**Exploring Genetic Variation, Trait Associations and Path Analysis in Chilli (*Capsicum annum* L.) Cultivars**

**Abstract**

A field experiment entitled “Structural and Functional Parameters for Screening of Different Chilli Varieties” was carried out in the *Kharif* season during 2015-16 at Research Farm, Department of Horticulture, College of Agriculture, Tikamgarh, J.N.K.V.V., Jabalpur (M.P.). The experiment was conducted in a randomized block design with three replications. The genetic variability, correlation and path analysis were studied in ten varieties of chilli for 18 different qualitative and quantitative characters. Correlation coefficients at genotypic and phenotypic levels indicated that fruit yield per plant was positively and significantly correlated with plant height (cm), no. of branches plant-1, no. of leaves plant-1, fresh weight of ten fruits-1, number of fruits plant-1, number of seeds fruit-1 and test weight content but negative and significant association was found with relative growth rate (RGR), crop growth rate (CGR) and fruit length. It might be associated with increasing the fruits yield per plant. Path coefficient analysis revealed that the highest positive direct effect on fruit yield per plant was exerted by number of fruits plant-1 followed by plant height at 90 DAT and number of leaves plant-1 at 90 DAT, while highest negative direct effect on fruit yield per plant was exerted by number of branches plant-1 at 90 DAT, test weight, fruit girth and fruit length. Therefore, selection should be practiced for fresh weight of fruit, number of fruits per plant, fruit width and fruit length for direct improvement of fruit yield per plant.

**Keyword**:- Chilli, Varieties, Correlation, Genetic variability and Path analysis

1. **Introduction**

Chilli (*Capsicum annum* L.) is a member of the *Solanaceae* family that includes tomato, potato and brinjal. Capsicum was domesticated at least five times by prehistoric peoples in different parts of South and Middle America. The genus Capsicum consists of approximately twenty wild species and five domesticated species, most cultivated chillies in the world belong to the species *Capsicum annum* L. The five domesticated species of chilli are *Capsicum annum, Capsicum frutescens, Capsicum chinense, Capsicum pubescens* and *Capsicum baccatum.* The substances responsible for pungency in chilli are Capsaicin (C18H37NO3) and several related chemicals, collectively called Capsaicinnoids. Green fruit of chilli and sweet peppers are one of the richest sources of anti-oxidants and vitamins such as vitamin A, C and E. These antioxidants in food protect occurrence of cancer and delay ageing. Chilli (*Capsicum annum* L.) is a vegetable as well as a spice and one of the most important cash crops of India. It is used for industrial purposes due to the extraction of oleoresin. India is the world’s largest producer, consumer and exporter of chilli. Guntur in Andhra Pradesh produces 30% of chilli, particularly in India. This has the potential to improve the income and the livelihood of thousands of small farmers.

Correlation simply measures the association between yield and other traits, whereas path coefficient analysis permits the separation of correlation into direct effects (path coefficient) and indirect effects (effects exerted through other variables). Hence, the present investigation was carried out with a view to studying the character association and direct and indirect effect of different independent characters on the dependent variable, green chilli yield in chilli varieties. The present research works on “Structural and Functional Parameters for Screening of Different Chilli Varieties” was conducted with the objective to study the periodic changes in structural and functional parameters of different varieties of chilli.

**2. Materials and Methods**

***2.1 Experimental detail:-***

Tikamgarh district lies in the Bundelkhand Zone (Agro-climatic Zone –VIII). It is situated in the north-eastern part of Madhya Pradesh at 240 43’ North latitude and 780 49’ East longitudes at an altitude of 358 meters mean sea level. It has a sub-tropical climate characterized by hot dry summers and cool dry winter. The average maximum temperature during October varies between 35 - 36.5°C, while the average minimum temperature varies between 3.5 to 5.5 0C during the month of December, which is the coldest month of the year. The average season rainfall of this region is about 213.7mm, which is mostly received between July- August and a little rainfall is also obtained during January. The average humidity of the tract is about 73%. The soil of the experiment field was clay loam in texture. International Journal of Chemical Studies, It was medium in organic matter and had good water holding capacity with PH ranging from 6.9. The manure and fertilizers were applied as per respective plot. Full dose of RDF (100:60: 40 kg NPK ha-1) and 1/3 nitrogen were given to the plot before sowing as a basal dose. The remaining 2/3 quantity of nitrogen was applied in two split doses, *i.e.,* 30 and 60 days after transplanting.

