E-3.1 Microclimatic Formation by Plant Community

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Abstract

The study site was selected in the Pasoh Forest Reserve, Negeri Sembilan, west Malaysia Inside the Pasoh Forest Reserve, a canopy walkway system, two 30 m towers and one 40 m tower was constructed. Diurnal and seasonal changes in temperature, water vapor pressure deficit and photon flux density were measured using the canopy walkway. The differences of these climatic factors are not influenced by the seasonality but by the weather conditions of the day of the measurement.

For the estimation of the seasonality of diameter increases, 192 trees (38 species) were selected. Dendrometers were installed on tree trunks in August, 1991. The estimation of leaf dynamics of five canopy trees were stared to monitor from August, 1992. Among 190 trees, the rate of increase in diameter of 80 trees was less than 1 mm yr^{-1}, and no increase in diamter was detected in 2 of them. The growth period was different between species and individuas. *E. malaccense* increased its diameter continuously, while *D. sublamellatus* and *Shorea leprosula* showed the periodic increase. From the analyses of the interaction between precipitation and increase in diameter, the slow growing periods were found to be corresponded to low precipitation periods.

Key Words Canopy walk-way, Micro-climate, Diameter Increase, Phenology, Forest Canopy

1. Introduction

In these days, many scientist warn that the rapid declines of tropical forest influence the global climatic changes. It is reported that the annual precipitation at the tropical forest area is more than four times as great as the precipirtation at the temperate forest area and a half of the amount of precipitation is evaporated from the plant canopy and soil surface into the atmosphere. Furthermore, the tropical forest is considered to be the source of CO_2 because of the burning and logging in a large scale.

The purpose of the present study is to measure the micro-climatic factors at various sites of the tropical forest and clarify the effects of these climatic factors on the ecophysiological characteristics of key tree species. These growth parameters may provide fundamental informations on charactenstics of the tree growth in relation to the environmental factors inside the forest. For this purpose, seasonality of diameter growth, shoot elongation and leaf dynamics were measured in the present study.

2. Materials and methods

The study site was selected in the Pasoh Forest Reserve, Negeri Sembilan, west Malaysia (Fig. 1). The Pasoh Forest Reserve is 2450 ha and is a lowland Dipterocapa forest. Eight hundred

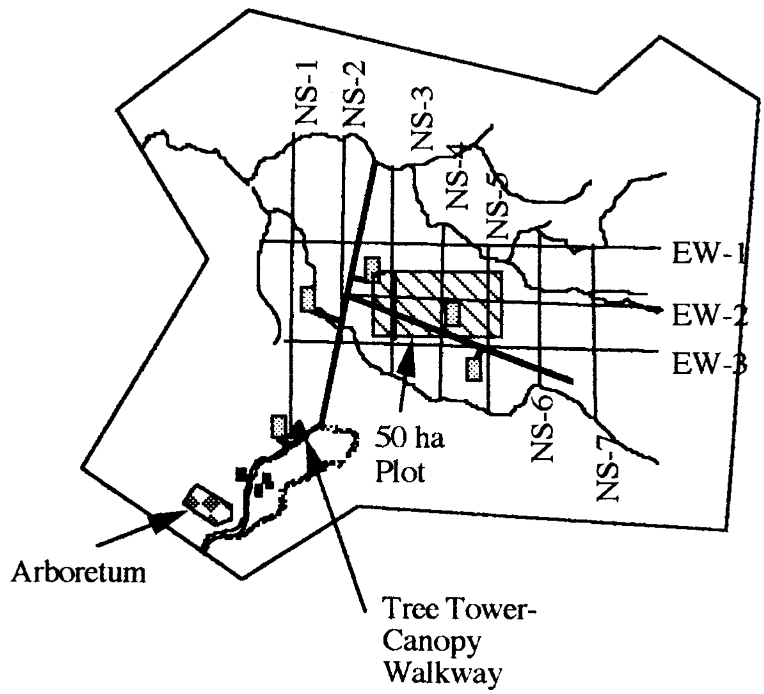

Fig. 1. The outline of the Pasoh Foresh Reserve.

hectare of the Forest Reserve was logged over in 1954 and regenerated after that. In the present, the north, south and east of the Forest Reserve is surrounded by the oil palm plantation. It is not clear whether these surrounding environment affects or not, the number of gaps is increasing in these days.

