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Study of Morphological and Seed Yield Architecture in Genotypes of Fenugreek (*Trigonella foenum-graecum* L.)

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ABSTRACT: The productivity of fenugreek is very low as it is often cultivated on marginal lands with poor management of soil fertility, irrigation, fertilizer and with little insect pest management. Further the seeds of improved varieties have limited availability; hence farmers are forced to use local materials for sowing which are variable in productivity and susceptible to various diseases. Considering the above points, there is a great scope to improve the productivity of this crop by varietal improvement and adopting the improved production technology in our country. The real yield potential of the crop can be exploited through varietal improvement program. Considering same present investigation, was conducted during the *Rabi* 2020-21 at Research farm Department of Horticulture, RAK College of Agriculture, Sehore (M.P.). This investigation was carried out on sixteen genotypes collected from different part of the country. The research experiment was laid out in Randomized Block Design with three replications. The results revealed that, all the parameters were exhibited significantly differences among genotypes during investigation. The maximum plant height (cm) plant^{-1} (13.00, 34.20 and 60.13), number of branches plant^{-1} (7.13, 9.07 and 11.01), leaf area (cm^2) plant^{-1} (14.04, 37.00 and 65.00) and leaf area index (0.19, 0.44 and 0.82) at all stages of crop and the maximum germination (%) (93.28), number of pods plant^{-1} (38.07), number of seeds pod^{-1} (17.13) and seed yield (721.76 Kg ha^{-1}) were recorded in Sehore-7, which were found remarkably better than other genotypes. The leaf area was recorded by using laser area meter (LI-300) at different stages of the crop. The LAI calculated the assimilatory surface area over a certain ground area. The yield parameter was recorded on five randomly selected plants from every treatment at the time of harvest.

Keywords: plant height, number of leaves, leaf area, leaf area index, germination percentage, pods per plant, seed yield.

INTRODUCTION

Fenugreek (*Trigonella foenum-graceum* L.) belongs to the family Fabaceae. Fenugreek generally known as methi, occupies an important position amongst leafy vegetables and condiment crop largely grown in central northern India during *Rabi* season. Fenugreek is also grown for forage. It is regarded as traditional forage in Egypt, India, Turkey and the Mediterranean region (McCormick *et al.,* 2009). 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). Fenugreek seeds contain alkaloids including trigonelline, saponins, flavonoids, mucilage protein 4.4%, mineral matter, 1.1%, fat 0.9%, calcium 360.0 mg, and vitamin 'A' 6450 IU (Singh and Kaur, 2007). Seeds and leaves of fenugreek are well characterized with a distinctive pungent scent that has made it highly desirable in culinary applications (Max, 1992). The crop species has long been used as a galactogogue to promote lactation in weaning mothers and to promote weight-gain in women (Rguibi and Belahsen, 2006 and Tiran, 2003). Fenugreek is the third major seed spices in India after coriander and cumin. In India total annual production of about 220 thousand metric tons (NHB, 2017). The maximum area and production about 80% of fenugreek is in Rajasthan. Madhya Pradesh shared 10.12% of the total production of India. The major Fenugreek growing districts of M.P. are Jabalpur, Chhatarpur, Indore, Mandsaur, Neemuch, Sehore and Sagar. The importance of fenugreek cultivation has been increased due to presence of asteroid called "*Diosgenin"* and it is used in the synthesis of sex hormones and contraceptives (Meena *et al.,* 2017). Fenugreek leaves and seeds are generally consumed as a spice in food preparation because of its strong flavor and aroma and also used as an ingredient in traditional medicine. Seed yield is a major parameter, which is influenced by several yield and yield attributing characters controlled by polygenes and also influenced by environment (Hosamath *et al.,* 2017). Farmers of Madhya Pradesh are still growing local cultivars of fenugreek which are low yielding and poor

marketable quality. Even though huge number of fenugreek varieties is released by various research institutes with high seed yield and vegetative leaves potential and marketable quality, these varieties are more popular in their geographical location. Hence these varieties are needed to be popularize among the farmers of Madhya Pradesh.

