
Seasonal incidence and apparent rate of infection of *Alternaria* leaf spot in different varieties of chilli under field conditions

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Natural incidence and severity of *Alternaria* leaf spot (*A. solani*) on different varieties of chilli were recorded both in *rabi* and *kharif* seasons. Sixteen chilli varieties that included hybrids, high yielding improved local types and few germplasms were tested and generally in most cases observations were recorded at 10 days interval starting from 30 to 60 DAT (days after transplanting). It was observed that during *rabi* season of 2003 and 2004, at 60 DAT, IR-8 recorded maximum (73.33%) incidence with a severity of 25.55% while, Bullet recorded minimum incidence (33.33%) and severity (3.70%). In *kharif* seasons of both the years, the same varieties also showed the maximum and minimum percentage of incidence and severity of disease. When the apparent rate of infection was recorded for both the years, it was observed that at 50-60 DAT, it decreased in most varieties with the maturity of the plants.

Key words : Natural incidence, apparent rate of infection, *Alternaria* leaf spot, chilli

INTRODUCTION

Chilli (*Capsicum annum* L.) also known as red pepper is the highest consumed spice in the world, belongs to the family Solanaceae and genus *Capsicum*. *Capsicum annum* L. is the most widely cultivated species in the world. India, ranked first in the world with a production of 10.18 lakh tonnes of dry chilli cultivated in an area of 9.15 lakh hectares spread over 23 States and expected to reach 15 lakh tonnes within few years (Peter and Nybe. 2002). India also exports chilli up to 12.39% of its total production over 90 countries (Peter and Nybe. 2002). In spite of availability of good varieties, technologies developed for high production, the main constraint for low productivity or quality fruits in India is due to attack of various diseases and pests which are very commonly found in cultivars, irrespective of seasons or geographical locations. In West Bengal various diseases which generally affect the production of chilli as well as its quality are commonly found from seedling to maturity stages and among these *Alternaria* leaf spot is predominant and causes great damage to the crop. Leaf spot of chilli caused by *Alternaria solani* (Ell. Mart.) Jones and Grout is an important disease in the plains of

West Bengal. In spite of the regular occurrence of leaf spot no evaluation on the extent of incidence or management studies has been reported from West Bengal. Chilli leaf spot caused by *A. solani* has been recorded from different States of India like Delhi (Dull, 1938), Tamil Nadu and Kerala (Jayasekhar *et al.*, 1988; Mathew *et al.*, 1995), Maharashtra (Khodke *et al.*, 2000) and Bangladesh (Basak. 1994: Basak and Chowdhury. 1997).

Khodke *et al.* (2000) have described the symptom of leaf spot of chilli as small, circular to brown or black spots of various sizes on the leaves of the plant surrounded with concentric zonation. Lower leaves are attacked first and then the disease progresses upwards.

MATERIALS AND METHODS

Observations on the incidence of diseases and pests during different cropping seasons were taken in the experimental farms of the University and farmers fields. Experiments were conducted at the District Seed Farm (C-unit) of Bidhan Chandra Krishi

Viswavidyalaya, located at Kalyani, Nadia, West Bengal in summer, rainy and winter seasons during the year 2003 and 2004. The characteristic symptoms of *Alternaria* leaf spot disease were considered for their visual diagnosis.

The varieties/germplasms were of local type and named by the farmers based on location, fruit type or due to some other attributes. Such varieties/germplasms were used for this studies merely because of wide acceptance by the growers in this locality.

The experiment was laid out in a randomized block design (RBD). Observations on the incidence of fungal diseases (leaf spot, die back, wet rot), viral diseases (chilli leaf curl, chilli mosaic) and pests (mites, thrips, aphids, whiteflies) were taken in different seasons both on the farmers field as well as in the University plots. Generally in most of the cases natural incidence of diseases and their severity were recorded at 30, 40, 50 and 60 days after transplanting (DAT).

