LOCATION Any Location
KEYWORD Refine Search Results with a Keyword
CATEGORY All Categories
SHOW: 365 Days
DATE: m/d/yyyy
GO!

SHOW ALL LOCATIONS
SHOW AS LIST
SHOW MONTHLY
GO!

2

Grown In Marin Event

Title:	International Symposium on the Application of Precision Agriculture for Fruits and Vegetables
Start Date:	06-Jan-08
End Date:	09-Jan-08
URL:	http://www.precisionag2008.com/
Contact:	Reza Ehsani at (863) 956-1151 ext. 1228 or e-mail ehsani@ufl.edu Christen Taylor at (863) 956-1151 ext. 1248 or e-mail chris29@ufl.edu
Time:	
Location:	Grosvenor Resort
Address:	Orlando, Florida
Description:	

The International Society of Horticultural Science, the International Society of Citriculture, the American Society of Agricultural and Biological Engineers, and the University of Florida are pleased to invite you to join the International Symposium: "Application of Precision Agriculture for Fruits and Vegetables."

Deadlines:

· Call for Papers and Abstract deadline - September 28, 2007
· Registration deadline - October 26, 2007
· Hotel discount room reservation deadline - December 7, 2007

Registration Rates:

· Society Members (ASABE, ISHS, ISC) $320
· Non-Society Members $370
· Students $270
· Spouse $100

***If paying with credit card, add $20 to your total ***Cancellation fees apply to registration rates:
· Cancellation within 30 or more days before the start date of the symposium: Full refund minus a 10% charge for handling
· Cancellation within 30 days before the start date of the symposium: 50% refund minus a 10% charge for handling
· Cancellation within seven days before the start date of the symposium: No Refund

Keynote Speakers:

Dr. Simon Blackmore: Managing Director of UniBots Ltd, UK
Dr. Pol Coppin: Katholieke University, Leuven, Belgium
Dr. John F. Reid: Director, Enterprise Product Technology and Innovation, John Deere, Illinois
Dr. Larry Gaultney: E.I DuPont de Nemours & Co., Newark, Delaware

Discussion Topics Include But Are Not Limited To:

Site Specific Management:
* Decision Support Systems and Management Zones
* Geospatial Applications for Fruits and Vegetables
* GIS/GPS
* Variable Rate Technology
* Yield Monitoring
* Environmental Issues
* Traceability
* Information Technology (IT) Data Management
* Weather Networks
* Site-Specific Management for Quality Enhancement

Sensing and Control Systems:
* Automation, Robotics and Auto-Guidance for Fruit and Vegetable Production

* New Soil and Plant Sensors
* New Technologies for Quality Detection
* New Technologies for Stress, Pests, and Disease Detection
* Remote Sensing
* Wireless Communication
* Tracking, Traceability, and Food Security

Educational and Economic Aspects:
* E-Ag Business
* Supply and Chain Management
* Economics of Precision Agriculture for Fruit and Vegetables
* Education/ Training Methods for New Production Technologies

For more information or to register, visit our website at

http://www.PrecisionAg2008.com <http://www.precisionag2008.com/ or contact: Reza Ehsani at (863) 956-1151 ext. 1228 or e-mail ehsani@ufl.edu
Christen Taylor at (863) 956-1151 ext. 1248 or e-mail chris29@ufl.edu

Attached Files

Call for papers

Sponsorship

Instrumented Citrus Production

A. Torre-Neto, C.M.P. Vaz, D.M. Milori,
L.A.C. Jorge, L.M. Rabello, L.H.C. Mattoso
and R.Y. Inamasu
Embrapa Agricultural Instrumentation Center
P.O. Box 741
13560-970 São Carlos, SP, Brazil

J. S. Schepers
USDA-ARS Department of Agronomy
113 Keim Hall, University of Nebraska
Lincoln, NE

R.B. Bassanesi
Fundecitrus
Av. Adhemar Pereira de Barros, 201
14807-040 - Araraquara - São Paulo

Keywords: Wireless sensors, RFID, irrigation, reflectance, chemical sensors, electronic tongue, fluorescence spectroscopy

Abstract

Despite the notable technological support that has made the Precision Agriculture feasible around the world, there are still opportunities for the development of instrumentation and automation in this area. These opportunities are more plentiful considering perennial crops and the traceability of agricultural products. The Precision Agriculture has been developed more intensively for grains what gives chances for the development of technological tools for site-specific management of perennial crops, like citrus. Besides, the traceability of fruits is an immediate and strategic necessity in order to face non-economical issues for exporting, like phytosanitary measures. Therefore, for developing countries like Brazil it is very important the development of technologies to identify the origin and the history of fruits, that can potentially figure among its major exporting products. For the last five years, at the Embrapa Agricultural Instrumentation Center, in Brazil, some of these opportunities have been explored, in order to start the development of an information system and associated tools to make possible the integration of traceability and the site-specific management system for perennial crops. The use of sensors, fixed and on-board instrumentation, wired and wireless network and advanced methodologies have been accomplished to implement precision agriculture and traceability for citrus. The main problems that have been faced are: phytosanitary control, spraying control, automation of fertirrigation and evaluation of product quality.

INTRODUCTION

According to the Food and Agricultural Organization (FAO, 2005) from 2000 to 2004 Brazil was responsible for about 20% of the citrus production in the world (Fig. 1). This number has not changed much during the last years. The production area is concentrated mostly in the São Paulo State (85%). There are 700 thousand ha producing about 15 million tons of oranges a year. Despite those important numbers, the average productivity is 22 ton/ha, what can be considered low compared to Florida productivity in the USA. This low productivity is associated to many different factors:

- Spreading of plagues and diseases with the expansion of planted area;
- No irrigation for most orchards;
- Narrow genetic base;
- Lack of technological support;

Besides this, the production costs have increased, generating economical and social issues like unemployment and rural migration. Believing that the site-specific management and an instrumented citrus production could help to overcome this situation, in 2003 a project entitled "*Agrobusiness in the Information Society: Exploring Opportunities in Citrus Production*" was started by the Embrapa Agricultural Instrumentation Center and its collaborators. This project main objective is to explore opportunities in the development of instrumentation to insert the Brazilian citrus production in the information society with the practice of the Precision Farming and traceability.

