Original Research Article

~~Occurrence and i~~Incidence of wilt disease on fenugreek (*Trigonella foenum-graecum* L.) caused by *Fusarium oxysporum* Schlecht in Rajasthan

ABSTRACT

Fenugreek (*Trigonella foenum-graecum* L.) is an annual legume crop with small seeds and self-pollinated plant, belonging to the family *Fabaceae*. It ranks as the third largest seed spice in India following coriander and cumin. The crop suffers from several diseases, among them wilt caused by *Fusarium oxysporum*is one of the major economically important diseases in many fenugreek growing states of our country including Rajasthan. A proper investigation needs a perfect scrutiny. So, the survey was carried out to monitor the disease incidence in major fenugreek growing districts of Rajasthan namely Bikaner, Sikar and Nagaur during *Rabi* season 2021-22 and 2022-23. The survey revealed that wilt disease caused by *Fusarium oxysporum*is an imperative pathological problem. Average per cent disease incidence was 24.03 per cent recorded in surveyed districts of Rajasthan. Highest average disease incidence (29.31%) was reported in Nagaur followed by Sikar (24.85%), while lowest in Bikaner (17.93%) district.

Key words: Disease, Fenugreek, *Fusarium oxysporum*, Rajasthan, Wilt

INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) commonly known as *'**Methi**'*, is a self-pollinated, small seeded, annual legume crop which belongs to the family *Fabaceae*. It is an annual forage legume and spice crop and is widely known for its medicinal, pharmaceutical and nutraceutical properties. Fenugreek is native to an area extending from Iran to northern India (Acharya *et al*., 2006), but it is now grown as a spice in most parts of the world. Fenugreek seed is used as a spice, is one of the main ingredients in curry powder (Srinivasan, 2006 and Mary, 2009) and also has a long history of use as a medicinal herb, being used

Comment [u1]: Which country? Remove this, and replace it with the name of the country please

Comment [u2]: Which season? Give universal name instead

Comment [u3]: Citation needed

UNDER PEER REVIEW

extensively in both Indian ayurvedic and traditional chinese medicine (Tiran, 2003). It is regarded as the oldest known medicinal plant in recorded history (Lust, 1986).

Fenugreek is an important multipurpose winter season seed spice crop. It ranks as the third largest seed spice in India following coriander and cumin. In India, the major fenugreek growing states are Rajasthan, Madhya Pradesh, Gujarat, Haryana, Uttarakhand and West Bengal. In India, it is cultivated on approximately 168716 ~~h~~hectare~~a~~ (ha) area of land with an annual production of about 252063 tonnes and a productivity of 1.49 tonnes ha^{-1}. Rajasthan leads in both area and production of fenugreek in India with 90469 ha area under cultivation, an annual production of 110869 tonnes and a productivity of 1.23 tonnes ha^{-1} (Anonymous, 2021-22a). In Rajasthan, the major fenugreek growing districts are Bikaner, Jodhpur, Pratapgarh, Nagaur, Churu and Sikar etc. Bikaner takes the first position in terms of area and production of fenugreek in Rajasthan with 25533 ha area and 27372 tonnes production along with 1.07 tonnes ha^{-1} productivity (Anonymous, 2021-22b).

The production and productivity of fenugreek is highly affected by fungal diseases such as root rot, powdery mildew, downy mildew, wilt, rust, leaf spot and charcoal rot diseases (Prasad *et al.*, 2014). Among them, wilt caused by *Fusarium oxysporum*Schlecht is one of the major economically important diseases in many fenugreek growing states of our country including Rajasthan. The disease was first reported from Rajasthan by Shivpuri and Bansal (1987). Fusarium wilt of fenugreek can lead to annual losses up to 56 per cent (Rani, 2015).Wilt of fenugreek, exhibited various types of symptoms at any stage of the crop. Infections at the seedling stage result in complete drying, while infected plants exhibit various types of symptoms such as stunting of the plants, gradual yellowing of lower leaves, drooping, epinasty, drying of leaves and in some cases partial wilting. Dried leaves remain attached to the wilted plants. When wilted plants split longitudinally, they reveal brown vascular discoloration. Ultimately, wilted plants lose vigor, leading to the death of the entire plant (Rani *et al*., 2017a).

