

Research Article

Evaluation of Fenugreek (*Trigonella Foenum-Graecum*) Varieties in Kellem Wollega Zone of Western Oromia

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Abstract

Fenugreek (*Trigonella foenum-graecum* L.) is an annual herb, self-pollinating with diploid ($2n=16$) chromosome numbers. The production and distribution of fenugreek is nearly similar to those of other cool season food legumes such as faba bean, field pea, lentils, chickpea, and grass pea. The evaluation of fenugreek experiment was conducted at two sub-sites Haro Sabu Agricultural Research Center research, from 2023-2024 at Belam FTC and in 2024 at Gute Anani FTC of Kellem Wollega zone, during main cropping season with the objective of selecting and recommending high yielder, disease and insect pest tolerant fenugreek varieties at for potential areas of Kellem Wollega. Six improved fenugreek varieties collected from Sinana Agricultural Research Center and one local check were evaluated with the objective of selecting and recommending high yielding, disease tolerant varieties. Analysis of variance (ANOVA) revealed that the main effect of variety showed highly significant effect on days to flowering, days to maturity, number of pod per plant, number of seed per pod and total where as it revealed significant effect on plant height and number of primary branch per plant and thousand seed weight were non-significant. Similarly the main effect of environment showed highly significance on all recorded parameters except number of seed per pod and thousand seed weight. The highest (292.87kg ha^{-1}) and the lowest (52.50kg ha^{-1}) total yield were recorded from local check and Chala variety. Hence local check is recommended and it directs the collection and characterization of fenugreek landraces in the studied areas of Western Oromia.

Keywords

Fenugreek, Local Check, Pod per Plant, Seed Weight

1. Background and Justification

Fenugreek (*Trigonella foenum-graecum* L.) is an annual herb, self-pollinating with diploid ($2n=16$) chromosome numbers. It originated from the countries bordering on the eastern shores of the Mediterranean and is widely cultivated in China, India, Egypt, Ethiopia, Morocco, Ukraine, Greece, Turkey, etc. [3, 8, 16, 17]. In Ethiopia, fenugreek growing regions are the high plateaus (1800-2300m.a.s.l.) character-

ized by subtropical climate of wet and dry seasons. The principal use of fenugreek in Ethiopia includes: 1) as a rotation crop, it improves both the soil structure and fertility; 2) it also fetches high revenue for farmers and producers; 3) its flourish used as a flavoring of the traditional bread (loaf) and maintains soft texture of “tef-injera” in relatively cooler zone of the country where the latter is a staple food [11]. The flour of

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fenugreek is used in various spice makings. In a typical case of such a use, the powder is soaked over-night and the water poured off the next morning while the remnant is mixed with honey which becomes a delicious beverage. In the absence of milk, fenugreek is a substitute of infant feed.

Fenugreek is a plant in the family of fabaceae. It is used both as an herb (the leaves) and as a spice (the seed). It is cultivated world wide as a semi-arid crop. It is frequently used in curry. The word for fenugreek in Amharic is *abesh*, and the seed is often used in Ethiopia as a natural herbal medicine in the treatment of diabetes. It is also sometimes used as an ingredient in the production of clarified butter; its flour is used as a flavouring of the traditional bread and maintains soft texture of “*tef injera*”. Major fenugreek producing countries are India, Argentina, Egypt, France, Spain, Turkey, Morocco and China. Fenugreek seed is widely used as a galactagogue (milk producing agent) by nursing mothers to increase in adequate breast milk supply. Since the maple syrup-like flavour is strong and not always liked, the seeds are ground to a powder and administered in capsules. Studies have shown that fenugreek is a potent stimulator of breast milk production and its use was associated with increases in milk production of as much as 900% [10]. According to [5] report, the total area under production was 30,145.56 hectares and the production in quintals was 353,282.89 with productivity of 11.72Qu/ha at national level, however the area under production in Oromia region was 14,374.46 and the production in quintals was 130.613.96 with productivity of 9.09 Qu/ha.

