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Seasonal and diurnal changes of two leaf pathogens of Rubber (Hevea brasiliensis Muell. Arg.) in the air of Iyanomo, Nigeria

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Air spore concentrations of *Drechslera hevea* Petch and *Colletotrichum gloesporoides* Penz were studied in a rubber nursery, over a 12-months period, from March 1976 to February 1977, using both the exposed nutrient medium technique and Rotorod samplers. Both methods showed seasonal changes in the spore concentrations of these organisms throughout the year. The spore concentrations of *D. hevea* were consistently higher than those of *C. gloeosporoides*. The highest spore concentrations were recorded in February and August for *D. hevea* and *C. gloeosporoides* respectively.

In both cases there were diurnal fluctuations, with peaks occurring between 12.00h and 14.00h. The effect of environmental factors on these changes in discussed.

INTRODUCTION

Drechslera hevea and *Colletotrichum gloeosporoides* respectively cause 'birds-eye' and 'gloeosporum leaf' spots in the rubber nursery in Iyanomo, Nigeria. The devastating effect of these infections lies in the reduction of leaf photosynthetic area leading to premature defoliation and the ultimate death of rubber seedlings. For a thorough understanding of the epidemiology of these diseases, knowledge of the concentrations of their conidia in the air over a year is necessary. Surveys of their presence in the air have been very limited in Nigeria.

Dransfield (1966), using a petri dish traping technique at Samaru, Northern Nigeria, has observed that *Dreschlera*, among other fungi, occurred in the air at a fairly even concentration throughout the whide year. The need for studying the spore con-

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centrations of *D. hevea* and *C. gloesporoides* has been first mentioned by Hilton (1922) in Malaysia.

In this study both seasonal and diurnal fluctuations of *D. hevea* and *C. gloesporoides* have been investigated.

MATERIAL AND METHODS

Nursery air was sampled using the nutrient medium technique and the Retored samplers.

Nutrient Medium Technique

Potato Dextrose Agar (PDA), acidified with 1% acetic acid (to inhibt bacterial growth), was used as the growth medium. Two sets eight plates each, were exposed in two main nurseries in Iyanomo. Another net of eight plates was exposed under a nature plantation. This was to find out whether the presence of relatively disease--free leaves of rubber 'weed' seedlings was due to the absence of viable spores in the plantation air. All exposures were made at 09.00h for a 30 mins' period on a platform 1.52 m above ground. Plates were exposed three times a week (Monday, Wednesday and Friday) from March, 1976 to February, 1977. The plates were incubated immediately after exposure for four days at room temperature (28±2°C) before being examined. Fungal spores from all colonies were studied under the microscope (×40), measured and identified. Colonies of *D. hevea* and *C. gloeosporoides* were then counted and their number expressed as mean concentration percentage. The eight plates exposed under the mature plantation were similarly treated.

Rotorod samplers

In the second method, the Rotorod metronic sampler was used, using "1" shaped rods as the collector rods. Two such samplers were operated for 30 minutes, one in the open air nursery and the other under the mature rubber plantation at a height of 1.52 m.

The concentration of spores per unit volume was calculated using the formula:

Spores/Volume (litre) = Total spores
= Total volume
= Total spores
2400×0.05×30.

Diurnal test

Both methods were used to determine diurnal rhythms in *D. hevea* and *C. gloeosporoides.*

Four PDA plates were exposed for a 30 min period at 2-hours intervals from 06.00h to 22.00h. At the end of each sampling, plates were incubated at room temperature 28±2°C for four days before they were examined. With the Rotorod sampler, air was sampled for 30 min at 2-hours intervals from 06.00-22.00h.

Relative air humidity and temperature at the sampling site were recorded with a thermohygrograph, while rainfall was daily recorded with casella rain gauge.

RESULTS

Throughout the 12-months air sampling period, using the PDA plate exposure method, *D. hevea* and *C. gloeosporoides* were consistently trapped, the former with higher concentrations than the latter at any given time. *C. gloeosporoides* had maxima peaks in August, November and February, while *D. hevea* in August and February (Fig. 1).

