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Research Article

VARIABILITY PARAMETERS FOR GROWTH AND YIELD CHARACTERS IN FENUGREEK (*Trigonella Spp.*) GENOTYPES

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Abstract- A field experiment comprising of twenty six germplasm of fenugreek (*Trigonella spp.*) along with two standard checks Pant Ragini and Pusa Early Bunching was carried out. The analysis of variance revealed highly significant differences among all the genotypes for all traits. High genotypic and phenotypic coefficient variation were observed for characters, namely no. of primary branches per plant, number of leaves at 30, 45 and 60 DAS, green leaf yield per plant(g),green leaf yield q/ha .The GCV values were highest for number of primary branches per plant (21.41%) and number of leaves per plant at 30, 45 and 60 DAS (20.38%, 19.31% and 20.37%), 1000 seed weight (18.85%).The PCV values were maximum for number of leaves per plant at 30 DAS (25.71%).The genetic advance recorded highest in green leaf yield q/ha (33.93) followed by green leaf yield per plant (21.20). Highest percent of heritability were shown by 1000 seed weight (99.12%) followed by number of primary branches per plant (97.18%).Green leaf yield per plant (g) and green leaf yield q/ha showed high heritability and high genetic advance.

Keywords- PCV, GCV, Genetic advance, Heritability, Seed and fenugreek.

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Introduction

India is a leading producer and consumer of fenugreek for its culinary uses and medicinal application. In India most of the people are of vegetarian class. In such a situation, a leafy vegetable, such as fenugreek is of chief concern due to its high neutraceutical property, medicinal values and industrial uses.

The green fenugreek leaves (fresh or dried) are used as herb. The fresh leaves are used as vegetable in the diets. The genus *Trigonella* is one of the largest genera of the tribe *Trifoliatae* in the family "Fabaceae" and sub–family "Papilionaceae". It is an autogamous crop with chromosome no. 2n=16 [4]. It is an important multipurpose crop grown during rabi season in India and in Mediterranean region both irrigated and as a rainfed crop for seed, fodder, leafy vegetables and spices. Its seeds contain 25.5% protein, 7.9% fat, 20% mucilaginous matter and 4.8% sap. They are aromatic, carminative, antibacterial and may be eaten raw or cooked. It constitutes 50% unavailable carbohydrates (fiber) making its highest concentration among all the natural sources of fiber.

Genetic diversity refers as the variety of alleles and genotypes present in a population and this is revealed in morphological, physiological and behavioral differences between individuals and populations [5]. Improvement of the crop depends upon the magnitude of genetic diversity of economic characters. Across the world only noted and well defined cultivars are grown in specific areas. The neglected and the underuse status of these locally chief crops reveal a possibility of removal of important plant material developed over thousands of years of cultivation. One of the most important factors restricting their large scale production and development of superior varieties is that very scanty knowledge is provided about their genetic diversity, inter and intraspecific variability and genetic relationship among the species. Therefore, attempts to analyze possible untapped genetic diversity become extremely essential for breeding and crop improvement.

A detailed extent study of variability and heritability in relation to their contribution towards yield is pre-requisite for an efficient plant breeding programme

Thus, keeping above considerations in view, the present research work was carried out to analyses the variability parameters for growth and yield character in twenty eight fenugreek genotypes.

Material and Methods

Twenty six germplasm along with 2 checks of fenugreek (*Trigonell aspp*) were evaluated for genetic variability during rabi season 2015-16 at Pantnagar Centre for Plant Genetic Resources Govind Ballabh Pant University of Agriculture and Technology Pantnagar, U.S. Nagar, Uttarakhand. Twenty six germplasm were grown in Randomized Block Design with two checks in three replications. The suggested package of practices was followed to grow a vigorous fenugreek crop. The observations were taken on five randomly selected competitive plants from a particular plot on 10 yield and yield contributing characters like number of primary branches per plant, No. of leaves at 30 DAS, No. of leaves at 45 DAS, No. of leaves at 60 DAS, Days to first leaf harvest, leaf area (cm^2) green leaf yield per plant (g), number of seeds per pod, green leaf yield q/ha and 1000 seed weight. Data were analyzed statistically through computer by using STPR3 Programme for their mean, range, genetic variability, coefficient of variation, heritability, genetic advance as percent of mean.

