International Journal of Plant & Soil Science

Volume 36, Issue 1, Page 199-206, 2024; Article no.IJPSS.111995
ISSN: 2320-7035

Estimates of Genetic Variability and Correlation Coefficient for Yield and Its Attributes in Fenugreek (*Trigonella foenum-graecum* L.)

Anuj Tiwari [a*], C. N. Ram [a], Dharmendra Bahadur Singh [a], Nitesh Kumar Singh [a] and Prashant [a]

[a] Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.) 224229, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2024/v36i14350

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/111995

Original Research Article

Received: 12/11/2023
Accepted: 16/01/2024
Published: 20/01/2024

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 no number. of seed per pod. The heritability estimates for

**Corresponding author: E-mail: anujtiwari05092000@gmail.com;*

various traits ranged from 15.9 (no number. 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.

Keywords: Fenugreek variability; GCV; PCV; heritability; genetic advances; correlation genotypic; phenotypic.

1. 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. [1], the genus has two significant species: *Trigonella corniculata* L. (kasuri methi) and *Trigonella foenum graecum* 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 [2]. 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 [3]. Fenugreek seed contains rigogenin, neorigogenin, diosgenin, yamogenin and gitogenin. Diosgenin content in fenugreek seed varies from 0.78 to 1.9% [4] depending on genotypes as well as on cultural practices. The nutritional value of fenugreek, as reported by Gupta et al. [5], per 100 g of edible part. Fenugreek seeds are used to treat dysentery, diarrhoea, dyspepsia, cough, liver and spleen enlargement, rickets, and gout [6]. Both the leaves and seeds are anti-diabetic, reducing blood sugar and cholesterol levels [7]. The asteroid "Diosgenin" has increased the significance of fenugreek since it is necessary for the generation of sex hormones and contraceptives [8,9]. 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 [10].

“The genetic improvement of a crop depends upon its advisable exploitation adopt 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 programmed 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, [10] 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.

2. MATERIALS 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).

2.1 Estimation of Coefficient of Variation

In accordance with Burton and de Vane [11], the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated.

$$GCV = \frac{\text{Genotypic standard deviation}}{\text{Mean } (\overline{X})} \text{x100}$$

$$GCV = \frac{\sqrt{\sigma^2 g}}{\overline{X}} \text{x100}$$

2.2 Correlation Coefficient

The correlations between different characters at genotypic (g) and phenotypic (p) levels were worked out between characters as suggested by Searle [12].

1. Phenotypic correlation coefficient between characters X and Y

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

2. Genotypic correlation between characters X and Y

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

Where,

r_{xy} =Correlation coefficients between X and Y.
Covariance
XY=Co-variance between characters X andY
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.

3. RESULTS 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*.* [13], Chaudhary et al*.* [14], Patel et al*.* [15] 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*.* [16], Gaikwad et al*.* [17] and Patel et al*.* [15] 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*.* [18], Maurya et al*.* [19] and Patel et al*.* [15]. 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.

3.1 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 Tables 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 haves also reported “significant and positive association of seed yield per plant with no. pod per plant, no. seed per pod and 1000 seed weight” [20-22].

Table 1. Analysis of variance (mean squares) for eleven quantitative characters in fenugreek germplasm

S. No.	Traits	Mean square		
		Replications 2	Treatments 41	Error 82
1	Days to 50% flowering	107.42**	17.80*	9.95
2	Days to maturity	97.80	277.24**	37.17
3	Plant height(cm)	633.80**	61.60**	22.57
4	No. of branches per plant	0.12	0.41*	0.26
5	No. of pod per plant	217.55**	85.18**	17.64
6	Pod length(cm)	0.58	0.93**	0.39
7	No. of seed per pod	3.48	2.69*	1.52
8	Biological yield per plant(g)	155.71**	18.85**	6.17
9	Harvesting index (%)	218.94**	23.76*	14.65
10	Test weight(g)	0.20	1.35**	0.72
11	Seed yield per plant(g)	4.53	11.66**	2.93

**-Significant at 5 percent probability level, **-Significant at 1per cent probability level*

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	Genetic advance	Genetic advance in per cent of mean
	Min.	Max.		GCV	PCV	ECV	5%	5%	5%
Days to 50% flowering	39.00	50.83	44.93	3.60	7.88	7.02	20.8	1.52	3.38
Days 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 1per cent probability level*

Table 3. Estimates of phenotypic correlation coefficients among eleven characters in fenugreek germplasm

Traits	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of pod per plant	Pod length (cm)	No. of seed per pod	Biological yield per plant	Harvest index (%)	Test weight (g)	Seed yield per plant (g)
Days to 50% flowering	**1.000**	-0.058	0.064	-0.131	-0.088	0.082	-0.020	-0.111	-0.146	-0.184*	-0.194*
Days to maturity		**1.000**	-0.077	-0.060	-0.025	-0.145	-0.309**	-0.074	-0.004	0.021	-0.060
Plant height(cm)			**1.000**	0.228*	0.292**	0.117	0.100	0.014	-0.088	-0.103	-0.119
No. of branch per plant				**1.000**	0.250**	0.296**	0.131	0.197*	0.175*	0.035	0.269**
No. of pod per plant					**1.000**	0.473**	0.201*	0.528**	-0.019	0.061	0.203*
Pod length(cm)						**1.000**	0.218*	0.332**	0.014	0.034	0.158
No. of seed per pod							**1.000**	0.276**	0.095	0.054	0.226*
Biological yield per Plant(g)								**1.000**	-0.095	0.237**	0.492**
Harvest index (%)									**1.000**	0.190*	0.785**
Test weight(g)										**1.000**	0.291**

