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*Research Article*

# Genetic Variability, Heritability and Genetic Advance for Growth, Yield and Quality of Fenugreek (*Trigonella foenum*-graecum L.)

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**ABSTRACT**

*The mean performance of the genotypes revealed the variation was highest for seed yield per plot, days taken to maturity, germination percentage. The PCV was higher than the GCV for all the characters. High PCV and GCV were observed for weight of seeds per pod, seed yield (q/ha$^{-1}$), length internodes, number of pods per plant. High heritability coupled with high genetic advance for traits such as a like seed yield, weight of pod, weight of seed per pod. All the characters except number of branches at 90 DAS, germination percentage and days taken to maturity were found to be significant, which indicates high extent of genetic variability for all the traits under study.*

***Keywords:*** *genotypes, germination, Fenugreek, Heritability*

## INTRODUCTION

The fenugreek (*Trigonella foenum-graecum* L.) belongs to the family *Fabaceae* and is a multiuse and commercially important spice crop grown for its seeds, tender shoots, and fresh leaves. It is a small-seeded self pollinated, diploid annual legume plant with 2n= 16, grown as spice-cum-medicinal crop.

It is an annual plant, extensively cultivated as a food crop in India, the Mediterranean region, North Africa, and Yemen. Fenugreek seeds and herbs are well known for their distinct aroma and slightly bitter taste. The cultivation of this crop is confined to areas with moderate or low rainfall and a cool growing season without extreme temperatures. It can tolerate 10–15°C of frost (Duke 1986).

Fenugreek seed contains alkaloids including trigonelline, saponins, flavonoids, 4.4% protein, 86% moisture, 6% carbohydrate, 0.9% fat and 1.1% dietary fibers lipids, 360.0 mg calcium,167.0 mg sulphur, 76.1 mg sodium, 67.0 mg magnesium, 541 mg phosphorous, 51 mg potassium, 17.2 mg iron, 0.05 mg thiamin, 6450 IU vitamin 'A', 54 mg vitamin 'C', cellulose starch, ash, calcium, iron and β-carotene USDA (2001).

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Also it has been found to contain niacin, diosgenin (which are a compound that has properties similar to estrogen). Other active constituents in fenugreek are alkaloids, lysine and L-tryptophan, as well as steroidal saponins therefore it is used to in artificial flavoring and in the production of hormones. Green fenugreek is a good source of iron (Fe) as well as other minerals for human beings (Chhibba et al., 2000).

## MATERIALS AND METHODS

In the present investigation ten genotypes of fenugreek (*Trigonella foenum-graecum* L.) were evaluated in Randomized Block Design (RBD) at the Department of Horticulture, School of Agricultural Sciences, Career Point University, Kota (Rajasthan) during *rabi season* 2019-2020. The experimental materials consisting ten genotypes of fenugreek (*Trigonella foenum-graecum* L.) i.e. RMt-305, RMt-303, RMt-351, RMt-305, RMt-361, RMt-1, RMt-354, RMt-143,AM-1, AM-1 and PARM-45. The experiment was laid out in a Randomized Block Design (RBD), with thirty treatments and three replications. Each genotypes was grown in a plot and plot size 7.92 $m^2$. Each plot was grown in 30 cm row to row spacing and 10 cm plant to plant spacing. The observation was recorded on five randomly selected plants for nine-teen characters viz., germination percentage, plant height (cm) at 30,60 and 90 DAS, number of branches at 30, 60 and 90 DAS, number of leaves at 30 , 60 and 90 DAS, length internodes (cm), days taken to 50% flowering, days taken to maturity, fresh weight of plant (g),dry weight of plant (g), days to first pod formation,1000 seed weight (g),number of pods per plant, number of seeds per pod, pod length(cm),weight of pod (g),weight of seeds per pod (g),seed yield per plant (g), seed yield per plot (g), seed yield (q/$ha^{-1}$).The data were estimated for variation among the genotypes analysis of variance was carried out suggested by Panse and Sukhatme (1995). Estimation of heritability in broad sense was done as per the formula given by Hanson et al. (1956) and the genetic advance (GA) was calculated by the following formula as suggested by allard (1960).

## RESULT AND DISCUSSION

The analysis of variances for all the characters studied have been presented in Table 1. Mean sum of squares among treatment was found significant for the characters viz. germination percentage, plant height (cm) at 30,60 and 90 DAS, number of branches at 30, 60 and 90 DAS, number of leaves at 30 , 60 and 90 DAS, length internodes (cm),days taken to 50% flowering, days taken to maturity, fresh weight of plant (g),dry weight of plant (g),days to first pod formation,1000 seed weight (g),number of pods per plant, number of seeds per pod, pod length(cm),weight of pod (g),weight of seeds per pod (g),seed yield per plant (g),seed yield per plot (g), seed yield (q/$ha^{-1}$).

