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Study of growth, phenology and seed yield in fenugreek (*Trigonella foenum-graecum* L.) varieties

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Abstract

The present field experiment was conducted at Research Farm, K N K College of Horticulture, Mandsaur. This investigation was carried out with twenty varieties includes seven local collected genotypes and thirteen released varieties. The research experiment was laid out in simple Randomized Block Design in three replications during the year 2018- 19. The analysis of variance revealed significant difference in all the growth parameters among the varieties. However, the maximum leaf area index (0.31, 0.53 and 0.35) and leaf area duration (4.59, 8.00 and 6.85 cm² day⁻¹) recorded in V₁₀ PEB at all the growth stages at 30 days fixed intervals. The variety V₅ AFg-2 was recorded maximum crop growth rate (0.59, 1.30 mg cm² day⁻¹) and relative growth rate (55.98 and 82.35 mg g⁻¹ day⁻¹) at 30-60 and 60-90 DAS respectively, but 90-at harvest in V₁₇ Jaora Local-2 crop growth rate (1.29 mg cm²day⁻¹) and V₈ AFg-5 relative growth rate (79.50mg g⁻¹day⁻¹). The maximum leaf area (26.82, 156.66, 163.19, and 47.54 cm² plant⁻¹) in V₁₀ PEB, fresh weight (2.30, 34.33, 100.30 and 72.62 g plant⁻¹) in V₅ AFg-2, SPAD value (57.29, 67.42, 78.56, and 52.94) in V₁₀ PEB at all the growth stages at 30 days fixed intervals and seed yield (8.77g plant⁻¹) in V₅ AFg-2. The variety V₉ HM-57 was took minimum days to 50% germination (4.33), 50% flowering (43.67) and days to maturity (119.00) as compared to other varieties.

Keywords: Fenugreek, LAI, LAD, CGR, RGR

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is self-pollinated and destogamous annual diploid species, popularly grown by its vernacular name “*Methi*”, belongs of the family “*Fabaceae*”. It is native to the Mediterranean Region, extending to Central Asia. Fenugreek is used as whole seed and in powdered form and often roasted to reduce its bitterness and enhances the flavor. Bitter taste of seeds due to presence of an alkaloid “*Trigonelline*”. The importance of fenugreek has been increased due to presence of steroid called “*Diosgenin*” and it is used in the synthesis of sex hormones and contraceptives (Meena *et al.*, 2017) ^[10]. 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. It is rich source of calcium, iron, alpha-carotene and other vitamins (Chouhan *et al.*, 2017) ^[11]. Fenugreek is an annual herb, 30 to 90 cm tall having light green leaves which are pinnately trifoliate. The flowers are papilionaceous and white or yellow coloured. The plant produces slender curved pods, which contain 10 to 20 small, yellowish brown seeds, which are smooth and oblong, about 3 mm long, bitter in taste and having distinct flavor (Farooqui *et al.*, 2004) ^[4].

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) ^[11]. Among different states of India, Rajasthan is leading state followed by Madhya Pradesh accounting for 25 thousand tons of production contributing 10.13% share (NHB, 2017) ^[11].

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) ^[6]. 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 are released by various research institutes with high yield potential and marketable quality, these

varieties are more popular in their geographical location. 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, College of Horticulture Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during *rabi* season of 2018-19 with Randomized Block Design which replicated thrice. This investigation was carried out with twenty varieties includes seven local collected genotypes from the Mandsaur, Jaora and Tikamgarh district of Madhya Pradesh and thirteen released varieties obtained from different centers. The five plants were collected from each plot at 30,

60, 90 DAS and at harvest to recorded all the parameters 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 (1985)^[12]. 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

The results revealed that, all the parameters were significantly differed among varieties in relation to growth, phenological and yield parameters during investigation at all the growth intervals and all the attributes are presented in the Table 1&2 and Figure 1.

