

# **Estimates of genetic variability and correlation coefficient for yield and its attributes in Fenugreek (*Trigonella foenum-graecum* L.)**

## **Abstract**

The study was conducted throughout the autumn/winter season 2021-2022 with the aim of estimating genetic variability for different characters in available Fenugreek germplasm viz: heritability in broad sense, genetic advance in per cent of mean and correlation coefficient among the characters pairs. The study's experimental material comprised 42 genotypes along with one check (Hisar Sonali). There were eleven quantitative characteristics (traits) on which observations were made. The magnitude of the phenotypic coefficient of variation (P.C.V.) was greater than the genotypic coefficient of variation (G.C.V.). The greatest differences in phenotype and genotype have been found in seed yield per plant followed by (no.) number of branches per plant, harvest index, days to maturity, test weight and nonnumber. of seed per pod. The heritability estimates for various traits ranged from 15.9 (nonnumber. of branches per plant) to 68.3 (plant height). Genetic advance in per cent of mean ranged from 3.36 per cent (No. number of seed per pod) to 12.64 per cent (days to maturity). The phenotypic and genotypic correlation coefficients were computed among the eleven characters. The most (A very) important trait, seed yield per plant exhibited highly significant and positive phenotypic correlation with, harvest index (0.948) and test weight (0.935). While, days to 50% flowering (-0.678) was significantly and negatively correlated with seed yield per plant. These findings suggested that the current fenugreek germplasm has a great deal of promise for effective crop improvement and better yield and yield-(components) attributing traits.

**Keyword:** Fenugreek variability, GCV, PCV, heritability, genetic advances, correlation genotypic, phenotypic.

## **Introduction:**

Fenugreek is a diploid species, belonging to family Fabaceae. All the species of this genus having  $2n=16$  except *T. neoana* ( $2n=30$ ). The word "Trigonella" is a Latin word, having meaning

from little triangle; refers to its triangular shape of flower. The species name “foenum-graecum” means “Greek-hay” indicated that it was used as a forage crop in the past. According to Kumari et al. (2016), the genus has two significant species: *Trigonellacorniculata* L. (kasurimethi) and *Trigonellafoenumgraecum* L. (common methi). Although it is planted all over the world, its original territory is southern Europe and the Mediterranean. In India, it is commonly grown under its common name methi (Acharya et al. 2011). Seeds have a bitter (taste) flavour because to the alkaloid "Trigonelline." Fenugreek seed contains 6.3% moisture, 9.5% protein, 10% fat, 18.5% crude fibre, 42.3% carbohydrate and 13.4% ash. Fenugreek seed contains 0.02% volatile oil (Ravindran et al., 2001). Fenugreek seed contains rigogenin, neorigogenin, diosgenin, yamogenin and gitogenin. Diosgenin content in fenugreek seed varies from 0.78 to 1.9% (Sharma and Kamal 1982) depending on genotypes as well as on cultural practices. The nutritional value of fenugreek, as reported by Gupta et al. (1989), per 100g of edible part. Fenugreek seeds are used to treat dysentery, diarrhoea, dyspepsia, cough, liver and spleen enlargement, rickets, and gout (Sharma et al. 1996). Both the leaves and seeds are anti-diabetic, reducing blood sugar and cholesterol levels (Chouhan et al. 2017). The steroid "Diosgenin" has increased the significance of fenugreek since it is necessary for the generation of sex hormones and contraceptives (Meena et al. 2017 and Prasad et al. 2020). Rajasthan is the fenugreek bowl of the country, contributing about 80% to the country's production. In India, it has a production of 156'000 MT from an area of 241'000 Ha and with a productivity of 1.54t/ha (Anonymous, 2020-21).

