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Correlation and path coefficient analysis in cherry tomato (*Solanum lycopersicum* var. *cerasiforme*)

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Abstract
Thirty cherry tomato genotypes were evaluated under naturally ventilated polyhouse at the Experimental Farm, Department of Vegetable Science, Kittur Rani Channamma College of Horticulture, Arabhavi during *rabi* season, 2019-20 to study the correlation and path analysis in diverse genotypes of cherry tomato. Fruit yield per plant exhibited highly significant and positive correlation with plant height, polar diameter of the fruit, average fruit weight, number of fruits per plant, equatorial diameter of the fruit and number of seeds per fruit at both genotypic and phenotypic levels. Number of locules per fruit and days to first flowering were negatively and non-significantly associated with fruit yield per plant at both genotypic and phenotypic level. The path coefficient analysis revealed that days to first flowering (3.219) exhibited very high positive direct effect on fruit yield per plant, followed by average fruit weight (1.636), number of seeds per fruit (1.280), polar diameter of the fruit (0.820), number of locules per fruit (0.618), and the negative direct effects on yield were showed by days to 50 per cent flowering (-3.733), equatorial diameter of the fruit (-1.830), and number of fruits per plant (-0.575). These characters may be given more emphasis for direct selection of high yielding cherry tomato genotypes in future breeding programmes.

Keywords: Correlation, path analysis, fruit yield per plant and cherry tomato

Introduction
Cherry tomato (*Solanum lycopersicum* var. *cerasiforme)* is regarded as a botanical variety of the cultivated tomato, having chromosome number 2n=2x=24 (Maheshkumar *et al.*, 2016) [8]. It is the probable ancestor of all cultivated tomatoes. The wild cherry tomato was first found throughout tropical and subtropical America and then propagated in the tropics of Asia and Africa (Gharezi *et al.*, 2012) [4]. Presently, cherry tomatoes are widely cultivated in Central America and distributed to Spain, Japan, Europe, Mexico and Florida (Renuka *et al.*, 2014) [16]. In India cherry tomato crop is ideally available in a hill track (Ramya *et al.*, 2016) [15]. About 24.00 per cent of retail sales of tomatoes in the U.S.A are contributed by cherry tomato. They are becoming popular in the retail chains and marketed at a premium price compared to ordinary tomatoes (Venkadeswaran *et al.*, 2018) [25].

Cherry tomato is generally considered to be similar but not identical to the relatives of the cultivated tomato. It is becoming popular all over the world because of its favourable characteristics such as good source of vitamin-A, vitamin-C, sugars, taste, aroma, and low calories and good fruit set even at high temperature (Prema *et al.*, 2011) [14]. It has become a good alternative crop for many small farmers, for being rustic, productive and marketable, besides tasting good (Shiksha *et al.*, 2018) [19].

Cherry tomato cultivation is gaining popularity with Indian growers due to increasing awareness among the urban community for its high nutritive value and use as salad purpose or as snack packs. They are perfect for making processed products like sauce, soup, ketchup, puree, curries, paste, powder, rasam, and used in the pasta and sandwich. Unripe green fruits are used for preparation of pickles and chutney (Shiksha *et al.*, 2018) [19].

A study of correlation between different characters provides an idea of association. It could be effectively exploited to formulate selection strategies for improving yield and quality. Association of characters like yield, its components, and its components, and other economical traits is important for making selection in the breeding programme. It suggests the advantage of a scheme of selection for more than one character at a time (Kalloo, 1994) [5]. Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters, on which selection can be based for genetic improvement in yield, whereas, path analysis split the correlation coefficients into direct and

Indirect effects, thereby assists in the selection of genotype. On the basis of these studies, the quantum importance of individual character will facilitate the selection programme for better gains.

The concept of path analysis was developed by Wright in 1921 [26], but it was first used by Dewey and Lu in 1959 [3]. Path coefficient analysis is a standardized partial regression coefficient which splits the correlation coefficient into the direct and indirect effects. It assesses the direct and indirect contribution of various independent traits on a dependent trait. It reveals whether the association of these traits with yield is due to their direct effect on yield or is a consequence of their indirect effects via other component traits.

