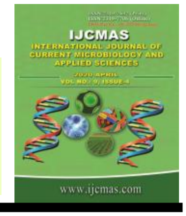
Int.J.Curr.Microbiol.App.Sci (2020) *9*(4): 12-17

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 4 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.904.003

Effect of Weather Parameters on Intensity of Early Blight of Tomato

T. D. Parmar[1], N. M. Gohel[1*] and A. D. Kalola[2]

[1]Department of Plant Pathology, [2]Department of Agril. Statistics, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India

**Corresponding author*

Keywords

Early blight, Tomato, Correlation, regression, Per cent disease intensity

Article Info

Accepted:
04 March 2020
Available Online:
10 April 2020

A B S T R A C T

The early blight caused by *Alternaria solani* is a severe constraint in tomato production and the disease intensity has been increasing day by day for the last few years in India due to changes in the environment. The field experiment was carried out to understand the development of early blight on tomato with respect to weather conditions during *kharif* 2018-19 at AAU, Anand. Results showed that maximum and minimum temperature (-0.913 and -0.875) was highly significant with negative correlation and wind speed (0.566) was highly significant with a positive correlation which was responsible for disease intensity. Multiple linear regression of PDI indicated that an increase in one unit of morning relative humidity (1%), evening relative humidity (1%) and bright sunshine hours (1 h/day), there was a corresponding increase of 0.91, 1.22 and 8.74 in per cent disease intensity of early blight. The value of the coefficient of determination (R^2) indicating 93.33 per cent variation in per cent disease intensity of weather factors in tomato crops.

Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most remunerative and widely grown vegetables in the world. Tomato is a rich source of minerals, vitamins, organic acid, essential amino acids and dietary fibers. It is known as productive as well as protective food. The major tomato growing states in the country are Odisha, Bihar, Gujarat, Karnataka, Andhra Pradesh, Uttar Pradesh, Maharashtra, Madhya Pradesh, West Bengal and Tamil Nadu accounting total production of 19696 MT from an area of 808 hectares with an average productivity of 24.40 MT per hectare, while in Gujarat state, it was grown in 46.40 ha with an annual production of 1319.11 MT with productivity of 28.43 MT per hectare during the year 2017 (Anon., 2017).

A large number of fungal diseases cause severe losses in tomato. Among the fungal diseases, early blight caused by the necrotrophic fungus *Alternaria solani* (Ellis and Martin) Jones and Grout is one of the world's most catastrophic disease of tomato occurring over a wide range of climatic conditions, incurring loss both at pre and post-harvest stages in tomato growing tracts of India (Tewari and Vishunavat, 2012).

Alternaria solani has the ability to survive for a long time on the diseased plant debris in the soil in the absence of the main host (Moore and Thomas, 1942; Basu, 1971). The disease affects on all foliar plant parts and causes a great reduction in quantity (Waals *et al*., 2001), causing fruit yield losses of up to 86 per cent in India (Datar and Mayee, 1981; Sahu *et al*., 2013).

Environmental factors play a key role in the development of the disease. Early blight develops more rapidly during periods when environmental conditions alternate between humidity and drought.

Spores of the fungi are one of the most important means of dissemination and also used in the identification and classification of the organism. It was well established that tomato early blight fungus could survive on the infected seeds for several years. But, it is still speculative whether the seed-borne inoculums of *A. solani* serve as a source for triggering a primary infection in the next season (Neergaard, 1945).

Understanding the effect of weather factors on disease development is pre-requisite to strategically manage this disease. In view of the importance of early blight in tomato, an experiment was conducted on effect of weather parameters on the development of early blight disease in tomato.

