RESEARCH ARTICLE Legume Research- An International Journal, Volume 48 Issue 6: 938-943 (June 2025)

# Variability, Correlation and Path Coefficient Analysis in Fenugreek (*Trigonella foenum-graecum*) Genotypes

M. Mohanalakshmi[1], M. Prabhu[1], V. Jegadeeswari[2], K.R. Vijayalatha[3], A. Nithya Devi[4], K. Venkatesan[1], T. Umamaheswari[3]

10.18805/LR-5427

## ABSTRACT

**Background:** Fenugreek (*Trigonella foenum-graecum*) is an important leguminous seed spice and belongs to the family Fabaceae.Both seed and leaves of fenugreek are widely used as a cooking spice to enhance the taste of many meat, poultry and vegetable dishes. Utilization of variability is essential for selection of best genotypes. With this background, present experiment was conducted to estimate genetic variability, correlation and path coefficients for yield and other yield attributing traits to select the promising genotypes for high yield in fenugreek.

**Methods:** The experiment on assessment of variability, correlation and path coefficient in Fenugreek genotypes for growth and yield attributes was carried out at the College Orchard, Tamil Nadu Agricultural University, Coimbatore. Sixteen fenugreek genotypes, sourced from various locations, were sown in a randomized block design with two replications during winter season of 2021-22 and 2022-23. Observations on growth and yield parameters were recorded and analysed for variance, variability, correlation and path coefficients.

**Result:** Cultivar TFG.12 recorded significantly highest values plant height (48.76 cm), number of grains per pod (11.25), 1000-grain weight (11.18 g), grain yield per plant (6.39 g) and estimated yield per hectare (440 kg) with least number of days taken to flowering (34.50 days). In this study, analysis of variance revealed the presence of considerable amount of variability. Moderate to high genotypic and phenotypic coefficient of variation was observed for characters like grain yield per plant and length of pods, number of grains per pod. High heritability coupled with genetic advance as per cent of mean were observed for characters like number of productive branches, number of pods per plant, length of pod, number of grains per pod and grain yield per plant. The genotypic and phenotypic correlation studies revealed the grain yield recorded significant and positive correlation with 1000-grain weight and number of grains per pod number of branches per plant, number of grains per pod and 1000 grain weight exerted the highest positive direct effect on grain yield per plant.

**Key words:** Correlation, Fenugreek, Genetic advance, Heritability, Path analysis, Variability, Yield.

## INTRODUCTION

Fenugreek (*Trigonella foenum-graecum*) is an important leguminous seed spice crop. Fenugreek is an annual plant valued for its significant medicinal properties (Gupta *et al*., 2013). The cultivated fenugreek or common methi originated in the Mediterranean region and spread to various parts of the world, from Greece to Russia, China and India. Two cultivated species of genus *viz.Trigonella foenum-graecum* (commonly known as fenugreek) and *Trigonella corniculata* (commonly known as pan methi or methi) are commercially cultivated seed spices in tropical as well as temperate regions of India (Meena *et al.,* 2021). The tender leaves and stem are consumed as curried vegetable and also as a fodder crop before flowering. The leaves contain seven kinds of saponins, which are known as graecunins. These compounds are glycosides of diosgenin. Leaves contain 86.1% moisture, 4.4% protein, 0.9% fat,1.5% minerals (calcium, iron, phosphorous), 1.1% fibre and 6% carbohydrates and traces of vitamins *viz*.,carotene, thiamine, riboflavin, niacin and vitamin C (Brar *et al.,* 2013). Both grains and leaves of fenugreek are widely used as a culinary spice to enhance the taste of many meat, poultry and vegetable dishes (Thomas *et al.,* 2011). The fresh or dried leaves are used to flavour dishes in many parts of India. In Egypt and Asia sprouts of fenugreek and young leaves are eaten as green vegetables. Fenugreek grain is a natural source of galactomannan gum. This property of fenugreek grain has provided the food industry with an opportunity to use grain extracts as thickening agent in foods or as food emulsifier (Dhull *et al.,* 2023). The area and production of fenugreek in India during

[1]Horticultural College and Research Insttitute, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India.
[2]Grapes Research Station, Tamil Nadu Agricultural University, Theni -625 526, Tamil Nadu, India.
[3]Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University, Trichy-620 027, Tamil Nadu, India.
[4]MS Swaminathan Agricultural College and Research Insttitute, Thanjavur-614 902, Tamil Nadu, India.