***2.2 Experimental design***

The experiment was laid out in the randomized block design with three replications. Varieties- PusaJwala, PusaSadabahar, JM-218, JM-283, Sonakshi-44, Divyajyoti, Classica-152, Natasha-727, Suryamukhi and Prajwala. Observations recorded for yield and quality parameters. Five plants were randomly selected from each treatment and replication for the study. Five plants were randomly selected from each treatment and replication for the study. Sampling was done at 30, 60 & 90 DAS intervals for growth parameters Leaf area, Leaf area index (LAI) and Dry weight per plant (g), such sampling was also done and physiological parameters. Plant height (cm), No. of branches plant-1, No. of leaves plant-1, at 60 & 90 DAT for physiological parameters i.e. Relative growth rate (RGR), Crop growth rate (CGR) and Bio-mass duration (BMD) and other parameter was recorded finally done at one time Fruit length, Fruit girth, Fresh weight of ten fruit-1, Number of fruit plant-1, number of seed fruit-1, Test weight, Fruit yield plot-1 and Fruit yield ha-1.

***2.3 Plant growth and physiological parameters***

**Leaf area (cm2):** The five plants of leaves are randomly selected and removed in the field. The leaf area was measured with helped by graph method.

**Leaf area index (LAI):** Crop production is the practical means of trapping solar energy and converting it into photosynthesis. Enhancing crop production, strategies are usually emphasized to maximize light interception and promoting leaf expansion.

LAI (Leaf area index) represents the ratio of leaf surface (only of one side) to the ground area occupied by the crop.

LAI =

Where,

LA = Leaf area, P = Ground area

**Relative growth rate (RGR):** The rate of increase in biomass and over a time internal or we can say in another word that it expresses the dry weight. The RGR calculated from measurement taken at times t1 and t2.

RGR = (g/g/day)

Where,

W1 and W2 are the dry weight at times t1 and t2 respectively.

**Crop growth rate (CGR):** The gain in weight of a community of plants on a unit of land of time is termed as crop growth rate.

It is estimation by calculating the average daily increment of biomass (W1& W2) per unit area (p) per unit time interval (t1& t2). This provides the rate of dry matter production of the crop stands.

CGR = (g/m2/day)

**Bio-mass during (BMD):** It is analogous to leaf area duration. If the area under time curve for biomass production is calculated for LAD, the value for biomass persistence with time is obtained. The value may be useful in the calculation of maintenance of respiratory temperature. The derived quantities can assist in better understanding of crop responses and in construction of models of plant responses to measurable parameters.

BMD =(g/day)

Where,

W1 and W2 are biomass at successive growth stage at t1 and t2 time

***2.4 Statistical Analysis***

The data collected from all the quantitative characters, qualitative character pest and disease parameters were subjected to basic analysis and following different statistical parameters were work out.

**3. Results and Discussion**

**3.1 Genetic variability**

**3.1.1 Range and mean performance**

The Range and mean performance of the ten varieties of chilli for all the eighteen characters are presented in Table 1,2,3. The variation was highest for fruit yield plant-1 (129.00-786.00 g) followed by number of fruit plant-1 (26.23-62.63), fruit yield ha-1 (4.78-26.41 t), plant height at 90 DAT (38.35-61.44), plant height at 60 DAT (29.08-43.21), plant height at 30 DAT (16.27-32.24), number of branches plant-1 at 30 DAT(3.23-7.06), number of branches plant-1 at 60 DAT (6.90-14.76) and number of branches plant-1 at 90 DAT (11.46-26.07). The present findings are in accordance with the earlier findings of **Nandadevi and Hosmani (2003)** and **Vani *et al.* (2007)** reported highest variation fruit yield plant-1 and number of fruit plant-1. **Singh and Yadav (2008)** found the wide range of variability for most of the characters *viz*., number of fruits plant-1, plant height and fruit yield plant-1.

**3.1.2 Coefficient of variation**

Estimation of components of genetic parameters of variation for yield and its attributes exhibited a wide range of variation for the character studies (Tables 1 and 2**)**. Result indicated that the value of phenotypic coefficient of variation was of higher in magnitude than that of genotypic coefficient of variation for all the characters showing that the environment had an important role in influencing the expression of the characters.

**3.1.2.1 Phenotypic coefficient of variations (PCV)**

The phenotypic coefficient of variation ranged from 7.25% for relative growth rate at 90 DAT to 63.63% for number of fruits plant-1.

