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EFFECT OF ENVIRONMENTAL FACTORS ON *Phytophthora* BLIGHT DEVELOPMENT OF COLOCASIA

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ABSTRACT: Progress of *Phytophthora* blight of taro (*Colocasia esculenta* var. *antiquorum*) caused by *Phytophthora colocasiae* Racib. was found greatly influenced by environmental factors prevalent under field condition. Per cent plant infection, disease intensity, coefficient of disease index and related progress of disease were periodically recorded on a susceptible variety Narendra Arvi-2. The maximum and minimum infection rate ('r') was observed in 33rd and 32nd standard week during 2006 and 2007. Disease intensity and per cent plant infection were significantly but positively correlated with rainfall and relative humidity in both the year. Disease intensity and per cent plant infection were negatively but none significantly correlated with maximum temperature in 2007 but positively correlated in the year 2006. However, rest of the weather factors were positively correlated to disease intensity and per cent plant infection in both the years. Relative humidity, cumulative rainfall and sunshine hour were found most congenial environmental factors for leaf blight development of taro.

Keywords: *Taro, Phytophthora blight, environment, regression, correlation.*

Leaf blight of taro is caused by a destructive fungus *Phytophthora colocasiae* Racib. which is host specific and widely distributed disease on a large number of crops. Taro (*Colocasia esculenta* var. *antiquorum*) is known as "*Arvi*" / "*Ghuiya*" in Hindi. The disease causes damage to all parts and high cormel yield losses upto 70% (Jackson and Gollifer, 2). *P. colocasiae* appears under warm and humid conditions, on foliage severe blight in congenial environmental conditions resulting significantly loss in yield. In India, crop growth and appearance of disease coincide with the onset of monsoon making the conditions most favourable for explosive development of disease (Vanderplank, 8). The disease assumes severe from in areas having high relative humidity with frequent rainfall. The relationship between disease progression and weather factors is of paramount importance for effective disease development. The present study was conducted to determine leaf blight intensity was subjected to correlation and regression analysis with weather factors for the specific periods of the same year, to determine their relationship.

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MATERIALS AND METHOS

The present investigations were conducted in the Main Experiment Station, Vegetable Science, N.D.U.A.T., Kumarganj, Faizabad. Cormels of susceptible variety Narendra Arvi-2 were sown in plot size 3.6 m x 3.0 m (spacing 60 x 30 cm) in three replications on 15 March, 2006 and 2007 using recommended dose of fertilizers for the study of role of weather factors on disease development. Development of disease in terms of per cent plant infection, disease intensity was recorded at 7 days interval periodically, after the first appearance of the disease in both the year. Disease intensity was recorded on the basis of 10 plants randomly selected from each plot at random from each replication of using 0-5 scale (Prasad, 5). Simultaneously, meteorological data on temperature (°C) (minimum and maximum), relative humidity (%), cumulative rainfall (mm) and sunshine (hour) were also recorded for the intervening period between two consecutive disease intensity. Data recording and bivariate correlation analysis was conducted to determine the

effect of individual as well as combined weather factors on disease development. Weather parameters were recorded from Meteorological Observatory located at University campus. Leaf blight intensity was subjected to correlation and multiple regression analysis with weather factors for the specific periods of the same year, to determine their relationship. The prediction equation used was $Y = a+b_1x_1 + b_2x_2 + ... b_nx_n$.

where,

Y = Per cent disease intensity

b_1 to b_n = Partial regression coefficient (slop)

a = Intercept

The disease progress was also measured by calculating apparent infection rate

('r') as per method given by Vanderplank (8) using logistic equation.

$$r \quad \frac{2.303}{t_2 \quad t_1} \log_e \frac{X_2 (1 \quad X_1)}{X_1 (1 \quad X_2)}$$

where,

r = apparent infection rate per unit per day

$t_2 \quad t_1$= time interval between two observations.

X_1 and X_2 = proportion of disease plant parts at t_1 and t_2 time intervals

1 X_1 and 1 X_2 = proportion of healthy plant parts at t_1 and t_2 time intervals

$\log_e$ = natural log

The relative progress of disease (RPD) as calculated under following formula

Relative progress of disease = Disease intensity in present week- Disease intensity of previous week

Coefficient of disease index calculated under following formula

$$\text{CODEX} = \frac{\text{PPI} \quad \text{PDI}}{100}$$

where,

CODEX = Coefficient of disease index

PPI = Per cent plant infection

PDI = Per cent disease intensity

Disease intensity and per cent plant infection were processed, correlated and interpreted with different epidemiological factors to find out the positive correlation for prediction of disease development.

