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Genetic variability and character association in fenugreek (*Trigonella foenum- graecum* L.)

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Abstract

Fifty germplasm of fenugreek (*Trigonella foenum-graecum* L.) along with five standard checks namely Hisar Suvarna, Hisar Sonali, RMt-361, RMt-1 and AFg-3 were evaluated in Augmented Block Design in five blocks during *rabi* season of 2012-13 at the research farm of National Research Centre on Seed Spices, Tabiji, Ajmer (Rajasthan) to estimate genetic variability, to study association among seed yield and its contributing traits and to determine direct and indirect effects of the yield contributing traits on seed yield. Analysis of variance revealed significant variability for most of the traits. High estimates of PCV along with GCV as well as broad sense heritability, genetic advance and genetic advance as percentage of mean were observed for number of pods on main axis and seed yield per plant. Total number of pods per plant showed high heritability with moderate genetic advance. Moderate to high estimates of heritability along with moderate to high genetic advance was recorded for the characters namely primary branches per plant, secondary branches per plant and test weight. Moderate to low heritability coupled with moderate genetic advance was observed for number of seeds per pod. Seed yield per plant was significantly and positively correlated with plant height, number of pods on main axis, total number of pods per plant and test weight, while its association with secondary branches per plant and number of seeds per pod was non-significant but positive. It had significant and negative association with days to 50 percent flowering while its association with primary branches per plant and pod length was non- significant but negative correlation. Path coefficient analysis revealed that test weight, seeds per pod, total number of pods per plant, number of pods on main axis, secondary branches per plant and plant height 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, selection

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”. It is native to the countries bordering the Eastern shores of Mediterranean region, extending to Central Asia. It is a self- pollinated crop with chromosome no. 2n=16 (Frayer, 4). It is an important condiment crop grown for both seed as well as leaves purpose, largely in North India during *rabi* season. Fenugreek can be grown under a wide range of climatic conditions. It is 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). It is widely cultivated in India, Iran, Nepal, Bangladesh, Pakistan, North Africa, East Africa, Ukraine, South East Asia, Russia, Greece, Argentina, Egypt, France, Spain, Turkey, Morocco and China. 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.

Yield is a complex character governed by several other yield attributing characters. Since, most of the yield attributing characters are quantitatively inherited and highly affected by environment, it is difficult to judge whether the observed variability is heritable or not. Correlation studies are helpful in determining the components of complex traits like yield. 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.

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Material and Methods

The experimental material comprised of 50 diverse genotypes from geographic and genetic origin and five checks namely Hisar Suvarna, Hisar Sonali, RMt-1, RMt-361 and AFg-3 which are locally used and famous high yielding improved varieties. These 50 germplasm line were evaluated in Augmented Design. The experiment was laid in 5 blocks with 10 test entries and 5 checks in each block during *rabi* 2012-13 at NRCSS, Ajmer**.** The plot size was of 0.5 m x 2 m with row to row spacing of 50 cm and plant to plant spacing of 5-10 cm. All recommended agronomic practices and plant protection measures were followed timely for successful raising the crop. Randomly five competitive plants were taken to record observation on nine quantitative characters namely number of primary branches per plant, number of secondary branches per plant, plant height (cm), number of pods on main axis, total number of pods per plant, pod length (cm), number of seeds per pod, test weight and seed yield per plant where as days to 50 percent flowering was recorded on 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 (Singh and Chaudhary, 16).

Results and discussion

The analysis of variance revealed that significant amount of variability was present in germplasm lines for almost all morphological traits studied except pod length (Table 1). Similar result was found by Hariharan and Vijayakumar (6), Gangoupadhyay *et al.* (5).