Table 1

Spore concentration under mature plantation (shaded) and in the open air nursery (unshaded) using both PDA and rotorod samplers

Month of sampling	*D. hevea*		*C. gloeosporoides*	
A) PDA method:	Average No. of colonies per 30 minutes plate exposure			
	shaded	unshaded	shaded	unshaded
November	35	40	13	6
December	10	38	1	0
January	26	63	0	0
February	142	156	3	5
B) Rotorod sampler:	Average spore concentrations per unit volume			
August	100	500	0	0
September	60	460	0	0
October	40	360	20	140
November	100	490	160	170
December	140	470	10	50
January	200	530	12	80
February	410	600	230	230

Monthly spore concentrations from November, 1976 to February 1977 under a mature plantation (under shade) gave a lower number of colonies for both *D. hevea* and *C. gloeosporoides* than the air of the open nursery (Table 1A).

Also Rotorod sampling showed *D. hevea* spores to be abundant in the air in August, November and February, while *C. gloeosporoides* had maxima peaks in November and February. Spore catches under shade for both *C. gloeosporoides* and *D. hevea* were lower than those in open air (Table 1B).

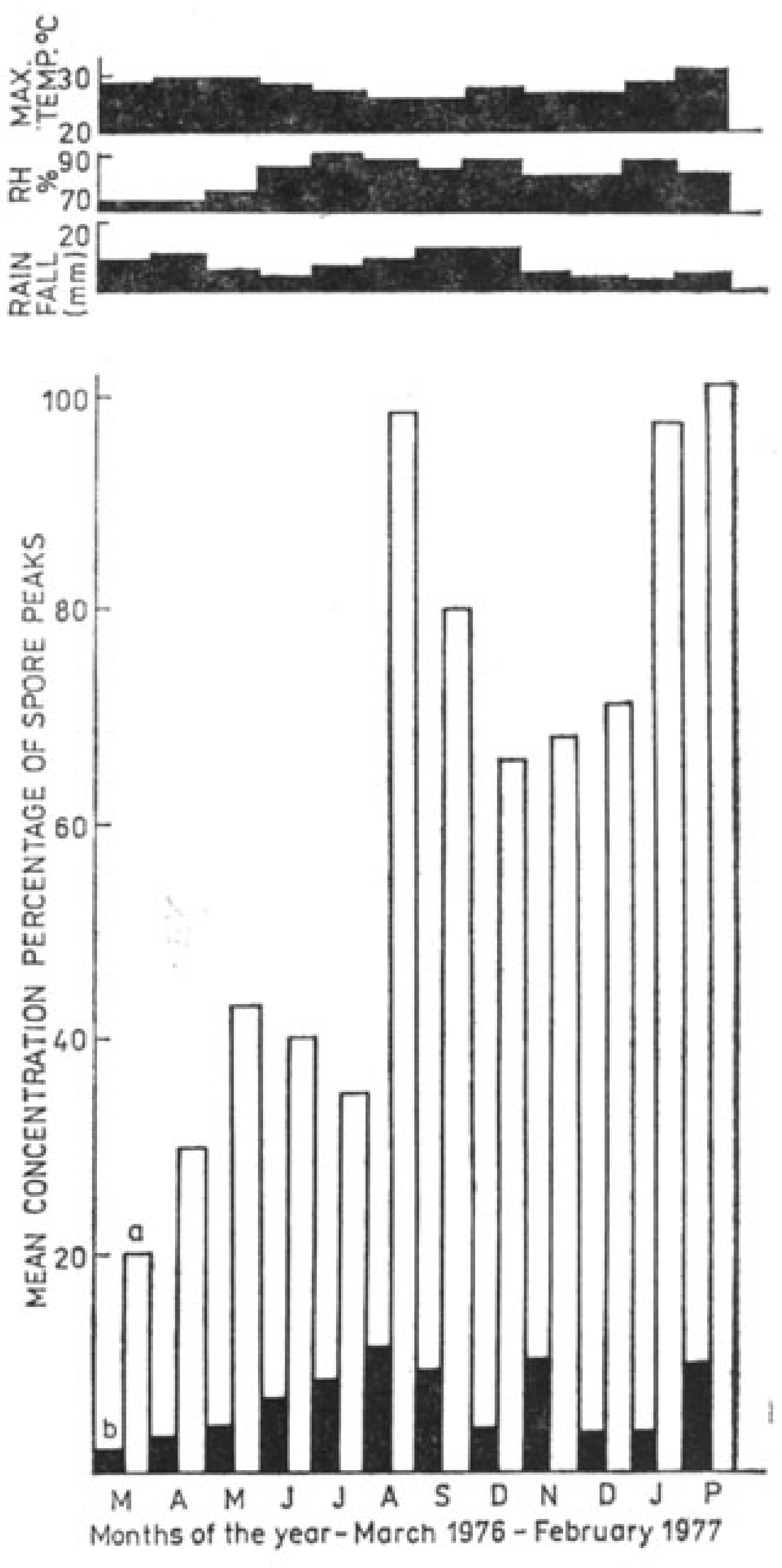

Fig. 1. Seasonal rhythms of *D. hevea* (*a*), *C. gloeosporoides* (*b*)

Diurnal records using both methods indicated that both *D. hevea* and *C. gloeosporoides* have diurnal rhytms with maximum spore concentration in the air between 10.00-14.00h (Fig. 2). Average monthly rainfall and relative humidity showed significant variation throudhout the year while mean maximum temperature was relatively constant. This was correlated to seasonal spore concentrations.

