

## THE IMPACT OF CLIMATE VARIABILITY ON DEVELOPMENT OF FOLIAR DISEASES OF *SESAMUM INDICUM* L.

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**Abstract:** Leaf blight caused by *Alternaria sesami* and powdery mildew caused by *Erysiphe cichoracearum* are the major yield limiting factors in sesame. Environmental factors play an important role in development of foliar diseases of sesame. Three different dates of sowing was taken using the susceptible variety VRI-1 to study the influence of weather factors on the occurrence of foliar diseases of sesame. The weather parameters were recorded and correlated with the disease intensity. The results revealed that foliar disease severity was more in unprotected plots as compared to protected plots. The disease intensity was found to be increased with an increase in age of the plants. Correlation studies revealed that *Alternaria* leaf blight intensity was significantly negatively correlated with maximum and minimum temperature. There was a positive relationship observed between powdery mildew incidence and Relative humidity.

**Keywords :** Sesame, Foliar diseases, Weather factors, Correlation

### INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oilseed crop of tropical and sub tropical region and is called as queen of oilseed crops because of its oil quality. Sesame oil has excellent stability due to the presence of the natural antioxidants sesamol, sesamin, and sesamol. Oil soluble lignans, sesamin and sesamol, are further demonstrated to be of remarkable antioxidative activity *in vivo* and functional characteristics of sesame seeds have increased the demand of sesame seed and caused a good liquidity of the crop globally.

India ranks first in the world in sesame cultivation (27.7% area) but its productivity is quite low (368 kg/ha) as compared to world average (489 kg/ha). The main reason for the low productivity of this crop is due to the attack of various fungal [Charcoal rot of sesame (*Macrophomina phaseolina*), *Alternaria* leaf spot (*Alternaria sesami*), *Corynespora* blight (*Corynespora cassiicola*), Powdery mildew (*Erysiphe cichoracearum*), *Cercospora* leaf spot (*Cercospora sesami*)], bacterial [Bacterial blight (*Xanthomonas campestris* pv. *sesami*)], viral and phytoplasma [phyllody] diseases (Cagirgan *et al.*, 2009; Silme and Cagirgan 2010).

Leaf blight caused by fungus *Alternaria sesami* and powdery mildew caused by fungus *Erysiphe cichoracearum* are the major foliar disease of sesame in Tamil Nadu. *Alternaria sesami*, seed borne pathogen attacked all parts of the plant at all stages. Small, dark brown water soaked, round to irregular lesions, with concentric rings, 1-8 mm in diameter appeared on the leaves, midrib and veins of the leaves. Temperature of 20-30°C and high humid conditions favoured the disease with more number and increased size of spots. For powdery mildew infection, small cottony spots appeared on the infected leaves which gradually spread on the lamina. Before maturity, defoliation of severely

infected plants occurred. Regular occurrence of *Alternaria* leaf spot and powdery mildew disease has been recorded from different districts of Tamil Nadu state with varying incidence causing huge losses in yield. Maiti *et al.* (1988) documented that *Alternaria sesami* was one of the important fungal diseases of sesame causing considerable losses in India.

Climate change has an effect on agricultural production and farming practices over the globe, which may also lead to a dramatic change in crop health. To cope with the expected impact of climate change and to reduce food insecurity, modelling is done to help policy makers and to governments. Roos *et al.* (2011) proposed models for impact of climate change on future crop production and food security losses from a given factor. However, there are uncertain factors in these models which may also hold unpredicted impacts such as interactions between abiotic and biotic stress factors.

Environmental factors play an important role in development of foliar diseases of sesame. Temperature (maximum and minimum) and relative humidity play a major role in the growth of the pathogen and disease development of foliar diseases. However there is lack of precise information on the influence of environmental factors on the development of foliar diseases on sesame. Deepthi *et al.* (2014) reported that non significant positive correlation was observed between sesame charcoal rot and temperature while significant, negative correlation was noticed between disease development and relative humidity. Tripathi *et al.* (1998) conducted field trials to study the effect of sowing date and variety on severity of *Alternaria* leaf spot of sesame caused by *A. alternata* and found significant differences in disease severity between sowing dates and that disease severity increased with delayed sowings.