Fenugreek is the most important crop in Ethiopia, but over the years a number of problems tend to faced against the production of this crop in the country. Out of them, lack of improved varieties is the critical problem for Fenugreek production. Smallholders of Kellem Wollega and West Wollega farmers were cultivating the local cultivar of fenugreek which is low in yield around. Although, it is an important crop in Kelem and West Wollega zones, a number of factors constrained productivity of the crop in the target area. Productivity of Fenugreek in the study area (6.53Qu/ha) was lower than regional (10.01Qu/ha) and national yield (12.24Qu/ha) [6]. This is associated with the lack of improved varieties that have been appreciated as one of the primary sources of lower fenugreek production in the target areas. However, fenugreek varieties available at the hands of farmers in the major growing areas are low yielded, poor quality and susceptible to diseases (powdery mildew, leaf spot and pod spot) which have been under production for many years. Hence, the need to collect improved fenugreek varieties to the target area is crucial for fenugreek production and productivity. Thus the experiment was conducted with the objective of identifying and recommending adaptive, high yielding, and disease /insect

pest tolerant/resistant fenugreek varieties for Kellem Wollega zone and similar agro-ecologies.

2. Material and Methods

2.1. Experimental Materials and Design

The experiment was conducted at Belam Farmers Training Center (FTC) from 2023 to 2024 and Gute Anani Farmers Training Center (FTC) in 2024 of Haro Sabu Agricultural Research Center of sub sites. Six improved fenugreek varieties were collected from Sinana, Debreziet and Sirinka Agricultural Research Centers and evaluated with one local check.

The experiment was laid out in randomized complete block design (RCBD) with three replications. Each variety was planted in the main field in a gross plot size of 4m*1.5m with previously recommended spacing of 30cm inter row spacing and 10cm intra row spacing. The three middle rows were used for data collection leaving the two rows as borders. All agronomic practices (sowing time, cultivation, and weeding) and fertilizer were applied uniformly for all plots according to the recommendation of the crop. NPS fertilizer was used in the rate of 90Kg/ha.

2.2. Data Collection and Data Analyses

Ten plants were randomly sampled from middle three rows. Data on days to flowering, days to maturity, total yield (kg/ha) and disease reaction were taken on plot basis. On the other hand, data on plant height (cm), plant canopy length (cm), number of primary branches per plant and number of pod per plant were recorded per plant while measurements such as number of seed per pod and thousand seed weight was taken per pod and per seed, respectively.

All collected data were analyzed using SAS and GenStat 18th edition software. Least Significant Differences (LSD) was used to compare the treatment mean at 5% level of significance.

3. Result and Discussion

3.1. ANOVA

The combined analysis of variance (ANOVA) for growth parameters, yield components and yield and disease data of seven fenugreek varieties grown at Belam FTC from 2023 to 2024 and at Gute Anani FTC in 2024 revealed significant varietal difference (Table 1).

Table 1. Analysis of Variance for fenugreek variety evaluation on yield and yield component parameters.

Source of variation	D.f	Mean squares								
		DF	DM	PH(cm)	CL(cm)	NPrBPP	NPPP	NSPP	TSW(g)	TY(kg/ha)
Replication	2	0.97	0.83	11.00	16.12	0.20	5.20	8.33	17.65	1408.91
Variety	6	79.73**	33.98**	42.39*	12.85ns	1.10ns	57.05**	18.01**	18.07	67130.86**
Environment	2	368.83**	241.16**	440.44**	1601.21**	13.87**	603.83**	5.45ns	1.88	98984.29**
Variety*Environment	12	38.44**	5.23ns	11.78ns	16.00ns	1.33ns	32.95*	1.40ns	6.12	18316.53**
Residual	40	6.43	2.79	15.86	10.46	0.79	15.5	1.77	11.52	1370.78
CV (%)		6.05	1.97	14.47	27.08	49.86	51.4	19.89	27.8	35.26

Where DF, DM, PH, CL, NPrBPP, NPPP, NSPP, TSW(gram), TY(Kg/ha) and CV are, days to 50% flowering, days to 90% maturity, plant height, canopy length, number of primary branches per plant, number of pod per plant, number of seed per pod, thousand seed weight, total yield Kg/ha and coefficient of variation, respectively.

Table 2. Analysis of Variance for fenugreek varieties evaluation on disease reaction.