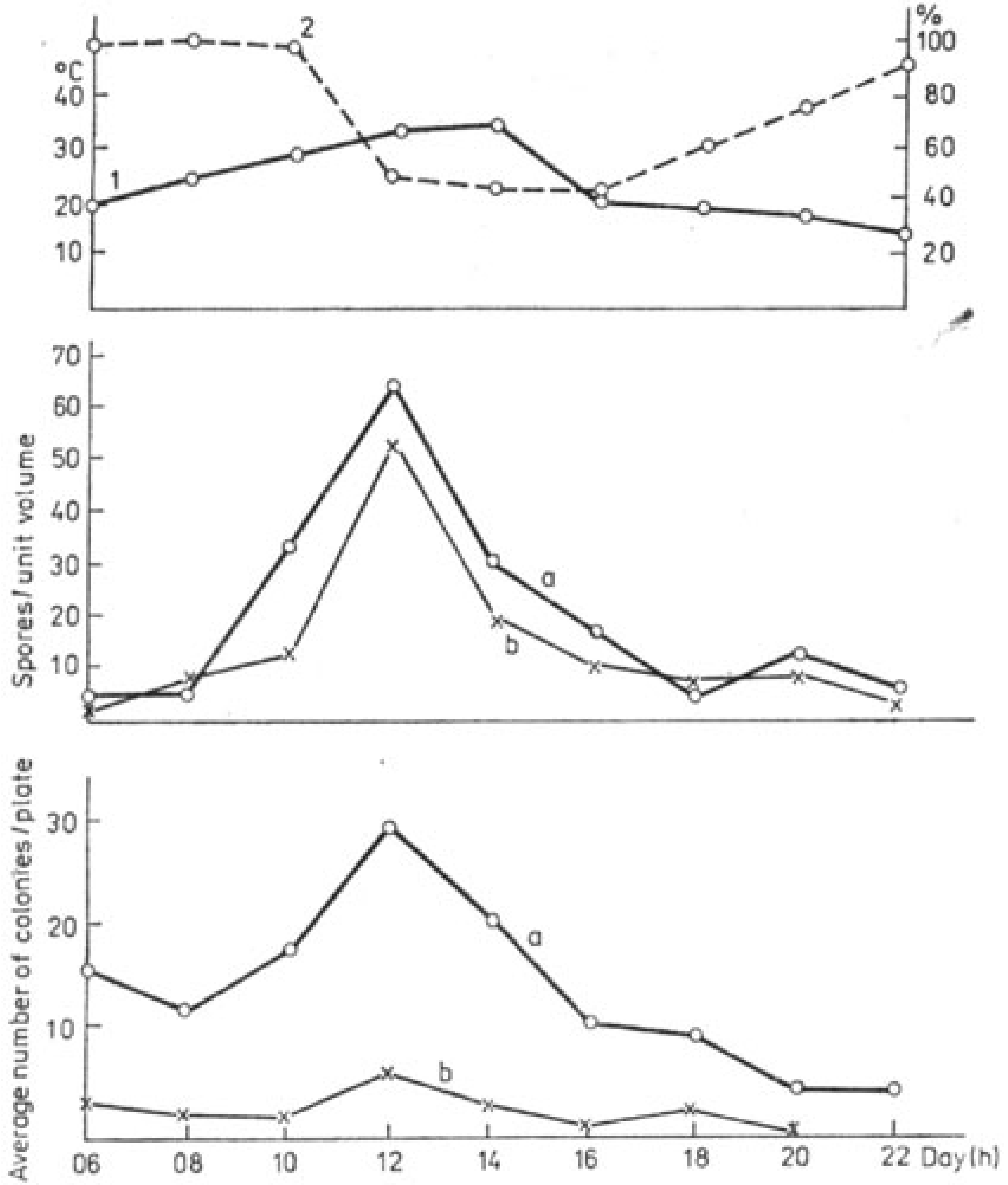

Fig. 2. Diurnal fluctuation test using Rotorod sampler (Spores/unit) and PDA (Average number)
Each graph is an average of three replicates *1* — temp. °C, *2* — Rh %; *a* — *D. hevea*; *b* — *C. gloeosporoides*

DISCUSSION

The investigations show that at any time of the year spores of *D. hevea* are more abundant in the air than *C. gloeosporoides*. This observation in consistent with the higher incidence of birdseye leaf spot (caused by *D. hevea*) than gloeosporium leaf spot (caused by *C. gloeosporoides*). The seasonal peaks of *D. hevea* occur (both in wet (July-September) and dry (November-February) seasons. The wetseason peaks probably reflect the stimulation of sporulation of these organisms by heavy rainfall followed by favourable for them high humidity. Also in the rainy season fresh leaves are formed which can be easily attacked by these pathogens. Infections lead to subsequent spore production and dissemination. The effect of rain on spore discharge is however, complex. Large raindrops not only help tosplash spores into the air, but also cause considerable stem vibration and leaf flutter which may intensity spore liberation (Ingold 1971). During the dry season in Iyanomo, the air during early morning hours is very humid (r. h. 80+%). Such high r.h. induces spore discharge (Rockett et Kramer 1974; Zoberi 1964). Fresh flushes of rubber leaves which appear between January and February are from observation, always highly infected. Thus, the relatively high spore peak in the air in February correlates with the heavy infection of young rubber leaves during this period.

