

Short communication

Assessment of losses due to early blight (*alternaria solani* ell. And mart.) and influence of weather factors on disease development in tomato

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Tomato is one of the most popular vegetables grown all over the world. In India tomato has wider coverage in comparison to other vegetable. Tomato universally treated as “Protective food” and is a very good source of income to small and marginal farmers. Every year cultivation of tomato cause declining in yield due to different biotic and abiotic stress. Among the biotic stress diseases play pivotal role. Early blight caused by *Alternaria solani* is the most destructive one (Doo little, 1948). Tomescu and Negru (2003) also reported that the main fungi causing the economical losses in all region is *Alternaria solani* and it is prevalent throughout the tomato growing areas in the world (Calvo *et al.*, 1990) as well as causes major yield loss (Waals *et al.*, 2001). Yield losses may range between 50-86 percent (Mathur and Shekhawat, 1986).

The disease starts appearing about 40-50 days after planting and continue till complete defoliation depending upon the susceptibility of the variety and the prevailing weather mostly temperature, relative humidity, rainfall and bright sunshine hour. Therefore, an attempt was made to assess the loss by calculating the losses in yield and fruit loss under protected (spraying of fungicide) and unprotected (control) condition the effect of different weather factors on disease development in tomato during rabi season of 2008 and 2009 has also been analysed.

The experiments were carried out at the University Instructional Farm Jaguli, under Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal in the year 2008 and 2009. Four susceptible tomato varieties Patharkuchi (Local), EG 294, BSS 494 ARTH-128 was selected and planted during winter season. Plot size was 5m × 5m which were divided into two parts as protected and unprotected. Natural epiphytotic of the disease was considered and in protected plot (Mancozeb 75percentage WP) @ 0.25% was sprayed starting from 30 days after transplanting and subsequently three more sprays at 10 days intervals were applied to keep the plot free from early

blight disease. Water was used @ 600 liters ha⁻¹. All the recommended agromonic practices were followed to raise a good crop. The trial was conducted in and factorial randomized block design with five replications. The disease severity was recorded as per the scale suggested by Mayee and Datar (1986) at 10 days interval.

$$PDI = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaf observed} \times \text{maximum rating}} \times 100$$

Relative progress of disease (RPD) was calculated as follows:

$$RPD = \frac{\text{Disease intensity of present recorded data} - \text{disease intensity of previous recorded data}}{\text{Disease intensity of present recorded data}}$$

The following formula was used to calculate the losses in yield:

$$\text{Losses in yield (\%)} = \frac{Y_p - Y_u}{Y_p} \times 100$$

Where Y_p = yield under protected condition,

$$Y_u = \text{Yield under unprotected condition}$$

Yield data was recorded from each plot. The yield was recorded by adding the quantity after each number of harvests.

The meteorological data on temperature, rainfall, relative humidity, number of rainy days and sunshine were collected from the All India co-ordinated Research Project on Agro-Meteorology, Kalyani and Dept. of Agro-Meteorology Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal. Ten days mean of those weather parameter (variables) were calculated except for the ten days cumulative rainfall and the number of rainy days for the entire period of disease assessment were worked out and correlated with disease severity.

The results showed that the disease appeared 45-50 days after transplanting of the crop. Unprotected plot of tomato varieties showed higher disease severity of early

Table 1 : Effect of disease severity on losses in yield and number of fruit loss in four different tomato varieties due to early blight (pooled data of 2008 and 2009)

Varieties	Disease severity		Yield t ha ⁻¹		Yield loss %	No. of fruit/ plant		Average no. of fruit loss %
	Unprotected	Protected	Unprotected	Protected		Unprotected	Protected	
V ₁ (Pathar kuchi)	46.72	13.93	48.41	70.80	31.62	75.08	136.05	44.81
V ₂ (EG 294)	34.63	9.77	50.36	72.93	30.95	71.84	125.43	42.73
V ₃ (BSS494)	38.63	10.39	46.29	68.98	32.89	74.85	127.30	41.20
V ₄ (ARTH 128)	36.58	9.89	41.41	67.67	38.81	69.86	121.42	42.46
	SEm ±	CD(0.05)	SEm ±	CD(0.05)		SEm ±	CD(0.05)	
Type(unprotected/ protected)		0.31	0.93	0.46	1.40	0.30	0.92	
Variety	0.43	1.31	0.68	1.98		0.43	1.30	
Type x Variety	0.61	1.86	0.92	2.79		0.61	1.84	

Table 2 : Effect of weather factors on disease development of early blight in tomato (mean data of rabi season, 2008-2009)

Temperature (°C)		RH%		Suns	Varieties							
Min	Max.	Min	Max.	hours	Patharkuchi		EG-294		BSS-494		ARTH 128	
					PDI#	RPD	PDI	RPD	PDI	RPD	PDI	RPD
17.1	27.9	53	96	9.2	2.04	2.04	-	-	-	-	-	-
15.3	28.7	47	97	7.1	2.78	0.74	1.98	1.98	1.09	1.09	-	-
13.1	26.9	51	97	8.3	5.51	2.73	3.35	1.37	3.45	2.36	1.48	
11.2	25.5	45	98	7.5	13.82	8.31	9.41	6.06	10.41	6.96	5.62	
10.5	25.0	48	95	7.4	39.78	25.96	13.87	4.46	16.30	5.89	14.57	8.95
11.5	27.9	42	94	8.7	50.76	10.98	26.66	12.79	36.30	20.00	25.07	10.50
13.0	27.2	41	95	8.2	60.28	9.52	33.49	6.83	41.09	4.79	30.37	5.30