Comment [u4]: Write the name of the country instead

Comment [u5]: There is need for a last paragraph. The paragraph should include the justification and objective of the study

MATERIALS AND METHODS

Survey for the occurrence of wilt of fenugreek was conducted during *Rabi* 2021-22 & 2022-23 to assess the prevalence and incidence in major fenugreek growing areas of Rajasthan. Survey was conducted in Bikaner, Sikar and Nagour districts of Rajasthan. Three tehsils under each district and four villages under each tehsil were included. Under each

Comment [u6]: ?

Comment [u7]: include the coordinates of the farm locations please

Comment [u8]: what does this mean, give universal name please

UNDER PEER REVIEW

village, four (4) farmer's fields were assessed. In each field, five (5) spots of one square meter area (m^2)were marked diagonally at randomly to cover entire field. Diseased and healthy plants were counted in each spot and the per cent disease incidence was calculated by using the following formula.

$$\text{Percent Disease Incidence} = \frac{\text{Number of wilted plants}}{\text{Total number of observed plants}} \times 100$$

Roots of some infected samples were collected from surveyed fields. These samples were brought to laboratory for isolation of pathogens and further studies.

Data analysis

RESULT AND DISCUSSION

Survey was conducted in major fenugreek growing districts of Rajasthan during Rabi season 2021-22 and 2022-23 which showed the wilt disease caused by *Fusarium oxysporum* is an imperative pathological problem. Average per cent disease incidence was 24.03 per cent recorded in surveyed districts of Rajasthan. Highest average disease incidence (29.31%) was reported in Nagaur followed by Sikar (24.85%) while lowest in Bikaner (17.93%) district (Table, Fig & Plate 1).

The survey in Bikaner district revealed that the average disease incidence ranged from 15.13 to 21.57 per cent during the *Rabi* seasons of 2021-22 and 2022-23. The maximum per cent disease incidence was observed in fenugreek fields at Punrasar village of Shri Dungargarh*tehsil* that is upto 21.57 per cent and minimum per cent disease incidence (15.13%) in Parwa village of Nokha*tehsil*. In the Sikar district, the average disease incidence was recorded from 22.86 to 26.23 per cent. The highest per cent disease incidence was observed at Gokulpura (26.23%) village of Sikar *tehsil* and minimum per cent disease incidence in Kayamsar (22.86%) village of Fatehpur *tehsil*. The survey conducted in Nagaur district demonstrated an average disease incidence ranging from 27.30% to 31.32%. The highest per cent disease incidence was observed at Kuchera (31.32%) village of Nagaur*tehsil* and minimum per cent disease incidence in Dangavas (22.86%) village of Merta *tehsil*. The elevated disease incidence could be attributed to factors such as the previous crop, monocropping system and the complex nature of the pathogen, which may have exacerbated the disease situation. Similar finding was reported by Singh *et al.* (2014), who assessed the

Formatted: Superscript

Comment [u9]: Give the procedures of how your conduct this lab work.

What is the result, I mean what did you isolate to confirm your expectation. If you didn't have the result for this lab work, you better remove it, or else contradict and invalidate the result

Comment [u10]: How did you analyse the data? Which statistical package and tool did you use?

If you didn't use any statistical package, did you use excel in doing the analysis? Specify and explain please.

Comment [u11]: ?

UNDER PEER REVIEW

pathogenic disease incidence of foot rot of fenugreek (*Trigonella foenum--graecum* L.) caused by *Fusarium moniliforme* and recorded occurrence of disease incidence ranged from 44-58 per cent in Rohilkhand region of Uttar Pradesh.

Our findings are also in accordance with the earlier reports of Rani and Hegde(2017), who conducted survey for wilt of fenugreek in three districts *viz.*, Dharwad, Belagavi and Haveri. Highest per cent disease incidence was recorded in Dharwad (1.00 to 56.19%) followed by Haveri (11.31% to 42.59%) and least disease incidence was observed in Belagavi (9.71% to 29.22%). Similarly, Bhimani *et al.* (2018a) isolated *Fusarium oxysporum*schlecht. in fenugreek from fifteen different locations of Saurashtra regions of Gujarat. Among them, one isolate (Khadpipali) found highly pathogenic with 93.33 per cent PDI.