“The genetic improvement of a crop depends upon its advisable exploitation adopted through breeding methods. When cultivating certain high production types, genetic homogeneity is frequently the result. It is also well established that genetic homogeneousness led to genetic vulnerability abiotic and biotic stresses. In crop breeding operations, genotypes are the primary source of diversity for different character types. The potential value of each genotype line as a viable genotype for use in a varietal development programme may be estimated through appropriate screening and assessment. Selection and hybridization methods approaches are simply followed in bringing about the quantitative improvement in desired character. It is critical to evaluate the nature and extent of variability, heritability and genetic progress for various traits in relation to genotypes available for improving the correlated response to selection”. (Anonymous, 2020-21) Good genetic improvement along with high heritability estimates

provide enough possibilities for further advancement in subsequent generations. Plant breeders find genetic diversity more beneficial for selection or hybridization, but phenotypic variability changes in response to environmental factors.

## Material and Methods

The research work was carried out in a Randomised Block Design with three replications at the Department of Vegetable Science's main experiment site at Acharya Narendra Deva University of Agriculture and Technology in Kumarganj, Ayodhya (U.P.) over the autumn-winter season of 2021-22 to evaluate the performance of 42 genotypes for several variables to quantify the level of variability and scope of selection in fenugreek. Each treatment consisted of twelve plants in two rows. All essential plant protection techniques and agronomic practices were followed to yield a satisfactory harvest. The observation included: Days to 50% flowering, days to maturity, plant height (cm), no of branches per plant, no. of pods per plant, pod length (cm), no. of seeds per pod, biological yield per plant (g), harvest-index (%), 1000-seed weight (g), seed yield per plant (g).

### Estimation of coefficient of variation:

In accordance with Burton and de Vane (1953), the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated.

$$GCV = \frac{\text{Genotypic standard deviation}}{\text{Mean } (\bar{X})} \times 100$$

$$GCV = \frac{\sqrt{\sigma^2_g}}{\bar{X}} \times 100$$

### Correlation coefficient:

The correlations between different characters at genotypic (g) and phenotypic (p) levels were worked out between characters as suggested by Searle (1961).

i) Phenotypic correlation coefficient between characters X and Y

$$r_{xy(p)} = \frac{\text{Cov.}_{xy(p)}}{\sqrt{\text{Var. X (p)}. \text{Var. Y (p)}}}$$

ii) Genotypic correlation between characters X and Y

$$r_{xy(g)} = \frac{\text{Cov.}_{xy(g)}}{\sqrt{\text{Var. X (g). Var. Y (g)}}}$$

Where,

$r_{xy}$  = Correlation coefficients between X and Y.

Covariance XY = Co-variance between characters X and Y

Var. X = Variance for X character

Var. Y = Variance for Y character

The significance of phenotypic correlation coefficients was tested against (n-2) degrees of freedom at 5% and 1% probability level. Where, n is the number of germplasm on which the observations were recorded.

**Result and Discussion:**

The analysis of variance for forty-two genotypes for eleven characters are significant showed in Table 1. The estimates of phenotypic coefficients of variation (PCV) were higher than genotypic coefficients of variation (GCV) for all the traits showed in table 2. High magnitudes of PCV and GCV was observed in case of seed yield per plant (11.12 and 7.85%), no. of branches per plant (10.90 and 4.34%), harvest index (9.70 and 4.02%), days to maturity (8.98 and 7.42%), test weight (8.33 and 3.93%), no. of seed per pod (8.05 and 3.62%). Moderate PCV and GCV were recorded in days to 50% flowering (7.88 and 3.60%), biological yield per plant (6.44 and 4.10%), plant height (6.32 and 3.82%). And low PCV and GCV were noticed in, no. pod per plant (6.17 and 4.62%), and pod length (6.06 and 3.38%). Singh *et al.* (2019), Chaudhary *et al.* (2017), Patel *et al.* (2021) also reported similar results in their studies.

