

## Microclimate of coconut varieties and cacao and cinnamon grown as mixed crops with coconut

T. K. BALAKRISHNAN, P. K. R. NAIR and E. V. NELLIAT

Central Plantation Crops Research Institute, Kasaragod, Kerala

(Received 27 August 1974)

**ABSTRACT.** During the peak period of evaporation (December-May) when evaporation from the open surface (observatory) exceeded 5 mm/day, the corresponding values for the microclimate of cacao and cinnamon, during the early stages of their growth as mixed crops with coconut palms, were 2-4 mm. The diurnal variations in relative humidity and vapour pressure in the microclimate of cacao and cinnamon were relatively much less compared to those of observatory and microclimate of coconut. There were no differences in the microclimate of tall and dwarf varieties of coconut at their full bearing stage.

### 1. Introduction

Environmental conditions associated with the productivity of the coconut palm has been discussed by Dwyer (1938) and Menon and Pandalai (1958). The effect of climate on the palm characters relating to productivity has been reported by Patel (1938), Sayeed and Narayana (1953) and Pillai and Satyabalan (1960). In Sri Lanka, Abeywardena (1955, 1971) established that although each bunch of coconut is subject to the changes in the 12-month weather cycle, the critical period when the impact of adverse seasonal conditions is the greatest, is the first 3-4 months of development of the nuts. The effect of atmospheric humidity, temperature and rainfall on the incidence of leaf rot fungus on coconut and yield has been studied by Radha *et al.* (1961, 1962). However, almost all the studies mentioned above are based on macroclimatic informations. To our knowledge, information on the microclimatic parameters of coconut is almost nonexistent. A knowledge on the microclimatic parameters is essential for successful management of the plantations, particularly in the context of inter and mixed cropping with annuals and perennials respectively in coconut plantations becoming increasingly promising and popular. This note describes the results of the observations carried out on this aspect at the Central Plantation Crops Research Institute (CPCRI), Kasaragod.

### 2. Observations

In addition to the regular meteorological observations being recorded daily at the agro-meteorological observatory attached to the CPCRI, microclimatic observations were initiated in 1972-

73 for tall and dwarf varieties of coconut, cacao and cinnamon. Two palms each of tall and dwarf varieties of coconut aged about 20 years were selected from the centre of palm field of pure stand of coconut spaced 7.5 m × 7.5 m. The tall and dwarf palms were about 8 to 9 and 5 to 6 m tall, respectively. Two plants each of cacao and cinnamon of two age groups—one and three years old—were selected from CPCRI farm where these plants were planted in a double hedge system as mixed crop with tall variety of coconut (two rows of cacao or two rows of cinnamon, as the case may be between the coconut rows). The heights of cacao and cinnamon canopies ranged between 1.0 to 1.5 m during the course of this study (Anon 1972, 1973). Cacao or cinnamon were, however, not raised as monocrops. The mixed cropping plot of coconut and cacao/cinnamon was sprinkler-irrigated at weekly intervals, during the dry months, depth of irrigation being 2.8 cm. All the observations were recorded in pure palm stands as well as the mixed stands from the centres of the respective plots.

The parameters studied were—

- (i) Evaporative power—using cup evaporimeter, daily at 1430 hr
- (ii) Relative humidity—using Assman's psychrometer daily at 0730 and 1430 hr
- (iii) Vapour pressure—using Assman's psychrometer daily at 0730 and 1430 hr

Observations commenced in February 1973. Psychrometer measurements continued till July 1973 and suspended during the rainy season,

