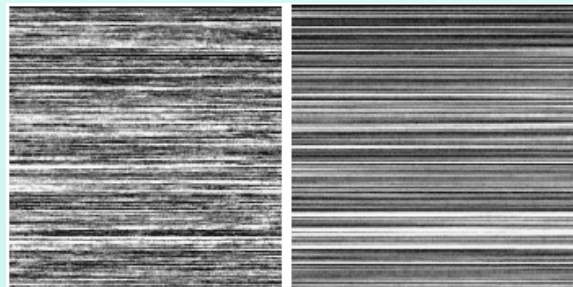




USE OF BIOSPECKLE LASER TO EVALUATE WATER BEHAVIOR IN COFFEE LEAVES

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INTRODUCTION



- Water is a noble natural resource and its monitoring and control are fundamental to an efficient and responsible use concerning to the impacts to the environment.
- The determination of water need in a crop, at different stages of development, is an important step to manage irrigation and thus, the search for technical instrumentation to measure those needs plays a key role (Cairo,1995; Canny,1995).
- The introduction of the **DYNAMIC SPECKLE/ BIOSPECKLE** phenomenon as an optical approach capable of measuring the biological activity in animal and in plant tissues has been great progress since the 1970s, when it was proposed by Briers (1975).



INTRODUCTION



➤ **BIOSPECKLE** is configured as a valuable tool to support the studies of diverse knowledge areas and has been developed through the analysis of biological materials activity .

➤ According to Rabal & Braga Jr (2008), in recent years, there are some important applications of **DYNAMIC SPECKLE** in agriculture:

- ❖ The determination of seeds viability (Braga Jr et al., 2003),
- ❖ The detection of fungi presence in seeds (Braga Jr et al., 2005),
- ❖ The monitoring of damages to fruit (Pajuelo et al., 2003),
- ❖ The observation of maturation and senescence in oranges (Rabelo et al., 2005),
- ❖ The determination of animal sperm quality (Carvalho et al., 2009).

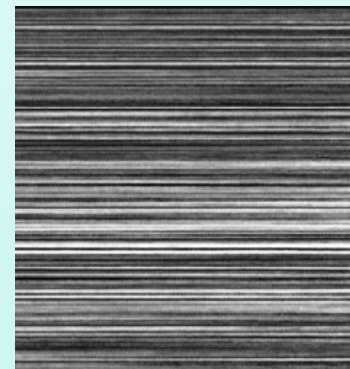
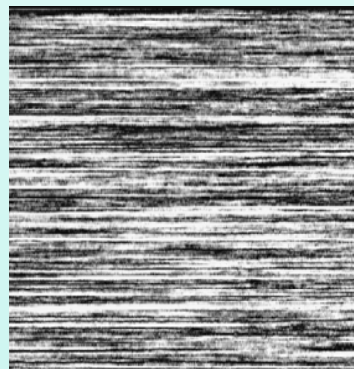


INTRODUCTION

➤ There are some methods to analyse the **DYNAMIC SPECKLE**.

➤ The **INERTIA MOMENT**, can be considered as a feasible approach to evaluate numerically the evolution of a phenomenon, and in particular, the activity of water in a biological tissue (Braga Jr et al., 2003).

➤ The **INERTIA MOMENT** is based on the analysis of data using a second order statistical method, with the creation of two intermediary matrices known as **Space Time Speckle - STS** (Xu et al., 1995) and Occurrence Matrix (Arizaga et al., 1999).



STS



INTRODUCTION



This study presents a methodology for using the technique of **BIOSPECKLE** as a tool of correlation between the biological activity in a leaf and its level of water content.



MATERIAL AND METHODS





MATERIAL AND METHODS

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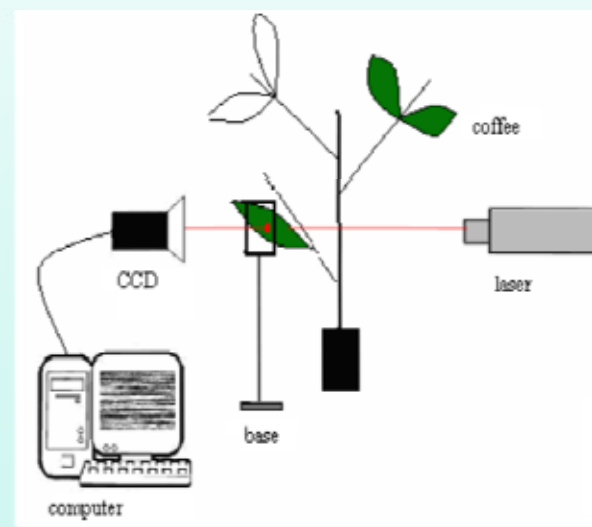


For the experiment were used:

- Computer with a system image acquisition and digital image processing software (Image J 1.37);
- Camara CCD (“Charge Coupled Device”);
- Laser - HeNe (source of 10MW);
- *Coffea arabica*.

