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Variability, correlation and path coefficient analysis in fenugreek (*Trigonella foenum- graecum* L.) under water limited conditions

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Abstract

Genetic variability, character association and path analysis between yield and its component traits were carried out in 48 genotypes of fenugreek (*Trigonella foenum graecum*) at Udaipur (Rajasthan). Highly significant differences between genotypes were recorded for all the characters studied. High phenotypic and genotypic coefficient of variation coupled with high heritability and high genetic advance was observed for seed yield plot^{-1}, biological yield plot^{-1}, harvest index and pods plant^{-1} indicating the importance of additive gene effects for these traits. Biological yield plot^{-1} and harvest index exhibited positive and significant correlation with seed yield while days to 50% flowering exhibited negative and significant association with seed yield. Path coefficient analysis revealed that biological yield plot^{-1} had highest positive direct effect on seed yield followed by branches plant^{-1}, pod length and test weight. It was concluded that improvement in the seed yield of fenugreek is possible through selection for biological yield plot^{-1}, harvest index, branches plant^{-1}, pod length and test weight.

Keywords: fenugreek, genotype, *Trigonella foenum-graecum*, variability.

Fenugreek (*Trigonella foenum-graecum* L.), occupies a prime position among the seed spices grown in Rajasthan. However the productivity of fenugreek is low due to non-availability of suitable high yielding varieties for various agro-climatic regions. In order to make this crop more productive and resistant to diseases and insect pests in Rajasthan, an intensive breeding programme is required for incorporating an array of variability. Hence, an attempt was made to study the genetic variability, by determining the magnitude of genetic coefficient of variation, heritability estimates and expected genetic advance of different biometric traits, their correlation and effects in 48 genotypes of fenugreek.

The 48 genotypes of fenugreek were collected from different fenugreek growing areas of Rajasthan namely, Ajmer, Jobner, Udaipur, Nagore, Bundi, Jhalawar, Rajsamand and Nimbahera. These genotypes were evaluated

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in a randomized complete block design with three replications at the Research Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) during *rabi* (winter) 2004-05. In each replication, the genotypes were sown in a plot of 2.0 m x 0.6 m size accommodating two rows of 2 m length spaced 30 cm apart with an intra-row spacing of 10 cm maintained by dibbling. All the recommended package of practices were followed to raise a good crop; two irrigations were given to raise the crop. Observations were recorded on five plants from each plot per replication, for plant height, branches plant^{-1}, pods plant^{-1}, pod length and seeds pod^{-1}, while for days to 50% flowering, test weight, seed yield, biological yield and harvest index, the data were recorded on whole plot basis. Analysis of variance was done by the method suggested by Panse & Sukhatme (1985). The phenotypic and genotypic coefficient of variation was worked out as per Burton (1952) and heritability (broad sense) and genetic advance were determined following the methodology of Johnson *et al.* (1955). The phenotypic and genotypic correlation coefficients were calculated as per the methods given by Al-Jibouri *et al.* (1958). The path coefficients were obtained by following the method of Dewey & Lu (1959).

Analysis of variance revealed significant differences among genotypes for all the traits studied indicating presence of significant variability in the materials (Table 1). The range of variation was high for seed yield plot^{-1} (116.67-266.67 g) followed by plant height (66.67-88.33 cm) and pods plant^{-1} (20.67-42.33) as observed by Gangopadhyay *et al.* (2009). The estimates of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the traits studied which is an indicator of additive effect of the environment on the expression of the trait. The estimates of PCV and GCV indicated the existence of fairly high degree of variability for seed yield plot^{-1}, biological yield plot^{-1}, harvest index and pods

Table 1. Range, mean, phenotypic and genotypic coefficient of variation, heritability and genetic advance as per cent of mean of various characters in 48 genotypes of fenugreek

Character	Range	Mean ± SE	Phenotypic coefficient of variation (PCV)	Genotypic coefficient of variation (GCV)	Heritability (broad sense) (%)	Genetic advance as % of mean
Days to 50% flowering	45.67-51.67	47.81 ± 0.50	3.71	2.60	67.23	4.39
Plant height (cm)	66.67-88.33	79.85 ± 1.93	7.08	5.71	64.99	9.48
Branches plant^{-1}	3.33-5.00	4.28 ± 0.28	13.41	7.14	28.35	7.83
Pods plant^{-1}	20.67-42.33	32.56 ± 2.12	17.94	13.94	60.41	22.32
Pod length (cm)	9.83-12.83	10.88 ± 0.29	7.36	5.71	60.22	9.13
Seeds pod^{-1}	14.33-18.00	15.94 ± 0.53	6.47	2.95	20.83	2.78
Test weight (g)	9.33-12.67	10.33 ± 0.40	10.28	7.80	57.58	12.19
Biological yield plot^{-1} (kg)	0.70-1.70	1.20 ± 0.05	17.35	15.57	80.56	28.80
Harvest index (%)	11.01-21.45	16.09 ± 0.50	15.35	14.37	87.63	27.71
Seed yield plot^{-1} (g)	116.67-266.67	190.03 ± 7.61	23.23	22.17	91.08	43.58

Table 2. Genotypic and phenotypic (in parenthesis) correlation coefficient among 10 quantitative traits in fenugreek