RESULTS AND DISCUSSION

The results depicted in Table 1 and on weather parameters (Fig. 1 and 2) revealed that for the first time the disease appeared on 16th July, *i.e.,* 28th standard week of 2006 and the per cent plant infection, disease intensity and coefficient of disease index increased gradually till maturity and reached its maximum 98.07, 66.06 and 64.78 per cent at 34th standard week (August 27-September 2), however, the relative progress of disease and infection rate ('r') were maximum in 34th standard week (August 27-September 2) and 33rd standard week (August 20-26) which was 13.85 per cent and 0.617 unit per day, respectively with minimum temperature (26.20 °C), maximum temperature (33.00 °C) sunshine hours (4.40) and minimum temperature (26.50 °C), maximum temperature (34.00 °C) with relative humidity 78.10 (%), rainfall (34.50 mm) and sunshine hours (8.50) for infection rate per unit per day and followed by infection rate ('r') was observed in 30th standard week (July 30-August 5) with 0.519 per unit per day at minimum temperature (26.20 °C), maximum temperature (32.30 °C), average relative humidity (80.10%), cumulative rainfall (36.40 mm) and sunshine hours (7.80) respectively. The minimum infection rate ('r') was observed in 32nd standard week (August 13-19) with (0.162) per unit per day at minimum temperature (26.00 °C), maximum temperature (32.40 °C) relative humidity (77.80 %), cumulative rainfall (6.20 mm) and sunshine hours (7.50), respectively. There are three weather factors i.e., average relative humidity, cumulative

rainfall and sunshine hours very congenial for leaf blight development.

During 2007, the first appearance of leaf blight was noticed on 20th July *i.e.* 28th standard week (July 16-22) and the per cent plant infection, disease intensity and coefficient of disease index increased gradually till maturity of crop and reached upto 96.15, 73.27 and 70.45 per cent at 34th standard week (August 27-September 2). However, the relative progress of disease and infection rate ('r') were maximum in 34th standard week (August 27-September 2) and 30th standard week (July 30-August 5) was 15.00 per cent and 0.601 unit per day, respectively at minimum temperature (26.40 °C), maximum temperature (31.90 °C), relative humidity (79.90%), cumulative rainfall (15.60 mm) and sunshine hours (3.80) and minimum temperature (24.50 °C), maximum temperature (30.20 °C), average relative humidity (84.90%), cumulative rainfall (22.20 mm) and sunshine hours (4.47), respectively which followed by infection rate ('r') was observed in 34th standard week (August 27-September 2) with (0.528) per unit per day at minimum temperature (26.40 °C), minimum temperature (31.90 °C), average relative humidity (79.90%), cumulative rainfall (15.60mm), sunshine hours (3.80), respectively. The minimum infection rate ('r') was observed in 31st standard week (August 6-12) with 0.133 per unit per day at minimum temperature (26.00 °C), maximum temperature (32.40 °C), average relative humidity (81.70%), cumulative rainfall (49.20 mm) and sunshine hours (2.50), respectively. These are the similar weather factors during the year 2006 very congenial for leaf blight development.

These results also corroborate the findings of earlier workers (Pathak and Mishra, 3; Shakywar *et al.,* 7 and Yadav *et al.,* 9). Garde and Joshi (1) have reported various weather factors that influenced leaf blight incidence of colocasia.

Simple correlation

Simple correlation between per cent plant infection, disease intensity were also found significantly and positively correlated with total rainfall for the 2006 (r=0.834, 0.776) and 2007 (r=0.632, 0.653) year respectively (Table 2). Similar trend was seen for the sunshine hours in the first (r=0.798, 0.772) and second (r=0.698, 0.665) year also. Disease intensity were significantly and positively correlated with average relative humidity for the first (r=0.635) year. Per cent plant infection and disease intensity were negatively but non-significantly correlated with maximum temperature in the second year. However, rests of the weather factors were positively but non-significantly correlated to per cent plan infection and disease intensity in the 2006 and 2007 year. Thus, it is clearly indicates that total rainfall and sunshine hours favoured disease development during both years.

Multiple correlation and regression equation

The multiple correlation coefficient between leaf blight intensity and group of independent variables during crop season 2006 and 2007 were found 0.930 and 0.957, which indicates that 93.00 and 95.70 per cent leaf blight intensity was caused by average relative humidity, rainfall and sunshine hours. In the year 2006, regression equation $y = (-0.3090.03) + 101.54\ x_1\ (-11.17)\ X_2 + 10.36\ X_3 + (-0.351)\ x_4 + 94.8\ X_5$ showed minimum temperature influenced disease intensity followed by average relative humidity, sunshine hours, maximum temperature and total rainfall, respectively (Table 3).

