

INFLUENCE OF WEATHER PARAMETERS ON DEVELOPMENT OF TWISTER DISEASES OF ONION

SURESH PATIL*, V. B. NARGUND AND SANTHOSH REDDY MACHENAHALLI

*Department of Plant Pathology, University of Agricultural Sciences, Dharwad
Central Coffee Research Institute, Chikmagalur, Karnataka, INDIA
e-mail: sureshpatil007@gmail.com

KEYWORDS

Twister disease
Onion
influence of weather
parameters
date of planting,

Received on:

07.09.2016

Accepted on:

21.10.2016

*Corresponding
author

ABSTRACT

Onion twister disease has become epidemic in coastal tract and major onion growing districts in Karnataka. This disease is causing heavy yield loss. The study was carried out to find out the association between weather factors and disease severity. The weather factors had direct and significant influence on the disease incidence and studies revealed that PDI was progressing at linear rate throughout the plant growth coefficient of correlation revealed that the mean cumulative rainfall contributed maximum ($r = 0.93$) to disease development compared to other parameters followed by maximum temperature ($r = 0.84$). The coefficient of determination (R^2) value for pooled data equation was 0.97. The observed severity of twister disease varied from 3.25 to 66.00 and predicted severity varied from 1.86 to 66.38 with difference of -5.56 to 4.88. The model was validated at University of Agricultural Sciences, Dharwad, Karnataka, India; this study will serve as a scientific basis for establishment of integrated disease management module for the disease.

INTRODUCTION

Onion (*Allium cepa* L.) called as “queen of kitchen” is one of the important vegetable crop grown in India. Onion is suffering by sixty six diseases, of which ten bacterial, thirty eight fungal, six nematodes, three viral, one phytoplasmal, one phanerogamic plant parasite and seven miscellaneous diseases and disorder (Yadav *et al.*, 2013). Onion twister disease has become epidemic and 40-60 per cent severity recorded on onion crop in coastal tract and other major onion growing districts in Karnataka (Nargund *et al.*, 2013). Twister disease is complex in nature caused by pathogens *Colletotrichum gloeosporioides*, *C. acutatum*, *Fusarium oxysporum* and root knot nematode *Meloidogyne* spp. *Colletotrichum capsici*, *C. gloeosporioides*, *C. acutatum*, *Fusarium oxysporum* and *Alternaria* causes complex disease fruit rot, seed and seedling rot in chilli (Santoshreddy Machenahalli *et al.*, 2014; Anonymous, 2005 and Hegde *et al.*, 2012). Infected plants show twisting of leaf and neck with blight, anthracnose as well as die-back. Root system with slight to prominent galls, proliferated, discolored scanty root system containing fungal growth (Suresh Patil *et al.*, 2016).

Increase in frequency and intensity of climate events associated with EL-Nino-Southern Oscillation during 2005-06, twister disease has seriously attacked red onion crop in a number of onion production centers (Wiyono, 2007), from laboratory research, when being exposed to high temperatures, this crop became less resistant to this disease (Tondok, 2003). Weather factors that favour the development and spread of the disease are essential to pinpoint the crucial contributing to

development of disease epidemics Guyota *et al.* (2005). So, research was initiated on these lines and the results of which are reported here under.

MATERIALS AND METHODS

Effect of weather factors on twister disease of onion

The role and interaction effect of various climatic factors on intensity of twister disease of onion was assessed. For which the weather parameters like temperature (maximum and minimum), relative humidity (RH) (morning and evening), precipitation and number of rainy days were collected for cropping period from Main Agricultural Research Station (MARS), Dharwad. The weekly disease severity was continuously recorded. Scoring of the disease was done by using 0-5 scale as described earlier and PDI was calculated.

RESULTS AND DISCUSSION

Favorable environmental conditions are indispensable for any plant disease in addition to the virulence of pathogen, age and susceptibility of host. Date of planting and survival ability of pathogen helps to gather information about disease distribution and spread. It is also important in order to forecast the occurrence of disease and in devising management practices.