**Corresponding Author:** M. Prabhu, Horticultural College and Research Insttitute, Tamil Nadu Agricultural University, Coimbatore-641 003, Tamil Nadu, India. Email: muthusamyprabhu@gmail.com

**How to cite this article:** Mohanalakshmi, M., Prabhu, M., Jegadeeswari, V., Vijayalatha, K.R., Devi, A.N., Venkatesan, K. and Umamaheswari, T. (2025). Variability, Correlation and Path Coefficient Analysis in Fenugreek (*Trigonella foenum-graecum*) Genotypes. Legume Research. 48(6): 938-943. doi: 10.18805/LR-5427.

**Submitted:** 19-09-2024 **Accepted:** 09-02-2025 **Online:** 13-05-2025

2023-24 was 1,45,366 ha and 2,28,649 t respectively. Productivity of fenugreek is low in India. The productivity of crop mainly depends on yield and yield contributing characters.

High heritability and high genetic advance are important for the improvement of any character Kumar *et al.* (2020). Heritability estimates in broad sense when used in conjunction with the genetic advance would give better information than the heritability alone. This study helps to identify the superior genotypes and further utilization of these genotypes in breeding programme. The yield is determined by number of characters and consequently help to select suitable genotype. Study by Gurjar *et al*. (2016) revealed that fenugreek yield improvement is achievable through selection for traits including dry weight at flowering, protein content, biological yield, seeds per pod and 1000-seed weight, which showed high variability, heritability and positive correlation with seed yield. According to a study by Shekawat *et al*. (2023) the significant genotypic and phenotypic coefficient of variation, along with high heritability and substantial genetic gain in traits such as the number of branches per plant, number of pods per plant, test weight and seed yield per plant, indicate that these characteristics can be valuable selection criteria for identifying superior parental lines in fenugreek breeding programs.

The level of association among the growth and yield attributes can be determined by correlation analysis The crop yield is always relies on the action and interaction of important growth and yield characters (Tiwari *et al*., 2024). Identification of high yielding adaptable varieties and proper plant geometry are the first and prime cultural operation to augment productivity of fenugreek (Sharanya *et al*., 2018). Genotypic correlation coefficients give a measure of genetic association between characters to identify the important characters (Gerring *et al.,* 2022). Phenotypic correlations do not always indicate genetic causation but may in fact be due to the underlying population structure (Li *et al.,* 2021). With this background, studies on variability, correlation and path coefficient studies in Fenugreek genotypes was carried out to screen the superior genotypes for further improvement.

## MATERIALS AND METHODS

The present experiment was conducted at College Orchard of Tamil Nadu Agricultural University, Coimbatore during winter season of 2021-22 and 2022-23. The experiment was conducted in randomized block design and replictaed thrice. The treatments consisted of 16 cultivars of fenugreek collected from different sources. The crop was sown on raised beds at spacing of 20 cm × 15 cm using seed rate of 40 g/bed. Data from five plants of each genotype were averaged replication wise and mean data was used for statistical analysis. Observations on growth parameters *viz*., plant height, number of branches per plant, number of productive branches per plant, days taken to first flowering and days taken to 50 per cent flowering were recorded. The yield attributes *viz*., number of pods per plant, pod length, number of grains per pod, one thousand grain weight and grain yield per plant were recorded. Analysis of variance was carried out by the procedure recommended by Panse and Sukhatme (1967).

