J. Mycopathol, Res, ***51(1)*** *: 157-161,* 2013; (ISSN 0971-3719)

Natural incidence and apparent rate of infection of different varieties/genotypes of chilli (*Capsicum annuum* L.) in West Bengal against Chilli Leaf Curl Virus under field conditions

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Received : 08.10.2012 Accepted : 14.02.2013 Published : 29.04.2013

During *kharif* season of 2003 and 2004, the variety NS-II0I showed maximum incidence (71.11%) with a severity of 21 .84% while, Pusa Sadabahar showed minimum incidence 47 .78% and severity (II .72%) at 60 days after transplanting. During *rabi* season of 2003 and 2004, maximum CLCV incidence (55.55%) and severity (15.79%) were recorded in NS-I I0I and ARCH-228 respectively. While, minimum incidence (38.S9%) and severity (4.81%) was recorded in Pant C-I at 60 DAT. It was also observed that at early stage, apparent rate of infection during *kharif* season ranged from 0.0I 2 to 0.041 in Akashi and Pant C- I . While in *rabi* seasons it ranged from 0.004 to 0.040 in NS- I I0I and Suryamukhi at 30-40 DAT while, it was found that apparent rate of infection decreased in most varieties with the increased in plant age.

Key words : Chilli, varieties, genotypes, natural incidence, apparent rate of infection

INTRODUCTION

Chilli (*Capsicum annuum* L.) also known as red pepper is the highest consumed spice in the world, belongs to the family Solanaceae and genus Capsicum. Green chillies are rich in vitamin A and C and the seeds contain the traces of starch (Saimbhi, 1977). The chillies are used for its pungency and spicy taste for preparation of food products specially for human consumption. There is an immense possibility for export of dry chilli and its derivatives especially that have low pungency and high colour (Mathew *et al.*,2000). Inspite of availability of good varieties, technologies for high production, the main constraints for low productivity or quality fruits in India are due to attack of Chilli Leaf Curl Virus which is very commonly found in all types of chilli cultivars, irrespective of seasons or geographical locations. Chilli Leaf Curl Virus (CLCV) is one of the economically important disease of Chilli causing great loss to the crop. CLCV belongs family of Gemini-viridiae and transmitted by whitefly (*Bemisia tabaci* Genn.) in circulative non propagative manner.Sastry and Singh (1973) have reported that the plants infected by CLCV within 20 days of transplanting remain stunted in growlh and produce fewer leaves and fruits than those infected 35 to 50 days following transplanting. Early infection results in 97.3% yield reduction as compared with 74.1 to 28.9% yield reduction in plant infected 35 to 50 days after transplanting. Singh *et al.*, (1979) have further reported that the disease caused heavy loss in yield and quality of fruits. If the plants get infected within 20-25 days *after transplanting the loss* in yield goes up to 80-90%, but in case of later infection the loss is comparatively less.So considering the importance of the crop, a systematic study has conducted to record the incidence and severity of Chilli Leaf Curl Virus in different chilli varieties commonly occurring in different seasons.

MATERIALS AND METHODS

Field experiment to record the disease incidence, severity and rate of spread was conducted during

kharif and *rabi* seasons of 2003 and 2004 at the research farm of Bidhan Chandra Krinshi Viswavidyalaya, West Bengal. The percentage of disease incidence, severity index or percentage of disease index (PDI) were calculated as and when necessary using the standard formula (McKinney, 1923):

$$\text{Percentage of Disease Incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

$$\text{Percentage of Disease Index (PDI)} = \frac{\text{Sum of all numerical rating}}{\text{Maximum disease grade x Total number of plants observed}} \times 100$$

Severity of CLCV disease was determined on the disease scoring scale as suggested by Ekbote (2004).