MATERIALS AND METHODS

The field experiment was carried out at Research farm, Department of Horticulture, RVSKVV- RAK College of Agriculture, Sehore (M.P.) during *Rabi* season of 2020-21 with Randomized Block Design which replicated thrice. This investigation was carried out with sixteen genotypes collect from different part of the country. In each block, genotypes were sown in a plot size 2.0×1.5 m^2 consisting of one row. The row to row and plant to plant distance was kept 30 cm and 10 cm, respectively. Recommended cultivation practices were adopted to raise a normal crop. The five plants were collected from each plot at 30, 45, 60 DAS and at harvest to recorded all the parameters *viz*., Plant height, number of branches, number of leaves, leaf area (cm^2), leaf area index, days to first flowering, Days to 50% flowering, days to seed maturity, pods $plant^{-1}$ seeds per pod^{-1}, seed yield (g) $plant^{-1}$ and seed yield (q ha^{-1}) and later on their mean was calculated. The experimental data were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1967). Where the "F" test was found significant at 5% level of significance, the critical differences for the treatment's comparison were worked out.

RESULTS AND DISCUSSION

Morphological parameters: The results revealed that, all the parameters were significantly differed among genotypes in relation to morphological parameters during investigation at all the growth stages presented in (Table 1). The analysis of variance revealed that mean squares were highly significant for all the characters studied indicating sufficient variability present in the genotypes. Wide range of variation in mean performance of genotypes was observed for all characters under study. In other words, the performance of the genotypes with respect to these characters were statistically significant, suggesting that there is ample scope for selection in different traits for the improvement of fenugreek. Result revealed that the maximum plant height (cm) $plant^{-1}$ (13.00, 34.20 and 60.13), number of branches $plant^{-1}$ (7.13, 9.07 and 11.01) number of leaves $plant^{-1}$ (9.01, 22.00 and 65.00) leaf area (cm^2) $plant^{-1}$ (14.04, 37.00 and 65.00) and leaf area index (0.19, 0.44 and 0.82) at 30, 45 and 60 DAS were recorded in Sehore-7, which were found remarkably better than other genotypes studied this investigation. It was at par to genotypes Sehore-8 and Sehore-9.While the minimum plant height (8.00, 22.03 and 45.18), number of branches $plant^{-1}$ (4.00, 6.04 and 7.02), number of leaves (5.01, 14.04 and 45.11), leaf area (cm^2) $plant^{-1}$ (12.03, 33.00 and 61.00) and leaf area index (0.14, 0.37 and .075) at 30, 45 and 60 DAS were found in Saryu genotype of fenugreek. This suggest that there is sample scope to identify high yielding and early genotypes with resistance to insect pests and diseases to improve different characters simultaneously, subjected to judicious selection pressure being observation sixteen traits had a wide range of variability. Similar results for most of the characters were also reported by Gangopadhyay *et al*., (2009); Naik (2013); Chowdhury *et al.* (2014); Kole and Goswami (2015); Jyothi & Hedge (2018) in fenugreek.

Phenological parameters: The results obtained during the investigation in respect to phenological parameters *viz.*, seed germination (%), days to first flowering, days to 50% flowering and days to seed maturity, present in (Table 2, Fig. 1).

Table 1: Performance of fenugreek genotypes for different morphological characteristics.

