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Variability, Character Association and Path Analysis Studies in Fenugreek (*Trigonella foenum-graecum* L.)

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ABSTRACT

Fifty germplasm of fenugreek (Trigonella foenum-graecum L.) along with five checks namely Hisar Suvarna, Hisar Sonali, RMt-361, RMt-1 and AFg-3 were evaluated in Augmented Block Design in five blocks during Rabi 2013-2014 at the research farm of National Research Centre on Seed Spices, Tabiji, Ajmer (Rajasthan) to estimate variability, character association and path analysis among seed yield and its contributing traits. Analysis of variance revealed significant variability for most of the traits. High estimates of phenotypic coefficient of variance along with genotypic coefficient of variance as well as broad sense heritability, genetic advance and genetic advance as percentage of mean were observed for days to 50 percent flowering and seed yield per plant. Seed yield per plant was significantly and positively correlated with plant height, number of seeds per pod and number of pods per plant, while its association with days to 50 percent flowering, primary branches per plant, secondary branches per plant number of pods on main stem, pod length, shelling percent and test weight was non-significant but positive. Path analysis revealed that test weight, number of seeds per pod, number of pods per plant, number of pods on main stem and secondary branches per plant were the important characters for selection of high yielding germplasm line as they exhibited direct and positive effect on seed yield per plant.

Key words: *Fenugreek, variability, character association, path coefficient.*

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is an annual diploid species, popularly grown by its vernacular name "*methi*", belonging to the sub-family "Papilionaceae" of the family "Fabaceae". The word *"Trigonella*" is a Latin word, having means from little triangle; referring to its triangular shape of flower. The species name "*foenum-graecum*" means "Greek-hay**"** indicate its used as a forage crop in the past. Fenugreek is native to the countries bordering the Eastern shores of Mediterranean, extending to Central Asia. It is a self-pollinated crop with chromosome no. 2n=16[6]. It is an important condiment crop grown for both seed as well as leaves purpose, largely in North India during *Rabi* season.

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Fenugreek can be grown under a wide range of climatic conditions. It requires cool climate and dry weather at the time of maturity. In India fenugreek is cultivated in an area of about 81,200 ha with the average production of about 1, 18,400 tones and productivity of 1,458 kg/ha[1]. Fenugreek is mainly cultivated in the states of Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh and Uttar Pradesh.

Fenugreek is an important spice crop due to its multitudinous uses. Fenugreek are extensively used as fresh leaves (green leafy vegetable), chopped leaves (flavouring agent), sprouts (salad), micro greens (salad), pot herbs (decoration), seeds (spice, condiments or medicines), extracts and powders (medicines). The seeds and leaves of fenugreek are widely known for its culinary properties for flavouring food preparations to enhance the taste of meat, poultry and vegetables. Fenugreek leaves are used in making parantha, khakra, herbal tea and injera/taita. Fenugreek seeds are also used as a main constituent of curry powder. Fenugreek seeds are used to treat flatulence, dysentery, enlargement of lever span, gout, headache, deafness, baldness, vata disease, leucorrhoea, back pain, mouth ulcer, abdominal pain, kidney problem, hernia, beri-beri, chapped lips, diabetes, colic, dropsy, spleen, heart disease, obesity, etc. Seeds are considered to be a restorative, to ease mensuration, promote milk flow and have aphrodisiacal property. In laboratory studies highlighted fenugreek ability to stop breast cancer cell and leukemia cell growth.

Grain yield is a complex character and is controlled by many factors. Selection for desirable types should not only be restricted to grain yield alone but other components related to grain yield should also be considered. The correlation coefficient may also help to identify characters that have little or no importance in the selection programme. The existence of correlation may be attributed to the presence of linkage or pleiotropic effect of genes or physiological and development relationship or environmental effect or in combination of all. Path coefficient analysis is a statistical technique of partitioning the correlation coefficients into its direct and indirect effects[5] so that the contribution of each character to yield could be estimated. It is used in plant breeding programs to determine the nature of the relationships between yield and yield components that are useful as selection criteria to improve the crop yield. The goal of the path analysis is to accept descriptions of the correlation between the traits, based on a model of cause and effect relationship and to estimate the importance of the affecting traits on specific traits. The present study was undertaken at NRCSS, Ajmer to estimate the variability present in active germplasm of fenugreek and to evaluate the extent of association among yield and yield contributing traits.

