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Effect of environmental factors on disease development of black rot of cauliflower incited by *Xanthomonas campestris pv. campestris* in Udaipur district of Rajasthan

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ABSTRACT

Major cauliflower growing area of Udaipur district was surveyed to know the severity of pathogens on development of black rot. An environmental factor essentially affects the intensity and spread of cauliflower black rot. Cauliflower plants inoculated at one week intervals, throughout the investigation during the rabi season (October 2003 to February -2004).The severe disease development was recorded during the month of January when the humidity between 82-89 per cent and temperature ranges between 23-30^0 prevailed. While the disease development was trace during October and November and low in the month of December. Disease progressed faster during the crop growth period in January and February under cage house condition. Regression and correlation coefficient important environment factors in relation to the progress of disease were noticed. The disease curve had three distinct phase (period) *viz*, initial inoculum build up or disease establishments, rapid disease progress and disease establishment. Regression showed positive picture and negative correlation was obtained for maximum and minimum temperature, which signified their role of the rapid disease progress period. However, maximum infection was noticed, when RH range between 82-89 per cent. It was observed that disease development gained momentum when the maximum temperature started lowering down from 33^0 C, minimum temperature below 23^{0}C adversely affect the disease development in cauliflower.

Key words: Severity, environmental factors, disease development, black rot, cabbage, *Xanthomonas campestris pv. Campestris*

Introduction

Cauliflower (*Brassica oleracea* var.*botrytis* L) is one of the important vegetable crops of India. It is native of South Europe in the Mediterranean region (Thompson and Kelly, 1957). It was introduced in to India during Moghul period. Cauliflower is the most important member of the genus *Brassica*. In India, total area under cauliflower cultivation is 0.33 million ha and production 6.41 million tones during 2010 (NHB, Gurgaon 2010). It is cultivated for its shortened flower parts, which is used in many preparations like curries, soups and pickles. The edible portion of the plants is the "curd" made up of numerous divided hypertrophic branches, which terminate the main stem at the plant and is highly suppressed with number of parts of flower apparent there. Shah 1995 reported that a minimum inoculums level was necessary for pathogenensis in different host pathogen combination. Environmental condition *i.e* temperature, humidity and rain in particular decisively affect the intensity and spread of plant disease (Shekhawat and Patel 1977, Srivastava and Bais, 1985 and Santiranjan *et al*, 1986). Keeping in view, the present investigation was under taken with the objective to investigate the severity and effect of environmental factors on disease development of black rot of cauliflowers.

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Material and methods

The periodical survey of four selected villages' namely Hawala, Bhujeda, Choti Nokha and Manva Khera of Udaipur district of Rajasthan were carried during rabi season (November to February 2003-2004) for collection of diseased samples of bacterial black rot of cauliflower. Disease severity in cauliflower was randomly recorded during survey and assessment. In the surveyed fields, incidence of black rot was recorded. To assess the incidence of disease , three fields were observed in each village and five plots from each fields was randomly selected for sampling and then per cent diseased incidence was calculated. In each fields disease and healthy plants were counted from each randomly selected five plots and per cent incidence of disease was calculated by using following formula given by (Wheeler, 1969)

$$PDI = \frac{\text{Numbers of Diseased Plants}}{\text{Total number of plants observed}} \times 100$$

For close observation disease, disease rating was made on twenty plants for each inoculation methods. To measure the quantum of disease, following disease rating key was devised based on disease development in which infected plants were categorized in six arbitrary classes (Scale 0-5).

0 = No infection
1 = Very slight bacterial infection covering 1-10 per cent leaf area.
2 = Slight bacterial infection covering 11-25 per cent leaf area.
3 = Moderate bacterial infection which covering 26-50 per cent leaf area.
4 = Severe bacterial infection which covering 51-75 per cent leaf area.
5 = Very severe bacterial infection which covering more then 75 per cent leaf area.

Per cent infection index was calculated by using following formula (Mc Kiny,1923;Chester 1959 and Wheeler,1969).

$$PDFC = \frac{\text{Sum of Individual rating}}{\text{No. of plants or leaves assessed x Maximum disease rating}} \times 100$$

Effect of environmental factor on disease development of black rot of cauliflower

Effect of weather parameters on black rot development of cauliflower was carried out at Rajasthan college of Agriculture, (MPUAT) Udaipur, during crop season of Rabi 2003-04. Cauliflower variety Pusi* seed were sown in seed bed at weekly intervals. After 35-40 days, the cauliflower seedlings were transplanted in 30 cm earthen pots at every weekly interval so as to provide the plants of same age for inoculation. In each pot two plants were accommodated and five pots were used for each inoculation. Plants were inoculated after 10-12 days of transplanting in pots from seed bed by carborundum abrasion technique with bacterial suspension (concentration 10^8 cfu/ml) at 7 days intervals. The infection index was recorded 21 days after inoculation on each plant. The weather data *viz* .weekly tempertature, relative humidity and rainfall were obtained from farm metrology observatory, RCA, Udaipur.

Observation in respect of disease development under cage house condition was carried out at Department of Plant Pathology cage house at RCA Udaipur. In rabi season 2003-04 and were correlated with the meteorological data obtained from the farm weather observatory of RCA Udaipur. To recorded the observation, ten plants on which initial symptoms of the disease observed on 20th October 2003 were tagged and there after observation on disease development were recorded at the weekly intervals.