The percentage of disease incidence, severity index or percentage of disease index (PDI) were calculated according to McKinney, (1923) :
Percentage of Disease Incidence = Number of plants infected/Total number of plants observed \times 100

Percentage of Disease Incidence = Sum of all numerical rating / (Maximum disease grade \times Total number of plants observed) \times 100

Severity of the *Alternaria* leaf spot was determined by using 0 - 9 scale. (Mayee and Datar, 1986), which are as follows : 0, No symptoms on leaf; 1, Small irregular, brown spots covering 1% or less of leaf area ; 3, Small irregular, brown spots with concentric rings covering 1-10% of leaf area ; 5, Lesions enlarging irregular brown with concentric rings, covering 11-25% of leaf area ; 7, Lesions coalesce to form irregular brown patches with concentric rings covering 26-50% of the leaf area, and 9, Lesions coalesce to form irregular dark brown patches with concentric rings covering 51% or more of leaf area.

The apparent or logistic infection rate (r) as given by Vanderplank (1963) were calculated by the following formula : Apparent or logistic infection rate (r) = 1/

$t_2 - t_1 \times (\logit x_2 - \logit x_1)$ where, t_1 = first observation date ; t_2 = Last observation date ; x_1 = Percentage of disease incidence on first observation, and x_2 = Percentage of disease incidence on last observation.

RESULTS

From the pooled results of *rabi* season (Table 1) it was observed that at 30 DAT, the incidence of the disease ranged from 21.11% and 61.11% in Akashi and Tapan respectively. At 40 and 50 DAT, the incidence of disease was maximum in Tapan (65.55% and 67.77% respectively), while it was minimum in Bullet (25.55% and 31.11% respectively). At 60 DAT, maximum disease incidence was recorded in IR-8 (73.33%) followed by Tapan and Bhangar (71.11%). NS-I 101 (63.33%), ARCH-228 and Beldanga (62.22%), Mocha Nilganj (58.89%), Suryamukhi and Pant C-I (48.88%), Pusa Sadabahar (47.77%), Akashi (45.00%), Ashari (44.44%), Pusa Jwala and CH-3 (43.33%) and Bullet (33.33%). At 60 DAT, the severity of disease was maximum in IR-8 (25.55%) and it was minimum in Bullet (3.70%). However, the range of disease severity in other varieties were 5.18 % (Akashi), 7.52% (Pusa Sadabahar), 8.02% CH-3), 1.3.70% (Beldanga), 8.84% (Pant C-I), 9.25% (Pusa Jwala), 5.92% (Ashari), 21.72% (Tapan), 17.89% (Bunon Seoraphulli), 11.23% (NS-1 101), 17.28% (Bhangar), 12.59 (ARCH-228), 15.68% (Mocha Nilganj) and 10.37% (Suryamukhi), respectively.

It is evident from the pooled results of *kharif* season (Table 2) that at 30 DAT, the incidence of the disease was highest in IR-8 (69.99%) followed by Bhangar (55.56%) and Tapan (54.44%), while it was lowest in Bullet (25.55%) and Akashi (25.55%). However, at 40 and 50 days after transplanting the incidence of the disease was highest in IR-8 (71.11% and 73.33%) and found lowest in Bullet and Akashi. At 60 DAT the maximum incidence of the disease was recorded in IR-8 (75.56%) followed by Tapan (67.78%), Bhangar (67.78%), Bunon Seoraphulli (66.66%), NS-1101 (66.66%), Beldanga (65.55%), ARCH-228 (62.22%), Mocha Nilganj (62.22%), Suryamukhi (60.00%), Pusa Jwala (55.55%), CH-3 (53.33%), Ashari (52.22%), Pusa Sadabahar (51.11%), and Pant C-I (45.55%), while Akashi and Bullet recorded the disease incidence of (38.89%). When the incidence of the disease in

Table 1 : Incidence and severity of leaf spot of chilli (*A. solani*) in different varieties/germplasms at different dates after transplanting (DAT) during *rabi* season under field conditions (based on the pooled mean of 2003 and 2004)