Conclusion

Comment [u12]: ? Provide this section please

REFERENCES

Acharya, S. N., Srichamroen, A., Basu, S., Ooraiku, B. and Basu, T. (2006). Improvement in the nutraceutical properties of fenugreek (*Trigonella foenum-graecum* L.). *J.Sci. Tech.* **28**(1): 1-9.

Anonymous, 2021-22a. Directorate of Arecanut and Spices Development, Kozhikode, Kerala, GoI.

Comment [u13]: Write the name of the organisation

Anonymous, 2021-22b. Rajasthan Agricultural Statistics at a glance, G0R.

Comment [u14]: Write the name of the organization too

Bhimani, M. D., Akbari, L. F. and Golakiya, B. A. (2018a). Characterization of Indian isolates of *Fusarium oxysporum* Schlecht causing fenugreek wilt. *Int. J. Chem. Studies.* **6**(2): 1167-1172.

Lust, J. B. (1986) The herb book. Bantam books Inc. New York.1-55.

Mary, J. (2009). Fenugreek seed benefits the digestive system and lowers blood pressure. *http://EzineArticles.com*.

Prasad, R., Acharya, S., Erickson, S. and Thomas, J. (2014). Identification of cercospora leaf spot resistance among fenugreek accessions and characterization of the pathogen. *Australian J. Crop. Sci.* **8**(6): 822-830.

UNDER PEER REVIEW

Rani, N. (2015). Studies on root rot/wilt of fenugreek with special reference to *Fusarium oxysporum Schlecht*. *Doctoral dissertation*, University of Agricultural Sciences Dharwad.

Rani, N. and Hagde, Y. R. (2017). Survey for the incidence of root rot/wilt of fenugreek in Northern Karnataka, *India. Int. J. Curr. Microbiol. App. Sci.***6**(5): 1564- 1569.

Rani, N., Hegde, Y. R. and Nargund, V. B. (2017a). Symptomatology, proving pathogenicity and standardization of inoculum density of *Fusarium oxysporum* causing wilt of fenugreek. *J. Pharma. Phytochem.* **6**(6): 505-509.

Shivpuri, A. and Bansal, P. K. (1987) Fusarium wilt of *Trigonella foenum-graecum* L. *Indian J. Mycolo. Pl. Pathol.***26**: 749-751.

Singh, C. P., Mishra, U. S., and Pandey, U. C. (2014). Occurrence and incidence of foot rot disease on fenugreek caused by *Fusarium moniliforme* in Rohilkhand region of Uttar Pradesh, India. *J. Environ. Sci. Technol.* **2**(2): 25-28.

Srinivasan, K. (2006). Fenugreek (*Trigonella foenum-graceum*): a review of health beneficial physiological effects. *Food Rev. Int*. **22**: 203-224.

Tiran, D. (2003). The use of fenugreek for breast feeding woman. Comp. *Ther. Nurs. Midwifery*. **9**(3): 155-156.

UNDER PEER REVIEW

Table: 1 Per cent disease incidence offenugreek wilt disease in major growing districts of Rajasthan