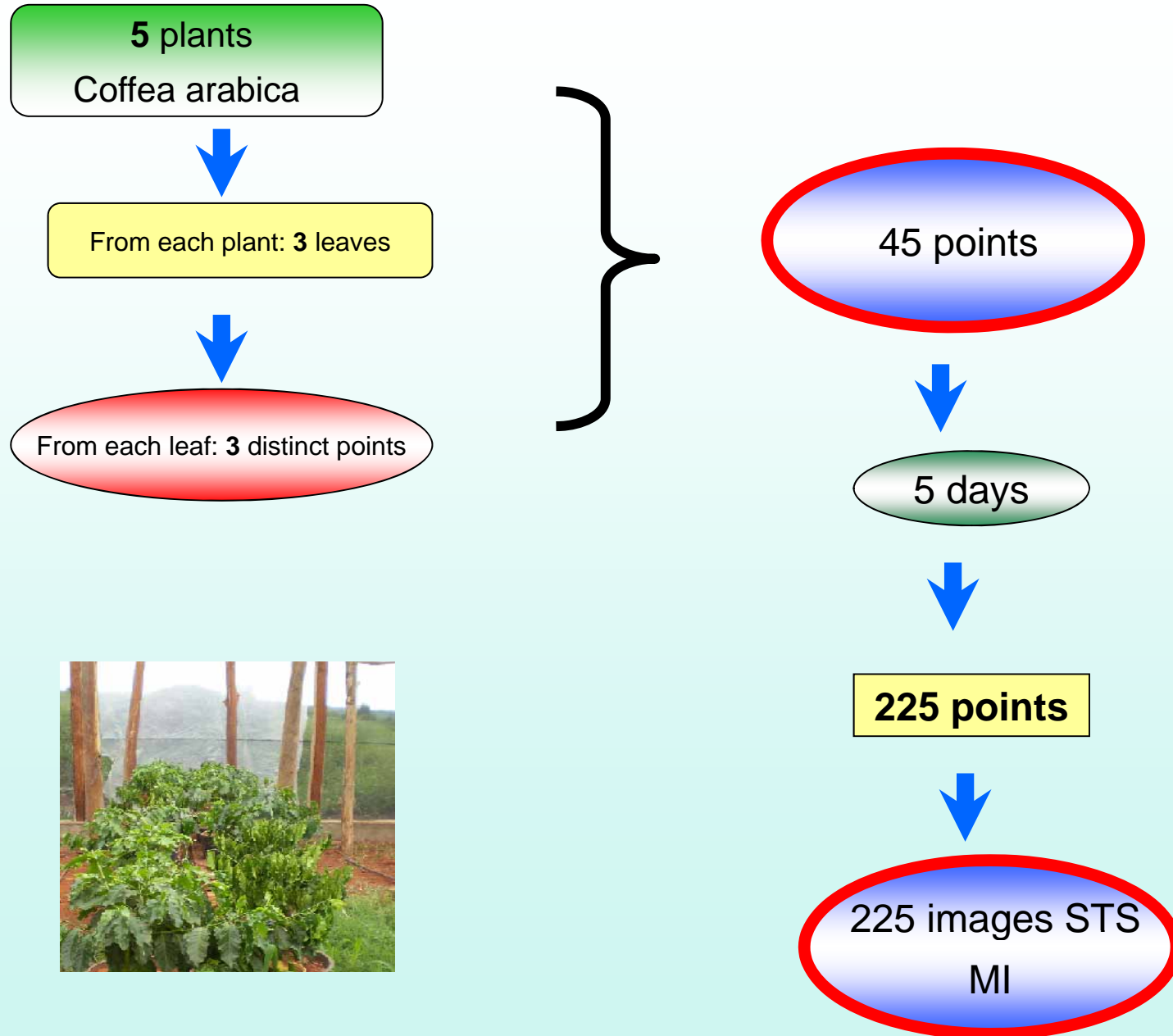


Set up





MATERIAL AND METHODS





MATERIAL AND METHODS



- Before the process of illumination, the plants were saturated with water.
- During the experiment, the plant remained in a greenhouse for control of humidity.
- On the fifth day of lighting, all plants were stressfully wilted and the plants were close to Permanent Wilting Point (PWP).
- One side of the leaves was illuminated with the laser and on the other side was placed a CCD camera.
- From the STS images, were calculated the values of **Inertia Moment**