Thus, keeping above considerations in view, the present research work has been conducted to study the correlation and path coefficient analysis in 30 genotypes on 12 characters on cherry tomato.

Materials and Methods

The investigation was carried out during *rabi* season of 2019-20 in naturally ventilated polyhouse at the experimental block of the Department of Vegetable Science, Kittur Rani Channamma College of Horticulture, Arabhavi. It is situated in northern dry zone (Zone No. 3; Rgion-2) of Karnataka at 16º 15' N latitude and 74º 45' E longitude, at an altitude of 612 m above mean sea level. It is considered to have the benefit of both south-west and north-east monsoons. The average rainfall of this area is about 735.40 mm, distributed over a period of five to six months with peak during October.

The experimental material for the present investigation comprised of 30 cherry tomato genotypes collected from different places in India. The experiment was conducted in Completely Randomized Design (CRD) with two replications with ten plants in each replication. Ten plants of each genotypes were planted at a spacing of 60 cm × 45 cm. The seeds of all the genotypes were sown in plastic portrays of 99 cells with cocopeat as a growing media and transplanted after four weeks in naturally ventilated polyhouse on raised beds at a spacing of 60 cm x 45 cm. All the agronomical practices were followed as per the POP of UHS, Bagalkot to raise a good crop. Observations recorded were plant height (cm), number of primary branches per plant, stem girth (mm), days to first flowering, days to 50 per cent flowering, polar diameter of the fruit (cm), equatorial diameter of the fruit (cm), pericarp thickness (mm), number of locules per fruit, number of fruits per plant, average fruit weight (g), number of seeds per fruit and fruit yield per plant.

Results and Discussion

In the present study both phenotypic and genotypic correlations were performed for yield per plant and its attributing characters. Genotypic correlation indicated the inherent association between genes controlling any two traits, thus helps in effective selection scheme. Phenotypic correlation does not provide true estimates of relationship between two characters because of environment influence.

The present study discloses a very small difference between the genotypic and phenotypic correlation for various characters and this showed the little influence of the environment in the expression of these characters and presence of strong inherent correlation among the characters (Table 1 &2). Similar findings were observed by Najeema *et al.* (2018) [12] and Maheshkumar *et al.* (2016) [8].

Fruit yield per plant exhibited highly significant and positive correlation with plant height, polar diameter of the fruit, average fruit weight, number of fruits per plant, equatorial diameter of the fruit and number of seeds per fruit at both genotypic and phenotypic levels.

The positive correlation of these traits suggested their role in effective selection for increased yield. Similar results were reported by Najeema *et al.* (2016), Singh *et al.* (2007) [20], Prashanth *et al.* (2008) [13], Khan and Samadia (2012) [6] and Manivannan *et al.* (2005) [9].

Number of locules per fruit and days to first flowering were negatively and non-significantly associated with fruit yield per plant at both genotypic and phenotypic level. Similar findings were reported by Maheshkumar *et al.* (2016) [8] and Najeema *et al.* (2018) [12] and Maheshkumar *et al.* (2016) [8] respectively.

Path coefficient analysis facilitates the partitioning of correlation coefficients into direct and indirect effects of various characters on yield and yield attributing traits. Therefore, information on the cause and effect of various yield and yield attributes and the relative importance of their direct and indirect effects on yield in cherry tomato are essential in crop improvement programme. Correlation studies in conjunction with path coefficient analysis revealed a better picture of the cause and effect relationship of different attributes. The data on path coefficient analysis at genotypic level showing direct and indirect effects of significant characters over fruit yield per plant is tabulated in (Table 3).