Source of variation	D.f	Mean squares			
		LS	PS	PM	AB
Replication	2	1.06	0.21	1.00	0.76
Variety	6	0.33ns	0.47*	0.66*	1.31*
Environment	2	1.25*	1.92**	0.05ns	0.43ns
Variety*Environment	12	0.55ns	0.11ns	0.47*	0.61ns
Residual	40	0.33	0.16	0.2	0.45
CV (%)		25.31	24.19	29.35	29.81

Where LS, PS, PM, AB and CV are leaf spot, pod spot, powdery mildew, ascochyta blight and coefficient of variation, respectively

3.2. Days to Flowering and Days to Maturity

From the combined mean of analyses days to 50% days to flowering and 90% days to maturity was revealed highly significance ($p \leq 0.01$) on fenugreek varieties and environment; whereas the interaction of variety and environment was highly significant on days to flowering and non-significant on days to maturity (Table 1). The earliest days to flowering (37.33) were recorded from local check; while the latest (46.67) days to flowering was recorded from Bishoftu variety (Table 3). Similarly the shortest (80.56) and the longest (86.67) days to maturity was recorded from local check and Bishoftu varieties, respectively.

The main differences among varieties on days to flowering and maturity might be genetic factor which either accelerate or lag the life cycle of the same crop of different variety. In line with the current result, [2] found significant variation in

flowering and maturity time among fenugreek genotypes. Further, reports showed that days taken for maturity varied significantly due to varieties [20].

3.3. Plant Height and Plant Canopy Length

Analysis of variance showed that there were a significant ($p \leq 0.05$) effect on plant height plant and non-significant effect due to variety, while there were highly significant on environment for both plant height and plant canopy length ($p \leq 0.01$) (Table 1). The variation in plant height on variety and environment might be due to specific genetic makeup of different cultivars and prevailing environmental condition. The variation in plant canopy length due environment might be due to variation in number of branches, genetic makeup and agro climatic conditions, which indirectly governs the morphology of the plant. These results were in conformity with the findings of [19] in fenugreek genotypes. The longest

(29.91cm) and the shortest (23.6cm) plant height were recorded from Wereilu and local check varieties (Table 3). The current study was in line with work of [9] who reported significant plant height among fenugreek genotypes. Similarly, [13] reported that significant effect of different varieties on plant height in which local cultivar was the shortest under different environmental conditions. Likewise [18] also reported significant effect of plant height on different fenugreek varieties; where the maximum (27.34cm) and the minimum (21.69cm) plant height were recorded for Pusa Early Bunching and Anantapur farmers' variety, respectively.

3.4. Number of Primary Branches per Plant and Number of Pod per Plant

Analysis of variance showed that there was highly significant ($p \leq 0.01$) effect on number of primary branches per plant and there was no significant effect due variety (Table 1). In line with this current study [7] reported the fenugreek varie-

ties were not significantly affected by number of primary branches per plant. On the other hand there was highly significant ($p \leq 0.01$) on number of pods per plant due to variety and environment (Table 1). The significant effect of pods per plants due variety might be due to congenial climatic condition like cool relative humidity, low temperature and optimum photoperiod for luxuriant vegetative growth and flowering which favors better pods production. In agreement with the current study [9] reported that the significant effect of fenugreek genotypes on number of pods per plant in which the highest pod per plant was recorded by genotype FG-12 with 4.34 whereas genotype 52062-02 showed the least with 3.63. Likewise [14] reported significant of variety on number of pods per plant of fenugreek varieties. Similarly, [2] reported that significant effect of variety on number of pod per plant. In contrast with result, different reports suggested that non-significant effect of primary branches and number of pod per plants on fenugreek varieties [7, 12].

Table 3. Combined mean of yield and yield components of fenugreek varieties.

