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Original Research Article

EVALUATION OF FENUGREEK (*TRIGONELLA FOENUM-GRAECUM L.*) GERMPLASM UNDER SUBTROPICAL CLIMATE CONDITIONS OF FAISALABAD

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Abstract: *Fenugreek (Trigonella foenum-graecum L.) commonly known as methi, is a self-pollinating, leguminous crop native to the subcontinent and the Eastern Mediterranean region. An experiment was conducted to evaluate nine genotypes in Faisalabad region during year 2022-23.The study highlighted significant variations among fenugreek genotypes, with MethiQasoori (Check) being the fastest to first cutting at 40.2 days. Other quick-maturing varieties included Fenu-06 and Fenu-05, while Fenu-07 and Fenu-02 took longer. For the second cutting, MethiQasoori also led at 70.2 days. Fenu-04 was the tallest at 90.1 cm and had the highest leaf yield of 23.62 T/Ha. EFG-1144A had the lowest yield at 7.88 T/Ha. Fenu-04 had the highest 1000 seed weight at 1.333 g, indicating potential for better seed quality. Yellow flowers found in Fenu-04, MethiQasoori, Fenu-02, Fenu-01, and EFG-1144A, indicating a preference or trend towards yellow flowers in several varieties. White flowers had been found in Fenu-06, Fenu-05, Fenu-03, and Fenu-07, suggesting that white flowers was less common. All varieties were vulnerable to aphids, emphasizing the need for pest management.*

Keywords: Fenugreek, Trigonella foenum-graecum L., genotypes, MethiQasoori, phenotypic variation, yield performance, flowering traits, seed quality,

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is an ancient annual legume cultivated for various uses across the globe. The name *Trigonella* is derived from Latin, meaning "little triangle," which refers to the triangular shape of its small yellowish-white flowers. The species name *foenum-graecum* translates to "Greek hay" (Rosengarten, 1969). It is also known as "ox horn" or "goat horn" due to the two seed pods that extend in opposite directions from the base of the stem, resembling the horns of an ox or goat (Petropoulos, 2002). Different landraces and species of *Trigonella* can be found in regions including Europe, northern Africa, western and southern Asia, as well as North and South America and Australia (Basu, 2006; Acharya *et al*., 2006). The leaves and seeds of fenugreek are utilized in various countries for multiple purposes, including medicinal uses (such as anti-diabetic properties, lowering blood sugar and cholesterol levels, anti-cancer effects, and antimicrobial activity), culinary applications (like stews with rice in Iran, cheese flavoring in Switzerland, syrup production, mixed seed powder for flatbreads in Egypt, curries, dyes, and young seedlings consumed as vegetables), and even as a coffee substitute in Africa. Additionally, fenugreek is used for pest control in grain storage and in the perfume industry. Medicinal species within the *Trigonella* genus include *T. foenum-graecum L., T. balansae, T. corniculata, T. maritima, T. spicata, T. occulta, T. polycerata, T. calliceras, T. cretica, T. caerulea, T. lilacina, T. radiata*, and *T. spinosa* (Petropoulos, 2002; Basu, 2006). The biological and pharmacological effects of fenugreek are attributed to its diverse constituents, which include steroids, nitrogen compounds, polyphenolic substances, volatile compounds, and amino acids (Mehrafarin *et al*., 2010). Fenugreek seeds contain 45-60% carbohydrates, primarily in the form of mucilaginous fiber (galactomannans), and 20-30% proteins that are rich in lysine and tryptophan. They also have 5-10% fixed oils (lipids), along with pyridine alkaloids, mainly trigonelline (0.2-0.38%), choline (0.5%), gentianine, and carpaine. The seeds are rich in flavonoids such as apigenin, luteolin, orientin, quercetin, vitexin, and isovitexin, as well as free amino acids like 4-hydroxyisoleucine (0.09%), arginine, histidine, and lysine. Additionally, they contain calcium, iron, saponins (0.6-1.7%), glycosides that yield steroidal sapogenins upon hydrolysis (including diosgenin, yamogenin, tigogenin, and neotigogenin), cholesterol, sitosterol, and vitamins A, B1, C, and nicotinic acid, along with 0.015% volatile oils consisting of n-alkanes and sesquiterpenes (Budavari, 1996; Newall *et al*., 1996; Mehrafarin *et al*., 2010). An experiment was planned to evaluate germplasm collected from different sources to understand the forage yield potential of fenugreek genotypes.