The average seed yield per plot was 274.72 g and the ranged was observed to be 219.56 to 383.89 **(**Table-2**)**. The average germination (%) was found to be 93.07%, where as germination (%) ranged from 91.11to 95.33 %. The average plant height at 90 DAS was found to be 59.11 cm, where as plant height ranged from 57.07 to 61.7 cm. The average days taken to 50% flowering was found to be 54.57 and the ranged was observed to be 49.4 to 57.07. The average length internodes (cm) was found to be 4.29 cm and the ranged was observed to be 3.5 to 5.83 cm. The average fresh weight of plant (g) was found to be 19.51g and the ranged was observed to be 17.47to 23.31g. The average days to first pod formation was found to be 12.02g and the ranged was observed to be 10.04 to 15.88g and all the other parameters the average and range of variation was high.

The phenotypic coefficient of variation (PCV) was higher to its corresponding genotypic coefficient of variation (GCV) for all the parameters under present study. High

genotypic coefficient of variation was observed in weight of seeds per pod (25.38%), followed by seed yield (24.2%), number of pods per plant (20.77%). However, GCV was moderate for the characters such as seed yield per plant (16.78%), number of branches at 90 DAS (15.25%), number of leaves at 90 DAS (15.09%). Low genotypic coefficient of variation was observed for number of seeds per pod (10.63%), followed by 1000 seed weight (10.19%), fresh weight of plant (8.19%), plant height at 30 DAS (7.63%), plant height at 60 DAS (7.02%), days taken to maturity (6.02%) and high phenotypic coefficient of variation was observed in weight of seeds per pod (26.95%), followed by seed yield (25.37%), length internodes (24.31%), number of pods per plant (22.03%). However, PCV was moderate for the characters such as seed yield per plant (18.68%), number of branches at 90 DAS (16.65%), number of leaves at 90 DAS (16.18%). Low phenotypic coefficient of variation was observed for 1000 seed weight (12.19%), followed by number of seeds per pod (12.04%), plant height at 30 DAS (10.50%), fresh weight of plant (9.87%), plant height at 60 DAS (7.57%), days taken to maturity (7.47%). These findings were quite similar to as reported by Verma (2003), Singh (2014) and Santhosh *et al*. (2017).

Heritability estimates in broad sense was high for seed yield (91.03), number of pods per plant (88.91), weight of pod (88.80), weight of seeds per pod (88.66), seed yield per plot (88.31), number of branches at 90 DAS (83.88), seed yield per plant (80.70), pod length (78.53), number of seeds per pod (77.98), days to first pod formation (70.88), length internodes (70.3). The findings were similar to findings of Patahk et al. (2014), Narolia et al. (2017) and Million et al. (2012).

Higher yield is the main breeding objective in all the crops but generally yield has moderate to low heritability. Yield is regarded as a complex parameter or super parameter, which is influenced by many component or contributing traits both in positive and negative direction. In the present investigation, expected genetic advance was recorded high with seed yield per plot (93.58), number of leaves at 90 DAS (17.78), number of pods per plant (16.82) and days taken to maturity (11.82). While medium values were observed for days taken to 50% flowering (6.09). Low genetic advance was recorded for seed yield (3.76), weight of seed per pod (3.56), weight of pod (3.55), seed yield per plant (3.14), number of branches at 90 DAS (2.87), fresh weight of plant (2.73), dry weight of plant (2.65), number of seeds per pod (2.42), pod length (2.28), germination percentage (1.6), plant height at 90 DAS (1.55), length internode (1.51). This is accordance with finding of Aman et al. (2018), Jain et al. (2013) and Japhet Singh (2014).

Heritability estimates along with the genetic advance are more useful than heritability alone in prediciting the resultant effect on selecting best individuals. In the present investigation, expected genetic advance expressed as percentage of mean was high for weight of seeds per pod (49.23%), seed yield (47.57%), dry weight of plant (22.06%), weight of pod (36.65%), length internodes (35.21%), seed yield per plot (34.06%), seed yield per plant (31.06%), number of leaves at 90 DAS (29.02%), number of branches at 90 DAS (28.77%), pod length (25.22%), dry weight of plant (22.06%) exhibited high genetic advance as percent of mean. While medium values were observed for number of seeds per pod (19.34%), 1000 seed weight (17.56%), fresh weight of plant (24.02%), days taken to maturity (10.05%). Low genetic advance as percent of mean was recorded for days to first pod formation (9.04%), days taken to 50% flowering (4.67%), plant height at 90 DAS (2.62%), germination percentage (1.72%). This is accordance with finding of Mamatha et al. (2017), Mahendra et al. (2016) and Lodhi et al. (2015).