Significant and positive correlation between per cent plant infection and disease intensity with rainfall and relative humidity was also recorded by Pouono *et al.* (4) and Radford (1967). Yadav *et al.* (9) have also found significant and positive correlation between leaf blight intensity with minimum temperature, maximum temperature, relative humidity, rainfall, sunshine hours and number of rainy days. Thus, the findings in the present investigation are well supported by the results of previous workers.

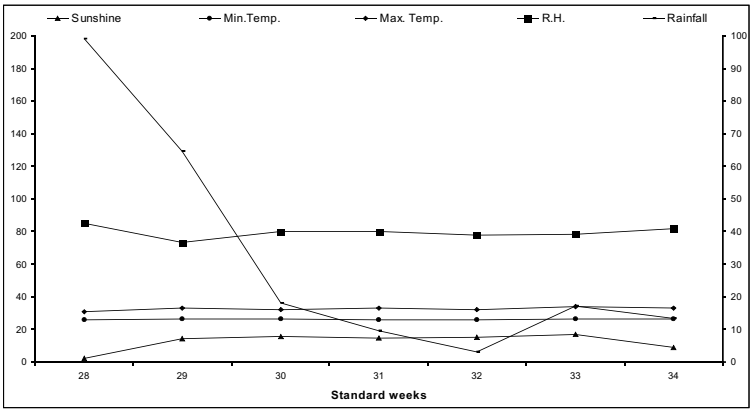

Fig. 1

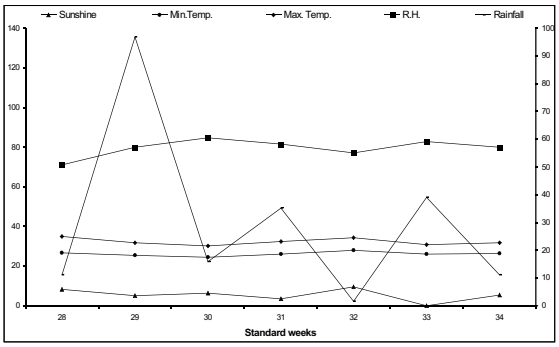

Fig. 2

Table 1: Effect of meteorological factors on leaf blight of taro variety Narendra Arvi-2.

Standard week	PPI		PDI		RPD		CODEX		Infection rate per unit per days	
	2006	**2007**	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**
28	5.76 (13.88)	3.80 (11.24)	3.87 (11.34)	4.13 (11.72)	0.00	0.00	0.22	0.16	0.00	0.00
29	15.38 (23.08)	13.46 (21.51)	9.25 (17.70)	12.52 (20.71)	5.38	8.39	1.42	1.69	0.349	0.439
30	46.15 (42.77)	48.07 (43.88)	21.12 (27.35)	26.21 (30.78)	11.87	13.69	9.74	12.60	0.519	0.601
31	59.61 (50.52)	57.69 (49.40)	34.71 (36.08)	36.76 (37.31)	13.59	10.55	20.69	21.21	0.187	0.133
32	71.15 (57.49)	73.07 (58.72)	43.24 (41.10)	43.51 (41.25)	8.53	6.75	30.76	31.80	0.162	0.221
33	94.23 (76.07)	80.76 (63.96)	52.21 (46.25)	58.27 (49.74)	8.97	14.76	49.19	47.06	0.617	0.150
34	98.07 (81.98)	96.15 (78.65)	66.06 (54.35)	73.27 (58.84)	13.85	15.00	64.78	70.45	0.376	0.528
C.D. (P=0.05)	11.75	11.21	7.76	8.39						

Figures in parentheses are arcsine transformed value

PPI = Per cent plant infection PDI = Per cent disease intensity

RPD = Related progress disease CODEX = Coefficient of disease index

Table 2: Simple correlation between per cent plant infection, per cent disease intensity and meteorological factors during 2006 and 2007.

		2006		2007	
		PPI	PDI	PPI	PDI
Temperature °C	Minimum	0.248	0.198	0.237	0.226
	Maximum	0.535	0.584	-0.319	-0.322
Average relative humidity (%)		0.003	0.635*	0.465	0.565
Total rainfall (mm)		0.834**	0.776**	0.632*	0.653*
Sunshine (hours)		0.798**	0.772**	0.698*	0.665*

* Significant at 5% ** Significant at 1%

Table 3: Regression of leaf blight intensity and meteorological factors on taro variety.

Year	Regression equation	R^2
2006	$Y = (-3090.03) + 101.54\ X_1 + (-11.17)\ X_2 + 10.36\ X_3 + (-0.351)\ X_4 + 9.48\ X_5$	0.930
2007	$Y = (-201.37) + 43.25\ X_1 + (-29.07)\ X_2 + 0.922\ X_3 + (=0.23)\ X_4 + 1.00\ X_5$	0.957

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