Genotype Symbols	Genotype Details	Plant height (cm) $plant^{-1}$			Number of branches			Number of leaves			Leaf area (cm^2)			Leaf area index		
		30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
V_1	**Sehore 1**	11.02	30.67	55.37	5.70	7.66	9.48	7.12	18.69	56.08	13.25	35.55	63.55	0.17	0.40	0.78
V_2	**Sehore 2**	11.42	31.70	56.63	5.85	7.90	9.55	7.44	19.28	57.40	13.32	35.85	63.85	0.17	0.41	0.79
V_3	**Sehore 3**	10.66	27.91	52.61	5.28	7.30	8.77	6.53	18.13	53.72	12.85	34.77	62.77	0.16	0.39	0.77
V_4	**Plume 55**	9.46	25.89	49.49	4.76	6.76	8.08	5.48	15.90	50.49	12.47	34.03	62.03	0.16	0.38	0.76
V_5	**Sehore 5**	10.50	26.47	51.59	5.09	7.09	8.61	6.16	16.70	52.92	12.68	34.62	62.62	0.16	0.39	0.77
V_6	**Kesar**	10.80	29.25	53.53	5.50	7.50	9.04	6.76	18.56	54.08	13.04	35.40	63.40	0.17	0.40	0.78
V_7	**Sehore 7**	13.00	34.20	60.13	7.13	9.07	11.01	9.01	22.00	65.00	14.04	37.00	65.00	0.19	0.44	0.82
V_8	**Sehore 8**	12.89	33.82	59.45	6.92	8.92	10.72	8.90	21.89	63.95	13.79	36.91	64.91	0.18	0.43	0.81
V_9	**Sehore 9**	12.55	33.01	59.09	6.86	8.73	10.45	8.47	21.56	60.08	13.69	36.69	64.69	0.18	0.42	0.80
V_{10}	**Sehore 10**	11.43	32.00	57.40	5.96	7.96	9.67	7.88	19.54	58.74	13.46	36.06	64.06	0.17	0.41	0.79
V_{11}	**Sehore 11**	12.18	32.56	58.00	6.17	8.17	9.97	7.99	20.32	59.39	13.50	36.25	64.25	0.17	0.42	0.79
V_{12}	**Sehore12**	8.92	24.51	48.40	4.54	6.54	7.95	5.30	14.82	48.55	12.41	33.82	61.82	0.15	0.38	0.76
V_{13}	**Suraj**	12.38	32.84	58.64	6.42	8.42	10.03	8.45	20.69	59.48	13.66	36.37	64.37	0.17	0.42	0.80
V_{14}	**Lajabab**	9.79	26.11	50.38	4.89	6.89	8.31	6.02	16.35	51.42	12.59	34.38	62.38	0.16	0.39	0.77
V_{15}	**Saryu**	8.00	22.03	45.18	4.00	6.04	7.02	5.01	14.04	45.11	12.03	33.00	61.00	0.14	0.37	0.75
V_{16}	**Shree**	8.45	23.66	47.40	4.37	6.37	7.49	5.22	14.62	46.98	12.39	33.45	61.45	0.15	0.38	0.76
	SEm ±	**0.36**	**0.45**	**0.63**	**0.18**	**0.18**	**0.26**	**0.22**	**0.43**	**1.64**	**0.26**	**0.10**	**0.26**	**0.007**	**0.006**	**0.006**
	CD 5%	**1.06**	**1.32**	**1.82**	**0.52**	**0.52**	**0.75**	**0.64**	**1.26**	**4.75**	**0.75**	**0.28**	**0.77**	**0.02**	**0.01**	**0.01**

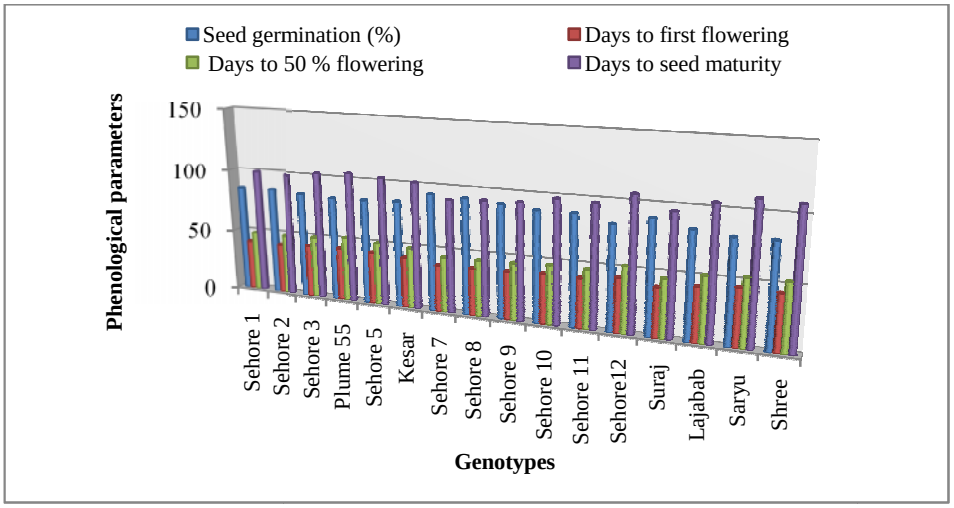

Fig. 1. Performance of fenugreek genotypes for phenological parameters.

