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Genetic variability, correlation and path analysis in fenugreek (*Trigonella foenum-graecum* L.)

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Abstract

Genetic variability was studied in a population of 22 genotypes of fenugreek (*Trigonella foenum-graecum*) at Sriniketan (West Bengal). Phenotypic and genotypic coefficients of variability were high for stem weight; moderate for plant height, branches plant^{-1}, days to flowering, duration of flowering, shelling per cent and test weight; and low for pod length. High to moderate estimates of heritability coupled with moderate to high genetic advance were recorded for plant height, days to flowering, duration of flowering, shelling per cent and test weight indicating the predominance of additive gene action. Grain yield was positively correlated with branches plant^{-1}, pods plant^{-1}, pod length, seeds pod^{-1}, pod weight, biological yield, shelling per cent and harvest index at both phenotypic and genotypic levels. Results of path analysis revealed that days to flowering, pods plant^{-1}, pod length and seeds pod^{-1} are the important characters determining seed yield in fenugreek.

Key words: fenugreek, interrelationship, path coefficient, *Trigonella foenum-graecum*, variability.

Low productivity of fenugreek (*Trigonella foenum-graecum* L.) in India is due to non-availability of suitable high yielding varieties for various agroclimatic regions in the country and poor crop husbandry. Studies on variability and/or character associations for different agronomic characters in fenugreek have been made by Singh & Raghuvanshi (1984), Sharma *et al.* (1990), Dash & Kole (2000) and Saha & Kole (2001). Such studies are prerequisites for genetic improvement of any crop. The present study was undertaken to assess variability and interrelationships among different quantitative characters in fenugreek in West Bengal.

The experimental material consisted of 22 diverse genotypes of fenugreek, collected from Main Spices Research Station, Jagudan (Gujarat), Hissar (Haryana) and National Bureau of Plant Genetic Resources, New Delhi. The genotypes were grown in a randomized block design with three replications during *rabi* 2000–03 at the Agriculture Farm, Institute of Agriculture, Visva-Bharati University, Sriniketan (23°39′ N 87°42′ E, 58.9 m MSL). (West Bengal). Each plot consisted of five

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rows of 3 m length with inter- and intra-row spacing of 20 cm and 5 cm, respectively. A uniform fertilizer dose of 25 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied and normal agronomic practices were followed. Observations were taken on five randomly selected plants from each of the replications for 14 quantitative characters. Mean data from each of the replications were used to estimate phenotypic and genotypic coefficients of variation (Burton 1952), heritability and genetic advance (Johnson *et al.* 1955), correlation (Robinson *et al.* 1951), and path coefficient (Dewey & Lu 1959) following standard methods.

The analysis of variance revealed significant differences among the genotypes for all the 14 characters studied. The estimates of phenotypic and genotypic coefficients of variation (PCV and GCV) were high for stem weight; moderate for plant height, branches $plant^{-1}$, days to flowering, duration of flowering, shelling per cent and test weight; and low for pod length (Table 1). The results are in agreement with Sharma *et al.* (1990) and Saha & Kole (2001) for stem weight. Moderate GCV for branches $plant^{-1}$ (Sharma *et al.* 1990; Saha & Kole 2001) and low GCV for pod length (Sharma *et al.* 1990) were also reported earlier. The difference between PCV and GCV was high for pods $plant^{-1}$, pod length, seeds pod^{-1}, pod weight, stem weight, biological yield and seed yield indicating greater role of environmental factors and low for plant height, days to flowering, shelling per cent and test weight indicating greater role of genetic factors.