MATERIALS AND METHODS

The experimental material for the present investigation consisted of 50 diverse genotypes from different geographic and genetic origin and five checks viz., (Hisar Suvarna, Hisar Sonali, RMt-1, RMt-361 and AFg3). The experiment was laid out in an Augmented Design in five blocks with ten test entries and five checks in each block. The plot size was of 0.5 m x 2 m with row to row spacing of 50 cm and plant to plant spacing was 5-10 cm. All recommended agronomic practices and plant protection measures were followed timely for successful raising of the crop. Observation on the characters were recorded on five randomly selected plants from each testing germplasm at the time of maturity except days to 50 per cent flowering and days to 75 percent maturity, which was recorded on the whole plot basis. These quantitative characters were used to estimate phenotypic and genotypic coefficient of variation, broad sense heritability, expected genetic advance at 5 per cent selection intensity, correlation coefficient and path coefficient following the standard statistical methods[13].

RESULTS AND DISCUSSION

The analysis of variance revealed that significant amount of variability was present in germplasm lines for almost all morphological traits studied (days to 50 percent flowering, number of pods on main stem, number of pods per plant, pod length, shelling percent, number of seeds per pod, test-weight and seed yield per plant.) while non significant amount of variability days to 75 percent maturity, plant height, primary branches and number of secondary branches per plant (Table 1).The present findings confirm the earlier reports on variability in characters suitable for selection[7].

Higher GCV (genotypic coefficient of variation) was recorded for yield per plant (26.08), number of per plant (14.21), test weight (13.79), number of secondary branches per plant (12.97), shelling (%) (10.68) and number of seeds per pod (9.88). It expresses the true genetic potential which indicated the presence of high amount of genetic variability for these characters thus, selection may be more effective for these characters because the response to selection is directly proportional to the component of variability. Similarly, Higher PCV (phenotypic coefficient of variation) was recorded for yield per plant (29.14), secondary branches per plant (21.16), number of pod per plant (15.23), primary branches per plant (13.21), test weight (14.38), and number of seed per pod (11.25),(Table 2).

The results revealed that the differences between genotypic and phenotypic variations were low and this is expected in augmented design. In an augmented design, the error component used is based on checks which are repeated in blocks. This often is very limited; hence the difference is very limited. The closeness of the estimates of genotypic and phenotypic coefficient of variation indicates that these traits are least affected by the environment.

The estimates of heritability in (broad sense) expressed in percentage was high for the characters viz. days to 50 percent flowering, number of pods per plant, seed yield per plant, test weight, shelling percent and number of seeds per pod, indicating that these characters are less influenced by environment and direct selection for these yield contributing traits would be effective for future improvement in yield. Similar result was found in the findings of Meena *et al*[9]., Naik *et al*[10]., Verma and Ali[14], Pushpa[12]. Genetic advance as percentage of mean for the characters ranged from 0.00 (days to 75 percent maturity) to 48.10 (yield per plant). High magnitude of genetic advance as percentage of mean was estimated for yield per plant and days to 50 percent flowering.

The phenotypic correlation coefficient was higher than their genotypic correlation coefficient counterparts in most of the characters. This implies that the non-genetic causes affect the values of genotypic correlation because of the influence of the environmental factors. The association analysis at both genotypic and phenotypic level revealed that the seed yield per plant was significantly and positively correlated with plant height, number of seeds per pod and number of pods per plant. While the associations of seed yield per plant with days to 50 percent flowering, primary branches per plant, secondary branches per plant, number of pods on main stem, pod length, shelling percent and test weight were non-significant but positive (Table 3). The present findings confirm the earlier reports of Ayanoglu *et al*[2]., and Prajapati *et al*[11].