More specifically it was devised:

- The development of sensors and systems to acquire georeferenced information from the environment and crop in a frequent, efficient, reliable and economically feasible way;
- The implementation of transmission means to make possible the traceability and analyses of georeferenced information from the environment and crop;
- The development of methodologies assisted by electronic systems, to make use of georeferenced information from the environment and crop;

MATERIALS AND METHODS

The project has been conducted as an on-farm-research in a pilot area of 25 ha (500m x 500m) on the Maringa farm, a private property of the *Fisher Agropecuaria* group. It was started in 2002 when the orchard was already grown up with 12 year-old *valence* trees. A drip irrigation system had just being installed. The total farm area is around 2000 ha. In the following paragraphs it is briefly described what has been carried out so far by each planned activity.

RESULTS AND DISCUSSION

Origin and Yield maps

When a truck gets to a factory or a packing house the usual information it carries is the farm and eventually the plot where the oranges come from. The objective of this activity is to establish a more precise origin for the fruits in a truck, informing also from which trees exactly the fruits were picked.

Harvesting oranges process is totally manual. The reaper carries a small bag and transfers the harvested oranges from it into a big bag located aside the grove rows. After this, the big bags are loaded into trucks. Radio Frequency Identifier (RFID) tags were installed at each tree in the pilot area and also in the big bags and in the trucks. Rewritable RFID tags were used for the big bags and the trucks. During the harvesting process the reaper uses a data collector to transfer the trees ID to the big bag. Next, for each big bag loaded into a truck, its rewritable tag content is transferred to the truck RFID unit. Doing so, it is possible to map the trucks origin and the yield for the pilot unit area (Fig. 2). The yield map resolution is 50m in average and it is calculated on the number of trees used to get a truck load.

No special training was given to the reapers in order not to interfere on the original harvesting process: picking following a row. That is why the maps take the shape of the grove rows. Training the reapers, based on planning the picking in a square basis, would improve the method resolution. Tagging the entire farm may be too expensive. Nowadays, with GPS receiver price going down, this method is not cost effective.

Hydric stress map

Sao Paulo region has a dry season that can be as long as four months. That helps to state a desired hydric stress for the orange trees to increase the grove production. For irrigated farms it is possible to control the degree of hydric stress. Usually this control is done by a subjective observation of some elected trees that allows classifying their hydric situation in three classes: 1) *No stress*; 2) *Average stress* and 3) *Total stress*. When most of them reach the *Total stress* condition, the irrigation system is started. The objective of this work is to establish an instrumented method to map the hydric stress classes and through this map to calculate the number of trees in the *Total stress* condition.

By using a hand held active sensing device the Normalized Difference Vegetation Index (NDVI) is obtained and compared to the subjective evaluation of each hydric stress condition (Fig. 3). Observing that the numbers are significantly different, at least for the *No stress* and *Total stress* condition, the next step was to mount a GPS and the hand held sensing device over an ATV (All Terrain Vehicle), both connected to a portable computer to map the NDVI (Fig. 4).

This method of mapping NDVI is not properly tested to control the irrigation system. Besides the comparison to a subjective evaluation it shall be compared to another measurable property. The future step on this activity is to establish a correlation to the NVDI and the leaf water potential, measured by the pressure chamber method. Even if it proves not being so accurate, mapping the NDVI would be a better choice instead of the subjective evaluation in order to control the degree of hydric stress.

Site-specific Irrigation System

The largest part of the citrus production area in Brazil is not irrigated yet. Due to recent spreading of some new diseases, like the Sudden Death, this scenario is changing and most groves tend to be irrigated. Therefore, water source conservation methods should be applied. For this activity it was developed a wireless fixed instrumentation (sensor and actuator network) and software tools to site-specifically irrigate perennial crops (Torre-Neto et al., 2005). This system outcame from an initial effort to develop a variable rate microsprinkler irrigation in Florida, USA (Torre-Neto et al., 2000).

The system operates in a star architecture and is based on a proprietary communication protocol. It is composed by Sensor and Actuators Nodes, one or more Field Stations, a Base Station and an Installation Kit (Fig. 5). At the Base Station a personal computer runs the control program, which has geographical information system (GIS) functionalities and works on a space-temporal database. The Nodes developed so far are: a) a combined soil moisture and soil temperature sensor and b) a combined latching solenoid actuator and flow meter. An ion selective Node to measure soil nutrients has been developed (Artigas et al., 2003 and Lemos et al., 2004).

Forty nine soil sensors, in a 7x7 grid pattern distribution, were installed in the pilot unit. At every hour soil moisture maps are obtained (Fig. 6). The expected result from those maps is to identify different needs of irrigation water for the grove in order to establish management zones that reflect the spatial variability for the combination of different factors like soil texture and terrain topology. The piping system has to be installed or modified accordingly to these zones. The Base Station software allows addressing an automated valve and establishing a control loop for each individual zone.

The system was conceived to be low-cost, reliable, and compatible with contemporary local citrus production practices. The big challenge is to assure the Node battery lasts long enough (couple of years) in order to achieve system feasibility. Future steps are evaluating a Zigbee based version, regarding the operation time for the Nodes battery and comparing the water consumption against a conventional automated system.

Soil physical properties

Chemicals are applied very often in citrus production as phytosanitary measures. This heavy traffic of machinery causes the soil compaction, what affects mainly root growth and water flow. The objective of this activity is to determine the soil strength by measuring the soil penetration resistance and simultaneous water content.

An automated pneumatic equipment was developed to be adapted on a truck or on a small tractor in order to allow on-the-go measurements (Fig. 7). This equipment is based on a soil cone penetrometer combined with soil moisture measurements as proposed by Vaz and Hopmans, 2001. Instead of a TDR, it was used a capacitive sensor embedded close to the cone, along the penetrometer rod. The 40kg unit is versatile and the electronic system allows computer connection. This equipment was not developed exclusively for Citrus. The prototype has been tested for sugar cane, its primary target crop (Fig. 8). Next step is to evaluate it in the Pilot Unit.

