ASSESSMENT OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCEMENTIN FENUGREEK (*Trigonellafoenum-graecum* L.)

Abstract

The present study was conducted at Main Experiment Station, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya during *Rabi* season of 2022-23. Plant material consisted of 63 genotypes of fenugreek including 3 checks namely Pusa Early Bunching (PEB), Hisar Sonali and Narendra Methi-1 in Augmented Block Design.In analysis of variance, the variance due to block were highly significant for all other characters. High coefficient of variationswas estimated for seed yield per plant followed by harvest index and number of pods per plant. High heritability was expressed by number of pods per plant followed by seed yield per plant, harvest index, test weight, plant height, biological yield, pod length, days to 50% flowering, number of primary branches per plant and days to maturity. High heritability coupled with high genetic advance were most of the traits which indicated opportunity for selection response in available germplasm of fenugreek with low selection, intensity for improvement. When variability, heritability and genetic advance as per cent of mean are considered together seed yield per plant may be the best trait that could be exploited for hybridization and selection improvement since these characters recorded high variability, high heritability and high to moderate genetic advance.

Key words: Fenugreek, variance, variability, heritability and genetic advance.

Introduction

"Fenugreek (*Trigonellafoenum-graecum* L.) is an annual crop belonging to the family 'Fabaceae".It is a diploid species with the chromosome number of 2n=16. Centre of origin of fenugreek is South Europe, Mediterranean region and Western Asia. It is self-pollinating crop. The most common Indian or vernacular name is 'Methi' and there are several more well-known regional names. It requires cool climate and dry weather at the time of maturity. It is extremely difficult to manipulate for artificial emasculation and hybridization as flowers are very small. The genus Trigonella includes two economically important species. *Trigonellafoenum-graecum* L. is the common methi and other is *Trigonellacorniculata*, kasuri or champamethi. During 2021-22, 248'000 MT of fenugreek was produced from 167'000-hectare area (Anonymous, 2021-22).The major fenugreek producing states of India are Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh, Maharashtra, Haryana and Punjab" (Shakti *et al.* 2020).

Fenugreek, cultivated as leafy vegetable, is typically grown during the winter or *Rabi* season. Both its leaves and seeds find use in human food, animal food and as green manure, contributing to soil fertility by fixing nitrogen. Its leaves are rich in vitamins, minerals and protein. Fenugreek seed contains 0.02% volatile oil (Ravindran *et al.* 2001). "Fenugreek contains active constituents such as steroid saponin compounds, fibres, phenolic compounds, protodioscin, flavonoids, hydrocarbons, alkaloids, terpenes, fatty acids glycosides, carbohydrates, amino acids and their derivatives" (Shashikumar *et al.* 2018). Fenugreek seed contains rigogenin, neorigogenin, diosgenin, yamogenin and gitogendin. 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. Both leaves and seeds have medicinal uses and act as anti-diabetic, lowering blood sugar level and cholesterol level (Chouhan *et al.* 2017).The whole fenugreek plant has many therapeutic values but a number of studies have been conducted on properties of seeds. Several studies have demonstrated the medicinal benefits of seeds, including their antimicrobial, antibacterial, anti-inflammatory, anthelmintic and hypoglycemic qualities. (Basu *et al.* 2008, Dixit *et al.* 2010, Kumar *et al.* 2013).

Any crop's ability to increase productivity requires an understanding of variability. The careful utilisation of effective breeding techniques is essential for the genetic advancement of any crop. A small number of highly productive cultivars dominate, which frequently results in genetic homogeneity. Genetic susceptibility to both biotic and abiotic stresses is a consequence of genetic uniformity. Germplasm is the most valuable source of variability for different traits in any crop breeding programme. An assessment of a germplasm line's potential value as a suitable genotype for use in a varietal development programme would be possible with proper screening and evaluation.

Materials and Methods

"The site of experiment was Main Experiment Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya. Narendra Nagar falls under humid sub-tropical climate and is located in between 24.47 and 26.56 N latitude and 82.12and 83.98 E longitude at an altitude of 113 m above sea level in the Gangetic alluvial plains of Eastern Uttar Pradesh". [17]

The experimental material of the investigation consisted of sixty-three genotypes of fenugreek including three checks viz. Pusa Early Bunching (PEB), Hisar Sonali and Narendra Methi-1obtained from the in the Department of vegetable scienceAcharya Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya. The experiment was carried out in Augmented Block Design. The data were collected on eleven traits viz., days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of pods per plant, pod length (cm), number of seed per pod, biological yield per plant (cm), harvest index (%), test weight (g) and seed yield per plant (g).

The statistical analysis was performed on the total mean values of different characters. The Augmented Block Design analysis approaches were used to perform the statistical analysis. Phenotypic and genotypic coefficients of variation were estimated according to (Burton and de Vane, 1953), Heritability in broad sense was estimated by Hanson et al., 1956 and the extent of genetic advance and genetic advance as per cent of mean were worked out using the formula suggested by Robinson, 1965.