Methodology

The germplasm consisted of nine genotypes evaluated at Vegetable Research Institute Faisalabad during 2022-23. Faisalabad site has Sub tropical climatic condition and lies between latitude 31.4504º N and at a longitude 73.1350º E with an elevation of about 189 m from sea level.The

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experiment was conducted under Randomized Complete Block Design with 3 replications with plot size of 7.5 × 0.75 m. Kera method was used for sowing. One bag of DAP and one bag of SOP fertilizer per acre was applied at the time of sowing and one bag of urea was applied after 20 days of sowing. Weeding was performed after 35 days of sowing keeping the field clear from weeds. The recommended agronomic and plant protection measures were adopted to maintain the crop. The data was recording for days to first cutting, days to second cutting, plant height, leaf yield and disease/Insect Incidence. Data on weather parameters were obtained from the Department of Agricultural Meteorology in Faisalabad, Punjab, spanning two crop seasons from October to April (see Fig. 1). The highest temperature recorded was 26.0 °C for genotypes during the first cutting, whereas second cutting experienced temperatures of 29.2 °C. A temperature increase of 3 °C was observed. The highest relative humidity was 95%, with bright sunshine lasting for 6.7 hours and rainfall measuring 0.2 mm.

Results & Discussion

The results indicated significant variation among different fenugreek genotypes. MethiQasoori (Check) had been the fastest variety, taking only 40.2 days to reach the first cutting, making it an excellent choice for growers who had sought quick returns on their investment (Fotopoulos, 2002). Varieties like Fenu-06 (43.2 days) and Fenu-05 (45.1 days) had slightly longer growth periods but still been within a reasonable range for quick cropping. EFG-1144A had taken 45.3 days, which had been comparable to Fenu-05, suggesting it might have been a viable option for similar harvest timelines. The varieties with the longest days to first cutting had been Fenu-07 (49.2 days) and Fenu-02 (48.1 days). These are less desirable for growers focused on rapid turnover but might have offered other benefits, such as higher yields or better pest resistance (Aggarwal *et al.*, 2013). Fenugreek as slow growing plant remains in a rosette condition for most part of the vegetative growth (Dhaliwal, 2012) and mainly grown as leafy vegetable. Fresh tender leaves and pods are eaten as fried vegetable being rich in iron, calcium, protein and vitamins (Singh *et al*., 2012). Understanding the days to first cutting had allowed farmers to plan their planting schedules effectively. Quick-maturing varieties had been able to be planted in succession to maximize land use. Fast-growing varieties help farmers respond quickly to market demands, especially if prices fluctuated seasonally. Varieties that had matured quickly might have required less water and nutrients over time, which could have been beneficial in resource-limited settings (Acharya *et al.*, 2006). MethiQasoori (Check) had been the fastest variety to reach the second cutting, taking 70.2 days. This rapid regrowth had been advantageous for farmers looking to maximize their harvest frequency. Fenu-04 had followed closely with 75.3 days, indicating a relatively quick recovery time after the first cutting (Ahmad *et al.*, 2002). Fenu-06 (73.1 days) and Fenu-03 (74.3 days) had shown competitive regrowth times, making them good options for growers who want a balance between yield and cutting frequency. EFG-1144A had also taken 74.3 days, suggesting it could have been a viable choice for similar harvest timelines. The varieties with the longest days to the second cutting had been Fenu-07 (79.2 days) and Fenu-05 (78.2 days). While these had taken longer to regrow. Fenu-01 (76.2 days) and Fenu-02 (74.3 days) had also fallen into this category, indicating that while they had taken longer to mature for the second cutting, they might have had other advantageous traits (Ahmad *et al.