Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(1): 1733-1738
Received: 06-11-2017
Accepted: 07-12-2017

A Mishra
Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture and Technology, Odisha, India

A Nandi
Professor & Officer-in-Charge, AICRP on Vegetable Crops, Directorate of Research, Orissa University of Agriculture and Technology, Odisha, India

Correspondence
A Mishra
Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture and Technology, Odisha, India

Correlation and path coefficient analysis for quality traits in tomato (*Solanum lycopersicon* L.)

A Mishra and A Nandi

Abstract
Correlation and path analysis were carried out in fiftyfive tomato genotypes for quality characters. The association studies showed that ascorbic acid content was positively correlated with days to first flowering, days to 50% flowering, number of cluster per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, length of fruits, pericarp thickness of fruit, number of locules per fruit and TSS of fruit. However, ascorbic acid content per fruit was negatively correlated with diameter of fruits, plant height, total number of branches, average fruit weight, yield per plant and acidity content. Path analysis studies done to study the cause and effect relationship revealed that number of fruits per plant, number of locules per fruit and number of flowers per cluster had high positive direct effects on ascorbic acid content per fruit. Hence, direct selection for these traits is done for improving ascorbic acid content of fruit.

Keywords: Correlation and Path analysis, Tomato, Genotypes and quality

Introduction
The scientists prove that the Vitamin C have been important vitamin for the human health. Ascorbic acid is reversibly oxidized to form L-dehydroascorbic acid (DHA) which also exhibits biological activity. Dehydroascorbic acid has been converted into acetic acid in the human body. To determine the activity of Vitamin C it's important for both acetic acid and Dehydroascorbic acid in fruits and vegetables. Vitamin C is the real water-soluble antioxidant within the body. It lowers blood pressure and levels cholesterol.
Recently many articles bas been shown that the effect of Vitamin C reduced the risk of developing cancers of breast, colon, rectum, lung, mouth. Vitamin C is very important for everybody such as in formation of bone and tissue repair. To maintain a good and sound health and for the prevention of cold a healthy body, the human must remain saturated with Vitamin C. Vitamin C is needed for collagen synthesis, the protein that serves so many connective functions in the body. Among the body's collagen-containing materials and structures are the framework of bone, gums and binding materials in skin muscle or scar tissue. Production of certain hormones and of neurotransmitters and the metabolism of some amino acids and vitamins require vitamin C. This vitamin also helps the liver in the detoxification of toxic substances in the system, and the blood in fighting infections. Ascorbic acid is important in the proper function of the immune system. As an antioxidant, it reacts with compounds like histamines and peroxides to reduce inflammatory symptoms. Its antioxidant property is associated with the reduction of cancer incidences (Mary Walingo, 2005) [10].
Keeping in view its importance; the estimation of Vitamin C containing this vitamin assumes significance. It is known widely by ordinary people today that the best sources of Vitamin C are vegetables like tomato which is easily and locally available in domestic market. To make better use of fruits and vegetables as food, mortal, and a clear understanding of the nutritional value, as well as estimating the content of Vitamin C is necessary.

Materials and methods
The present experiment entitled "Path Analysis study of Tomato" was carried out during Rabi, 2016 at Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar. The investigation was carried to study the path analysis of 45 F_1 hybrids along with their 10 parents of tomato. The experiment was laid out in a Randomized Block Design with two replications. Seeds were sown in the nursery beds on October 9th and transplanting was done on 8th November, 2016. All recommended cultural practices were followed to raise good crop stand and growth of the plants.
The observation were recorded on five randomly selected plants per replication for each germplasm on eighteen different characters:

(i) days to 1st flowering, (ii) days to 50% flowering, (iii) number of cluster per plant, (iv) number of flowers per cluster, (v) number of fruits per cluster, (vi) number of fruits per plant, (vii) length of fruits, (viii) diameter of fruits, (ix) pericarp thickness, (x) number of locules per fruit, (xi) plant height, (xii) total number of branches, (xiii) average fruit weight, (xiv) yield per plant, (xv) total yield per plot, (xvi) TSS, (xvii) acidity content of fruit and (xviii) ascorbic acid content of fruit.

The correlations of coefficients among yield and quality attributes were calculated as suggested by Panse and Sukhatme (1957). Path coefficient analysis was carried out according to Dewey and Lu (1959) [2].