Effect of weather parameters on development of twister disease of onion

An attempt was made to study the effect of various weather

Table 1: Development of twister disease of onion in relation to weather parameters during *kharif* 2011 and 2012

Meteorological weeks	Temperature (°C)						Relative humidity (%)					
	Maximum			Minimum			Morning			Evening		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
32	26.66	22.64	24.65	21.2	17.83	19.51	93.29	72.29	82.79	77.14	74	75.57
33	26.86	24.06	25.46	20.69	17.29	18.99	93	87.86	90.43	77	65.14	71.07
34	28.24	28.27	28.26	20.47	20.6	20.54	97	91.71	94.36	72.43	76	74.21
35	24.91	26.34	25.63	20.64	20.31	20.48	95.29	91.57	93.43	88.83	86.71	87.77
36	26.04	26.93	26.49	20.69	20.61	20.65	91.43	88.29	89.86	80.71	89.29	85
37	28.89	27.49	28.19	20.33	20.2	20.26	90	77.43	83.71	66.86	81.29	74.07
38	28.2	28.59	28.39	19.54	18.77	19.16	87.86	81.29	84.57	64.14	73.71	68.93
39	30.03	30.66	30.34	18.59	19.04	18.81	89.71	89	89.36	53.29	71.57	62.43
40	30	27.33	28.66	19.5	20.53	20.01	92	71.14	81.57	63.71	84	73.86
41	29.94	30.46	30.2	20.2	18.43	19.31	93.5	57.57	75.54	58.43	58.86	58.64
42	29.75	31.23	30.49	20.08	16.99	18.53	84.43	66.57	75.5	57.25	36.14	46.7
43	29.83	25.5	27.66	19.01	15.34	17.18	88.86	77.14	83	54	46.86	50.43
44	29.97	27.61	28.79	18.23	17.83	18.03	69.86	85	77.43	54.71	60.14	57.43
45	30.63	30.11	30.37	15.67	20.07	17.87	93.29	72.29	82.79	31.29	59.43	45.36

Table 1: Continue..

Meteorological weeks	Cumulative rainfall (mm)			PDI (%)
	2011	2012	Mean	
32	14.2	40.2	27.2	2.5
33	22.6	54.6	38.6	5
34	47	62.2	54.6	25
35	104.2	78	91.1	30
36	150	104	127	46
37	154.8	108.8	131.8	56
38	161.8	110	135.9	65
39	167.2	161.8	164.5	68
40	206.4	205	205.7	70
41	339.2	242.6	290.9	70
42	383.5	242.6	313.05	70
43	385.5	251	318.25	70
44	388.1	285.5	336.8	70
45	388.1	285.5	336.8	70

Table 2 : Correlation coefficient (r) of twister disease of onion with weather parameters during *kharif* 2011 and 2012

Weather parameters	r values		
	2011	2012	Pooled
Maximum temperature (°C)	0.83**	0.58*	0.84**
Minimum temperature (°C)	-0.44	-0.24	-0.58*
Relative humidity (morning) (%)	-0.43	-0.35	-0.56*
Relative humidity (evening) (%)	-0.60*	-0.61*	-0.73**
Cumulative rainfall (mm)	0.84**	0.98**	0.93**

Table 3: Multiple regression analysis between weather parameters on the incidence of twister disease of onion during *kharif* 2011 and 2012