Result and Discussion

The analysis of variance for various characters is presented in [Table-1]. Highly significant differences among the genotypes were obtained for all the characters namely number of primary branches per plant, number of leaves per plant at 30, 45, 60 DAS, days to first leaves harvest, leaf area, green leaf yield per plant, number of seeds per pod, green leaf yield q/ha, 1000 seed weight. Among all the

genotypes PFG- 21 showed the maximum leaf area and PFG- 31 showed the minimum leaf area [Fig-1]. Our results are in close agreement with the findings obtained by Aggrwal*et al*. [1].

Table-1 *Analysis of variance with respect to various characters studies of fenugreek*

Source	d. f	No. of primary branches per plant	No. of leaves at 30 DAS	No. of leaves at 45 DAS	No. of leaves at 60 DAS	Days to first leaf harvest	Leaf Area (cm^2)	Green leaf yield/ plant (g)	No. of seeds per pod	Green leaf yield q/ha	1000 seed weight (g)
Replication	2	0.106	0.42	5.51	6.89	6367.76	73.41	9.48	0.42	63.38	0.29
Treatment	27	2.01**	19.00**	32.85**	105.00**	39.93**	26.05**	339.29**	10.81**	914.32**	29.98**
Error	54	0.19	3.13	3.65	10.28	2.76	11.08	5.57	0.14	26.75	0.88

** Significant at 1% level of significance

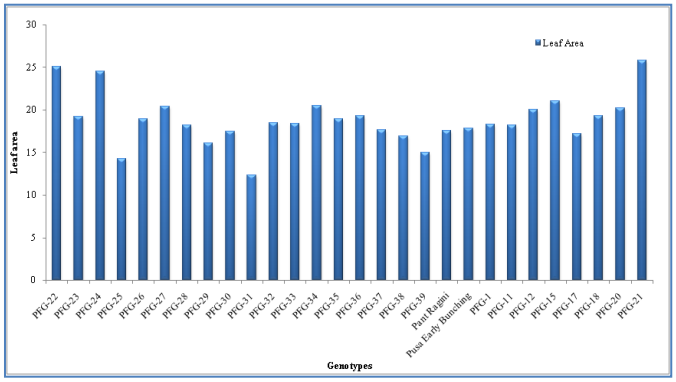

Fig-1 Variation in Leaf area (cm^2) in different genotypes of fenugreek

The present study depict that there was a wide range of variability in the germplasm for all the traits. For an effective breeding programme, the exploitation of diversity is of much importance and is a prerequisite for effective screening of superior genotypes. Larger variability ensures greater scope of selection and improvement. The mean values of all the genotypes were evaluated and have been presented in [Table-2]. The maximum primary branches per plant were recorded in genotypes PFG-37 (5.56) followed by PFG-31 (5.16) and PFG-28 (5.14) whereas minimum primary branches per plant were recorded in PFG- 1 (2.50) followed by PFG-22 (2.64). The result for number of primary branches per plant was similar with the findings of Naik *et al*.[9]. Data revealed that mean value for number of leaves at 30 DAS ranged from 7.66 to 17.66. The variation among the genotypes for no. of leaves at 30 DAS was also reported by Aggrwal *et al*. [1]. The maximum days to first green leaf harvest was recorded in genotypes PFG-11(53.33), followed by PFG-35 (51.33) and PFG-37 (50.66). The results for days to first leaves harvest are in accordance with finding of Singh[13]. The mean values for green leaf yield per plant (g) varied from 42.42 g to 81.24 g and the general mean value was 64.03 g [Table-2]. The variation for this character was also reported by Fikreselassie *et al* [4].

The highest green leaf yield q/ha was founded in PFG-30 (129.90 q/ha) followed by PFG-37 (129.84 q/ha) and PFG-35 (120.79 q/ha). Chhibba *et al*. [3] also recorded the variation among the genotypes for green leaf yield q/ha.

