Pertanika 9(2), 147 – 150 (1986)

Diurnal Periodicity of Spore Discharge in *Ganoderma boninense* Pat. from Oil Palm in Malaysia

Y.W. HO and A. NAWAWI [1]
Department of Biology,
Faculty of Science and Environmental Studies,
Universiti Pertanian Malaysia,
43400 Serdang, Selangor, Malaysia.

Key words: ***Ganoderma boninense;*** **oil palm; diurnal periodicity.**

ABSTRAK

Penyampelan spora dengan perangkap spora Hirst dalam satu kawasan kelapa sawit yang telah dijangkiti oleh G. boninense *menunjukkan jumlah bilangan spora* G. boninense *rendah pada waktu siang terutama pada jam 12.00 – 16.00 dan tinggi pada waktu malam dari jam 22.00 – 06.00; tertinggi pada tengah malam. Penyampelan dengan menggunakan higrotermograf yang diubahsuai dan perangkap spora Hirst untuk memerangkap spora-spora yang terdapat daripada setiap sporofor yang dikembangkan dari batang kelapa sawit di Taman Botani, University Malaya, yang telah dijangkiti oleh parasit ini, menunjukkan pola yang serupa seperti di atas. Dengan menggunakan suhu 26 – 28°C dan kelembapan relatif (85 – 90%) dalam makmal perubahan periodisiti diurnal pembebasan spora tidak berlaku.*

ABSTRACT

Spore sampling with a Hirst spore trap in an oil palm area infected with G. boninense *showed that the concentration of* G. boninense *spores was low in the day especially from noon to 16.00 hr and was very high at night from 22.00 – 06.00 hr; the peak being around midnight. Sampling with a modified hygrothermograph and a Hirst spore trap of spores discharged from individual sporophores of* G. boninense *produced from infected oil palm trunks in the Botany Garden of University of Malaya also showed a similar pattern of nocturnal maximum and daytime minimum. Subjecting sporophores to a constant temperature of between 26 – 28°C and relative humidity of 85 – 90% in the laboratory did not result in any apparent changes in the diurnal periodicity of spore discharge.*

INTRODUCTION

It has long been recognised that *Ganoderma* species are the cause of basal stem rot in oil palm (Navaratnam, 1961, 1965; Turner, 1965a, b; Varghese *et al.*, 1976). Their spores are air-borne and are widely distributed (Turner, 1981). Disease infection has been reported to be generally through root contact with an inoculum source and air-borne spores do not play a significant role. However, it has been suggested that colonisation of cut stump surfaces of coconut was initiated by the air-borne spores (Turner, 1981) and that these colonised stumps later acted as a source of infection to young oil palms planted next to them. Very little is known on the periodicity of spore discharge of these *Ganoderma* species.

In an earlier paper (Ho & Nawawi, 1985), sporophores of *Ganoderma* from oil palms infected with basal stem rot have been identified

[1] Department of Botany, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia.

to belong to the species *Ganoderma boninense* Pat. This paper reports on the diurnal periodicity of spore discharge of *G. boninense*.

MATERIALS AND METHODS

For sampling the spore discharge of *G. boninense* two apparatuses were used. One was a modified hygrothermograph which was adjusted to collect spores and at the same time record the temperature and humidity. This apparatus gave only a rough estimate of the relative spore load at different hours of the day. A circular polythene sheet marked into 24 portions, with each portion corresponding to the hour in the graph paper of the rotating drum of the hygrothermograph, was firmly fixed to the top of the rotating drum *(Fig. 1)*. The top cover of the cabinet containing the rotating drum was removed and was replaced by a piece of waterproof material which had a slit (1 × 6 cm) in it. This slit enabled an hourly deposition of spores discharged by the sporophore on the marked polythene sheet. The polythene sheet was changed daily at 09.00 hr and spores deposited on the different hourly portions counted under a microscope.