Higher GCV (genotypic coefficient of variation) was recorded for number of pods on main axis (51.23), seed yield per plant (33.63), secondary branches per plant (22.96), total number of pod per plant (18.25), primary branches per plant (15.12) and test weight (14.64), 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 number of pods on main axis (52.49), seed yield per plant (38.06), secondary branches per plant (28.24), total number of pod per plant (21.36), primary branches per plant (19.83) and test weight (19.40) (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 estimates of heritability (broad sense) expressed in percentage was high for the characters *viz.,* days to 50 percent flowering, number of pods on main axis, total number of pods per plant and seed yield per plant indicating less influence by environment and direct selection for these yield contributing traits would be effective for future improvement in yield. Similar results were reported by Sharma and Sastry (14), Prajapati *et. al.* (11), Dashora *et al*. (2), Naik *et al*. (10), Verma and Ali (17), Pushpa *et al.* (12). Genetic advance as percentage of mean for the characters ranged from 3.95 (pod length) to 103.00 (number of pods on main axis). High magnitude of genetic advance as percentage of mean was estimated for number of pods on main axis and seed yield per plant. High Heritability (broad sense) coupled with high genetic advance as percent of mean was observed for the characters viz. number of pods on main axis and seed yield per plant.

The phenotypic correlation coefficient was higher than their genotypic correlation coefficient counterparts in most of the characters. This implied 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 pods on main axis, total number of pods per plant and test weight. While the association of seed yield per plant with secondary branches per plant and number of seeds per pod were non-significant but positive. These results are in agreement with those obtained Singh and Kaur (15), Sharma and Sastry (14) and Pushpa *et al.* (12).

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, seeds per pod, total number of pods per plant, number of pods on main axis, secondary branches per plant and plant height 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 effects via component traits are almost equal to its direct effect. Hence, correlations explained the true interrelationship and suggested that a direct selection of these traits will be effective. These findings are in accordance with the reports of Sharma *et al.* (13), Mathur (8), Dash and Kole (1), Datta *et al*. (3), Gangoupadhyay *et al.* (5), Million *et al*. (9), Kole and Saha (7), while days to 50 percent flowering, pod length and number of primary branches per plant exerted direct and negative effect on seed yield per plant.

Important information which emerged from the correlation

Table 1: Analysis of variance for different characters

Sources of variation	D f	Days to 50% flowering	Primary branches per plant	Secondary branches per plant	Plant height (cm)	No. of pods on main axis	No. of pods per plant	Pod length (cm)	No. of seed per pod	Test weight (g)	Seed yield per plant (g)
Block (Eliminating check + Var.)	4	0.361	0.781	0.086	60.994**	4.813	18.001	0.155	2.322	2.207	1.841
Entries (Ignoring Block)	54	5.055**	1.837*	1.195**	29.633*	92.629**	158.076**	0.910	4.431*	8.152**	8.582**
Checks	4	12.060**	1.597	0.046	13.792	3.565	245.145**	2.456*	6.256*	16.191**	26.479**
Germplasm	49	4.583**	1.886*	1.300**	30.012*	100.736**	151.215**	0.758	4.337*	7.520*	7.081**
Checks vs. Germplasm	1	0.167	0.405	0.589	74.469*	51.626**	146.026*	2.182	1.730	7.011	10.560**
Error	16	0.359	0.631	0.343	12.117	3.391	31.087	0.522	1.954	2.602	1.163

** Significant at p = 0.01

* Significant at p = 0.05

Table 2: Overall mean value of genotypes, their range, genotypic and phenotypic ccefficient 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	54.78	52.88-62.88	3.139	3.324	89.15	3.344	6.105
Primary branches per plant	6.19	3.71-9.47	15.127	19.833	58.17	1.472	23.767
Secondary branches per plant	3.57	1.18-5.98	22.969	28.247	66.12	1.371	38.4736
Plant height (cm)	60.96	43.83-68.47	5.806	8.144	50.83	5.197	8.527
No of pods on main axis	16.11	9.63-76.59	51.234	52.493	95.26	16.596	103.009
Total no of pods per plant	50.23	22.43-81.03	18.255	21.365	73.01	16.140	32.132
Pod length (cm)	10.37	8.89-12.58	3.917	8.000	23.97	0.409	3.950
No of seed per pod	15.46	7.18-19.30	8.356	12.313	46.05	1.805	11.681
Test weight (g)	12.67	4.12-18.41	14.640	19.400	56.95	2.884	22.757
Seed yield per plant (g)	6.05	1.39-13.99	33.630	38.061	78.07	3.704	61.212