Estimates of heritability and genetic advance for eleven characters are presented in table-2. The heritability in broad sense ranged from 15.9 per cent in case of **no. of branches per plant to 68.3 plant height**. High estimates of heritability were exhibited for all the characters except no.

of branches per plant(15.9), harvest index (17.02), no. of seed per pod (20.03), days to 50% flowering (20.08), test weight (22.03). Upadhyay *et al.* (2020), Gaikwad *et al.* (2020) and Patel *et al.* (2021) also reported high heritability for all traits. Highest value of genetic advance in per cent of mean was shown by days to maturity (12.64 %) while no. of seed per pod (3.36) exhibited lowest value for this parameter. The characters showed high estimate of genetic advance were days to maturity (12.64 %), seed yield per plant (11.41%), no. of pod per plant (7.12%). While low genetic advance in per cent of mean for no. of seed per pod (3.36 %), days to 50% flowering (3.38%), harvest index (3.42), no. of branches per plant (3.56), test weight (3.83) and pod length (3.88). High heritability coupled with high genetic advance were observed for most of the traits except no. of branches per plant (15.09 and 3.56), harvest index (17.02 and 3.42), no. of seed per pod (20.03 ad 3.36), days to 50% flowering (20.8 and 3.38) and test weight (22.03 and 3.83) which indicated opportunity for selection response in available germplasm of fenugreek with low selection, intensity for improvement. Similar results were also reported by Pushpa *et al.* (2012), Maurya *et al.* (2013) and Patel *et al.*(2021). Characters seed yield, no. of branches per plant, no. pod per plant and harvest index exhibited high heritability along with high genetic advance as per cent of mean indicating that it is largely influenced by additive gene effect and consequently the scope is more for improving seed yield, no. of branches per plant, no. pod per plant and harvest index through selection.

### **Correlation coefficients:**

The nature and strength of connections between yield and its component traits are essential for successful selection in future generations. Correlations between characters are influenced by gene linkage or pleiotropy. As a result, choosing one attribute influences the other related or pleiotropically impacted qualities. Correlation studies have received a lot of study in plant improvement since they aid with successful selection. The phenotypic and genotypic correlation coefficients computed among the eleven characters under study have been present in Table 3 and 4, respectively. among general, phenotypic correlation coefficients were larger than genotypic correlation coefficients, indicating a significant underlying link among distinct relationships of features in fenugreek genotypes. The most important trait, seed yield per plant exhibited highly significant and positive phenotypic correlation with, harvest index (0.948) and test weight (0.935). While, days to 50% flowering (-0.678) was significantly and negatively correlated with

seed yield per plant (Table- 2). Test weight was significantly and positive correlated with no. of seed per pod (0.931) and harvest index (0.920), while significantly and negatively correlated with days to 50% flowering (-0.535). Harvest index showed highly significant and positive correlation with no. of seed per pod (0.871) and biological yield per plant (0.821) while it showed highly significant and negative correlation with days to 50% flowering (-0.925). Biological yield per plant was highly significantly and positively correlated with no. of branches per plant (0.933) and no. of pod per plant (0.899). While significant and negative correlation with days to 50% flowering (-0.334). No. of seed per pod was highly significantly and positively correlated with no. of branches per plant (0.856) and pod length (0.760). It also showed highly significant and negative correlation with days to maturity (-0.455). Pod length showed highly significant and positive correlation with number of no. of pod per plant (0.910) and plant height (0.718). It also showed significant and negative correlation with days to maturity. The no of pod per plant showed highly significant and positive correlation with no. of branches per plant (0.922). The no. of branches per plant was highly significantly and positively correlated with plant height (0.932) and days to 50% flowering. Plant height showed highly significant and negative correlation with days to maturity (-0.289). Many earlier research workers have also reported “significant and positive association of seed yield per plant with no. pod per plant, no. seed per pod and 1000 seed weight”. (Prajapati *et al.* 2010), (Kumar *et al.* 2018) and (Prakash *et al.* 2021).