Grade	Symptions
0	Leaf curl symptoms absent
1	Very mild curling of 1-10% leaves
3	Curling, puckering symptoms on nearly 11-25% leaves
5	Curling, puckering symptoms on nearly 26-50% leaves
7	Severe curling, puckering symptom on nearly 5l-75% leaves with stunting of the plants and smalling of leaves
9	All leaves of plants > 75% showing severe symptoms, severe stunting of plants, bushy appearance and pronounced smalling of leaves

Apparent rate of infection (r)

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

$$\text{Apparent or logistic infection rate (r)} = \frac{1}{t_1 - t_2} (\text{logit } x_2 - \text{logit } x_1)$$

where,

t_1 = first observation date
t_2 = Last observation date
x_1 = Percentage of disease incidence on first observation
x_2 = Percentage of disease incidence on last observation

RESULTS AND DISCUSSION

Chilli Leaf Curl Virus (CLCV) is one of the most devastating diseases and in West Bengal the disease is commonly found in many of the popular chilli varieties growing round the seasons but no information on the extent of natural incidence of CLCV in any of the chili variety is presently available. Loss in yield due to CLCV depends on various factors that include host susceptibility to virus strain and vector population. The use of resistant varieties are the best method for management of virus diseases, but presently no such varieties are available. So, considering the importance of the disease, natural incidence and severity of CLCV with sixteen chilli varieties that included hybrids, high yielding improved, local type and few chilli germplasms (obtained from co-ordinated vegetable improvement project) were tested under field conditions during *kharif* and *rabi* seasons for two years. Incidence and severity of CLCV was measured at different days after transplanting. The result of 2003 and 2004 were pulled together separately for *kharif* and *rabi* seasons.

In general, incidence of the CLCV disease was more when cultivated in *kharif* season (May - June) as compared lo *rabi* season (February - March). Highest incidence of disease in *kharif* season (Table 1) was recorded in NS-ll0l (71.11%) while, minimum in Pusa Sadabahar (47.78%) at 60 DAT. Similarly low incidence of disease in *kharif* season was recorded in Pusa Sadabahar and the respective percentage were 34.44 and 39.99 and 46.66 percent at 30,40 and 50 DAT.

The incidence of the disease in *kharif* season at 60 DAT was recorded as 56.66,47.78, 63.33,67.77,5g.gg, 55.55, 49.99,56.66,69., 66.67,66.67,71.11,66.67,6g.g9, 61,11 and 56.66 per cent in varieties Akashi, Pusa Sadabahar, CH-3, Beldanga, IR-8, Pant C-1, Pusa Jwala, Ashari, Tapan, Bullet, Bunon Seoraphulli, NS-ll0l, Bhangar, ARCH-228, Mocha Nilganj and Suryamukhi respecrively.

When the natural incidence of CLCV during *rabi* season was taken into consideration at 60 DAT (Table 2) a high incidence of disease was recorded in NS-l 101 (65.55%) followed by ARCH-228 (62.21%), Bunon Seoraphulli (61.11%), Ashari (58.88%), Bullet (57.77%), Mocha Nilganj (56.66%), Tapan (55.55%), Bhangar (54.44%), CH-

3 (53.33%), IR-8 (53.33%), Beldanga (5I.II%), Akashi (44.4%), Suryamukhi (42.22%), Pusa Jwala (40.00%), Pusa Sadabahar (38.89%) and Pant C-I (38.89%) respectively.

(19.91%),CH-3 (18.38%), Bhangar (18.01%), Mocha Nilganj (17.64%), IR-8 (I7.15%), Tapan (16.18%), Beldanga (16.29%), Suryamukhi (15.18%), Ashari (14.68%). ARCH- 228 (14.32%),

Table 1 : Incidence and severity of chilli leaf curl virus (CLCV) in different varieties/germplasms at different dates after transplanting (DAT) during *kharif* (May - June) season under field conditions (Based on the pooled mean of 2003 and 2004)

Varieties	Percentage of disease incidence and severity							
	30 DAT		40 DAT		50 DAT		60 DAT	
Germplasms	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Aklashi	41.11	10.49	44.44	11.46	53.33	13.57	56.66	13.95
Pusa Sadabahar	34.44	8.76	39.99	9.37	46.66	11.60	47.78	11.72
CH-3	51.11	15.79	55.55	16.53	58.89	17.40	63.33	18.38
Beldanga	53.33	14.07	55.55	15.92	62.22	16.29	67.77	16.29
IR-8	46.66	15.06	53.33	16.54	57.78	17.03	58.88	17.15
Plant C-1	38.89	10.98	48.88	12.10	54.44	13.94	55.55	13.07
Pusa Jwala	34.44	9.01	41.11	9.75	47.77	11.72	49.99	11.97
Ashari	38.89	11.23	45.55	11.97	52.21	14.19	56.66	14.68
Tapan	45.55	13.94	52.22	15.18	57.77	16.54	68.88	16.78
Bullet	49.99	17.89	56.66	19.37	63.33	19.62	66.67	19.99
Bunon Seoraphulli	52.22	17.64	55.55	18.35	58.88	19.50	66.67	19.91
NS-1101	61.11	19.38	64.44	21.23	66.66	21.84	71.11	21.84
Bhangar	51.11	14.81	57.77	16.28	62.21	17.52	66.67	18.01
ARCH-228	55.55	11.36	62.22	12.10	68.89	14.32	68.89	14.32
Mocha Nilganj	42.22	14.31	48.89	15.79	55.55	17.27	61.11	17.64
Suryamukhi	39.99	11.84	43.33	12.96	53.33	14.80	56.66	15.18