The path coefficient analysis revealed that among these characters, days to first flowering (3.219) exhibited very high positive direct effect on fruit yield per plant, and it was supported by earlier findings of Kumari and Sharma (2013) [21] and Sunilkumar *et al.* (2015) [23]. High positive direct effects on fruit yield per plant through average fruit weight (1.636) was supported by earlier findings of Sunilkumar *et al.* (2015) [23], Manna and Paul (2012) [10], Kumari and Sharma (2013) [21], Mahapatra *et al.* (2013) [7] and Maheshkumar *et al.* (2016) [8]. Number of seeds per fruit (1.280) and Polar diameter of fruit (0.820) had positive direct effect on yield per plant which was in accordance with Prema *et al.* (2011) [14], Maheshkumar *et al.* (2016) [8]. High positive direct effects on fruit yield per plant through number of primary branches per plant (0.477) was supported by the results of Maheshkumar *et al.* (2016) [8], Prema *et al*. (2011) [14], Sunilkumar *et al*. (2015) [23], Singh and Singh (2008) [22] and Mahapatra *et al.* (2013) [7].

Table 1: Genotypic correlation coefficients among growth, flower and yield parameters in cherry tomato genotypes

	PB	SG	DFFL	D50FL	PD	ED	PT	NLF	NFP	AFW	NSF	FYPP
PH	0.062	0.302*	-0.127	-0.112	0.148	0.152	-0.185	0.155	0.286*	0.009	0.270*	0.537**
PB		0.210	0.009	0.106	-0.187	-0.104	0.301*	0.019	0.292*	-0.107	0.265*	0.238
SG			0.157	0.127	0.078	0.118	0.113	0.253	0.231	0.017	0.377**	0.267*
DFFL				0.948**	0.237	0.091	0.02	0.318*	0.180	0.257*	-0.096	-0.038
D50FL					0.264*	0.132	0.057	0.322*	0.135	0.323*	0.116	0.042
PD						0.920**	0.114	-0.307*	0.123	0.930**	0.271*	0.520**
ED							0.211	-0.360**	-0.051	0.918**	0.249	0.446**

PT								-0.150	-0.090	0.268*	-0.253	0.093
NLF									0.341**	-0.316*	-0.119	-0.106
NFP										0.124	0.288*	0.466**
AFW											0.212	0.481**
NSF												0.393**

*Significant at 5 % probability level, **Significant at 1 % probability level, Correlation r value= 0.2542 (5 %) and 0.3301 (1 %)
PH- Plant height PB- Number of primary branches per plant SG- Stem girth
DFFL-Days to first flowering D50FL- Days to 50 % flowering PD- Polar diameter of the fruit
ED- Equatorial diameter of the fruit PT- Pericarp thickness NLF- Number of locules per fruit
NFP- Number of fruits per plant AFW- Average fruit weight NSF- Number of seeds per fruit
FYPP- Fruit yield per plant

Table 2: Phenotypic correlation coefficients among growth, flower and yield parameters in cherry tomato genotypes

	PB	SG	DFFL	D50FL	PD	ED	PT	NLF	NFP	AFW	NSF	FYPP
PH	0.058	0.252	-0.063	-0.051	0.151	0.143	-0.196	0.151	0.268*	0.011	0.265*	0.507**
PB		0.161	0.014	0.075	-0.182	-0.088	0.283*	0.029	0.267*	-0.107	0.255*	0.255*
SG			0.071	0.023	0.070	0.121	0.095	0.199	0.185	0.020	0.339**	0.195
DFFL				0.845**	0.168	0.051	0.025	0.225	0.057	0.176	-0.063	-0.009
D50FL					0.194	0.076	0.051	0.204	0.076	0.234	0.095	0.059
PD						0.914**	0.108	-0.296*	0.118	0.927**	0.269*	0.497**
ED							0.205	-0.35**	-0.049	0.905**	0.243	0.441**
PT								-0.149	-0.09	0.266*	-0.250	0.095
NLF									0.317*	-0.306*	-0.112	-0.089
NFP										0.124	0.286*	0.427**
AFW											0.213	0.462**
NSF												0.377**