Pooled analysis was carried out by combining two winter seasons data for all the 11 characters studied. Mean, genotypic coefficients of variation (GCV) and

**Table 1:** Mean performance of fenugreek genotypes on growth characters.

| Genotypes | Plant height (cm) | Number of branches per plant | Number of productive branches per plant | Days taken for first flowering | Days taken for 50% flowering |
|---|---|---|---|---|---|
| TFG.1 | 36.13 | 3.06 | 5.08 | 40.00 | 31.46 |
| TFG.2 | 39.44 | 2.45 | 4.59 | 37.50 | 32.90 |
| TFG.3 | 35.51 | 1.75 | 4.56 | 40.00 | 32.44 |
| TFG.4 | 40.01 | 2.45 | 5.05 | 41.50 | 32.95 |
| TFG.5 | 43.13 | 3.10 | 4.60 | 38.00 | 31.20 |
| TFG.6 | 41.29 | 3.43 | 4.44 | 36.50 | 32.62 |
| TFG.7 | 33.55 | 3.13 | 3.36 | 38.50 | 31.49 |
| TFG.8 | 31.21 | 2.71 | 3.72 | 36.50 | 30.99 |
| TFG.9 | 38.69 | 3.44 | 4.33 | 34.50 | 33.07 |
| TFG.10 | 46.78 | 2.77 | 3.99 | 38.50 | 34.36 |
| TFG.11 | 48.45 | 3.11 | 3.81 | 36.50 | 32.80 |
| TFG.12 | 48.76 | 3.44 | 3.92 | 34.50 | 31.98 |
| TFG.13 | 39.42 | 3.08 | 3.36 | 35.00 | 30.59 |
| TFG.14 | 36.44 | 2.07 | 4.44 | 38.50 | 31.89 |
| Hisar Sonali | 39.29 | 2.47 | 4.55 | 35.50 | 31.26 |
| CO.2 | 40.30 | 3.11 | 5.88 | 35.50 | 31.81 |
| Grand mean | 39.90 | 2.85 | 4.35 | 32.62 | 31.11 |
| SE (d) | 0.35 | 0.03 | 0.45 | 0.83 | 0.38 |
| CD (5%) | 0.69 | 0.07 | 0.91 | 1.68 | 0.76 |

phenotypic coefficients of variation (PCV) were calculated by following Burton (1952); heritability in broad sense ($h^2bs$) was calculated by following Burton and De Vane (1953) genetic advance (GA) and genetic advance as per cent of mean were estimated by following Johnson *et al*. (1955); correlation coefficient analysis was carried out by following Al Jibouri *et al*. (1958) path coefficient analysis was carried out by following Dewey and Lu (1959); Lenka and Misra (1973). To quantify the degree of character associated with yield and yield attributes correlation coefficient was generated. Path coefficient is a standardized partial regression coefficient and as such measures the direct influence of one trait upon another and permits the separation of correlation coefficient into component of direct and indirect effect. Pooled season data was used for statistical analysis.

## RESULTS AND DISCUSSION

### *Per se* performance of genotypes

A persual of data presented in Table 1 and Table 2 revealed that all sixteen fenugreek genotypes resulted in significant differences in various growth and yield parameters (Table 1 and Table 2). Cultivar TFG.12 recorded significant results for growth parameters *viz.,* plant height (48.76 cm), number of branches per plant (3.44) and less number of days taken for first flowering (34.50) and 50% flowering (31.98). TGF.12 recorded highest grain yield per plant (6.39 g) while genotype TFG.10 recorded significantly lowest (0.90 g) grain yield/ plant. Similarly, the number of grains per pod ranged from 8.66 (TFG.10) to 11.25 (TFG.12). These results align with findings of Meena *et al*. (2021). Similar findings were observed in a study by Yaldiz and Camlica (2021) where PI

