Summary

Hybrids between the two Asiatic diploid species of cotton, *G. herbaceum* and *G. arboreum* were produced and treated with colchicine to double their chromosome number. The resulting synthetic tetraploid was crossed with *G. hirsutum*. Leaves from the diploids, synthetic tetraploid and its hybrid with *G. hirsutum* were killed and fixed in FAA. Transverse sections of leaves were studied. The Asiatic diploids had isobilateral leaves with a well developed adaxial palisade and a less developed abaxial palisade parenchyma. The synthetic tetraploid too had a similar leaf anatomy. Its hybrid with *G. hirsutum* had a leaf structure similar to the Asiatic diploids but with larger leaf blade width. *G. hirsutum* leaves were dorsiventral with a single layer of (adaxial) palisade. The significance of these findings had been discussed.

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Estimating leaf water potential of coffee with the pressure bomb

Resumo. Foi utilizada análise de regressão linear para calcular a relação entre potencial da água do xilema e potencial da água de folhas de cafeeiros, determinando-se uma curva de calibração para estimativa, através da bomba de pressão, do potencial da água de folhas adultas de cafeeiros (*Coffea arabica*, L.), cultivar 'Mundo Novo'.

Introduction

Thermocouple psychrometry has been considered the most accurate method for measuring leaf water potential. Several difficulties encountered in the determinations, such as errors caused by liberation of heat by respiring tissue, adsorption of water vapor on the walls of the psychrometer chamber, and resistance of tissue to vapor transfer (3), have been overcome by suitable procedures (2). However, there remains the inconvenience regarding the time necessary for samples of some species to reach equilibrium with the psychrometer chamber, thus imposing a limitation on the use of the method to estimate plant water status under field conditions. On the other hand, the pressure bomb (10) allows fast measurements of negative hidrostatic sap pressure in the xylem. Boyer (4) suggested that accurate determination of leaf water potential can be made if the pressure chamber measurements are calibrated against the values obtained by the thermocouple psychrometer. Determination of water potential by the pressure bomb has been carried out in citrus (8), forest trees (8), tomato (2, 6), sorghum and corn (5), and pine seedlings (7).

This paper reports the calculation of the relationship between xylem potential and leaf water potential in coffee for estimating plant water status by the pressure bomb.

Materials and methods

Coffee plants (*Coffea arabica* L., cv. 'Mundo Novo'), two years old, growing in the greenhouse, were subjected to different levels of soil moisture. For the determination of xylem potential, mature leaves were detached from the plant and immediately placed in the pressure chamber, "PMS" model 1000. At the time the leaf was excised, one disc was punched out from the blade and placed in a thermocouple psychrometer apparatus, "Wescor" model MJ-55, with chamber model C-51. The effect of leaf hydration on the equilibrium time of tissue with the psychrometer chamber was determined in discs removed from leaves with different water potentials and measurements were made in 10 minute intervals after the sample was placed in the chamber.

Results and discussion

Figure 1 shows the equilibrium times curves for three mature leaves with water potentials of —12.5 bars, —16.5 bars and —25.0 bars. Equilibration of leaf tissue with the psychrometer chamber took from 30 to 90 minutes, depending on the leaf water status. The leaf with high water potential reached equilibrium in approximately 90 minutes while samples with lower water potential attained equilibrium sooner, 50 and 30 minutes at —16.5 and —25.0 bars, respectively. The relatively long time for equilibration imposes some difficulty on the use of the thermocouple psychrometer to determine the daily pattern of leaf water potential of coffee in the field.

Figure 2 presents the calibration curve relating leaf water potential to xylem potential. Linear regression can be expressed by the equation:

$$y = 0.8493 + 0.8346\,x \qquad (r^2 = 0.97)$$

where y indicates leaf water potential and χ measures xylem water potential in bars.