Quality evaluation

The electronic tongue has been successfully used for beverage analysis worldwide (Ciosek and Wroblewski, 2007). In Brazil this sensor has been used mostly for analyzing coffee quality (Ferreira et al., 2007). In this activity the electronic tongue was evaluated to analyze orange juice. An array of seven sensorial units composed by ultra-thin films produced with non-structured conducting polymers was tested to brand recognition. As shown in Fig. 9, using the Principal Component Analysis method it is possible to distinguish four different kinds of ready to drink juice (brands A, B, C and D), two kinds of reconstituted juice (brands E and F) and two kinds of fresh juice (L Lima and L Pera).

Optical Instrumentation

The *Sudden Death* is the most important Citrus disease in Brazil. From 1999 to 2004 it caused the death of more than 1.5 million orange trees (Roman et al., 2004). The usual method to identify contaminated trees is the observation of brightness loss of leaves and yellowish in the internal part of stem. As an alternative for this method, induced fluorescence analyses were carried out with samples from infected and healthy trees (Terencio et al., 2005). The result is a spectroscopic index obtained from leaves that allows the identification of *Sudden Death* disease in 90% cases (Fig. 10).

A portable equipment was developed with a specific computer software that is capable of providing this fluorescence spectroscopic index within a few seconds (Fig. 11). The equipment has been tested in laboratory. The goal is to prepare a mobile lab to carry out measurements in the field. The precocious detection of the disease makes possible a quick taking decision, diminishing losses for the citrus producers.

Image processing

The objective of this activity is the development of methodologies and related software tools to identify diseases by aerial and terrestrial images. An Unmanned Aerial Vehicle (UAV) has been used to acquire the aerial images (Trindade et al. 2004). As described by Jorge et al. 1998, Spectral Variations and Neural Networks have been used to identify infected trees (Fig. 12). For terrestrial images the focus has been on fluorescence images to identify the *Sudden Death* (Fig. 13).

CONCLUSIONS

The results of this work are in different stages and can be considered mostly initial efforts. This project is a start up for several other proposals to promote an Instrumented Citrus Production guided by the site-specific management and product traceability in Brazil. Some of these proposals are already approved running projects.

ACKNOWLEDGMENTS

Thanks to the World Bank for financial support through Embrapa PRODETAB initiative and to FAPESP, FINEP, CAPES and CNPq for complementary financial support from national funds.

Literature Cited

Artigas, J., Jimenez, C., Lemos, S.G., Nogueira, A.R.A., Torre-Neto, A., Alonso, J. 2003. Development of a screen-printed thick-film nitrate sensor based on a graphite-epoxy composite for agricultural applications. Sensors and Actuators B. 88:337-344.

Ciosek, P. and Wróblewski, W. 2007. Sensor arrays for liquid sensing – electronic tongue systems. Analyst. 132:963-978.

Ferreira, E.J.; Pereira, R.C.T.; Delbem, A.C.B.; Oliveira, O.N.; Mattoso, L.H.C. 2007. Random subspace method for analysing coffee with electronic tongue. Electronics Letters. 43:21:1138:1139

Food and Agricultural Organization. 2005. www.fao.org

Lemos S. G.; Nogueira A.R.A.; Torre-Neto A.; Parra, A.; Artigas, J.; Alonso J. 2004. In-Soil Potassium Sensor System J. Agric. Food Chem. 52:5810-5815.

Jorge, L.A.C.; TOZZI, C.L.; De Maria, I.C.; Crestana,S. 1998. Automatic classification system of soil cover based on color information. In: Zazueta, F.S.; Xin, J.. (Org.). Computers in agriculture: proc of the 7th International Conference on Computers in Agriculture. St. Joseph: ASAE, CD ROM, 688-696.

Roman, M.P.; Cambra, M.; Juarez, J. et al. 2004. Sudden death of citrus in Brazil: A graft-transmissible bud union disease. Plant Disease; An International Journal of Applied Plant Pathology. St. Paul, 88:5:453-467.

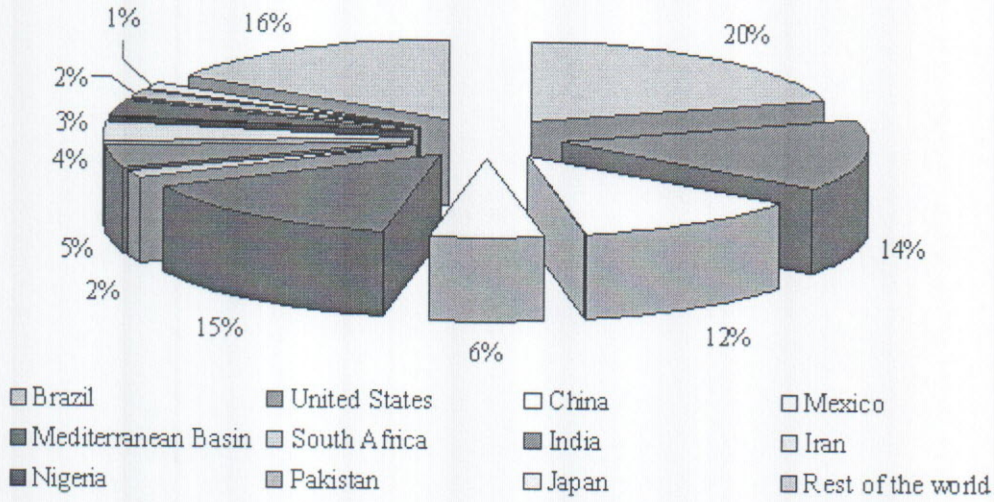
Terencio, J.C.C.; Milori, D.M.B.P.; Martin-Neto, L. 2005. http://www.cnpdia.embrapa.br/publicacoes/download.php?file=BPD11_2005.pdf.

Torre-Neto, A.; Schueller, J.K.; Haman, D.Z. 2000. Networked Sensing and valve actuation for spatially-variable microsprinkler irrigation. Proc. ASAE Annual International Meeting, 25th. Milwaukee, USA July. Paper # 001158.

Torre-Neto, A.; Ferrarezi, R.A.; Razera, D.E.; Speranza, E.; Lopes, W.C.; Lima, T.P.F.S.; Rabello, L.M.; Vaz, C.M.P. 2005. Wireless sensor network for variable rate irrigation in Citrus. Proc. Fruit, Nut and Vegetable Production Engineering Symposium, 7th – Information & Technology for Sustainable Fruit & Vegetable Producution. Montpellier, France Sept. CD-ROM.