**Table 2:** Mean performance of fenugreek genotypes for yield characters.

| Genotypes | Length of pod (cm) | Number of pods per plant | Number of grains per pod | Weight of 1000 grains (g) | Grain yield per plant | Estimated grain yield (t/ha) |
|---|---|---|---|---|---|---|
| TFG.1 | 9.17 | 23.68 | 11.18 | 9.33 | 1.11 | 0.33 |
| TFG.2 | 9.72 | 24.14 | 9.63 | 9.26 | 2.00 | 0.30 |
| TFG.3 | 9.49 | 23.92 | 10.27 | 10.27 | 2.63 | 0.35 |
| TFG.4 | 8.76 | 29.31 | 9.27 | 9.27 | 2.03 | 0.33 |
| TFG.5 | 8.99 | 38.55 | 9.16 | 9.16 | 3.01 | 0.35 |
| TFG.6 | 9.23 | 31.76 | 9.40 | 9.40 | 1.99 | 0.38 |
| TFG.7 | 10.66 | 22.28 | 8.90 | 8.90 | 2.44 | 0.37 |
| TFG.8 | 8.71 | 27.65 | 9.67 | 9.67 | 3.38 | 0.39 |
| TFG.9 | 8.56 | 23.40 | 9.14 | 9.14 | 2.35 | 0.32 |
| TFG.10 | 8.93 | 28.32 | 8.77 | 8.77 | 0.90 | 0.38 |
| TFG.11 | 8.48 | 26.67 | 8.66 | 8.66 | 2.07 | 0.42 |
| TFG.12 | 9.66 | 31.92 | 11.25 | 11.18 | 6.39 | 0.44 |
| TFG.13 | 9.25 | 30.17 | 9.78 | 9.78 | 2.15 | 0.36 |
| TFG.14 | 9.16 | 28.46 | 10.21 | 10.21 | 2.30 | 0.38 |
| Hisar Sonali | 8.91 | 22.52 | 10.45 | 10.45 | 3.55 | 0,44 |
| CO.2 | 11.05 | 20.64 | 9.00 | 9.00 | 3.17 | 0.43 |
| Grand mean | 9.30 | 27.08 | 9.67 | 9.52 | 2.59 | 0.33 |
| SE (d) | 0.18 | 1.81 | 0.23 | 0.23 | 0.05 | 0.004 |
| CD (5%) | 0.35 | 3.64 | 0.46 | 0.46 | 0.11 | 0.008 |

**Table 3:** Genotypic and phenotypic coefficient of variation, heritability and genetic advance as per cent of mean for fenugreek genotypes.

| Characters | GV | PV | GCV | PCV | Heritability | GA as % of mean |
|---|---|---|---|---|---|---|
| Plant height | 17.17 | 28.54 | 10.77 | 13.89 | 60.16 | 17.22 |
| Number of branches | 0.76 | 1.48 | 12.10 | 16.87 | 51.45 | 17.88 |
| Number of productive branches | 2.90 | 4.11 | 43.86 | 52.19 | 70.63 | 75.95 |
| Days to first flowering | 2.51 | 5.74 | 4.14 | 6.26 | 43.70 | 5.64 |
| Days to 50% flowering | 2.94 | 4.33 | 5.21 | 6.32 | 68.00 | 8.85 |
| Number of pods per plant | 17.62 | 24.76 | 15.66 | 18.56 | 71.17 | 27.22 |
| Length of the pod | 4.17 | 4.90 | 22.12 | 23.97 | 85.12 | 42.04 |
| Number of grains per pod | 3.79 | 6.54 | 16.27 | 21.37 | 57.99 | 25.53 |
| Thousand grain weight | 0.33 | 0.33 | 6.52 | 6.58 | 98.34 | 13.34 |
| Grain yield per plant | 1.47 | 1.44 | 50.93 | 51.10 | 99.33 | 88.28 |

**Table 4:** Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficient of variation between different characters of fenugreek genotypes.

