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Ajmer Fenugreek-4 (AFg-4): A high-yielding and improved quality fenugreek variety

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Abstract

A high-yielding coupled with enhanced quality parameters variety of fenugreek, Ajmer fenugreek-4 (AFg-4), was developed through pure line selection from a germplasm line collected from Jaipur area of Rajasthan. In multilocation coordinated trials conducted during 2010-12, AFg-4 showed 12.5 % superiority for seed yield over national check Hisar Sonali. AFg-4 has advantage in terms of quality aspects viz. 18.1% higher saponin, 30.8% higher diosgenin content, 11.9% higher 4-hydroxyisoleucine content and 13.9 higher fiber content. AFg-4 was found moderately resistant to powdery mildew and root rot diseases. The average percent disease intensity for powdery mildew was 22.7% while it was 40-50 % in check varieties. It is notified for cultivation for all the fenugreek cultivating areas of India (Notification No. S.O 3666 (E) dated 06-12-2016). Seed of AFg-4 has been deposited in NBPGR and IC number (IC-612494) allotted for future reference.

Keywords: Ajmer fenugreek-4, germplasm, diosgenin, 4-hydroxyisoleucine, powdery mildew.

Introduction

Fenugreek (*Trigonella foenum-graecum* L.) popularly known as *Methi* is a self-pollinated, annual legume multipurpose crop being used as a spice, condiment, leafy vegetable, fodder and medicinal, nutraceuticals, cosmeceuticals and industrial purposes. Fenugreek is spread over the entire West Asian and Mediterranean regions. India is the largest producer, consumer and exporter of fenugreek which occupies a leading position among various seed spices grown throughout the country for both leaf and seed purposes. Among the seed spices, fenugreek stands at third position in area (1.45 lakh ha) and in production (2.3 lakh q) after cumin and coriander (Anon. 2022). Among the states, fenugreek is concentrated mainly in Rajasthan, which has a share of about 80 per cent of the total fenugreek production in the country. Other states cultivating fenugreek are Gujarat, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh,

Andhra Pradesh, Tamil Nadu and Punjab (Lal., 2018). The seeds and green leaves of fenugreek are used as food as well as in medicinal applications that is the old practice of human history. It has been used to increase the flavouring and color, and also modifies the texture of food materials. Seeds of fenugreek spice have medicinal properties such as antibacterial, gastric stimulant, for anorexia, antidiabetic agent, galactagogues, hepatoprotective effect and anticancer (Srinivasan, 2006). Fenugreek seeds are a rich source of protein (23–26%) and carbohydrates (58%), of which about 25% is dietary fiber, besides it contains 6–7% fat. It is well known for its fiber, gum and other chemical constituents. Because of its high fiber, protein, and gum content, it is used as a food stabilizer, adhesive, and emulsifier. Fenugreek has a non-protein amino acid, 4-Hydroxyisoleucine, which has a high potential for insulin-stimulating activity (Mahatma *et al.*, 2022). Diosgenin, a sapogenin derived from fenugreek seeds, belongs to the triterpene group of compounds which are invaluable to the pharmaceutical industry due to their oestrogenic properties (Saxena *et al.*, 2013). Considering the medicinal importance of fenugreek, it is important to develop a high-yielding fenugreek variety which also possesses higher amounts of bioactive compounds.

Material and Methods

A number of fenugreek germplasm was collected by the NBPGR and various Agricultural Universities of Rajasthan, Gujarat, Andhra Pradesh, Haryana, Uttar Pradesh, Madhya Pradesh, Karnataka, Bihar, Himanchal Pradesh etc. Initially, ICAR-NRCSS acquired fenugreek germplasm from NBPGR and all the agricultural universities having germplasm of fenugreek followed by field collection through exploration (Lal, 2018). Up to 2005 more than 200 germplasm accessions was acquired from different sources (Anonymous 2006). Ajmer fenugreek-4 is a pure line selection from germplasm, collected from Jaipur district of Rajasthan during 2001. Many single plants were selected with better seed yield from this germplasm line and harvested individually during 2004-05. Plant-to-row progenies of selected plants were evaluated for seed yield and attributing traits during 2005-06. The selected promising advanced lines were

evaluated in station trial and compared to check varieties during 2007-09 at ICAR-NRCSS, Ajmer. In station trials, the proposed line gave more than 40 % seed yield over the check varieties hence, contributed for testing under multilocation trials of AICRP on Spices during 2010. Ajmer fenugreek-4 was tested in coordinated trials with code no. of FGK-28 along with twelve other test entries, national check (Hisar Sonali) and different local check at twelve locations *viz.* Ajmer, Jobner and Udaipur (Rajasthan), Jagudan (Gujrat), Hisar (Haryana), Faizabad (UP), Jabalpur (MP), Dholi (Bihar), Pantnagar (UK), Raigarh, (Chhattisgarh), Guntur (AP) and Coimbatore (TN) during 2010-12.