Trindade Jr., O. ; Jorge, L. A. C. ; Aguiar, J. G. B. 2004. Using Uavs for Precision Farming: First Results. Proc. Auvisi´s Unmanned Systems North America. California SP (Proci-04.00100) (TRI)

Vaz, C.M.P. and Hopmans, J.W. 2001. Simultaneous Measurement of Soil Penetration Resistance and Water Content with a Combined Penetrometer–TDR Moisture Probe. Soil Science Society of America Journal 65:4-12.

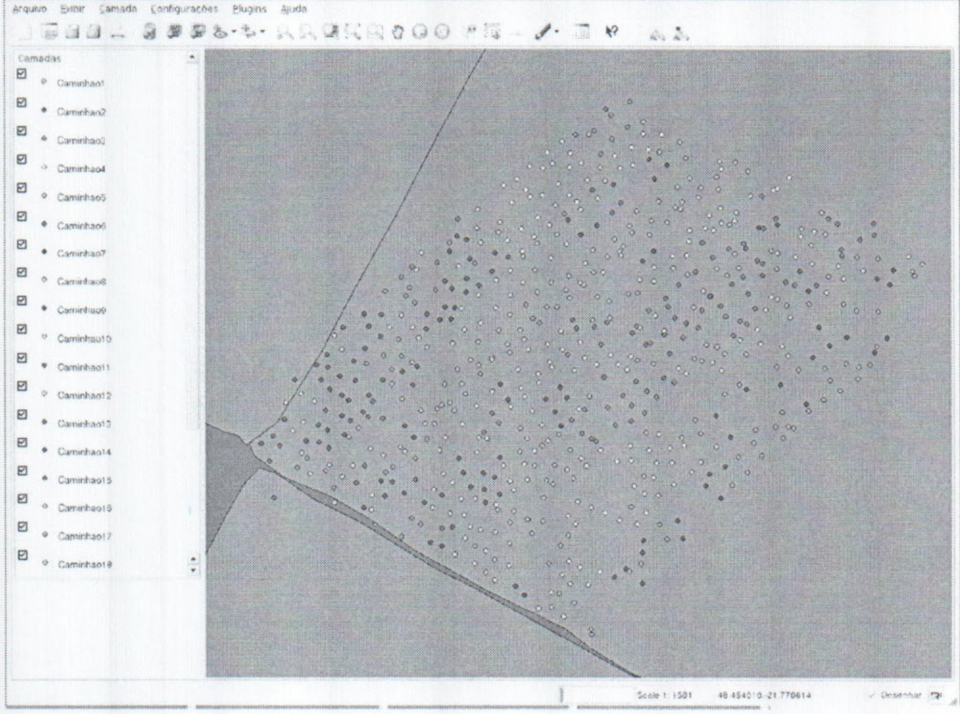


Source: UNCTAD from FAO data

* Note: Proportion of average annual production data for 2000-2004

Fig. 1 – Worldwide geographical distribution of fresh citrus production.

a)



b)

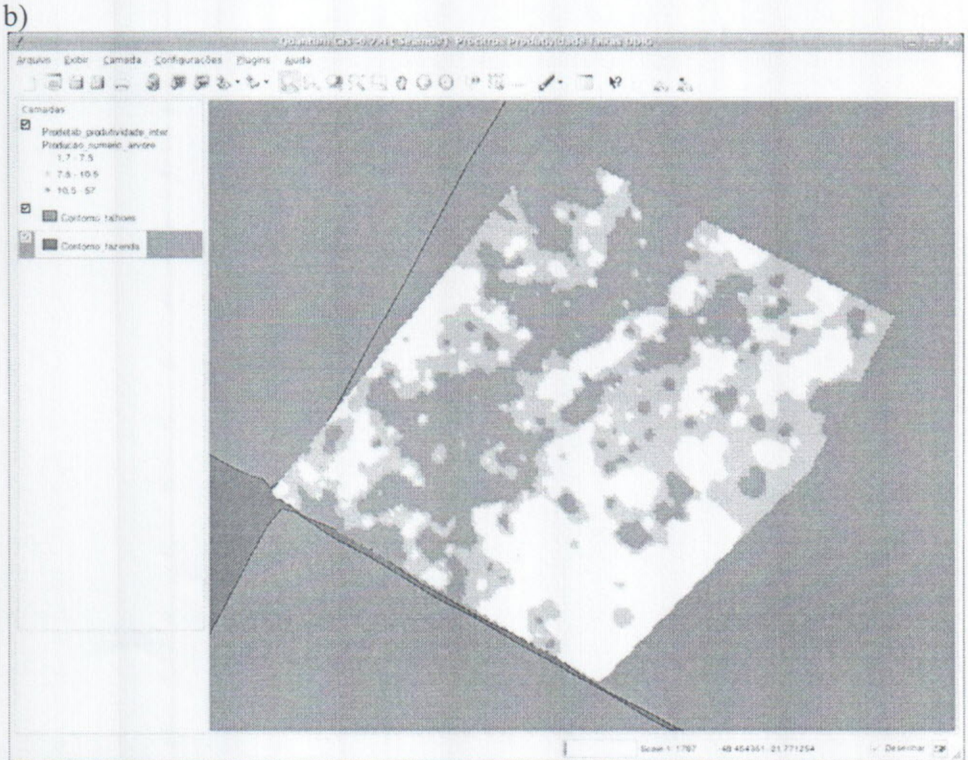


Fig. 2. a) Origin map showing the trees for each truck load and b) yield map in box/tree within a 50 m average resolution (one box = 40.8kg).