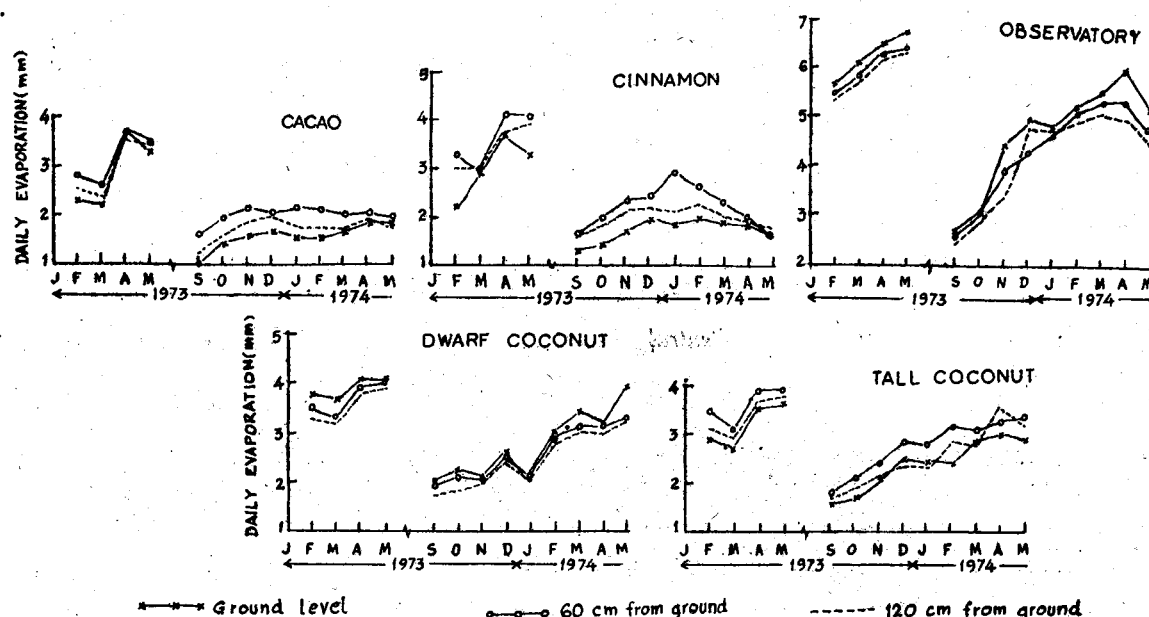


Fig. 1. Mean daily evaporation from the microclimate of different crops and the observatory