Path analysis revealed that the direct effects were stronger than indirect effects and the changed in either direction between the genotypic and phenotypic path coefficient were seldom noted. Path coefficient analysis as based on genotypic and phenotypic correlations indicated that test weight, number of seeds per pod, number of pods per plant, number of pods on main stem and secondary branches per plant were the important characters for selection of high yielding germplasm line as they exhibited direct and positive effect on seed yield per plant. Magnitude of the correlation coefficient between a causal factor and the effect is almost equal to its direct effect. Hence, correlations explained the true interrelationship and suggested that a direct selection of these traits will be effective (Table 4). These findings are in accordance with the reports of Dash and Kole[3], Datta *et al*[4]., Gangopadhyay *et al*[7]., Prajapati *et al*[11]., Kole and Saha[8], while days to 75 percent maturity, number of primary branches per plant exerted direct and negative effect on seed yield per plant, while days to 50 percent flowering had genotypic direct positive effect but phenotypic is negatively direct effect on seed yield, same as the plant height had showed the genotypic is positive direct effect but phenotypic is negatively direct effect on seed yield. Important information which emerged from the correlation and path coefficient analysis studies is that test weight, plant height, number of pods per plant and number of pods on main stem are the most important yield contributing traits for seed yield per plant and these were also found to be responsible for the observed relationship of different morphological characters with seed yield per plant. Hence, due emphasis should be given to seeds per pod, pod length, days to 50 percent flowering and branches per plant in yield improvement.

Table 1: Analysis of variance for different characters

Sources of variation	Df	Days to 50% flowering	Days to 75% maturity	Plant height	Primary branches per plant	Secondary branches per plant	No. of pods on main stem	No. of pods per plant	Pod length	Shelling%	No. of seeds per pod	Test weight	Yield per plant
Block (Eliminating check + Var.)	4	0.554	0.302	41.331	0.829	1.572	0.430	2.393	0.169	6.526	0.320	0.152	0.245
Entries (Ignoring Block)	54	14.97***	2.072	50.202	0.572	2.769	3.008*	99.288***	0.229*	73.855***	3.454***	5.301***	9.374***
Checks	4	36.59***	2.1	49.690	1.169*	2.396	9.698**	91.071***	0.006	64.617**	7.463***	2.260**	21.996***
Germplasm	49	13.508***	2.101	48.898	0.520	2.704	2.396	84.80***	0.238*	73.957***	3.197***	5.641***	7.165***
Checks vs. Germplasm	1	0.24	0.54	116.124	0.721	7.437*	6.242*	842.061***	0.7004**	105.856*	0.035	0.837	67.160***
Error	16	1.085	2.524	47.826	0.381	1.453	1.343	7.944	0.0805	12.755	0.547	0.320	1.060

** Significant at p = 0.01

* Significant at p = 0.05

Table 2: Overall mean values of genotypes, their range, genotypic and phenotypic coefficient of variation, heritability in broad sense, genetic advance and genetic advance as % of mean for different characters in fenugreek

Characters	**Mean**	**Range (min.- max.) (adjusted value)**	**Genotypic coefficient of variation (GCV %)**	**Phenotypic coefficient of variation (PCV %)**	**Heritability in broad sense (%)**	**Genetic advance**	**Genetic advance as % of mean**
Days to 50 percent flowering	54.97	48.88-70.28	5.366	5.691	88.91	5.72	40.4222
Day of 75% maturity	133.96	132-136.20	0.000	1.114	0.00	0.000	0.00
Plant height	87.18	66.32-101.43	0.996	8.017	1.55	0.2225	0.2552
No. of primary branches	5.26	3.97-7.09	5.957	13.209	20.34	0.2900	5.5351
No of secondary branches	7.27	4.84-10.64	12.977	21.160	37.61	1.1824	16.3948
No. of pods on main stem	13.14	9.70-16.18	6.563	11.025	35.44	1.0531	8.0487
No. of pods per plant	52.24	25.66-64.50	14.216	15.229	87.13	14.1042	27.3359
Pod length	10.88	9.40-11.81	3.063	4.027	57.85	0.5211	4.7991
Shelling (%)	61.03	34.52-94.35	10.685	12.172	77.06	11.8360	19.3223
No. of seeds per pod	13.78	8.16-19.70	9.887	11.253	77.2	2.4648	17.8948
Test weight	14.01	9.30-19.09	13.798	14.379	92.08	3.8149	27.2744
Yield per plant	8.10	1.99-12.26	26.088	29.145	80.12	3.8119	48.1051