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

Table 4. Estimates of genotypic correlation coefficients among eleven characters in fenugreek germplasm

Traits	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	No. of pod per plant	Pod length (cm)	No. of seed per pod	Biological yield per plant	Harvest index (%)	Test weight (g)	Seed yield per plant
Days to 50% flowering	**1.000**	-0.050	0.129	0.369**	-0.056	0.211*	-0.042	-0.334**	-0.925**	-0.535**	-0.678**
Days to maturity		**1.000**	-0.289**	-0.173	-0.034	-0.179*	0.455**	-0.159	0.182*	-0.002	-0.046
Plant height (cm)			**1.000**	0.932**	0.758**	0.718**	0.229**	0.334**	-0.448**	-0.017	-0.207*
No. of branches per plant				**1.000**	0.922**	0.706**	0.856**	0.933**	0.570**	0.745**	0.662**
No. of pod per plant					**1.000**	0.910**	0.731**	0.899**	0.358**	0.528**	0.566**
Pod length (cm)						**1.000**	0.760**	0.769**	0.353**	0.444**	0.516**
No. of seed per pod							**1.000**	0.828**	0.871**	0.931**	0.738**
Biological yield per plant (g)								**1.000**	0.821**	0.832**	0.925**
Harvest index (%)									**1.000**	0.920**	0.948**
Test weight (g)										**1.000**	0.935**

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

4. 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.

ACKNOWLEDGEMENT

The first author would like to acknowledge the whole Department of Vegetable Science for providing the necessary resources for conducting an experiment, and especially my Advisor, Dr. C.N. Ram, for their helpful suggestions and inspirations during my research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kumari J, Kulkarni GU, Sharma LK. Stability analysis in fenugreek (*Trigonella foenum-graecum* L.). Electronic Journal of Plant Breeding. 2016;7(4):904- 910.
2. Acharya SS, Basu K, Acharya S, Paul S, Datta Banik, Prasad R. Fenugreek: A spice, forage and nutraceutical crop. De. AK (edited) Spices: The elixir of life. Originals, New Delhi, India. 2011;129-150.
3. Ravindran PN, Kallupurackal JA, 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.
4. Sharma GL, Kamal R. Diosgenin content from seeds of f e n u gr e ek (*Trigonella foenum-graecum* L.) collected from various geographical regions. Ind. J. Bot. 1982;5(1):58–59.
5. Gupta KK, Thakral A, Wagle DS. Abstract of papers. First national seminar on seed spices held at R.A.U. Jaipur, During. October 1989;55:24-25.
6. Sharma RD, Sarkar A, Hazra DK, Misra B, Singh JB, Maheshwari BB, Sharma SK. Hypolipidemic effect of fenugreek seeds: A chronic study in non – insulin dependent diabetic patients. Phytother. Res. 1996; 10(4):332–334.
7. Chauhan J, Singhal RK, Kakralya BL, Kumar S, 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.
8. Meena ML, Narolia SL, Atal MK, Verma N. Evaluation of Fenugreek (*Trigonella foenum-graecum* L.) genotypes for horticultural traits, Chem. Sci. Rev. 2017; 6(23):2014-2018.
9. Prasad, Shakthi N, Meena KC, Naruka IS, Surendra SG. Study of growth, phenology and seed yield in fenugreek (*Trigonella foenum-graecum* L.) varieties. Int. J. Chemical Studies. 2020;8(4):2924-2927.
10. Anonymous Annual report of NHB Gurgaon. (Haryana); 2020-21.
11. Burton GW, de Vane EH. Estimated heritability in tall replicated clonal material. Agron. J. 1953;45:474-478.
12. Searle SR. Phenotypic, genotypic and environmental correlations. Biometrics/ 1961;17:474-480.
13. Singh AK, Singh DR, Singh A, Maurya JK, Pandey VP, 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.
14. Choudhary M, Gothwal DK, Kumawat R, Kumawat KR. Assessment of genetic variability and character association in fenugreek (*Trigonella foenum-graecum* L.) genotypes, Int. J. Pure Appl. Bios; 2017.
15. Patel DK, AM, Sundesha DL. 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.
16. Upadhyay R, Naidu AK, Dhakhariya T. Studies on genetic variability among yield attributing traits of fenugreek genotypes. Int. J. Chem. Stud. 2020;8(4):1821-1825.
17. Gaikwad SP, Dhumal SS, Bhagat AA, Sagbhor DA. Genetic variability fenugreek Genotypes. Ind. J. Pure App. Biosci. 2020; 8(1):199-203.
18. Pushpa TN, Chandregowda M, Srikantaprasad D, Gowda APM. Evaluation of fenugreek (*Trigonella foenum-graecum* L.) genotypes for growth and seed yield. Crop Res. 2012;43(1, 2&3):238-244.

19. Maurya BP, Yadav BK, Yadav AK, Yadav PK. Studies on variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L). Biochem. Cell. Arch, 2013;13(2):311-313.
20. Prajapati DB, Ravindrababu Y, Prajapati BH. Genetic variability and character association in fenugreek (*Trigonella foenum-graecum* L.). J. Spices Aromat. Crops. 2010;9(1/2):61-64.
21. Kumar A, Pandey VP, Maurya VK, Tiwari DS. Genetic variability, heritability and genetic advance in fenugreek (*Trigonella foenum-graecum* L.). Int. J. Chem. Stud, 2018;6(4):153-156.
22. Prakash S, Pandey VP, Kumar B. Assesment of correlation and path analysis in fenugreek (*Trigonella foenum-graecum* L.). Int. J. Chem. Stud. 2021;9(1):3432-3434.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/111995