Ascorbic acid (Vitamin C) determination (mg/100g)

Ascorbic acid content of mature fruits was estimated by volumetric method (Sadasivam and Balasubramanian, 1987) [9]. Dye solution was prepared by dissolving 42 mg of sodium bicarbonate in distilled water taken into 200 ml volumetric flask, to which 52 mg of 2-6 dichlorophenol indophenol was added and the volume was made up to 200 ml with distilled water. Stock solution was prepared by dissolving 100 mg ascorbic acid in 100 ml of 4% oxalic acid solution and 10 ml of this stock solution was diluted to 100 ml with 4% oxalic acid to get the working standard of 100 mg per ml.

5 ml of working standard solution was pipetted into a 100 ml of conical flask to which 10 ml of 4% oxalic acid was added. The contents were titrated against the dye (V_1ml) to get a pink end point. The tomato sample (5 g) was extracted in 4% oxalic acid and the volume was made up to 100 ml and the contents were centrifuged. 5 ml of this supernatant was pipetted out, to which 10 ml of 4% oxalic acid was added and titrated against dye (V_2ml). The ascorbic acid content was calculated using the formula given below.

Ascorbic acid (mg/100 g) = (0.5 mg ÷ V_1) x (V_2 ÷ 5ml) x (100 ml ÷ Wt. Of sample) x 100

Results and discussion

The mean value for ascorbic acid content of the genotypes revealed that the highest value being shown by Utkal Kumari X BT-19-1-1-1 (602.500) followed by BT-1 X BT-507-2-2 (550.000), BT-1 X BT-317 (418.000) and the lowest value possess by BT-22-4-1 (122.000) followed by BT-19-1-1-1 X BT- 22-4-1 and BT-22-4-1 X BT-17-2 (130.000) and BT-3 (150.000) (Table No. 1). The range for ascorbic acid content of tomato genotypes under study is (122.000-602.500).

Simple correlation studies were carried for all the characters studied. Average fruit weight is significantly and positively correlated with yield per plant. The results are in accordance with Kumar *et al*. (2006) [6], Dhankhar and Dhankar (2006) [3]. Number of flowers per cluster had positive significant correlation with number of fruits per cluster, number of locules per fruit, plant height and average fruit weight. Similar results are also observed by Prashanth *et al*. (2008) [8]. Days to 50% flowering have significant positive correlation with length of fruits. Diameter of fruits had positively and significantly correlated with number of locules per fruit. Results are in accordance with Kumar and Dudi (2011) [4]. Days to first flowering, days to 50% flowering, number of cluster per plant, number of flowers per cluster, number of fruits per cluster, number of fruits per plant, length of fruits, pericarp thickness of fruit, number of locules per fruit and TSS of fruit had positive association whereas diameter of fruits, plant height, total number of branches, average fruit weight, yield per plant and acidity content had negative correlation with ascorbic acid content. Results are in accordance with Kumar and Dudi (2011) [4] for fruit weight, TSS, acidity. (Table No. 2 and 3).

The path coefficient studies revealed that days to 50% flowering, number of flowers per cluster, number of fruits per plant, pericarp thickness of fruit, number of locules per fruit, plant height, TSS of fruit and acidity content of fruit had positive direct effects on ascorbic acid content of fruit. Negative direct effects on ascorbic acid content of fruit had been observed for days to first flowering, number of cluster per plant, number of fruits per cluster, length of fruits, diameter of fruits, total number of branches per plant, average fruit weight and yield per plant. The results are in accordance with the findings of Asati *et al*. (2008) [1] for plant height, number of primary branches per plant, days to 50% flowering and fruit weight, Kumar and Thakur (2007) [5] for number of fruits per plant, fruit length and diameter of fruit. (Table No. 4).

Table 1: Mean of 45 F1 hybrids and 10 parents

	Genotypes	Ascorbic Acid Content
V1	Bt-1 x Utkal Dipti	158.500
V2	BT-1 x Utkal Kumari	232.500
V3	BT-1 x BT-19-1-1-1	321.500
V4	BT-1 x BT-317	418.000
V5	BT-1 x BT-22-4-1	268.000
V6	BT-1 x BT-3	350.000
V7	BT-1 x BT-17-2	270.500
V8	BT-1 x BT-507-2-2	550.000
V9	BT-1 x BT-21	270.000
V10	Utkal Dipti x Utkal Kumari	190.000
V11	Utkal Dipti x BT-19-1-1-1	222.000
V12	Utkal Dipti x BT-317	310.000
V13	Utkal Dipti x BT-22-4-1	271.000
V14	Utkal Dipti x BT-3	394.000
V15	Utkal Dipti x BT-17-2	190.000
V16	Utkal Dipti x BT-507-2-2	405.500