Materials and Methods

A field experiment was conducted during *kharif* 2018-19 at Agronomy farm, BACA, AAU, Anand using variety Anand tomato 3 with plot size 10 × 10 m, divided equally into four quadrates. The standard method was followed for other cultural practices. Ten plants from each quadrate were selected at randomly, labeled and intensity of early blight was recorded at seven days interval starting from the date of transplanting on leaves using 0-5 grade scale (Mayee and Datar, 1986). The per cent disease intensity (PDI) was calculated by using the following formula (Wheeler, 1969).

$$PDI = \frac{\text{Sum of the individuals disease ratings}}{\text{Number of leaves examined} \times \text{Maximum disease scale}} \times 100$$

No protection was given against any disease. The data on weather parameters [maximum and minimum temperature (°C), morning and evening relative humidity (%), bright sunshine (hrs/day), rainfall (mm) and wind speed (km/hr)] were obtained from Department of Agril. Meteorology, BACA, AAU, Anand during *kharif* 2018-19. They were correlated with the Karl Person's correlation coefficient (r). Correlation coefficient values were tested individually for their significance at 5 and 1% probability level. Further, the data were subjected to multiple linear regression analysis to find out the linearity of the independent variables for the prediction of disease. The following prediction equation was used.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6$$

Where, Y is the disease intensity, a is the intercept (constant), b_1 to b_6 is the partial regression coefficient associated with each $X_{i,}$ i= 1, 2, 3, 4, 5 and 6 are the weather variables, X_1 is the maximum temperature (°C), X_2 is the minimum temperature (°C), X_3 is the morning relative humidity (%), X_4 is the evening relative humidity (%), X_5 is the bright sunshine (hrs/day) and X_6 is the wind speed (km/hr).

Results and Discussion

Progressive disease development

Disease development under natural conditions was found to be influenced by environmental factors. The data from crop season revealed that 30 days old seedlings transplanted on the 34th standard meteorological week (SMW) during 2018. Observations were recorded from 43rd SMW at weekly interval. The first appearance of early blight was noticed 60 days after transplanting (DATP) in 2018 which progressed thereafter (Table 1). The development of the disease was initially slow but it reached to the maximum (77.34%) during the 3rd SMW of 2018 which happened in the month of January.

During the cropping period, maximum temperature ranged from 24°C (52nd SMW 2018) to 36.80°C (43rd SMW 2018), minimum temperature from 7.1°C (52nd SMW 2018) to 17.40°C (44th SMW 2018), relative humidity during morning ranged from 70% (52nd SMW 2018) to 89% (43rd SMW 2018) and relative humidity during evening ranged from 25% (52nd SMW 2018) to 45% (49th SMW 2018), bright sunshine ranged from 7.10 hrs/day (49th SMW 2018) to 9.90 hrs/day (44th SMW 2018), wind speed ranged from 1.6 km/hr (46th SMW 2018) to 3.9 km/hr (50th SMW 2018). However, there was no rainfall during 43rd to 4th SMW.

Increase in per cent disease intensity was comparatively higher in the temperature ranged from 27.7-34.5°C (maximum), 9.1-16.1°C (minimum) and wind speed ranged from 1.6-3.9 km/hr was most congenial for disease development.

Correlation studies

Correlation coefficient study revealed that maximum and minimum temperature (-0.914 and -0.875) was highly significant with a negative effect, whereas wind speed highly significant with positive effect (0.566) on development of early blight (Table 2).

The present results are in agreement with the earlier findings (Kumar and Singh, 1996; Kemmitt, 2002 and Sahu *et al*., 2014). However, Saha and Das (2013) reported a simple correlation between the relative progress of early blight and weather factors in four tomato varieties (Patharkuchi, BSS 494, ARTH 128, EG 294) and showed that temperature did not have a significant correlation with disease severity. The disease severity and its relative progress of all the four cultivars of tomato depended upon relative humidity positively and significantly. Devi *et al*. (2017) reported that maximum temperature ranging between 25.5^{0}C and 32.7^{0}C and RH ranging between 68 and 94 per cent found to have a significant positive correlation with tomato early blight disease severity.

Regression studies

During the year 2018-19, the coefficient of multiple determinants (R^2) was 0.9333 indicating 93.33% of the variation in early blight development explained by the set of a variable in the study (Table 3).

