Research Article

Influence of Environmental Factors on Downy Mildew (*Peronospora Trigonella* Gauman) Development of Fenugreek (*Trigonella Foenum-Graecum* L.)

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Abstract

Fenugreek is one of the important leafy vegetable and seed spice having many medicinal values. Downy mildew of fenugreek caused by *Peronospora trigonella* Gauman, has emerged as a constraint in its cultivation in Rajasthan. The field experiment was conducted during *rabi* 2010-11 to determine the effect of meteorological parameters *viz*., maximum and minimum temperature, morning and evening relative humidity, rainfall and sunshine hours on the development and spread of downy mildew of fenugreek under field conditions. Disease appears in the last week of November and reaches its peak in January, yellowish patches appeared on leaves in severe cases leaves dry pre maturely, physiology of infected plants get impaired as a results there is a loss in quality and quantity of seed. The results of cropping season with respect of weather parameters revealed that downy mildew of fenugreek is greatly favoured by high relative humidity more than 80% and minimum and maximum temperature range of 3.7 - 9.1^{0}C and 17.8 - 24.0^{0}C, respectively. Significant and negative correlation was recorded with maximum and minimum temperature whereas, positive significant correlation with morning and evening relative humidity.

Keywords: Meteorological parameters, influence, fenugreek, downy mildew, *Peronospora trigonella*

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Introduction

Fenugreek (*Trigonella foenum-graecum* L.) commonly known as “methi”. It is important herbaceous annual self pollinated seed spice crop belongs to family *Fabaceae.* Fenugreek is fast growing crop it comes up well on loamy soil. The leaves are used as a vegetable for human consumption, the grains as spice for adding nutritive value and flavor to the food and forage for cattle and to some extent for medicinal purposes. Fenugreek is attacked by a number of diseases. Among these, downy mildew (*Peronospora trigonella* Gaumann) is an important and serious disease causes maximum crop loss. It is most widespread and devastating causing heavy losses in production not only quantitatively but also qualitatively and many times has been a limiting factor in the successful and economical cultivation of fenugreek in India [1]. For the last few years, this disease is appearing regularly under Rajasthan conditions. The yellowish patches are easily recognizable on infected leaves. On the adaxial surface of these patches shows the presence of cotton grayish violet mycelium and sporangiophores. Infected plants become weak and flaccid as complete physiology get impaired; as a result, seeds remain small, poor in quality and flavour also. Young leaves are less susceptible than older ones. In case of severe infection disease causes premature defoliation and plants appear abnormal and remain stunted. In present investigation an attempt has been made to study the effect of temperature, relative humidity, rainfall and duration of sunshine hours for initiation and development of downy mildew of fenugreek.

Materials and Methods

To know the effect of different abiotic factors such as temperature, relative humidity, rainfall, and sunshine hours etc. on the development of the disease a field experiment was concluded during 2010-11 crop season on susceptible fenugreek local cultivar at Agro Meteorology observatory, Sri Karan Narendra College of Agriculture, Jobner. Sowing was made in the first week of November. Cumulative disease progression from initiation and at interval of 7

days was recorded and correlation was also worked out. Average intensity of the disease was recorded on 100 tagged plants with four replications throughout the season in the field. Per cent disease intensity (PDI) was calculated every time till the maturity of the crop. Observations were recorded at end of every meteorological week. Weekly meteorological data on maximum and minimum temperature, mornings, evening relative humidity, rainfall and duration of sunshine hours were obtained for the period between two consecutive disease recordings to establish their correlation with disease development. The prediction equation used was Y= x1 + x2 + ----------+x7 where, Y=Predicted disease intensity, x1 = Max. temp. (°C), x2 = Min. temp.(°C), x3 = morning R.H. (%), x4 = evening R.H. (%),x5 = average R.H. (%) x6 = Rainfall (mm) and x7 = Duration of sunshine (hrs/day). Per cent disease intensity was calculated by using formula given below.

$$\text{Per cent disease intensity} = \frac{\text{Sum of all numerical rating}}{\text{No. of leaves examined X Maximum disease rating}} \text{ X } 100$$

Result and Discussion

The results of cropping season with respect of weather parameters revealed that the disease first appeared in the last week of November, 2010 i.e. in 48 meteorological week, at this period the average maximum and minimum temperature was 23.9 and 8.1^{0}C, average morning and evening relative humidity was 93 to 33%, respectively. The disease became conspicuous in 2nd week of January to 1st week of February and declined after 2nd week of February. The peak per cent disease intensity of fenugreek downy mildew was recorded in 4th meteorological week during 2011, at this period the average maximum and minimum temperature was recorded 22.5 and 4.5^{0}C and average morning and evening relative humidity was recorded 84 and 30%, respectively (**Table 1**).

Table 1 Per cent disease intensity of downy mildew of fenugreek in relation to weekly major meteorological factors

