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Epidemiology of Bacterial Leaf Stripe Disease of Arecanut Palm

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Abstract. Bacterial leaf stripe caused by *Xanthomonas campestris* pv. *arecae* is a disease of arecanut palm (*Areca catechu* L.) in Karnataka, India. Disease outbreaks are confined to the monsoon season, i.e., July to October. Studies on the epidemiology of bacterial leaf stripe showed that disease incidence and severity are high when there are more than ten rainy days per month in the period from July to October, with an average of 130 mm of rain during the month. High temperatures reduce disease occurrence but a temperature range of 17.5° to 25.5°C, combined with the high rainfall, causes a heavy disease incidence.

Introduction

A bacterial disease of arecanut palm (*Areca catechu* L.) has been reported from the inland plains of Karnataka State. It causes watersoaked, 1–2 mm wide linear lesions or stripes, with a copious bacterial exudation on the undersurface of the leaflets resulting in severe blighting of the leaves. Earlier publications reported the isolation and identification of the bacterial pathogen *Xanthomonas campestris* pv. *arecae* (Kumar, 1981; Rao and Mohan, 1970). The present studies were carried out to investigate biometeorological variables in order to predict disease incidence and its severity under field conditions.

Materials and methods

Data were collected from the Research Institute orchard during 1974–78. Disease intensity, i.e. total leaf area affected by bacterial leaf stripe, was recorded periodically at various stages of growth. The inoculum was obtained from naturally occurring stripe disease on adjacent palms. During the summer months the plants were flood irrigated once in fifteen days to supplement soil moisture. The annual recordings from 1974 to 1978 consisted of qualitative and quantitative data of weather factors like maximum temperature, minimum temperature, rainfall etc.

To simplify comparison of disease intensity (severity) with climatic variations and to minimise errors in correctly ranking the years, the average percentage disease intensitites have been grouped and converted to a 0–4 disease index.

Method of scoring disease severity

Field assessment of disease incidence was measured as the number of affected palms in the orchard.

Individual leaflets in the frond represented the sampling units and they were rated for disease intensity based on the leaf area affected.

Periods and amounts of rainfall were recorded regularly during the period of observation. Temperature (maximum and minimum) was measured with a sheltered maximum and minimum thermometer and the data presented in Table 1.

TABLE 1. WEATHER DATA DURING 1974–78

Year	Month	Mean temperature Maximum H	Maximum L	Minimum H	Minimum L	No. of rainy days	Total rain (mm)	% Disease incidence
1974	January	32.0	25.5	16.0	11.0	–	–	–
	February	32.0	25.0	17.0	10.5	–	–	–
	March	34.0	29.0	24.0	12.0	–	–	–
	April	36.0	28.0	23.5	18.0	3	28.6	1
	May	36.0	25.5	25.0	17.5	15	201.5	1
	June	32.0	25.0	21.0	18.0	6	55.4	1
	July	30.0	22.0	22.0	18.0	10	146.6	4
	August	29.5	25.0	21.5	18.0	9	53.9	6
	September	30.0	24.0	21.0	14.5	17	211.9	15
	October	28.5	23.5	21.5	9.7	13	249.3	26
	November	28.5	22.0	21.5	9.5	–	–	20
	December	28.5	23.5	18.5	8.0	–	–	12
1975	January	30.0	23.0	17.5	8.0	–	–	–
	February	32.5	24.5	21.0	12.0	1	6.2	–
	March	34.5	25.5	22.0	13.5	1	17.6	–
	April	35.5	25.0	23.0	18.0	2	25.6	1
	May	34.5	24.0	23.0	19.0	11	101.9	2
	June	31.5	25.0	22.0	18.5	9	54.6	4
	July	29.0	25.0	21.5	19.0	14	323.9	15
	August	28.5	22.0	22.0	18.0	12	134.4	25
	September	29.5	23.0	21.0	17.5	20	321.5	31
	October	30.0	22.0	20.0	17.5	10	224.4	37
	November	29.0	19.5	20.5	10.5	6	131.2	35
	December	27.0	23.0	17.5	8.0	1	8.0	15
1976	January	27.0	22.5	15.0	7.5	–	–	–
	February	31.5	24.0	16.0	11.0	–	–	–
	March	35.0	32.0	22.0	12.0	–	–	–
	April	36.0	27.0	22.0	17.5	7	95.8	1
	May	35.5	30.0	16.0	11.0	6	58.5	1
	June	32.5	29.7	21.0	17.5	4	8.7	1
	July	33.5	24.0	21.5	18.0	9	55.3	2
	August	30.5	25.5	21.0	18.0	14	143.2	3
	September	31.0	25.0	21.0	16.0	8	111.2	8
	October	32.0	23.5	22.0	16.5	4	50.6	10
	November	29.5	20.0	21.5	11.5	10	79.8	10
	December	29.0	23.0	17.0	11.0	–	–	6
1977	January	30.0	22.0	22.0	11.0	–	–	–
	February	34.0	21.0	21.0	13.0	–	–	–
	March	35.0	31.0	21.0	15.0	2	12.0	–
	April	37.0	30.5	24.0	19.0	6	61.5	1
	May	35.0	27.0	24.0	18.5	9	163.5	1
	June	31.5	25.0	21.0	19.0	7	138.8	1
	July	32.0	20.6	23.0	19.0	15	73.0	3
	August	29.0	22.0	21.0	19.0	4	170.0	3
	September	31.5	25.5	22.0	18.0	8	119.6	6
	October	32.0	23.0	21.0	14.5	12	153.7	11
	November	29.5	23.0	20.0	15.0	6	53.3	10
	December	28.5	25.0	17.0	10.5	–	–	6
1978	January	27.5	27.0	10.0	8.0	–	–	–
	February	30.5	29.5	20.0	14.0	1	1.6	–
	March	32.0	31.5	22.5	14.0	–	–	–
	April	33.2	32.5	23.0	18.5	6	38.0	1
	May	31.7	27.5	24.0	16.0	5	109.6	1
	June	29.0	27.0	22.0	18.0	12	35·9	1
	July	26.5	24.2	20.5	18.0	14	125.1	2
	August	26.7	25.0	21.0	18.0	12	109.8	3
	September	26.0	24.5	21.0	18.0	9	224.6	8
	October	28.0	26.0	21.5	16.5	10	158.8	12
	November	25.7	25.2	21.5	11.5	2	39.2	10
	December	24.0	23.5	20.0	10.5	3	34.4	7

