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# PATH COEFFICIENT ANALYSIS OF TOTAL SOLUBLE SOLIDS IN *SOLANUM LYCOPERSICUM* L.

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Genetic correlation coefficients were partitioned using path coefficient analysis to examine direct and indirect effects of plant characters on total soluble solids (TSS) in *Solanum lycoprsicum* (L.). Analysis of variance for number of days to 50% flowering (NDFL), number of days to 50% fruit setting (NDFR), number of flowers per cluster (NFLC), number of fruits per cluster (NFRC), fruit length (FRL), fruit width (FRW), fruit firmness at pink stage (FFP), fruit firmness at red stage (FFR), pericarp thickness (PT), pH of the juice (pH) and TSS revealed significant genotypic differences for all the characters. Results showed that genotypic correlation of NFRC and NDFL with TSS was positive and significant. Path coefficient analysis showed that NFRC had contributed directly to TSS followed by FRL, FFR and FRW and may be given due consideration.

**Keywords:** *Solanum lycoprsicum* (L.), Genotypic correlation, Path coefficient analysis, Total soluble solids

## 1. Introduction

Due to secondary importance in crop husbandry in Pakistan, little efforts were made improving vegetable crops including tomato, because of their secondary importance in the crop husbandary. In tomato a few local varieties are available for cultivation and most of them are selections from exotic germplasm. In addition, the available varieties are poor in quality traits, and therefore, are not popular among the consumers. Certainly these drawbacks in tomato need to be improved through selection and breeding.

In breeding when several variables are mutually correlated with some complex characters like plant yield and its components, simple correlation coefficients provide incomplete information about the nature of association between two traits. Thus by using simple correlation coefficients a breeder looking for high yield, may make a wrong selection of a plant character. Path coefficient analysis developed by Dewey and Lu [1] is a precise biometrical technique which could partition genotypic correlation coefficients into direct and indirect effects through alternative pathways.

In the present study path analysis technique has been used to study direct and indirect effects of various quantitative traits on total soluble solids in tomato. Generally genotypic ($r_g$) correlation coefficients show relationships among independent characteristics and degree of linear relationship between these characteristics. Each correlation coefficient between a predictor variable and the response variable is partitioned into its component parts: the direct effect or path coefficient (a standardized partial regression coefficient) for the predictor variable and indirect effects, which involve the product of a correlation coefficient between two predictor variables with the appropriate path coefficient in the path diagram [1].

## 2. Materials and Methods

In the present study 18 varieties/ hybrids of tomato namely Advanta 1202, Advanta 1203 Advanta 1204 Advanta 1205 Advanta 1206 Advanta 1207 Advanta 1208 Advanta 1209, Advanta 1210, Advanta 1211, Advanta 1212, Sitara TS-7, Sitara 607, Sitara 6001, QF Red, D-22-44, Tomato Cherry, Money Maker auriga and two checks namely Nagina and Riogrande were examined. The plant material was sown in the experimental area of Department of Plant Breeding and Genetics, University of agriculture, Faisalabad, Pakistan during the year 2008-09. The nursery of plant material was sown on well prepared small

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Table1. Mean squares obtained from analysis of variance of different plant characters of Solanum Lycopersicum L .

| Source of variation | d. f | NDFL | NDFR | NFLC | NFRC | FRL | FRW | FFP | FFR | PT | TSS | pH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replication MS | 2 | 8.07 | 13.62 | 0.12 | 0.05 | 14.92 | 17.44 | 0.02 | 0.010 | 0.005 | 0.03 | 0.02 |
| Genotypic MS | 19 | 251.9** | 405.52** | 5.44** | 5.94** | 215.28** | 267.37** | 1.76** | 1.14** | 5.08** | 0.97** | 0.07** |
| Error mean MS | 38 | 11.04 | 10.12 | 0.15 | 0.02 | 14.34 | 7.21 | 0.15 | 0.06 | 0.06 | 0.03 | 0.01 |

** = Significance at P≤ 0.01 levels of probability MS= Mean squares

beds and one month old saplings were transplanted in the field following randomized complete block design with three replications. Each entry consisted of a single row of 6.5 meter length, with intra-row and inter-row spacing of 50 cm and 125 cm, respectively and 13 plants in each row. Transplanting was done on one side of the bed just after irrigation. Agronomic and plant protection practices were used as and when needed. At maturity ten random plants of each entry were measured for days to 50% flowering, days to 50% fruit setting, number of flowers/cluster, number of fruits/cluster, fruit length (mm), fruit width (mm) [2], fruit firmness at pink stage (kg/cm$^2$), fruit firmness at red stage (kg/cm$^2$), pericarp thickness (mm), total soluble solids (%) and pH of the juice [3]. Means of each character were subjected to ANOVA [4] Genotypic correlation coefficients ($r_g$) were computed using the formula given by Kwon and Torrie [5]. Path coefficients analysis was done as described by Dewey and Lu [1].

