Studies on genetic variability in fenugreek (*Trigonella foenum-graecum*L.) germplasms grown under Bundelkhand region

Abstract

An evaluation of 12 fenugreek genotypes. The test genotypes were raised in randomized block design with three replications during *rabi* season 2023 at Organic Research Farm, Karguanji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.). The various morphological characters recorded during the ontogeny of fenugreek genotypes under study *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of branches per plant, number of seed per pod, number of pods per plant, pod length, test weight (g), biological yield per plant (g), harvest index and seed yield per plant. Data recorded on five competitive plants chosen at random from each plot for gathering information on existing genetic variability..All of the traits under study showed a wide range of variation. The variation was highest for days to maturity ranged from 119.67 days to 131.67 days, plant height ranged from 72.03 cm to 93.99 cm, days to 50% flowering ranged from 48.67 days to 56.00 days, number of pods per plant ranged from 37.00 to 55.80, biological yield per plant ranged from 28.93 g to 46.15 g, harvest index ranged from 20.65 % to 31.81 %, number of seed per pod ranged from 12.33 to 17.53, pod length ranged from 9.21 cm to 13.08 cm, test weight ranged from 9.53 g to 13.18 g, seed yield per plant ranged from 8.35 g to 12.10 g and number of branches per plant ranged from 3.60 to 6.53.In the present investigation, genotypes *viz.*, RMT-354 and RMT-303 were superior not only for seed yield per plant but also related traits like pod length, biological yield, test weight and number of pods per plant. These diverse genotypes can be used in future breeding programme of fenugreek.

Keywords: Genetic varibility,heritability, fenugreek

Introduction

Fenugreek [*Trigonella foenum-graecum* (L.)] also known as Methi, is an annual spice herb of the sub-family Papilionaceae of Leguminaceae. It is a small seeded self-pollinated, diploid annual plant with 2n=16. An important non spice use of fenugreek is as a potential source of diosgenin. It is also known as one of the oldest medicinal plants recognized in the recorded history. Fenugreek has two centers of origin, the Indian sub-continent and the Eastern Mediterranean Region. Fenugreek is considered to have originated in the Mediterranean region in parts of Asia (De Candolle, 1884). The species name "*foenum-graecum*" means "Greek hay" indicating its use as a forage crop in the past. Fenugreek is widely cultivated in warm temperate and tropical regions of the Mediterranean, Europe and Asia. It is largely cultivated in Argentina, Egypt, Brazil, Southern France, Morocco, Algeria, Ethiopia and Lebanon besides India. The major seed producing countries are India, Ethiopia, Egypt and Turkey. India exports fenugreek to Saudi Arabia, Japan, Malaysia, USA, UK, Singapore and Sri Lanka. It is a *rabi* crop, can be grown under wide range of climatic conditions. It requires low temperature during early stage for better vegetative growth, while a dry and relatively high temperature favours better ripening and high seed production. It can be grown on all types of well drained soils. Unlike other legumes, it is quite tolerant to salinity and can be grown in black cotton soil. It is an erect, hardy, annual plant, typically growing to a height of 20-160 cm.

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Fenugreek is also grown for forage. It is regarded as traditional forage in Egypt, India, Turkey and the Mediterranean region (McCormick *et al.*, 2009). Many researchers have suggested that it has been used extensively in the past as hay, green fodder, silage and as a supplement with other animal feed. In addition fenugreek, mixed with cotton seed and fed to weaning cows to increase flow of milk. It is also used to mix with inferior hay and sour hay (mildewed hay) to increase palatability (Petropoulos, 2002). It is recommended as alternative leguminous forage in alfalfa based cattle farms since it can prevent bloating in cattle which is a disadvantage associated with use of alfalfa fodder (Acharya *et al.*, 2007).

The maximization of seed yield of fenugreek is the major objective for its improvement. Very little effort has been made in collection, maintenance and utilization of different genotypes for the improvement of this crop. There is need to assess and improve the existing genotypes and introduce cultivars for seed purpose.