Table 3: Phenotypic and genotypic correlation coefficient between different characters in fenugreek

Characters	Level	Days to 50% flowering	Days to 75% maturity	Plant height	Primary branches per plant	Secondary branches per plant	No. of pods main stem	No. of pods per plant	Pod length	Shelling%	No. of seeds per pod	Test weight	Yield per plant
Days to 50% flowering	P	1	0.079	-0.163	-0.353*	-0.063	0.062	0.172	-0.187	0.099	0.188	-0.250	0.190
	G	1	0.111	-0.256	-0.238	-0.010	0.031	0.190	-0.248	0.110	0.194	-0.256	0.204
Days to 75% maturity	P		1	-0.285*	-0.188	0.053	-0.167	-0.011	-0.052	-0.389**	-0.088	-0.375**	-0.065
	G		1	-0.303	-0.359**	-.109	-0.155	-0.032	-0.131	-0.405	-0.046	-0.356**	-0.070
Plant height	P			1	0.079	0.007	0.316*	0.246	0.177	0.140	0.239	0.327*	0.285*
	G			1	0.176	0.151	0.226	0.222	0.18	0.160	0.163	0.367**	0.290*
Primary branches per plant	P				1	0.283*	0.200	0.178	0.129	-0.101	-0.105	0.083	0.018
	G				1	0.068	0.263	0.163	0.224	0.027	-0.050	0.161	0.015
Secondary branches per plant	P					1	-0.046	0.125	0.168	0.015	-0.106	0.163	0.155
	G					1	0.004	0.128	0.313*	-0.003	-0.088	0.112	0.163
No. of pod on main stem	P						1	0.094	0.212	-0.024	0.224	0.121	0.200
	G						1	0.070	0.133	0.135	0.175	0.149	0.185
No. of pods per plant	P							1	0.072	-0.016	0.239	-0.024	0.824**
	G							1	0.065	-0.024	0.257	-0.015	0.828**
Pod length	P								1	-0.136	0.121	0.001	0.004
	G								1	-0.191	0.073	0.081	0.027
Shelling %	P									1	0.152	0.375**	0.028
	G									1	0.114	0.385**	0.020
No of seeds per pod	P										1	-0.173	0.306*
	G										1	-0.194	0.317*
Test weight	P											1	0.122
	G											1	0.116
Yield per plant	P												1
	G												1

Table 4: Direct (diagonal) and indirect effects of different characters on seed yield per plant in fenugreek at genotypic and phenotypic level

Characters	G/P	Days to 50 % flowering	Days to 75% maturity	Plant height (cm)	Primary branches per plant	Secondary branches per plant	No. of pods on main axis	No. of pods per plant	No. of seed per pod	Test weight
Days to 50% flowering	G	**0.037**	-0.002	-0.011	0.041	-0.000	0.003	0.152	0.018	-0.035
	P	**-0.001**	-0.001	0.003	0.066	-0.007	0.008	0.140	0.019	-0.038
Days to 75% maturity	G	0.004	**-0.019**	-0.013	0.062	-0.006	-0.019	-0.025	-0.004	-0.049
	P	-0.000	**-0.015**	0.006	0.035	0.006	-0.021	-0.009	-0.009	-0.057
Plant height (cm)	G	-0.009	0.005	**0.043**	-0.030	0.008	0.027	0.178	0.015	0.050
	P	0.000	0.004	**-0.022**	-0.014	0.000	0.040	0.201	0.025	0.050
Primary branches per plant	G	-0.008	0.006	0.007	**-0.174**	0.003	0.032	0.131	-0.004	0.022
	P	0.000	0.002	-0.001	**-0.189**	0.032	0.025	0.145	-0.011	0.012
Secondary branches per plant	G	-0.000	0.002	0.006	-0.012	**0.056**	0.000	0.103	-0.008	0.015
	P	0.000	-0.000	-0.000	-0.053	**0.115**	-0.005	0.102	-0.011	0.009
No. of pods on main stem	G	0.001	0.002	0.009	-0.046	0.000	**0.123**	0.056	0.017	0.020
	P	-0.000	0.002	-0.007	-0.038	-0.005	**0.128**	00.77	0.023	0.018
No. of Pods Per plant	G	0.007	0.000	0.009	-0.028	0.007	0.008	**0.801**	0.025	-0.002
	P	-0.000	0.000	-0.005	-0.033	0.014	0.012	**0.816**	0.025	-0.003
No. of seeds per pod	G	0.007	0.000	0.007	0.008	-0.004	0.021	0.206	**0.097**	-0.026
	P	-0.000	0.001	-0.005	0.019	-0.012	0.028	0.195	**0.104**	-0.026
Test weight	G	-0.009	0.006	0.015	-0.028	0.006	0.018	-0.012	-0.018	**0.138**
	P	0.000	0.005	-0.007	-0.015	0.007	0.015	-0.019	-0.018	**0.154**