**Table1:Analysisofvariance(meansquares)forelevenquantitativecharactersinfenugreekgermplasm.**

S. No.	Traits	Meansquare		
		Replications	Treatments	Error
		2	41	82
1	Daysto50%flowering	107.42**	17.80*	9.95
2	Daystomaturity	97.80	277.24**	37.17
3	Plantheight(cm)	633.80**	61.60**	22.57
4	No.ofbranchesperplant	0.12	0.41*	0.26
5	No.ofpod perplant	217.55**	85.18**	17.64
6	Podlength(cm)	0.58	0.93**	0.39
7	No.ofseedperpod	3.48	2.69*	1.52
8	Biologicalyieldperplant(g)	155.71**	18.85**	6.17
9	Harvestingindex(%)	218.94**	23.76*	14.65
10	Testweight(g)	0.20	1.35**	0.72
11	Seedyieldperplant(g)	4.53	11.66**	2.93

**\*-Significantat5percentprobabilitylevel,\*\*-Significantat1percentprobabilitylevel**

**Table 2: Range, grand mean, phenotypic (PCV), genotypic (GCV) coefficient of variation, heritability in broad sense, genetic advance in percent of mean (Ga) for eleven characters in fenugreek germplasm**

Characters	Parameters								
	Range		Mean	Coefficient of variation (%)			Heritability in broad sense 5%	Genetic advance 5%	Genetic advance in percent of mean 5%
	Min.	Max.		GCV	PCV	ECV			
Day to 50% flowering	39.00	50.83	44.93	3.60	7.88	7.02	20.8	1.52	3.38
Day to maturity	95.66	135.66	120.42	7.42	8.98	5.06	68.3	15.22	12.64
Plant height (cm)	83.68	105.97	94.28	3.82	6.32	5.03	36.6	4.49	4.76
No. of branches per plant	4.54	6.13	5.15	4.34	10.90	9.99	15.9	0.18	3.56
No. pod per plant	89.27	109.85	102.67	4.62	6.17	4.09	56.1	7.31	7.12
Pod length (cm)	11.56	13.56	12.51	3.38	6.06	5.03	31.1	0.48	3.88
No. of seed per pod	14.70	19.30	17.20	3.62	8.05	7.18	20.3	0.57	3.36
Biological yield per plant (g)	45.26	54.43	50.05	4.10	6.44	4.96	40.6	2.69	5.38
Harvest Index (%)	36.93	49.55	43.33	4.02	9.70	8.83	17.2	1.48	3.42
Test weight (g)	10.46	13.43	11.62	3.93	8.33	7.34	22.3	0.44	3.83
Seed yield per plant (g)	17.33	26.73	21.73	7.85	11.12	7.87	49.8	2.48	11.41

\*-Significant at 5 percent probability level, \*\*-Significant at 1 percent probability level

**Table-3: Estimates of phenotypic correlation coefficients among eleven characters in fenugreek germplasm**

Traits	Daysto50% flowering	Days to maturity	Plantheight (cm)	No.ofbranchesper plant	No.ofpodper plant	Pod length(cm)	No.ofseed perpod	Biologicalyieldper plant	Harvest index(%)	Testweight(g)	Seedyieldper plant (g)
Daysto50% flowering	<b>1.000</b>	-0.058	0.064	-0.131	-0.088	0.082	-0.020	-0.111	-0.146	-0.184*	-0.194*
Daystomaturity		<b>1.000</b>	-0.077	-0.060	-0.025	-0.145	-0.309**	-0.074	-0.004	0.021	-0.060
Plantheight(cm)			<b>1.000</b>	0.228*	0.292**	0.117	0.100	0.014	-0.088	-0.103	-0.119
No.ofbranchper plant				<b>1.000</b>	0.250**	0.296**	0.131	0.197*	0.175*	0.035	0.269**
No.of pod per plant					<b>1.000</b>	0.473**	0.201*	0.528**	-0.019	0.061	0.203*
Podlength(cm)						<b>1.000</b>	0.218*	0.332**	0.014	0.034	0.158
No. of seedper pod							<b>1.000</b>	0.276**	0.095	0.054	0.226*
Biologicalyield per Plant(g)								<b>1.000</b>	-0.095	0.237**	0.492**
Harvestindex(%)									<b>1.000</b>	0.190*	0.785**
Testweight(g)										<b>1.000</b>	0.291**