Percentage of disease severity for both the years as well as in different seasons was found to vary widely among the different varieties. In general, percentage of disease severity was more in *kharif*

Akashi (13.95%), Pant C-I (13.07%), Pusa Jwala (11.97%), and Pusa Sadabahar (11 .97%), respectively (Table 1).

Table 2 : Incidence and severity of chilli leaf curl virus (CLCV) 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	Percentage of disease incidence and severity							
	30 DAT		40 DAT		50 DAT		60 DAT	
Germplasms	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Aklashi	26.66	4.93	33.33	5.77	41.10	6.90	44.44	7.40
Pusa Sadabahar	23.33	3.08	28.89	3.70	34.44	4.56	38.89	5.16
CH-3	38.88	10.48	45.55	10.98	53.33	13.82	53.33	13.82
Beldanga	31.10	6.91	37.78	7.64	46.66	9.13	51.11	9.87
IR-8	29.10	6.53	36.66	7.27	45.55	8.51	53.33	9.37
Plant C-1	23.33	2.84	28.89	3.45	35.55	4.56	38.89	4.81
Pusa Jwala	23.33	3.82	30.00	4.56	36.66	6.04	40.00	6.41
Ashari	27.77	5.79	35.55	6.66	41.11	8.14	58.88	8.14
Tapan	37.78	9.62	45.55	9.99	52.21	11.97	55.55	12.34
Bullet	41.11	10.98	47.77	11.97	53.33	13.33	57.77	13.82
Bunon Seoraphulli	39.99	10.36	48.89	11.59	55.55	13.08	61.11	13.32
NS-1101	47.78	11.48	53.33	12.32	56.67	13.95	65.55	14.07
Bhangar	38.89	9.25	43.33	9.99	49.99	12.22	54.44	12.96
ARCH-228	49.99	12.95	55.55	13.82	61.10	15.67	62.21	15.79
Mocha Nilganj	36.66	9.27	43.33	9.74	51.10	12.59	56.66	12.71
Suryamukhi	24.44	4.69	32.22	5.55	39.99	7.15	42.22	7.40

season than the *rabi* season. At 60 DAT maximum percentage of Disease Index (PDI) in *kharif* season was observed in NS-1101 (21 .84%) which was followed by Bullet (19.99%), Bunon Seoraphulli

In respect to *rabi* season severity index at 60 DAT ranged from (15.79%) in ARCH-228 followed by NS-I 101 (14.07%), Bullet (13.82%), CH-3 (13.82%), Bunon Seoraphulli (13.32%), Bhangar (12.96%),

Mocha Nilganj (12.71%), Tapan (12.34%), Beldanga (9.87%),IR-8 (9.37%), Ashari (8.14%), Suryamukhi (7.40%), Akashi (7.40%), Pusa Jwala (6.41%), Pusa Sadabahar (5.16%) and Pant C-1 (4.81%) respectively (Table 2).

The apparent rate of infection of CLCV was calculated at 10 days interval between 30-40, 40-50 and 50-60 DAT for both the seasons. Infection rate was calculated from the average mean of two years. Results on the infection rate (Table 3) showed that at early stage, rate of infection during *kharif* season ranged from 0.012 to 0.041, while in *rabi* season it ranged from 0.004 to 0.040 at 30 to 40 DAT in few of the varieties/germplasms. However, in *rabi* season at 40-50 DAT, a slight increase on the infection rate was observed in Akashi, Beldanga, IR-8; NS-1101, Bhangar and Mocha Nilganj. At 50-60 DAT, rate of infection in most of the varieties/ germplasms was found to decrease except in Tapan, Bunon Seoraphulli and NS-1101. In *kharif,* when the increment of the disease at different intervals was taken into consideration, very low amount of infection at 50-60 DAT than that of 40-50 DAT was observed in Pusa Sadabahar, IR-8, Pant C-1, Pusa Jwala, Ashari, Bullet, ARCH-228, Mocha Nilganj and Suryamukhi. On the contrary, the varieties like Tapan, Bunon Seoraphulli and Bhangar recorded high rate of infection.