| Characters | Plant height | Number of branches | Number of productive branches | Days to first flowering | Days to 50% flowering | Number of pods per plant | Length of the pod | Number of grains per pod | Thousand grain weight | Grain yield per plant |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant height | 1 | -0.798** | 0.136 | -0.517* | 0.583* | 0.089 | 0.448* | 0.44 | 0.313 | 0.093 |
| Number of branches | -0.294 | 1 | -0.011 | 1.084** | -0.857** | -0.162 | -0.717** | -0.6 | -0.354 | -0.268 |
| Number of productive branches | -0.354 | 0.742** | 1 | -0.409 | 0.159 | -0.241 | 0.011 | -0.715** | -0.151 | -0.262 |
| Days to first flowering | -0.333 | 0.441 | 0.385 | 1 | 0.481* | 0.122 | -0.621** | -0.452** | -0.34 | -0.308 |
| Days to 50% flowering | 0.54 | -0.559* | -0.835** | -0.306 | 1 | 0.206 | 0.925** | 0.685** | 0.057 | 0.197 |
| Number of pods per plant | 0.072 | -0.221 | 0.049 | 0.097 | 0.077 | 1 | -0.19 | -0.044 | 0.091 | 0.168 |
| Length of the pod | 0.322 | -0.544 | -0.821** | -0.352 | 0.814** | -0.168 | 1 | 0.762** | 0.132 | 0.313 |
| Number of grains per pod | 0.44 | -0.6** | -0.715** | -0.452** | 0.685** | -0.044 | 0.762** | 1 | 0.319 | 0.403** |
| Thousand grain weight | 0.313 | -0.354 | -0.151 | -0.34 | 0.057 | 0.091 | 0.132 | 0.319 | 1 | 0.605** |
| Grain yield per plant | 0.093 | -0.268 | -0.262 | -0.308 | 0.197 | 0.168 | 0.313 | 0.403 | 0.605** | 1 |

*significance at 5% level; **significance at 1% level.

568215 as a potential genotype for high seed yield and PI 577712 for superior protein content.

**Variability parameters**

A wide range of variability was found among cultivars of fenugreek, with PCV is higher than GCV for all characters, showing environmental interaction. The narrow gap between PCV and GCV indicates low environmental influence. Moderate to high GCV was observed in characters like grain yield per plant, length of pods, number of grains per pod followed by number of pods, number of branches and plant height. Similar findings were reported by Tiwari *et al.* (2024) and Krishnaveni *et al.* (2021). Low level of GCV was recorded for days taken to first flowering followed by days taken to 50 per cent flowering and 1000 grain weight. The present findings are in agreement with Krishnaveni *et al*. (2021); Meena *et al.* (2021) in fenugreek. High PCV recorded with grain yield per plant followed by length of pod, number of branches and number of grains per pod. Moderate PCV was recorded with characters *viz*.,number of pods per plant followed by number of productive branches per plant and plant height. Low PCV was recorded by the days taken to first flowering followed by days taken to 50 per cent flowering and 1000-grain weight. These reports are in agreement with the findings of Mori *et al.* (2016); Mori *et al*. (2015); Verma *et al.* (2016); Verma *et al*. (2015) and Krishnaveni *et al*. (2021) in fenugreek.

**Heritability and genetic advance**

High levels of heritability values for number of productive branches per plant, number of pods per plant, length of pod and grain yield per plant along with high genetic gain (Table 3) indicate additive gene effects. These findings are in agreement with Meena *et al.* (2021); Singh *et al.* (2012) for number of pods per plant, grain yield per plant and number of pods per plant. The trait 1000-grain weight recorded high heritability with moderately low genetic gain revealing both additive and non-additive genetic effects and depicting suitability for the selection in breeding programme. This is in conformity with the results of Prakash *et al.* (2020). Moderate heritability values recorded for days taken to first flowering coupled with low genetic advance as per cent of mean. These results indicated that this trait was controlled by additive or non-additive gene action, which was present in the parental genotype (Anshul Mishra and Dave, 2021). Days taken to 50% flowering recorded high heritability with low GA. These results are in accordance with findings of Maurya *et al*. (2021) and Meena *et al*. (2021). Results from Singh *et al*. (2020) revealed significant genetic variability across fenugreek genotypes for most biometrical traits with high GCV and PCV values for yield components. Moderate to high heritability combined with substantial genetic advance was observed for economically important traits.