The results revealed that, all the parameters were significantly differed among genotypes in relation to phenological parameters during investigation. The highest germination percentage was observed in Sehore-7 (93.28%), which was found remarkably better than other genotypes studied.

It was at par to genotypes Sehore-8 (92.25%) and Sehore-9 (90.25). The lowest germination percentage (80.71%) was recorded in Saryu genotype. The variation in the germination among the varieties due to climatic factors *viz.*, temperature, rainfall and relative humidity these findings were in accordance with the results obtained by Latye *et al.*, (2016) in fenugreek. The minimum days to first flowering, days to 50 % flowering and days to seed maturity was observed in Sehore-7 (37.09, 44.09 and 90.00), which was found remarkably better than other genotypes studied this investigation. It was at par to genotypes Sehore-8 and Sehore-9. The maximum days to first flowering (45.03), days to 50% flowering (53.01) and days to seed maturity (109.19) was recorded in genotype Saryu. The results are in confirmation with the results achieved by Gangopadhyay *et al.*, (2009); Chitra and Rajamiani (2010); Prajapati *et al.*, (2010).

Yield parameters: The number of pods plant^{-1}, number of seeds pod^{-1}, seed yield (g) plant^{-1} seed yield (q ha^{-1}) present in (Table 2, Fig. 2 and 3). The results revealed that, all the parameters were significantly differed among genotypes in relation to yield parameters during investigation. The maximum number of pods plant^{-1} (38.07), number of seeds pod^{-1} (17.13) seed yield (g) plant^{-1} (8.02) and seed yield (721.76 Kg ha^{-1}) were recorded in Sehore-7, which was found higher than all other genotypes studied. The minimum number of pods plant^{-1}, number of seeds pod^{-1}, seed yield (g) plant^{-1}, and seed yield (Kg ha^{-1}) were recorded in Saryu genotype of fenugreek. Among the varieties Sehore-7 recorded higher values in respect of many yield attributing parameters. This might be due to favorable environmental conditions available to the crop.

Table 2: Performance of fenugreek genotypes for Phenological and Yield characteristic.

Genotype Symbols	Genotype Details	Phenological Parameters				Yield Parameters			
		Seed Germination (%)	Days to first flowering	Days to 50% flowering	Days to seed maturity	No. of pods plant^{-1}	No. of seeds pod^{-1}	Seed yield (g) plant^{-1}	Seed yield (Kg ha^{-1})
V_1	Sehore 1	85.31	40.24	48.16	99.28	28.59	14.54	5.11	460.00
V_2	Sehore 2	85.62	40.00	47.57	98.61	29.53	14.74	5.36	482.14
V_3	Sehore 3	84.74	41.77	49.35	102.66	27.72	13.85	4.73	425.31
V_4	Plume 55	83.25	42.54	51.70	104.50	23.96	12.94	3.82	343.40
V_5	Sehore 5	83.92	41.80	49.88	102.92	25.67	13.64	4.31	387.56
V_6	Kesar	85.28	40.58	48.77	101.34	28.42	14.03	4.90	441.43
V_7	Sehore 7	93.28	37.09	44.09	90.00	38.07	17.13	8.02	721.76
V_8	Sehore 8	92.25	37.58	44.58	91.79	36.05	16.85	7.47	672.51
V_9	Sehore 9	90.25	38.44	45.44	92.83	34.17	16.30	6.85	616.28
V_{10}	Sehore 10	87.69	39.83	46.83	97.82	30.38	15.54	5.81	522.68
V_{11}	Sehore 11	87.92	39.40	46.40	96.95	31.31	15.74	6.06	545.76
V_{12}	Sehore12	82.52	42.88	52.07	105.94	22.19	12.71	3.47	312.36
V_{13}	Suraj	89.28	38.79	45.79	95.58	33.59	16.04	6.63	596.68
V_{14}	Lajabab	83.66	42.35	51.21	103.98	24.71	13.19	4.01	360.74
V_{15}	Saryu	80.71	45.03	53.01	109.19	20.01	12.02	2.96	266.37
V_{16}	Shree	81.25	44.21	52.86	107.73	21.52	12.52	3.31	297.92
	SEm ±	2.077	0.56	0.39	0.95	0.62	0.251	0.15	13.88
	CD 5%	5.998	1.64	1.12	2.76	1.80	0.72	0.44	40.09