Parameter	X ₁ (Max. Temp.)			X ₂ (Min. Temp.)			X ₃ (Morn. RH)			X ₄ (Even. RH)			X ₅ (CumulativeRainfall)		
	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
²-value (RC)	13.73	0.63	7.51	-12.37	-1.48	-8.8	-2.63	0.73	-0.61	3.56	-0.33	1.55	0.17	0.18	0.14
SE of ² (r)	2.75	0.81	1.63	6	2.26	3.5	1.68	0.41	0.99	1.09	0.21	0.64	0.03	0.01	0.02
t value of ²	4.99	0.76	4.61	-2.06	-0.65	-2.47	-1.56	1.78	-0.61	3.26	-1.59	2.4	4.56	9.53	6.29
Table t value at 5%	2011			2012			Pooled			Pooled					
Intercept (±)	-143.2			-24.46			-80.12			0.97					
R² value	0.94			0.97			0.97			0.97					
2011	Y ₁ = -143.20 + 13.73 X ₁ ** - 12.37 X ₂ * - 2.63 X ₃ + 3.54 X ₄ ** + 0.17X ₅ **														
2012	Y ₂ = -24.46 + 0.62 X ₁ * - 1.48 X ₂ + 0.73 X ₃ - 0.33 X ₄ + 0.18 X ₅ **														
Pooled	Y _p = -80.12 + 7.52 X ₁ ** - 8.80 X ₂ ** - 0.62 X ₃ + 1.56 X ₄ * + 0.15 X ₅ **														

parameters on development of twister disease of onion by monitoring the independent variables such as maximum and minimum temperature, relative humidity (morning and evening), rainfall and cumulative rainfall and dependent

variable twister disease during *kharif* 2011 and 2012. The weekly averages of various weather parameters and disease severity were recorded for the two cropping seasons. The correlation and multiple regression analysis of independent

Table 4: Observed and predicted PDI of twister disease of onion during *kharif* 2011 and 2012 by regression equation

Meteorological weeks	2011			2012			Pooled		
	Observed	Predicted	Difference	Observed	Predicted	Difference	Observed	Predicted	Difference
32	2.50	-1.50	4.00	4.00	3.99	0.01	3.25	1.86	1.39
33	5.00	11.90	-6.90	6.00	5.97	0.03	5.50	9.58	-4.08
34	25.00	24.92	0.08	12.00	12.83	-0.83	18.50	19.56	-1.06
35	30.00	33.41	-3.41	12.00	14.18	-2.18	21.00	24.49	-3.49
36	46.00	41.78	4.22	14.00	17.83	-3.83	30.00	31.06	-1.06
37	56.00	41.42	14.58	20.00	19.89	0.11	38.00	33.12	4.88
38	65.00	56.60	8.40	24.00	17.48	6.52	44.50	40.82	3.68
39	68.00	67.21	0.79	30.00	31.21	-1.21	49.00	52.12	-3.12
40	70.00	64.20	5.80	38.00	36.25	1.75	54.00	49.98	4.02
41	70.00	75.04	-5.04	42.00	43.33	-1.33	56.00	61.56	-5.56
42	70.00	66.06	3.94	42.00	43.53	-1.53	56.00	59.06	-3.06
43	70.00	58.19	11.81	48.00	46.96	1.04	59.00	56.34	2.66
44	70.00	71.35	-1.35	52.00	54.13	-2.13	61.00	66.38	-5.38
45	70.00	66.91	3.09	62.00	58.33	3.67	66.00	64.28	1.72