The multiple linear regression equation was fitted to the data and the equation arrived for the weather parameters was

$$Y = 122.090 - 8.261^{*}x_1 - 0.511x_2 + 0.919x_3 + 1.224x_4 + 8.742x_5 - 7.958x_6.$$

Table.1 Effect of weather parameters on disease development and intensity of early blight of tomato during *kharif* 2018-19

SMW	DI (%)	Increase in PDI	Weather parameters					
			Temperature (°C)		Relative humidity (%)		Bright sunshine (hrs/day)	Wind speed (km/hr)
			Max.	Min.	Morning	Evening		
43	0	0	36.80	16.70	89.00	26.00	9.80	1.70
44	2.5	0	35.50	17.40	78.00	29.00	9.90	2.40
45	5.5	3	34.30	14.60	85.00	32.00	9.60	2.20
46	9.25	3.75	34.50	14.40	88.00	35.00	9.30	1.60
47	19.51	10.26	34.40	16.10	88.60	38.40	9.20	1.70
48	37.52	18.01	30.90	13.90	82.00	40.00	8.10	2.80
49	49.51	11.99	30.10	13.60	87.00	45.00	7.10	2.10
50	52.44	2.93	28.10	11.10	82.00	39.00	8.60	3.90
51	56.67	4.23	27.70	9.10	85.00	35.00	9.30	3.70
52	64.85	8.18	24.00	7.10	70.00	25.00	8.30	2.50
1	69.58	4.73	28.70	8.20	87.00	31.00	9.30	1.90
2	72.67	3.09	26.50	9.40	83.00	37.00	9.10	3.10
3	77.34	6.67	29.70	10.70	88.00	37.00	9.50	2.50
4	77.34	0	25.50	10.70	86.00	39.00	9.20	4.00
Range of weather parameters			24.00-36.80	7.10-17.40	70.00-89.00	25.00-45.00	7.10-9.90	1.70-4.00
Total	594.68	-	426.70	173.00	1178.60	488.40	126.30	36.10
Mean	42.48	-	30.48	12.36	84.19	34.89	9.02	2.58
SD	29.55	-	4.03	3.31	5.13	5.67	0.76	0.82
Correlation	-	-	-0.913	-0.875	-0.138	0.311	-0.327	0.566
SE of r	-	-	0.09	0.10	0.21	0.20	0.20	0.18

Table.2 Correlation coefficient between weather parameters and early blight intensity

Weather parameters	Correlation coefficient 'r' value
Temperature (Max.) °C	-0.913**
Temperature (Min.) °C	-0.875**
Relative humidity (Morning) (%)	-0.138
Relative humidity (Evening) (%)	0.311
Bright sunshine (hrs/day)	-0.327
Wind speed (km/hr)	0.566**

*Significant at (p=0.05) level, n=14
** Significant at (p=0.01) level

Table.3 Multiple regression equation for *A. solani* in tomato crops

Particulars		Regression coefficient 'b' value
	Constant (Intercept)	122.090
x_1	Temperature (Max.) °C	-8.261*
x_2	Temperature (Min.) °C	-0.511
x_3	Relative humidity (Morning) (%)	0.919
x_4	Relative humidity (Evening) (%)	1.224
x_5	Bright sunshine (hrs/day)	8.742
x_6	Wind speed (km/hr)	-7.958
	R^2	0.9333
	Adjusted R^2	0.876

* Significant at (p = 0.05) level, n=14

This revealed that when there was an increase in one unit of maximum temperature (1°C), minimum temperature (1°C) and wind speed (1 km/hr), the per cent disease intensity decreased by 8.26, 0.51 and 7.95, respectively. While, when there was an increase in one unit of morning relative humidity (1%), evening relative humidity (1%) and bright sunshine (1 h/day), the per cent disease intensity increased by 0.91,1.22 and 8.74, respectively (Table 3).

In order to know the predictive abilities of weather parameters to PDI of early blight, the multiple regression analysis was carried out by taking per cent disease intensity (Y) as dependent variable and weather parameters (X) as the independent variable.

There was one weather parameter predicted the negative significant impact on PDI of *A. solani*. The weather factors influenced the disease incidence to the extent of 93.33 per cent. These findings are in agreement with the earlier finding of Sahu *et al*. (2014). They reported that maximum temperature showed negative significant and morning and evening relative humidity showed positive significant regression effect with early blight disease development in tomato.

