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# Estimates of Genetic Parameters for Quantitative and Qualitative Traits in Tomato (*Lycopersicon esculentum* Mill.)

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**Abstract** The present experiment to estimate the genetic parameters for quantitative and qualitative traits in tomato (*Lycopersicon esculentum* Mill.) was carried out during 2011-12. In the present study, 16 genotypes of tomato were evaluated for sixteen quantitative and qualitative characters. The phenotypic variance for all the nineteen characters was found to be higher than the genotypic variance. High phenotypic coefficients and genotypic of variation were observed for Plant beight, number of leaves per plant, number of flower per plant, number of cluster per plant, number of fruit weight per plant, number of fruit per plant, pericarp thickness, TSS High heritability coupled with high genetic advance observed for these characters imply the potential for crop improvement through selection.

**Keywords** Tomato, Genetic variability, Heritability, Genetic advence.

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## Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crop, which belongs to family Solanaceae and belived to be the native of Peru Equandor region. Tomato is one of the most popular and widely grown vegetable in the world. It is grown extensively in tropical and subtropical areas. It is planted 4.39 millon hectares of with a total production of 150.51 million tonnes [1]. India is the second largest tomato producer in the world after china accounting for about 11% of the world tomato production [2]. The present demand for tomato is based on the industrial requirement and ultimately the consumer preference. So there is an immediate need for further improvement of this crop through development of superior varieties and hybrids in order to meet the present day requirements.The efficiency of selection depends on the extent of genetic variability and degree of transmissibility characters. Since the quantitative characters are influenced by the environment a study under different locations and years is likely to bring out the genotype-environment interaction for the precise estimation of genetic parameters and predicting the process of selection. Moreover acknowledge about association of various characters and their relative contribution to yield is helpful for multiple trait selection. The present investigation was conducted to generate this informantion in a collection of some indigenous genotype of tomato in order to estimating genetic variability, heritability and genetic advance to formulate a sound breeding plan for its improvement.

**Table 1.** Analysis of variance for 16 characters of the tomato (*Lycoperssicon esculentum* Mill.). *Significant at 5% and 1% Probability level respectively.

| Sl. No. | Source of Variance | Replication (2) | Treatments (15) | Error (30) |
|---|---|---|---|---|
| 1. | Plant height (cm) | 2.489 | 224.996** | 2.312 |
| 2. | Days to marketable picking | 4.126 | 78.157** | 2.599 |
| 3. | Number of branches | 0.018 | 2.095** | 0.104 |
| 4. | Intermodal length | 0.019 | 1.328** | 0.047 |
| 5. | Number of leaves/plant | 107.642 | 8065.120** | 46.444 |
| 6. | Days to first flower opening | 0.044 | 12.056** | 0.306 |
| 7. | Number of flower/plant | 1.319 | 2173.695** | 19.46 |
| 8. | Days to 50% flowering | 1.447 | 5.917** | 0.633 |
| 9. | Number of flower/cluster | 0.946 | 3.132** | 0.237 |
| 10. | Number of cluster/plant | 4.364 | 131.007** | 1.62 |
| 11. | Number of fruit/cluster | 0.053 | 0.696** | 0.020 |
| 12. | Number of fruit/plant | 2.319 | 58.450** | 4.351 |
| 13. | Fruit weight/cluster | 73.339 | 665.845** | 34.012 |
| 14. | Fruit length (cm) | 0.007 | 0.230** | 0.009 |
| 15. | Fruit width (cm) | 0.027 | 0.638** | 0.022 |
| 16. | Number of locules/fruit | 0.004 | 0.781** | 0.006 |
| 17. | Pericarp thickness (mm) | 0.001 | 0.229** | 0.002 |
| 18. | TSS | 0.002 | 0.173** | 0.002 |
| 19. | Fruit weight (g) | 191.122 | 15005.951** | 1016.835 |