Results and Discussion

The analysis of variance revealed significant differences between the genotypes for all trait under study.The range, general means, phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), heritability in broad sense, genetic advance and genetic advance as percent of mean for different characters of fenugreek genotypes are presented in table 1.

The genotypic coefficient of variation is crucial for breeders because genetic variance by itself does not indicate which traits exhibit the greatest variability. Hence, a precise comparison can be achieved using both phenotypic and genotypic coefficients of variation.

The phenotypic coefficient of variation (PCV) ranged from 2.69% for days to maturity to 30.28% for seed yield per plant, while the genotypic coefficient of variation (GCV) ranged from 2.55% for days to maturity to 29.78% for seed yield per plant. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits indicating to environmental effect.A high estimate (>20%) of both phenotypic (PCV) and genotypic (GCV) coefficients of variation was recorded for seed yield per plant (PCV = 30.28% and GCV = 29.78%), followed by harvest index (PCV = 29.81% and GCV = 29.31%) and number of pods per plant (PCV = 21.12% and GCV = 20.81%). These results are in agreement with earlier reports for number of branches per plant, test weight, number of pods per plant, number of nodules per plant, plant height and seed yield per plant by Panwar *et al.*, 2018. The results indicate a very high degree of variability, suggesting a promising scope for improvement.

Moderate estimate (10% - 20%) of PCV and GCV were recorded for number of primary branches per plant (PCV=18.23% and GCV= 17.53%) followed by test weight (PCV=17.78% and GCV=17.36%)whereas,the low estimate (<10%) of phenotypic and genotypic coefficients of variation were observed for pod length (PCV=10.35% and GCV=9.98) followed by plant height(PCV=8.83% and GCV= 8.61%), biological yield (PCV=7.66% and GCV= 7.45%), number of seeds per pod (PCV=7.56% and GCV=6.05%), days to 50% flowering (PCV=4.537 and GCV=4.372) and days to maturity (PCV=2.69% and GCV=2.55%).

Table 1: Estimates of range, grand mean, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability in broad sense [h^2%], genetic advance (GA) and GA (in percent of mean) for eleven characters in fenugreek genotypes

Character	Range		Grand Mean (X)	PCV (%)	GCV (%)	Heritabilityb road sense(h^2%)	Genetic Advance (G.A.)	Genetic Advance in percent of mean
	Lowest	Highest						
Days to 50% flowering	63.68	79.42	71.16	4.53	4.37	92.89	6.17	8.68
Days to maturity	118.67	132.67	124.91	2.69	2.55	90.21	6.25	5.00
Plant height (cm)	68.19	105.34	87.43	8.83	8.61	95.10	15.11	17.30
Number of primary branches per plant	1.37	4.77	3.40	18.23	17.53	92.47	1.17	34.73
Number of pods per plant	14.95	40.02	26.36	21.12	20.81	97.14	11.16	42.26
Pod length (cm)	7.30	13.76	11.22	10.35	9.98	93.06	2.22	19.84
Number of seeds per pod	14.48	24.02	19.91	7.56	6.05	64.04	1.98	9.98
Biological yield per plant (g)	42.73	57.62	49.51	7.66	7.45	94.63	7.37	14.93
Harvest index (%)	4.15	16.87	9.02	29.81	29.31	96.66	5.29	59.37
Test weight (g)	5.61	11.88	8.31	17.78	17.36	95.26	2.93	34.90
Seed yield per plant	2.07	8.71	4.53	30.28	29.78	96.76	2.70	60.35

Heritability, which indicates the proportion of phenotypic variance due to genotypic variance and transmissible from parent to offspring, is actually a character selection index. High heritability (>75%) was expressed by number of pods per plant (97.14%) followed by seed yield per plant (96.76%), harvest index (96.66%), test weight (95.26%), plant height (95.10%), biological yield (94.63%), pod length (93.06%), days to 50% flowering (92.89%), number of primary branches per plant (92.47%) and days to maturity (90.21%).

"Heritability estimates combined with genetic advance are more reliable since heritability alone does not give adequate evidence for the amount of genetic advance. Genetic advance is not an independent variable, but it has an advantage over heritability as it indicates an amount of character improvement through selection.High heritability coupled with high genetic advance were observed for most of the traits which indicated opportunity for selection response in available germplasm of fenugreek with low selection, intensity for improvement.Characters seed yield per plant, harvesting index, number of pods per plant, test weight and number of primary branches per plant 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 through selection.Similar results were also reported" by Pushpa *et al.* (2012), Maurya *et al.* (2013), Kumar *et al.* (2020) and Patel *et al.* (2021).

Conclusion

In this study, number of pods per plant, seed yield per plant, harvest index, test weight, plant height, biological yield, pod length, days to 50% flowering, number of primary branches per plant and days to maturity recorded high heritability.The above traits can be effectively improved by selection.

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