The phenotypic coefficient of variations was high for characters *viz*., fruit yield plot-1, fruit yield ha-1, fruit yield plant-1, number of seeds plant-1, dry weight of plant-1 at 30 DAT, number of fruits plant-1, number of branches plant-1 at 30 DAT, test weight. Nandadevi and Hosmani (2003) found high PCV for number of branches, number of fruits plant-1 and length of fruit, **Varkey *et al.* (2005)** for fruit yield plant-1 and number of fruits plant-1, **Singh and Yadav (2008),** and **Tasso *et al.* (2014)** found high PCV for plant height, **Pandit and Ahikary (2014)** for test weight and number of fruits plant-1.

However, low PCV was exhibited by traits viz., in low for characters like plant height at 30 DAT, rate at 90 DAT, number of leaves plant-1 at 90 DAT, number of leaves plant-1 at 60 DAT, number of leaves plant-1 at 30 DAT, plant height at 60 DAT, plant height at 90 DAT.

Rest of the characters such as fruit yield plot-1, plant height at 30 DAT, number of branches at 90 DAT and number of branches at 30 DAT, exhibited moderate phenotypic coefficient of variation. The findings are in accordance with the findings of **Diwakar *et al.* (2012).**

**3.1.2.2 Genotypic coefficient of variation (GCV)**

The genotypic coefficient of variation varied from 5.36% for relative growth rate at 90 DAT to 63.39% for fruit yield plant-1.

High genotypic coefficient of variation was observed for the number of fruit plant-1, test weight, number of branches plant-1 at 90 DAT and number of branches plant-1 at 60 DAT. The findings are in close harmony with the findings of **Ibrahim*et al.* (2001), Nandadevi and Hosmani (2003)** for number of branches, **Singh et al. (2013)** for numberof fruits plant-1, **Tasso *et al.* (2014)** for test weight.

Plant height at 90 DAT, number of leaves at 30 DAT, plant height at 30 DAT and number of leaves at 60 DAT.

Moderate GCV was observed for traits i.e., fruit girth, fruit length and height at 60 DAT. Those traits having high GCV & PCV, showed the preponderance of additive genetic effect for these characters selection of these traits will be effective.

**3.1.3 Heritability (Broad sense)**

The heritability (BS) was computed for each of the characters by the variance components for estimating their relative magnitudes of genotypic and phenotypic variability contributed through environmental factors. The estimates of heritability (BS) for all the characters have been discussed in Table 1 and 2. It was partitioned as very high (above 90%), high (70 to 90%), medium (50-70%) and low (less than 50%).

Very high estimates of heritability was reported for fruit yield plant-1, fruit yield ha-1number of fruit plant-1, number of branches plant-1 at 90 DAT, test weight and plant height at 90 DAT.

However, it was high for fruit length, number of leaves plant-1 at 60 DAT,number of leaves plant-1 at 90 DAT. The findings are in close harmony with the results of **Smitha and Basavaraja (2006)** for number of fruits plant-1, number of branches, plant height, length of fruit and fruit yield plant-1,**Ibrahim *et al.* (2001), Smitha and Basavaraja (2006), Johari and Kumar (2007)** for number of fruits plant-1 and plant height. High heritability values for these traits indicating that variation observed mainly under genetic control and was less influenced by environment.

Moderate heritability was recorded for number of branches plant-1 at 30 DAT, plant height at 60 DAT, dry weight plant-1 at 90 DAT, dry weight plant-1 at 60 DAT,

Low magnitude of heritability was recorded for dry weight plant-1 at 60 DAT, crop growth rate at 90 DAT, bio-mass duration at 60 DAT, bio-mass duration at 90 DAT, and dry weight plant-1 at 30 DAT.

**3.1.4 Genetic advance (as % of mean)**

Due to masking influence of environment upon characters concerned, values of genetic advance exhibited high fluctuations. Therefore, to attain relative comparison of the characters in relation to environment genetic advance as percentage of mean was calculated to predict the genetic gain (Table 1 and 2). The estimated values of genetic advance as percent of mean were classified as high (more than 20%), moderate (10-20%) and low (less than 10%).

