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► To cite this version:

E. Lardo, A. M. Palese, Aissa Arous, G. Ferrazzano, C. Xiloyannis, et al.. Apparent Electrical Conductivity as a Tool for Earthworm Parameters Evaluation in a Commercial Orchard. 8. International Peach Symposium, International Society for Horticultural Science (ISHS). INT., Jun 2013, Matera, Italy. 10.17660/ActaHortic.2015.1084.66 . hal-02741321

HAL Id: hal-02741321

<https://hal.inrae.fr/hal-02741321>

Submitted on 3 Jun 2020

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“Apparent electrical conductivity as a tool for earthworm parameters evaluation in a commercial orchard”

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Introduction

The non-invasive geophysical techniques, such as EMI (Electromagnetic Induction), are innovative approaches to study soil biological parameters.

Objectives

This work was carried out to assess relationships between soil earthworm abundance and biomass and soil apparent electrical conductivity (EC_a) measured by means of a GSSI EMP-400 Profiler.

Research Scenario and Measurements

Peach orchard:	cv Springbrigh/GF677 rootstock transversal Y (1111 plants ha ⁻¹)
Soil:	Clay loam classified as <i>Vertic Calcixerepts</i> (SSS, 1998)
Soil management:	Chemical Weeded on tree rows–CW Cover Cropped between tree rows–CC
Geophysical measurements:	Soil EMI (ElectroMagnetism Induced) performed by a multifrequency EMP-400 Profiler (GSSI, Salem, NH-USA)

Earthworms evaluation was performed by sampling twenty areas (1 m x 1 m) according to a regular grid pattern (20 areas/ha) (Photo 1).

Earthworm sampling was carried out by means of the mustard method combined with hand-sorting (Pelosi *et al.*, 2009).

Measurements of endogeic and anecic earthworm abundances (ind/m²) and biomasses (g/m²) were then performed in the laboratory.

Photo 1. Single area for earthworms sampling

Results and Discussion

EC_a values rose as the used wavelengths decreased and soil depth exploration increased. Soil EC_a map, performed at 3 kHz frequency, is reported in Fig. 1.

As found by Joschko *et al.* (2010) in cereal field, by Valckx *et al.* (2009) in horticultural arable fields and by Lardo *et al.* (2012) for tilled and cover cropped vineyards, the EC_a values measured in the peach orchard (Photo 2) were significantly correlated with earthworm parameters, thus confirming such experimental evidences.

Fig. 1. EC_a map at 3 KHz measured within the experimental peach orchard

The EC_a signal, obtained at the different frequencies, regressed on earthworm parameters (abundance and biomass according to a statistically significant decreasing linear model). In particular, the 3 kHz frequency showed the strongest relations with endogeic parameters (Fig. 2).

Otherwise, the relation between the EC_a and abundance values was weaker than biomass data.

Photo 2. The experimental peach orchard

Fig. 2 Relationships between EC_a values, abundance (ind/m²) and biomass (g/m²) for endogeic earthworms.

Conclusions

The EMI technique can be a useful tool to investigate and predict the spatial and temporal variability of these biological indicators at different spatial scales.

Our findings suggest to verify the possibility of defining an integrated procedure (classical sampling methods combined with geophysical measurements) for earthworm community assessment under different pedoclimatic conditions.

According to this innovative procedure, EC_a signals can identify high earthworms density areas where abundance and biomass measurements should be performed. This can reduce the expensive measurement campaigns which are usually carried out to characterize earthworm growth environments.

Moreover, it could be possible to spatialize biota data at whole field level by guaranteeing the reliability of the estimates of mean real values of earthworm parameters and their surface spatial distribution.

Acknowledgements

This research was financed by Ministero dell'Istruzione, dell'Università e della Ricerca (PRIN 2008, *Carbon Cycle in managed tree ecosystems*). The authors thank the farm owner Dr Giancarlo Mellone (Società Idea Natura - Eboli).

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