Variety	DF	DM	PH(cm)	CL(cm)	NPrBPP	NPPP	NSPP	TSW(g)	TY(kg/ha)
Burqaa	40.89c	85.11ab	28.67ab	12.24	2	8.42ab	7.33a	11.6	122.31b
Localcheck	37.33d	80.56c	23.6c	11.8	2.02	8.91ab	7.8a	10.62	292.87a
Ebbisa	44.22b	85.56ab	25.71bc	12.36	1.98	8.8ab	8.2a	12.52	77.38c
Chala	42.67bc	84.33b	27.71ab	9.76	1.27	4.62c	5.13bc	13.73	52.50c
Jamma	41.22c	84.89b	29.04ab	11.2	1.47	5.51bc	4.63c	13.66	53.06c
Wereilu	40.44c	85.44ab	29.91a	12.78	1.56	5.62bc	6b	13.1	56.76c
Bishoftu	46.67a	86.67a	28ab	13.44	2.2	11.73a	7.67a	10.22	80.22c
Mean	41.92	84.65	27.52	11.94	1.78	7.66	6.68	12.21	105.01
LSD (0.05)	2.42	1.59	3.79	NS	NS	3.75	1.27	3NS	35.27
CV (%)	6.05	1.97	14.47	27.08	49.86	51.4	19.89	27.8	35.26

Where DF, DM, PH, CL, NPrBPP, NPPP, NSPP, TSW(gram), TY(Kg/ha), LSD and CV are, days to 50% flowering, days to 90% maturity, plant height, canopy length, number of primary branches per plant, number of pod per plant, number of seed per pod, thousand seed weight, total yield(Kg/ha), least significance difference and coefficient of variation, respectively.

3.5. Number of Seed per Pod

The analysis of variance showed that there was highly significant ($p < 0.01$) effect of number of seed per pod on variety, however there was no significant effect due to environment and its interaction (Table 1). The significant effect of number of seed per pod on variety might be due to genetic factor of different varieties of the same crop. The highest (8.2) and the lowest (4.63) number of seed per pod were recorded from Ebbisa and Jamma varieties, respectively (Table 3). The result

is in agreement to [2] who reported variation of seed per pod among fenugreek varieties in which the highest number of seed per pod was recorded from Bishoftu variety. On the contrary [9, 15] suggested that there was no significant effect on number of seed per pod among eight fenugreek genotypes evaluated against Chala variety.

3.6. Thousand Seed Weight and Total Yield

The effect of variety environment and their interaction showed non-significant on thousand seed weight, whereas the

effect of variety, environment and their interaction revealed highly significant ($p < 0.01$) on total yield (Table 1). The significance effect of variety and environment on total yield might be due to significant effect of variety on yield related parameters such as number of pod per plant and number of seed per pod. This also related with seed yield of a crop is a

function of yield attributes such as number of pods per plant, number of seeds per pod and 1000-seed weight that increasing in growth due to enhanced nutrient uptake and utilization which have direct and positive effect on seed, straw and biological yields of fenugreek.

Table 4. Mean yield of fenugreek varieties over year and location.

Variety	Belam FTC		Gute Anani FTC	Mean	YA (%)
	2023	2024	2024		
Local check	125.09a	196.2a	557.3a	292.86	0.00
Burqa	53.7b	162.6ab	150.6b	122.3	-1.39
Ebbisa	19.72c	92.9bc	119.5bc	77.37	-2.79
Wereilu	15.09c	77.5c	77.7c	56.76	-4.16
Jamma	13.7c	72.2c	73.2c	53.03	-4.52
Chala	6.57c	85bc	65.9c	52.49	-4.58
Bishoftu	3.43c	85.2bc	152b	80.21	-2.65
LSD(0.05)	17.877	82.641	71.401		
CV (%)	29.6	42.1	23.5		

YA= Yield advantage

On the other hand the increase in seed yield due to environment might be due to favorable climatic conditions like temperature, high relative humidity and optimum sunshine hours. The highest (292.87kg) and the lowest (52.5kg) yield per hectare were recorded from local check and Chala (Table 3) varieties, respectively. This study was agreement with findings of [2] who reported significant effect of variety on biological yield where Chala variety produced highest biological yield over all tested genotypes. Similarly [14] suggested that significant effect of fenugreek on seed yield.

3.7. Disease Reaction of Varieties

The major recorded diseases of fenugreek at the studied

areas were cercospora leaf spot, pod spot, powdery mildew and ascochyta blight. The main factor of variety was significantly ($p < 0.05$) affected by pod spot, powdery mildew and ascochyta blight whereas leaf spot was non-significant (Table 2). However; the environment was highly significant ($p < 0.01$) on pod spot and has significantly ($p < 0.05$) effect on leaf spot (Tables 2 and 5). Abdisa, 2021 [1] reported that powdery mildew and cercospora leaf spots are the major diseases of fenugreek varieties. Similarly [4] reported that cercospora leaf spot, pod spot, powdery mildew and ascochyta leaf spot are major fenugreek diseases affecting yield in which different cultivars were significantly affected.