## 3. Results

Ordinary analysis of variance of the data showed that genotypic differences for all the characters were significant (P≤ 0.01) showing the existence of variation in the plant material (Table 1) the results of genotypic correlation and path coefficient analysis of plant characters are given in Tables 2 and 3 respectively.

Coefficient of genetic correlation ($r_g$) showed that NFLD appeared to have positive significant relationship with NFRD ($r_g$ = 0.6937) whilst with all the remaining characters either has weak or negative correlation. Genetic correlation of NFRD with FRL ($r_g$= 0.5161) and PT ($r_g$= 0.5282) was also positive and significant, however with NFLC and TSS it showed negative relationship ($r_g$= -0.4621 and -0.0114 respectively) Association of NFLC with NFRC and TSS was positive and significant, with $r_g$= 0.9279 and 0.4565 respectively whilst association with FRL ($r_g$= -0.8842) FRW ($r_g$= -0.8490) and PT ($r_g$= -0.7650) was negative and significant. FRL appeared to show strong relationship with FRW, PT, pH and TSS $r_g$ being 0.8147, 0.8036, 0.550 and 0.7125 respectively however with FFP and FFR, relationship appeared to be very weak. FRW had also strong association ($r_g$= 0.536) with PT whilst FFP, FFR, pH and TSS had either negative or weak relationship. Association of FFP with FFR and PT was positive and significant ($r_g$= 0.8132 and 0.5839) respectively however with pH and TSS it was associated weakly. FFR appeared to show strong and significant relationship with PT ($r_g$= 0.4628). Similarly PT had weak and negative correlation with pH and TSS.

The results of path coefficient analysis presented in Tble 3 revealed that number of fruits/plant had the greatest (5.400) direct effect on TSS whilst indirect effect of NDFR (0.220) and PT (0.620) was more pronounced than the FRW and FFP. Genetic correlation of FRL with TSS ($r_g$= 0.713) was strong, its direct effect also appeared to be greater (2.912) and similarly indirect effect through NFLC was impressive (2.703). Direct effect of FRW on TSS was smaller (0.875) than indirect effect via NFLC (2.596) and FRL (2.373) however through pH it was of lesser extent. Direct effect of FFR on TSS was higher (1.510) it also contributed through NFLC and FRL to the similar extent.

Table 2. Genotypic ($r_g$) correlation coefficients of various character combinations.

| Character | NDFR | NFLC | NFRC | FRL | FRW | FFP | FFR | PT | PH | TSS |
|---|---|---|---|---|---|---|---|---|---|---|
| NDFL | 0.6937* | -0.0307 | 0.1182 | 0.0468 | -0.1841 | -0.0466 | 0.1921 | 0.1147 | 0.0150 | 0.2217 |
| NDFR | | -0.4621* | -0.3345 | 0.5161* | 0.3456 | 0.1858 | 0.3645 | 0.5282* | 0.0227 | -0.0114 |
| NFLC | | | 0.9279** | -0.8842** | -0.8490** | -0.2961 | -0.1642 | -0.7650** | 0.0573 | 0.4565* |
| NFRC | | | | -0.8996** | -0.9306** | -0.2047 | -0.1093 | -0.675** | 0.2187 | 0.5437* |
| FRL | | | | | 0.8147** | 0.2704 | 0.1750 | 0.8036** | 0.550* | 0.7125** |
| FRW | | | | | | 0.0668 | -0.0259 | 0.536* | -0.2526 | -0.4157 |
| FFP | | | | | | | 0.8132** | 0.5839** | 0.2187 | -0.0725 |
| FFR | | | | | | | | 0.4628* | 0.2891 | 0.0856 |
| PT | | | | | | | | | 0.1279 | -0.5374* |
| pH | | | | | | | | | -0.0235 | |