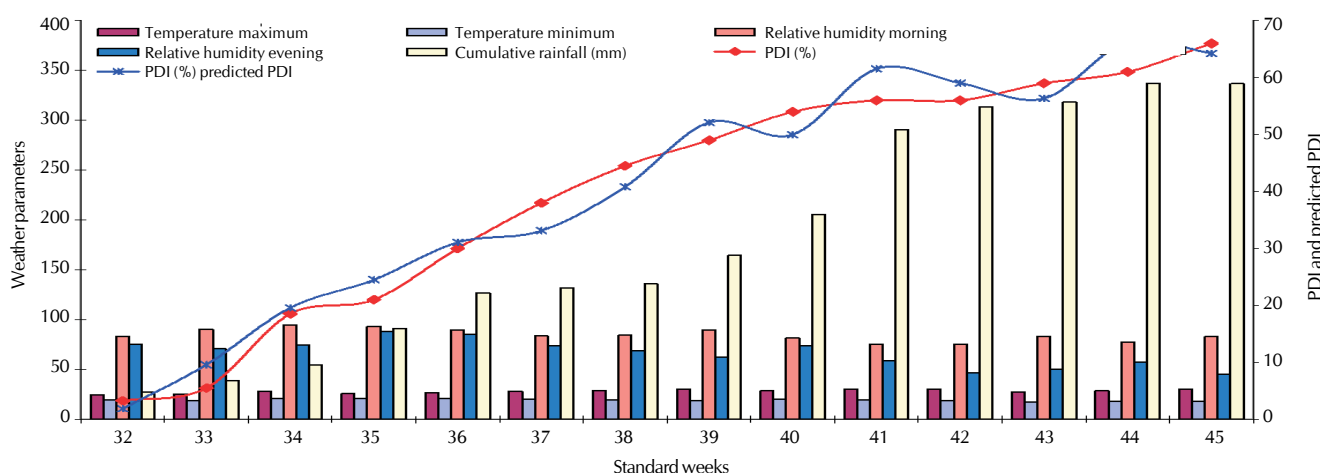


Fig.1. Development of twister disease of onion in relation to weather parameters during *kharif* 2011 and 2012

variables were worked out (Table 1).

In the pooled data of two consecutive years (2011 and 2012), cumulative rainfall recorded highly significant positive correlation ($r = 0.93$) followed by maximum temperature ($r = 0.84$). Whereas, other weather parameters *viz.*, relative humidity of evening and morning were negatively correlated but evening relative humidity was highly significant ($r = 0.73$) Table 2 Fig1.

The coefficient of determinative value (R^2) was found to be 94 and 97 per cent in 2011 and 2012 respectively. There was variation in the disease development which was accounted by the linear functions of the independent variables such as maximum and minimum temperature, morning and evening relative humidity, rainfall and number of rainy days and dependent variable was disease severity (Table 3). The regression equations are as below.

$$Y_1 = -143.20 + 13.73 X_1^{**} - 12.37 X_2^* - 2.63 X_3 + 3.54 X_4^{**} + 0.17 X_5^{**}$$

$$Y_2 = -24.46 + 0.62 X_1^* - 1.48 X_2 + 0.73 X_3 - 0.33 X_4 + 0.18 X_5^{**}$$

$$Y_p = -80.12 + 7.52 X_1^{**} - 8.80 X_2^{**} - 0.62 X_3 + 1.56 X_4^* + 0.15 X_5^{**}$$

The observed PDI of twister disease varied from 2.50 to 70.0

and 4.0 to 62.0 during *kharif* 2011 and 2012 respectively. The predicted PDI varied from -1.50 to 75.04 and 3.90 to 58.33 during 2011 and 2012 respectively. The difference between observed and predicted values varied from -6.92 to 14.58 and -3.83 to 6.52 respectively for the year 2011 and 2012. Pooled analysis of both years had predicted the PDI (1.86 to 66.38), observed (3.25 to 66.00) with difference of -5.56 to 4.88 (Table 4).

The coefficient of determinative value (R^2) was found to be 94 and 97 per cent in 2011 and 2012 respectively. This is one of the best equations in disease development model, which is accounted by the linear function.

These results are similar with that of Ebenebe (1980), who proposed the possible dispersal of conidia of *C. gloeosporioides* by rain, wind and insects (Peregrine, 1970). Rajasab and Chawda (1994) also reported the dispersal of conidia of *C. gloeosporioides* by rainfall, wash-off and splash mechanisms. Frequent rainfall during the crop growth period was apparently associated with the buildup of the disease. (Sanath kumar 1999). The rainfall also creates favourable environmental conditions such as availability of free water and high relative humidity causing effective infection of host surfaces. Further, Weeraratne (1997) reported high relative

humidity (85-96%), moderate temperature (20-31°C) and cloudy rainy weather are the factors that favour the development and spread of twister disease. Kuruppu (1999) reported that onion twister pathogens occurred only from October until January, coinciding with the rainy season in Sri Lanka.