\*-Significantat5percentprobabilitylevel, \*\*-Significantat1percentprobabilitylevel

**Table4:Estimatesofgenotypiccorrelationcoefficientsamongelevencharactersinfenugreekgermplasm**

Traits	Daysto50% flowering	Days to maturity	Plant height(cm)	No. of branches per plant	No.ofpod per plant	Podlength (cm)	No.ofseed per pod	Biological yield per plant	Harvest index(%)	Testweight (g)	Seedyield per plant
Daysto50% flowering	<b>1.000</b>	-0.050	0.129	0.369**	-0.056	0.211*	-0.042	-0.334**	-0.925**	-0.535**	-0.678**
Daystomaturity		<b>1.000</b>	-0.289**	-0.173	-0.034	-0.179*	0.455**	-0.159	0.182*	-0.002	-0.046
Plantheight(cm)			<b>1.000</b>	0.932**	0.758**	0.718**	0.229**	0.334**	-0.448**	-0.017	-0.207*
No.ofbranchesper plant				<b>1.000</b>	0.922**	0.706**	0.856**	0.933**	0.570**	0.745**	0.662**
No.of podper plant					<b>1.000</b>	0.910**	0.731**	0.899**	0.358**	0.528**	0.566**
Podlength (cm)						<b>1.000</b>	0.760**	0.769**	0.353**	0.444**	0.516**
No.ofseed perpod							<b>1.000</b>	0.828**	0.871**	0.931**	0.738**
Biologicalyieldper plant(g)								<b>1.000</b>	0.821**	0.832**	0.925**
Harvestindex(%)									<b>1.000</b>	0.920**	0.948**
Testweight(g)										<b>1.000</b>	0.935**

**\*-Significantat5percentprobabilitylevel, \*\*-Significantat1percentprobabilitylevel.**

## CONCLUSION:

Based on the above result of correlation studies it could be concluded that characters like Harvest index, Biological yield per plant and Test weight, No. of branches per plant showed highly positive significant correlation with the yield. As a result, our research showed that these features may be used in various breeding and development plans. The information can help breeders in developing suitable approaches for increasing yield and improvement of character in fenugreek.

## References:

Acharya, S.S, Basu, K, Acharya, S, Paul, S, Datta Banik, and Prasad, R. Fenugreek: A spice, forage and nutraceutical crop. De. AK (edited) Spices: The elixir of life. Originals, New Delhi, India.2011. pp.129- 150.

Anonymous Annual report of NHB Gurgaon2020-21. (Haryana).

Burton, G.W, and de Vane, E.H. Estimated heritability in tall replicated clonal material. Agron. J.1953. 45: 474-478.

Burton, G.W, and de Vane, E.H. Estimated heritability in tall replicated clonal material. Agron. J.1953. 45: 474-478.

Chauhan, J, Singhal, R. K, Kakralya, B. L, Kumar, S.and Sodani, R. Evaluation of yield and yield attributes of fenugreek (*Trigonella foenum-graecum* L.) genotypes under drought conditions. Int. J. Pure App. Biosci.2017. 5(3):477-484.

Choudhary, M, Gothwal, D.K, Kumawat, R, and Kumawat, K.R. Assessment of genetic variability and character association in fenugreek (*Trigonella foenum-graecum* L.) genotypes, Int. J. pure Appl. Biosci.2017.

