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**Measurement of relative water content in plant leaves using photonic and acoustic**

**techniques: A non-destructive approach based on non-contact methods**

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**Abstract:**

Precision agriculture is nowadays a field of research of major interest around the world.Solutions destined to offer alternatives to improve performance and maintenance of crops are suitable and desiderated. Plant leaves are important targets, because they are essential organs that perform photosynthesis, transpiration, and food manufacturing, hence its observation can provide important and useful information on the physiological status of plants. The plant leaves structure can be thought as the combination of several layers with different properties, so it is a complex structure that can be assessed using mechanical and optical tools. In general terms, the internal structure of a leaf is the combination of stacked layers with defined properties, that as a whole conform a “composite plate” that is the leaf.

We can extract elastic properties of this “plate” generating elastic waves on medium, and later extracting its mechanical properties as thickness, sound speed and elastic modulus. This last property is associated with turgid properties of the leaf, and hence with the water content in plants. Also, using the interaction between light and every layer in leaf we can obtain information about pigments, disease, and water status.

In this work, we report preliminary results from experimental testing on leaves of coffee arabica. Two approaches were implemented: 1) A mechanical approach where we induced an elastic wave using air-coupled ultrasonic transducers, at ultrasonic frequencies, to extract the elastic modulus of samples and from this obtain its relative water content. 2) An optical approach through reflectance spectrum of light on leaf surface, using an optic fiber and spectrometer, in the Vis/NIR range, to determine the relationship between the reflectance and the water content on sample. Results of this research could allow new tools, non-contact and non-destructive, to improve product quality by controlling irrigation, efficient fertilizer application, disease detection and determination of harvest time.

Key words:

Plant leaves, Reflectance spectrum, Relative water content, Ultrasonic spectroscopy