## Materials and Methods

The experimental material for the present study consisted of sixteen genotypes of tomato obtained from Indian institute of vegetable research , Varanasi (UP). The experiment was conducted using randomized block design (RBD) with three replication at Horticulture Research Farm of Department of Applied Plant Science, Babasaheb Bhimrao Ambedkar University, Vidya-Vihar, Rae Bareli Road, Lucknow (UP) during *rabi* season of 2011-2012. Observation were recorded from five randomly selected plants of each genotypes of each replication for nineteen characters viz. plant height, days to marketable picking, number of branches per plant, intermodel length, number of leaves per plant, days to first flower opening, number of flower per plant, days to 50% flowering, number of flower per cluster number of cluster per plant, number of fruit per cluster, number of fruit per plant, fruit weight per cluster, fruit length (cm), fruit width (cm), number of locules, pericarp thickness, TSS and fruit weight . The data generated was subjected to analysis the variability through genotypic coefficient of variation (GCV) phenotypic coefficient of variation (PCV) and genetic advance as suggested by Burton and D-vane [3].

## Results and Discussion

The analysis of variance showed highly significant difference among the genotypes for all the characters studied in (Table 1). This indicated presence of substantial amount all the characters. These results are an agreement with findings of Anitha et al. [4].

A wide range of variation (Table 2) was observed for plant height at the time of last harvesting ranged from 51.41 cm for EC-620-448 to 81.12 cm for EC-620-144. The number of branches per plant ranged from 8.08 for EC-620-440 to 10.33 for EC-620-444. Days to marketable picking ranged from 59.67 for EC-620-445 to 76.67 for EC-620-434. The intermodal length ranged from 3.88 cm for EC-620-444 to 6.00 cm for EC-620-435. The number of leaves per plant from 225.50 EC-620-446 to 393.58 for EC-620-440.Opening of First flower after sowing ranged from 43.70 for EC-620-448 to 50.66 for EC-620-431. Number of flower per plant ranged from 73.94 for EC-620-446 to 162.33 for EC-620-445. Days to first flowering ranged from 59.42 from for EC-620-449 to 64.65 for EC 620-431. Number of flower per cluster ranged from 5.84 for EC-620-449 to 9.75 for EC-620-445. Number of cluster per plant ranged from 14.00 for EC-620-448 to 35.58 EC-620-445.