*, 2009). Fenu-04 had been the tallest variety at 90.1 cm, indicating strong growth characteristics, which could have been beneficial for maximizing light capture and overall biomass. MethiQasoori (Check) had followed closely at 88.1 cm, suggesting robust growth potential (Basu *et al.*, 2006). Fenu-06 (85.2 cm) and Fenu-05 (84.3 cm) had also been relatively tall, indicating they might have performed well in terms of yield and biomass production. Fenu-03 (82.2 cm) and Fenu-07 (83.1 cm) had been slightly shorter but still within a competitive range for growth. Fenu-02 (81.2 cm) and Fenu-01 (78.3 cm) had shown moderate heights, which might have still been suitable for certain growing conditions or markets. EFG-1144A had been the shortest at 74.2 cm, which could have limited its competitiveness in terms of biomass but might have still other desirable traits (Mehrafarin *et al.*, 2010). Different responses to plant height might be due to genetic characteristic of genotypes and adaptability to a particular environment. These findings confirm the result obtained by (Aggrwal *et al*., 2013; Chowdhury *et al*., (2014) and Singh *et al*., (2015) in fenugreek. Taller plants like Fenu-04 and MethiQasoori had captured more sunlight, potentially leading to higher photosynthetic rates and better yields. Generally, taller varieties had produced more biomass, which could have translated to higher yields, especially in crops where height correlated with pod or seed production (Nagarajan *et al.*, 2005). Depending on market demands, certain heights might have been preferred for specific uses, such as culinary applications or for use in traditional medicine. The varieties had been grouped into yellow and white colors, which might have reflected different genetic characteristics or environmental adaptations (Rohlf *et al.*, 2005). Yellow flowers had been represented by Fenu-04, MethiQasoori, Fenu-02, Fenu-01, and EFG-1144A, indicating a preference or trend towards yellow flowers in several varieties. White flowers had been found in Fenu-06, Fenu-05, Fenu-03, and Fenu-07, suggesting that while white flowers had been less common in this dataset, they still represented a significant portion of the varieties. Fenu-04 had had the highest 1000 seed weight at 1.333 g, while MethiQasoori (Check) had followed closely with a 1000 seed weight of 1.267 g. The increase in seed weight might be due to favorable climatic conditions like temperature, high relative humidity and optimum sunshine hours. The similar results were founded by Datta & Chatterjee (2004); Pushpa *et al*., (2012); Thakral *et al*. (2006) and Singh et al., (2015) in fenugreek. All varieties had been vulnerable to aphids, highlighting the need for effective pest management strategies. Fenu-04 had led with a leaf yield of 23.62 T/Ha, indicating that it had been exceptionally productive, making it an attractive option for commercial growers looking to maximize their output (Zviniene *et al.*, 1996). MethiQasoori (Check) had followed closely with 22.79 T/Ha, also demonstrating strong productivity. This variety might have been favored for its reliability and high yield. Fenu-06 (19.65 T/Ha) and Fenu-05 (19.08 T/Ha) had shown respectable yields,

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suggesting they had been solid choices for farmers who had wanted good production without necessarily opting for the highest-yielding varieties (Cleveland *et al.*, 1996). Fenu-03 (18.77 T/Ha) and Fenu-07 (18.70 T/Ha) had been slightly lower but still competitive, indicating they could have been effective in various growing conditions. Fenu-02 (17.65 T/Ha) and Fenu-01 (17.52 T/Ha) had had lower yields, which might have limited their attractiveness for large-scale production (Irfan *et al.*, 2000). However, they might have still been suitable for niche markets or specific agricultural practices (Sumayya *et al,* .2012). EFG-1144A had had the lowest yield at 7.88 T/Ha, suggesting it might not have been the best choice for growers focused on maximizing output. This variety might have had other beneficial traits, but its low yield could have been a significant drawback.