Variety release proposal of Ajmer fenugreek-4 was submitted to the Central Sub-Committee on Crop standards, Notification and Release of Varieties of Agri-Horticultural crops for identification during 23rd Annual Workshop of AICRP on Spices held at ICAR-IISR, Calicut during Sep. 29 to Oct 1, 2012. Based on three years (2009-10 to 2011-12) pooled mean, percent superiority of AFG-4 was calculated. Disease scoring for powdery mildew and downy mildew was recorded at Ajmer center during (2007-8) and 2008-09. Agronomical trial on spacing and fertilizer doses was conducted during 2012-13 at Ajmer center. All combinations of two spacing (30x10 cm and 20x10 cm) and two combinations of NPK *viz.* NPK-40:40:20 and NPK-50:50:25 were evaluated in factorial design.

Results and Discussion

Based on average performance of 32 trials, Ajmer fenugreek-4 gave 17.6 % higher seed yield (Table 1) coupled with moderate resistance against powdery mildew and root rot. This variety ranked 1st at six locations namely Ajmer, Jobner, Udaipur, Dholi, Jabalpur and Guntur centre on pooled mean basis. It gave highest seed yield at Udaipur (2789 kg ha⁻¹) followed by Jagudan (2408 kg ha⁻¹), Jobner (2375 kg ha⁻¹), Ajmer (2264 kg ha⁻¹) based on overall mean. On the basis of disease scoring for two years at Ajmer center under natural conditions, AFG-4 was found moderately resistant against both powdery and downy mildew diseases. Average PDI of AFG-4 for powdery mildew was 22.7 % as compared to national check (50.0%). The proposed variety had added advantage for variety release due to enhanced quality parameters *viz.* 30.8%

higher diosgenin content, 11.9% higher 4-hydroxyisoleucine content and 13.9% higher fiber content (Table 2). Ajmer fenugreek-4 variety was notified for cultivation for all the fenugreek cultivating areas of India in 2016 (Notification No. S.O 3666 (E) dated 06-12-2016). Seed of Ajmer Fenugreek-4 has been deposited in NBPGR and IC number (IC-612494) allotted for future reference for retrieval from long-term storage system of ICAR-NBPGR, New Delhi.

Salient Features of AFg-4

- In multilocation testing, AFg-4 gave 19.25 q ha⁻¹ average seed yield which was 12.5 % superior as compared to national check Hisar Sonali in 11 trials conducted at different locations across Rajasthan (2010-12).
- AFg-4 gave 13.6 q ha⁻¹ average seed yield which was 17.6 % higher than the national check Hisar Sonali in coordinated trials conducted during 2010-12.
- It gave 16.32 q ha⁻¹ seed yield which showed more than 16 % superiority over RMT-1 and RMT-305 at adaptive trials center during 2013-14 in Zone-IIIa of Rajasthan.
- Under agronomical trials on spacing and fertigation conducted during 2012-13, AFg-4 yielded 26.4 q ha⁻¹ in row to row spacing of 22.5 cm and fertigation of NPK at 50,50,25 kg ha⁻¹.
- AFg-4 found moderately resistant to powdery mildew and root rot diseases.
- Superior quality of AFg-4 reported owing to its seed containing 0.97 % 4-hydroxyisoleucin, 1.79 %

diosgenin and 21.9 % crude fibre which is 11.9, 30.8 and 13.9 percent higher respectively, as compared to Hisar Sonali.

Disease and pest reaction

Ajmer fenugreek-4 found moderately resistant for powdery mildew and root rot. Screening for powdery mildew and root rot was done in station trial conducted for two years during 2007-09 at Ajmer location under natural conditions. The average percent disease intensity was recorded 22.7% while it was 40-50 % in check varieties. The aphid infestation was at par with other popular varieties hence recommended POP is to be followed for harvesting potential production (Table 4).

Agronomic Aspects

Ajmer fenugreek-4 is recommended for cultivation in all fenugreek growing areas of India. It is found suitable for cultivation on loamy and sandy loam soils having good drainage conditions, dry cool and frost-free environments. For optimizing productivity, second fortnight of October is the most suitable time for sowing with seed rate of 18-20 kg ha⁻¹. Line sowing with 22.5 cm line to line and 10 cm plant to plant distance was found best for maximizing the seed yield. Sufficient conserved soil moisture from late rains or pre-sowing irrigation is recommended for uniform emergence. First irrigation is recommended at 30-35 days followed by 3-4 subsequent irrigations in sandy loam soil and 2-3 irrigations in heavy soils. Fenugreek crop is prone to shattering at full maturity therefore, crop should be harvested at physiological maturity (Table 3).