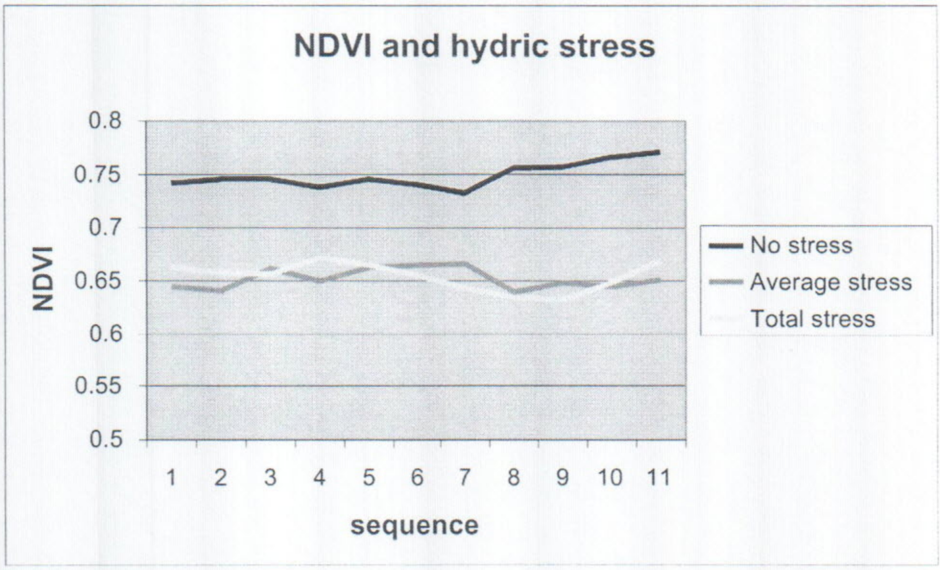


Fig. 3. Normalized difference vegetation index (NDVI) obtained for three subjective classes of hydric stress.

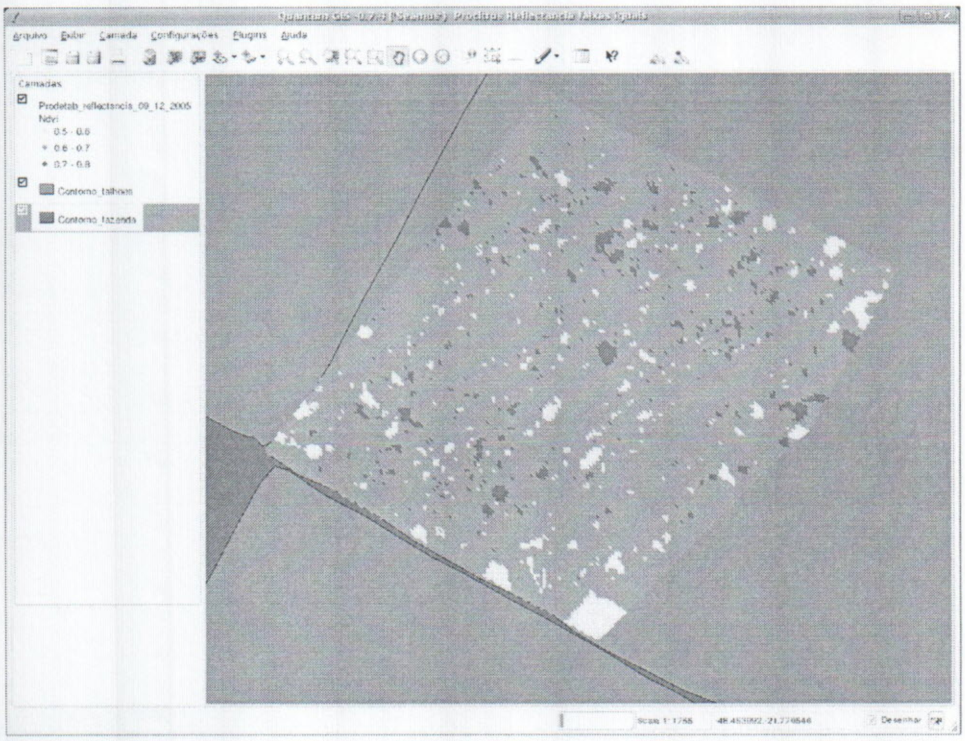


Fig. 4. NDVI map indicating that most of the grove trees have not reached the *Total stress* condition (NDVI < 0.7).

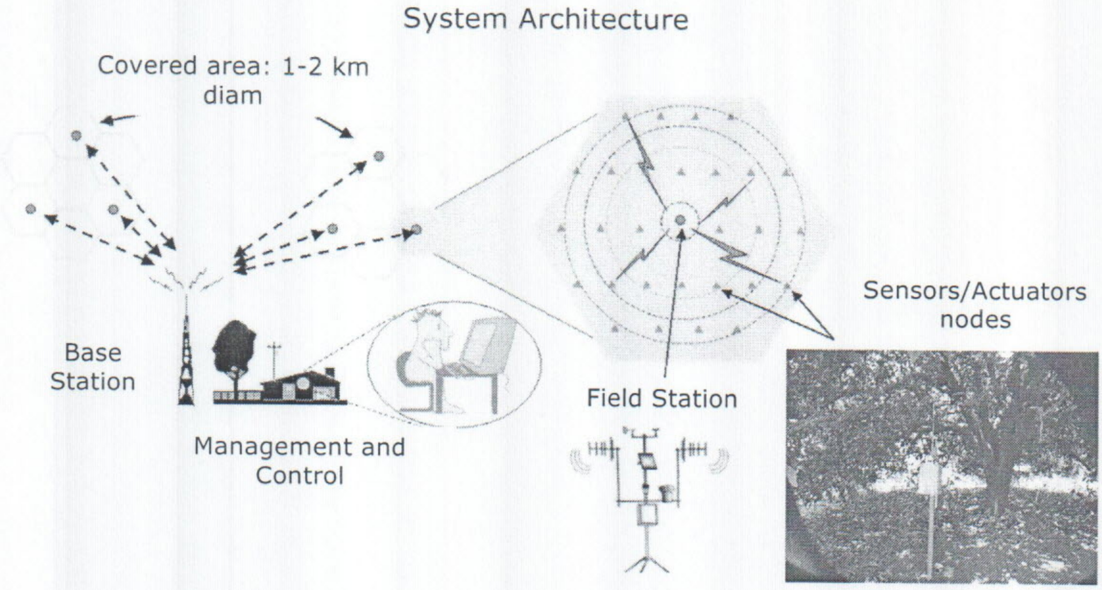


Fig. 5. Wireless sensor and actuator architecture developed for a site-specific irrigation system in perennial crops.