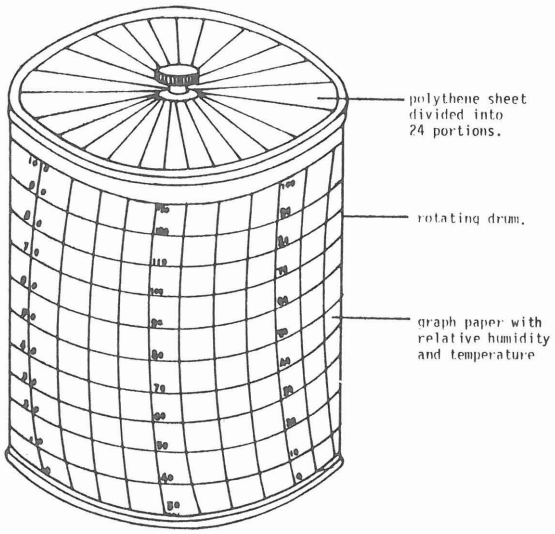

Fig. 1: Rotating drum of a hygrothermograph modified for spore sampling.

The other spore sampling apparatus was a Hirst spore trap which gave a more accurate and efficient record of the amount of spores present in a fixed quantity of air sucked in. Preparation of slides for exposure in the trap was adapted from the method by Cammack (1955) where paraffin with 1.5% ceresin wax was used. Mounting and counting of spores deposited on the slides and conversion of the counted number of spores to estimated number per m^3 of air were done according to the methods given by Hirst (1953). The slides were changed daily at 09.00 hr. All times given in this investigation are G.M.T. (Greenwich Mean Time).

The diurnal periodicity of spore discharge was observed for 30 days in 3 different localities. In the first locality, the Hirst spore trap was placed 1 m above the ground in the centre of an oil palm area infected with *G. boninense* stationed in Harrisons Malaysian Plantations Berhad (HMPB) Oil Palm Research Station, Banting. The second locality was in the Botany Garden, University of Malaya, Kuala Lumpur. The sporophores (about 1½ months old) were produced from cut portions (1 m high) of oil palm trunks infected with *G. boninense* and brought back to the Botany Garden from HMPB Oil Palm Research Station, Banting. Both the Hirst spore trap and modified hygrothermograph were used here. The Hirst spore trap was placed 15 cm away from the sporulating sporophore and the modified hygrothermograph was placed 15 cm below another sporulating sporophore about 3 m away from where the Hirst spore trap was placed. The third locality was in the laboratory and the spores (from sporophores about 1½ months old) were trapped by the same instruments mentioned above. Temperature and humidity of the laboratory were maintained between 26 – 28°C and 85 – 90% respectively throughout the experiment.

RESULTS AND DISCUSSION

Continous spore sampling with a Hirst spore trap in the *G. boninense* infected area at HMPB Oil Palm Research Station, Banting, indicated the presence of a considerable variety of fungal spores besides *G. boninense* spores and a wide

range in their frequency. *Fig. 2* shows the mean diurnal periodicity curves of *G. boninense* spores and 7 other spore types common in the air-spora of the oil palm area. The curves were dervived from the arithmetic means of the estimated number of spores/m^3 air at each hour. The values were then converted to a percentage of the highest of these arithmetic means for each spore type (Hirst, 1953). The diurnal periodicity of different spore types could be easily compared by this method of plotting. The concentration of *G. boninense* spores was low during the day especially from noon to 16.00 hr and was very high at night from 22.00 hr to 06.00 hr; the peak being around midnight. In contrast, the maximum concentration of the other 7 spore types occurred in the day — *Cladosporium, Curvularia* and *Melanconium* had their maxima at noon, *Pestalotia* and *Helminthosporium* at 14.00 hr, *Nigrospora* at 10.00 hr and *Fusarium* around 06.00 hr.