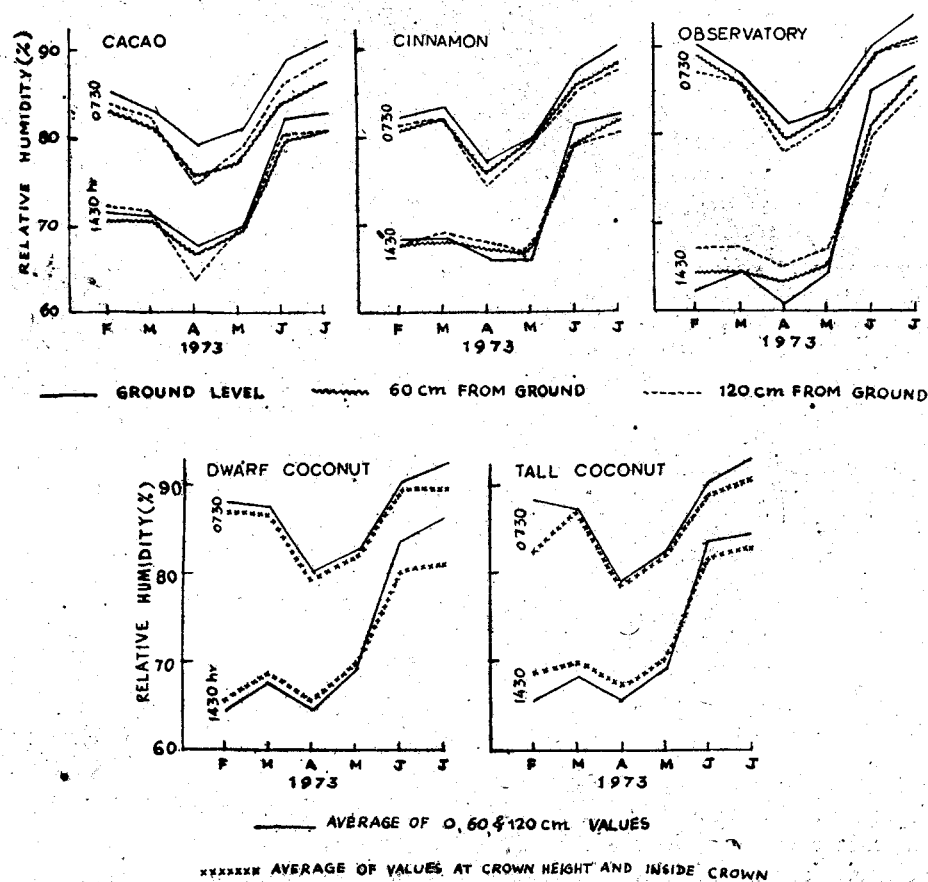


Fig. 2. Variations in relative humidity in the microclimate of different crops and the observatory

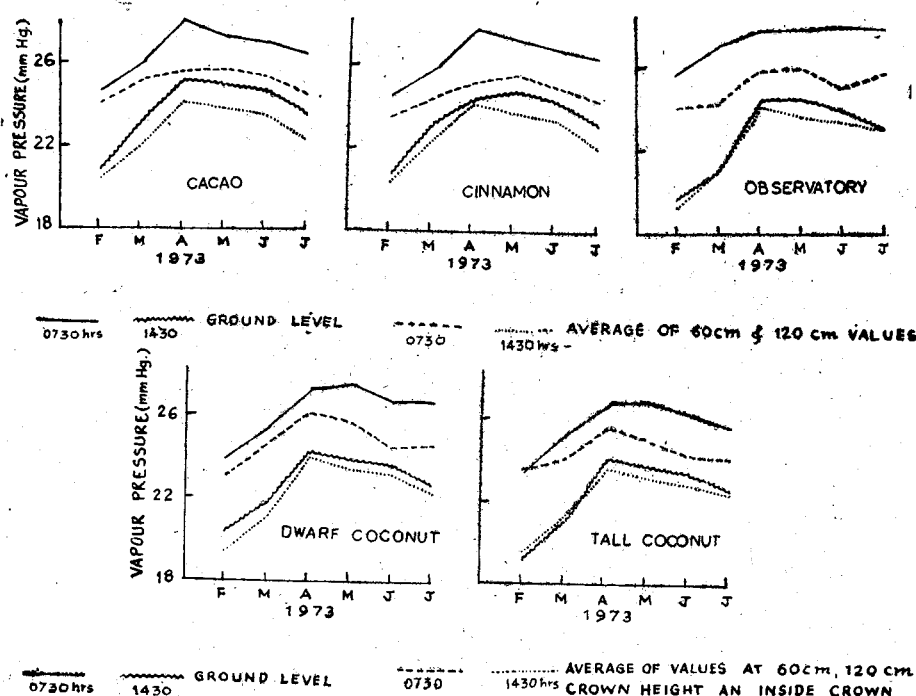


Fig. 3. Variation of vapour pressure in the microclimate of different crops and the observatory

These measurements, though resumed in September 1973, could not be continued beyond November 1973. Cup evaporimeter readings, suspended in May 1973 at the onset of the southwest monsoon, were resumed in September 1973 and continued till May 1974.

### 3. Results and discussion

The replicated values for a particular crop and season of measurement were almost of the same order and therefore such values were averaged crop/variety-wise.

(i) *Evaporative power*—The results presented in Fig. 1 show that evaporative power at the surface was least in the microclimate of cacao followed by that of cinnamon, tall coconut palm, dwarf coconut palm and observatory in the increasing order. At all levels the evaporative power tended to be lower in the microclimate of cacao than that of cinnamon. This is evidently due to the umbrella type closed canopy of cacao as compared to the tapering type of canopy structure of cinnamon. The differences in the evaporative power between the mixed and the pure stands were less discernible at higher levels.

Though the differences in evaporation potential with height is not appreciable, it is higher at the surface in dwarf coconut and on observatory while in the case of cinnamon, cacao and tall coconut the reverse condition is obtained.