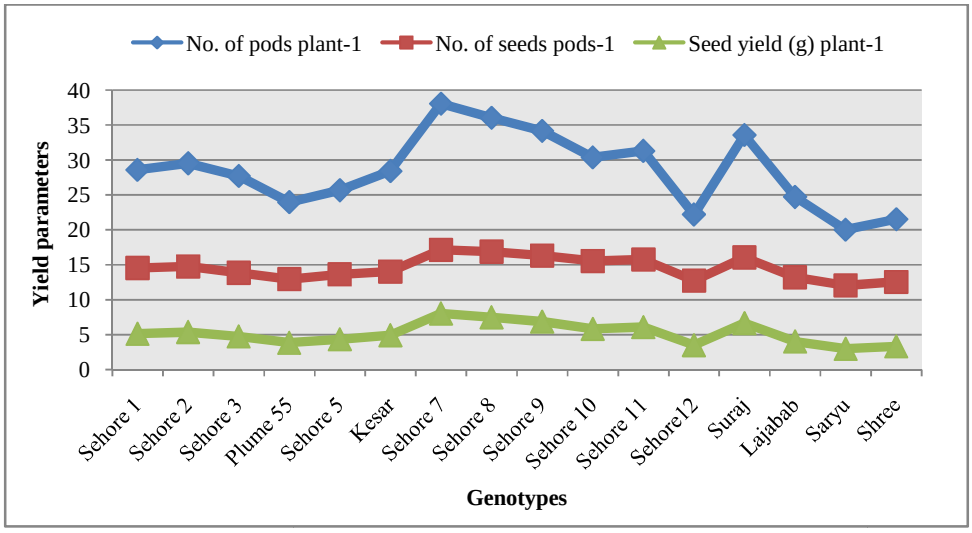

Fig. 2. Performance of fenugreek genotypes for Yield Parameters.

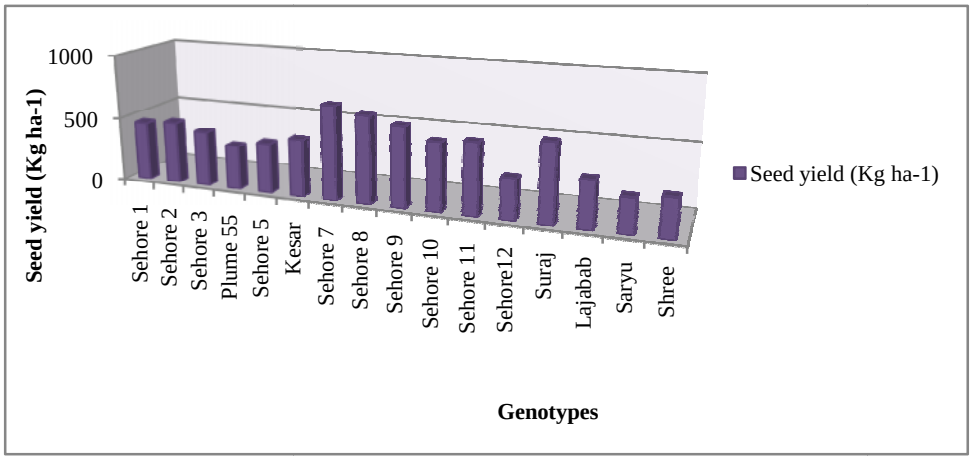

Fig. 3. Performance of fenugreek genotypes for Seed Yield.