*Significant at 5 % probability level **Significant at 1 % probability level Correlation r value= 0.2542 (5 %) and 0.3301 (1 %)
PH- Plant height PB- Number of primary branches per plant SG- Stem girth
DFFL-Days to first flowering D50FL- Days to 50 % flowering PD- Polar diameter of the fruit
ED- Equatorial diameter of the fruit PT- Pericarp thickness NLF- Number of locules per fruit
NFP- Number of fruits per plant AFW- Average fruit weight NSF- Number of seeds per fruit
FYPP- Fruit yield per plant

Number of locules per fruit (0.618) had positive direct effect on yield, which was in accordance with Singh *et al.* (2018) [17] and Tiwari and Upadhyay (2011) [24]. Pericarp thickness (0.482) had positive direct effect on yield, which was in accordance with Dar *et al.* (2012) [2], Sharma *et al.* (2019) [18] and Meena and Bahadur (2015). Maheshkumar *et al.* (2016) [8], Sunilkumar *et al.* (2015) [23], Singh and Singh (2008) [22] and Ara *et al.* (2009) [1] reported high positive direct effect of plant height (0.599) on total yield. Days to 50 per cent flowering (-3.733) had negative direct effect on total yield was in accordance with Mahapatra *et al.* (2013) [7], Prema *et al.* (2011) [14] and Sunilkumar *et al.* (2015) [23]. Stem girth (-0.483) showed negative direct effect on total fruit yield per plant was in accordance with result of Najeema *et al.* (2016). Equatorial diameter of the fruit (-1.830) had negative direct effect on total yield was in accordance with Tiwari and Upadhyay (2011) [24]. The present research findings indicate that direct selection of plant height, polar diameter of the fruit, equatorial diameter of the fruit, number of fruits per plant, average fruit weight and number of seeds per fruit can be used as basis of selection for improvement in tomato in respect of fruit yield per plant.

It can be concluded that days to first flowering, average fruit weight, number of seeds per fruit, polar diameter of the fruit and plant height can be put to direct selection pressure to increase yield of the cherry tomato because these characters exerted direct effect on yield.

Table 3: Genotypic path coefficient analysis for yield and its components in cherry tomato genotypes

	PH	PB	SG	DFFL	D50FL	PD	ED	PT	NLF	NFP	AFW	NSF	rG
PH	0.599	0.029	-0.146	-0.409	0.417	0.121	-0.278	-0.089	0.096	-0.165	0.015	0.346	0.537**
PB	0.037	0.477	-0.102	0.029	-0.394	-0.153	0.191	0.145	0.012	-0.168	-0.175	0.339	0.238*
SG	0.181	0.100	-0.483	0.506	-0.474	0.064	-0.215	0.054	0.156	-0.134	0.028	0.483	0.267*
DFFL	-0.076	0.004	-0.075	3.219	-3.538	0.194	-0.166	0.009	0.196	-0.103	0.421	-0.123	-0.038
D50FL	-0.067	0.050	-0.061	3.052	-3.732	0.216	-0.241	0.027	0.198	-0.078	0.528	0.149	0.042
PD	0.088	-0.089	-0.037	0.762	-0.986	0.820	-1.700	0.054	-0.190	-0.070	1.521	0.347	0.520**
ED	0.091	-0.049	-0.056	0.292	-0.492	0.762	-1.830	0.101	-0.223	0.029	1.502	0.319	0.446**
PT	-0.111	0.143	-0.054	0.064	-0.212	0.093	-0.386	0.482	-0.092	0.051	0.439	-0.324	0.093
NLF	0.093	0.009	-0.122	1.023	-1.200	-0.252	0.661	-0.072	0.618	-0.195	-0.516	-0.153	-0.106
NFP	0.171	0.139	-0.111	0.578	-0.506	0.100	0.093	-0.043	0.210	-0.575	0.038	0.369	0.466**
AFW	0.005	-0.050	-0.008	0.828	-1.205	0.762	-1.680	0.129	-0.195	-0.013	1.636	0.271	0.481**
NSF	0.161	0.126	-0.182	-0.309	-0.434	0.222	-0.456	-0.122	-0.074	-0.165	0.347	1.280	0.393**