**Genotypic and phenotypic correlation coefficients with grain yield**

The genotypic and phenotypic correlation among the yield components in fenugreek were presented in Table 4. The genotypic and phenotypic correlation coefficient

**Table 5:** Estimation of path coefficient analysis.

| Variables | Plant height | Number of branches | Number of productive branches | Days to first flowering | Days to 50% flowering | Number of pods per plant | Length of the pod | Number of grains per pod | 1000-grain weight |
|---|---|---|---|---|---|---|---|---|---|
| Plant height | 0.0260 | -1.616 | 2.3406 | -0.1509 | -1.2333 | 0.0293 | -0.3217 | 0.6891 | 0.3497 |
| Number of branches | -0.0191 | 2.1972 | -4.2998 | 0.4174 | 1.9355 | -0.089 | 0.5514 | -0.7160 | -0.3773 |
| Number of productive branches | -0.0138 | 2.1429 | -4.4087 | 0.3176 | 2.1048 | -0.0280 | 0.6479 | -0.9397 | -0.1406 |
| Days to first flowering | -0.0100 | 2.3526 | -3.5921 | 0.3898 | 1.2408 | 0.03835 | 0.4106 | -0.8697 | -0.4136 |
| Days to 50% flowering | 0.0147 | -1.9485 | 4.2517 | -0.2216 | -2.1825 | 0.0180 | -0.7059 | 0.9553 | 0.0548 |
| Number of pods per plant | 0.0014 | -0.3707 | 0.2324 | 0.0281 | -0.0742 | 0.5315 | 0.0996 | -0.3156 | 0.0655 |
| Length of the pod | 0.0125 | -1.8194 | 4.2895 | -0.2403 | -2.3136 | -0.0795 | -0.6659 | 1.0383 | 0.1202 |
| Number of grains per pod | 0.0191 | -1.6747 | 4.4101 | -0.3609 | -2.2193 | -0.1786 | -0.7360 | 0.9394 | 0.3390 |
| Thousand grain weight | -0.0106 | -0.9722 | 0.7270 | -0.1891 | -0.1402 | 0.0408 | -0.0938 | 0.3735 | 0.8527 |

Residual effect: 0.5153.

estimates were significant and positive with 1000-grain weight and number of grains per pod. Non-significant and positive correlation was recorded for plant height, days taken to 50% flowering, number of pods per plant and length of pod. Non-significant and negative correlation was recorded for number of branches per plant, number of productive branches per plant and days taken to first flowering. Similar findings were recorded by Arif *et al*. (2014) in coriander. The characters *viz.,*1000 grain weight, number of grains per pod and number of pods effect the grain yield per plant. The association among the component characters suggest the scope for simultaneous improvement of this traits with a balanced approach to effect the yield. These results align with the findings of Singh and Singh (2022), where the genotypic and phenotypic correlations were exhibited significantly positive for number of pods per plant (0.765, 0.725 and 0.670, 0.651), number of seeds per pod (0.705, 0.650 and 0.666, 0.640) and pod length (0.376, 0.348 and 0.351, 0.327) with seed yield per plant in both the normal and limited irrigation conditions.

### Path coefficient analysis

The estimate of residual effect reflects the adequacy and appropriateness of the characters chosen for path analysis (Table 5). The residual effect was 0.513 indicating the adequacy of characters chosen for the study. The results of the path coefficient analysis indicated the direct and indirect effects of nine contributing traits on grain yield. The traits *viz.,* number of branches per plant, number of grains per pod and thousand grain weight recorded highest positive direct effect. One thousand grain weight showed positive indirect effect on grain yield through plant height, number of productive branches per plant, number of pods per plant and number of grains per pod. Similar results were reported by Krishnaveni *et al*. (2021).

