A study on the weather associated with the abnormal leaf fall disease of rubber *(Hevea brasiliensis)*

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ABSTRACT

The meteorological factors associated with the triggering of the abnormal leaf fall caused by *Phytophthora spp.* in rubber *(Hevea brasiliensis)* plantations are presented. An out break invariably follows a five-day rain spell with an overcast day. The epidemics can be expected within 9-15 days after the first overcast day, depending on the onset of South West monsoon.

Introduction

Abnormal leaf fall caused by different species of *Phytophthora* is the most serious disease of rubber, in which mature leaves drop while still green or turning coppery red. This disease causes considerable crop loss every year. In South India, severe defoliation occurs annually in June-July, coinciding with the South-west monsoon period. This disease incidence is closely correlated with pod infection which occurs in May-June just after the onset of monsoon. Sanitation with copper fungicide as prophylactic treatment has been found necessary (Radhakrishna Pillai, 1977) to retain a reasonable canopy and to avoid severe depression in yield.

Weather plays an important part in disease management (Fry, 1982), since the severity and timing of attack is often linked to certain sequences of weather events and the optimum timing of control measures may also be deduced from a combination of meteorological data and crop observations. Since every process of either the plant or the pathogen is influenced by micro-climate (Aust and Hvene, 1986; Waggoner, 1965), identification of optimum conditions are beneficial.

A careful study under field conditions would often indicate the reasons for the epidemic incidence of a plant disease and methods of reducing its intensity (Berger, 1977; Waggoner, 1965). Waiste (1973) and Perise (1969, 1973, 1979) studied the epidemiology of *Phytophthora* under the agroclimatic conditions of Malaysia and Sri Lanka respectively. However, under South Indian conditions Radhakrishna Pillai, *et al.* (1980 a) noticed that prolonged rains and cloudy weather are favourable for *Phytophthora*. The present study is attempted to critically examine the weather association with the abnormal leaf fall at Kottayam.

Materials and Methods

The biological symptoms of the triggering of the abnormal leaf fall in the unsprayed field of the Rubber Research Institute of India, Kottayam were observed during May-August, 1934 to 1986. The meteorological parameters such as, rainfall, temperature, humidity, sunshine and wind were recorded. The microclimate inside and also in the border of the plantation during 1985-86 was also recorded. The moving graphical technique was followed to identify the favourable weather conditions triggering the abnormal leaf fall.

Results and Discussion

The rainfall pattern indicates (Fig. 1 a) that the onset of South West monsoon was on 14th June. A continuous spell of rains provided the surface moisture on rubber trees which is essential to cause infection of the Hevea leaf petiole. This indicates the necessity of a minimum quantum of rainfall (112 mm) with at least 1.0 mm (light shower) per day for a period of five consecutive days

The fluctuation in minimum temperature (Fig, 1 a) was comparatively lesser than maximum temperature. The minimum temperature during the first five-day rainspell was 22.7°C and the mean temperature was 29.3°C. However, the lowest minimum temperature recorded was 21.8°C.

The fluctuation in relative humidity (Fig. 1c) shows that the maximum humidity level was below 90 per cent upto the onset of the monsoon. Then, it increased to above 93 per cent which favoured the pathogen, indicating the optimum for *Phytophthora* propagation. Low temperature together with high humidity are congenial for development of *Phytophthora*.

The overcast sky (Fig. 1 b) with moist weather promotes the fungal multiplication. It was further noticed that the severity of this fungus depends on the number of overcast days. This may be the probable reason for the severe attack in Trichur region and lesser incidence in Kanyakumari region. Further, with four consecutive overcast days, second attack was observed during the middle of August 1986.

Fig. 1 d indicates that the wind speeds of the order of 2-4 km ph occurred at the time of the triggering of the disease.

A combination of meteorological factors associated with the triggering of *Phytophthora* are indicated in Table-1. The meteorological factors were more specific at the beginning of the incubation period. The incubation period varies from 10 days (late onset, 1986) to 14 days (normal onset, 1984 and early onset, 1985) depending on the onset of South West monsoon. Moreover, the beginning of the incubation period coincided with the first appearance of overcast sky. A comparison with earlier schemes by Peeries (1979) and Radhakrishna Pillai, *et al*. (1980 a) indicates that the present study more clearly defines the weather association with the abnormal leaf fall

A comparison of microclimate inside and outside the plantation (Table-2) indicates that the low thermal and high moisture (Humidity) regimes which are