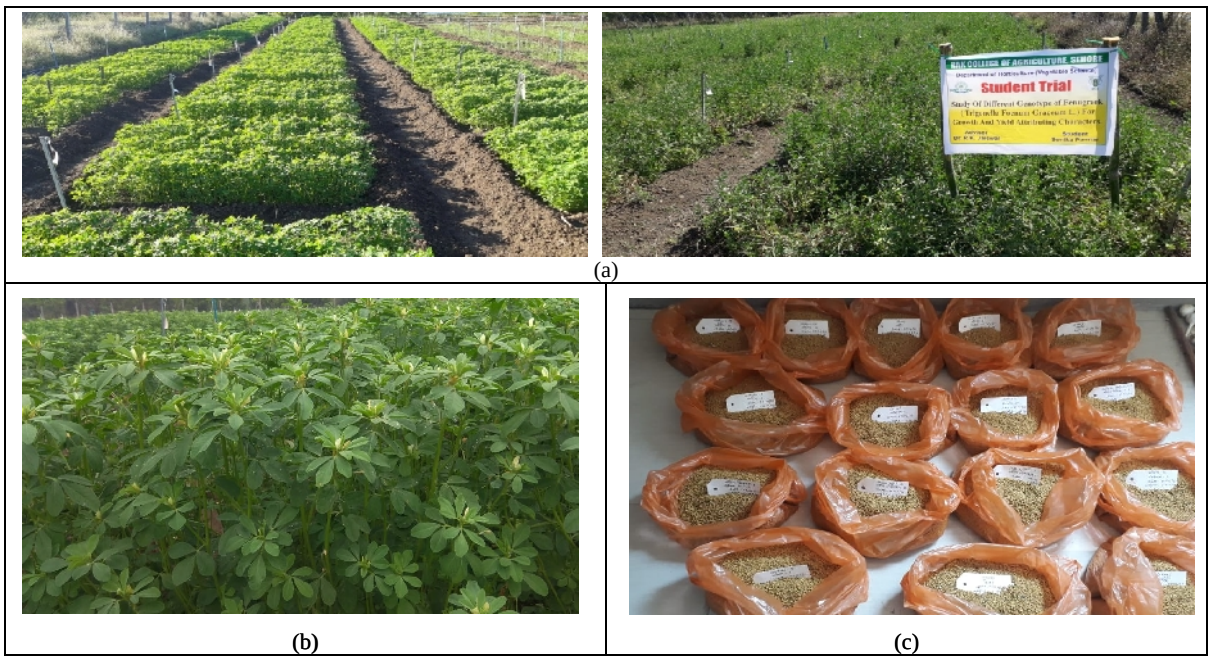

Plate 1: Research field; Flowering stage; Seed yield per plot.

Sehore-7 genotype were found to produce more number of pods per plant, number of seeds per pod, seed yield per plant, and seed yield per hectare. This might be due to favorable environmental conditions available couple with high genetic potential of crop variety. These results are supported by the Yadava *et al*., (2013); Giridhar *et al.* (2015); Mamatha *et al.* (2017); Anitha *et al.*, (2018) of fenugreek.

CONCLUSION

Thus it can be concluded from the result of present investigation that huge variation was noticed among the sixteen genotypes studied in this investigation for all the plant characteristics, growth and phenological parameters in fenugreek as well as yield parameters of fenugreek. The genotype Sehore-7 was found significantly superior as compared to all genotypes included in this study with respect to growth parameters, phenological parameters and yield parameters of fenugreek.

FUTURE SCOPE

Fenugreek as a crop provides other environmental, economic and social benefits. It is a dry-land adaptive crop which can reduce water requirement during cultivation. It can passively prevent contamination of ground water and soil run-off by irrigation water. As a legume it binds nitrogen in root nodules. Incorporation of the plant into the soil after harvest can serve as a nitrogen source for subsequent crops, thus fenugreek also can lower the need for application of nitrogenous fertilizers in the field, it can also successfully be used by farmers and upcoming scholars in short term rotations to maintain soil productivity.

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Conflict of Interest. The author declares that there is no conflict of interests concerning the publication of this paper.

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