Varieties Germplasms	Percentage of disease incidence and severity							
	30 DAT*		40 DAT		50 DAT		60 DAT	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Akashi	21.11	3.70	33.33	4.19	37.78	4.69	45.00	5.18
Pusa Sadabahar	35.55	4.93	39.99	5.92	41.11	6.29	47.77	7.52
CH-3	33.33	5.67	36.67	6.53	39.99	7.39	43.33	8.02
Beldanga	47.78	10.98	55.56	11.73	58.78	13.21	62.22	13.70
IR-8	59.99	20.74	63.33	21.11	66.66	25.55	73.33	25.55
Pant C-1	36.66	6.29	42.22	6.91	45.55	7.78	48.88	8.84
Pusa Jwala	32.22	8.02	38.89	8.76	42.22	9.13	43.33	9.25
Ashari	29.99	4.32	38.89	5.18	42.22	5.55	44.44	5.92
Tapan	61.11	17.90	65.55	19.38	67.77	20.12	71.11	21.72
Bullet	24.44	2.71	25.55	2.84	31.11	3.45	33.33	3.70
Bunon Seoraphulli	57.77	14.57	64.44	16.54	66.77	17.27	71.11	17.89
NS-1101	48.88	8.15	56.66	9.50	59.99	10.36	63.33	11.23
Bhangar	58.89	13.95	65.55	15.43	67.77	15.55	71.11	17.28
ARCH-228	51.11	9.87	56.66	11.28	59.99	12.40	62.22	12.59
Mocha Nilganj	44.44	12.34	48.88	13.82	54.44	14.93	58.89	15.68
Suryamukhi	37.78	8.14	43.33	8.76	46.67	9.87	48.88	10.37

* DAT = Days after transplanting

Table 2 : Incidence and severity of leaf spot of chilli (*A. solani*) in different varieties/germplasms at different dates after transplanting (DAT) during *kharif* season under field conditions (based on the pooled mean of 2003 and 2004)

Varieties Germplasms	Percentage of disease incidence and severity							
	30 DAT*		40 DAT		50 DAT		60 DAT	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Akashi	25.55	5.06	32.22	6.29	38.89	7.03	38.89	7.03
Pusa Sadabahar	34.44	6.04	41.11	7.28	47.77	8.02	51.11	8.64
CH-3	36.67	10.50	45.55	12.72	49.99	13.45	53.33	13.83
Beldanga	49.99	14.69	56.67	16.91	63.33	17.65	65.55	17.89
IR-8	69.99	28.52	71.11	28.89	73.33	31.11	75.56	31.11
Pant C-1	28.89	9.25	35.55	11.48	42.22	12.22	45.55	12.59
Pusa Jwala	40.00	11.85	46.66	14.07	53.33	14.81	55.55	15.06
Ashari	37.77	8.39	44.44	10.74	50.00	11.73	52.22	12.22
Tapan	54.44	20.63	61.11	22.59	64.44	23.70	67.78	24.07
Bullet	25.55	4.32	32.22	5.80	38.89	6.54	38.89	6.54
Bunon Seoraphulli	52.22	15.92	58.89	18.14	64.44	18.76	66.66	19.01
NS-1101	53.33	13.82	58.89	16.04	64.44	16.54	66.66	16.79
Bhangar	55.56	15.65	61.11	17.15	65.55	18.88	67.78	19.38
ARCH-228	46.67	14.07	53.33	16.29	58.89	16.91	62.22	17.28
Mocha Nilganj	45.55	15.43	52.22	17.66	58.88	18.39	62.22	18.76
Suryamukhi	43.33	10.98	49.99	13.21	56.67	13.95	60.00	14.32

Table 3 : Apparent rate of infection of leaf spot of chilli (*A. solani*) in different varieties/germplasms during *rabi* and *kharif* seasons of 2003 and 2004 (pooled mean of two years)