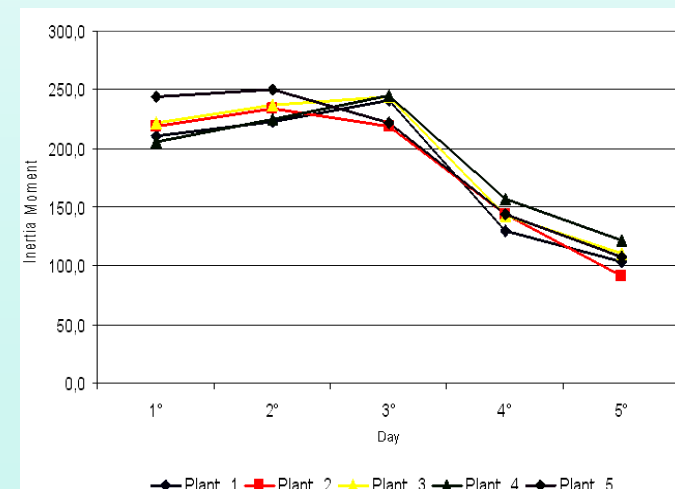


RESULTS AND DISCUSSIONS



The graph represents the **Inertia Moment** of the 5 plants of *Coffea arabica* during the 5 days of illumination. Each curve represents the average of the illuminated spots of each plant.

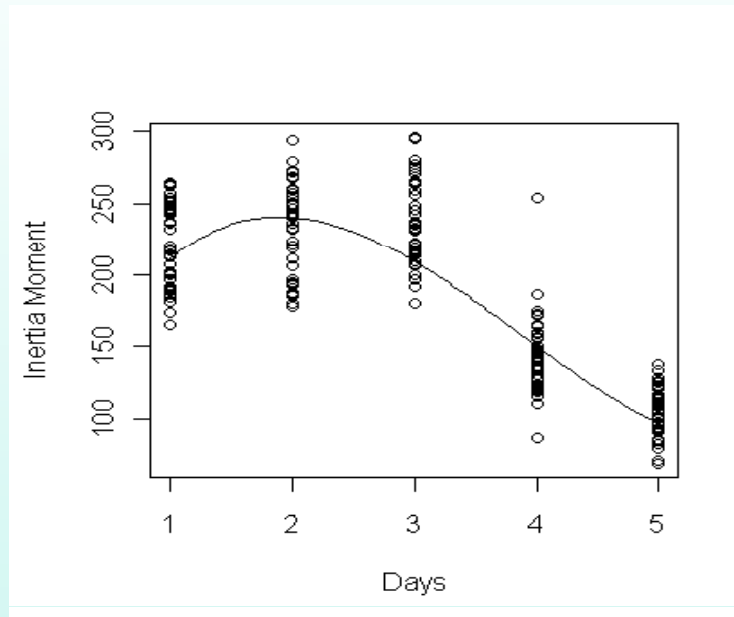
- It was noticed that by the 3rd day, the **Inertia Moment** remained constant and after that, there was a marked change in their values.
- This change has coincided to the beginning of plant water stress, noticed by the wilting of the leaves from the 4th day on.
- After 5 days, the values of the **Inertia Moment** run to be steady.





