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Genetic Variability in Fenugreek Genotypes

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ABSTRACT

A set of 24 genotypes were evaluated for 14 qualitative characters, to study the variability in fenugreek genotypes. The experiment was laid out in randomized block design with two replications. A wide range of variability was observed for quantitative characters. The estimates of genotypic coefficient of variation (GCV) were lower than that of phenotypic coefficient of variation (PCV). The highest genotypic coefficient of variation as well as phenotypic variation was observed for the copper content in fenugreek followed by zinc content, iron content and total chlorophyll content in leaves. Both the components were lowest for days to harvesting.

High estimates of heritability in broad sense were recorded for the characters like total chlorophyll content, copper content, iron content, number of leaves, number of secondary roots, biological yield, leaf area. Moderate heritability percentage was observed for manganese content, number of root nodules and zinc content. However low heritability was observed for days to harvesting. Hence, these characters might be improved by simple selection. High estimates of genetic advance were recorded for total chlorophyll content followed by biological yield, copper content , number of leaves, iron content, number of secondary roots, plant height , number of root nodules , plant height along with root , leaf area , average weight of plant , zinc content, days to harvesting and manganese content.

Keywords: *Fenugreek, Genotypes, Heritability, Genetic advance and Coefficient of variation*

INTRODUCTION

Fenugreek is widely cultivated in China, North and South Africa, Ukraine and Greece (Petropoulos, 2002). In India, it is mainly cultivated in Rajasthan, Gujarat, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Himachal Pradesh and Haryana with total area of 1.23 lakh hectare and production of 1.31 lakh MT. It is grown in *rabi* season, in frost free, moderately cool climate and clear sky throughout the growth. It is essentially a winter season crop and grows well in low temperature, but for leafy vegetables off-season cultivations also practiced.

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Fenugreek is mainly grown as leafy vegetable throughout Maharashtra. But there is lack of systematic research work on fenugreek particularly with respect to crop as a leafy vegetable in Maharashtra.

Heritability and genetic advance are the important genetic parameters for selecting a genotype that permit greater effectiveness of selection by separating out environmental influence from total variability. Heritability estimate provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson et al. 1955). An attempt was made in the present investigation to estimate heritability in broad sense and categorized as low (<50 %), moderate (50 %-70 %) and high (>70 %) as suggested by Robinson (1966).With this aim the genotypes from the different parts of the Maharashtra were collected and performance was studied under Kolhapur conditions. In point of view, present investigation was undertaken to study the variability by estimating GCV, PCV, heritability and genetic advance, genetic divergence in fenugreek genotypes.

MATERIALS AND METHODS

The experimental material for the present investigation consisted 24 lines of fenugreek collected from different parts of Maharashtra as well as Vegetable Research Scheme, NARP, Ganeshkhind, Pune was used in the present study. A uniform piece of fertile land was selected and brought to the fine tilth by adopting recommended preparatory operations. A basal dose of 25 kg N, 45 kg P_2O_5, 45 kg K_2O per ha was applied at the time of sowing. Seeds were directly sown by line sowing. The spacing of 15 cm between the rows was adopted. The cultural practices like plant protection and weeding were followed as and when required during the crop growth period. The experiment was laid out in randomized block design with two replications. The analysis of variance was done as suggested by Panse and Sukhatme (1985). Five plants were selected at random from each genotype in each replication. The randomly selected plants were tagged for recording observations.

Estimation of components of variation

The phenotypic and genotypic variances were calculated by using the respective mean squares from variance table (Johnson et al. 1955) as below.

Environmental variance (σ^2_e) = EMS

Genotypic variance (σ^2_g) = $\frac{GMS-EMS}{r}$

Phenotypic variance (σ^2_p) = $\sigma^2_g + \sigma^2_e$

Where,

GMS = Genotypic mean sum of square
EMS = Error mean sum of squares
r = Number of replications.

Estimation of coefficient of variation

The genotypic and phenotypic coefficients of variation were calculated by the formulae as suggested by Burton and De-vane (1953).

Genotypic coefficient of variation (GCV)

$$GCV(\%) = \frac{\sqrt{\sigma_g^2}}{\bar{X}} * 100$$

Where,

σ^2_g = Genotypic variance and,
$\bar{X}$ = Mean of character

Phenotypic coefficient of variation (PCV)

$$PCV(\%) = \frac{\sqrt{\sigma_p^2}}{\bar{X}} * 100$$

Where,

σ^2_p = Phenotypic variance and,
$\bar{X}$ = Mean of character

The high, medium and low GCV and PCV estimates were classified as:

Low : 10 per cent
Medium : 10 to 20 per cent
High : > 20 per cent

Estimation of heritability (b.s.)

Heritability in broad sense was estimated as suggested by Hanson *et al.*, (1956).

$$h^2(b.s.) = \frac{\sigma_g^2}{\sigma_p^2} * 100$$

Where,

h^2 = Heritability

σ^2_g = Genotypic variance

σ^2_p = Phenotypic variance

The high, medium and low heritability estimates were classified on the basis of values given by Robinson et al. (1966).

Low heritability = 0-30 %

Moderate heritability = 30-60%

High heritability = > 60 %

Estimation of Genetic advance (G.A.)