**Table 2.** Mean performance of different tomato genotypes with respect to various traits.

| | Characters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Genotypes | Plant hieght (cm) | Days to marketable picking | No. of branche/ plants | Internodal length (cm) | No. of leaves/ plant | First flower opening after sowing | No. of flower/ plant | Day of 50% flowering | No. of flowers cluster |
| EC-620-449 | 53.67 | 72.33 | 9.67 | 4.99 | 311.72 | 46.87 | 99.83 | 59.42 | 5.84 |
| EC-620-448 | 51.45 | 69.33 | 7.51 | 5.43 | 306.03 | 43.70 | 91.50 | 61.83 | 8.20 |
| EC-620-447 | 53.23 | 62.92 | 8.33 | 4.34 | 334.00 | 49.41 | 90.72 | 63.08 | 6.67 |
| EC-620-446 | 57.07 | 74.67 | 8.78 | 5.95 | 225.50 | 46.71 | 73.94 | 63.66 | 7.70 |
| EC-620-445 | 52.77 | 59.67 | 10.31 | 4.54 | 399.92 | 47.17 | 162.33 | 61.88 | 9.75 |
| EC-620-444 | 81.12 | 68.33 | 10.33 | 3.88 | 389.58 | 43.91 | 134.42 | 63.32 | 8.25 |
| EC-620-443 | 56.95 | 73.00 | 9.59 | 4.80 | 333.58 | 43.78 | 83.17 | 62.67 | 6.58 |
| EC-620-442 | 57.00 | 73.67 | 8.36 | 4.77 | 390.67 | 46.91 | 102.83 | 63.33 | 7.00 |
| EC-620-440 | 52.11 | 65.67 | 8.08 | 4.45 | 393.58 | 48.03 | 69.38 | 62.80 | 6.67 |
| EC-620-439 | 38.94 | 63.33 | 9.33 | 4.80 | 333.50 | 44.40 | 38.40 | 62.16 | 7.37 |
| EC-620-438 | 54.96 | 62.67 | 9.73 | 5.70 | 333.83 | 45.69 | 98.32 | 62.65 | 6.33 |
| EC-620-437 | 58.03 | 65.33 | 9.93 | 4.29 | 294.67 | 47.55 | 91.49 | 64.47 | 6.57 |
| EC-620-435 | 48.75 | 71.67 | 8.59 | 6.00 | 307.83 | 47.91 | 101.66 | 62.53 | 6.59 |
| EC-620-434 | 53.65 | 76.67 | 9.37 | 5.98 | 314.67 | 47.68 | 85.67 | 63.90 | 6.26 |
| EC-620-432 | 57.12 | 72.00 | 8.45 | 4.77 | 246.25 | 47.40 | 86.98 | 60.27 | 5.82 |
| EC-620-431 | 64.78 | 72.67 | 8.62 | 5.45 | 312.33 | 50.66 | 98.32 | 64.95 | 6.87 |
| GM (X) | 55.72 | 68.99 | 9.06 | 5.01 | 322.35 | 46.74 | 94.31 | 62.62 | 7.03 |
| SEm ± | 0.878 | 0.931 | 0.186 | 0.126 | 3.935 | 0.319 | 2.547 | 0.459 | 0.281 |
| CD at 5% | 2.534 | 2.688 | 0.536 | 0.363 | 11.364 | 0.922 | 7.356 | 1.327 | 0.812 |

**Table 2.** Continued.

| Genotypes | No. of cluster/ plant | No. of fruit/ cluster | No. of fruit/ plant | Fruit weight cluster (g) | Fruit weight (cm) | Fruit width (cm) | No. of locudes fruit | Pericarp thickness (mm) | TSS | Fruit wt/plant (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| EC-620-449 | 19.33 | 3.25 | 22.88 | 69.75 | 4.07 | 3.84 | 3.08 | 3.60 | 4.83 | 873.00 |
| EC-620-448 | 14.00 | 3.33 | 27.93 | 75.54 | 4.54 | 3.40 | 3.92 | 3.37 | 4.42 | 873.58 |
| EC-620-447 | 18.33 | 3.33 | 22.17 | 69.17 | 4.45 | 3.35 | 4.67 | 3.23 | 4.33 | 861.17 |
| EC-620-446 | 20.67 | 3.34 | 25.67 | 68.67 | 4.34 | 3.70 | 4.67 | 3.61 | 4.42 | 892.33 |
| EC-620-445 | 35.58 | 4.88 | 35.20 | 117.14 | 4.00 | 3.92 | 3.92 | 3.79 | 4.67 | 1009.51 |
| EC-620-444 | 33.78 | 3.98 | 31.63 | 97.98 | 3.99 | 3.91 | 4.50 | 3.34 | 4.75 | 858.67 |
| EC-620-443 | 17.26 | 2.95 | 19.17 | 58.17 | 4.29 | 3.99 | 4.08 | 3.84 | 4.58 | 776.67 |
| EC-620-442 | 18.65 | 2.88 | 21.25 | 71.25 | 4.58 | 3.51 | 4.50 | 3.60 | 4.50 | 894.50 |
| EC-620-440 | 24.11 | 3.26 | 21.58 | 67.92 | 4.10 | 3.48 | 4.50 | 3.34 | 4.58 | 736.25 |
| EC-620-439 | 28.62 | 3.08 | 23.92 | 76.00 | 3.95 | 3.69 | 3.67 | 4.03 | 4.83 | 831.99 |
| EC-620-438 | 32.93 | 3.73 | 20.83 | 71.89 | 5.69 | 4.30 | 3.67 | 3.72 | 4.92 | 816.83 |
| EC-620-437 | 22.43 | 3.76 | 22.42 | 68.50 | 3.78 | 4.12 | 3.92 | 3.69 | 4.25 | 851.67 |
| EC-620-435 | 22.64 | 3.73 | 21.50 | 70.12 | 4.09 | 3.44 | 3.50 | 3.92 | 4.92 | 776.25 |
| EC-620-434 | 18.98 | 3.70 | 19.10 | 93.25 | 4.17 | 3.90 | 2.25 | 3.53 | 4.50 | 830.57 |
| EC-420-432 | 16.70 | 3.37 | 21.83 | 83.00 | 4.90 | 3.55 | 4.58 | 3.56 | 5.08 | 768.33 |
| EC-420-431 | 18.40 | 3.75 | 22.33 | 90.92 | 3.55 | 4.39 | 3.83 | 4.26 | 4.83 | 825.50 |
| GM (X) | 22.65 | 3.52 | 23.71 | 78.08 | 3.75 | 4.33 | 4.02 | 3.67 | 4.65 | 848.55 |
| SEm ± | 0.737 | 0.081 | 1.204 | 3.367 | 0.054 | 0.086 | 0.044 | 0.029 | 0.024 | 18.41 |
| Cd at 5% | 2.130 | 0.235 | 3.478 | 9.725 | 0.155 | 0.250 | 0.127 | 0.083 | 0.069 | 53.17 |