V17	Utkal Dipti x BT-21	266.500
V18	Utkal Kumari x BT-19-1-1-1	602.500
V19	Utkal Kumari x BT-317	414.000
V20	Utkal Kumari x BT-22-4-1	314.000
V21	Utkal Kumari x BT-3	366.500
V22	Utkal Kumari x BT-17-2	202.000
V23	Utkal Kumari x BT-507-2-2	182.000
V24	Utkal Kumari x BT-21	202.500
V25	BT-19-1-1-1 x Bt-317	205.500
V26	BT-19-1-1-1 x BT-22-4-1	130.000
V27	BT-19-1-1-1 x BT-3	245.500
V28	BT-19-1-1-1 x BT-17-2	230.000
V29	BT-19-1-1-1 x BT-507-2-2	205.500
V30	BT-19-1-1-1 x BT-21	243.500
V31	BT-317 x BT-22-4-1	225.500
V32	BT-317 x BT-3	210.000
V33	BT-317 x BT-17-2	269.500
V34	BT-317 x BT-507-2-2	188.500
V35	BT-317 x BT-21	233.500
V36	BT-22-4-1 x BT-3	269.500
V37	BT-22-4-1 x BT-17-2	130.000
V38	BT-22-4-1 x BT-507-2-2	270.000
V39	BT-22-4-1 x BT-21	198.000
V40	BT-3 x BT-17-2	309.500
V41	BT-3 x BT-507-2-2	272.500
V42	BT-3 x BT-21	202.500
V43	BT-17-2 x Bt-507-2-2	238.000
V44	BT-17-2 x BT-21	235.000
V45	BT-507-2-2 x Bt-21	213.000
V46	BT-1	235.000
V47	Utkal Dipti	242.000
V48	Utkal Kumari	310.000
V49	BT-19-1-1-1	285.500
V50	BT-317	209.000
V51	BT-22-4-1	122.000
V52	BT-3	150.000
V53	BT-17-2	305.000
V54	BT-507-2-2	194.000
V55	BT-21	158.500
SED		3.193
CD		6.402

Table 2: Genotypic correlation co-efficient (r_g) between all pairs of 17 characters in tomato

Characters		Days to 50% flowering	No. of cluster/ plant	No. of flowers/ cluster	No. of fruits/ cluster	No. of fruits/ plant	Length of fruits	Diameter of fruits	Pericarp thickness of fruit	No. of locules/ fruit	Plant height	Total no. of branches/ plant	Average fruit weight	TSS of fruit	Yield/ plant	Acidity content of fruit	Ascorbic acid content
Days to 1st flowering	r_g	-1.139**	-0.130	-0.551*	-0.127	-0.127	0.180	0.144	0.151	0.246	-0.142	-0.233	0.072	-0.104	0.076	-0.001	0.106
Days to 50% flowering	r_g		-0.126	-0.540*	-0.361	-0.233	0.433*	-0.260	0.310	0.211	0.124	0.032	0.173	0.151	0.038	0.008	0.288
No. of cluster/plant	r_g			0.056	-0.237	0.310	-0.388	-0.035	-0.114	0.138	-0.089	0.342	-0.562**	0.026	-0.160	-0.087	0.221
No. of flowers/cluster	r_g				0.950**	-0.114	0.219	-0.427*	0.145	0.471*	0.450*	0.035	0.440*	0.028	-0.008	0.335	0.312
No. of fruits/cluster	r_g					0.105	0.089	0.071	0.201	0.250	0.142	0.116	0.312	0.146	0.085	0.164	0.185
No. of fruits/plant	r_g						0.002	0.318	0.080	-0.238	-0.444*	0.167	-0.244	0.356	0.061	-0.375	0.109
Length of fruits	r_g							0.047	0.037	0.199	0.128	0.232	-0.111	-0.066	-0.213	-0.231	0.024
Diameter of fruits	r_g								0.372	0.448*	0.026	-0.263	0.156	0.324	0.156	0.281	-0.055
Pericarp thickness of fruit	r_g									0.202	0.092	-0.177	-0.059	0.064	0.048	-0.043	0.211
No. of locules/fruit	r_g										-0.131	0.086	0.167	0.174	0.082	0.167	0.204
Plant height	r_g											-0.006	0.128	0.045	-0.051	0.025	-0.135
Total no. of branches/plant	r_g												-0.363	0.193	-0.409*	-0.351	-0.160
Average fruit weight	r_g													0.041	0.642**	0.221	-0.134
TSS of fruit	r_g														-0.030	-0.152	0.236
Yield/plant	r_g															0.134	-0.339
Acidity content of fruit	r_g																-0.060