Table-2 *Mean performance of different genotypes for different quantitative characters*

Genotypes	No. of primary branches per plant	No. of leaves at 30 DAS	No. of leaves at 45 DAS	No. of leaves at 60 DAS	Days to first leaf harvest	Leaf Area (cm^2)	Green leaf yield/ plant (g)	No. of seeds per pod	Green leaf yield q/ha	1000 seed weight (g)
PFG-22	2.64	12.00	15.66	20.33	45.33	25.07	66.04	14.60	105.63	14.58
PFG-23	4.92	10.20	13.00	27.00	41.33	19.23	59.34	9.62	94.94	15.20
PFG-24	3.05	14.66	22.66	38.33	44.33	24.49	72.48	14.43	115.96	14.37
PFG-25	3.58	8.33	18.66	30.66	50.33	14.23	60.06	14.55	80.97	18.31
PFG-26	3.26	9.66	14.33	21.66	43.33	18.93	56.01	18.51	89.61	16.47
PFG-27	3.76	12.33	17.33	28.00	39.33	20.37	73.83	12.83	118.13	15.33
PFG-28	5.14	13.00	17.33	35.33	42.66	18.17	74.63	12.70	119.42	15.38
PFG-29	4.53	9.33	18.00	25.00	49.33	16.09	68.82	12.03	110.10	21.00
PFG-30	4.53	8.66	16.33	24.66	44.66	17.40	81.24	13.38	129.90	14.46
PFG-31	5.16	10.33	13.66	28.20	42.66	12.31	66.80	12.24	106.87	19.61
PFG-32	4.30	15.00	14.66	25.66	41.33	18.47	52.23	14.00	83.56	18.42
PFG-33	3.07	8.66	14.00	23.33	47.00	18.39	51.50	13.67	82.40	19.91
PFG-34	3.88	9.66	15.33	26.00	42.00	20.45	65.46	12.55	104.58	16.20
PFG-35	3.24	8.66	16.00	29.66	51.33	18.87	75.50	14.58	120.79	18.53
PFG-36	3.38	13.66	14.66	21.33	46.33	19.29	56.59	15.46	90.54	16.20
PFG-37	5.56	17.66	27.33	40.66	50.66	17.63	81.15	13.85	129.84	7.81
PFG-38	3.16	12.00	14.33	24.33	44.00	16.88	72.43	12.46	115.89	17.71
PFG-39	4.85	8.66	11.33	23.00	47.66	14.93	54.77	13.56	87.63	18.39
Pant Ragini	3.99	9.00	13.00	17.33	47.33	17.55	53.65	11.32	85.84	18.33
Pusa Early Bunching	3.56	15.00	21.00	32.33	42.33	17.77	71.62	12.57	114.60	19.46
PFG-1	2.50	12.33	14.00	26.33	43.33	18.23	66.38	16.53	106.20	19.81
PFG-11	3.14	13.66	19.66	34.00	53.33	18.16	73.07	16.40	116.91	14.16
PFG-12	3.27	7.66	16.33	27.00	42.33	20.04	48.10	12.46	76.96	18.51
PFG-15	4.66	11.00	15.00	21.66	44.66	21.03	64.03	14.60	102.45	18.51
PFG-17	3.10	10.66	13.33	23.66	41.66	17.17	45.56	15.46	72.49	17.93
PFG-18	3.53	9.00	15.22	21.66	45.33	19.32	42.42	13.96	67.87	20.73
PFG-20	3.32	13.66	17.23	38.33	49.33	20.19	73.46	16.49	117.53	8.64
PFG-21	3.55	12.00	14.22	34.00	50.33	25.82	65.67	11.17	105.08	16.61
GM	**3.81**	**11.28**	**16.15**	**27.57**	**47.00**	**18.80**	**64.03**	**13.78**	**101.90**	**16.74**
SEM	**0.80**	**1.02**	**1.10**	**1.85**	**0.95**	**1.92**	**1.36**	**0.21**	**2.98**	**0.17**
CD 1%	**0.30**	**3.85**	**4.16**	**6.99**	**3.62**	**7.25**	**5.14**	**0.82**	**11.27**	**0.64**
CD 5%	**0.22**	**2.89**	**3.12**	**5.25**	**2.72**	**5.44**	**3.86**	**0.62**	**8.46**	**0.48**
CV	**3.64**	**15.68**	**11.82**	**11.63**	**3.65**	**17.70**	**3.68**	**2.75**	**5.07**	**1.77**