Inside the Pasoh Forest Reserve, we constructed a canopy walkway system (see Fig. 1), two 30 m towers and one 40 m tower. The walkway is set at the top of 30 m towers. The span between the towers is 20 m. Instruments for the measurements of climatic factors such as temperature, humidity, radiation, wind velocity and direction and precipitation are set at the 40 m tower.

Diurnal and seasonal changes in temperature, water vapor pressure deficit (VPD) and photon flux density (PFD) were measured using the canopy walkway. For the measurement of PFD, a LI-COR quantum sensor was used. VPD was calculated from the atmospheric temperature and humidity. Temperature was measured by a fine wire thermo-couple and humidity was measured using a Visala Humi-Cap.

For the estimation of the seasonality of diameter increases, 192 trees (38 species) were selected from a 2 ha plot (Plot 1). An aluminum belt dendrometer was installed on each trunk in August, 1991. Changes of stem diameter was monitored using dendrometers. At the end of JuIy, 1992, the measurement were continued for 170 trees. The estimation of leaf dynamics of five canopy trees were stared to monitor from August, 1992.

3. Results and discussion

(1) Diurnal changes of climatic conditions

The diurnal changes in vapor pressure deficit (VPD), air temperature and incident PFD in dry (July) and rainy (November) seasons are shown in Figs. 2, 3 and 4, respectively. The major difference in aerial environmental conditions between the two days in the dry season was that the level of PFD was lower during the morning of the day 2 in the early morning due to cloud cover.

