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Predicting Canopy Temperature Distribution Within the Canopies of Tropical Fruit Trees Based on Thermographic Measurements

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Abstract

Thermal imaging is a potential tool for estimating plant temperature, which can be used as an indicator of stomatal closure and water deficit stress. For the field use, however, devices are not commonly affordable. In this study, thermal photographs have been used to develop a reference scheme which allows predicting the temperature distribution within the canopy of fruit trees. Based on this, drought stress can be determined by use of common infrared (IR) thermometry.

With mango (*Mangifera indica* L.) and longan (*Dimocarpus longan*, Lour.), two of the most important fruit crops of northern Thailand, commercially produced under irrigation, have been selected. Two field experiments and one greenhouse experiment were surveyed with a thermal camera (Infratec VarioCAM). Different levels of water supply, different canopy shapes and the respective temperature distribution within the canopy were analyzed. A wet cloth and a latex coated leaf served as wet and dry reference, respectively. Thermographic data was evaluated with "Irbis professional 2.2" software. Climate data (air temperature, wind speed, relative humidity and global radiation) were recorded in the same intervals as thermal photographs were taken. Light penetration through the canopy was taken as a measure for the leaf area. Leaf transpiration was measured by use of a porometer for leaves exposed to sunlight and in the shade.

It was shown that leaves at the outer area of the canopy have a stronger cooling effect by transpiration, which maintains the temperature at a rather constant level, while inner leaves and not transpiring plant parts heat up in the curse of the day. Gradients were worked out for different shapes of canopy, in order to predict the spatial temperature distribution within the three dimensional body of the canopy. Predicted values are being compared to field measurements with IR thermometry.

Keywords: Canopy shape, infrared thermometry, longan, mango, stomatal resistance, water supply

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