Character		Days to 50 % flowering	Plant height	Branches plant^{-1}	Pods plant^{-1}	Pod length	Seeds pod^{-1}	Test weight	Biological yield plot^{-1}	Harvest index	Seed yield plot^{-1}
Days to 50% flowering	rg	**1.00**	0.12	-0.03	0.03	0.10	-0.32*	0.04	-0.03	-0.49**	-0.34*
	rp	**(1.00)**	0.08	0.01	0.02	0.00	-0.03	-0.06	-0.01	-0.38**	-0.27
Plant height	rg		**1.00**	0.26	0.17	-0.01	0.08	-0.02	-0.03	-0.20	-0.15
	rp		**(1.00)**	0.08	0.06	-0.04	-0.09	-0.04	-0.01	-0.17	-0.11
Branches plant^{-1}	rg			**1.00**	0.68**	-0.37**	0.28	0.23	-0.22	-0.08	-0.17
	rp			**(1.00)**	0.22	-0.13	0.10	0.13	-0.09	-0.04	-0.07
Pods plant^{-1}	rg				**1.00**	-0.27	0.39**	0.21	0.23	-0.21	0.01
	rp				**(1.00)**	-0.12	0.23	0.02	0.17	-0.18	-0.00
Pod length	rg					**1.00**	0.22	-0.28	0.12	0.03	0.12
	rp					**(1.00)**	0.09	-0.16	0.05	0.05	0.07
Seeds pod^{-1}	rg						**1.00**	0.00	0.21	-0.15	0.03
	rp						**(1.00)**	-0.11	-0.02	-0.04	-0.04
Test weight	rg							**1.00**	-0.24	0.14	-0.06
	rp							**(1.00)**	-0.17	0.14	-0.02
Biological yield plot^{-1}	rg								**1.00**	0.08	0.77**
	rp								**(1.00)**	-0.00	0.74**
Harvest index	rg									**1.00**	0.70**
	rp									**(1.00)**	0.66**
Seed yield plot^{-1}	rg										**1.00**
	rp										**(1.00)**

* Significant at P=0.05; ** Significant at P=0.01; rg=genotypic correlation; rp=phenotypic correlation

plant^{-1}. High magnitude of PCV and GCV was also observed for seed yield and biological yield by Rakesh & Korla (2003) and for pods plant^{-1} by Raje *et al.* (2003). The seed yield plot^{-1} showed the highest PCV value of 23.23% in comparison to GCV of 22.17% suggesting less environmental influence on this character, which was confirmed by its high heritability. The difference between PCV and GCV was minimum for harvest index, seed yield plot^{-1}, days to 50% flowering, pod length and biological yield plot^{-1} suggesting that these traits were least affected by environment. This observation draws support from the high value of heritability recorded for these traits. In corollary to high heritability estimates, high estimates of genetic advance as per cent of mean was observed for seed yield plot^{-1}, harvest index, biological yield plot^{-1} and pods plant^{-1} indicating predominance of additive gene effects for these traits. Similar finding was observed for pods plant^{-1} by Rakesh & Korla (2003) and Raje *et al.* (2003).

The phenotypic and genotypic correlation among the yield and yield components in fenugreek are presented in Table 2. Significant correlation of characters suggested that there is much scope for direct and indirect selection for further improvement. In general, the estimate of genotypic correlation coefficient was higher than their corresponding phenotypic ones, thereby, suggesting strong inherent association among the characters studied. In the present investigation, seed yield was positively and significantly correlated with biological yield plot^{-1} and harvest index at both genotypic and phenotypic level, while it showed negatively and significantly correlated with days to flowering. Therefore, these characters should be considered while making selection for yield improvement in fenugreek. These results are in accordance with the results of Ananya & Kole (2004) for biological yield plant^{-1} and harvest index. Pods plant^{-1} showed positive and significant genotypic correlation with branches plant^{-1}. On the other hand seeds pod^{-1} showed positive and significant genotypic

Table 3. Direct and indirect effect of different characters on seed yield in fenugreek

Character	Days to 50% flowering	Plant height	Branches plant^{-1}	Pods plant^{-1}	Pod length	Seeds pod^{-1}	Test weight	Biological yield	Correlation with seed yield
Days to 50% flowering	**-0.43**	-0.01	-0.02	-0.01	0.03	0.12	0.01	-0.03	-0.34*
Plant height	-0.05	**-0.09**	0.12	-0.06	-0.00	-0.03	-0.00	-0.03	-0.15
Branches plant^{-1}	0.01	-0.02	**0.47**	-0.25	-0.10	-0.10	0.06	-0.23	-0.17
Pods plant^{-1}	-0.01	-0.02	0.32	**-0.37**	-0.07	-0.14	0.05	0.25	0.01
Pod length	-0.04	0.00	-0.18	0.10	**0.27**	-0.08	-0.07	0.12	0.12
Seeds pod^{-1}	0.14	-0.01	0.13	-0.14	0.06	**-0.37**	0.00	0.22	0.03
Test weight	-0.02	0.00	0.11	-0.08	-0.08	-0.00	**0.26**	-0.25	-0.06
Biological yield	0.01	0.00	-0.10	-0.09	0.03	-0.08	-0.06	**1.05**	0.77**

Residual effect: 0.3317; Bold figures in main diagonal indicate direct effects

correlation with pods plant^{-1} at genotypic level. Path analysis based on genotypic correlation coefficient showed that biological yield plot^{-1} which has high positive correlation with seed yield plot^{-1}, also had the highest direct effect (Table 3). It may, however, be noted that its influence was reduced to a great extent due to negative indirect effects of branches plant^{-1}, pods plant^{-1} and seeds pod^{-1}. The direct effects of branches plant^{-1}, pod length and test weight were also positive and high. The direct effect of days to 50% flowering on seed yield was negative. The value of residual effect (0.3317) indicates that there may be some other secondary components that should not be ignored.

The study indicated that characters such as biological yield plot^{-1}, harvest index, branches plant^{-1}, pod length and test weight should be considered for yield improvement in fenugreek breeding programme.

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