*1st appearances of the disease symptom # PDI under unprotected condition considered only

Table 3: Estimation of simple correlation co-efficient value (r) computed using severity of early blight in tomato and weather factors in four tomato cultivars (Pooled data of 2008 and 2009)

Varieties	Temperature	R.H	Rainfall	No. of rainy days	Sunshine
Patharkuchi	0.464	0.913**	0.410	0.412	-0.569
EG-294	0.167	0.955**	-	-	-0.586
BSS-494	0.157	0.959**	-	-	-0.632
ARTH-128	0.328	0.964**	-	-	-0.403

**Significant at 1% level

blight. Maximum disease severity was recorded in unprotected plots of Patharkuchi (46.72) followed by BSS 494 (38.63), ARTH 128 (36.58) and EG 294 (34.63) (Table 1).

The disease severity in EG 294 (34.63) differed significantly from ARTH-128 (36.58) and BSS 494 (38.63). The severity recorded in BSS 494 and ARTH 128 also differed significantly from each other (Table 1).

In protected plot the disease severity of the four varieties ranged from 9.77 to 13.93 and were on par to each other except the most susceptible variety Patharkuchi (13.93) (Table 1).

The highest fruit yield was obtained in EG 294 (72.93 t ha⁻¹) followed by Patharkuchi (70.80 t ha⁻¹) and their difference was statistically significant. The minimum fruit yield was recorded in ARTH-128 (67.67 t ha⁻¹) that was at par with BSS 494 (68.98 t ha⁻¹). This situation was noticed in protected condition. Whereas, in unprotected condition maximum fruit was also recorded in EG 294 (50.36 t ha⁻¹) followed by Patharkuchi (48.41 t ha⁻¹) and their difference was statistically significant. Similarly, ARTH-128 (41.41 t ha⁻¹) and BSS 494 (46.29 t ha⁻¹) showed significant difference in between them in fruit yield production of tomato under unprotected condition. Data indicated that highest yield loss was recorded in ARTH 128 (38.81 percent) followed by BSS 494 (32.89 percent) and minimum in EG 294 (30.95 percent) followed by Patharkuchi (31.62 percent). All the tested varieties showed lowest fruit yield in the unprotected plots in comparison to protected plots (Table 1).

Number of fruits/plant was also highest in protected plots in comparison to unprotected plots and their differences were statistically significant. In unprotected plots maximum number of fruits/plant was harvested in Patharkuchi (75.08) followed by BSS 494 (74.85) which were found at par. Lowest number of fruits per plant was harvested in ARTH 128 (69.86) followed by EG 294 (71.84), though the number of fruits/plant were found to differ significantly in ARTH 128, BSS 494 and EG 294. In protected plots maximum number of fruits per plant was noticed in Patharkuchi (136.05) followed by BSS 494 (127.30) and their difference was statistically significant. EG 294 (125.43) and ARTH 128 (121.42) showed significant difference in between them in the production of number of fruits/plant. Average number of fruit loss / plant was noticed maximum in Patharkuchi (44.81 percent)

followed by EG 294 (42.73 percent), ARTH-128 (42.46 percent) and BSS 494 (41.20 percent) showed similar type reduction in fruit number/plant (Table 1).

Thus it clearly indicated that early blight might cause upto 38.81 percent loss in yield and 44.81 percent loss in average fruit yield depending upon the susceptibility of the variety, age of the plant and the prevailing weather condition at that particular time period. The results obtained from the yield loss experiment are in accordance with the report of Mathur and Shekhawat (1986).

Dubey (2002), reported that the temperature, relative humidity, rainfall, number of rainy days and bright sunshine hour play an important role in the development of early blight.

In the present study a simple correlation between the relative progress of early blight and weather factors in four tomato varieties were undertaken to find out the effect of weather factor on disease development in tomato. Table 2 represents the data on weather factors recorded on the average ten days temperature and RH (both maximum and minimum were considered) after the first symptoms of the disease appear in the field. Total rainfall, number of rainy days and bright sunshine hours were also taken into account. In case of the varieties the percent disease index only in the unprotected condition and the relative progress of the disease over ten days were computed.

The correlation coefficients (r) were calculated using disease severity of each four cultivars and five weather parameters i.e average ten days temperature, RH, total rainfall, number of rainy days and bright sunshine hours (Table 3). The results show that the temperature did not have significant correlation with disease severity. On the other hand, it was observed that the disease severity and its relative progress of all the four cultivars depended upon RH positively and significantly. The high correlation coefficient value (r) supports the fact strongly. Here, the variation in disease severity can be explained from 82.81 percent to 92.16 percent as confirmed by the r value (0.913 to 0.964) with the effect of RH (Table 3).

The experiment was carried out during rabi season and only one rainy day recorded with 8 mm rainfall throughout the experimental period. Though, the statistical interpretation revealed positive linear correlation among the variables. Negative correlation was recorded with bright sunshine hours and disease severity in case of all four varieties of tomato infected with early blight caused

by *Alternaria solani* (Table 3). Chakroborty and Chatterjee (2002) studied the epidemiological relation (temperature, RH and soil pH) to the incidence of *Alternaria solani* under West Bengal condition. Gupta *et al.* (2010) reported similar result in case of web blight of mung bean.

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Received : December 2012 ; Accepted : April 2013