.005	0.051	0.633**
4	-0.020	0.184	0.110	-1.225	0.297	0.047	-0.610	0.539	-0.145	-0.012	0.230	0.127	-0.106	-0.078	0.317	-0.346*
5	-0.218	0.023	-0.050	-0.900	0.404	0.113	-0.614	0.538	0.005	0.003	0.068	0.048	-0.147	-0.072	0.297	-0.501**
6	0.358	0.211	0.307	0.251	-0.201	-0.228	0.527	-0.579	-0.369	0.054	0.592	-0.011	0.055	0.061	-0.106	0.924**
7	0.297	-0.069	0.056	0.572	-0.190	-0.092	1.306	-1.381	0.045	0.178	-0.310	0.068	0.138	0.114	-0.167	0.565**
8	0.339	-0.050	0.077	0.469	-0.154	-0.093	1.280	-1.409	0.035	0.198	-0.328	0.060	0.134	0.129	-0.150	0.536**
9	0.229	0.298	0.339	-0.374	-0.004	-0.177	-0.123	0.103	-0.474	-0.023	0.911	-0.013	-0.066	-0.048	0.098	0.677**
10	0.235	-0.020	0.057	0.064	0.006	-0.052	0.988	-1.182	0.046	0.236	-0.364	0.087	0.139	0.137	-0.100	0.277
11	0.024	0.180	0.210	-0.268	0.026	-0.128	-0.384	0.438	-0.410	-0.081	1.053	-0.053	-0.108	-0.090	0.142	0.552**
12	0.015	0.016	-0.008	-0.529	0.066	0.009	0.302	-0.285	0.020	0.070	-0.188	0.295	0.099	0.050	0.048	-0.022
13	0.173	-0.099	-0.048	0.450	-0.204	-0.043	0.619	-0.653	0.108	0.114	-0.391	0.101	0.290	0.168	-0.371	0.213
14	0.105	0.003	-0.007	0.361	-0.111	-0.053	0.563	-0.690	0.086	0.123	-0.359	0.055	0.185	0.264	-0.338	0.187
15	0.104	-0.064	-0.039	0.780	-0.241	-0.049	0.438	-0.426	0.094	0.047	-0.301	-0.028	0.216	0.179	-0.498	0.211

Residual=0.004; Bold diagonal figures indicate direct effect, rP= Phenotypic correlation coefficient of Total yield

* and ** indicate significant at 5 and 1 per cent probability level, respectively.

1. Plant height
2. Number of primary branches
3. Number of secondary branches
4. Days to first flowering
5. Days to 50 % flowering
6. Fruit set (%)
7. Fruit weight
8. Pericarp weight
9. Number of fruits per plant
10. Ascorbic acid content
11. Total chlorophyll content
12. β-Carotene content
13. Seedling vigour index-I
14. Seedling vigour index-II
15. Speed of germination
16. Total yield

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