REFERENCES

1. Anonymous, Indian Horticulture Database, *NHB Ministry of Agri., Government of India* (2014).
2. Ayanoglu, F., Arslan, M. and Mert, A., Correlation and path analysis of the relationship between yield and yield components in fenugreek (*Trigonellafoenum - graecum* L.). *Turkish Journal of Field Crops*, **9:** 11-15 (2004).
3. Dash and Kole, Association analysis of grain yield and its components in fenugreek (*Trigonellafoenum-graecum* L.). *Crop Research* (*Hisar*), **20:** 449 – 452 (2000).
4. Datta, S., Chatterjee, R. and Mukherjee, S., Variability, heritability and path analysis studies in fenugreek. *Indian Journal of Horticulture*, **62:** 96-98 (2005).
5. Dewey, J.R. and Lu, K.H., Correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomy J.*, **51:** 515-518 (1959).
6. Frayer, J.K., Chromosome Atlas of flowering plant. *George Allen and Urwin London*, pp.519 (1930).
7. Gangopadhyay, K.K., Yadav, S.K., Gunjeet, Kumar., Meena, B.L., Mahajan, R.K., Mishra, S.K. and Sharma, S.K., Correlation, path-coefficient and genetic diversity pattern in fenugreek (*Trigonellafoenum - graecum*). *Indian Journal of Agricultural Sciences*, **79:** 521-526 (2009).
8. Kole, P.C. and Saha, A., Correlation co-efficient of component characters with seed yield and their direct effects in path analysis in fenugreek grown under six environments. *Journal of Horticulture and Forestry*, **5:** 17-20 (2013).
9. Meena, R.S., Kakani, R.K., Anwer, M.M. Panwar, Alka, Chaudhary, Sharda and Meena, Shiv Ram, Variability studies in fenugreek (*Trigonellafoenum-graecum*L.). *International Journal of Seed Spices*, **1:** 44-46 (2011).
10. Naik, Abhishek.,Akhtar, Sbirin and Pandey, V.P., Variability in growth, yield attributes and yield in different genotypes of fenugreek (*Trigonellafoenum-graecum* L.) grown during winter season. *Environment and Ecology*, **30:** 1366-1368 (2012).
11. Prajapati, D.B., Ravindrababu, Y. and Prajapati, B.H., Genetic variability and character association in fenugreek (*Trigonellafoenum-graecum* L.). *Journal of Spices and Aromatic Crops*, **19:** 61-64 (2010).
12. Pushpa, T.N., Chandregowda, M., Srikantaprasad, D. and Gowda, A.P.M., Evaluation of fenugreek (*Trigonellafoenum-graecum* L.) genotypes for growth and seed yield. *Crop Research* (*Hisar*), **43:** 238-244 (2012).
13. Singh, R.K. and Choudhary, B.D., Biometrical Methods in Quantitative Genetic analysis. Kalyani Publishers, New Delhi. pp. 318 (1979).
14. Verma, Preeti. and Ali, Mashiat, Genetic variability in fenugreek (*Trigonellafoenum -graecum* L.) assessed in South Eastern Raj. *International Journal of Seed Spices*, 2: 56-58 (2012).