## CONCLUSION

Among the sixteen fenugreek cultivars evaluated, cultivar TFG.12 recorded highest plant height (48.76 cm), number of grains per pod (11.25), 1000-grain weight (11.18 g), grain yield per plant (6.39 g) and estimated yield per hectare (440 kg) with earliest flowering (34.50 days). High heritability coupled with substantial genetic advance was noted for productive branches, pods per plant, pod length, grains per pod and grain yield per plant. Grain yield has a positive correlation between 1000 grain weight and grains per pod, suggesting that these traits significantly contribute to yield improvement.

### Conflict of interest

The authors here by declare that there are no conflicts of interest.

## REFERENCES

Al Jibouri, H.A., Miller, P. and Robinson, H. (1958). Genotypic and environmental variances and covariances in an upland Cotton cross of interspecific origin. Agronomy Journal. 50(10): 633-636.

Anshul, M., Dodhiya, N.S., Dashora, A., Meena, B.S., Deora, N.S. and Dave, M. (2021). Assessment of genetic variability, heritability and genetic advance in fenugreek [*Trigonella foenum-graecum* L.]. The Pharma Innovation Journal. 10(9): 3.

Arif, M., Khurshid, H. and Khan, S. (2014). Genetic structure and green leaf performance evaluation of geographically diverse population of coriander (*Coriandrum sativum* L.). European Acedemic Research. 2(3): 3269-3285.

Brar, J.K., Rai, D.R., Singh, A. and Kaur, N. (2013). Biochemical and physiological changes in Fenugreek (*Trigonella foenum-graecum* L.) leaves during storage under modified atmosphere packaging. Journal of Food Science and Technology. 50: 696-704.

Burton, G.W. (1952). Quantitative Inheritance in Grasses. Proceedings of 6th International Grassland Congress. 1: 277-283.

Burton, G.W. and De Vane, D.E. (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. Agronomy Journal. 45: 478-481.

Dewey, D.R. and Lu, K. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal. 51(9): 515-518.

Dhull, S.B., Bamal, P., Kumar, M., Bangar, S.P., Chawla, P., Singh, A., Mushtaq, W., Ahmad, M. and Sihag, S. (2023). Fenugreek (*Trigonella foenum-graecum*) gum: A functional ingredient with promising properties and applications in food and pharmaceuticals- A review. Legume Science. 5(3): 176.

Gerring, Z.F., Thorp, J.G., Gamazon, E.R. and Derks, E.M. (2022). A local genetic correlation analysis provides biological insights into the shared genetic architecture of psychiatric and substance use phenotypes. Biological Psychiatry. 92(7): 583-591.

Gupta, M., Dohroo, N.P. and Bharat, N. (2015). Outbreak of downy mildew of fenugreek in Solan district of Himachal Pradesh, India. Agricultural Science Digest. 35(3): 244-246. doi: 10.5958/0976-0547.2015.00057.9.

Gurjar, M. and Naruka, I. and Shaktawat, R.P.S. (2016). Variability and correlation analysis in fenugreek (*Trigonella foenum-graecum* L.). Legume Research. doi: 10.18805/lr.v0iOF.9286.

Johnson, H. W., Robinson, H. and Comstock, R. (1955). Estimates of genetic and environmental variability in soybeans. Agronomy Journal. 47: 314-318.

Krishnaveni, B., Vethamoni, P.I., Selvi, B.S. and Raveendran, M. (2021). Studies on genetic variability, correlation and path coefficient analysis in fenugreek (*Trigonella foenum-graecum* L.) genotypes. Electronic Journal of Plant Breeding. 12(3): 835-840.