RESULTS AND DISCUSSIONS

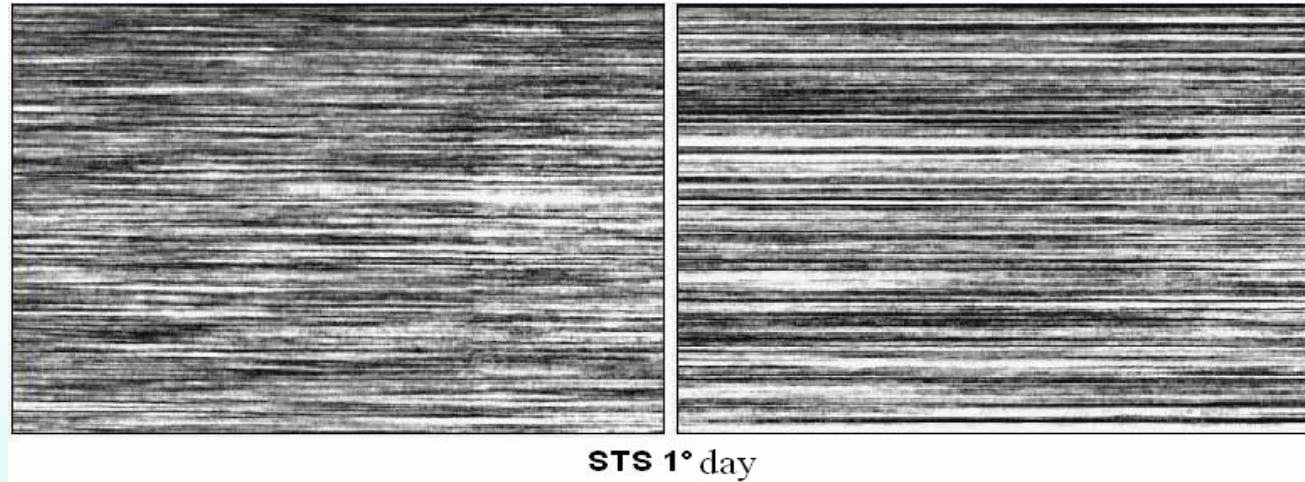
➤ In the graph you can see all the values of the **Inertia Moment**.



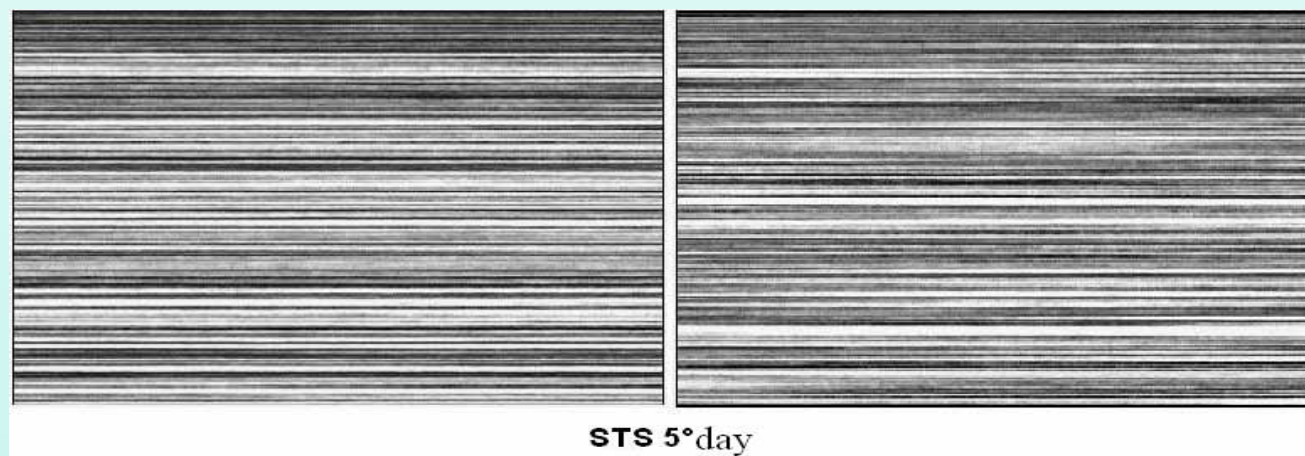


RESULTS AND DISCUSSIONS

- The images represent STS on first day, when water was utmost available to the plant.



- The images represent STS on the fifth day, in the worst water condition.





RESULTS AND DISCUSSIONS



➤ The results had a significant relation between the reduction of water content and the values of **BIOSPECKLE**.

➤ With these results, it was confirmed that the loss of water in Coffea arabica leaves influences the **BIOSPECKLE**.



CONCLUSION



- It was final and directly attested the influence of the reduction of water in coffee leaf with the results of **INERTIA MOMENT**.
- By the **BIOSPECKLE** monitoring, the inflection point was more evident when the plants demanded more water.



This work is under registration with INPI: PI 0301926-8 / 014 090 001 090

Thank you very much...

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