Both organisms show diurnal oscilations with maxima peaks between 10-14h. These occur when r.h. of the air is low (40-60%). Fall in r.h. and increase in temperature can be factors responsible for these diurnal rhythms. Most conidia are discharged into the air when the ambient temperature is relatively high (Ingold 1971). Spore discharge rhythms of components of air spore have been found to be clearly related to the oscilations of environmental factors that influence the spore release. One of these is the rapid drying of the air near the ground shortly after sunrise (Ingold 1971). Also Meredith (1961, 1962) has found that in *Deightoniella torulosa* and *Cordana musae*, the steep rise in the concentrations of their spores in the air just after dawn is associated with a sharp decline in the relative humidity of the air. These results are different from those of Wastie (1972) who has found conidia peak at 2300h. This can be due to ecological differences between Malaysia, where that work has been done, and Nigeria. For example fresh flushes of rubber leaves occur in April in Malaysia (Wastie 1972) while it is in February in Nigeria.

The observed reduction of spores catches under shade perhaps explains why leaves of rubber 'weed' seedlings under the plantation are relatively free from leaf spots. It has been already reported that light intensity of 20% or more greatly reduces the incidence of leaf diseases (Hilton 1952; Ayanru et Otoide 1972). The low spore number under shade, could be govern by the fact that the canopies of mature trees in the plantation act as physical barriers in the deposition process of spores. However, more work is needed for a full understanding of the phenomenon.

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