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Material and Methods

The current investigation was conducted with 12 fenugreek genotypes, raised in randomized block design with three replications during the *Rabi* season 2023 to understand the nature and magnitude of the genetic component of variation for yield and yield traits in fenugreek.The experimental data were subjected to statistical analysis using the analysis of variance technique suggested by Panse and Sukhatme (1985). Where the "F" test was found significant at 5% level of significance, the critical differences for the treatment's comparison were worked out. The phenotypic and genotypic coefficients of variation were worked out as per Burton, 1952. Heritability in broadJohnson *et al.,* (1955).PCV and GCV were classified as suggested by Sivasubramanian and Menon (1973) such as less than 10 % is low, 10-20 % is moderate and more than 20 % is high.The heritability h 2 (b) was classified as suggested by Johnson *et al.,* (1955), 0-30 % is low, 31- 60 % is moderate, 61 % and above is high. The genetic advance as per cent of mean was classified as suggested by Johnson *et al.*,(1955) less than 10 % is low, 10-20 % is moderate and more than 20 % is high.

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Results and Discussion

The study emphasized the growth and yield parameters for illustrating the performance of different germplasms of fenugreek concerning various productivity parameters. The data obtained on variability for all studied characters have been summarized in Table .1. The analysis of variance revealed that estimated mean sum of squares for all the characters were significant at 1% level and 5% indicating the large variation amongst the genotypes. This result was accordance with the earlier findings of by Sarada *et al.* (2008), Gangopadhyay *et al.* (2009), Singh & Pramila (2009), Prajapati *et al.* (2010), Verma and Ali (2012), Jain et al (2013), Pathak *et al.* (2014), Singh *et al.* (2015), Panwar *et al.* (2017), Bhatt *et al.* (2019), Singh *et al.* (2019) and Prakash *et al.* (2020). All of the traits under study showed a wide range of variation. The variation was highest for days to maturity ranged from 119.67 days to 131.67 days, plant height ranged from 72.03 cm to 93.99 cm, days to 50% flowering ranged from 48.67 days to 56.00 days, number of pods per plant ranged from 37.00 to 55.80, biological yield per plant ranged from 28.93 g to 46.15 g, harvest index ranged from 20.65 % to 31.81 %, number of seed per pod ranged from 12.33 to 17.53, pod length ranged from 9.21 cm to 13.08 cm, test weight ranged from 9.53 g to 13.18 g, seed yield per plant ranged from 8.35 g to 12.10 g and number of branches per plant ranged from 3.60 to 6.53. Early flowering and early maturing genotype is RMT-354. Dwarf genotype is RMT-351.These studies are in agreement with the findings of Singh & Pramila (2009), Dashora et al (2011), Singh et al (2012), Verma and Ali (2012), Yadav *et al.* (2013),

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Pathak *et al.* (2014), Singh *et al.* (2015), Gurjar *et al.* (2015), Panwar *et al.* (2017), Bhatt *et al.* (2019), Meena *et al.* (2019) and Singh *et al.* (2019).
The mean sum of squares due to genotypes was highly significant for all the characters studied, thus indicated presence of substantial amount of genetic variability in the material.

In general, estimates of phenotypic coefficients of variation (PCV) were slightly higher than their corresponding genotypic coefficient of variation (GCV) indicating the minor effect of the environment on the expression of the characters. Moderate GCV values were observed for plant height, number of branches per plant, number of seed per pod, number of pods per plant, pod length, test weight, biological yield per plant, harvest index and seed yield per plant indicating the presences of genetic variability for the traits. The characters *viz.*, days to 50 per 72cent flowering, days to maturity exhibited lower genotypic coefficient of variation. The highest PCV was observed for plant height, number of branches per plant, number of seed per pod, number of pods per plant, pod length, test weight, biological yield per plant, harvest index and seed yield per plant. Traits like days to 50 per cent flowering, days to maturity had low PCV.