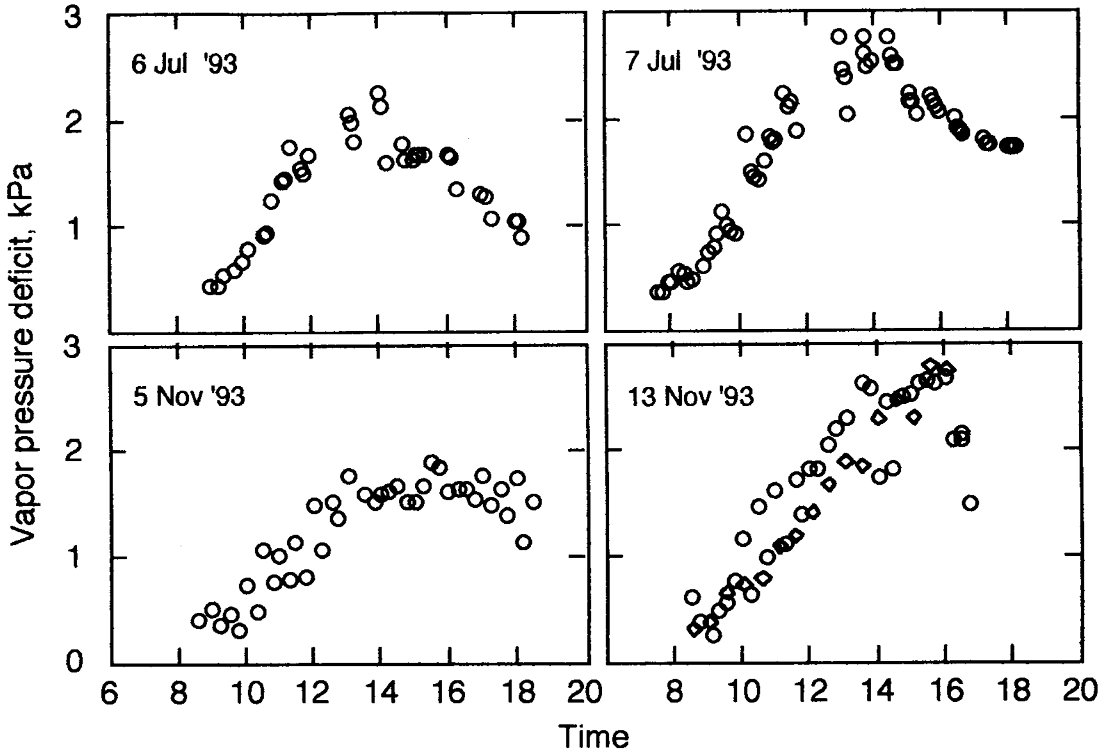

Fig. 2. Diurnal courses of vapor pressure deficit on 6 , 7 July, 5, 13 November 1993 at Pasoh, Malaysia. The points are the means of 5 replicates.

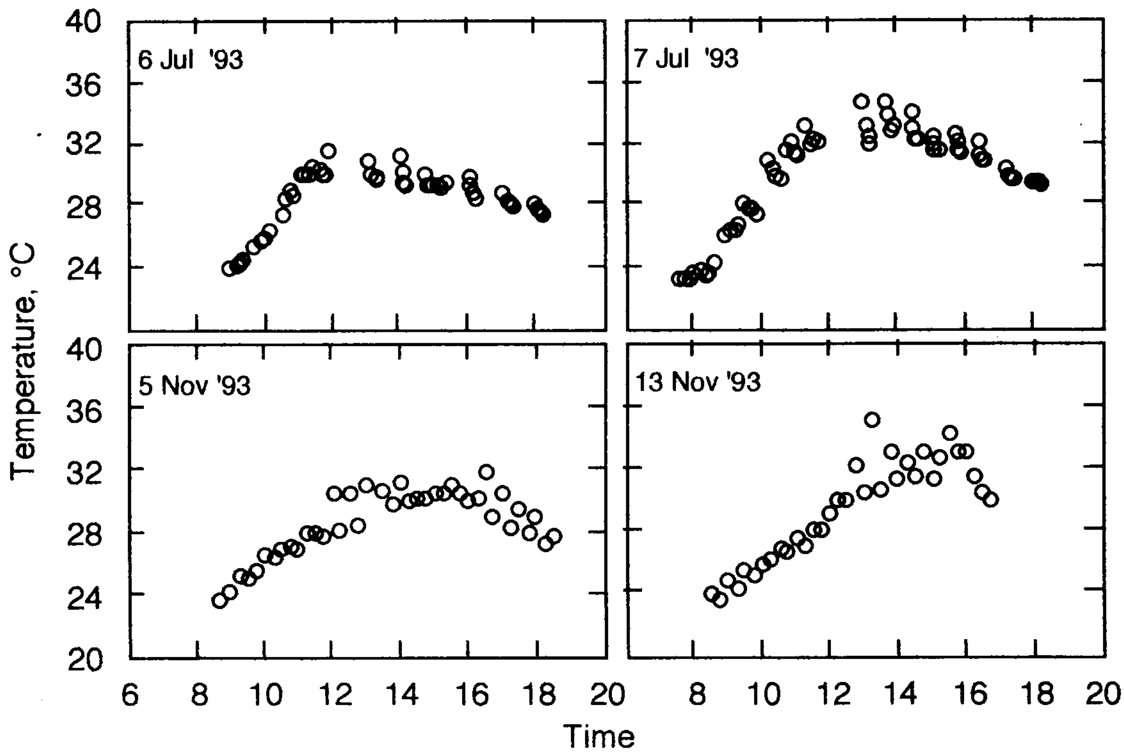

Fig. 3. Diurnal courses of temperature on 6 , 7 July, 5, 13 November 1993 at Pasoh, Malaysia. The points are the means of 5 replicates.

