com ventos paralelos às ruas, uma relação linear de baixa correlação (R^2= 0,58), ao contrário do ocorrido no dia 13/11/87 com ventos perpendiculares às ruas e a linearidade com "U" de alta correlação (R^2= 0,94).

Através dos resultados verifica-se que, apesar da pouca diferença entre os valores dos parâmetros aerodinâmicos entre os dias em relação à direção dos ventos , a estimativa desses parâmetros se mostraram mais confiáveis nos dias de ventos com direção perpendicular às ruas da cultura da videira.

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DAILY CHARACTERIZATION OF TEMPERATURE AND HUMIDITY PROFILES IN A CACAO (THEOBROMA CACAO L.) PLANTATION.

Ricardo Augusto Calheiros de Miranda
Luiz Carlos Eduardo Milde
Alberto Lavigne Bichara
(CEPLAC / CEPEC / INFES)
(C.P. 07 - Itabuna (Ba) - CEP. 45.600)

INTRODUCTION

In defining a suitable climate for underlying crops, as cacao trees, it has been realized that microclimatic variables may be quite different from the standard weather data.

This paper presents results on the space and time variations of temperature and humidity above and within a cocoa plantation under dry and wet conditions.

MATERIALS AND METHODS

The data were collected, at the Research Station of the Cocoa Research Center situated in Ilhéus, Bahia, Brazil (14° 31' S, 36° 16' W and 55 masl).

The measurements above, within and below of canopy of temperature and humidity were made using "Fuess" thermohygrographs. Calibrations of all temperature and humidity sensors were checked periodically by comparison with an Assman psychrometer at 09:00 and 15:00 hours.

RESULTS AND DICUSSIONS

Characteristic daily profile variations at different heights of temperature and humidity, and above-canopy rainfall, within the two contrasting periods are presented.

TEMPERATURE AND HUMIDITY TIME - HEIGHT IN THE SUMMER

During the summer week, the daily pattern in the above and the intra-cacao canopy temperatures reveals that temperatures outside the research site were, under dry daylight hours, always higher than those recorded underneath the shelter trees. Futhermore, changes in one, generally, reflected the changes in the other, although not to the same extend.

From sunrise to midday air temperatures at different height, may reach 5° C below from that measured at the meteorological station. However, in the afternoon, its behaviour exhibited characteristic amplitude reductions. The differences in air temperatures among the three canopy layers, were generally small if compared to the air temperature measured at the meteorological station. In cacao plantations, the influence of shelter trees are also dominant, and as such, the trends of air temperatures at different heights tends to be emphasized more in the morning than in the afternoon. In the morning, the ratio of direct to diffuse radiation is sufficiently altered by the combined effects of the overhead shade and the cacao canopy (Bonaparte and Ampolfo, 1975).

At night, the temperature cycle responds to long wave radiation cooling from the botton two-thirds layers of the cacao canopy. The nocturnal air temperature trend is reversed and reflects a difference in energy storage and its dependence with height. The temperature of the air, outside the plantation, decreases and sometimes is decoupled from that in the lower layer of the cacao canopy.

Unlike temperature, the relative humidity cycle tends to decrease progressively from the undercanopy layer upwards over the whole daily cycle, and in both wet and dry conditions.

During the overnight period, conditions outside the cocoa plot were different. However, a change in one was reflected in the other. The relative humidity under the canopy, never fell below 85%, however, humidities values outside the canopy some times were higher than 90%. The maximun relative humidity did not fluctuate as much as the minimun humidity which represent conditions during the daily hours. The lowest humidity value of 57% (within cacao the canopy) and 52% (outside) were recorded after a period of rain.

TEMPERATURE AND HUMIDITY TIME - HEIGHT IN THE WINTER

In the winter week, the maximum temperatures difference between outside and inside the cocoa plantation layers was around 2° C however, values lower than those, were recorded during the summer week. Independently of prevaling weather conditions, the temperature gradients recorded from early evenings to sunrise were positive at the 1.5 to 3.0 m layers. At night, the trends of air temperature above the canopy were lower than those of the botton canopy layers. No doubt this is due to the decrease in turbulent exchange as the atmosphere stability increases within the period. The temperature at the meteorological stations were usually higher than that measured at 6 m and remained 0.2° to 1° C below that measured at the cocoa canopy lower down layers. For the remainder hours, it was observed that temperature profiles reveals differenciated trends.

From early morning to noon, under dry weather conditions, the air temperature profile inside the cacao plantation was almost identical than the profile measured at the meteorological station. After midday, the air temperature at the meteorological station decreased progressively in relation to the temperatures measured at the lowest layers of the cocoa canopy. With the incoming solar radiation decreasing, the cocoa canopy losses more energy than the received and reaches lower temperatures than that of the air above (6.0 m).

Conditions of relative humidity during a winter week, were significantly differents than those observed during the summer week. For the winter week, overnight humidity conditions above and under the cacao canopy never fell below 95 %. The minimum relative humidity, which represents conditions during the day, did not fluctuated as much as in the summer. During the period, the minimum relative humidity under the cocoa canopy was above 80 % but that recorded at the meteorological station remained at 70 % for most of the time. The under canopy minimum relative humidity was very unstable, particularly after noon, when the lowest humidity value (58 %) as measured. In contrast, the value measured at the meteorological station was 48%.