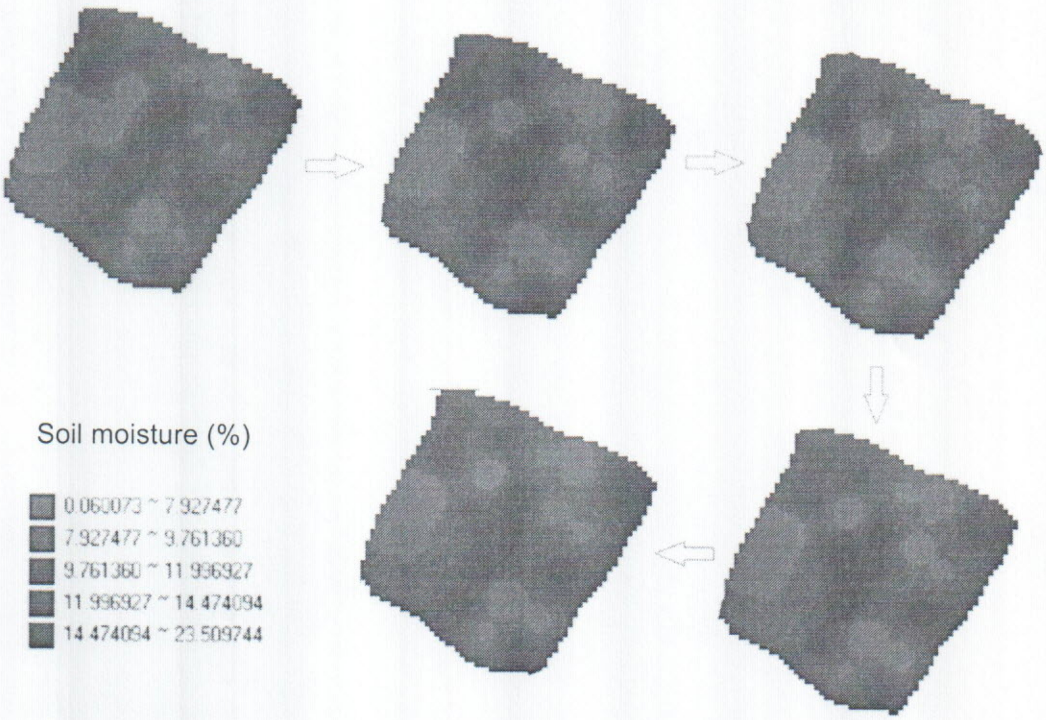


Fig. 6. Sequence of soil moisture maps at 25cm depth, obtained by a 7x7 grid of wireless sensors spaced 40 m from each other at one hour time interval.

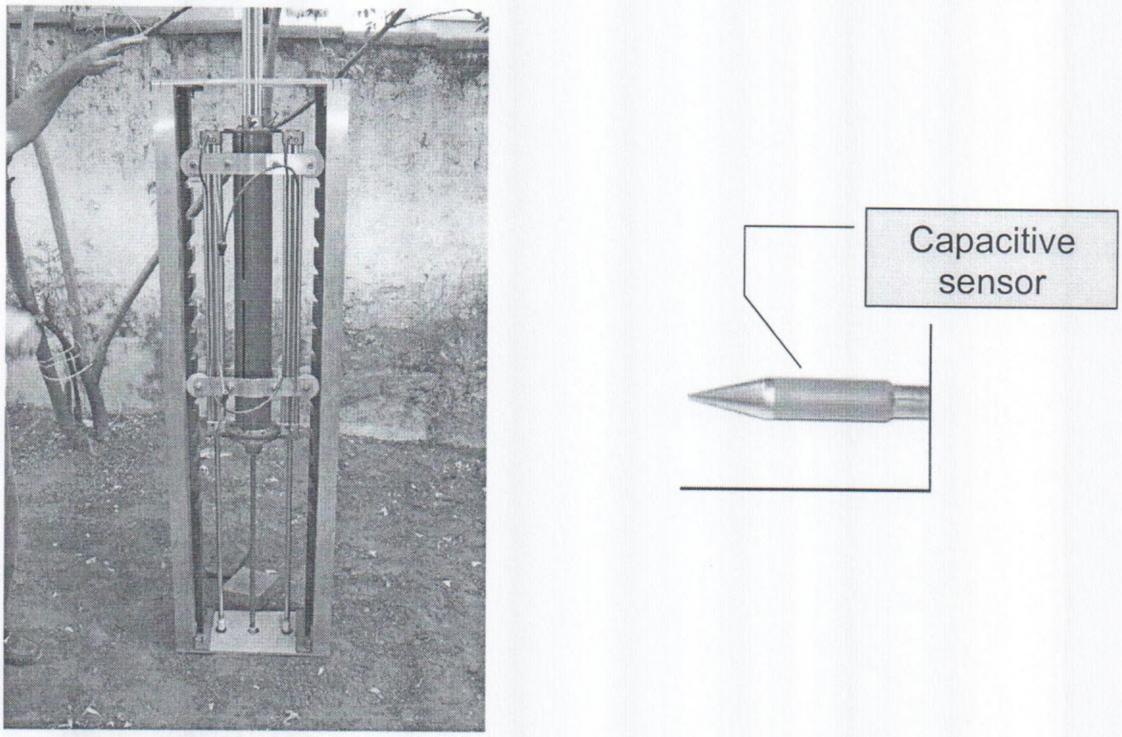


Fig. 7. Pneumatic on-the-go equipment developed to measure simultaneously the soil penetration resistance and moisture.