High to moderate estimates of heritability accompanied with high to moderate genetic advance for plant height, days to flowering, duration of flowering, shelling per cent and test weight indicated the predominance of additive gene action for the expression of these characters (Johnson *et al.* 1955; Panse 1957). The results of phenotypic and genotypic coefficient of variability, heritability and genetic advance revealed that selection of quantitative characters like plant height, duration of flowering, test weight and shelling per cent

Table 1. Genotypic and phenotypic coefficients of variability, heritability and genetic advance for 14 quantitative characters in fenugreek

Character	Mean	Range	Coefficient of variation (%)		Heritability	Genetic	Genetic advance as
			GCV	PCV	(%)	advance	per cent of mean
Plant height (cm)	42.40	31.00–54.29	15.21	16.06	89.8	12.59	82.77
Branches $plant^{-1}$	5.80	4.50–7.17	11.08	15.48	51.2	0.96	8.66
Days to flowering	57.12	51.00–70.33	12.51	12.83	95.1	14.38	114.94
Duration of flowering (day)	22.33	17.00–26.33	12.43	14.24	76.1	4.99	40.14
Pods $plant^{-1}$	12.19	9.00–17.42	15.96	22.88	48.6	2.79	17.48
Pod length (cm)	6.76	6.00–7.34	4.59	9.63	22.7	0.30	6.53
Seeds pod^{-1}	9.90	7.81–12.33	7.98	13.87	33.1	0.94	11.77
Pod weight (g)	3.28	2.20–4.28	16.75	24.66	46.1	0.77	4.59
Stem weight $plant^{-1}$ (g)	4.88	2.99–7.73	20.27	29.27	47.9	1.41	6.95
Biological yield (g)	8.16	5.20–11.98	15.72	23.39	45.2	1.78	11.32
Shelling percentage (%)	57.77	33.04–65.87	11.59	12.58	84.9	12.71	109.66
Harvest index (%)	23.52	13.00–32.00	17.70	21.65	66.8	0.07	0.39
Test weight (g)	16.22	12.13–20.87	13.89	15.24	83.0	4.23	30.45
Seed yield $plant^{-1}$ (g)	1.89	1.19–2.67	18.55	26.84	47.8	0.50	2.70

GCV=genotypic coefficient of variation; PCV=phenotypic coefficient of variation

Table 2. Genotypic (G) and phenotypic (P) correlation coefficients among 14 quantitative characters in fenugreek

Character		Branches plant^{-1}	Days to flowering	Duration of flowering	Pods plant^{-1}	Pod length	Seeds pod^{-1}	Pod weight	Stem weight	Biological yield	Shelling percentage	Harvest index	Test weight	Seed yield plant^{-1}
Plant	G	-0.542**	-0.846**	0.711**	-0.296*	-0.367**	-0.596**	-0.176	-0.388**	-0.375**	0.321**	0.318**	0.588**	0.044
height	P	-0.325**	-0.789**	0.602**	-0.093	-0.103	-0.277*	-0.073	-0.262*	-0.227	0.333**	0.304*	0.517**	0.087
Branches	G		0.646**	-0.497**	0.694**	0.589**	0.477**	0.216	0.454**	0.443**	0.166	-0.069	-0.549**	0.327**
plant^{-1}	P		0.439**	-0.306*	0.406**	0.371**	0.362**	0.199	0.485**	0.447**	0.154	-0.155	-0.304*	0.249*
Days to	G			-0.919**	0.519**	0.119	0.564**	0.234	0.602**	0.565*	-0.385**	-0.488**	-0.741**	-0.036
flowering	P			-0.861**	0.332**	0.065	0.350**	0.178	0.379**	0.359**	-0.377**	-0.370**	-0.661**	-0.012
Duration of	G				-0.470**	0.007	-0.391**	-0.142	-0.544**	-0.480**	0.278*	0.428**	0.585**	0.044
flowering	P				-0.238	0.026	-0.219	-0.085	-0.219	-0.200	0.270*	0.242	0.479**	0.047
Pods plant^{-1}	G					0.670**	0.522**	0.836**	0.567**	0.795**	0.015	0.118	-0.496**	0.784**
	P					0.361**	0.312*	0.668**	0.398**	0.581**	0.083	0.191	-0.327**	0.667**
Pod length	G						0.441**	0.510**	0.088	0.286*	0.318**	0.503**	-0.036	0.709**
	P						0.591**	0.520**	0.203	0.372**	0.295*	0.361**	0.046	0.629**
Seeds pod^{-1}	G							0.183	0.336**	0.338**	0.273*	0.105	-0.559**	0.381**
	P							0.523**	0.355**	0.487**	0.278*	0.231	-0.183	0.618*
Pod weight	G								0.337**	0.688**	-0.264*	0.198	-0.147	0.755**
	P								0.411**	0.731**	-0.120	0.283*	0.029	0.863**
Stem weight	G									0.915**	-0.123	-0.615**	-0.331**	0.234
plant^{-1}	P									0.922**	-0.035	-0.563**	-0.094	0.335**
Biological	G										-0.208	-0.390**	-0.318**	0.504**
yield plant^{-1}	P										-0.077	-0.302*	-0.059	0.616**
Shelling	G											0.602**	0.397**	0.438**
percentage	P											0.527**	0.348**	0.383**
Harvest index	G												0.399**	0.599**
	P												0.308*	0.544**
Test weight	G													0.137
	P													0.187