Except when the water potential was high (above —4 bars), xylem pressure was always 1.5 to 5 bars

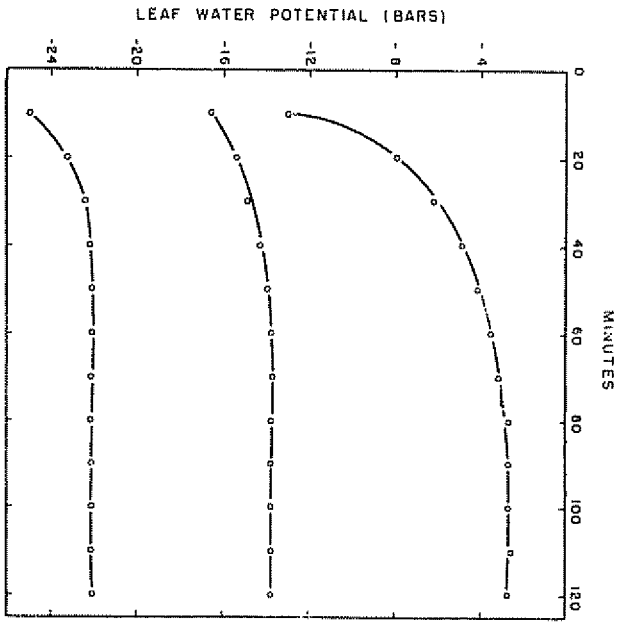

Figure 1—Equilibrium time-curves for three mature leaves of coffee, cv. "Mundo Novo" with different water status

more negative than leaf water potential. As suggested by Duniway (6), these discrepancies may be due to the gain of water by the mesophyll cells from the xylem under conditions allowing for high transpiration. Because leaf elasticity may change with age caution must be exercised in determining the relationship between leaf water potential and xylem water potential, and the use of leaves of comparable ages becomes an important requeriment. Kaufmann (9) reports that there are two sources of error in the pressure chamber technique which would result in low estimates of pressure potential: the resistance to water movement through the xylem toward the cut surface, which may cause a greater application of pressure, and the leakage of water into voids existing in the leaf attached to the plant.

In conclusion, the pressure chamber may be used to estimate leaf water potential of coffee after determination of calibration curves which should account for varietal differences and leaf age. The relationship presented in this paper can be used for mature leaves of Arabica coffee, cv. 'Mundo Novo'.

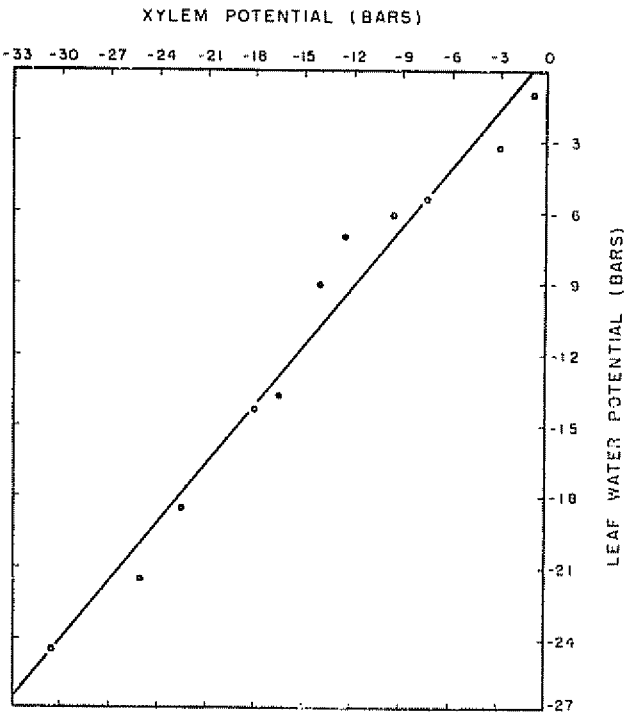

Figure 2—Regression curve associating leaf water potential to xylem potential of coffee.

Summary

Linear regression analysis was used to calculate the relationship between xylem potential and leaf water potential of coffee, and to determine a calibration curve for estimating leaf water potential of coffee (*Coffea arabica* L., vc Mundo Novo) with the pressure bomb.

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