*Significant at 5 % probability level **Significant at 1 % probability level Correlation r value= 0.2542 (5 %) and 0.3301 (1 %)
rG- Genotypic correlation with fruit yield per plant Residual value – 0.6009 Bold diagonal figures indicate direct effect
PH- Plant height PB- Number of primary branches per plant SG- Stem girth
DFFL-Days to first flowering D50FL- Days to 50 % flowering PD- Polar diameter of the fruit
ED- Equatorial diameter of the fruit PT- Pericarp thickness NLF- Number of locules per fruit
NFP- Number of fruits per plant AFW- Average fruit weight NSF- Number of seeds per fruit

FYPP- Fruit yield per plant

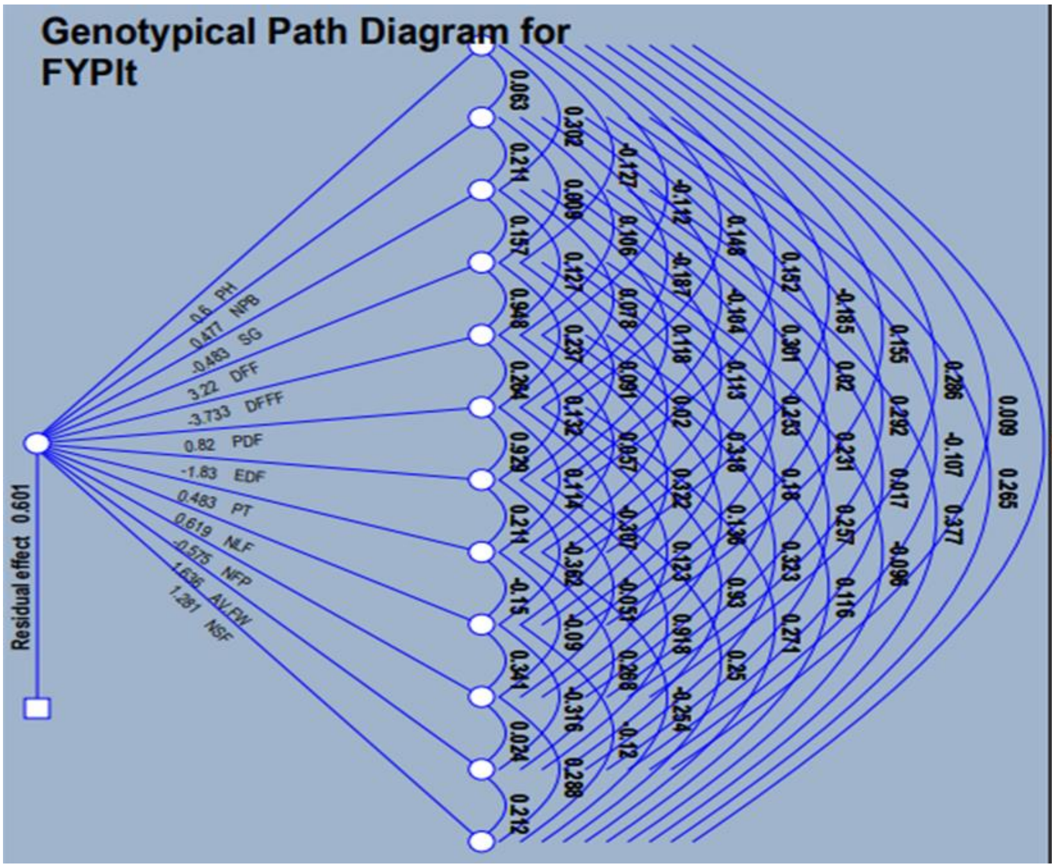

Fig 1: Genotypic path coefficient analysis for yield and its components in cherry tomato genotypes

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