The Pharma Innovation Journal 2022; 11(10): 814-817

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(10): 814-817

www.thepharmajournal.com
Received: 14-07-2022
Accepted: 18-08-2022

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Correlation and path analysis study in Byadgi Dabbi derivatives of Chilli (*Capsicum annuum* L.)

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Abstract
The study was under taken on 64 genotypes of chilli using randomized complete block design (RCBD) with two replications. The result on phenotypic and genotypic correlation coefficient revealed that fruit yield per plant was significantly and positively correlated with number of primary branches at 120 DAT, number of secondary branches at 120 DAT, number of fruits per plant, average fruit, fruit length, fruit diameter and length of dry pod both at genotypic and phenotypic level. Path coefficient analysis different yield and yield contributing traits on plant height at 120 DAT, number of primary branches at 120 DAT, number of fruits per plant, and fruit length showed positive direct effect with fruit yield per plant at both level. These characters play a major role in recombination breeding and suggested that direct selection based on these traits will be rewarded for crop improvement of chilli.

Keywords: Chilli, genotypic correlation, phenotypic correlation, path coefficient

1. Introduction
Chilli (*Capsicum annuum* L.) with chromosome number 2n=2X=24 is a new world crop from the Solanaceae family originated and domesticated in the American tropics. It is one of the cash crops grown for its fruits and the spice of commerce. It is also high valued crop grown commercially in almost all parts of the world. India being the world's largest producer, consumer and exporter of chilli and has the largest area of 7.33 lakh ha (18.11 lakh acres) accounting for 42.81% of world area. India leads the world in chilli production with 17.64 lakh tonnes followed by China (3.21 lakh tonnes), Ethiopia (2.94 lakh tonnes), Thailand (2.47 lakh tonnes) and Pakistan (1.48 lakh tonnes). (Chilli Outlook 2021) [4].
Yield is a complex character and is governed by polygenic system. Moreover, it is highly influenced by environmental fluctuations. Selection for such character may not necessarily lead to its improvement unless the unfavourable linkages among such components are favourably altered through hybridization. The correlation characters may be due to genetic linkage or pleiotropy (Harland, 1939) [9]. Correlation study measures the natural relationship between various characters and helps in determining the component characters on which selection can be based for yield improvement. Correlation coefficient measures the degree of association either in positive or negative direction. There are three types of correlations *viz*., phenotypic, genotypic and environmental correlations. Phenotypic correlation is the observable correlation between two variables, which includes both genotypic and environmental effects. Genotypic correlation on the other hand, is the inherent association between two variables and it may be either due to pleiotropic action of genes or linkage or both. Environmental correlation arises entirely due to environmental effects.

2. Material and method
2.1 Experimental site and location: The research was conducted at vegetable block, college of horticulture Bagalkot (university of horticultural science, Bagalkot), which comes under northern dry zone of Karnataka (zone-3) and this location is situated at 16.10' north latitude and 17° 42' east longitude and elevation of 542 m above mean sea level. The annual average rainfall of South-West monsoon and North-East monsoon is 57.89 mm during the year 2020. During the experimental period, the meteorological data were recorded at the recorded at the meteorological observatory of MHREC, UHS and Bagalkot.

2.2 Experimental methodology and material: The material for the present study comprised of 64 Byadgi Dabbi chilli genotypes in which 14 lines are derived from "Tirlapur selection", 25 lines are derived from "75 Byadgi Dabbi selection" and 25 lines are derived from "70 Byadgi Dabbi selection". The details of genotypes are given below. The experiment was laid out in completely randomized block design (RCBD) with two replications. Fourty five days old seedlings were transplanted to the experimental plot the experimental plot was ploughed and brought to fine tilth and were applied farm yard manures (FYM) and recommended dose of fertilizers (NPK). Seedlings were transplanted at spacing of 60 cm × 60 cm in two replications. Observations were recorded from five randomly selected plants in each experimental plot for growth, yield and quality parameters.

