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Spatial dispersion statistics and Sequential sampling plan for Frog eye leaf spot disease caused by *Cercospora capsici* in chilli

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Iwao's patchiness regression technique was used to study the spatial distribution of *Cercospora capsici* infecting chilli leaves in its five growth stages viz., nursery, vegetative, flowering, podding and fruit ripening stages. The dispersion statistics indicated that the basic components of the disease lesion population aggregates and they were contagiously distributed in chilli leaves at all growth stages. Botanical extracts spray did not alter the basic distribution pattern of disease. The dispersion statistics obtained from pooled data enabled to arrive at sequential sampling plan that requires a maximum of 58 leaves sample for assessing the threshold level of diseases in order to initiate control measures. A preliminary economic threshold of one lesion per leaf was used to prepare the sequential sampling plan for timing the initiation of plant extract to control the disease. It is a cost effective ecofriendly quantitative method in plant disease management.

Key words : Spatial dispersion statistics, Frog eye leaf spot, chilli, sequential sampling plan, *Cercospora capsici*

INTRODUCTION

Cercospora leaf spot caused by *Cercospora capcisi* is a major and common disease of chilli (*Capsicum annum*) in both hills and plains of Manipur. The disease can cause total damage to the crop especially during rainy days. Since a blanket weekly spraying of fungicide is usually practiced by the farmers, there is scope to develope a need based spray schedule. Accurate disease estimation to assess the threshold level is, therefore, very essential for recommending timely spray of fungicide (Boivin and Vincent, 1987).

Spatial distribution of disease is helpful to know the number of samples necessary to obtain an estimation of the density of diseased plants in the field (Lorbeer and Jares, 1981). Therefore, dispersion parameters are helpful to establish sampling plant (Iwao and Kuno, 1971).

The present investigation has been carried out so as to assess the spatial distribution pattern of the disease and also to assess the lesion density in the context of the economic threshold levels, based on certain reliable number of samples using sequential sampling plan.

MATERIALS AND METHODS

The present investigation was carried out at Elangkhangpokpi, 55 km away from Imphal under Thoubal district of Manipur, an experimental area measuring 180 sq km. was divided into six blocks each measuring 6 m i.e. (1×6 m). Each block was further divided into 6 of size 6 sq. m. for growing the experimental material (chilli). After preparing the land, seeds of six acceptable varieties of chilli namely, Abbreviata fingarh (V_1), Longum bailey (V_2), Abbreviata fingarh (V_3), Fasciculatum bailey (V_4), Chiengpi (V_5) and Conoids (V_6) were raised during rainy season in the plot using random numbers table.

After one month nurseries were transferred to another plot maintaining plant to plant distance at 25 cm and 30 cm apart respectively.

The meteorological data such as relative humidity, rainfall and temperature were recorded at each sampling. At each sampling 100 leaves were randomly selected from the population of each variety

in a plot having 5 replications. Therefore, 500 observations were made at each pre-fungicide sampling for each variety. The sampling unit consisted of leaf (premature and matured) and the datum recorded was the number of characteristic Cercospora leaf lesion on it.

Iwao's patchness regression technique : Iwao's patchiness regression was calculated using the relation given by Lloyd (1967).

$$\dot{X} = \overline{X} + \left(\frac{S^2}{\overline{X}} \right) - 1$$

where $\dot{X}$ = the mean crowding of the sample

$\overline{X}$ = the mean number of lesion per leaf and

S^2 = the variance of the number of lesions per leaf

At each sampling, the mean number of lesions per leaf was determined and used to calculate the mean crowding of sample ($\dot{X}$). Iwao and Kuno (1971) demonstrated that the relationship between mean density ($\overline{X}$) and mean crowding ($\dot{X}$) can be described by a simple linear regression of $\dot{X}$ on $\overline{X}$, which quantifies the aggregation of individuals (Boivin and Sauriol, 1984).