Genetic advance (as percentage of mean) ranged between 8.16% for relative growth rate at 60 DAT to 130.50% for fruit yield plant-1. The high estimate of genetic advance as percentage of mean were recorded for fruit yield plant-1, fruit yield plot-1, number of fruit plant-1, test weight, fruit yield ha-1, number of branches plant-1 at 90 DAT, fruit girth, number of branches plant-1 at 60 DAT, fruit length. The results were in consonance with **Ganigerand Yenjerappa (2001)** and **Ibrahim *et al.* (2001)** for number of branches, number of fruits plant-1 and length of fruit, **Smitha and Basavaraja (2006)** and **Diwakar *et al.* (2012)** for number of fruits plant-1, number of branches, plant and fruit yield plant-1, **Johari and Kumar (2007)** for fruit girth. High genetic advance revealed additive gene effects are important in determining these characters.

Whereas, low estimates of genetic advance as % of means were observed for number of leaves plant-1 at 90 DAT (15.71%), plant height at 60 DAT (16.80%), number of leaves plant-1 at 60 DAT (19.83%), number of leaves plant-1 at 30 DAT (20.86%), plant height at 90 DAT (27.85%), plant height at 30 DAT and number of branches at 30 DAT. The finding of **Datta and jana (2010)** for plant height, **Diwakar *et al.* (2012)** for number of branches are in agreement with the present findings.

**3.2. Correlation coefficient analysis**

Correlation coefficient was worked out at phenotypic, genotypic and environmental levels for all possible combination of twenty-five yield and its attributing characters (Table 3 and 4).

The results of phenotypic correlation coefficients have been discussed only as the genotypic and environmental correlation were mostly influenced by the environmental conditions, hence phenotypic correlation will give the correct idea about the association between two variables.

The magnitude of genotypic correlation was higher than the phenotypic correlation for all the traits that indicated inherent association between various characters. The findings were in agreement to **Dipendra and Gautam (2003).**

In the present findings significant positive phenotypic correlation of fruit yield plant-1, plant height, fresh weight of ten fruits, test weight, number of fruits plant-1, number of branches plant-1, number of seeds fruit-1, fruit girth and length of fruit, indicating that these characters are the primary yield determinant in Chilli. These findings corroborated the earlier findings of **Dipendra and Gautam (2003)** for plant height, number of fruits plant-1, fresh weight of ten fruits, length of fruit and test weight. **Ajjapplavara *et al.* (2005)** for width of fruit.

**3.3. Path coefficient analysis**

To measure the direct as well as indirect association of one variable through another on the end product, path coefficients were calculated at genotypic and phenotypic levels for all the yield attributing traits. The observed correlation coefficients of yield with its contributing traits were partitioned into direct and indirect effects. In the present investigation, important characters *viz.,* fruit yield plant-1 has been used as dependable variables with other traits. Since the values of genotypic path are more reliable in predicting the correct idea about the direct and indirect effects of the component traits, only this has been discussed as below.

The estimates of path coefficient were furnished in the Table 5. In general the genotypic direct as well as indirect effects were slightly higher in magnitude as compared to corresponding phenotypic direct and indirect effects. The results obtained from genotypic direct and indirect effects are presented as under.

In the presented study number of fruits plant-1, plant height at 90 DAT and number of leaves plant-1 at 90 DAT had high positive direct effect on fruit yield plant1 of these traits may rewarded in other words these traits showed given importance, while practicing selection aimed at improvement of yield in chilli. Similar results were observed by **Nandadevi and Hosamani (2003)** for number of fruits plant-1.

However, number of branches plant-1 at 90 DAT, test weight, fruit girth and fruit length had high negative effect on fruit yield plant1. The results corroborated the findings of **Patel *et al.* (2009)** for number of branches plant-1, fruit length, **Pandit and Ahikary (2014)** for test weight, **Datta and Jana (2010)** for number of branches plant-1, fruit girth.

Rest of the traits viz., number of branches plant-1 did not exhibit, higher direct effect on fruit yield, they expressed higher indirect effect on it through fruit length, plant height and fruit width and hence, simultaneous selection for these characters can be made for further improvement of yield.

Path coefficient analysis revealed that number of fruits plant-1, plant height, number of branches plant-1, number of leaves plant-1, fruit girth, fruit length, fresh weight of ten fruits, number of seeds fruit-1 and test weight were the most important characters contributing towards fruit yield plant-1 and hence purposeful and balanced selection based on these characters would be made rewarding for improvement of chilli.