2.3 Genotypic and phenotypic correlation coefficients analysis

The correlation coefficient among all possible character combinations at phenotypic (r_p) and genotypic (r_g) level were estimated employing formula (Al-Jibouri *et al.* 1958) [2].

$$\text{Phenotypic correlation} = r_{xy}(p) = \frac{\text{Cov}_{xy}(p)}{\sqrt{V \times (p) \times V_y(p)}}$$

$$\text{Genotypic correlation} = r_{xy}(p) = \frac{\text{Cov xy}(g)}{\sqrt{V_x(g) \times V_y(g)}}$$

Where,

Cov_{xy} (g) = Genotypic coefficient of variance between x and y

Cov_{xy} (p)= Phenotypic coefficient of variance between x and y

V_x (g) = Genotypic variance of character x

V_x (p) = Phenotypic variance of character x

V_y (g) = Genotypic variance of character y

V_y (p) = Phenotypic variance of character y

Test of significance of correlation was tested by comparing the 'r' value with obtained value.

2.4 Path coefficient analysis

The path coefficient analysis was carried out by the method suggested by Dewey and Lu (1959) [6]. The genotypic and phenotypic correlation coefficients were used in finding out the direct and indirect effects of the morphological traits on the plant yield. The following set of simultaneous equations were formed and solved for estimating various direct and indirect effect.

$r_{1y} = a + r_{12}b + r_{13}c + \ldots\ldots\ldots\ldots + r_{11}i$

$r_{2y} = a + r_{21}a + b + r_{23}c + \ldots\ldots\ldots\ldots + r_{21}i$

$r_{3y} = r_{31}a + r_{32}b + c + \ldots\ldots\ldots\ldots + r_{31}i$

$r_{1y} = r_{11}a + r_{12}b + r_{13}c + \ldots\ldots\ldots\ldots + I$

Where

R_{1y} to 1_{1y} = Co-efficient of correlation between casual factors 1 to I with dependent character y.

R_{12} to r_{11} = Co-efficient of correlation among casual factors

A, B, C ……I = Direct effect of character 'a' to 'I' on the dependent characters y.

Residual effect (R) was computed as followed.

$$\text{Residual effect (R)} = 1-\sqrt{a^2 + b^2 + c^2 + \ldots. i^2 + 2abr_{12} + 2acr_{13} + \ldots.}$$

3. Results and Discussion

3.1 Phenotypic and genotypic correlation coefficient: A narrow difference between the genotypic and phenotypic correlation coefficients was observed for various traits in the present finding and this indicates the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits.

Yield per plant had positive and significant association with plant height at 120 DAT, number of primary branches at 120 DAT, number of secondary branches at 120 DAT, number of fruits per plant, average fruit, fruit length, fruit diameter and length of dry pod both at genotypic and phenotypic level (Table 1). These results are in conformation with those of Datta and Jana (2010) [5] and Yatung *et al.* (2014) [22], Ullah *et al.* (2011) [21] and Kumar *et al.* (2012) [13] for average fruit weight, number of fruits per plant, fruit length and number of branches per plant. Bijalwan and Mishra (2014) [3], Janaki (2018) [11] for plant height and Kumar *et al.* (2012) [13] and Hasan *et al.* (2016) [10] for number of primary and secondary branches.

Yield per plant had negative and significant association with days to first flowering and days to first harvest for both at genotypic and phenotypic level. These results are in line with Ullah *et al.* (2011) [21], Jogi *et al.* (2013) [12], Bijalwan and Mishra (2014) [3], for days to first flowering. Whereas, negative and significant association with days to first flowering indicating that early flowering and early picking might be associated with increasing the fruits yield per plant reported by Janaki *et al.* (2018) [11] and Saisupriya *et al.* (2020) [17].