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

Characters	Level	Days to 50% flowering	Primary branches per plant	Secondary branches per plant	Plant height (cm)	No. of pods on main axis	Total no of pods per plant	Pod length (cm)	No. of seed per pod	Test weight (g)	Seed yield per plant (g)
Days to 50% flowering	P	1	0.412**	0.286*	-0.180	0.060	0.016	-0.376**	-0.095	-0.239*	-0.277*
	G	1	0.311*	0.228	-0.252*	-0.052	0.047	-0.320*	-0.028	-0.241*	-0.274*
Primary branches per plant	P		1	0.399**	-0.192	0.028	0.157	-0.216	-0.048	-0.151	-0.108
	G		1	0.383**	-0.124	0.060	0.201	-0.020	-0.0207	-0.198	-0.081
Secondary branches per plant	P			1	-0.174	0.191	0.104	-0.199	-0.137	-0.084	0.030
	G			1	-0.039	0.200	0.129	-0.106	-0.211	-0.102	0.112
Plant height (cm)	P				1	0.041	0.153	-0.083	0.048	0.288*	0.327*
	G				1	0.103	0.087	-0.0191	0.096	0.308*	0.381**
No of pods on main axis	P					1	0.399**	-0.011	0.162	-0.096	0.309*
	G					1	0.401**	0.009	0.177	-0.099	0.286*
No. of pods per plant	P						1	0.0143	0.063	-0.026	0.361**
	G						1	-0.024	0.137	0.031	0.293*
Pod length (cm)	P							1	0.133	0.216	0.152
	G							1	0.047	0.181	0.159
No of seed per pod	P								1	-0.242*	0.217
	G								1	-0.261*	0.154
Test weight (g)	P									1	0.431**
	G									1	0.410**
Seed yield per plant (g)	P										1
	G										1

** Significant at p = 0.01

* Significant at p = 0.05

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

Characters	G/P	Days to 50 % flowering	Primary branches per plant	Secondary branches per plant	Plant height (cm)	No. of pods on main axis	No. of pods per plant	Pod length (cm)	No. of seed per pod	Test weight (g)
Days to 50% flowering	G	-0.141	-0.018	0.049	-0.044	-0.008	0.007	-0.019	-0.006	-0.09
	P	-0.134	-0.018	0.035	-0.021	-0.010	0.004	0.005	-0.026	-0.110
Primary branches per plant	G	-0.044	-0.057	0.083	-0.021	0.009	0.033	-0.001	-0.004	-0.07
	P	-0.055	-0.044	0.048	-0.023	0.004	0.042	0.002	-0.013	-0.070
Secondary branches per plant	G	-0.032	-0.022	0.217	-0.006	0.030	0.021	-0.006	-0.048	-0.040
	P	-0.038	-0.017	0.122	-0.020	0.031	0.028	0.002	-0.038	-0.038
Plant height (cm)	G	0.035	0.007	-0.008	0.174	0.015	0.014	-0.001	0.022	0.120
	P	0.042	0.008	-0.021	0.119	0.006	0.041	0.001	0.013	0.133
No of pods on main axis	G	0.007	-0.003	0.043	0.018	0.151	0.066	0.000	0.040	-0.038
	P	0.008	-0.001	0.023	0.004	0.165	0.106	0.000	0.045	-0.044
Total no of Pods Per plant	G	-0.006	-0.011	0.028	0.015	0.060	0.165	-0.001	0.031	0.012
	P	-0.002	-0.006	0.012	0.018	0.056	0.268	-0.000	-0.018	-0.012
Pod length (cm)	G	0.045	0.001	-0.023	-0.003	0.001	-0.004	-0.060	0.010	0.071
	P	0.050	0.009	-0.024	-0.010	-0.001	0.003	-0.013	0.037	0.100
No of seed per pod	G	0.004	0.001	-0.045	0.016	0.027	0.022	0.002	0.228	-0.102
	P	0.012	0.002	0.016	0.005	0.026	0.017	-0.001	0.0283	-0.112
Test weight (g)	G	0.034	0.011	-0.022	0.053	-0.015	0.005	0.010	0.059	0.392
	P	0.032	0.006	-0.010	0.034	-0.016	-0.007	-0.002	-0.068	0.046

Residual Effect : Genotypic = 0.753 and phenotypic = 0.712.

and path coefficient analysis studies is that test weight, plant height, total number of pods per plant and number of pods on main axis 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.