The number of fruit per cluster ranged from 2.88 for EC-620-442 to 4.88 for EC-620-445. Number of fruit per plant ranged from 19.10 for EC-620-434 to 35.20 for EC-620-445. Fruit weight per cluster ranged from 58.17 for EC-620-443 to 117.14 for EC-620-445.Fruit width ranged from 3.55 for EC-620-431 to 5.69 for EC-620-438. The length of fruit ranged from 3.35 for EC-620-447 to 4.39 for EC-620-431. Number of locules per

**Table 3.** Range, mean and estimate of genetic parameters in tomato.

| Characters | Mean | Range Mix. | Range Min. | Coefficient of variation (%) Genotypic | Coefficient of variation (%) Phenotypic | Heritability (%) | Genetic advance | Genetic advance in percentage of mean |
|---|---|---|---|---|---|---|---|---|
| Plant height (cm) | 55.72 | 81.12 | 38.94 | 74.28 | 76.54 | 97.00 | 17.47 | 31.36 |
| Days to marketable picking | 68.99 | 76.67 | 59.67 | 25.18 | 27.78 | 90.60 | 9.84 | 14.26 |
| Number of branches/plant | 9.06 | 10.33 | 7.51 | 0.66 | 0.76 | 86.50 | 1.56 | 17.22 |
| Intermodal length | 5.01 | 6.00 | 3.88 | 0.42 | 0.47 | 90.00 | 1.17 | 25.49 |
| Number of leaves/plant | 322.35 | 399.92 | 233.58 | 2672.19 | 2719.33 | 98.30 | 105.58 | 32.75 |
| Days to first flower opening after sowing | 46.74 | 50.66 | 43.70 | 3.91 | 4.22 | 92.80 | 3.92 | 8.40 |
| Number of flower/plant | 94.31 | 162.33 | 38.40 | 718.07 | 737.53 | 97.40 | 54.46 | 57.75 |
| Days to 50% flowering | 62.62 | 64.95 | 59.42 | 1.76 | 2.39 | 73.60 | 2.34 | 3.74 |
| Number of flower/cluster | 7.03 | 9.75 | 5.82 | 0.96 | 1.20 | 80.80 | 1.81 | 25.79 |
| Number of cluster/plant | 22.65 | 35.58 | 14.00 | 43.12 | 44.75 | 96.40 | 13.27 | 58.62 |
| Number of fruit/cluster | 3.52 | 4.88 | 2.88 | 0.22 | 0.24 | 91.90 | 0.93 | 26.62 |
| Number of fruit/plant | 23.71 | 35.20 | 19.10 | 18.03 | 22.83 | 80.60 | 7.85 | 33.32 |
| Fruit weight/cluster | 78.08 | 117.14 | 58.87 | 210.61 | 244.62 | 86.10 | 27.74 | 35.52 |
| Fruit length (cm) | 3.75 | 4.30 | 3.35 | 0.07 | 0.08 | 89.50 | 0.53 | 14.13 |
| Fruit width (cm) | 4.33 | 5.69 | 3.78 | 0.20 | 0.22 | 90.20 | 0.88 | 20.45 |
| Number of locules | 4.02 | 4.67 | 3.08 | 0.25 | 0.26 | 97.80 | 1.03 | 25.79 |
| Pericarp thickness | 3.67 | 4.26 | 3.23 | 0.07 | 0.07 | 96.80 | 0.55 | 15.17 |
| TSS | 4.65 | 5.08 | 4.25 | 0.05 | 0.05 | 97.10 | 0.48 | 10.42 |
| Fruit weight | 848.55 | 1009.51 | 736.25 | 4663.03 | 5679.87 | 82.10 | 127.45 | 15.01 |