Table 3: Phenotypic correlation co-efficient (r_p) between all pairs of 17 characters in tomato

Characters		Days to 50% flowering	No. of cluster/ plant	No. of flowers/ cluster	No. of fruits/ cluster	No. of fruits/ plant	Length of fruits	Diameter of fruits	Pericarp thickness of fruit	No. of locules/ fruit	Plant height	Total no. of branches/ plant	Average fruit weight	TSS of fruit	Yield/ plant	Acidity content of fruit	Ascorbic acid content
Days to 1st flowering	r_p	0.594**	-0.081	0.099	0.148	0.107	-0.163	-0.047	0.091	-0.003	-0.008	-0.291	0.056	-0.094	0.104	0.046	0.066
Days to 50% flowering	r_p		-0.104	0.226	0.158	0.109	-0.093	-0.016	0.182	-0.100	-0.017	-0.130	0.097	0.048	0.040	-0.003	0.150
No. of cluster/plant	r_p			-0.054	-0.105	0.218	-0.164	-0.094	-0.040	0.091	-0.052	0.208	-0.401	0.053	-0.084	-0.092	0.163
No. of flowers/cluster	r_p				0.818**	-0.025	0.081	0.123	0.069	-0.183	0.056	-0.007	0.127	0.035	-0.010	0.036	0.089
No. of fruits/cluster	r_p					0.041	0.047	0.198	0.048	-0.106	0.101	0.072	0.178	0.100	0.049	0.067	0.103
No. of fruits/plant	r_p						-0.066	0.143	0.035	-0.082	-0.232	0.104	-0.150	0.285	0.082	-0.313	0.088
Length of fruits	r_p							-0.004	0.036	0.069	-0.008	0.139	-0.133	-0.017	-0.184	-0.139	0.012
Diameter of fruits	r_p								0.172	0.090	-0.069	-0.069	0.021	0.156	0.052	0.170	-0.022
Pericarp thickness of fruit	r_p									0.062	-0.019	-0.166	-0.049	0.063	0.039	-0.040	0.172
No. of locules/fruit	r_p										-0.006	0.062	0.120	0.120	0.065	0.153	0.140
Plant height	r_p											0.034	0.102	0.014	0.005	0.050	-0.102
Total no. of branches/plant	r_p												-0.262	0.141	-0.281	-0.253	-0.122
Average fruit weight	r_p													0.038	0.600**	0.175	-0.128
TSS of fruit	r_p														-0.022	-0.148	0.230
Yield/plant	r_p															0.098	-0.326
Acidity content of fruit	r_p																-0.056

Table 4: Estimate of direct (diagonal) and indirect effect of component characters on yield in tomato