The highest mean performance for grain yield/ plant was observed for genotype RMT-354 followed by RMT-303 indicating that these genotypes can be used in hybridization programme to achieve higher yield. Heritability estimates were high for days to 50 per cent flowering, days to maturity, plant height, number of branches per plant, number of seed per pod, number of pods per plant, pod length, test weight indicating important role of these traits in fenugreek improvement. High genetic gain along with high heritability was recorded for number of branches per plant, number of pods per plant, pod length and test weight. Higher heritability coupled with greater genetic gain is suggestive of relatively greater role of additive genes in the available genetic variability. Further such character have high selective value.

This result was accordance with the earlier findings of by Sarada *et al.* (2008), Gangopadhyay *et al.* (2009), Singh & Pramila (2009), Dashora et al (2011), Singh et al (2012), Verma and Ali (2012), Jain et al (2013), Yadav *et al.* (2013), Pathak *et al.* (2014), Singh *et al.* (2015), Gurjar *et al.* (2015), Panwar *et al.* (2017), Meena *et al.* (2019) and Prakash *et al.* (2020).High heritability estimates indicated that the characters were less influenced by the environmental effects and their greater proportion of variability is transmitted to subsequent generations. Thus selection based on phenotypic expression is likely to be effective in the above traits. These results are in accordance with the findings of Gangopadhyay *et al.* (2009), Singh & Pramila (2009), Dashora et al (2011), Verma and Ali (2012), Jain et al (2013), Yadav *et al.* (2013), Singh *et al.* (2015), Gurjar *et al.* (2015), Panwar *et al.* (2017), Bhatt *et al.* (2019), Singh *et al.* (2019) and Prakash *et al.* (2020). High heritability with low genetic advance as percentage of mean had recorded for days to 50 per cent flowering and days to maturity. It indicates that no non-additive genes play major role in the inheritance of these characters. Thus, the direct selection based on these characters will be appropriate and reliable. Similar findings were agreement with Sarada *et al.* (2008), Gangopadhyay *et al.* (2009), Singh & Pramila (2009), Prajapati *et al.* (2010), Dashora et al (2011), Jain et al (2013), Yadav *et al.* (2013), Pathak *et al.* (2014), Gurjar *et al.* (2015), Panwar *et al.* (2017), Bhatt *et al.* (2019), Meena *et al.* (2019) and Prakash *et al.* (2020).

Conclusion:

A study of genetic variability, heritability, and genetic advance in fenugreek is useful for selecting high-yielding genotypes.In the present investigation, genotypes *viz*., RMT-354 and RMT-303 were superior not only for seed yield per plant but also related traits like pod length, biological yield, test weight and number of pods per plant. These diverse genotypes can be used in future breeding programme of fenugreek.

Table 1 : Analysis of variance (ANOVA) for yield and its component traits in fenugreek genotypes

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Source of variation	Degree of freedom (df)	Mean sum of squares										
		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of seeds per pod	Number of pod per plant	Pod length (cm)	Test weight	Harvest index	Seed yield per plant	Biological yield
Replications	2	0.44	1.86	9.298	0.14	0.03	20.201	0.31	0.09	0.61	2.03	25.33
Genotypes	11	22.14**	37.626**	178.925**	2.07**	6.56**	103.78**	5.44**	9.33**	38.65**	4.96**	91.76*
Error	22	1.17	1.740	11.729	0.08	0.21	8.98	0.16	0.12	7.52	1.30	32.83