Table 1: Performance of fenugreek varieties for leaf area index, leaf area duration, crop growth rate and relative growth rate

Varieties	LAI		LAD (cm ² day ⁻¹)				CGR (mg cm ⁻² day ⁻¹)			RGR (mg g ⁻¹ day ⁻¹)		
	30-60 DAS	60-90 DAS	90 DAS-harvest	30-60 DAS	60-90 DAS	90 DAS-harvest	30-60 DAS	60-90 DAS	90 DAS-harvest	30-60 DAS	60-90 DAS	90 DAS-harvest
V ₁ -Lam selection 1	0.21	0.35	0.22	3.09	5.31	3.61	0.29	1.19	0.73	32.30	79.28	60.36
V ₂ -Lam methi 2	0.18	0.33	0.22	2.66	4.93	3.66	0.29	0.74	0.78	31.76	63.38	62.36
V ₃ -Lam methi 3	0.23	0.37	0.21	3.42	5.50	3.56	0.29	1.01	0.74	31.84	73.83	60.00
V ₄ -Afg 1	0.21	0.41	0.30	3.22	6.21	4.48	0.35	0.99	0.80	38.33	73.36	66.07
V ₅ -Afg 2	0.27	0.48	0.31	4.12	7.15	5.05	0.59	1.30	0.83	55.98	82.35	64.72
V ₆ -Afg 3	0.23	0.39	0.25	3.49	5.89	3.92	0.44	1.08	0.70	46.22	76.06	60.54
V ₇ -Afg 4	0.23	0.43	0.28	3.51	6.39	4.31	0.35	1.05	0.94	38.96	75.21	70.30
V ₈ -Afg 5	0.22	0.35	0.22	3.26	5.32	3.35	0.34	0.85	1.25	37.42	68.00	79.50
V ₉ -HM 57	0.28	0.51	0.34	4.26	7.63	4.89	0.48	1.08	1.12	49.37	76.21	78.73
V ₁₀ -PEB	0.31	0.53	0.35	4.59	8.00	6.85	0.42	0.70	1.13	44.64	61.68	66.56
V ₁₁ -GM 1	0.24	0.39	0.24	3.63	5.87	3.60	0.46	1.10	0.92	47.38	76.64	71.33
V ₁₂ -GM 2	0.29	0.48	0.30	4.34	7.13	4.82	0.48	1.15	0.98	49.33	78.27	70.23
V ₁₃ -DFC 21	0.23	0.39	0.25	3.45	5.85	3.64	0.42	0.91	0.64	44.61	70.27	59.38
V ₁₄ -MDS Local 1	0.18	0.35	0.24	2.69	5.18	3.76	0.35	1.08	0.56	38.50	76.01	53.07
V ₁₅ -MDS Local 2	0.20	0.37	0.26	2.95	5.59	4.21	0.34	0.94	0.62	36.92	71.27	55.81
V ₁₆ -Jaora Local 1	0.20	0.34	0.23	2.93	5.09	3.63	0.32	1.18	0.70	35.61	79.02	60.72
V ₁₇ -Jaora Local 2	0.27	0.48	0.29	4.07	7.15	4.60	0.45	0.70	1.29	47.17	61.51	78.88
V ₁₈ -Jaora Local 3	0.25	0.40	0.24	3.70	5.98	3.69	0.23	0.70	0.97	24.31	61.76	72.36
V ₁₉ -Jaora Local 4	0.24	0.36	0.19	3.64	5.36	2.92	0.20	0.72	0.68	19.79	62.61	60.46
V ₂₀ -TKG Local	0.26	0.49	0.32	3.89	7.36	4.98	0.43	0.99	0.67	45.45	73.12	55.27
S. Em ±	0.01	0.01	0.01	0.13	0.17	0.17	0.01	0.02	0.06	1.13	0.77	2.93
CD @ 5%	0.03	0.03	0.02	0.38	0.49	0.50	0.03	0.06	0.17	3.23	2.21	8.38

Table 2: Performance of fenugreek varieties for leaf area, fresh weight, chlorophyll content and seed yield