However, the level of PFD of the day 2 was higher in the afternoon as compared with that of the day 1. The diurnal patterns of air temperature were similar on both days, but there was a difference of VPD between the two days and the VPD of the day 2 was higher

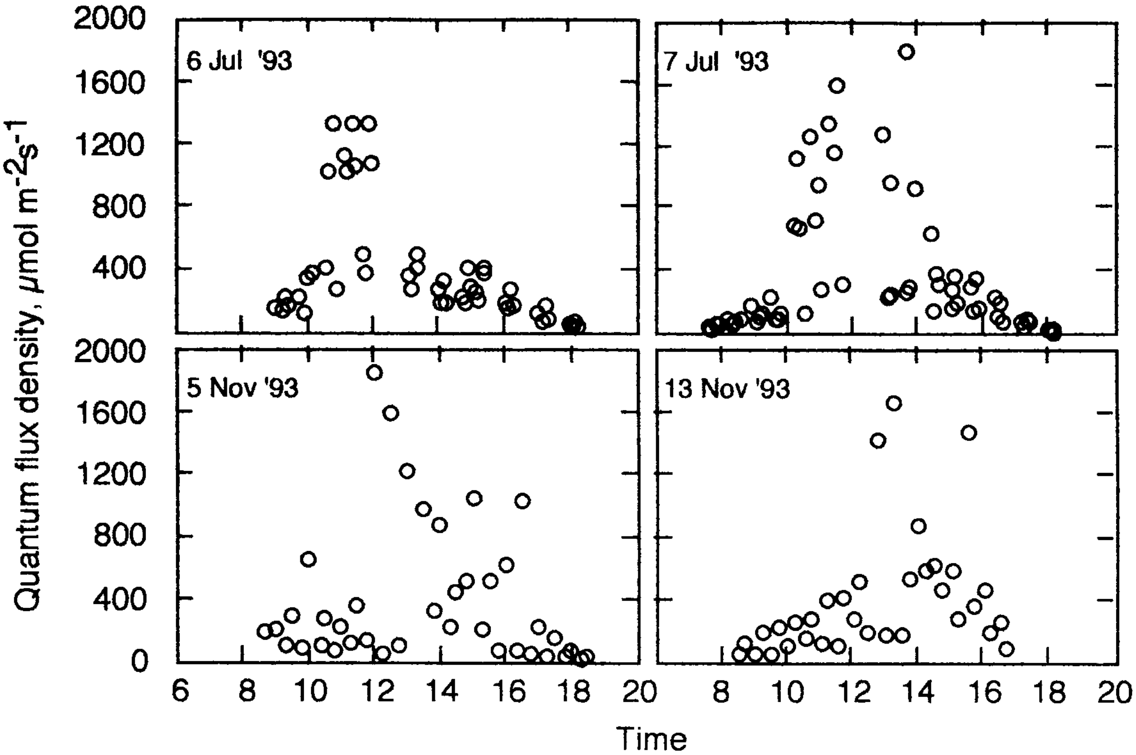

Fig. 4. Diurnal courses of photon flux density on 6 , 7 July, 5, 13 November 1993 at Pasoh, Malaysia. The points are the means of 5 replicates.

than that of the day 1. The diurnal changes of these climatic factors in the rainyl season were quite resembled with those in the dry season. The maximum value of VPD was not different between the dry and rainy seasons. Even in the morning when the fog was presented, the difference of VPD between the two seasons was not clear. From these results, we suspect that the differences of these climatic factors are not influenced by the seasonality but by the weather conditions of the day of the measurement.

(2)Diameter growth rate

Diameter growth rate of smaller trees were very slow and most of these trees terminated the increase in diameter. Among 190 trees, 80 trees increased diameter less than 1 mm yr^{-1}, and no increase in diameter was detected in 2 of them. The growth period was different between species and individuals. From the results of the time course of the diameter changes of those species that increased diameter more than 5 mm in 348 days, continuous and periodic increasing patterns were detected. This trend is similar with the shoot elongation patterns [1]. *E. malaccense* increased its diameter continuously, while *D. sublamellatus* and *Shorea leprosula* showed the periodic increase.