* = Significance at P≤ 0.01 levels of probability **= Significance at P≤ 0.05 levels of probability

Table 3. Direct and indirect effect of different plant characters on total soluble solids.

| Plant Characters | Direct effect | Indirect effects via: | | | | | | | | | | Genotypic correlation ($r_g$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NDFL | NDFR | NFLC | NFRC | FRL | FRW | FFP | FFR | PT | pH | |
| NFRC | 5.400 | -0.006 | 0.220 | -2.62 | | -2.814 | 0.055 | 0.080 | -0.165 | 0.620 | -0.226 | 0.544 |
| FRL | 2.912 | -0.002 | -0.340 | 2.703 | -3.432 | | 0.713 | -0.073 | 0.264 | -1.975 | -0.057 | 0.713 |
| FRW | 0.875 | 0.010 | -0.228 | 2.596 | -5.025 | 2.373 | | -0.018 | -0.039 | -1.221 | 0.261 | -0.416 |
| FFR | 1.510 | -0.010 | -0.240 | 0.502 | -0.590 | 0.509 | -0.023 | -0.220 | | -1.054 | -0.299 | 0.086 |

| | | | |
|---|---|---|---|
| NDFL | = Number of days to 50% flowering | NDFL | = Number of days to 50% flowering |
| NFLC | = Number of fruits/cluster | NFRC | = Number of fruits/cluster |
| FRL | = Fruit length | FRW | = Fruit width |
| FFP | = Fruit firmness at pink stage | FFR | = Fruit firmness at pink stage |
| PT | = Pericarp thickness | pH | = pH of the fruit juice |
| TSS | = Total soluble solids | | |

## 4. Discussion

Existence of variation in tomato germplasm for all the characters seems to be important for making selection of desirable genotypes. In the present study of plant material, TSS was kept as dependant variable whilst remaining variables were independent variable. Improvement in number of fruits per cluster may be made through direct selection and this can enhance TSS, previous information on genetic material has not been documented, this character was reported to be strongly associated with yield [6-9] also recorded that this character should be selected to increase the yield of tomato. Direct selection for fruit length can be made for increasing TSS, but [10] reported that fruit length had positive correlation with fruit diameter. In the present plant material fruit width was found to have direct effect on TSS and therefore, direct selection for this character may enhance TSS, but [10] reported that there is positive correlation between fruit diameter and fruit length. Direct selection for fruit firmness at red stage can be made for the enhancement of TSS but [11] reported positive heterosis for fruit firmness at red stage.

## 5. Conclusion

Selection of NFRC, FRL, FRW and FFR for increasing TSS is desirable than the other characters but information reported here can not be generalized, as the present study involved a small sample of genotypes. It is suggested that the present information must be substantiated by using a large number of genotypes representing whole of germplasm of *Solanum lycopersicum* (L.).

## References

[1] D. R. Dewey and K. H. Lu, Agron. J. **51** (1959) 515.

[2] Anonymous, Descriptor for tomato IPGRI. Secretariat Rome, Italy (1996) 35.

[3] N. Garg, S. D. Cheema and A. S. Dhatt, Euphytica. **159** (2008) 275.

[4] R.G.D. Steel, J.H. Torrie and D.A. Dickey. Principles and Procedures of Statistics: A Biometrical Approach, Singapore: 3rd Ed. McGraw Hill, Book Co. Inc (1997).

[5] S.H. Kwon and J.H. Torrie. Crop Sci. **4** (1964) 196.

[6] A. Haydar, M. A. Mandal, M. B. Ahmad, M. M. Hannan, R. Karim, M. A. Razvy, U.K. Roy and M. Salahin, Mid. East. J. Sci. Res. **2** (2007) 139.

[7] N. Metha and B. S. Asathi, Karnataka J. Agric. Sci. **21** (2008) 92.

[8] S. Nesgea, K. S. Krishnappa and T. B. P. Raju. Correlation coefficient analysis in tomato. Univ. of Agric. Sci. Bengalore, 560 065 India. (2001).

[9] U. K. Kohli and A. Joshi, Indian J. Agric. Sci. **73** (2003) 110.

[10] Hidayatullah, S. A. Jatoi, A. Ghafoor and T. Mahmood, Pak. J. Bot. **40** (2008) 627.

[11] S. A. S, Chisti, A. A. Khan, B. Sadia and I. A. Khan, J. Agric. **46** (2008) 325.