Effect of weather variables on the development of Lentil wilt caused by *Fusarium oxysporum* f.sp. *lentis.*

Abstract

Wilt of lentil, caused by *Fusarium oxysporum* f.sp. *lentis* is a serious disease caused by *Fusarium oxysporum* f.sp. *lentis* and plays major role in in reducing lentil yield in India and world.The present studieswere undertaken to study the effect of weather variables on the disease development. The crop was sown on four dates during rabi 2019-20 and 2020-21. The dates of sowing were 15th October, 30th October, 15th November and 30th November during both the years. Results revealed that temperature was positively correlated, Relative humidity was negatively correlated and with the disease incidence.

Key words: Lentil, Lentil wilt, *Fusarium oxysporum* f.sp. *lentis.*

1.Introduction

Pulses constitute an important part of human food and pulses are very rich in protein content and quality. The protein content ranges from 17-24 percent in pulses which is 2-3 times more than cereals. Pulses play an important role in the food and farming economy of our country. (Garkoti *et. al*., 2013). Lentil *(Lens culinaris*Medikus) is considered as the oldest pulse crop, maybe domesticated in habitation up to 13,000 years BC. It is mainly grown in India, Egypt, Greece, Bangladesh, Pakistan, Italy, countries in the Mediterranean region and North America. Lentil is highly proteinaceous crop as it contains 25 per cent of protein and is suitable for cultivation under varied climatic conditions. It improves the soil fertility in the areas where other legumesare not grown. Lentil provides affordable protein; hence it is also known as poor man's meat. *Fusarium* wilt caused by *Fusarium oxysporum* f. sp. *lentis* is predominant in the lentil growing areas worldwide, mainly India, Pakistan, Greece, Canada, Bangladesh, Syria, Italy, countries in theNorth America Mediterranean region. The pathogen is soil and seed borne. It colonizes and completely blocks the xylem vessels leading to wilting of plant. The disease can occur at any stage of the crop starting from seedling stage however, the yield losses depends upon the stage at which the plant wilts. Epidemiology and temporal factors also affects the disease incidence. Hence the current study was conducted to examine the incidence of wilt on lentil.

2. Materials and Methods

2.1 Isolation and identification of pathogen

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The roots of samples were washed in running water to remove the soil. The pathogen was isolated from the root and stem of the plant and maintained on potato dextrose agar medium. Under laminar air flow, small 5mm bits were cut from the intermittent zone of healthy and diseased tissue and were surface sterilized with 0.1% of mercuric chloride for 15-20 seconds and subsequently washed in sterilized distilled water for 3-4 times. Excessive moisture was removed by keeping the sterilized bits on sterilized blotting paper under aseptic conditions which were then transferred to PDA slants using sterilized inoculation needle. These test tubes were incubated at 28℃ for one week. All the precautions were taken to prevent contamination. The pure culture of the isolate was obtained by using single spore method. The diluted mycelial suspension was spread uniformly on 2 per cent water agar plates. Single spore was marked and allowed to grow. The single spore was then cut and transferred to the PDA slantsunder aseptic conditions with the help of inoculation needle and incubated at temperature of 28±1°C for 4 days, later the mycelial bits of the fungus were placed in the centre of Petri plates containing potato dextrose agar medium and incubated at 28±1°C.

2.2 Effect of weather variables on the development of disease

To study the effect of weather variables i.e. temperature (maximum, minimum and average), relative humidity (maximum, minimum and average) and Rainfall (mm) on the development of disease, an experiment was conducted atResearch sub-station (RSS), Akrot (Una). During*rabi* 2019-20 and 2020-21. Crop was sown at four different dates i.e. 15th October, 30th October, 15th November and 30th November and data on disease incidence were recorded weekly. Data on weather variables (temperature, relative humidity and Rainfall) were collected from the Meterological centre, IMD, Bibra House, Cliffend Estate, Shimla (HP).

Correlation between disease incidence (%) and weather variables were calculated and regression equations were derived. The relationship between disease incidence and various weather variables for disease development was determined by studying simple, partial and multiple correlations. Regression coefficients were calculated and regression equations were formed. From the data on disease incidence, further AUDPC and infection rate (r) were calculated by using respective formulas.

The AUDPC was calculated using the formula given by Shaner and Finney (1977).

$$AUDPC = \sum (y_i + y_{i+1}) / 2 \times (t_{i+1} - t_i)$$

Where, y_i = Disease incidence at time t_i

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y_{i+1} = Disease incidence at time t_{i+1}

Expected disease incidence was also calculated from regression equation developed and compared with observed disease incidence for testing the fitness of the calculated regression equation.

3.Results and Discussion

To study the effect of the weather variables (temperature, relative humidity and precipitation) on the development of lentil wilt, an experiment was conducted at RSS, Akrot. The lentil variety HPL-5 was sown on 15th, 30th October and 15th,30th November during *rabi*2019-2020 and 2020-21 under field conditions. The data on disease incidence (%), temperature (°C), relative humidity (%) and precipitation (mm) recorded at weekly interval and are presented in table 1 and figure 1. The data revealed that disease incidence during *Rabi* 2019-20 was more on the crop sown on15th October (9.67%) in comparison to 30thOctober (5.43%), 15thNovember (2.72%) and 30thNovember (1.95%). Similar trend was followed in *rabi* 2020-21 as the disease incidence was recorded more on 15th October (9.46%) followed by 30th October (5.74%), 15th November (2.61%) and 30th November (1. 61%).Ghatak*et al*. (2014) reported that increased amount of inoculum resulted in higher incidence of number of however, increased inoculum proved to be ineffective under cooler condition. Early sowing associated with high soil temperature (22.6°C) resulted in maximum wilt incidence (97.2%). Under laboratory conditions, maximum radial growth of the fungus was recorded at higher temperature (27°C). Data on disease incidence of four dates of sowing were correlated with temperature (maximum, minimum and average), relative humidity (maximum, minimum and average) and precipitation and the correlation coefficient and regression equations were calculated and presented in table 1.

