

Tree canopy volume measurement with ultrasonic sensors in fruit orchards, vineyards and citrus groves.

**Escolà, A.^{1,2}; Rosell, J. R.²; Masana, P.²; Planas, S.^{3,2}; Gil, E.⁴; Val, L.⁵; Camp, F.²
Gracia, F.^{1,2}; Solanelles, F.¹; Llorens, J.²; Vallès, J.M.²**

¹ Generalitat de Catalunya. DARP. Centre Mecanització Agrària. (aescola@gencat.net)

² Universitat de Lleida. Dep. Enginyeria Agroforestal.

³ Generalitat de Catalunya. Dep. Agricultura, Ramaderia i Pesca (DARP)

⁴ Universitat Politècnica de Catalunya. Escola Superior d'Agricultura de Barcelona.

⁵ Universitat Politècnica de València. Dep. Mecanització i Tecnologia Agrària

Introduction

The need to adjust the agrochemical application doses for the different orchards, vineyards and grooves makes necessary to find a dosage procedure as objective as possible. One of the research lines in this area is to characterize the vegetation by its geometry. The classification of the differences between orchards and grooves makes possible to provide the farmers and advisers or consultants with tools to decide the dose to be applied in an objective, repeatable way. This is the aim of a research program called PULVEXACT being developed in Catalonia and Valencia (Spain) in fruit orchards, vineyards and citrus groves.

The problem is how to measure the vegetation in a quick, precise and repeatable way. In this communication a prototype and a methodology is described. It is based on ultrasonic sensors and provides direct measurements of the vegetation.

Materials and methods

A prototype has been developed to be coupled to the tractor fitted with a vertical aluminium pole of 4m height. In the case of fruit tree orchards and citrus groves 6 ultrasonic sensors are distributed along that pole at a distance of 0.6m facing the canopies in a horizontal way to measure the distance of each one to the vegetation. The information obtained is 6 horizontal outlines giving the vegetation width along the row for 6 different heights from 0.5m to 4.0m. In vineyards, 6 outlines were taken from 0.5m to 2.5m. Simultaneously, manual exhaustive measurements were done in the vegetation to determine a canopy volume as real as possible to validate the data obtained with the prototype.

After all data is recorded on the field the information is analyzed in the office and treated with software to calculate the volume of vegetation for each orchard and grove.

It is possible to link the canopy volume information with data provided with a GPS system to create canopy volume maps of the orchards.

Preliminary results

At the moment the outlines obtained are treated with different software to find the method that better estimates the canopy volume from the 6 outlines in relation to the manual measurements. When the best adjustment will be determined, complementary studies will

be done to analyze the influence of the horizontal resolution (distance between measures in an outline) and the vertical resolution (number of outlines) in the canopy volume results.

In case of a conventional application, this work will help farmers and advisers to choose the dose that best fits an orchard or a grove. Also, in case of using variable dose sprayers, this work will improve the real-time application of agrochemicals by adjusting the dose using real-time or map based technologies.

References

Zaman Q U, Salyani M. 2004. *Effects of foliage density and ground speed on ultrasonic measurements of citrus tree volume. Applied Engineering in Agriculture. Vo. 20 (2): 173-178.*

Tumbo S D, Salyani M, Whitney J D, Wheaton T A, Miller W M. 2002. *Investigation of Laser and ultrasonic ranging sensors for measurements of citrus canopy volume. Applied engineering in agriculture. Vol. 18 (3): 367-372.*