Districts	Tehsils	Villages	Disease incidence (%)*		Mean PDI
			2021-22	2022-23	
Bikaner	Bikaner	Deshnok	15.25	18.25	15.25
		Himtasar	17.63	20.28	17.63
		Barsingsar	19.85	17.55	19.85
		Lalamdesar	15.69	17.86	15.69
	Nokha	Rasisar	18.46	16.74	18.46
		Parwa	15.13	18.00	15.13
		Bhamatsar	17.65	19.67	17.65
		Manyana	17.55	20.10	17.55
	Shri Dungargarh	Sheruna	19.17	17.45	19.17
		Sanwatsar	19.92	21.12	19.92
		Ridi	17.32	18.38	17.32
		Punrasar	21.57	20.65	21.57
Average			17.93	18.84	17.93
Sikar	Sikar	Gokulpura	27.67	24.78	26.23
		Shyampura	24.43	27.65	26.04
		Bajor	27.45	23.68	25.57
		Radha Kishanpura	25.64	26.75	26.20
	Lachhmangarh	Patoda	22.78	24.10	23.44
		Ghassu	26.25	24.00	25.13
		Dantujala	23.89	25.93	24.91
		Hameerpura	26.12	24.55	25.34
	Fatehpur	Ramgarh	25.36	22.85	24.11
		Bhojdesar	21.85	24.25	23.05
		Hetamsar	26.65	24.14	25.40
		Kayamsar	22.49	23.23	22.86

UNDER PEER REVIEW

Average			25.05	24.66	24.85
Nagaur	Nagaur	Kuchera	32.40	30.23	31.32
		Mundwa	29.32	31.17	30.25
		Bhadana	30.70	28.20	29.45
		Gothra	27.89	29.00	28.45
	Merta	Dangavas	28.24	26.35	27.30
		Netadiya	31.65	28.60	30.13
		Dholerao Khurd	29.56	30.45	30.01
		Raliyawata	31.20	27.32	29.26
	Degana	Langod	26.90	28.12	27.51
		Rewat	29.76	28.20	28.98
		Tamroli	28.50	30.37	29.44
		Jalsoo Khurd	30.43	28.87	29.65
Average			29.71	28.91	29.31
Total Average			24.23	24.13	24.03

*Average of four fields in each village

Comment [u15]: Take this table to the result section pleases.
Change the page orientation to landscape

Note: why some values of mean PDI resembles disease incidence of 2021-22 ?

UNDER PEER REVIEW

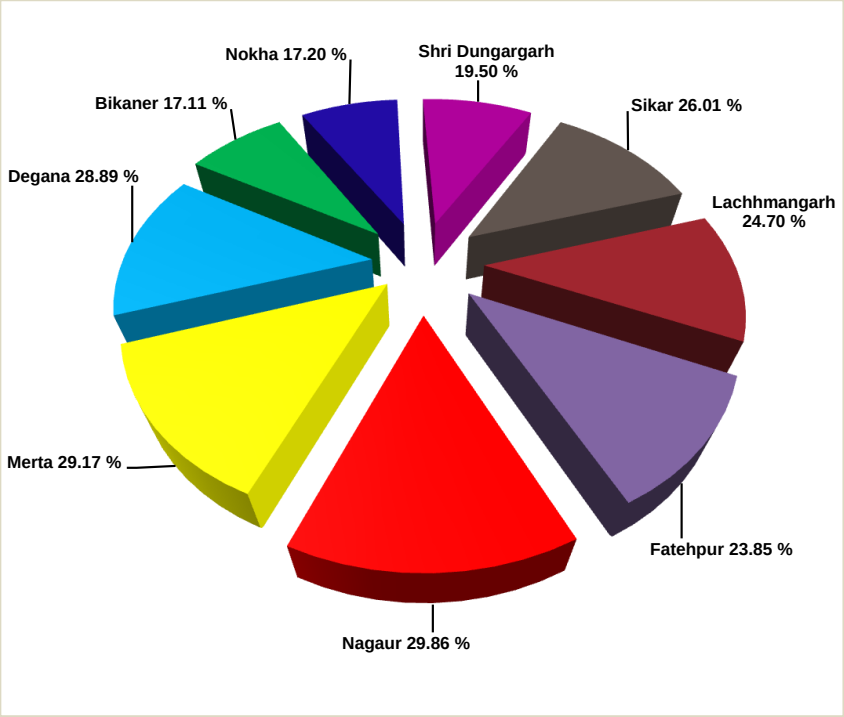

Fig:.1 Per cent disease incidence of fenugreek wilt disease in major growing districts of Rajasthan

Comment [u16]: This should also be moved to result section

UNDER PEER REVIEW

Plate: 1 Survey of wilt disease of fenugreek in major growing districts of Rajasthan

UNDER PEER