References

1. Dash, S. R., Kole, P. C. 2001. Studies on variability, heritability and genetic advance in fenugreek. *Journal of Interacademicia*; **5** (1): 7-10.
2. Dashora A, Maloo, S. R. and Dashora, L. K. 2011. Variability, correlation and path coefficient analysis in fenugreek (*Trigonella foenum-graecum* L.) under water limited conditions. *Journal of Spices and Aromatic Crops*; **20** (1): 38-42.
3. Datta, S., Chatterjee, R. and Mukherjee, S. 2005. Variability, heritability and path analysis studies in fenugreek. *Indian Journal of Horticulture*; **62** (1): 96-98.
4. Frayer, J.K. 1930. Chromosome atlas of flowering plant.*Georg Allen and Urwin London; pp.* 519.
5. Gangopadhyay, K. K., Yadav, S. K., Gunjeet Kumar, Meena, B. L., Mahajan, R. K., Mishra, S. K. and Sharma, S. K. 2009. Correlation, path-coefficient and genetic diversity pattern in fenugreek (*Trigonella foenum-graecum*). *Indian Journal of Agricultural Sciences*; **79** (7): 521-526.
6. Hariharan, K. and Vijayakumar, M. 1997. Studies on the genetic variability in fenugreek (*Trigonella foenum-graecum* L.). *South Indian Horticulture*; **45** (3, 4): 143-147.
7. Kole, P. C. and Saha, A. 2013. 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** (1):pp. 17-20.
8. Mathur, V. L. 1996. Correlations and path coefficient analysis in fenugreek.*Madras Agricultural Journal;* **83** (5): 278-279
9. Million, Fikreselassie; Habtamu, Zeleke and Nigussie, Alemayehu 2012.Genetic variability of Ethiopian fenugreek (*Trigonella foenum-graecum* L.) landraces. *Journal of Plant Breeding and Crop Science*; **4** (3): 39-48.
10. Naik, Abhishek, Akhtar, Sbirin and Pandey, V. P. 2012. Variability in growth, yield attributes and yield in different genotypes of fenugreek (*Trigonella foenum-graecum* L.) grown during winter season. *Environment and Ecology*; **30** (4): 1366-1368.
11. Prajapati, D.B., Ravindrababu, Y. and Prajapati, B.H. 2010. Genetic variability and character association in fenugreek (*Trigonella foenum-graecum* L.). *Journal of Spices and Aromatic Crops;* **19** (1&2): 61-64.
12. Pushpa, T. N., Chandregowda, M., Srikantaprasad, D. and Gowda, A. P. M. 2012. Evaluation of fenugreek (*Trigonella foenum-graecum* L.) genotypes for growth and seed yield. *Crop Research (Hisar)*; **43** (1/2/3): 238-244.
13. Sharma K.C., Sharma, M. M. and Sharma, R.K. 1990. Nature of variability and association in fenugreek. *Indian J. Genet.;* **50**: 260-262.
14. Sharma, K.C. and Sastry, E.V.D. 2008. Path analysis for seed yield and its component characters in fenugreek (*Trigonella foenum-graecum* L.). *Journal of Spices and Aromatic Crops;* **17** (2): 69-74.
15. Singh, Paramjit and Kaur, Amardeep 2007. Genetic evaluation of metha (*Trigonella foenum-graecum* L.) for seed yield and quality attributes. *Crop Improvement*; **34** (1): 90-94.
16. Singh, R.K. and Chaudhary, B.D. 1985. Biometrical Methods in Quantitative Genetic Analysis, Kalyani Publisher, New Delhi. pp 318.
17. Verma, Preeti and Ali, Mashiat 2012. Genetic variability in fenugreek (*Trigonella foenum-graecum* L.) assessed in South Eastern Raj. *International Journal of Seed Spices;* **2** (1): 56-58.

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