The present study was carried out to showcase that date of sowing and climate variability can be of

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positive impact on the occurrence of foliar diseases of sesame.

## MATERIALS AND METHODS

The field experiment on the influence of climate change on foliar diseases of sesame was conducted during *kharif* 2018 using the susceptible variety VRI-1. Sowing was taken at different intervals *viz.*, 15.07.18, 31.07.18 and 16.08.18 in a plot size of 2.4 x 3.0 m replicated thrice with two treatments T<sub>1</sub> - Protected and T<sub>2</sub> - Unprotected. Three replications were made for each date of sowing. The plot size used was 12 m<sup>2</sup>. Sesame seeds were sown in each plot at 30×30 cm spacing. All other cultural and pest control practices were followed as recommended in package of practices.

The occurrence of foliar diseases *viz.*, powdery mildew and *Alternaria* leaf spot was recorded at weekly intervals using 0-5 scale (0 - No infection; 1 - 1 to 10% leaf area infected; 2 - 11 to 25% leaf area infected; 3 - 26 to 50% leaf area infected; 4 - 51 to 75% leaf area infected; 5 - 76 to 100% leaf area infected) (Anonymous, 1998) both under protected and unprotected conditions. Disease intensity was recorded on the basis of 25 leaves/plants selected randomly from each replication. The meteorological observation at Regional Research Station, Vridhachalam was used for this experiment. The weather parameters *viz.*, maximum temperature, minimum temperature, relative humidity (morning), relative humidity (evening), total rainfall, wind speed and sunshine hours for standard weeks during the crop period was collected. The disease incidence was correlated with the recorded weather parameters *viz.*, maximum temperature, minimum temperature, relative humidity (morning), relative humidity (evening), total rainfall, wind speed and sunshine hours. The weather parameters recorded prior to seven days of disease observation were used for correlation analysis.

## RESULTS AND DISCUSSION

Climate change and variability is considered as a big challenge to food security. The main impacts of climate change on crop production has been through fluctuations in temperatures of minima and maxima, in rainfall patterns in amount, spatial and temporal distributions, increased rates of evapo-transpiration, elevated repeatability of floods and droughts, and intrusion of salty water with the raise of sea level affecting coastal areas (Lagoda, 2011).

The results of the field experiment conducted on the influence of climate change on foliar diseases of sesame revealed that disease intensity was higher in unprotected plots at all the three dates of sowing as compared to protected one. The grade of *Alternaria* leaf blight and powdery mildew diseases were gradually increased with the increase in age of

the plants (Table 1). As evident from the data presented in Table 1, the crop sown on July 15, recorded lowest disease grade of *Alternaria* leaf blight and powdery mildew diseases. Leaf blight and powdery mildew diseases initiated at 33<sup>rd</sup> standard meteorological week. When sesame sowing was taken up in July 15<sup>th</sup>, the leaf blight disease grade was 0.6 and the disease severity increased up to 2.1 in protected plot. In unprotected plot, the leaf blight disease grade was 0.8 and the disease severity increased up to 3.4. The powdery mildew disease grade ranged from 0.3 to 1.7 in protected plot and 0.5 to 1.9 disease grade in unprotected plot (Table 1). When the sowing was taken in 31.07.2018, *Alternaria* leafspot disease severity was more both in protected and unprotected plots. Whereas, powdery mildew disease severity was more both in protected and unprotected plots when sowing was taken in 16.08.2018 (Table 1). Similar results were also obtained by Sabalpara *et al.* (2007) for blight of green gram caused by *Macrophomina phaseolina* in which maximum disease incidence was found in the month of October when maximum (35°C), minimum temperatures (25°C) and relative humidity (85%) prevailed in the field. Studies on the effect of planting dates indicated that the crop sown early during second fortnight of June was found to suffer least with *Alternaria* blight disease with significant increase in seed yield; however in delayed sown crop, the blight disease intensity was found to increase drastically (Pawar and Dhiraj Vipin, 2017). The correlation of different weather parameters with disease development was depicted in Table 2. Correlation of disease with the weather parameters indicated that *Alternaria* leaf blight intensity was significantly negatively correlated with maximum and minimum temperature. There was a positive relationship observed between powdery mildew incidence and Relative humidity observed during morning and evening. *Alternaria* leaf spot and powdery mildew incidence were found to be significantly positively correlated with wind speed. Sunshine hours recorded per day was found to be negatively correlated with the occurrence of foliar diseases. There was a positive correlation between rainfall and the incidence of powdery mildew disease during *kharif* 2018 season (Table 2). The present findings were similar with the results of Patel and Patel (1990) who reported higher temperature (35°C) and low relative humidity were found to be favourable for maximum disease incidence of charcoal rot of sesame (*M. phaseolina*). Choudhary *et al.* (2015) highlighted that Multiple regression equation between disease index and weather variables exhibited strong relationship among the different components of epiphytotic during both the years of study (during *kharif*, 2002-03 and 2003-04) and indicated that the combined effect of different weather variables favoured the *Alternaria* leaf spot development causing up to 99