Kumar, S., Ram, C., Nath, S., Kumar, S., Kumari, M. and Singh, V. (2020). Studies on genetic variability, heritability and genetic advances in fenugreek (*Trigonella foenum-graecum* L.). Journal of Pharmacognosy and Phytochemistry. 9(5): 1358-1361.

Lenka, D. and Misra, B. (1973). Path-coefficient analysis of yield in rice varieties. Indian Journal of Agricultural Science. 43: 376-379.

Li, T., Ning, Z. and Shen, X. (2021). Improved estimation of phenotypic correlations using summary association statistics. Frontiers in Genetics. 12: 665252.

Maurya, H.K., Mishra, D.D., Singh, H. and Singh, A.V. (2021). Studies on genetic variability in fenugreek (*Trigonella foenum-graecum* L.). The Pharma Innovation Journal. 10(10): 5.

Meena, R., Choudhary, S., Verma, A., Meena, N. and Mali, S.C. (2021). Estimates of genetic variability, divergence, correlation and path coefficient for morphological traits in fenugreek (*Trigonella foenum-graecum* L.) genotypes. Legume Research-An International Journal. 44(3): 281-286. doi: 10.18805/LR-4090.

Mori, K., Sharma, L., Mori, V. and Kulkarni, G. (2016). Study of variability and association analysis in fenugreek (*Trigonella foenum-graecum* L.) under timely and late sown conditions.

Panse, V.G. and Sukhatme, P.V. (1954). Statistical Methods for Agricultural Workers. 2nd Edition, Indian Council of Agricultural Research, New Delhi.

Prakash, S., Pandey, V., Gautam, D.K., Bhargava, A.K. and Nath, T. (2020). Evaluation of germplasm genetic variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L.). International Journal of Current Microbiology and Applied Sciences. 9(4): 303-308.

Shekhawat, N., Meena, V. S., Singh, K., Rani, K. and Gupta, V. (2023). Studies on genetic variability, heritability and genetic advance for morphological traits in fenugreek (*Trigonella foenum-graecum* L.) for Arid Climate of Rajasthan. Legume Research. 46(3): 312-315. doi: 10.18805/LR-5046.

Singh, S., Maurya, I. B., Singh, B., Kavita, A. and Chopra, R. (2022). Assessment of genetic variability, heritability and genetic advance for biometrical traits in fenugreek. Agricultural Reviews. 43(3): 383-388. doi: 10.18805/ag.R-2302.

Singh, K. P., Jain, P., Sengupta, S., Mehta, A. and Nair, B. (2012). Variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L.) germplasms. Jawaharlal Nehru Krishi Vishwa Vidyalaya Research Journal. 46(3): 328-332.

Singh, S. and Singh, B. (2022). Character association and path coefficient analysis of certain biometrical traits among fenugreek genotypes under different environmental conditions. Agricultural Science Digest. 42(4): 420-425. doi: 10.18805/ag.D-5312.

Thomas, J.E., Bandara, M., Lee, E.L., Driedger, D. and Acharya, S. (2011). Biochemical monitoring in fenugreek to develop functional food and medicinal plant variants. New Biotechnology. 28(2): 110-117.

Tiwari, A., Ram, C., Singh, D.B., Singh, N.K. and Prashant, P. (2024). Estimates of genetic variability and correlation coefficient for yield and Its attributes in fenugreek (*Trigonella foenum-graecum* L.). International Journal of Plant and Soil Science. 36(1): 199-206.

Verma, P., Solanki, R., Dhasora, A. and Kakani, R. (2016). Genetic variability in Fenugreek (*Trigonella foenum-graecum* L) as expressed under South Eastern region of Rajasthan State. International Journal of Seed Spices. 6(1): 93-95.

Yaldiz, G. and Camlica, M. (2022). Performance of fenugreek (*Trigonella foenum-graecum* L.) genotypes towards growth, yield and UPOV properties. Legume Research. 45(1): 10-17. doi: 10.18805/LR-639.