**4. Conclusion**

In correlation study on fruit yield per plant was positive and significantly correlated with plant height, number of leaves plant-1, fruit girth, fruit length, fresh number of fruits plant-1, weight of ten fruits, number of seeds fruit-1 and test weight. In path coefficient analysis the number of fruits plant-1, plant height at 90 DAT and number of leaves plant-1 at 90 DAT had high positive direct effect on fruit yield plant1 of these traits may rewarded in other words these traits showed given importance, while practicing selection aimed at improvement of yield in chilli.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characters** |  | **Grand Mean** | **Range** | | **Coefficient of variations** | | **Heritability % (BS)** | **Genetic Advance** | **GA as % of mean** |
| **Min.** | **Max.** | **Phenotypic** | **Genotypic** |
| Plant height (cm) | 30 DAT | 26.94 | 16.27 | 32.24 | 17.88 | 16.30 | 83.12 | 8.25 | 30.61 |
| 60 DAT | 37.49 | 29.08 | 43.21 | 12.66 | 10.16 | 64.45 | 6.30 | 16.80 |
| 90 DAT | 51.22 | 38.35 | 61.44 | 14.87 | 14.18 | 90.95 | 14.27 | 27.85 |
| No. of branches / plant | 30 DAT | 5.17 | 3.23 | 7.06 | 28.24 | 22.99 | 66.30 | 1.99 | 38.59 |
| 60 DAT | 10.82 | 6.90 | 14.76 | 24.66 | 22.51 | 83.34 | 4.58 | 42.33 |
| 90 DAT | 19.62 | 11.46 | 26.07 | 24.73 | 23.72 | 92.02 | 9.20 | 46.88 |
| No. of leaves per plant at | 30 DAT | 31.51 | 23.57 | 36.81 | 12.21 | 11.12 | 82.89 | 6.57 | 20.86 |
| 60 DAT | 52.70 | 42.59 | 62.94 | 10.99 | 10.29 | 87.57 | 10.45 | 19.83 |
| 90 DAT | 73.40 | 62.42 | 82.71 | 8.81 | 8.20 | 86.53 | 11.53 | 15.71 |
| Number of fruits/plant | | 45.33 | 26.23 | 62.93 | 30.47 | 29.90 | 96.30 | 27.40 | 60.45 |
| Fruit length (cm) | | 8.53 | 5.27 | 11.47 | 22.56 | 19.10 | 71.65 | 2.84 | 33.31 |
| Fruit girth (cm) | | 1.29 | 1.04 | 2.02 | 22.11 | 21.41 | 93.71 | 0.55 | 42.75 |
| Fresh weight of ten fruit (g) | | 36.90 | 24.64 | 53.55 | 26.01 | 25.30 | 94.63 | 18.71 | 50.70 |
| Number of seeds /fruit | | 52.76 | 31.07 | 91.34 | 40.13 | 39.80 | 98.37 | 42.90 | 81.31 |
| Test weight (g) | | 6.38 | 4.70 | 9.24 | 27.84 | 26.46 | 90.32 | 3.30 | 51.79 |
| Fruit yield /plant (kg) | | 0.413 | 0.129 | 0.786 | 0.634 | 0.634 | 0.999 | 0.539 | 0.131 |
| Fruit yield /plot (kg) | | 24.8 | 7.7 | 47.2 | 63.63 | 63.30 | 98.98 | 32.13 | 129.57 |
| Fruit yield /ha (t) | | 15.34 | 4.78 | 29.10 | 63.62 | 63.30 | 98.98 | 19.83 | 48.01 |