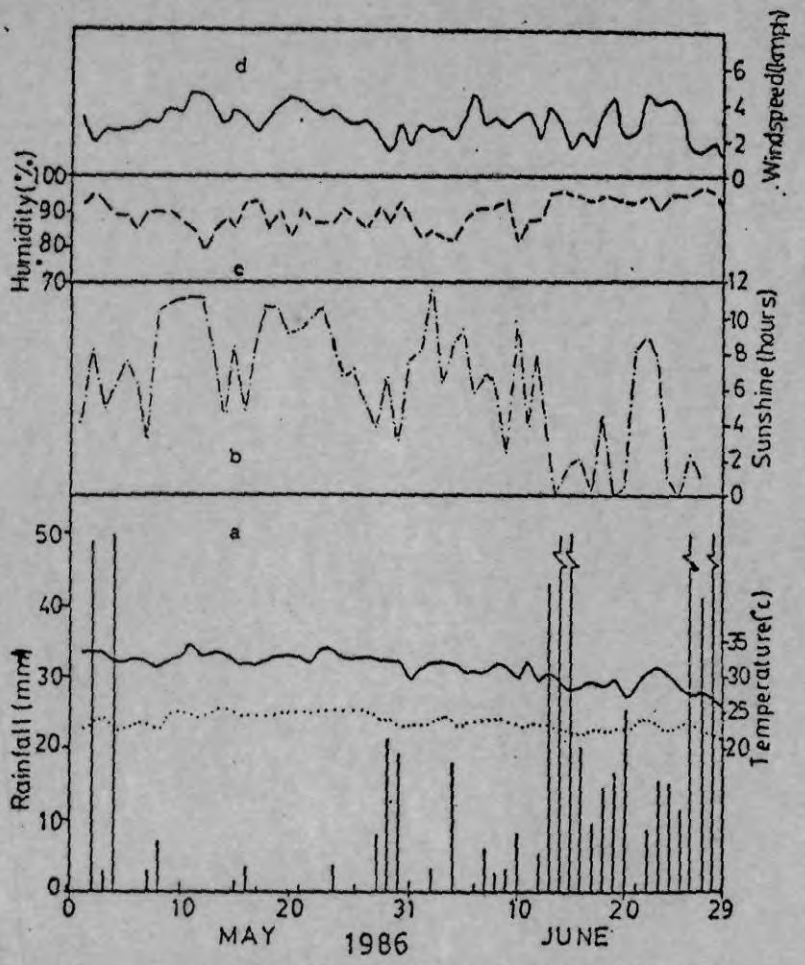

Fig. 1. METEOROLOGICAL FACTORS ASSOCIATED WITH THE TRIGGERING OF THE ABNORMAL LEAF FALL OF HEVEA CAUSED BY PHYTOPHTHORA spp.

a. RAINFALL AND TEMPERATURE (MAX. & MIN)
b. SUNSHINE DURATION
c. MORNING RELATIVE HUMIDITY
d. WINDSPEED

favourable conditions for disease establishment prevail inside the plantation. There was no appreciable difference in thermal and moisture conditions in the border of the estate and outside. Intense rain provided the pathogen from the overlying diseased pods and twigs and also underlying soil at a fast rate at the edge of the plantation. Whereas, the *Hevea* canopy intercepts the rain, reduces the intensity and thus causes low sporangia dissemination inside the plantation. Further, low wind speed which causes less spread of sporangia, seems to be the major factor influencing the outbreak of *Phytophthora*.

Table 1. Weather associated with the occurrence of abnormal leaf fall of *Hevea* caused by *Phytophthora*. The values in the parenthesis indicate the lowest observed value during the five day rainspell with 1.0 mm or more rainfall.

Year	First rainspell		Temperature (°C)		Humidity (%)		Sunshine (Hours)	Triggering on
	Date	Total (mm)	Max.	Mini.	Max.	Mini.		
1984	31 May	163.5	29.9	22.8	94	70	2.2	19 June
	04 June		(28.7)	(22.0)			(0.0)	
1985	23-27 May	112.0	30.7	22.7	93	71	3.8	5 June
			(28.5)	(22.0)			(0.0)	
1986	06-10 June	21.6	31.1	23.7	90	65	6.3	
			(29.9)	(22.9)			(2.5)	
	12-16 June	221.3	29.3	22.7	94	76	3.5	25 June
			(27.8)	(21.8)			(0.1)	

Table 2 Comparison of meteorological conditions within the *Hevea* plantation (a) to that of the open field (b)

Year	Period	Temperature (°C)		Humidity (%)	
		Max.	Mini.	Max.	Mini.
	A	28.8	21.7	96	78
1985	23-27 May				
	B	30.7	22.7	93	71
	A	30.8	23.2	94	70
1986	6-10 June				
	B	31.1	23.7	90	65
	A	28.2	22.2	95	83
	12-16 June				
	B	29.3	22.7	94	76

A. Rubber Plantation B. Open Field

Under the agroclimatic conditions of Kottayam, the weather associated with the initial triggering of the abnormal leaf fall are as follows: A rain spell of five consecutive days with at least 1.0 mm per day with a cumulative total of 112 mm or more accompanied with (a) the mean air temperature of 26.5 $\pm$ 0.5°C (b) the minimum temperature of 22.5 $\pm$ 0.5° (c) the mean relative humidity of greater than 80 per cent, in which it is more than 93 per cent in the morning and (d) at least one overcast day; then the epidemics can be expected to appear at the edge of the plantation after 9 to 15 days from the overcast day if the inoculum is present on the tree parts.

The critical weather parameters obtained in this study for triggering abnormal leaf fall disease will be useful for the control of this disease effectively and economically using systemic fungicides.

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