3.2 Phenotypic and genotypic path coefficient analysis: Among the eleven characters studied the characters such as plant height at 120 DAT, number of primary branches at 120 DAT, number of fruits per plant, and fruit length showed positive and significant positive direct effect with fruit yield per plant at both the level. Among these plant height at 120 DAT, primary branches and number of fruits per plant had positive direct effect indicating their true positive and significant association with total yield (Table 2). Similar findings were observed by Farhad *et al.* (2009) [8], Yatung *et al.* (2014) [22], Pandit and Adhikary (2014) [14], Patel *et al.* (2015) [16], Dolkar *et al.* (2015) [7], Sharma and Sridevi (2016) [18], Hasan *et al.* (2016) [10], Srividhya *et al.* (2017) [20] and Ain *et al.* (2019) [1] Therefore, direct selection for these traits would be rewarding for improvement of total yield.

Number of secondary branches at 120 DAT Days to first flowering, days to first harvest, average fruit weight, fruit diameter and length of dry pod showed negative direct effect with fruit yield per plant. Similar results were recorded by Pandiyaraj *et al.* (2017) [15] and Shwetha *et al.* (2018) [19] for secondary branches and fruit length, Sharma and Sridevi (2016) [18] for fruit diameter and Kumar *et al.* (2012) [13] for average fruit weight.

Table 1: Genotypic (G) and phenotypic (P) correlation coefficient for yield and its component characters in 64 chilli genotypes

		1	2	3	4	5	6	7	8	9	10	11
1	P	1	0.8846**	0.8675**	-0.9093**	-0.8485**	0.8927**	0.8810**	0.0478	0.1554	0.0617	0.9153*
	G	1	0.8894**	0.8740**	-0.9340**	-0.8769**	0.8987**	0.9487**	0.011	0.0881	0.0365	0.9220*
2	P		1	0.8024**	-0.8266**	-0.7384**	0.8183**	0.8166**	0.0713	0.1264	0.0763	0.8444*
	G		1	0.8083**	-0.8479**	-0.7555**	0.8186**	0.8920**	0.0456	0.074	0.0579	0.8458*
3	P			1	-0.7663**	-0.7597**	0.8930**	0.8324**	0.1355	0.0545	0.1406	0.9221*
	G			1	-0.7566**	-0.7477**	0.9025**	0.8787**	0.0946	-0.0646	0.1112	0.9374*
4	P				1	0.9049**	-0.8740**	-0.8637**	0.0443	-0.0818	0.0405	-0.8684*
	G				1	0.9169**	-0.899**	-0.9067**	0.1133	0.0704	0.0915	-0.8974*
5	P					1	-0.8673**	-0.8798**	-0.012	0.0076	-0.0182	-0.8627*
	G					1	-0.8974**	-0.9437**	0.0465	0.1799	0.0251	-0.8959*
6	P						1	0.9123**	0.0323	0.0578	0.0427	0.9885*
	G						1	0.9942**	-0.0026	-0.0151	0.0185	0.9965*
7	P							1	0.0835	0.034	0.0892	0.9308*
	G							1	-0.015	-0.203	0.0287	0.9248*
8	P								1	-0.2065	0.9658**	0.0651
	G								1	-0.3118**	0.9681**	0.0368
9	P									1	-0.1987	0.073
	G									1	-0.2795**	0.0136
10	P										1	0.0716
	G										1	0.0514

Critical difference = 0.25003; * and ** indicate significant at 1 and 5 per cent probability level, respectively.
1. Plant height at 120 DAT (cm), 2. Number of primary branches at 120 DAT (cm), 3. Number of secondary branches at 120 DAT (cm)
4. Days to first flowering, 5. Days to first harvest, 6. Number of fruits per plant
7. Average fruit weight (g), 8. Fruit length (cm) 9. Fruit diameter (mm)
10. Length of dry pod (cm), 11. Yield per plant (g)

Table 2: Genotypic (G) and phenotypic (P) Path coefficient for yield and its component characters in 64 chilli genotypes