**Table 1: Analysis of variance for different characters in fenugreek**

| Source of variance | D.F. | Germination (%) | Plant height (cm) | No. of branches/plant | No. of leaves/plant | Length internodes (cm) | Days taken to 50% flowering | Fresh weight of plant (g) | Dry weight of plant (g) | Days taken to maturity | Days to first pod formation | Pod length (cm) | Weight of pod (g) | Weight of seeds / pod (g) | No. of pods/plant | No. of seed/pod | 1000 seed weight (g) | Seed yield/ plant (g) | Seed yield/plot (g) | Seed yield ($q/ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replications | 2 | 2.769 | 0.423 | 0.101 | 19.278 | 9.815 | 4.069 | 2.841 | 10.921 | 0.173 | 8.265 | 0.062 | 0.332 | 1.687 | 14.23 | 0.561 | 0.085 | 0.153 | 0.366 | 0.083 |
| Treatment | 9 | 6.618 | 8.179 | 7.414 | 269.64 | 176.65 | 14.978 | 8.826 | 8.418 | 2.618 | 42.066 | 5.137 | 10.512 | 10.562 | 234.41 | 5.830 | 3.863 | 9.356 | 7320.6 | 11.348 |
| Error | 18 | 2.171 | 3.194 | 0.446 | 12.731 | 26.215 | 4.484 | 1.150 | 1.129 | 0.323 | 5.065 | 0.429 | 0.423 | 0.431 | 9.354 | 0.501 | 0.484 | 0.690 | 309.25 | 6.493 |

**Table 2: Mean value of genotypes, 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 | Grand Mean | Range | | PCV % | GCV % | $h^2$ | GA (K=2.06) | GA (% of mean) |
|---|---|---|---|---|---|---|---|---|
| | | Mininum | Maximum | | | | | |
| Germination percentage (%) | 93.07 | 91.11 | 95.33 | 2.05 | 1.31 | 40.58 | 1.6 | 1.72 |
| Plant height (cm) at 90 DAS | 59.11 | 57.07 | 61.7 | 3.72 | 2.18 | 34.21 | 1.55 | 2.62 |
| Number of branches at 90 DAS | 9.99 | 8.49 | 13.14 | 16.65 | 15.25 | 83.88 | 2.87 | 28.77 |
| Number of leaves at 90 DAS | 61.29 | 50.22 | 83.42 | 16.18 | 15.09 | 87.05 | 17.78 | 29.02 |
| Days taken to 50% flowering | 54.57 | 49.4 | 57.07 | 5.17 | 3.42 | 43.82 | 2.55 | 4.67 |
| Days taken to maturity | 117.58 | 105.58 | 126.57 | 7.43 | 6.02 | 65.66 | 11.82 | 10.05 |
| Length internodes (cm) | 4.29 | 3.5 | 5.83 | 24.31 | 20.39 | 70.3 | 1.51 | 35.21 |
| Fresh weight of plant (g) | 19.51 | 17.47 | 23.31 | 9.87 | 8.19 | 68.98 | 2.73 | 14.02 |
| Dry weight of plant (g) | 12.02 | 10.04 | 15.88 | 15.69 | 12.96 | 68.25 | 2.65 | 22.06 |
| Days to first pod formation | 67.32 | 59.07 | 72.18 | 6.19 | 5.21 | 70.88 | 6.09 | 9.04 |
| 1000 seed weight (g) | 10.40 | 9.22 | 12.71 | 12.19 | 10.19 | 69.92 | 1.82 | 17.56 |
| Number of pods per plant | 41.69 | 33.13 | 59 | 22.03 | 20.77 | 88.91 | 16.82 | 40.35 |
| Number of seeds per pod | 12.53 | 10.8 | 14.57 | 12.04 | 10.63 | 77.98 | 2.42 | 19.34 |
| Pod length (cm) | 9.06 | 7.73 | 11.56 | 15.59 | 13.81 | 78.53 | 2.28 | 25.22 |
| Weight of pod (g) | 9.71 | 7.5 | 13 | 20.03 | 18.88 | 88.80 | 3.55 | 36.65 |
| Weight of seeds per pod (g) | 7.24 | 5.04 | 10.52 | 26.95 | 25.38 | 88.66 | 3.56 | 49.23 |
| Seed yield per plant (g) | 10.12 | 8.23 | 13.83 | 18.68 | 16.78 | 80.70 | 3.14 | 31.06 |
| Seed yield per plot (g) | 274.72 | 219.56 | 383.89 | 18.72 | 17.59 | 88.31 | 93.58 | 34.06 |
| Seed yield ($q/ha^{-1}$) | 7.90 | 5.47 | 10.86 | 25.37 | 24.2 | 91.03 | 3.76 | 47.57 |

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