*, ** Significant at 5% and 1% levels, respectively

Table 2 : mean values of 12 genotypes for 11 characters in fenagreek

Chr	DF50	DM	PH	NBP	NSP	NPP	PL	TW	HI	BY	SYP
RMT-361	51.33	123.00	79.12	4.20	14.40	40.67	9.53	9.70	25.44	36.80	9.40
RMT-303	48.67	120.67	72.03	6.53	17.53	55.80	13.02	13.18	25.43	45.91	11.60
Hisar mukta	56.00	125.00	78.13	5.33	12.33	37.40	11.44	11.26	22.42	44.93	10.05
Hisar sonoli	56.00	131.67	93.92	5.00	13.20	43.87	10.29	9.53	25.28	36.85	9.22
Rajendra kranti	52.00	123.00	82.76	5.27	14.60	43.47	9.64	10.14	29.74	28.93	8.50
RMT-354	48.67	119.67	73.36	6.07	17.00	50.07	13.08	15.72	26.24	46.15	12.10
RMT-351	51.33	127.33	93.99	3.60	13.53	37.00	10.62	11.51	31.61	32.98	10.40
RMT-305	48.33	123.00	76.38	4.87	15.33	38.27	9.21	13.00	20.65	40.71	8.43
RMT-143	50.00	127.67	85.67	3.87	14.47	43.73	11.51	10.58	24.31	43.16	10.45
Hisar suarna	52.00	126.33	90.77	5.00	13.67	42.41	10.57	12.43	22.60	37.43	8.35
NRCSS-AM-1	54.67	123.00	77.85	4.93	14.53	34.47	11.71	11.03	23.49	35.80	8.39
RMT-1	53.33	129.00	76.14	5.13	14.67	42.60	9.30	10.81	31.81	34.11	10.62
GM	**51.72**	**124.58**	**82.18**	**4.97**	**14.60**	**42.47**	**10.97**	**11.64**	**25.75**	**38.65**	**9.72**
SE	**0.625**	**0.7616**	**1.9773**	**0.1709**	**0.2694**	**1.7301**	**0.2363**	**0.2007**	**1.5841**	**3.3081**	**0.6605**
CD 5%	**1.832**	**2.2336**	**5.7991**	**0.5011**	**0.7902**	**5.0741**	**0.6931**	**0.5886**	**4.6460**	**9.7024**	**1.9372**
CV	**2.09**	**1.06**	**4.19**	**5.94**	**3.20**	**7.05**	**3.78**	**3.00**	**10.65**	**14.83**	**11.68**

Table 3 : genetic variability parameters for yield and its attributing traits in fenugreek genotypes

Chr	DF50	DM	PH	NBP	NSP	NPP	PL	TW	HI	BY	SYP
Maximum	57.0000	133.0000	97.1100	7.0000	18.2000	58.6000	13.8600	16.4000	38.7473	49.47	12.6500
Minimum	47.0000	118.0000	70.4100	3.4000	11.6000	32.2000	8.9100	9.2300	19.2626	21.93	6.5300
GM	51.8611	124.9444	81.6769	4.9833	14.6056	42.4789	10.8272	11.5733	25.7524	38.6472	9.7919
SEm	0.6250	0.7616	1.9773	0.1709	0.2694	1.7301	0.2363	0.2007	1.5841	3.3081	0.6605
CD 5%	1.8329	2.2336	5.7991	0.5011	0.7902	5.0741	0.6931	0.5886	4.6460	9.7024	1.9372
CD 1%	2.4913	3.0358	7.8820	0.6811	1.0740	6.8966	0.9420	0.8000	6.3147	13.1872	2.6330
ECV	2.0872	1.0557	4.1930	5.9384	3.1951	7.0542	3.7804	3.0033	10.6542	14.826	11.6836
GCV	5.0988	2.7681	9.1401	16.3148	9.9598	13.2340	12.2487	15.1442	12.5075	11.4684	11.2773
PCV	5.5095	2.9626	10.0560	17.3622	10.4598	14.9967	12.8187	15.4391	16.4301	18.7439	16.2382
Heritability(BS)	0.8565	0.8730	0.8261	0.8830	0.9067	0.7787	0.9130	0.9622	0.5795	0.3744	0.4823
GA	5.0413	6.6571	13.9781	1.5738	2.8534	10.2194	2.6105	3.5416	5.0511	5.5864	1.5798
GA as % mean	9.7208	5.3280	17.1139	31.5813	19.5364	24.0576	24.1105	30.6014	19.6141	14.4549	16.1337

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