In the regression equation $\dot{X} = bo + b_1\overline{X}$, there are two parameters that describe the type of spatial distribution of the organism : The y-intercept of the regression line (bo), that is, the index of basic contagious, and the slope of the regression (b_1) which is the density contagiousness coefficient. The first of these parameters characterises the basic unit of the population, whereas the second characterises how the basic unit is distributed in space (Iwao and Kuno, 1971).

The significance of these parameters are already described (Boivin and Sauriol, 1984).

RESULTS AND DISCUSSION

The dispersion statistics of *Cercospora capsici*-leaf lesion obtained following Iwao's regression technique (Table 1) showed that there exist a relationship between mean crowding ($\dot{X}$) and mean density ($\overline{X}$) for the incidence of Cercospora leaf spot (Boivin and Sauriol, 1984).

When the pooled data from all varieties were considered regression of ($\dot{X}$) on ($\overline{X}$) were significant for all varieties confirming the existence of relation between ($\dot{X}$) on ($\overline{X}$). Four plant extracts namely Neem, Tulsi, Garlic and Ginger and these extracts treated data were pooled and compared with the pre plant extract pooled as well as data from individual variety. Regression analysis showed that plant extract application did not alter the pattern of distribution as no significant difference were observed between the regression parameters tested using the t-test at 0.05 level of significance.

Table 1 : Regression statistics of the mean crowding ($\dot{X}$) on mean density ($\overline{X}$) for each of the six varieties for three growth stages and pooled data from three growth stages, botanical extract treated and all varieties

Experimental sites/Treatments	Variety	Intercept (a)	Slope (b_1)	Correlation (r)	No. of sampling
Plant growth stages					
Nursery	V_1	1.2	3.1	0.80*	5
	V_2	1.5	2.9	0.75*	5
	V_3	1.9	5.1	0.69*	5
	V_4	1.8	2.8	0.53*	5
	V_5	1.1	3.0	0.89*	5
	V_6	2.1	5.2	0.90*	5
Vegetative	V_1	1.7	2.4	0.79*	5
	V_2	1.3	2.7	0.75*	5
	V_3	1.4	3.3	0.69*	5
	V_4	1.6	3.6	0.71*	5
	V_5	1.0	5.5	0.66*	5
	V_6	1.5	3.8	0.72*	5
Flowering	V_1	1.3	2.5	0.91*	5
	V_2	1.7	3.5	0.90*	5
	V_3	0.9	2.7	0.60*	5
	V_4	1.7	3.9	0.62*	5
	V_5	1.8	4.1	0.70*	5
	V_6	1.3	3.6	0.62*	5
All growth stages pooled	V_1	1.4	3.1	0.63*	15
	V_2	0.8	5.2	0.81*	15
	V_3	0.9	4.9	0.82*	15
	V_4	1.3	5.1	0.80*	15
	V_5	0.7	5.2	0.60*	15
	V_6	0.9	3.8	0.71*	15
All botanical treated pooled	V_1	1.3	4.5	0.75*	15
	V_2	2.1	3.9	0.81*	15
	V_3	1.9	4.5	0.79*	15
	V_4	0.9	2.7	0.66*	15
	V_5	0.8	1.9	0.68*	15
	V_6	1.9	5.1	0.83*	15
All varieties pooled	–	2.9	3.5	0.95*	15

r – statistically significant at 0.05 (*).

For the conduct of dispersion pattern of leaf lesion in chilli data from all varieties were pooled and regression equation ($\dot{X}$) = 2.913+3.523 ($\overline{X}$) (r = 0.95, P = 0.01) was presented in Table 1. The regression was highly significant and it covered the range of

disease intensity caused by *Cercospora capsici*. Therefore, these parameters were used in the sequential sampling plant. The intercept (bo = 2.913) and the slope (b_1 = 3.523) values were significantly different from 0 & 1. With an error level of 0.1, this sampling plant calls for a maximum of 58 sample as determined by the maximum sample equation.

This sampling plant may be used by counting the number of lesions on the sample number of leves obtained randomly and plotting the cumulative number of lesions on the y-axis after each sample.

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