

# GOSYRIS

Project title: Garden Orchard SYstems: Research Into the Soil-Plant-Atmosphere Continuum

Acronym: GOSYRIS

Project duration: 36 months - Start date: 01.11.2018 End date: 31.10.2021

Key-words: soil-plant-atmosphere continuum (SPAC); garden orchard; agroforestry; water and nitrogen balance

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## Summary:

### Context:

Driven by societal demands, the design of Territorial Food Systems leads to the development of innovative fruit and vegetable production systems in periurban zones. These production systems have to accommodate multiple objectives: (1) produce in sufficient quantity and quality, (2) optimize pesticide use and minimizing waste (with respect to human health and protection of neighbouring population), and (3) limit waste of resources. The concept of Agroforestry appears to be a suitable answer to this double challenge, namely of ecological intensification of production, and autarky of field-cropping systems. In Third World countries (countries of the Global South), the introduction of shade trees in field crop culture has been studied from an agronomic and socio-economic perspective, and the results of these studies are very promising. Closer to home, agroforestry systems consisting of timber trees and cereals have also been studied (Dufour et al., 2013). However, their application to a specific agroforestry system, the "garden orchard" is not a straight affair, for several reasons: (1) there is a high diversity and a rapid succession of vegetable rotations which renders the search for a suitable supplies and requirements for water and minerals rather complex, and (2) numerous agronomic interventions conducted on the fruit trees potentially induce a significant variability in the functioning of tree roots.

### Goals:

The objective of the project is to produce a model of the functional traits describing the soil-plant-atmosphere continuum system in a garden orchard. Based on the identification and hierarchisation of the different processes that are intervening in the regulation of water and mineral uptake and transport, this conceptual model will be formalized mathematically and then algorithmically implemented as a computer simulation, before being validated, both in an experimental and a professional context. As an immediate perspective, it will allow the formalisation of decision-support tools (DST) for better management of garden orchards.

### Methodology:

To reach this goal, the project will include

1. a characterization of the physical and chemical processes interacting through the soil-plant-atmosphere continuum (SPAC) based on a state-of-the-art review,
2. a quantification of these processes thanks to experimental field surveys on two garden orchards including microclimate data, physical and chemical properties of the soil, as well as plant growth and yield, with a spatial and temporal resolution sufficiently detailed to allow the observation of the effect of the trees,
3. the creation or adaptation of a model of the garden orchard in order to establish the efficiency of the system, in terms of yield, carbon and nitrogen balance, depending on its management,
4. the simulation of different management scenarios to validate the model, along with a catalogue of proposed measures to improve and adapt the studied system.