per cent variation in the disease index. The late sowing (August) crop favoured quick disease development and recorded highest (60.50 and 70.50%) disease intensity. The mean temperature of 21.94 to 29.14°C; mean relative humidity of 74.35 to 90.63 per cent, mean rainfall of 7.81 to 12.33 mm and 38 to 40 rainy days during the seasons favoured disease development (Choudhary *et al.*, 2015).

The correlation studies indicated that rainfall, minimum temperature and relative humidity (RH-I and II) had a positive correlation with the disease development in all sowing times whereas the maximum temperature had a negative correlation. The weather condition during 36 to 45 MW was observed to be the most congenial for the crop infection and further rapid build-up of the disease. The results of regression equation stated that, if the rains received coupled with high humidity above 80% and temperature in the range of 21 to 32°C favours the primary infection of the crop (Gud *et al.*, 2014). The correlation studies indicated that in early sowing, the rainfall, minimum temperature and relative humidity (RH-I and II) showed a positive correlation with the disease development whereas the maximum temperature showed negative correlation against leaf spot of safflower caused by *Alternaria carthami* (Gud *et al.*, 2014).

Saharan and Saharan (2004) observed significantly positive correlation between the disease severity and certain weather parameters (cumulative rainy days and cumulative rainfall) in *Alternaria* leaf blight of cluster bean. At Phaltan, the disease had a positive correlation with rainfall, temperature and relative humidity. Sangeetha and Siddaramaiah (2007) reported maximum temperature of 27-28°C minimum temperature of 14-15°C and average relative humidity more than 65% was found favourable for *Alternaria* blight development of Indian mustard,

*Brassica juncea* (Linn.). Saharan and Saharan (2004) reported the step-wise multiple regression analysis of data which revealed that minimum temperature, relative humidity in the evening and sunshine and cumulative rainfall played a major role in *Alternaria* leaf blight disease development of cluster bean.

Climate change and variability could significantly affect plant disease development. Precipitation, temperature, and relative humidity, among other climatic factors, are known to affect the occurrence of the disease and reproduction, development and behavior. Whether climate changes can increase or decrease the incidence of a plant disease will depend not only on the actual climatic conditions but also on local non-climatic epidemiologic and ecologic factors (Cacirgan *et al.*, 2013). Gupta (2016) observed positive correlation between relative humidity and foliar diseases of sesame.

Enikuomihin *et al.*, 2010 reported that *Cercospora* leaf spot incidence was significant and negatively correlated with seed weight while defoliation was significant and positively correlated with *Alternaria* leaf blight or *Cercospora* leaf spot incidence. Rainfall was significant and positively correlated with *Cercospora* leaf spot or *Alternaria* leaf blight incidence while intercropping induced microclimatic effects that influenced disease incidence. Correlation-coefficient studies revealed significantly and positively correlation between temperature (Maximum), relative humidity (RH - I) and rainfall with *Alternaria* blight disease intensity (Pawar and Dhiraj Vipin, 2017). Chattopadhyay *et al.* (2005) reported that *Alternaria* blight (*Alternaria brassicae*) disease severity on pods of mustard was favoured by a maximum day temperature of 20-30°C, daily mean temperature of >14°C, morning relative humidity of >90%, sunshine hours >9h and >10 h of leaf wetness.