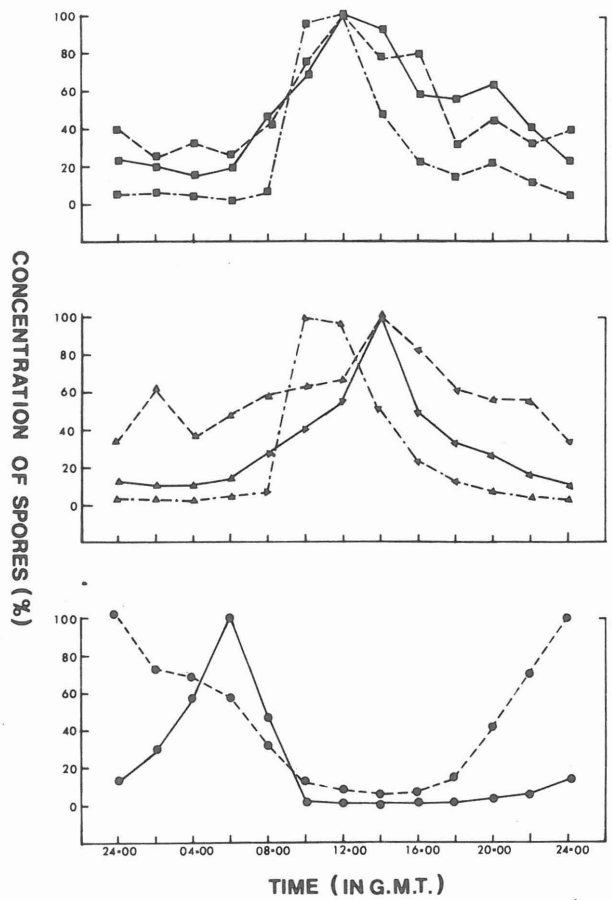

Fig. 2: Mean diurnal periodicity curves (expressed as percentage of the peak arithmetic mean concentration) of G. boninense *spores and 7 other common air-borne spores from an oil palm area infected with* G. boninense, G. boninense, Fusarium, Nigrospore, Helminthosporium, Pestalotia, Curvularia, Melanconium, Cladosporium

Results from daily sampling with a modified hygrothermograph and a Hirst spore trap of *G. boninense* spores from sporophores produced from infected oil palm trunks in the Botany Garden of University of Malaya and in the laboratory with constant temperature and relative humidity also showed a nocturnal maximum and daytime minimum *(Fig. 3)*. Sreeramulu (1963) reported a similar pattern of maximum spore discharge around midnight and minimum around noon for *G. applanatum*. However,

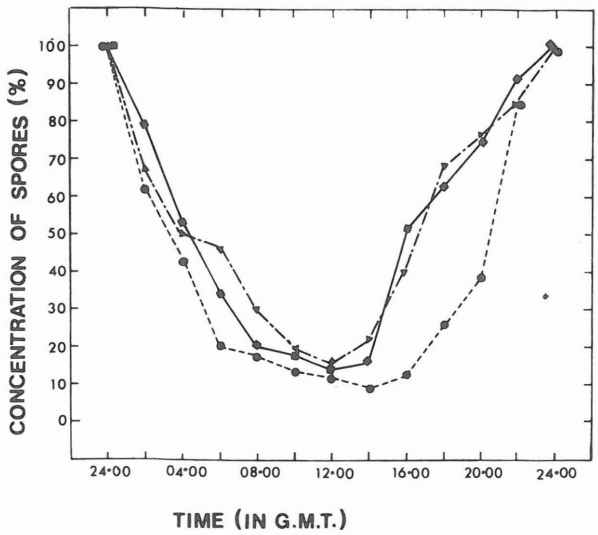

Fig. 3: Mean diurnal periodicity curves (expressed as percentage of peak arithmetic mean concentration) of G. boninense *spores from individual sporophores sampled with a Hirst spore trap, a modified hygrothermograph, and under laboratory temperature (26 – 28°C) and relative humidity (85 – 90%)*

Haard and Kramer (1970) detected a double peak pattern with maximum spore discharge occuring in the early morning and early evening for *G. applanatum* in one area but in another area, the spore release seemed to be primarily at night. Haard and Kramer (l.c.) also found that the basidiospore discharge of 19 genera of Hymenomycetes was principally at night. They suggested that environmental factors such as temperature, rainfall, relative humidity and available soil moisture might have some influence in determining the circadian pattern of basidiospore discharge. For most basidiomycetes, peak concentrations of basidiospore discharge occurred at night when the relative humidity was highest. Fewer basidiospores were released during the day as the relative humidity was lowest. As humidity increased, the concentration of basidiospores also increased correspondingly. However, results of this investigation *(Fig. 3)* showed that when *G. boninense* sporophores were subjected to near constant laboratory temperature (26 – 28°C) and relative humidity (85 – 90%) throughout the experimental period, the endogenous cyclic rhythm of spore release with a night maximum and day minimum was still unchanged. The high relative humidity maintained during the day did not result in a corresponding increase in spore discharge. This suggests that the cycle of spore discharge may not be dependent upon just one or two external factors but may require multiple and interacting environmental and endogenous factors.

ACKNOWLEDGEMENTS

We wish to thank the staff of Harrisons Malaysian Plantations Berhad Oil Palm Research Station, Banting for their cooperation and help in this investigation.

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(Received 16 January, 1986)