It may be mentioned here, that the evaporation as measured by the cup evaporimeter is on an average 80 per cent of that recorded with a mesh covered Class A Pan evaporimeter.

(ii) *Relative humidity*—The values of relative humidity at 0, 60 and 120 cm heights above ground level for tall and dwarf varieties of coconut were almost of the same pattern and the values were therefore averaged separately for forenoons and afternoons. In the case of cacao and cinnamon, the values at different heights are presented individually (Fig. 2). The pattern of variations in relative humidity at different heights of both tall and dwarf varieties of coconut was almost the same as in the case of observatory. As could be expected, the relative humidity was lower in the afternoons than in the forenoons. During the dry period from February to May, the difference in relative humidity between the forenoon and afternoon was of the order of 20 per cent in the observatory as well as in the case of coconut. On the other hand, in the microclimate of cacao and cinnamon, this difference was about 10 per cent only.

(iii) *Vapour pressure*—The vapour pressure values at 60 and 120 cm from ground level were almost equal in the case of cacao, cinnamon and the observatory and therefore they were averaged. Similarly, in the case of coconut palms, all values except at ground level were almost equal and they were also averaged. The results are presented in

Fig. 3. Variations in the vapour pressure at different heights of both varieties of coconut were almost same as in the observatory. Yet the readings at ground level were higher than the rest. Vapour pressure was understandably higher in the afternoons than in the forenoons. The difference between the forenoon and afternoon readings was much smaller in the case of cacao and cinnamon than in the case of the palm stands and the observatory. Between cacao and cinnamon, the differences at the 2 times of observation were of nearly the same magnitude.

#### 4. Summary

Microclimatic observations on rate of daily evaporation, vapour pressure and relative humidity at varying heights starting from ground level, were conducted in pure stands of tall and dwarf varieties of coconut, and cacao and cinnamon

plants grown as mixed crops with coconut. There was very little vertical gradient in evaporative power in all stands. The evaporation potential was lower in the mixed stands, especially of cacao than the pure stands. It was slightly higher at the surface in dwarf coconut stands and the observatory. In the observatory as well as in the microclimate of coconut, the vapour pressure was higher and relative humidity lower in the afternoons than in the forenoons. But in the microclimates of cacao and cinnamon, the diurnal variations were relatively much less.

#### Acknowledgements

The author are grateful to Shri K.V. Subramanian, Junior Technical Assistant for his periodic helps in the observations and Dr. K.V. Ahamed Bavappa, Director for his encouragement and interest in the work.

#### REFERENCES

- |                                                        |      |                                                                                 |
|--------------------------------------------------------|------|---------------------------------------------------------------------------------|
| Abeywardena, V.                                        | 1955 | <i>The Ceylon Coconut Quart.</i> , 6, pp. 17-21.                                |
|                                                        | 1971 | <i>Ibid.</i> , 22, pp. 97-103.                                                  |
| Dwyer, R. E. P.                                        | 1938 | <i>New Guinea Agri. Gazette</i> , 4, pp. 24-102.                                |
| Menon, K. P. V. and Pandalai, K. M.                    | 1958 | <i>The coconut palm, a monograph</i> , Indian Central Coconut Comm., Ernakulam. |
| Patel, J. S.                                           | 1938 | <i>The coconut—a monograph</i> , Government Press., Madras.                     |
| Pillai, R. V. and Satyabalan, K.                       | 1960 | <i>Indian Coc. J.</i> , 13, pp. 45-55.                                          |
| Radha, K., Sukumaran, C. K. and Prasanna Kumari, T. O. | 1961 | <i>Ibid.</i> , 14, pp. 45-55.                                                   |
| Radha, K., Sahasranama, K. N. and Menon, K. P. V.      | 1962 | <i>Ibid.</i> , 15, pp. 3-11.                                                    |
| Sayeed, P. M. and Narayana, G. V.                      | 1953 | <i>Ibid.</i> , 6, pp. 102-105.                                                  |