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INFLUENCE OF WEATHER PARAMETERS ON DEVELOPMENT OF TWISTER DISEASES OF ONION

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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 serves 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* (Anonymous,2005 *et al*, Hegde, 2012).

Fusarium oxysporum and Alternaria causes complex disease fruit rot, seed and seedling rot in chilli (Santoshreddy Machenahalli *et al.,* 2014). Infected plants show twisting of leaf and neck with blight(Anonymous ,2013 and Panday *et al* .,2012).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

Meteoro logical weeks	Temperature ($_o$C) Maximum			Minimum			Relative humidity (%) 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: Cont.....

Meteoro logical weeks	Cumulative rainfall (mm)			PDI (%)		
	2011	2012	Mean	2011	2012	Mean
32	14.2	40.2	27.2	2.5	4	3.25
33	22.6	54.6	38.6	5	6	5.5
34	47	62.2	54.6	25	12	18.5
35	104.2	78	91.1	30	12	21
36	150	104	127	46	14	30
37	154.8	108.8	131.8	56	20	38
38	161.8	110	135.9	65	24	44.5
39	167.2	161.8	164.5	68	30	49
40	206.4	205	205.7	70	38	54
41	339.2	242.6	290.9	70	42	56
42	383.5	242.6	313.05	70	42	56
43	385.5	251	318.25	70	48	59
44	388.1	285.5	336.8	70	52	61
45	388.1	285.5	336.8	70	62	66

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 (ºC)	0.83**	0.58*	0.84**
Minimum temperature (ºC)	-0.44	-0.24	-0.58*
Relative humidity (Morning) (%)	-0.43	-0.35	-0.56*
Relative humidity (evening) (mm)	-0.60*	-0.61*	-0.73**
Cumulative Rainfall (mm)	0.84**	0.98**	0.93**

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* 2011and 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 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.

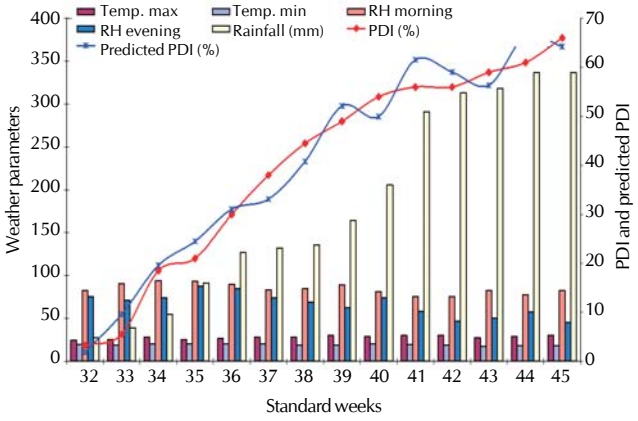

Figure1: Development of twister disease of onion in relation to weather parameters during *kharif* 2011 and 2012

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 (Cumulative Rainfall)		
	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	
Intercept (±)	-143.2						-24.46							-80.12	
R^2value	0.94						0.97							0.97	
2011	$Y_1 = -143.20 + 13.73 X_1^{**} - 12.37 X_2^{*} - 2.63 X_3 + 3.54 X_4^{**} + 0.17 X_5^{**}$														
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	$Y_P = -80.12 + 7.52 X_1^{**} - 8.80 X_2^{**} - 0.62 X_3 + 1.56 X_4^{*} + 0.15 X_5^{**}$														

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

Standard weeks	2011 Observed	2012 Predicted	Pooled 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

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 (Table 4) 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. The rainfall also creates favourable environmental conditions (Sanath kumar 1999).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 (20-31ºC) 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.

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