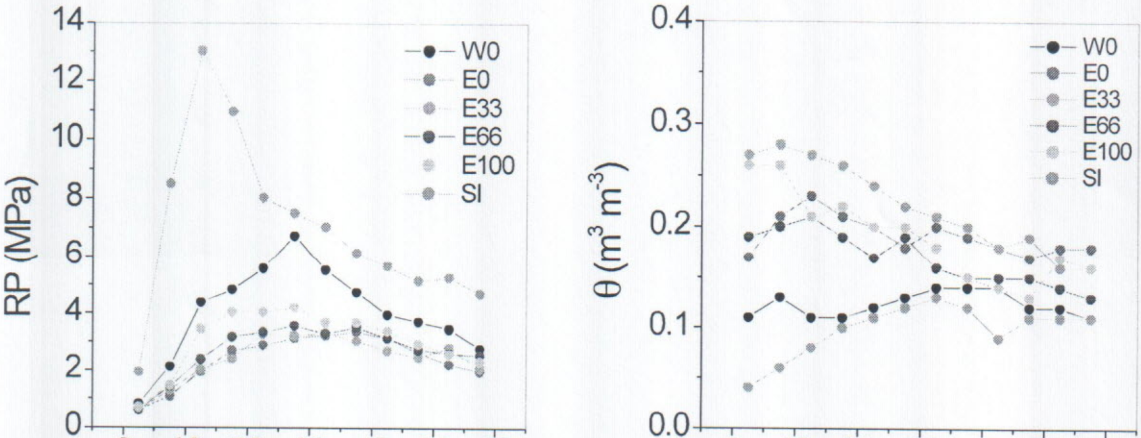
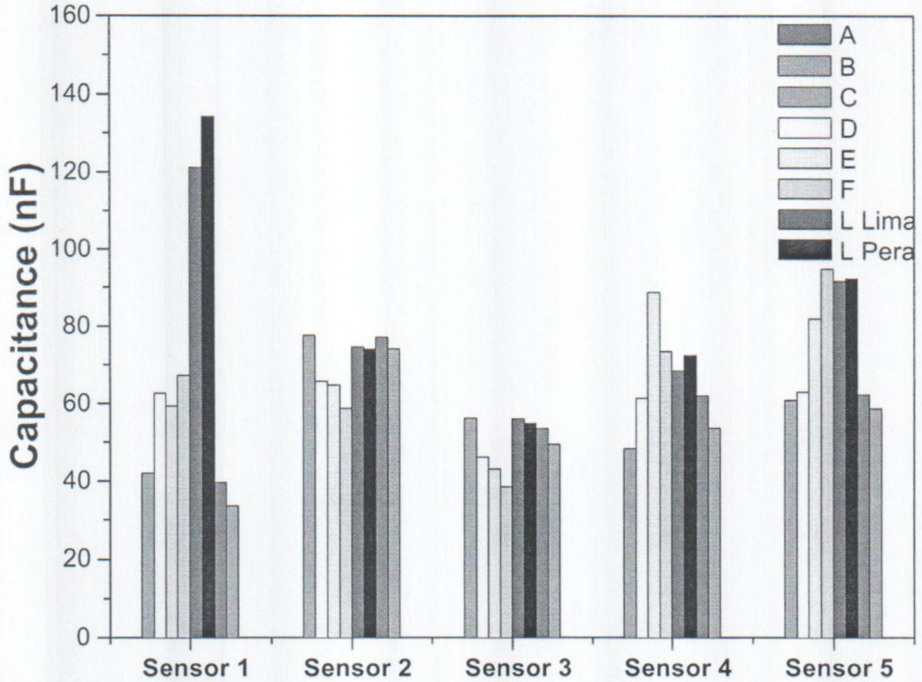


Fig. 8. Typical data obtained from six different spots with the combined soil penetration resistance and moisture probe.

a)



b)

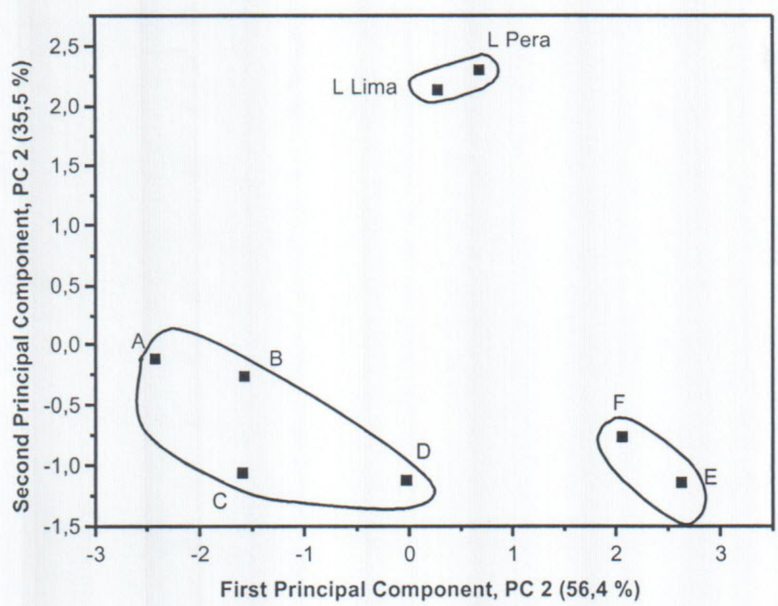


Fig. 9. a) Fingerprint of a five-sensor probe obtained for eight samples of juice and b) Principal Component Analysis showing the differentiation of each one.