Table 1. Seed yield of variety AFg-4 in Station trials and multilocation CVT of AICRP on Spices

Particulars	Station trial in Rajasthan (2008-09)			CVT of AICRP across India (2008-12)		
	AFg-4	RMT-1 check	Local check	AFg-4	Hisar Sonali	Local check
Average seed yield (qha ⁻¹)	19.25	17.11	15.13	13.64	11.59	11.93
Number of locations	32	30	29	29	27	26
% increase over checks	-	12.53	27.23		17.62	14.25

Table 2. Quality attributes of variety Ajmer fenugreek-4 as compared to check varieties

Particulars	AFg-4	Hisar Sonali	SD (±)	% increase over Hisar Sonali
Saponin (%)	8.37	7.09	0.641	18.1
Diosgenin (%)	1.74	1.33	0.252	30.8
Crude fat (%)	7.0	6.35	0.039	10.2
% Crude fiber (Insoluble)	21.7	19.05	1.607	13.9
4-Hydroxy-isoleusine (%)	0.94	0.84	0.068	11.9

Table 3. Agronomic traits of variety Ajmer Fenugreek-4

S.No.	Characteristics	Average of CVT trials at all India level		
		AFg-4	Hisar Sonali	Local check
1.	Days to flowering	56.8	59.9	60.0
2.	Days to maturity	136	136	132
3.	Plant height (cm)	72.8	68.33	60.69
4.	Primary branches plant ⁻¹ (Nos.)	5.76	5.10	5.44
5.	Secondary branches plant ⁻¹ (Nos.)	2.20	2.18	5.29
6.	Pods plant ⁻¹ (Nos.)	44.88	47.46	44.75
7.	Pod length (cm)	10.40	10.10	9.77
8.	Seeds pod ⁻¹ (Nos.)	14.90	15.6	14.9
9.	1000 seed weight (g)	13.73	15.60	11.96
10.	Seed yield (q ha ⁻¹)	17.8	11.07	11.21

Table 4: Disease scoring of variety Ajmer fenugreek-4 for powdery mildew at Ajmer

S.No.	Name of entry	Percent disease intensity of powdery mildew		
		2007-08	2008-09	Average
1.	Ajmer fenugreek-4	20.3	25.3	22.7
2.	Ajmer fenugreek-1(C)	40.0	50.7	45.3
3.	RMt-1(C)	-	30.7	30.7
4.	RMt-305(C)	50.0	-	50.0

Table 5. DUS characteristics of variety Ajmer Fenugreek-4 for identification

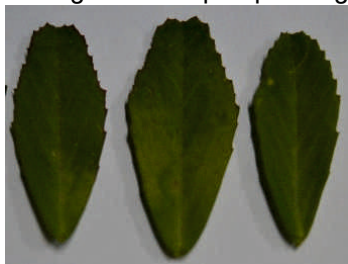
S.No.	DUS Characteristics	AFg-4
1.	Basal shape of first leaf blade	Acute
2.	Apex shape of first leaf blade	Rounded
3.	Size of leaf on first primary branches axis for length and width (L/W)	Large length but narrow
4.	Basal shape of leaf blade on first primary branch axis	Acute
5.	Apex shape of leaf blade on first primary branch axis	Rounded
6.	Size of leaf on first pod axis for length and width (L/W)	Small in length but wider
7.	Basal shape of leaf blade on first pod axis	Obtuse
8.	Apex shape of leaf blade on first pod axis	Acute
9.	Size of leaf on fully grown terminal leaf for length and width (L/W)	Small in length but wider
10.	Basal shape of leaf blade on first pod axis fully grown terminal leaf	Acute
11.	Apex shape of leaf blade on fully grown terminal leaf	Obtuse
12.	Number of primary branches	Less>6
13.	Plant growth pattern	V type
14.	Plant growth habit	Indeterminate
15.	Plant height (cm)	Tall (>45)
16.	Pod/plant	High (>50)
17.	Pod length (cm)	Long (>12)
18.	Pod curvature	Moderately curved
19.	1000 seed weight (g)	Low (<16 g)



Ajmer Fenugreek-4 crop at podding stage



Apical twigs of Ajmer Fenugreek-4



Ajmer Fenugreek-4: -Leaf shape and size



Seed of Ajmer Fenugreek-4

Conflicts of Interest: The authors declare no conflicts of interest.

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