Table 5. Combined mean of major diseases on fenugreek varieties.

Variety	Cercospora Leaf spot	Pod Spot	Powdery Mildew	Ascochyta leaf spot
Burqa	2.33	1.89a	1.67ab	2.11abc
Localcheck	2	1.67a	1.56ab	1.56c
Ebbisa	2.11	1.67a	1.67ab	2bc
Chala	2.44	1.56ab	1c	2.56ab

Variety	Cescospora Leaf spot	Pod Spot	Powdery Mildew	Ascochyta leaf spot
Jamma	2.44	1.56ab	1.67ab	2.33ab
Wereilu	2.44	1.22b	1.78a	2.67a
Bishoftu	2.11	1.89a	1.33bc	2.44ab
Mean	2.27	1.63	1.52	2.24
LSD	NS	0.38	0.43	0.64
CV (%)	25.31	24.19	29.35	29.81

3.8. Comparison Plot for Genotypes Based on the Concentric Circle

The ideal variety is one which is nearest to the center of circle. Hence in the current study, Local check was the most ideal variety. This also reflects that; the variety has highest economic yield and more stable than others.

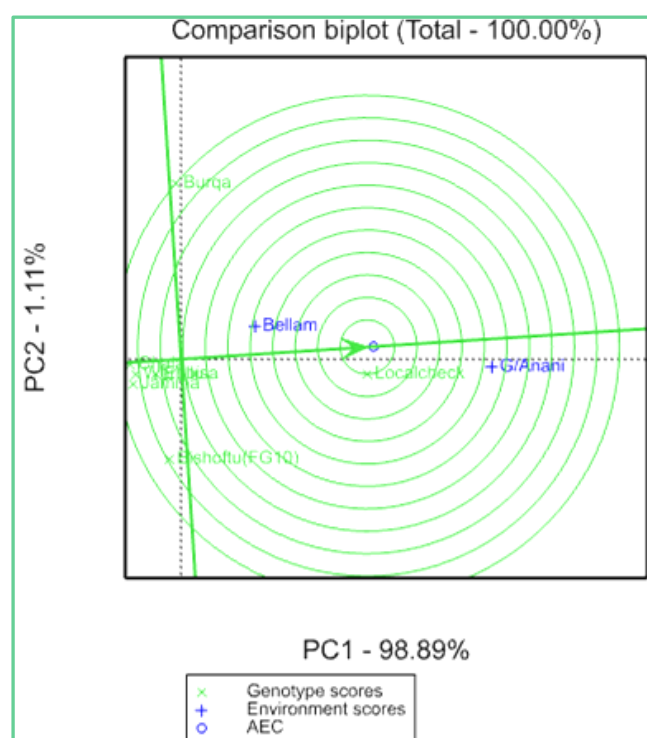


Figure 1. GGEbi-plot based on variety focused scaling for comparison of variety for yield stability of fenugreek.

4. Conclusion and Recommendation

The evaluation of fenugreek varieties were done to study the adaptability and performance of improved fenugreek varieties. Significant difference was shown on different yield related parameters such as number of pod per plant, number of

seed per pod among varieties. The highest number of pod per plant was recorded from Bishoftu variety and the highest number seed per pod was recorded from Ebbisa variety. In the current study, among the studied varieties local check was superior to all improved varieties in terms of economic yield and tolerant to major fenugreek diseases. Thus fenugreek producing farmers should maintain their own cultivar and further study on fenugreek should be compulsory for fenugreek variety development for the studied areas to improve the production and productivity of the crop.

Abbreviations

ANOVA	Analysis of Variance
a.s.l	Above Sea Level
CSA	Central Statistical Agency
EAA	Ethiopian Agricultural Authority
FTC	Farmers Training Center

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Author Contributions

Kibiru Kena: Conceptualization, Methodology, Writing-original draft, Writing-review & editing

Alemayehu Latera: Data curation, Formal Analysis, Methodology, Software

Conflicts of Interest

The authors declare no conflicts of interest.

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