Gaikwad, S.P, Dhumal, S.S, Bhagat, A.A and Sagbhor, D.A. Genetic variability fenugreek Genotypes. Ind. J. Pure App. Biosci.2020. 8(1): 199-203.

Gupta, K.K, Thakral, A. and Wagle, D.S. Abstract of papers. First national seminar on seed spices held at R.A.U. Jaipur, during October1989. 551.24-25.

Kumar, A, Pandey, V.P, Maurya, V.K, Tiwari, D. and S. Genetic variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L.). Int. J. Chem. Stud., 2018.6(4): 153-156.

Kumari, J., Kulkarni, G. U. and Sharma, L. K. Stability analysis in fenugreek (*Trigonella foenum-graecum* L.). *Electronic Journal of Plant Breeding*. 2016.7(4): 904-910.

Maurya, B.P, Yadav, B.K, Yadav, A.K. and Yadav, P.K. Studies on variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L.).*Biochem. Cell. Arch.*, 2013.13(2):311-313.

Meena, M. L, Narolia, S. L, Atal M. K. and Verma, N. Evaluation of Fenugreek (*Trigonella foenum-graecum* L.) genotypes for horticultural traits, *Chem. Sci. Rev.* 2017. 6(23): 2014-2018.

Patel, D.K. and A.M, Sundesha, D.L. Genetic variability, heritability and genetic Advance for seed yield in fenugreek (*Trigonella foenum-graecum* L.). *Int. J. Curr. Microbiol. App. Sci.* 2021.10(01): 3233-3237.

Prajapati, D. B, Ravindrababu, Y. and Prajapati, B. H. Genetic variability and character association in fenugreek (*Trigonella foenum-graecum* L.). *J. Spices Aromat. Crops.*2010.9(1/2):61-64.

Prakash, S, Pandey, V.P and Kumar, B. Assesment of correlation and path analysis in fenugreek (*Trigonella foenum-graecum* L.). *Int. J. Chem. Stud.*2021. 9(1):3432-3434.

Prasad, Shakthi N, Meena, K.C, Naruka, I.S. and Surendra, S.G Study of growth, phenology and seed yield in fenugreek (*Trigonella foenum-graecum* L.) varieties. *Int. J. Chemical Studies.* 2020. 8(4): 2924-2927.

Pushpa, T.N, Chandregowda, M, Srikantaprasad, D. and Gowda, A.P.M. Evaluation of fenugreek (*Trigonella foenum-graecum* L.) genotypes for growth and seed yield. *Crop Res.*2012. 43(1, 2&3): 238-244.

Ravindran, P.N, Kallapurackal, J.A. and Sivaranam, K. All India co-ordinate research project on spices: status of seed spices research. *Indian J. Arecanut Spices Med. Plants*, 2001.3(3):97–110.

Searle, S.R. Phenotypic, genotypic and environmental correlations. *Biometrics*,1961. 17: 474-480.

Sharma, G.L. and Kamal, R. Diosgenin content from seeds of fenugreek (*Trigonella foenum-graecum* L.) collected from various geographical regions. Ind. J. Bot.1982. 5(1): 58–59.

Sharma, R.D, Sarkar, A, Hazra, D.K, Misra, B, Singh, J.B, Maheshwari, B.B. and Sharma, S.K. Hypolipidemic effect of fenugreek seeds: a chronic study in non – insulin dependent diabetic patients. Phytother. Res.1996. 10 (4): 332–334.

Singh, A.K, Singh, D.R, Singh, A, Maurya, J.K, Pandey, V.P. and Sriom. Quantitative analysis of selection parameters in yield contributing traits of fenugreek (*Trigonella foenum-graecum* L.) genotypes. J. Pharmacogn. Phytochem.2019.8(3): 4791- 4795.

Upadhyay, R, Naidu, A.K. and Dhakhariya, T. Studies on genetic variability among yieldattributing traits of fenugreek genotypes. Int. J. Chem. Stud.2020. 8(4): 1821-1825.

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