Showers and their associated down-drought influence the daily cycle of temperature and humidity measured outside and inside the cocoa canopy. When showers occured, temperatures recorded outside and inside the plantation tends to fall. Also humidity increases in response to the advent of free water on the vegetation surface.

During morning, when air temperatures inside and outside plantation are expected to increase rapidly (Butler, 1980), the temperatures among the three cocoa canopy layers lag behind and remain some degrees lower. If rain occured and if it is sufficient to wet the vegetative sub-layers of the cocoa canopy, temperatures recorded inside the plantation undergo those recorded at the meteorological station, but not to the same extend. The differential gradients of temperatures decreased proportionally to the amount of rain intercepted by each layer and remained on this level until the complete dry off of each canopy sublayer. The undercanopy maximum temperatures were characterized by drops varying from 1.0° to 3.0° C. Inside canopy tempertures varied from 2.5°-to 4.0° C while the above canopy maximum temperature decreased from 1.5° to 3.5° C. Unlike temperature, the relative humidity recorded among the three cocoa sublayers becames, subsequently a shower, higher than that recorded at the meteorological site. For the two days under study, immediately after a showers of 10 mm and 5 mm, the maximum level of relative humidity steadily remained at 18% and 11% higher, inside and under canopy, than that recorded outside the cocoa plantation. At the same time, it was observed that, on both days, the gradient of humidity was very unstable over the cocoa canopy, particularly when isolated showers occured subsequently to the main rainfall period. This, in part, reflects an increase evaporation rate from the upper wet parts of the cocoa canopy.

It is clear that air temperature, relative humidity and rainfall are inter-related, and affect the seasonality of the microclimatic conditions inside a cocoa plantation. The weather inside the cocoa canopy was, slghtly different from the outside plantation. Temperatures outside the cocoa plantation stayed always higher than inside, within the summer week. Nevertheless, during the winter week, temperatures inside and outside did not fluctuate very much. The temperature measured under the botton of the cocoa canopy decoupled from thatrecorded at the meteorological station. Relative humidity inside the cocoa plantation was, during the summer week, higher and did not fluctuate as much as the outside relative humidity within the day light hours. During the winter week and under day light hours, the outside relative humidity was higher than inside the cacao canopy and fluctuated enourmously.

Over the whole daily cycle, it appears that rainfall has an influence on temperature and relative humidity from the botton of the cocoa canopy upwards. Rainfall, whether heavy or light, was always associated with a rapid drop in temperature and also with the rise in relative humidity 1 or 2 hours latter, particularly inside the cocoa canopy. Relative humidity at the top of the canopy exhibited a little response to the advent of free water retained on the cocoa canopy. In the lower layer, some rise in relative humidity was observed, mainly if the incident rainfall was enough to saturate the canopy.

The measurements reported here were made in two contrasting weeks, and, therefore, reflect only a limited range of conditions. Nevertheless, they provide valuable information on the behaviour of cocoa trees and their response to weather, and on the variability which can be expected when using modelling techniques for the study of plant disease.

FLUXÍMETRO PARA MEDIDAS DE BALANÇO DE CALOR NO SOLO

Jesus Marden dos Santos
Pedro Rubens de Carvalho
Mário de Miranda V.B.R.Leitão
Regina Célia dos Santos

INPE - Instituto Nacional de Pesquisas Espaciais

Resumo Ampliado

Desde os anos cincoenta o uso de fluxímetros para a medida de fluxos de calor no solo tem sido uma prática no campo da agrometeorologia. Por serem equipamentos simples alguns cuidados essenciais precisam ser tomados para que as determinações do balanço de calor no solo tenham um significado agronômico e possam ser utilizados nos estudos de balanço de energia.

Os erros na medida do fluxo de calor no solo podem ser minimizados desde que a variação de fluxo seja pequena considerando-se as condições de exposição do sensor. Com base na teoria do processo de transferência de calor é possível estabelecer três condições essenciais que devem ser obedecidas num projeto de fluxímetro.

A primeira condição é que o fluxímetro deve ter uma espessura diminuta e ser instalado com a sua menor dimensão na direção do fluxo de calor. A teoria indica que com o sensor instalado desta maneira e com o valor de f (razão entre a condutibilidade do fluxímetro e a do solo) não muito pequeno, os erros serão proporcionais a r(0.048), sendo r=E/L onde L é o comprimento do fluxímetro e E a sua espessura. Isto significa que, se as dimensões do fluxímetro são fixas (62x16x3mm) dobrando-se a espessura o erro será duplicado.

A segunda condição é que o fluxímetro deve ser especificamente calibrado para as condições de condutibilidade térmica (K) a serem encontrados no local de uso. Os valores de erro máximo serão muito pequenos se a calibração for realizada em um meio com condutibilidade térmica igual à média aritmética dos valores extremos onde será instalado o sensor.

A terceira condição é uma consequência da anterior e especifica que a condutibilidade térmica do sensor deve ser tão grande quanto possível, desde que o erro máximo é inversamente proporcional a esta condutibilidade.

Como a condutibilidade térmica do solo permanece entre os valores de 8×10^{-3} cal cm^{-1} s^{-1} $^{o}C^{-1}$ a $0,8 \times 10^{-3}$ cal cm^{-1} s^{-1} $^{o}C^{-1}$