		1	2	3	4	5	6	7	8	9	10	11
1	P	0.096	0.0241	0.1131	-0.0691	-0.0055	0.6303	0.1254	0.0026	0.0014	-0.0031	0.9153**
	G	0.379	0.0756	-0.0623	-0.3105	-0.0052	0.9458	-0.0928	0.0005	-0.0057	-0.0024	0.9220**
2	P	0.0849	0.0273	0.1046	-0.0628	-0.0048	0.5778	0.1163	0.0038	0.0011	-0.0039	0.8444**
	G	0.337	0.085	-0.0576	-0.2819	-0.0045	0.8615	-0.0872	0.002	-0.0048	-0.0038	0.8458**
3	P	0.0833	0.0219	0.1304	-0.0582	-0.0049	0.6305	0.1185	0.0073	0.0005	-0.0072	0.9221**
	G	0.3312	0.0687	-0.0713	-0.2515	-0.0045	0.9498	-0.0859	0.0041	0.0041	-0.0074	0.9374**
4	P	-0.0873	-0.0225	-0.0999	0.076	0.0059	-0.6171	-0.123	0.0024	-0.0007	-0.0021	-0.8684**
	G	-0.354	-0.0721	0.0539	0.3324	0.0055	-0.9461	0.0887	0.0049	-0.0045	-0.0061	-0.8974**
5	P	-0.0814	-0.0201	-0.0991	0.0688	0.0065	-0.6124	-0.1253	-0.0006	0.0001	0.0009	-0.8627**
	G	-0.3323	-0.0642	0.0533	0.3048	0.006	-0.9445	0.0923	0.002	-0.0116	-0.0017	-0.8959**
6	P	0.0857	0.0223	0.1165	-0.0664	-0.0056	0.7061	0.1299	0.0017	0.0005	-0.0022	0.9885**
	G	0.4731	0.2021	-0.0643	-0.2989	-0.0053	0.994	-0.0972	-0.0001	0.1325	-0.0012	0.9965**
7	P	0.0846	0.0223	0.1086	-0.0657	-0.0057	0.6441	0.1424	0.0045	0.0003	-0.0045	0.9308**
	G	0.3595	0.0758	-0.0626	-0.3014	-0.0056	0.9964	-0.0978	-0.0006	0.013	-0.0019	0.9748**
8	P	0.0046	0.0019	0.0177	0.0034	-0.0001	0.0228	0.0119	0.054	-0.0019	-0.0492	0.0651
	G	0.0042	0.0039	-0.0067	0.0377	0.0003	-0.0027	0.0015	0.0431	0.02	-0.0643	0.0368
9	P	0.0149	0.0034	0.0071	-0.0062	0.000	0.0408	0.0048	-0.0111	0.0091	0.0101	0.073
	G	0.0334	0.0063	0.0046	0.0234	0.0011	-0.0159	0.0199	-0.0135	-0.0643	0.0186	0.0136
10	P	0.0059	0.0021	0.0183	0.0031	-0.0001	0.0302	0.0127	0.0521	-0.0018	-0.0509	0.0716
	G	0.0138	0.0049	-0.0079	0.0304	0.0001	0.0195	-0.0028	0.0418	0.018	-0.0664	0.0514

Diagonal indicates direct effect * Significant at 1% ** Significant at 5% rG- Genotypic correlation value of fruit yield per plant
Residual effect = 0.0973
1. Plant height at 120 DAT (cm), 2. Number of primary branches at 120 DAT (cm), 3. Number of secondary branches at 120 DAT (cm)
4. Days to first flowering, 5. Days to first harvest, 6. Number of fruits per plant
7. Average fruit weight (g), 8. Fruit length (cm), 9. Fruit diameter (mm)
10. Length of dry pod (cm), 11. Yield per plant (g)

4. Conclusion

The present study suggested that while selection, emphasis should be given for plant height, number of primary branches and secondary branches, fruit weight, number of fruits per plant which had significant and positive correlation with fruit yield per plant. These characters play a major role in recombination breeding and suggested that direct selection based on these traits will be rewarded for crop improvement of chilli.

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