**Table 1: Genetic parameters in chilli.**

**Table 2: Genetic parameters in physiological parameters of chilli**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characters** |  | **Grand Mean** | **Range** | | **Coefficient of variations** | | **Heritability % (BS)** | **Genetic Advance** | **GA as % of mean** |
| **Min.** | **Max.** | **Phenotypic** | **Genotypic** |
| Leaf area (cm2) at | 30 DAT | 123.10 | 73.68 | 157.23 | 23.54 | 22.27 | 89.56 | 53.45 | 43.42 |
| 60 DAT | 315.16 | 205.34 | 431.10 | 24.91 | 22.23 | 79.61 | 128.76 | 40.86 |
| 90 DAT | 517.54 | 370.08 | 685.26 | 20.49 | 19.16 | 87.46 | 191.06 | 36.92 |
| Leaf area index at | 30 DAT | 0.045 | 0.027 | 0.058 | 23.83 | 22.56 | 89.65 | 0.02 | 41.04 |
| 60 DAT | 0.121 | 0.086 | 0.159 | 20.42 | 17.05 | 69.79 | 0.04 | 29.10 |
| 90 DAT | 0.193 | 0.145 | 0.253 | 19.06 | 17.71 | 86.40 | 0.07 | 34.50 |
| Dry weight per plant (g) at | 30 DAT | 4.22 | 2.94 | 5.96 | 30.57 | 18.94 | 38.37 | 1.02 | 24.16 |
| 60 DAT | 6.99 | 4.98 | 9.39 | 25.32 | 17.38 | 47.09 | 1.72 | 24.56 |
| 90 DAT | 12.93 | 9.84 | 16.77 | 19.71 | 15.79 | 64.18 | 3.37 | 26.05 |
| Relative Growth Rate (mg/g/day) at | 60 DAT | 7.50 | 4.74 | 8.40 | 15.95 | 13.29 | 69.38 | 1.71 | 22.81 |
| 90 DAT | 9.08 | 8.30 | 9.91 | 7.25 | 5.36 | 54.66 | 0.74 | 8.16 |
| Crop Growth Rate (mg/m2/day) at | 60 DAT | 0.341 | 0.251 | 0.482 | 22.26 | 21.48 | 93.08 | 0.15 | 42.83 |
| 90 DAT | 0.734 | 0.600 | 0.852 | 15.09 | 10.05 | 44.34 | 0.10 | 13.80 |
| Bio-Mass Duration (BMD) at | 60 DAT | 168.32 | 118.80 | 222.85 | 26.59 | 17.61 | 43.84 | 40.42 | 24.01 |
| 90 DAT | 284.39 | 160.08 | 357.90 | 27.95 | 17.47 | 39.08 | 63.98 | 22.50 |

**Table 3: Estimates of genotypic and phenotypic correlation coefficients among fruit yield and its attributing traits in chilli**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Characters |  | Plant height (cm) | No. of branches / plant | No. of leaves per plant | Number of fruits /plant | Fruit length (cm) | Fruit girth (cm) | Fresh weight of ten fruit (g) | Number of seeds /fruit | Test weight (g) | Fruit yield /plant (g) |
| Plant height (cm) | **G** | 1 | 0.646 | 0.989 | 0.673 | 0.576 | 0.591 | 0.925 | 0.557 | 0.714 | 0.902 |
| **P** | 1 | 0.613\*\* | 0.862\*\* | 0.623\*\* | 0.492\*\* | 0.534\*\* | 0.846\*\* | 0.534\*\* | 0.644\*\* | 0.859\*\* |
| No. of branches / plant | **G** |  | 1 | 0.803 | 0.934 | -0.033 | 0.538 | 0.441 | 0.103 | 0.411 | 0.591 |
| **P** |  | 1 | 0.750\*\* | 0.871\*\* | -0.046 | 0.533\*\* | 0.427\* | 0.097 | 0.343 | 0.566\*\* |
| No. of leaves per plant | **G** |  |  | 1 | 0.852 | 0.436 | 0.506 | 0.824 | 0.474 | 0.712 | 0.937 |
| **P** |  |  | 1 | 0.785\*\* | 0.331 | 0.500\*\* | 0.763\*\* | 0.418\* | 0.598\*\* | 0.870\*\* |
| Number of fruits/plant | **G** |  |  |  | 1 | -0.011 | 0.402 | 0.486 | 0.189 | 0.496 | 0.737 |
| **P** |  |  |  | 1 | 0.004 | 0.385\* | 0.467\*\* | 0.184 | 0.444\* | 0.720\*\* |
| Fruit length (cm) | **G** |  |  |  |  | 1 | 0.082 | 0.645 | 0.572 | 0.352 | 0.542 |
| **P** |  |  |  |  | 1 | 0.038 | 0.523\*\* | 0.468\*\* | 0.205 | 0.463\*\* |
| Fruit diameter (cm) | **G** |  |  |  |  |  | 1 | 0.679 | 0.075 | 0.540 | 0.505 |
| **P** |  |  |  |  |  | 1 | 0.669\*\* | 0.061 | 0.493\*\* | 0.486\*\* |
| Fresh weight of ten fruits (g) | **G** |  |  |  |  |  |  | 1 | 0.464 | 0.877 | 0.898 |
| **P** |  |  |  |  |  |  | 1 | 0.441\* | 0.803\*\* | 0.870\*\* |
| Number of seeds /fruit | **G** |  |  |  |  |  |  |  | 1 | 0.122 | 0.383 |
| **P** |  |  |  |  |  |  |  | 1 | 0.126 | 0.379\* |
| Test weight (g) | **G** |  |  |  |  |  |  |  |  | 1 | 0.801 |
| **P** |  |  |  |  |  |  |  |  | 1 | 0.759\*\* |
| Fruit yield /plant (g) | **G** |  |  |  |  |  |  |  |  |  | 1 |
| **P** |  |  |  |  |  |  |  |  |  | 1 |