Date of recording disease intensity (MW)*	Cropping season (2010-11)							
	Temperature (°C)		Relative humidity (%)			Rainfall (mm)	Sunshine hr/day	Per cent disease intensity
	Maximum	Minimum	Morning	Evening	Average RH (%)			
12/11/10 (46)	28.2	18.1	87	61	74	16.4	02.2	0.00
18/11/10 (47)	23.1	12.5	93	60	77	18.4	04.3	0.00
26/11/10 (48)	23.9	08.1	93	33	63	0.00	07.6	5.68
03/12/10 (49)	23.0	06.1	78	35	57	0.00	08.5	8.05
10/12/10 (50)	23.0	03.4	84	25	55	0.00	08.0	18.55
17/12/10 (51)	24.7	02.0	89	29	59	0.00	08.6	32.00
24/12/10 (52)	22.5	07.0	85	45	65	0.02	06.9	40.00
01/01/11 (1)	17.8	07.4	96	47	71	0.00	06.4	42.00
08/01/11 (2)	22.5	03.7	84	35	59	0.00	09.1	48.00
15/01/11 (3)	21.5	01.6	88	35	61	0.00	09.3	51.66
22/01/11 (4)	22.5	04.5	84	30	57	0.00	08.6	60.85
29/01/11 (5)	23.5	04.3	84	29	57	0.00	09.0	59.00
05/02/11 (6)	26.7	07.5	83	29	56	0.08	09.5	50.00
12/02/11 (7)	24.0	09.1	90	44	67	32.8	07.2	47.32
19/02/11 (8)	23.5	09.1	91	41	66	0.00	08.1	45.15
26/02/11 (9)	25.3	11.00	89	34	61	0.01	07.2	38.00
05/03/11 (10)	28.1	10.6	81	25	53	0.00	08.7	28.00

* Meteorological Week

The occurrence of disease in terms of per cent disease intensity in relation to weather variables was analyzed statistically by using step wise regression analysis. Correlation coefficient of per cent disease intensity with meteorological factors was worked out and regression equation was formulated. Correlation analysis of per cent disease intensity with weather parameters indicated that the maximum (higher than 17.8^{0}C) and minimum (lower than 11.0^{0}C) temperatures has significant negative correlation with disease intensity while morning (78 to 91 per cent) and evening (25-47 per cent) relatively humidity has significant positive correlation with the disease intensity during the study period. However, statistical analysis between rainfalls, sunshine hours showed non-significant negative correlation with disease intensity (**Table 2**). The multiple regression equation (**Table 3**) showed that 70.0 per cent variation in disease intensity was attributable to the combined effect of temperature (maximum and minimum),

relative humidity (morning and evening and average relative humidity), rainfall and sunshine hours. It may be devoted that maximum and minimum temperature jointly contributed 18.0 per cent variation in disease incidence. Inclusion of relative humidity or another variable improved the prediction value by 33.0 per cent indicating that relative humidity was the dominant weather element in disease intensity. However, the contribution of maximum temperature in explaining the variation (6.0 per cent) in disease intensity is noteworthy. fenugreek downy mildew is positively associated with weather conditions particularly relative humidity and temperature, prevailing during vegetative growth period of the crop which are in agreement with [2] who observed that maximum and minimum temperature, relative humidity (morning and evening), sunshine hours and rainfall play important role in the development of downy mildew of brassica caused by *Peronospora parasitica*. Relative humidity and minimum temperature was significantly positively correlated with disease severity in downy mildew of onion [3]. Meteorological prediction of P. destructor where relative humidity, leaf wetness was most often limiting factor [4]. Per cent disease intensity of downy mildew of pearl millet had positive correlation with relative humidity and negative correlation with sunshine hours in arid climate [5]. Maximum temperature played a crucial role in the epidemic development of downy mildew of fenugreek, since rise in temperature above 180C showed sharp decline in the disease [6]. Similar, trend was observed for downy mildew of brassica [7].

Table 2 Simple correlation of disease intensity with major meteorological factors

S.No.	Variables	Simple correlation coefficient
1.	Temperature (0C)	
	(i) Maximum	-0.535*
	(ii) Minimum	-0.647**
2.	Relative humidity (%)	
	(i) Morning	0.499*
	(ii) Evening	0.510*
	(iii) Average	0.495*
3.	Rainfall (mm)	-0.294
4.	Sunshine	-0.244

** Correlation in significant at 1% (P = 0.01)
* Correlation in significant at 5% (P = 0.05)

Table 3 Predication equation and R^2 for predicating downy mildew disease intensity in fenugreek

Variables	Regression equation	R^2
PDI	$Y = -297.73 + 4.30\ x_1 - 3.26\ x_2 + 1.87\ x_3 + 0.681\ x_4 + 1.41\ x_5 - 0.529\ x_6 - 1.948\ x_7$	0.70
	$Y = -96.72 - 2.94\ x_1 + 1.73\ x_2 + 0.55\ x_3 - 0.114\ x_4 - 0.211\ x_5 - 0.779\ x_6$	0.66
	$Y = -161.03 + 1.47\ x_1\ 0.45\ x_2 + 1.21\ x_3 - 0.92\ x_4 - 2.04\ x_5$	0.51
	$Y = -61.69 + 0.48\ x_1 + 1.87\ x_2 - 0.85\ x_3 - 4.046\ x_4$	0.43
	$Y = -58.11 + 68.56\ x_1 + 2.31\ x_2 - 0.90\ x_3$	0.42
	$Y = 85.95 - 0.860\ x_1 - 6.21\ x_2$	0.18
	$Y = 73.12 - 4.86\ x_1$	0.06

Y = Disease intensity; X1 = Maximum temperature; X2 = Minimum temperature; X3 = Morning relative humidity; X4 = Evening relative humidity; X5 = Average relative humidity; X6 = Rainfall; X7 = Sunshine hours; R2 = Multiple coefficient of determination

Conclusion

Whether data were correlated and regressed with disease intensity by applying simple and stepwise correlation and regression coefficient analysis and linear equation were derived to predict the disease intensity. The disease first appeared in the last week of November, 2010 *i.e*. in 48th meteorological week. The disease became conspicuous from 2nd week of January to 1st week of February and declined after 2nd week of February. The disease was greatly favoured by high relative humidity (>80%), maximum and minimum temperature ranging between (17.8-24.0^{0}C) and (1.6-11.0^{0}C), respectively. The value of coefficient of determination was 70 per cent.

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