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Table 1. Effect of weather variables on the development of disease during 2019-2020 and 2020-21.

a. Simple correlation coefficients between disease incidence and weather variables						
Date of sowing	Percent disease incidence	Simple correlation coefficients				
		DS×	DS×	DS×	DS × min	DS×

		maxT	minT	maxRH	RH	Precipitation
15th Oct.2019	9.67	0.920**	0.857**	-0.801**	-0.816**	0.147NS
30th Oct. 2019	5.43	0.813**	0.754**	-0.868**	-0.858**	0.326NS
15th Nov. 2019	2.72	0.682*	0.827**	-0.905**	-0.938**	0.364NS
30th Nov. 2019	1.95	0.702*	0.845**	-0.915**	-0.941**	0.392NS
15th Oct.2020	9.46	0.943**	0.823**	-0.932**	-0.764**	0.236NS
30th Oct. 2020	5.74	0.955**	0.855**	-0.869**	-0.576**	0.260NS
15th Nov. 2020	2.61	0.880**	0.976**	-0.896**	-0.543NS	0.178NS
30th Nov. 2020	1.61	0.836**	0.957**	-0.940**	-0.549NS	0.427NS

b. Partial correlation coefficients between disease incidence and weather variables

Date of sowing	Percent disease incidence	Partial correlation coefficients				
		DS× maxT	DS× minT	DS× maxRH	DS× minRH	DS× Precipitation
15th Oct.2019	9.67	-0.604	-0.607	-0.184	-0.179	0.272
30th Oct. 2019	5.43	0.133	0.128	-0.046	-0.044	0.335
15th Nov. 2019	2.72	0.224	0.226	-0.393	-0.396	-0.017
30th Nov. 2019	1.95	0.049	0.051	-0.476	-0.477	0.222
15th Oct.2020	9.46	0.559	0.555	-0.723	-0.032	-0.096
30th Oct. 2020	5.74	0.829	-0.286	-0.498	0.527	-0.001
15th Nov. 2020	2.61	0.277	0.795	-0.230	0.202	0.014
30th Nov. 2020	1.61	-0.438	0.798	-0.868	0.702	-0.556

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c. Regression equation between disease incidence and weather variables				
Date of sowing	Percent disease incidence	Regression equation	Multiple correlation coefficient R	Coefficient of determination (R^2)
15th Oct.2019	9.67	Y=7.324+0.688(V1)-0.029(V2)-0.203(V3)+0.004(V4)+0.077(V5)	0.977	0.9546
30th Oct. 2019	5.43	Y=13.14+0.481(V1)-0.219(V2)-0.345(V3)+0.135(V4)+0.144(V5)	0.9634	0.9282
15th Nov. 2019	2.72	Y=11.64-0.024(V1)+0.255(V2)+ 0.134(V3)-0.434(V4)-0.06(V5)	0.9588	0.9192
30th Nov. 2019	1.95	Y=7.255+0.018(V1)+0.217(V2)+0.043 (V3)-0.229(V4)+0.021(V5)	0.9644	0.9301
15th Oct.2020	9.46	Y=33.84+0.455(V1)-0.250(V2)-0.466(V3)-0.010(V4)-0.025(V5)	0.983	0.967
30th Oct. 2020	5.74	Y=3.915+0.442(V1)-0.107(V2)-0.232(V3)+0.174(V4)+0.00(V5)	0.972	0.944
15th Nov. 2020	2.61	Y=1.002+0.073(V1)+0.397(V2)-0.080(V3)+0.049(V4)+0.003(V5)	0.980	0.960
30th Nov. 2020	1.61	Y=18.050-0.063(V1)+0.206(V2)-0.305(V3)+0.120(V4)-0.068(V5)	0.990	0.980

**Values significantly correlated maxT (V1) = Maximum temperature (℃) min T(V2) = Minimum temperature max RH (V3) = Maximum relative humidity min RH (V4) = Minimum relative humidity Precipitation (V5) DI (Y) = Per cent disease incidence (%)

REFERENCES

Cruz RD, Leandro FS Leonor and Munkvold PG. 2019. Effects of temperature and pH on *Fusarium oxysporum* and soybean seedling disease. Plant disease **103**: 3234-3243.

Garkoti A, Kumar S, Singh M and Singh V. 2013. Epidemiology and disease management-A Review. *AGRIWAYS***1**:62-64.

Ghatak A., Shukla N., Ansar M., Balodi R., and Kumar J. 2014. Effect of sowing time, soil temperature and inoculum density on suppression of *Fusarium* wilt in lentil *(Lens culinaris). International journal of Bio-resource and stress management.* **6**: 268-273.

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Patil M, Om G, Pawar M and Chobe DR. 2015. Effect of culture media, pH and temperature on the mycelial growth and sporulation of *Fusarium oxysporum* f.sp. *ciceris* isolates of chickpea from Central Zone of India. *JNKVV Research Journal***49**: 54-60.

Shaner, G. and Finney, R.E. 1977. The use of area under the disease progress curve (AUPDC) to assess quantitative disease resistance in the crop. *Theoretical and Applied Genetics*, **102**: 32-40.

Vasudeva RS and Srinivasan KV.1952. Studies on the wilt disease of lentil (*Lens esculenta*Moench.). *Indian Phytopathology***5**:23-32.

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