Significant at 5% level = \* Significant at 1% level = \*\*

**Table 4: Estimates of genotypic and phenotypic correlation coefficients among fruit yield and physiological traits in chilli**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characters** | Leaf area (cm2) at60 DAT | Leaf area (cm2) at90 DAT | LAI at 30 DAT | LAI at 60 DAT | LAI at 90 DAT | Dry weight / plant (g) at30 DAT | Dry weight / plant (g) at60 DAT | Dry weight / plant (g) at90 DAT | RGR at60 DAT | RGR at90 DAT | CGR at60 DAT | CGR at90 DAT | BMD at60 DAT | BMD at90 DAT | Fruit yield /plant (g) |
| Leaf area (cm2) at 30 DAT | 0.811\*\* | 0.781\*\* | 0.999\*\* | 0.699\*\* | 0.781\*\* | 0.546\*\* | 0.587\*\* | 0.634\*\* | -0.266 | -0.625\*\* | 0.606\*\* | 0.567\*\* | 0.555\*\* | 0.543\*\* | 0.774\*\* |
| Leaf area (cm2) at60 DAT |  | 0.896\*\* | 0.810\*\* | 0.886\*\* | 0.876\*\* | 0.529\*\* | 0.628\*\* | 0.681\*\* | -0.157 | -0.547\*\* | 0.692\*\* | 0.553\*\* | 0.580\*\* | 0.615\*\* | 0.813\*\* |
| Leaf area (cm2) at90 DAT |  | 1 | 0.775\*\* | 0.773\*\* | 0.985\*\* | 0.618\*\* | 0.727\*\* | 0.783\*\* | -0.119 | -0.652\*\* | 0.730\*\* | 0.701\*\* | 0.683\*\* | 0.734\*\* | 0.849\*\* |
| LAI at 30 DAT |  |  | 1 | 0.698\*\* | 0.776\*\* | 0.548\*\* | 0.587\*\* | 0.633\*\* | -0.273 | -0.632\*\* | 0.601\*\* | 0.566\*\* | 0.554\*\* | 0.545\*\* | 0.775\*\* |
| LAI at60 DAT |  |  |  | 1 | 0.811\*\* | 0.437\* | 0.543\*\* | 0.595\*\* | -0.044 | -0.488\*\* | 0.674\*\* | 0.459\* | 0.481\*\* | 0.423\* | 0.732\*\* |
| LAI at90 DAT |  |  |  |  | 1 | 0.615\*\* | 0.748\*\* | 0.800\*\* | -0.109 | -0.687\*\* | 0.757\*\* | 0.718\*\* | 0.692\*\* | 0.688\*\* | 0.849\*\* |
| Dry weight /plant (g) at30 DAT |  |  |  |  |  | 1 | 0.767\*\* | 0.783\*\* | -0.574\*\* | -0.790\*\* | 0.327 | 0.619\*\* | 0.820\*\* | 0.649\*\* | 0.708\*\* |
| Dry weight /plant (g) at60 DAT |  |  |  |  |  |  | 1 | 0.962\*\* | -0.292 | -0.823\*\* | 0.614\*\* | 0.546\*\* | 0.973\*\* | 0.727\*\* | 0.777\*\* |
| Dry weight /plant (g) at90 DAT |  |  |  |  |  |  |  | 1 | -0.259 | -0.820\*\* | 0.702\*\* | 0.668\*\* | 0.953\*\* | 0.733\*\* | 0.842\*\* |
| RGR at60 DAT |  |  |  |  |  |  |  |  | 1 | 0.419\* | 0.324 | -0.071 | -0.403\* | -0.212 | -0.284 |
| RGR at90 DAT |  |  |  |  |  |  |  |  |  | 1 | -0.456\* | -0.605\*\* | -0.811\*\* | -0.693\*\* | -0.754\*\* |
| **CGR** at60 DAT |  |  |  |  |  |  |  |  |  |  | 1 | 0.664\*\* | 0.530\*\* | 0.445\* | 0.730\*\* |
| **CGR** at90 DAT |  |  |  |  |  |  |  |  |  |  |  | 1 | 0.531\*\* | 0.554\*\* | 0.716\*\* |
| BMD at60 DAT |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 0.741\*\* | 0.758\*\* |
| BMD at90 DAT |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 0.676\*\* |