Overall a reduction in infection rate as observed in some of the varieties/germplasms may be due to low transmission rate or low vector preference on the aged plants. The disease may appear within 20 days after transplanting and reduction in yield is high if the infection takes place at early stage (Sastry and Singh, 1973 and Singh *et al.*,1979). Under West Bengal situation, incidence of the leaf curl on chilli was observed by Mallick and Chowdhury (1996) and they noted that severity of CLCV is influenced by number of factors such as vector population, cropping season and varietal susceptibility. Singh *et al.* (1979) reported that incidence of disease was more in early summer before onset of rain due to favourable temperature, low temperature during winter season showed low infection rate due to low population of whitefly (Mazyad *et al.,* 1979).

Table 3 : Apparent rate of Infection of chilli leaf curl virus (CLCV) in different varieties/germplasms during *rabi* and *kharif* season of 2003 and 2004 (pooled mean of two years)

Varieties Germplasms	Apparent rate of infection					
	Rabi (2003-2004)			*Kharif* (2003-2004)		
	30-40	40-50	50-60	30-40	40-50	50-60
Aklashi	0.028	0.034	0.013	0.012	0.036	0.016
Pusa Sadabahar	0.032	0.023	0.021	0.025	0.029	0.004
CH-3	0.029	0.028	0.000	0.020	0.012	0.017
Beldanga	0.032	0.036	0.016	0.012	0.025	0.026
IR-8	0.036	0.037	0.028	0.000	0.044	0.004
Plant C-1	0.032	0.031	0.013	0.041	0.020	0.008
Pusa Jwala	0.036	0.032	0.012	0.030	0.028	0.004
Ashari	0.037	0.020	0.005	0.029	0.024	0.020
Tapan	0.032	0.024	0.028	0.025	0.024	0.048
Bullet	0.029	0.020	0.020	0.032	0.025	0.018
Bunon Seoraphulli	0.037	0.028	0.033	0.016	0.012	0.035
NS-1101	0.004	0.016	0.038	0.012	0.014	0.018
Bhangar	0.017	0.024	0.020	0.028	0.017	0.022
ARCH-228	0.028	0.020	0.004	0.025	0.031	0.000
Mocha Nilganj	0.025	0.036	0.020	0.028	0.028	0.021
Suryamukhi	0.040	0.034	0.009	0.013	0.040	0.016

Dharmasena (1998) in Sri Lanka observed that planting of chilli in May and June caused high infection of CLCV due to high population of vectors. Saikia and Muniyappa (1986) tested many germplasms in Karnataka and they observed incidence of CLCV in the range of 52.2 - 60.4 per cent during summer season. Similarly Rishi and Dhawan (1988) observed 5.21 to71.4 per cent of CLCV incidence in Haryana.

Large number of chilli varieties/germplasms have been tested in different places in India (Sanger *et al.,* 1988; Singh *et al.*,1990; Gandhi *et al.,* 1995; Roy *et al.,* 1997 and Kumar *et al.,* 1999) and all of them recorded high rate of incidence of CLCV under field conditions with a very few number of varieties which were found to be tolerant. A high positive correlation has been observed between disease incidence and the vector population and

source of CLCV also play a major role on the incidence of disease or its strains, which are abundantly distributed in many cultivated plants (Valand and Muniyappa, 1992). During *kharif* season possibly both the vectors and source of virus were present in adequate numbers which resulted in high incidence of disease in different varieties/ germplasms. Based on the two years observations using sixteen popular chilli varieties/germplasms it was observed that none of the varieties/ germplasms were found resistant to leaf curl disease under the present situation.

Thus the natural incidence clearly indicate that CLCV is widely prevalent in West Bengal and all the varieties/germplasms were found susceptible to the virus. To minimize the disease, application of insecticides is one of the suitable method when there is scarcity of suitable resistant varieties. On the basis of incidence, under field conditions, application of any systemic insecticides for 2-3 times with an interval of 2 weeks will help to reduce the diseases to a greater extent.

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