Varieties	Leaf Area (cm ² plant ⁻¹)				Fresh Weight (g plant ⁻¹)				Chlorophyll content SPAD				Seed yield (g plant ⁻¹)
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest	
V ₁ -Lam selection 1	13.97	109.54	102.86	28.24	0.97	17.21	80.32	59.67	49.35	56.59	65.49	41.38	6.29
V ₂ -Lam methi 2	15.08	91.15	106.00	27.08	0.87	18.17	61.83	54.49	49.12	54.61	67.19	42.17	5.19
V ₃ -Lam methi 3	19.14	117.70	102.12	24.78	0.97	20.13	76.87	56.33	48.75	63.10	65.83	45.24	7.01
V ₄ -Afg 1	22.56	106.30	141.98	37.09	1.27	20.80	66.12	49.83	49.97	62.72	73.93	42.78	5.88
V ₅ -Afg 2	25.78	139.01	146.83	40.75	2.30	34.33	100.30	72.62	57.03	66.89	76.71	48.84	8.77
V ₆ -Afg 3	19.66	120.12	115.58	34.33	1.33	26.70	92.75	48.87	50.82	59.40	71.83	46.35	6.73
V ₇ -Afg 4	19.36	121.20	134.56	32.53	1.31	21.80	67.20	54.01	51.19	58.61	64.59	44.59	6.50
V ₈ -Afg 5	20.65	109.73	103.10	26.27	1.57	19.57	78.37	61.73	54.27	63.14	72.78	47.58	6.69
V ₉ -HM 57	25.02	145.38	159.92	42.23	1.63	28.84	91.17	67.27	54.41	65.07	77.64	48.22	7.80
V ₁₀ -PEB	26.82	156.66	163.19	47.54	0.90	24.17	78.17	65.23	57.29	67.42	78.56	52.94	5.99
V ₁₁ -GM 1	23.64	121.69	113.24	32.33	1.60	27.90	91.13	61.07	52.96	55.73	66.99	42.77	7.03
V ₁₂ -GM 2	26.03	147.66	137.41	43.35	1.63	28.27	96.47	68.61	54.39	59.91	65.89	43.45	8.38
V ₁₃ -DFC 21	18.69	119.17	114.70	34.06	1.37	25.10	82.37	60.59	50.57	59.05	67.35	43.03	5.58
V ₁₄ -MDS Local 1	10.53	97.19	110.02	32.51	1.00	22.03	87.43	54.60	42.46	52.97	64.11	38.62	5.77
V ₁₅ -MDS Local 2	14.75	103.25	120.46	37.55	2.27	21.77	75.80	50.11	50.03	63.92	75.63	44.43	5.15
V ₁₆ -Jaora Local 1	15.99	101.09	102.54	36.72	0.67	17.67	78.37	59.17	50.27	57.69	66.53	41.10	6.09
V ₁₇ -Jaora Local 2	13.60	149.29	136.63	35.91	1.63	27.60	78.97	50.56	51.06	54.14	64.97	41.50	5.35
V ₁₈ -Jaora Local 3	22.83	125.22	113.79	31.88	1.20	15.37	54.95	47.75	49.49	55.40	68.53	45.88	4.12
V ₁₉ -Jaora Local 4	17.96	127.74	86.57	28.44	0.87	13.47	49.30	41.60	51.43	63.85	73.57	44.79	4.02
V ₂₀ -TKG Local	20.27	135.16	159.13	33.76	1.30	27.57	87.37	48.34	52.67	63.39	73.62	43.90	6.33
S. Em ±	0.66	5.19	4.60	1.31	0.06	1.93	3.49	2.00	1.48	2.02	3.52	1.50	0.34
CD @ 5%	1.89	14.86	13.16	3.75	0.16	5.52	9.99	5.74	4.25	5.79	10.08	4.28	0.97