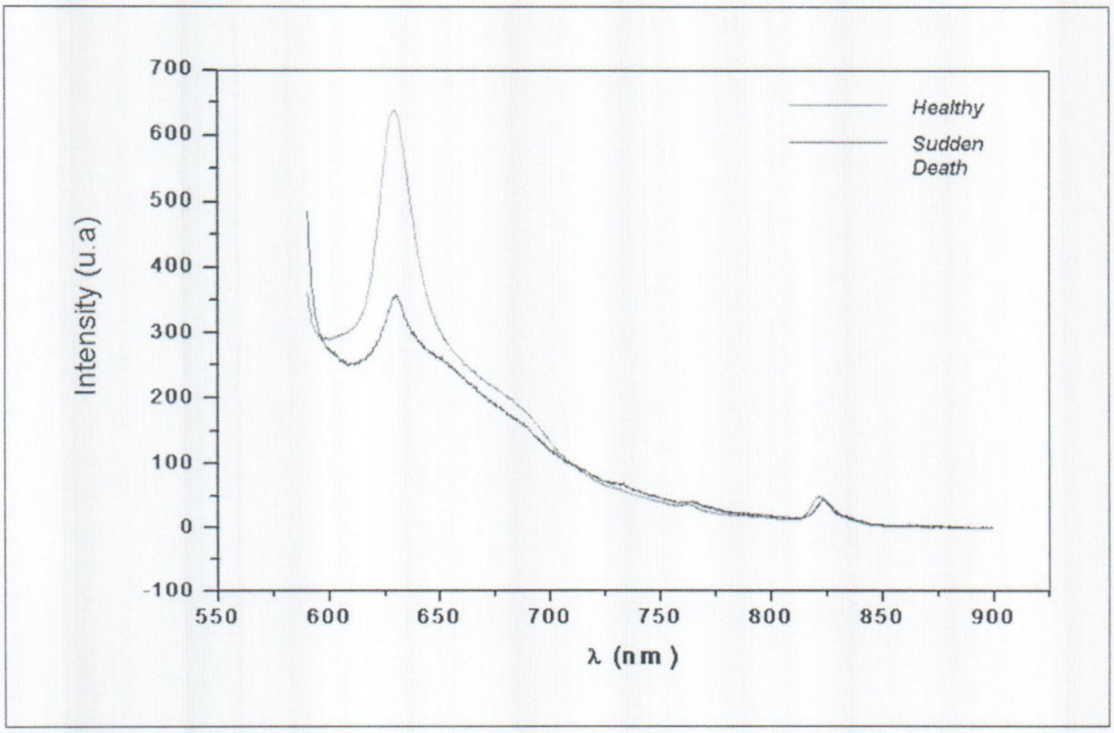


Fig. 10. Fluorescence spectroscopy of leaves from orange trees used to identify the Sudden Death disease.

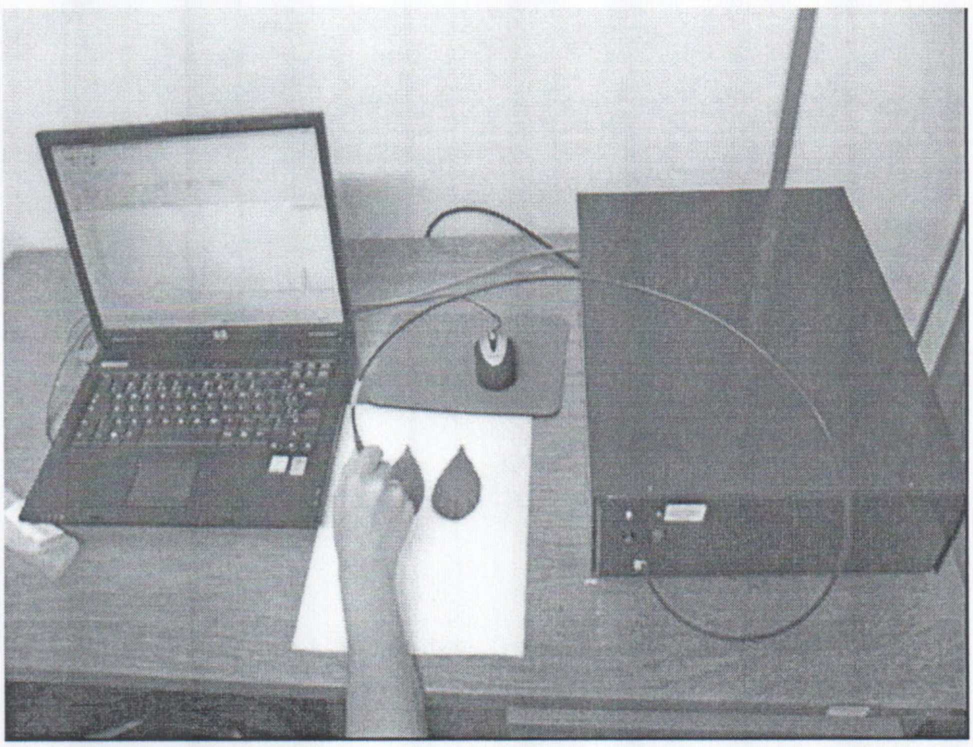


Fig. 11. Portable spectrometer and software developed for diagnosis in field.

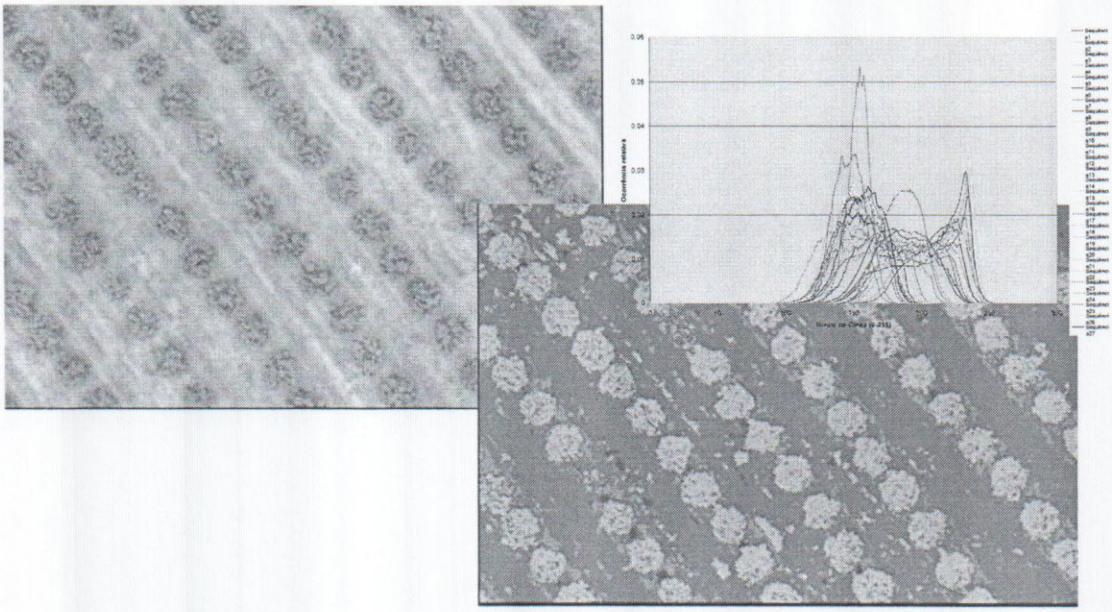


Fig. 12. Image acquired at 100m altitude by an Unmanned Aerial Vehicle, a sample of its spectral variation and processed image by neural network.

(a) (b) (c)

Fig. 13. a) Delimited region of interest and b) fluorescence image from a healthy leave and c) fluorescence image from a leave infected with *Sudden Death*.