The results similar to the present investigations were also achieved by Champawat and Sharma (2009), Soni (2015) and Roopa *et al.* (2016).

From the results presented, it is very clear that the maximum and minimum temperature was highly significant with negative correlation and wind speed was highly significant with positive correlations which were responsible for disease intensity. Multiple linear regression of PDI indicated that an increase in one unit of morning relative humidity (1%), evening relative humidity (1%) and bright sunshine (1 h/day), there was corresponding increase in per cent disease intensity and suggests preventive and/or protective measures are to be taken up with recommended fungicides.

References

Anonymous, 2017. *Horticultural Statistics at a Glance 2017* – National Horticulture Board.

Basu, P. K. 1971. Existence of chlamydospores of *Alternaria porri* f. sp. *solani* as overwintering propagules in soil. *Phytopathology*, 61: 1347.

Champawat, R. S. and Sharma, R. S. 2009. Influence of temperature, relative humidity and rainfall on Alternaria blight of tomato. *Journal of Plant Pathology and Microbiology,* 39: 550.

Datar, V. V. and Mayee, C. D. 1981. Assessment of loss in tomato yield due to early blight. *Indian Phytopathology*, 34: 191-195.

Devi, R. P., Prasadji, J. K., Srinivas, T., Rani, Y. A. and Ramachandra, R. G. 2017. Tomato early blight progress and its severity in relation to weather parameters in coastal Andhra Pradesh. *Journal of Agrometeorology*, 19 (3): 280-282.

Kemmit, G. 2002. Early blight of potato and tomato. *The plant health instructor*. DOI: 10.1094/PHI-I-2002-0809-01.

Kumar, R. and Singh, S. B. 1996. Influence of weather factors on Alternaria leaf spot development in sunflower. *Indian Journal of Mycology and Plant Pathology*, 26: 196-198.

Mayee, C. D. and Datar, V. V. 1986. *Phytopathometry*. (Marathwada Agricultural University, Parabhani) pp. 95.

Moore, W. D. and Thomas, H. R. 1942. Some cultural practices that influence the development of *Alternaria solani* on tomato seedlings. *Phytopathology*, 32: 1176-1184.

Neergaard, P. 1945. Danish species of *Alternaria* and *Stemphylium*. (Oxford University Press, London) pp. 566.

Roopa, R. S., Yadahalli, K. B. and Kavyashree, M. C. 2016. Effect of epidemiological parameters on severity of early blight of tomato. *Indian Phytopathology*, 69 (4S): 266-269.

Saha, P. and Das, S. 2013. Assessment of losses due to early blight (*Alternaria solani*) and influence of weather factors on disease development in tomato. *Journal of Agrometeorology*, 15 (1): 82-85.

Sahu, D. K., Khare, C. P. and Patel, R. 2013. Seasonal occurrence of tomato diseases and survey of early blight in major tomato growing regions of Raipur district. *The Ecoscan*, 4: 153-157.

Sahu, D. K., Khare, C. P., Singh, H. K., Patel, R. and Thakur, M. P. 2014. Epidemiological studies on early blight disease of tomato. *The Bioscan*, 9 (3): 1345-1350.

Soni, R. 2015. Epidemiology and management of early blight of tomato caused by *Alternaria solani* (Elli and Martin) in protected and natural cultivation. (M. Sc thesis, Rajasthan College of Agriculture, Udaipur).

Tewari, R. and Vishunavat, K. 2012. Management of early blight (*Alternaria solani*) in tomato by integration of fungicides and cultural practices. *International Journal of Plant Protection*, 5 (2): 201-206.

Waals, J. E., Korsten, L. and Aveling, T. A. S. 2001. A review of early blight of potato. *African Pl. Prot.*, 7: 91-102.

Wheeler, B.E.J. 1969. An Introduction to Plant Disease. (John Wiley and Sons Limited, London) pp. 301.

How to cite this article:

Parmar, T. D., N. M. Gohel and Kalola, A. D. 2020. Effect of Weather Parameters on Intensity of Early Blight of Tomato. *Int.J.Curr.Microbiol.App.Sci.* 9(04): 12-17.
doi: https://doi.org/10.20546/ijcmas.2020.904.003