General mean of 1000 seed weight for all the genotypes was found to be 16.74 g. The results are contradictory with the findings of Naik *et al*. [9].

Phenotypic coefficient of variation comprises both genetic as well as environmental variation, which does not aid in efficient selection. Therefore, the determining factors fundamentally contingent on genetic variability or more precisely on additive genetic variability in which breeder are particularly engrossed. Statistics like range, mean, coefficient of variation, heritability and genetic advance present primary knowledge on the variation of a character at phenotypic and genotypic level. This further provides an indication of the effect of environment in estimating the variation. The perusal of data [Table-3] indicated considerable variations for all the characters with higher magnitude of PCV and GCV as compare to ECV. The genotypic coefficient of variation (GCV) value >30% is considered as high, 30-20% as moderate and <20% as low. In our research the GCV values were highest for number of primary branches per plant (21.41%) and number of leaves per plant at 30, 45 and 60 DAS (20.38%, 19.31% and 20.37%), 1000 seed weight (18.85%). Moderate values of GCV of characters namely, green leaf yield per plant (16.47%) and green leaf yield q/ha (16.87%) whereas lowest estimates of GCV were founded in number of seeds per pod (13.67%) and days to green leaves cutting (7.77%). High values of GCV for number of primary branches per plant was in close agreement with Singh *et al*. [14], Prajapati*et al*. [11] and for 1000 seeds weight with Lodhi*et al*.[8].Similar result for GCV for number of primary branches per plant and 1000 seed weight were reported by Jain *et al*.[7]. Higher GCV values reveal the true genetic potential which expresses the existence of high measure of genetic variability for these characters thus; selection may be more efficient for these characters because the response to selection is directly proportional to the component of variability.

Table-3 *Coefficient of variation and other genetic parameters of fenugreek*

S. No	Characters	Range	GM	SEM	Heritability (h^2_b%)	Genetic advance	Genetic advance as (%) of mean	Coefficient of variation (%)		
								GCV(%)	PCV(%)	ECV(%)
1.	No. of primary branches per plant	2.50-5.56	3.81	0.80	97.18	1.65	43.30	21.41	21.71	3.64
2.	Number of leaves per plant at 30 DAS	7.66-17.66.	11.28	1.02	62.81	3.75	33.24	20.38	25.71	15.68
3.	Number of leaves per plant at 45 DAS	13.00-27.33	16.15	1.10	72.74	5.48	33.93	19.31	22.64	11.82
4.	Number of leaves per plant at 60 DAS	17.33-40.66	27.57	1.85	75.42	10.05	36.45	20.37	23.46	11.63
5.	Days to first green leaves cutting	39.33-53.33	47.00	0.95	81.77	6.55	13.93	7.77	8.55	3.65
6.	Leaf area (cm^2)	14.93-25.82	18.80	1.92	31.05	2.56	13.61	11.87	21.31	17.70
7.	Green leaf yield per plant (g)	42.42-81.24	64.03	1.36	95.22	21.20	33.10	16.47	16.87	3.68
8.	Number of seeds per pod	9.62-18.51	13.78	0.21	96.11	3.80	27.57	13.67	13.95	2.75
9.	Green leaf yield (q/ha)	67.87-129.90	101.90	2.98	91.70	33.93	33.29	16.87	17.62	5.07
10.	1000 seed weight (g)	7.81-21.00	16.74	0.17	99.12	6.47	38.64	18.85	18.93	1.77

The value of phenotypic coefficient of variation (PCV) >35% as high, 20-35% as moderate and <20% as low. In our research the PCV values were maximum for number of leaves per plant at 30 DAS (25.71%). Minimum estimates of PCV were recorded for days to green leaves cutting (8.55%). Moderate values of PCV were recorded for characters such as number of leaves per plant at 45 and 60 DAS (22.64% and 23.46%), number of primary branches per plant (21.71%), Leaf area (21.31%), 1000 seed weight (18.93%), green leaf yield q/ha (17.62), green leaf yield per plant (16.87%), number of seeds per pod (13.95%).