Results and discussion

The *X. c. pv. campestris* black rot of cauliflower severity was recorded in village of Udaipur district (Choti Nokha,Bhujeda, Hawala and Manva Khera) of Rajasthan. The disease appeared in most of the field wherever, the cauliflower (cv. Snowball) crop was grown. It was observed that PDI was more in the month of January and February.

Table 1 revealed that *X. c. pv. campestris* severity on black rot of cauliflower during rabi season 2003-04, ranged from trace to 40.30. The bacterial black rot disease was observed in all four villages, during the investigation. The maximum black rot (25.2 %) was recorded in Hawala village, followed by Bhujeda (23.92%), whereas the minimum disease incidence of bacterial black rot of cauliflower was recorded in Choti Nokha (18.85 %). The incidence of the disease was successively increased during the period but comparatively high during January and February. Similarly results were also observed by Santiranjan, 1986 and Singh, 2001.

The results presented in table 2 and fig 1 revealed that the disease could be produced artificially during the crop season although, its infection index was varied significant and affected by environmental conditions. The effect of various environmental factors on the progress and decline of the disease and regression and correlation coefficient was also obtained. In the crop season (October 2003 to February 2004) the disease was in trace to low on plants inoculated in month of October and November 2003. During this period a poor correlation existed between temperature and humidity conditions. The temperature was high (maximum temperature 30-33° C). The humidity was comparatively low, minimum humidity ranged between 31-34 and maximum humidity between 84-86 per cent. The precipitation was negligible. Disease development was better from second week of December onward and maximum disease was recorded on plant inoculated on 19th Jan .2004 followed by 26th Jan, 12th Jan and 2nd Feb, 2004, high humidity and temperature were favourable for disease development .The most favourable period of disease development was from last week of December 2003 to Second week of Feb., 2004, which decline there after. During favourable period the maximum humidity ranged between 82-89 per cent and maximum temperature range between 23-30° C. Shekhawat (1975) found high humidity and temperature between 22.34o C to be the most favourable for bacterial leaf spot of chilli (X. c. pv. vesicatoria).Similarly results were also found by Shekhawat and Patel (1977) in green leaf spot in mung bean. Choudhary and Chakraverti (1989), found that high relative humidity (above 70.75 per cent and maximum) temperature fluctuation around 30-35o C were congenial for spot and blight development of castor (*X.c.pv.ricini*). Gupta (1991) reported that black rot disease of cabbage in Manipur appeared in near the end of February. Oliveira *et al* (1996) found that major development of black rot (*X.c. pv.campestris)* on cole crops was registered during the warm and humid period.

Regression and correlation coefficient were calculated for important environmental factors in relation to the progress of the disease. These observations led to an important conclusion that the disease progress curve had had three distinct phase (periods) viz., initial inoculums

builds up or disease establishment, rapid disease progress and disease stabilization. This method had a given a very clear positive picture and negative correlation was obtained for maximum and minimum temperature, which signified their role of the rapid progress of the disease. Similar finding was also obtained by Singh, 2001.

Table 1. Per cent incidence of black rot of cauliflower incited by *X.c pv campestris*.

Place/Time	PDI (Per cent Disease Incidence)*				
	Nov.	Dec.	Jan	Feb.	Mean
Choti Nokha	Trace	20.1	24.5	30.8	18.55
Bhujeda	1.3	25.5	30.3	38.6	23.92
Hawala	1.6	27.3	31.6	40.3	25.2
Manva Khera	Trace	22.6	26-8	37.4	21.92

*Average of five replication.

Table 2. Black rot development on cauliflower plants on weekly inoculati on made during October. 2003 to February 2004 (in pots)

Date of inoculation	Per cent infection index	Temperature (^{0} C)		Relative humidity (%)	
		Maximum	Minimum	Maximum	Minimum
20 Oct.2003	Trace	32.2	14.9	73	33
27 Oct. 2003	Trace	32.8	14.7	73	34
03 Nov.2003	Trace	33.4	15.2	71	32
10 Nov.2003	1.8	32.2	13.9	70	31
17 Nov.2003	3.6	30.4	12.5	76	29
24 Nov.2003	4.2	29.1	12.7	72	32
01 Dec.2003	6.8	28.9	10.4	78	31
08 Dec.2003	14.3	30.8	10.3	84	25
15 Dec.2003	23.1	28.1	10.8	83	33
22 Dec.2003	30.4	26.8	6.4	82	34
29 Dec.2003	34.6	25.0	5.9	84	42
05 Jan. 2004	39.3	24.1	7.3	86	35
12 Jan. 2004	46.7	26.2	7.0	84	27
19 Jan. 2004	53.1	27.8	8.5	85	30
26 Jan. 2004	50.5	23.0	6.5	89	36
02 Feb. 2004	46.4	23.3	5.8	86	26
09 Feb. 2004	42.8	26.7	5.8	65	17
16 Feb. 2004	37.1	29.3	9.1	77	27
23 Feb. 2004	32.1	31.3	10.9	74	19

Table 3. Effect of different environmental factors on black rot development in cauliflower plant on weekly inoculation made during Oct.2003 to Feb. 2004 (in pots).

Environmental factors	Regression equation (Y= a + bx)	Correlation coefficient (r)
Maximum temperature	Y= 161.07**-4.78 x **	-0.807**
Minimum temperature	Y= 76.25**-5.20 x**	0.885**
Maximum humidity	Y =107.94**+1.69x	0.585*
Minimum humidity	Y =42.82**-0.060	-0.180

Y= Estimated disease infection a= Intercept, b= Regression coefficient

*Significant at 5 % ** Significant at 1%.

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