Characters	Days to 1st flowering	Days to 50% flowering	No. of cluster/ plant	No. of flowers/ cluster	No. of fruits/ cluster	No.of fruits/ plant	Length of fruits	Diameter of fruits	Pericarp thickness of fruit	No. of locules/ fruit	Plant height	Total no.of branches/ plant	Average fruit weight	TSS of fruit	Yield/ plant	Acidity content of fruit	Genotypic correlation with Ascorbic acid content
Days to 1st flowering	-0.00377	0.38398	0.12059	-0.45796	0.13911	-0.11898	-0.09348	-0.07252	0.02696	0.22650	-0.03272	0.05930	-0.02902	-0.01269	-0.02921	-0.00008	0.10602
Days to 50% flowering	-0.00429	0.33712	0.11619	-0.44896	0.39633	-0.21936	-0.22467	0.13065	0.05525	0.19443	0.02864	-0.00802	-0.06987	0.01851	-0.01453	0.00045	0.28786
No.of cluster/plant	-0.00049	0.04236	-0.92466	0.04699	0.26024	0.29196	0.20140	0.01757	-0.02023	0.12697	-0.02062	-0.08728	0.22728	0.00324	0.06129	-0.00486	0.22117
No.of flowers/cluster	-0.00208	0.18204	-0.05226	0.83143	-1.04316	-0.10745	-0.11324	0.21429	0.02581	0.43350	0.10399	-0.00882	-0.17795	0.00343	0.00318	0.01878	0.31150
No.of fruits/cluster	-0.00048	0.12161	0.21903	0.78945	-1.09863	0.09896	-0.04600	-0.03518	0.03588	0.22948	0.03270	-0.02960	-0.12640	0.01789	-0.03274	0.00918	0.18517
No.of fruits/plant	-0.00048	0.07862	-0.28702	-0.09498	-0.1159	0.94059	-0.00126	-0.15965	0.01426	-0.21872	-0.10251	-0.04248	0.09861	0.04372	-0.02346	-0.02105	0.10862
Length of fruits	0.00068	-0.14587	0.35867	0.18133	-0.09733	0.00229	-0.51923	-0.02350	0.00664	0.18384	0.02944	-0.05904	0.04492	-0.00813	0.08170	-0.01294	0.02345
Diameter of fruits	0.00054	0.08772	0.03236	-0.35483	-0.07697	0.29907	-0.02431	-0.50211	0.06624	0.41185	0.00602	0.06712	-0.06329	0.03976	-0.05979	0.01574	-0.05490
Pericarp thickness of fruit	0.00057	-0.10453	0.10499	0.12045	-0.22127	0.07526	-0.01935	-0.18667	0.17817	0.18577	0.02131	0.04517	0.02366	0.00790	-0.01854	-0.00240	0.21047
No.of locules/fruit	0.00093	-0.07120	-0.12754	0.39152	-0.27386	-0.22347	-0.10369	-0.22464	0.03595	0.92058	-0.03024	-0.02184	-0.06775	0.02133	-0.03134	0.00938	0.20413
Plant height	-0.00053	-0.04179	0.08251	0.37413	-0.15545	-0.41722	-0.06614	-0.01307	0.01643	-0.12045	0.23109	0.00132	-0.05174	0.00548	0.01952	0.00138	-0.13453
Total no.of branches/plant	-0.00088	-0.01060	-0.31634	0.02873	-0.12747	0.15661	-0.12017	0.13210	-0.03154	0.07883	-0.00120	-0.25511	0.14667	0.02369	0.15694	-0.01966	-0.15940
Average fruit weight	0.00027	-0.05821	0.51933	0.36561	-0.34315	-0.22921	0.05764	-0.07853	-0.01042	0.15413	0.02955	0.09247	-0.40467	0.00500	-0.24636	0.01240	-0.13416
TSS of fruit	-0.00039	-0.05082	-0.02441	0.02321	-0.16003	0.33490	0.03439	-0.16258	0.01146	0.15991	0.01031	-0.04921	-0.01648	0.12280	0.01142	-0.00852	0.23596
Yield/plant	0.00029	-0.01277	0.14767	-0.00689	-0.09370	0.05749	0.11054	-0.07823	0.00861	0.07518	-0.01175	0.10432	-0.25976	-0.00365	-0.38380	0.00749	-0.33896
Acidity content of fruit	-0.00001	-0.00268	0.08017	0.27832	-0.17973	-0.35289	0.11981	-0.14084	-0.00763	0.15399	0.00567	0.08941	-0.08946	-0.01866	-0.05126	0.05610	-0.05970

Residual effect = 0.8264591

Figures underlined denoted the Direct Effect

References

1. Asati BS, Rai N, Singh AK. Genetic parameters study for yield and quality traits in tomato. The Asian Journal of Horticulture. 2008; 3(2):222-225.
2. Dewey DR, Lu KH. A correlation and path co-efficient analysis of components of crested wheat grass seed production. Agronomy Journal. 1959; 51(9):515-518.
3. Dhankhar SK, Dhankar SS. Variability, heritability, correlation and path coefficient studies in tomato. Haryana Journal of Hortcultural Science. 2006; 35(1-2):179-181.
4. Kumar M, Dudi BS. Study of correlation for yield and quality characters in tomato (*Lycopersicon esculentum* Mill.). Electronic Journal of Plant Breeding. 2011; 2(3):453-460.
5. Kumar R, Thakur MC. Genetic variability, heritability, genetic advance, correlation coefficient and path analysis in tomato. Haryana Journal of Horticultural Science. 2007; 36(3-4):370-373.
6. Kumar R, Niraj Kumar, Jagadeesh Singh, Rai GK. Studies on yield and quality traits in tomato. Vegetable Science. 2006; 33(2):126-132.
7. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers (2nd Edn.), Indian Council of Agricultural Research, New Delhi. 1985, 381.
8. Prashanth SJ, Jaiprakashnarayan RP, Mulge R, Madalageri MB. Correlation and path analysis in tomato (*Lycopersicon esculentum* Mill.). The Asian Journal of Horticulture. 2008; 3(2):403-408.
9. Sadasivam S, Balasubramanian T. Practical manual in biochemistry. Tamilnadu Agricultural University, Coimbatore, 1987, 14.
10. Walingo M. Role of Vitamin C (Ascorbic acid) on human health- A Review. African Journal of Food Agriculture Nutrition and Development, 2005; 5(1):1-13.