Significant at 5% level = \* Significant at 1% level = \*\*

**Table 5: Genotypic and phenotypic path coefficients showing direct and indirect effects of different characters on fruit yield per plant (g) in chilli**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characters** |  | Plant height (cm) | No. of branches / plant | No. of leaves per plant | Number of fruits /plant | Fruit length (cm) | Fruit girth (cm) | Fresh weight of ten fruit (g) | Number of seeds /fruit | Test weight (g) | Fruit yield /plant (g) |
| Plant height (cm) | G | **0.5940** | -0.5689 | -0.6195 | 1.0196 | 0.0811 | -0.0826 | 0.9892 | -0.2009 | -0.3099 | 0.902 |
| P | **0.1601** | -0.2089 | 0.2080 | 0.3392 | 0.0620 | -0.0227 | 0.3013 | -0.0546 | 0.0750 | 0.859\*\* |
| No. of branches / plant | G | 0.3837 | **-0.8807** | -0.5028 | 1.4152 | -0.0046 | -0.0752 | 0.4713 | -0.0372 | -0.1783 | 0.591 |
| P | 0.0981 | **-0.3406** | 0.1808 | 0.4741 | -0.0058 | -0.0226 | 0.1521 | -0.0099 | 0.0399 | 0.566\*\* |
| No. of leaves per plant | G | 0.5876 | -0.7072 | **-0.6262** | 1.2905 | 0.0615 | -0.0707 | 0.8812 | -0.1709 | -0.3090 | 0.937 |
| P | 0.1380 | -0.2555 | **0.2412** | 0.4274 | 0.0417 | -0.0212 | 0.2717 | -0.0427 | 0.0696 | 0.870\*\* |
| Number of fruits /plant | G | 0.3998 | -0.8228 | -0.5335 | **1.5148** | -0.0015 | -0.0562 | 0.5198 | -0.0681 | -0.2156 | 0.737 |
| P | 0.0997 | -0.2967 | 0.1893 | **0.5443** | 0.0005 | -0.0164 | 0.1664 | -0.0188 | 0.0518 | 0.720\*\* |
| Fruit length (cm) | G | 0.3420 | 0.0289 | -0.2733 | -0.0161 | **0.1409** | -0.0115 | 0.6902 | -0.2063 | -0.1527 | 0.542 |
| P | 0.0788 | 0.0157 | 0.0798 | 0.0022 | **0.1259** | -0.0016 | 0.1864 | -0.0478 | 0.0239 | 0.463\*\* |
| Fruit girth (cm) | G | 0.3510 | -0.4738 | -0.3169 | 0.6089 | 0.0116 | **-0.1398** | 0.7261 | -0.0272 | -0.2346 | 0.505 |
| P | 0.0855 | -0.1815 | 0.1206 | 0.2096 | 0.0048 | **-0.0425** | 0.2382 | -0.0062 | 0.0575 | 0.486\*\* |
| Fresh weight of ten fruit (g) | G | 0.5495 | -0.3884 | -0.5160 | 0.7362 | 0.0909 | -0.0949 | **1.0693** | -0.1674 | -0.3809 | 0.898 |
| P | 0.1355 | -0.1454 | 0.1840 | 0.2542 | 0.0658 | -0.0284 | **0.3560** | -0.0450 | 0.0936 | 0.870\*\* |
| Number of seeds /fruit | G | 0.3309 | -0.0907 | -0.2968 | 0.2863 | 0.0806 | -0.0105 | 0.4962 | **-0.3606** | -0.0528 | 0.383 |
| P | 0.0855 | -0.0330 | 0.1008 | 0.1002 | 0.0589 | -0.0026 | 0.1570 | **-0.1022** | 0.0147 | 0.379\* |
| Test weight (g) | G | 0.4239 | -0.3620 | -0.4459 | 0.7513 | 0.0496 | -0.0755 | 0.9378 | -0.0440 | **-0.4343** | 0.801 |
| P | 0.1030 | -0.1168 | 0.1370 | 0.2417 | 0.0258 | -0.0210 | 0.2859 | -0.0129 | **0.1165** | 0.759\*\* |

Residual effect Genotypic = 0.1577 Residual effect Phenotypic = 0.2368