Fig. 5 shows the seasonal course of the rate of increase in diameter of five species of Dipterocarpaceae. Sample trees of these species showed fast diameter increase during the measured period. The range and fluctuation of the diameter increase rate were not similar between species. Those species that showed the periodic increase in diameter stopped to increase their diameter from March to April and December in 1992 and March to April in 1993. The growth rate and precipitation fluctuated sporadically. To eliminate the sporadic fluctuation, 61 days (2 month) of running mean were calculated and plotted for each variable.

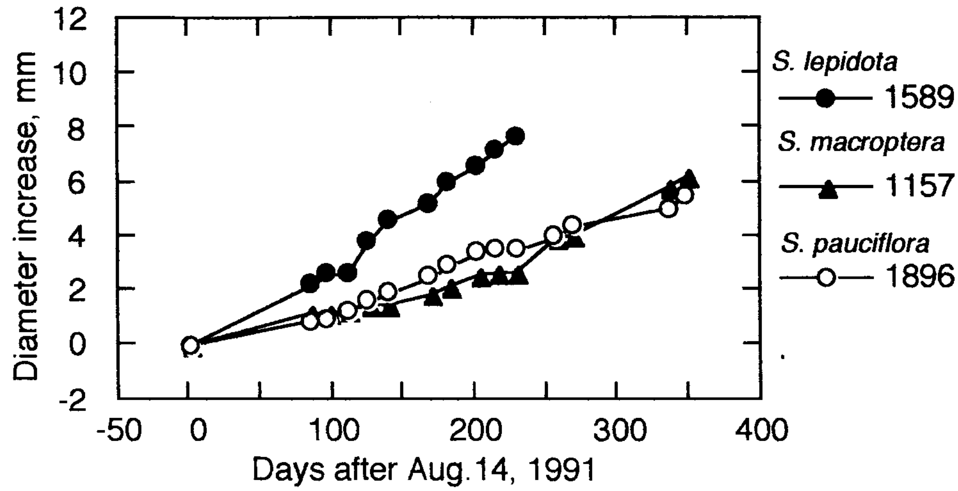

Fig. 5. The time course of the increase in diameter of three Shorea species.

Whitmore [3] suggested that even in humid tropical climates there are seasonal variations and the variations in the availability of water for plants.

(3) Dynamics of canopy leaves

Flushing of leaves of *N. heimii*, *P. caput-medusae* and *X. amoenum* were periodic. Leaf falling were also periodic for these species and the timing was corresponded to that of leaf flushing of each species. The leaf flushing pattern was similar in these species. When new shoots were coming out, old leaves on old-shoots fell down. Tese leaf-exchange periods were clear in *P. caput-medusae* and *X. amoenum*. Leaves of *N. hemii* were just after the flush when we started the measurement. At that time, the end of July 1992, most of the old leaves were fallen and new leaves were flushed. Leaf dynamics of *D. sublamellatus* was different from former three species. Shoots of this species elongated gradually and leaves flushed time to time. However, the periods of leaf flushing and falling were corresponded. Ogawa [2] reported that leaf-litter fall of Pasoh occurred with a distinct high peak in February-May and a vague peak in around October. In the same area we found that the time of the leaf flushing in the canopy followed the same pattern of timing of litter fall [1]. Our results also show the correspondence of the leaf flushing and leaf falling periods. In *D. sublamellatus*, leaves flushed when the increase in diameter was high. However, the observation period is too short to determine the relationship between leaf dynamics and diameter increase. It is necessary to continue the observation to analyze the growth seasonality of trees. It is difficult to measure the dynamics of canopy leaves for many species, since the leaf flushing periods should correspond to the leaf falling periods.

4. References

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