fruit ranged from 3.08 for EC-620-449 to 4.67 for EC-620-446. Pericarp thickness ranged from 3.23 for EC-620-447 to 4.26 for EC-620-431. The TSS. ranged from 4.25 for EC-620-437 to 5.08 for EC-620-432. The fruit weight per plant ranged from 736.25 gm for EC-620-440 to 1009.51 gm for EC-620-445.

The range, mean and other genetic parameter estimated are presented in (Table 3). A wide range of variability was observed for fruit weight (736.25–1009.51), number of flower per plant (38.40–162.33), number of leaves per plant (233.58–399.62), plant height (38.94–81.12), fruit weight per cluster (58.87–117.14), pericarp thickness (3.23–4.26) and total soluble solids (4.25–5.08). The traits showing wide range of variability have ample scope of selections for desirable genotypes.

The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters (Table 3). The genotypic coefficient of variation ranged from 0.05% for total soluble solids to 4663.03 for fruitm weight. High GCV was observed for fruit weight 4663.03 number of leaves per plant (2672.19), number of flower per plant (718.07) and fruit weight per cluster (210.61)

The high phenotypic coefficient of variation ranged from 0.05% for total soluble solids to 5679.87 for fruit weight. High PCV was observed for fruit weight 5679.87, number of leaves per plant 2719.33, number of flower per plant 737.53 and fruit weight per cluster 244.62 indicating the substantial modifying effect of environment in the expression of all traits Bhardwaj and Sharma Bhardwaj et al. [5] also reported similar results in tomato and Dar and Sharma [6] had obtained similar results under plastic house condition.

In the present study highest heritability (broad sense) was observed for number of eaves per pant (98.38%), number of locules (97.80%), TSS (97.10%), plant height (97.00%), number of flower per plant (97.40) and pericarp thickness (96.80%) indicating the least influence of environment in their expression. High genetic advance as percentage of mean observed for number of cluster per plant (58.62%), number of flower per plant (57.75%), fruit weight per cluster

(35.52%), and number of fruit per plant (35.12%). High genetic advance coupled with high heritability could be considered for selection among genotypes.

Therefore, the selection based on the phenotypic performance of these characters would be useful for achieving desirable results. High heritability and moderately high genetic advance for, number of leaves per plant, number of locules and height of plant was recorded by Golari et al., Haydar et al. and Kumar et al. [7–9]. Thus the strain EC 620-445 is highly significant for Days to marketable picking. Number of flower per cluster, Number of fruit per cluster, Number of fruit per plant, Fruit weight per cluster and for Fruit weight. All these characters can be effectively used as critria for selection of the present materials for further desired improvement in tomato.

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