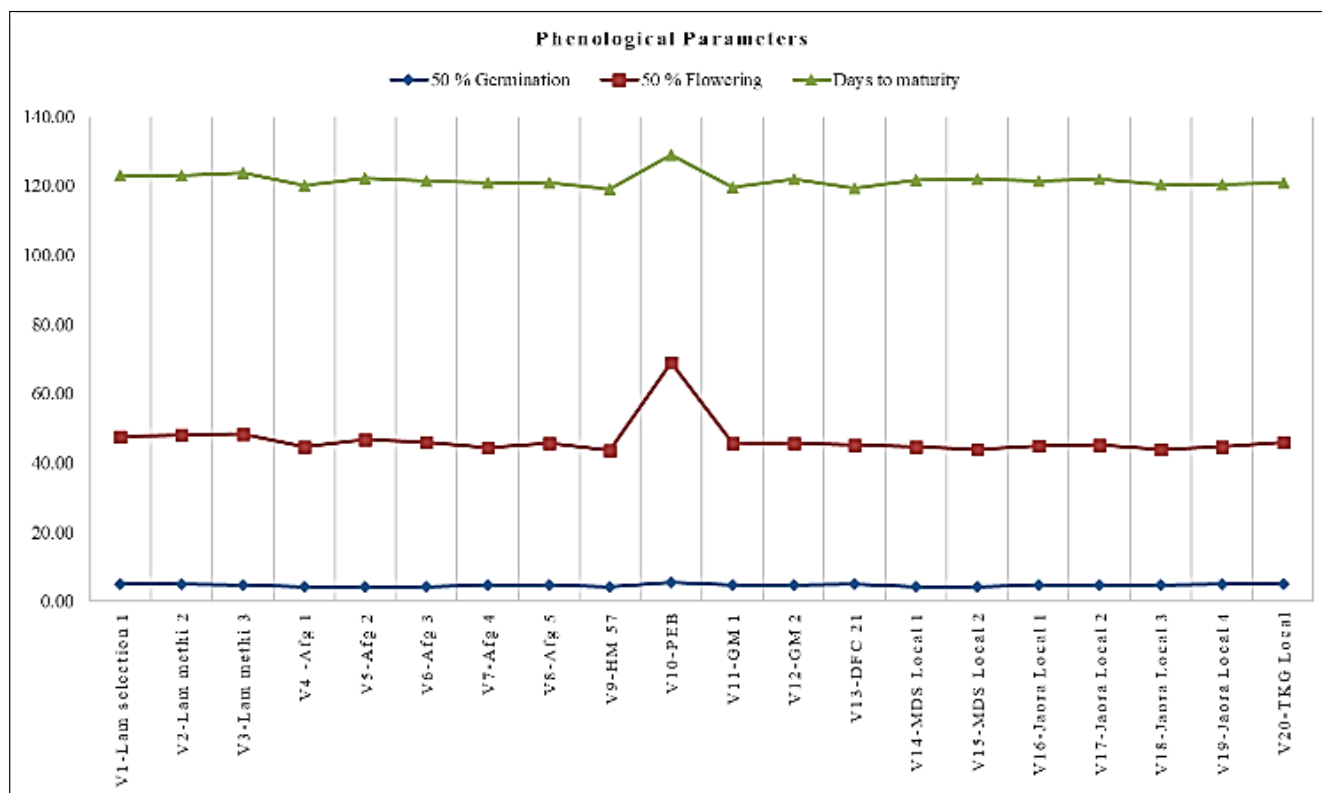


Fig 1: Presentation of fenugreek varieties for phenological parameters

The growth parameters like leaf area index, leaf area duration, crop growth rate, relative growth rate, leaf area, fresh weight, seed yield and chlorophyll content SPAD value were varied significantly among the varieties. The present study revealed that, the variety V₁₀ PEB was registered highest leaf area index (0.31, 0.53 and 0.35) and leaf area duration (4.59, 8.00 and 6.85 cm² day⁻¹) at 30-60, 60-90 DAS and 90-harvest respectively. The enhancement in the growth stages due to maximum size of the leaves and number of leaves leads to highest photosynthetic surface area as resulting by maximum leaf area that intern increases the leaf area index and leaf area duration. Similar results were reported by Kuri *et al.* (2015)^[8] in coriander and Latye *et al.* (2016)^[9] in fenugreek. The investigation revealed that, the variety V₅ AFg-2 was recorded maximum crop growth rate (0.59 and 1.30 mg cm⁻² day⁻¹) and relative growth rate (55.98 and 82.35 mg g⁻¹ day⁻¹) at all growth stages except 90 DAS to harvest which was V₁₇ Jaora Local-2 in crop growth rate (1.29 mg cm⁻² day⁻¹) and V₈ AFg-5 in relative growth rate (79.50 mg g⁻¹ day⁻¹). V₁₀ PEB was registered highest leaf area (26.82, 156.66, 163.19 and 47.54 cm² plant⁻¹) at 30, 60, 90 DAS and at harvest respectively. The variation in the growth parameters of variety is an outcome of genomic, environmental, and agronomic interaction. Meanwhile, these varieties grown under ideal agronomic and climatic condition the variation was observed in overall growth of varieties, it may be due to genetic makeup and also photo synthetically active leaf area results in more absorption and utilization of radiant energy which ultimately leads to maximum dry matter accumulation, number of primary and secondary branches. Similar findings were reported by Kuri *et al.* (2015)^[8] in coriander. The investigation revealed that, maximum fresh weight (2.30, 34.33, 100.30 and 72.62 g plant⁻¹) was recorded in variety V₅ AFg-2 at all growth stages. The reason for higher value of fresh weight due to plant have capacity to harvested maximum sunlight and synthesize photosynthates. These findings were agreement with Latye *et al.* (2016)^[9] and