**Table 1.** Disease severity of foliar diseases in different week intervals

Date of observation (week)	D/S : 15.07.2018				Date of observation (week)	D/S : 31.07.2018				Date of observation (week)	D/S : 16.08.2018			
	Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)			Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)			Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)	
	P	UP	P	UP		P	UP	P	UP		P	UP	P	UP
33 <sup>rd</sup>	0.6	0.8	0.3	0.5	35 <sup>th</sup>	1.1	1.3	0.4	0.5	37 <sup>th</sup>	1.1	1.2	0.2	0.3
34 <sup>th</sup>	0.9	1.4	0.7	1.1	36 <sup>th</sup>	1.4	1.7	0.5	0.3	38 <sup>th</sup>	1.4	1.4	0.5	0.5
35 <sup>th</sup>	1.2	1.6	0.9	1.2	37 <sup>th</sup>	1.9	2.1	0.7	0.6	39 <sup>th</sup>	1.7	1.5	0.8	1.1
36 <sup>th</sup>	1.4	2.0	1.2	1.6	38 <sup>th</sup>	2.2	2.3	0.6	0.9	40 <sup>th</sup>	2.1	2.2	1.1	1.3
37 <sup>th</sup>	1.9	2.2	1.4	1.8	39 <sup>th</sup>	2.6	2.7	0.8	0.7	41 <sup>st</sup>	2.3	2.7	1.1	1.5
38 <sup>th</sup>	2.1	3.4	1.7	1.9	40 <sup>th</sup>	2.9	2.9	0.6	1.1	42 <sup>nd</sup>	2.5	2.8	1.3	1.7

**Table 2.** Correlation of weather parameters with foliar diseases of sesame

Weather parameters	D/S : 15.07.2018				D/S : 31.07.2018				D/S : 16.08.2018			
	Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)		Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)		Alternaria leaf blight (0-5 scale)		Powdery mildew (0-5 scale)	
	P	UP	P	UP	P	UP	P	UP	P	UP	P	UP
Tem (Min)	-0.8184	-0.8293	-0.8076	-0.7122	-0.8230	-0.7894	-0.2413	-0.8466	-0.9679	-0.9327	-0.9724	-0.9396
Tem (Max)	-0.8523	-0.8272	-0.8723	-0.8266	-0.7941	-0.7977	-0.2890	-0.7201	-0.9357	-0.9724	-0.8804	-0.8715
RH(M)	0.5638	0.5432	0.5951	0.5413	-0.2073	-0.1836	-0.3600	-0.3106	0.7209	0.6531	0.7243	0.6850
RH(E)	0.5927	0.4381	0.5733	0.5550	-0.8144	-0.8244	-0.7561	-0.4846	0.1221	0.3246	-0.0102	-0.0107
Rainfall (mm)	0.8034	0.7071	0.7486	0.6912	-0.0310	-0.0597	0.3155	0.0848	0.0623	0.1689	-0.0626	0.0676
Wind speed (km/hr)	-0.0277	0.0467	0.1186	0.1804	0.3376	0.3414	-0.1153	0.1717	0.9212	0.8246	0.9647	0.9407
Sunshine (hrs)	-0.7217	-0.7084	-0.7405	-0.7054	0.0874	0.0261	-0.2364	0.2893	-0.2888	-0.4310	-0.1557	-0.2228

\*Mean of three replications

\*\*P-Protected; UP-Unprotected

where RH (M) – Relative humidity (Morning)

RH (E) – Relative humidity (Evening)

## CONCLUSION

The present investigation revealed that sesame leaf blight and powdery mildew disease severity were gradually increased with the increase in age of the plants. Correlation studies indicated that *Alternaria* leaf spot intensity was negatively correlated with maximum and minimum temperature. Powdery mildew incidence was positively correlated with Relative humidity.

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