Results

Rainfall in relation to disease

The results suggest that when there are more than ten rainy days per month on average during the period from July to October, with 130 mm rain during the month, disease incidence and severity was found to be high. During July to October 1975 there were 56 rainy days with a precipitation averaging 251 mm per month resulting in a heavy incidence of 37% at the end of the period. Incidence was much lower during the corresponding period during the years 1974, 1976, 1977 and 1978 (Fig. 1). The correlation between disease incidence, mean maximum and minimum temperature and total precipitation is presented in Table 2.

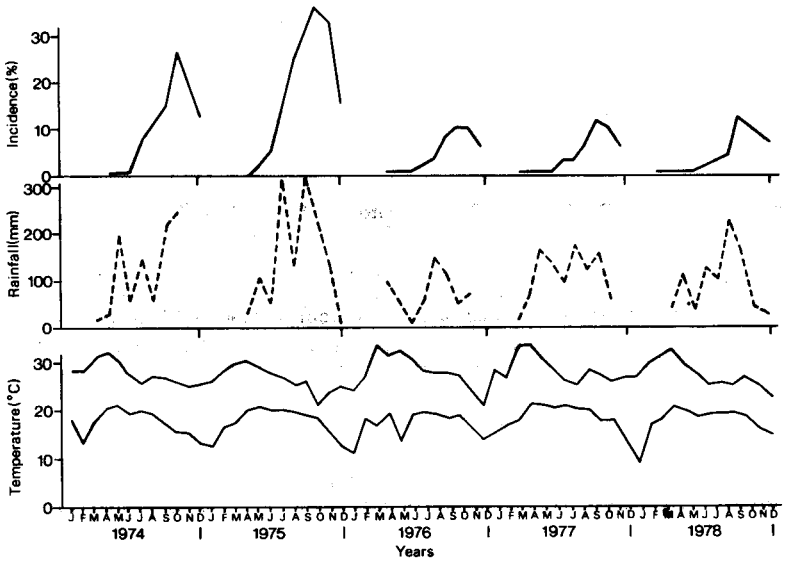

Fig. 1. Maximum and minimum temperatures, rainfall and disease incidence during 1974–78.

TABLE 2. CORRELATION COEFFICIENTS BETWEEN RAINFALL, TEMPERATURE AND DISEASE INCIDENCE DURING 1974–78

Year	Rainfall/Disease incidence (April–December)	Temperature/Disease incidence (January–December)
1974	+0.6503	+0.5757
1975	+0.8182	+0.2727
1976	+0.5734	+0.1399
1977	+0.4860	−0.9990
1978	+0.7480	−0.9860

Temperature in relation to disease incidence

The attempts to relate the average daily temperature (maximum and minimum) with disease occurrence showed that high temperatures reduce disease occurrence. During the year 1975 the period from July to October showed an average maximum of 25.5°C and a minimum of 17.5°C. It is this particular temperature range combined with high rainfall which resulted in heavy incidence (see Fig. 1). The correlation worked out has been positive for the years 1974, 1975 and 1976 and negative during the years 1977 and 1978.

Discussion

Reasonable success has been achieved in developing models based on biometeorological variables which can predict the severity of many of the well known diseases (Chester, 1946; Krause *et al.*, 1975; Stevens, 1934).

In many cases the effects of high, low or moderate temperatures are restricted (Adegbola and Hogedorn, 1969; Coakley, 1978; Hoch *et al.*, 1975; Pieczarka and Abawa, 1978). Description and accurate analysis of the dynamic process of increase of plant disease in time is needed to compare epidemics (Berger, 1981). The need to reach a specific disease severity is some times taken as a parameter to compare epidemics. Under Karnataka conditions it is generally seen that epiphytotics of bacterial leaf stripe of arecanut palm are confined to the monsoon season (July to October). It is of little importance during summer months. Though summer temperatures are known to inhibit stripe disease of arecanut, they do not eradicate the disease and activity will be renewed when the conditions become normal. Meteorological conditions which result in high humidities, moderate temperature and adequate free moisture will possibly enhance leaf infection and also the rate of lesion expansion. At high temperatures, regardless of rainfall and humidity, low infection rates occurred. It is assumed rather arbitrarily, that intermittent rains during July to December combined with longer leaf wetness and humidity would help infection and spread. Most wet periods that appeared favourable for bacterial leaf stripe development, but failed to give detectable infection, occurred during many years where infection was caused by primary inoculum. Environmental variations have increased the frequency and severity of stripe disease in recent years.

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