The environment coefficient of variation (ECV) value >25% was considered high, 25-10% as moderate and <10% as low. The ECV were highest for leaf area (17.70%) followed by number of leaves at 30 DAS (15.68%) where as lowest estimate of ECV was recorded 1000 seed weight (1.77%). Characters such as number of leaves at 45 and 60 DAS (11.82% and 11.63%) showed moderate values of ECV. The differences between PCV and GCV were maximum with leaf area. High amount of PCV and GCV was observed for characters, namely no. of primary branches per plant, number of leaves at 30, 45 and 60 DAS, green leaf yield per plant, green leaf yield q/ha suggesting the presence of large amount of variability. Similar results on variability for number of primary branches per plant and number of seeds per pod were reported by Pathak *et al*. [10]. For most of the characters, the differences in estimates of PCV and GCV were less, indicating that these characters were less affected by environment and were therefore, stable. The present findings are in confirmatory with the findings of Balai*et al*. [2].

In broad sense, heritability is the ratio of genotypic variance to phenotypic variance in percentage. It might differ extensively between populations and also from one environment to another in the same material. The knowledge about the beneficial parameter would be useful to increase the efficiency of a breeding system since; it is a measure of success in separating genotype by selection. The broad sense heritability (h^2_b) value >80% were considered as high, 80-50% as moderate and <50% as low. The estimate of heritability in broad sense, genetic advance and genetic advance as a percentage of mean are given in [Table-3]. Highest percent of heritability were shown by 1000 seed weight (99.12%) followed by number of primary branches per plant (97.18%). Sharma and Sastri[12] reported high heritability for 1000 seed weight and number of primary branches per plant. The genetic advance recorded highest in green leaf yield q/ha (33.93) followed by green leaf yield per plant (21.20), number of leaves at 60 DAS (10.05). It indicates that the character had additive gene effect and therefore, more reliable for effective selection for bringing about improvement in fenugreek crop whereas lowest genetic advance was recorded in seed yield q/ha (1.49). For genetic advance as percent of mean value >30% was considered as high, 15-30% as moderate and <15% as low. The value ranged from 13.61% to 43.30%. High genetic advance was recorded for number of primary branches per plant (43.30%) followed by 1000 seed weight (38.64%).Characters such as number of primary branches per plant, number of seeds per pod, green leaf yield per plant and green leaf yield q/ha showed high heritability coupled with high genetic advance as percent of mean, these characters will respond to selection better than those with high heritability and low genetic advance. Moderate heritability with high genetic advance as percent of mean was observed for number of leaves per plant at 30, 45 and 60 DAS. It is depicted that these parameters are governed by additive gene action and equally improved through selection. On the other hand, days to first leaves harvest exhibited high heritability with low genetic advance as percent of mean, indicated that this character was governed by non-additive genes and selection would not be effective for this character. Genotypes which exhibited both high variability and heritability along with high genetic advance for certain characters may be evaluated in multi location trials and can be isolated as donors for these characters or used as parents in hybrid development program.

Conclusion: Based on the studies on genetic variability, it may be concluded that there is significant difference among fenugreek genotypes with respect to various yield characters at different growth stage. The characters like number of primary branches per plant, number of leaves per plant at 60 DAS and 1000 seed weight showed high amount of genetic variability along with heritability and genetic advance. This reveals that there is a greater scope for improving these characters by simple phenotypic selection. Out of twenty-eight genotypes PFG-30, PFG-37, PFG-35 and PFG-28 had highest green leaf yield q/ha. These superior genotypes can be used in breeding programme.

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