* Significant at 5% level; ** Significant at 1% level

Table 3. Genotypic path coefficient analysis of seven quantitative characters on seed yield in fenugreek

Character	Plant height	Branches plant^{-1}	Days to flowering	Pods plant^{-1}	Pod length	Seeds pod^{-1}	Test weight	Correlation with seed yield
Plant height	**1.324**	0.283	-1.078	-0.009	-0.446	-0.165	0.136	0.045
Branches plant^{-1}	-0.718	**-0.522**	0.824	0.021	0.717	0.132	-0.127	0.327**
Days to flowering	-1.119	-0.337	**1.275**	0.016	0.145	0.156	-0.171	-0.035
Pods plant^{-1}	-0.391	-0.362	0.662	**0.030**	0.815	0.144	-0.114	0.784**
Pod length	-0.485	-0.307	0.152	0.020	**1.217**	0.122	-0.008	0.711**
Seeds pod^{-1}	-0.789	-0.249	0.719	0.016	0 .537	**0.277**	-0.129	0.382**
Test weight	0.779	0.287	-0.945	-0.015	-0.044	-0.155	**0.230**	0.137

Residual=0.1342; ** Significant at 1% level; Figures in bold indicate direct effects

would be effective for improvement of grain yield in this population.

Positive and significant correlations with grain yield were found for branches plant^{-1}, pods plant^{-1}, pod length, seeds pod^{-1}, pod weight, biological yield, shelling per cent and harvest index at both phenotypic and genotypic levels indicating the importance of these characters in determining seed yield (Table 2). The results are in agreement with Sharma *et al.* (1990), Singh *et al.* (1993) and Dash & Kole (2000) for seeds pod^{-1} and biological yield. Among other intercharacter correlations, pods plant^{-1} showed positive correlation with branches plant^{-1}, pod length and seeds pod^{-1} while test weight showed negative correlation with days to flowering, pods plant^{-1} and seeds pod^{-1}. Singh & Raghuvanshi (1984) and Saha & Kole (2001) also obtained similar association between pods plant^{-1} and branches plant^{-1}. Therefore, while selecting plants with higher number of branches and pods plant^{-1}, care should be taken for seed size so that a reasonable balance among pods plant^{-1}, seeds pod^{-1} and test weight within the limits of physiological compensation is achieved with higher seed yield.

Path analysis at genotypic level was carried out taking seven characters as independent variables and grain yield as dependent variables (Table 3). Other characters either containing grain yield as such or being overlapping with other were excluded from path analysis. Shrivastava & Sharma (1976) suggested that only direct yield component should be used for path analysis. The residual effect at genotypic level indicated that the seven characters included in this study explained the high percentage of variation in grain yield in this population. Moreover, majority of the values of path coefficients were less than unity indicating that inflation due to multicollinearity is minimal (Gravois & Helms 1992). Plant height and test weight although have positive direct effects and branches plant^{-1} has negative direct effect, the indirect contributions of other characters through these three characters are negative. Moreover, plant height and test weight had non-significant correlation with seed yield. Days to flowering, pod length, seeds pod^{-1} and pods plant^{-1} had positive direct effect and their indirect contributions through each other were also positive. Therefore, these characters should be given more weightage during selection for obtaining high yielding lines.

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