Genetic advance (at 5 % selection intensity) was calculated using the formula given by Allard (1960).

$$G.A. = k * \frac{\sigma_g^2}{\sigma_p^2} * \sqrt{\sigma_p^2}$$

Where,

σ^2_g = Genotypic variance

σ^2_p = Phenotypic variance

k = Selection differential (at 5 % selection = 2.06)

$\sqrt{\sigma^2_p}$ = Phenotypic standard deviation

The high, medium and low estimates of genetic advance were classified as

Low = 0-10%

Medium = 10- 20%

High = > 20%

RESULTS AND DISCUSSION

The parameters of genetic variability *viz*., mean, range, PCV, GCV, heritability (b.s.), per cent genetic advance and genetic advance as a per cent of mean are summarized in Table 1. The estimates of GCV were lower than PCV for all the characters under study. The magnitude of phenotypic coefficients of variation was greater than genotypic coefficients of variation. Highest genotypic coefficient of variation was exhibited in Cu content (48.25), followed by Zn content (40.50), total chlorophyll content in leaves (33.09), iron content (25.93), number of secondary roots (20.36), average weight of plant (20.07), biological yield (17.92), number of leaves (15.52), number of root nodules (14.99), leaf area (14.85), Mn content (9.07), plant height (8.06), plant height along with root (6.02), days to harvesting (2.24). The categorization of the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) as low (less than 10%), moderate (10-20%) and high (more than 20%) was done as suggested by Sivasubramanian and Madhavamenon (1973).

The inherent phenotypic variability is expressed by the genotypic coefficient of variation. Highest values for phenotypic coefficient of variation was observed for Zn content (50.00), Cu content (48.51), followed by total chlorophyll content in leaves (33.11), Fe (26.12), average weight of plant (21.81), number of secondary roots (21.32), biological yield (18.81), number of root nodules (18.44), number of leaves (15.97), leaf area (15.72), Mn (10.81), plant height (9.01), plant height along with root (7.11), days to harvesting (3.58) The lowest range of GCV and PCV was recorded in days to harvesting (2.24 to 3.58) respectively.

Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing their expression. Wide difference between phenotypic and genotypic coefficient of variations indicated their sensitiveness to environmental fluctuations whereas narrow difference showed less environmental interference on the expression of these traits. The traits which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection. The present findings are in agreement with

those of Mamatha et al. (2017), Sarada et al. (2008), Shukla and Sharma (1978) and Hariharan and Vijaya kumar (1997), Pant et al. (1983), Singh (1995), Datta et al. (2005) in fenugreek. They also observed smaller values of the genotypic and phenotypic coefficients of variability with larger differences in their magnitude for different characters.

Heritability % (b.s.)

The highest degree of heritability was observed for the characters total chlorophyll content (99.9 %), copper content (98.9%), iron content (98.6%), number of leaves (94.4 %), number of secondary roots (91.1%), biological yield (90.8 %), leaf area (89.1 %) while moderate heritability was observed for manganese content (70.3), number of root nodules (66.1 %), zinc content (65.6 %). Low heritability was observed for days to harvesting (39.0 %). Similar results were also reported by Choudhary et al. (2017) and Mamatha et al. (2017) in fenugreek.

Genetic advance

In the present study, estimates of genetic advance ranged from 0.31 to 72.01. Highest estimate of genetic advance was recorded for total chlorophyll content in leaves (72.01%) followed by biological yield (19.01 %), copper content (9.53 %), number of leaves (7.98 %), iron content (7.57%), number of secondary roots (7.06%), plant height (3.28 %), number of root nodules (3.15 %), plant height along with root (3.08 %), leaf area (1.92 %), average weight of plant (0.92 %), days to harvesting (0.82 %), zinc content (0.46 %) and manganese content (0.31%).

Table 1: Genetic variability for 14 characters in 24 genotypes of fenugreek

Sr. No	Characters	General mean	Range		GCV (%)	PCV (%)	Heritability (b.s.) %	G.A. (%)	G.A as a percent of mean (%)
			Minimum	Maximum					
1	Plant height along with root (cm)	29.31	25.55	33.24	6.02	7.11	71.8	3.08	10.51
2	Plant height (cm)	22.06	18.77	26.02	8.06	9.01	80.0	3.28	14.86
3	No. of leaves	25.70	19.90	33.05	15.52	15.97	94.4	7.98	31.08
4	No. of secondary roots	17.61	13.30	25.95	20.36	21.32	91.1	7.06	40.08
5	No. of roots nodules	12.55	8.15	16.85	14.99	18.44	66.1	3.15	25.10
6	Chlorophyll content (mg/100g)	105.67	25.33	154.04	33.09	33.11	99.9	72.01	68.14
7	Cu (mg/kg)	9.64	3.70	22.80	48.25	48.51	98.9	9.53	98.86
8	Fe (mg/kg)	14.28	8.30	21.10	25.93	26.12	98.6	7.57	53.05
9	Zn (mg/kg)	0.69	0.50	1.50	40.50	50.00	65.6	0.46	67.57
10	Mn (mg/kg)	1.99	2.20	1.90	9.07	10.81	70.3	0.31	15.67
11	leaf area (cm^2)	6.66	4.75	8.01	14.85	15.72	89.1	1.92	28.88
12	Days to harvesting	28.75	27.50	31.50	2.24	3.58	39.0	0.82	2.88
13	Biological yield (q/ha)	54.06	35.50	78.25	17.92	18.81	90.8	19.01	35.17
14	Average weight of plant at harvesting (g)	2.42	1.09	3.10	20.07	21.81	84.7	0.92	38.05

Variability in 24 genotypes of fenugreek

GCV= Genotypic coefficient of variation, b.s. = Broad sense, PCV = Phenotypic coefficient of variation, G.A. = Genetic advance

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