REFERENCES

- Ahmed, S. S. 1982.** Studies on seed borne aspects of anthracnose of chillies caused by *Colletotrichum capsici* (Sydow) Butler and Bisby. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Bangalore, Karnataka (India)
- Anonymous. 2005.** *Investigations on bulb rot and twisting of onion leaves and its management.* Report submitted by S. T. Yenjerappa, Krishi Vigyan Kendra, Hagari, Bellary to Dept. of Horticulture, GOK, Bangalore
- Anonymous. 2013.** All India network research project on onion and garlic 2012-13. *Directorate of Onion and Garlic*, Pune.
- Ebenebe, A. C. 1980.** Onion twister disease caused by *Glomerella cingulata* in northern Nigeria. *Pl. Dis.* **64**: 1030-1032.
- Guyota, Omandab, E. N., Pinardc, F. 2005.** Some epidemiological investigations on *Colletotrichum* leaf disease on rubber tree. *J. Crop Prot.* **24**: 65-77
- Hegde, G. M., Rajkumar, G. R. and Jaware Gouda. 2012.** Integrated disease management of twister disease of onion. *Ext. Bull. Uni. Agric. Sci. Dharwad (India)*.
- Kuruppu, P. U. 1999.** First Report of *Fusarium oxysporum* causing a leaf twisting disease on *Allium cepa* var. *ascalonicum* in Sri Lanka, Disease Notes Louisiana State University, Baton Rouge, **83(7)**: 695.
- Nargund, V. B., Gurudath, H., Nayak, G. V., Benagi, V. I., Suresh, P., Dharmatti, P. R. and Ravichandran, S. 2013.** Management of twister disease in sweet onion -a strategy for livelihood improvement and welfare of mankind. *Proc. Int. Symp. Human health effects of fruits and vegetables*, Univ. Agril. Sci., Dharwad, p.205.
- Panday, S. S., Alberto, R. T., and Labe, M. S., 2012.** Ultrastructural characterization of infection and colonization of *Colletotrichum gloeosporioides* in onion. *Pl. Path. and Quarantine.* **2(2)**: 168-177.
- Peregrine, W. T. H. 1970.** A serious disease of Annats caused by *Glomerella cingulata* - *Pans* **16**: 331-333.
- Rajasab, A. H. and Chawda, H. T. 1994.** Dispersal of the conidia of *Colletotrichum gloeosporioides* by rain and the development of anthracnose on onion. *Grana.* **33**: 162-165.
- Sanathkumar, V. B. 1999,** Studies on anthracnose of chilli caused by *Colletotrichum capsici* (Sydow) Butler and Bisby with special reference to epidemiology and management. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Bangalore (India).
- Santosh Reddy Machenahalli, Nargund, V. B. and Hegde, R. V. 2014.** Management of fruit rot causing seed borne fungal pathogens in chilli. *The Bioscan.* **9(1)**: 403-406.
- Suresh Patil, V. B., Nargund and Santosh reddy, Machenahalli. 2016.** Cultural and morphological characterization of causal agents of twister disease of onion *Advances in life sciences.* **5(10)**: 3983-3987.
- Tondok, E. 2003.** The causal agent of twister disease of Shallot. *M. Sc. (Agari.) Thesis*, University of Goettingen, Germany
- Weeraratne, G. W. A. P. 1997.** Leaf twister disease of onion (*Allium cepa* L.) Field Crops Research and Development Institute, Maha Illuppallama. *Thai Phytopathol.* **18**: 63-69.
- Wiyono, S. 2007.** Climate change and pests and diseases explosion. *Pro. Biodiversity in the middle of global warming.* Kheti Foundation, Jakarta, Indonesia.
- Yadav, P. M., Rakholiya, K. B., And Pawar , D. M. 2013.** Evaluation of bioagents for management of the onion purple blotch and bulb yield loss assessment under field conditions. *The Bioscan.* **8(4)**: 1295-1298.