Varieties/Germplasms	Apparent rate of infection					
	<i>Rabi</i> (2003-2004)			<i>Kharif</i> (2003-2004)		
	30-40	40-50	50-60	30-40	40-50	50-60
Akashi	0.061	0.022	0.029	0.030	0.030	0.000
Pusa Sadabahar	0.016	0.005	0.028	0.030	0.028	0.012
CH-3	0.018	0.012	0.013	0.037	0.012	0.016
Beldanga	0.032	0.012	0.013	0.032	0.025	0.013
IR-8	0.012	0.018	0.028	0.005	0.009	0.016
Pant C-I	0.021	0.016	0.012	0.032	0.026	0.016
Pusa Jwala	0.030	0.013	0.004	0.025	0.028	0.012
Ashari	0.040	0.013	0.008	0.025	0.024	0.008
Tapan	0.021	0.009	0.014	0.029	0.013	0.017
Bullet	0.010	0.025	0.009	0.030	0.030	0.000
Bunon Seoraphulli	0.026	0.013	0.004	0.028	0.022	0.013
NS-1101	0.032	0.013	0.012	0.024	0.022	0.013
Bhangar	0.030	0.009	0.014	0.021	0.021	0.009
ARCH-228	0.024	0.013	0.008	0.024	0.024	0.013
Mocha Nilganj	0.020	0.020	0.020	0.024	0.028	0.013
Suryamukhi	0.021	0.016	0.008	0.024	0.032	0.013

kharif season was compared with *rabi* season crop, it was observed that in *kharif* season incidence of disease was higher than in *rabi* season.

When severity of the disease was taken into consideration, it was observed that the varieties/germplasms which showed maximum disease incidence also recorded highest disease severity.

In *kharif* season (Table 2) at 60 DAT, it was observed that the disease severity ranged from 6.54 and 31.11 per cent in Bullet and IR-8 respectively. However, disease severity in all these varieties during *rabi* season was minimum

The apparent rate of infection was recorded in different varieties at 10 days interval from 30 to 60 DAT in *rabi* and *kharif* season. The data for two years were pooled and analysed (Vanderplank formula, 1963). It appeared from the results (Table 3) that in *rabi* season at 50 - 60 DAT, the rate of infection declined in varieties like Pant C-I (0.012), Pusa Jwala (0.004), Ashari (0.008), Bullet (0.009), Bunon Seoraphulli (0.004), NS-1101 (0.012), ARCH-228 (0.008) and Suryamukhi (0.008) respectively. While in varieties like IR-8, Akashi and Mocha Nilganj it was increased along with the

age of the plants. In *kharif* season, rate of infection decreased in maximum varieties along with the increase in plant age. In *kharif* season, when the rate of infection was recorded at 30-40 DAT it was observed that the rate of infection ranged between 0.005 and 0.037 on IR-8 and CH-3 respectively. In between 50 - 60 DAT, the rate of infection in the varieties like CH-3, IR-8, Tapan, increased to a greater extent while, Akashi, Pusa Sadabahar, Beldanga, Pant C-I, Pusa Jwala, Ashari, Bullet, Bunon Seoraphulli, NS-1101, Bhangar, ARCH-228, Mocha Nilganj and Suryamukhi showed a gradual decline in the rate of infection.

DISCUSSION

Chilli (*Capsicum annum* L.) crop is prone to attack by number of fungal diseases which causes great economic loss to the crop. The leaf spot of chilli caused by *A. solani* is one among them occurring in the plains in both *rabi* and rainy season and hampering the production of crop to a great extent (Basak, 1994; Basak and Chowdhury, 1997). However, in West Bengal the disease cause a considerable damage to chilli crop both in *rabi* and *kharif* season.

The incidence and severity was recorded maximum in *kharif* than in *rabi*. To develop the disease Singh (1987) reported that the pathogen require an optimum temperature of 28-30 °C with high relative humidity (85-90%). Based on this experiment it was noted that none of the varieties showed complete resistance to the disease. Khulbe and Sati (1987) also reported that pathogens over-wintered in diseased plant debris for one to two years and they also established seed-borne nature of *A. solani*. Shtienberg and Pry (1990) also reported that in fields where the early crop was tomato, the pathogen produced symptoms in both resistant and susceptible cultivars, however, they also reported that disease became serious with abundant moisture or frequent rain followed by warm and dry weather.

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