Sharanya *et al.* (2018)^[15] in fenugreek. The present study revealed that, the maximum chlorophyll content SPAD value (57.29, 67.42, 78.56 and 52.94) was recorded in V₁₀ PEB at 30, 60, 90 DAS and at harvest respectively. The significant difference in the chlorophyll content SPAD value may be due to genetic character of the variety. These results obtained are accordance with the findings of Kuri *et al.* (2015)^[8] in coriander, Gurjar *et al.* (2016)^[5], Hosamath *et al.* (2017)^[6], Sharanya *et al.* (2018)^[15] in fenugreek. The significant variations were observed in seed yield. The maximum seed yield (8.77 g plant⁻¹) was recorded in variety V₅ AFg-2. The seed yield was depending on the number of pods per plant, pod length, number of seeds pod⁻¹ and also harvest index and response of fenugreek varieties to favorable agro-climatic conditions, different vegetative character of the cultivar. The similar results are found by Datta and Chatterjee (2004)^[2], Thakral *et al.* (2006)^[16], Latye *et al.* (2016)^[9], Santhosha *et al.* (2014)^[14] in fenugreek.

A significant difference was noted in all the phenological parameters except days to 50% germination in different fenugreek varieties. The minimum days to 50% germination (4.33 days), days to 50% flowering (43.67 days) and days to maturity (119.00 days) were recorded in the variety V₉ HM-57 while it was maximum (5.67, 69.00 and 129.00 days) in the variety V₁₀ PEB respectively. 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)^[9] and Jhajhra *et al.* (2017)^[7] in fenugreek. It may be also due to adoptability of varieties to the specific environmental conditions, better and efficient utilization of nutrients, low quantity of flowering hormone and early end of vegetative phase and initiation of reproductive phase. These observations are confirmed with Datta and Chatterjee (2004)^[2] in fenugreek, Dhakad *et al.* (2017)^[3] in coriander, Patil *et al.* (2016)^[13], Hosamath *et al.* (2017)^[6], Yadav *et al.* (2018)^[17] in fenugreek.

Conclusion

Out of twenty varieties, the highest seed yield, fresh weight, crop growth rate and relative growth rate were recorded in AFG-2 followed by PEB in relation to leaf area, leaf area index, leaf area duration and chlorophyll content. On the basis of one year research, it could be concluded that AFG-2 and PEB are the outstanding performance and should be used for further breeding programme in fenugreek.

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