Table 1. MEAN VALUES OF PHENOLOGICAL, MORPHOLOGICAL, FORAGE YIELD AND YIELD RELATED TRAITS

Rank	Variety	Days to 1st cutting	Days to 2nd cutting	Plant height (cm)	Flower Color	1000 seed weight (g)	Leaf yield (T/Ha)	Disease/Insect Incidence
1	Fenu-04	42.1	75.3	90.1	Yellow	1.333	23.62	Aphids
2	MethiQasoori (Check)	40.2	70.2	88.1	Yellow	1.267	22.79	Aphids
3	Fenu-06	43.2	73.1	85.2	White	1.25	19.65	Aphids
4	Fenu-05	45.1	78.2	84.3	White	1.1	19.08	Aphids
5	Fenu-03	46.8	74.3	82.2	White	0.98	18.77	Aphids
6	Fenu-07	49.2	79.2	83.1	White	0.95	18.70	Aphids
7	Fenu-02	48.1	74.3	81.2	Yellow	0.85	17.65	Aphids
8	Fenu-01	47.9	76.2	78.3	Yellow	0.70	17.52	Aphids
9	EFG-1144A	45.3	74.3	74.2	Yellow	0.82	7.88	Aphids
LSD (0.05%)							0.79	-

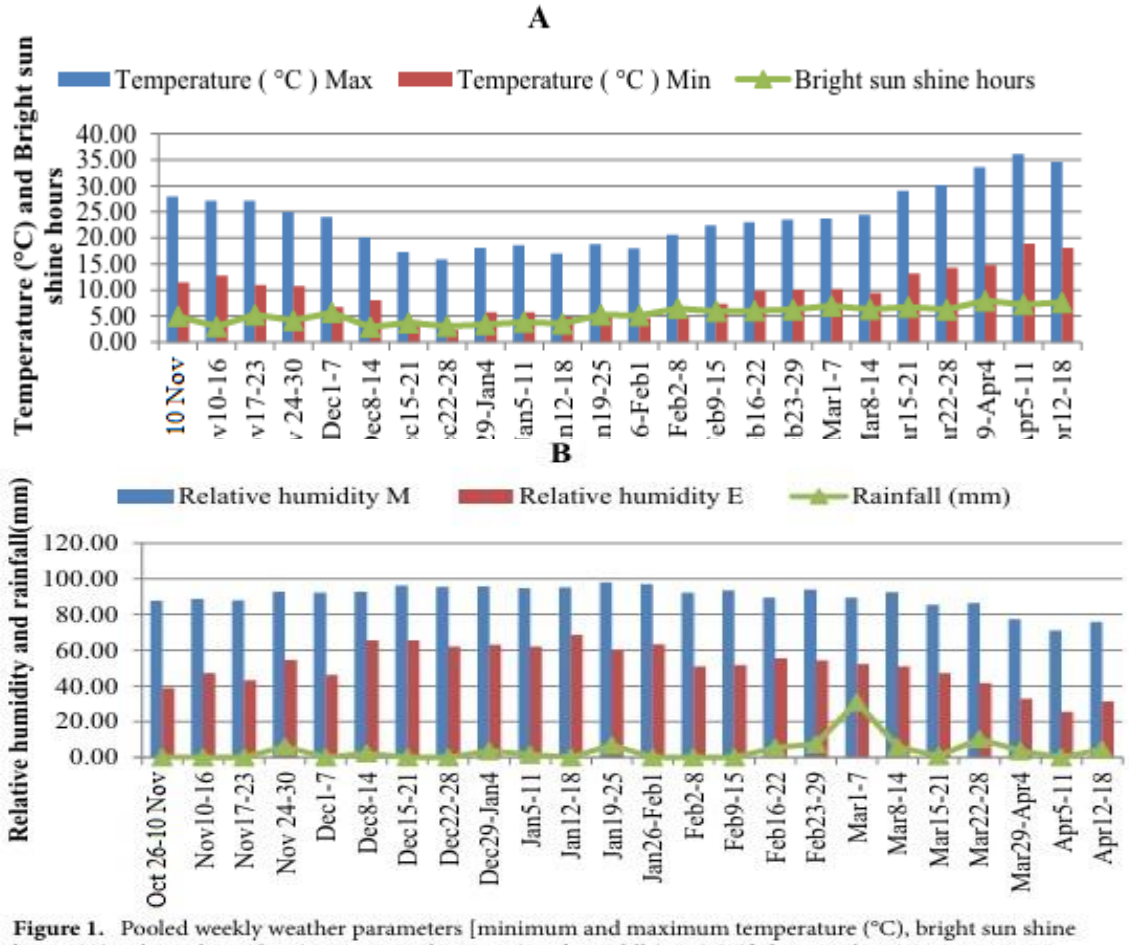

Figure 1. Pooled weekly weather parameters [minimum and maximum temperature (°C), bright sun shine hours (**A**), relative humidity (morning and evening) and rainfall (mm) (**B**)] during wheat growing season

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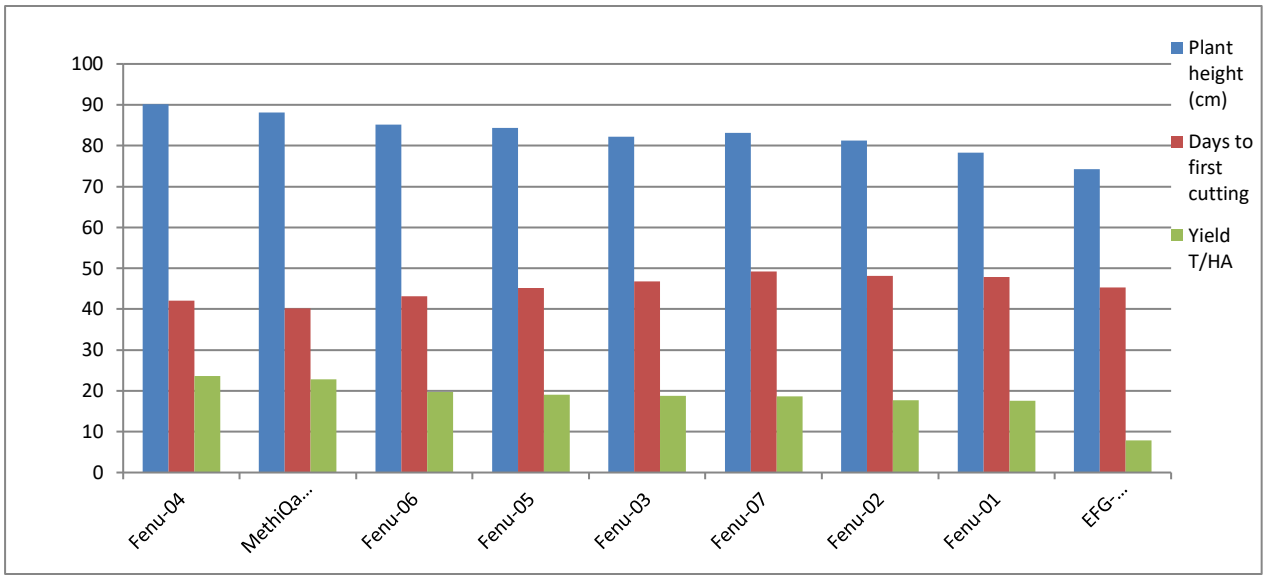

Fig 2. COMPARISON OF PLANT HEIGHT, DAYS TO FIRST CUTTING AND FORAGE YIELD OF DIFFERENT GENOTYPES

Fig 3. CONDITION OF DIFFERENT GENOTYPES AT FIELD

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Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

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