



**H.F.R.I.**  
Hellenic Foundation for  
Research & Innovation

**Description of the funded research project**  
**1st Call for H.F.R.I. Research Projects to Support Faculty**  
**Members & Researchers and Procure High-Value**  
**Research Equipment**

**Title of the research project:**  
**Nutrisense**

Development of an innovative technology using special ion electrodes and suitable software for hydroponic production with emphasis on recycling of the drainage solution in closed systems

**Principal Investigator:** Dimitrios Savvas

**Reader-friendly title:** Nutrisense

**Scientific Area:** Agricultural Sciences

**Institution and Country:** Agricultural University of Athens, Greece

**Host Institution:** AUA

**Collaborating Institution(s):**

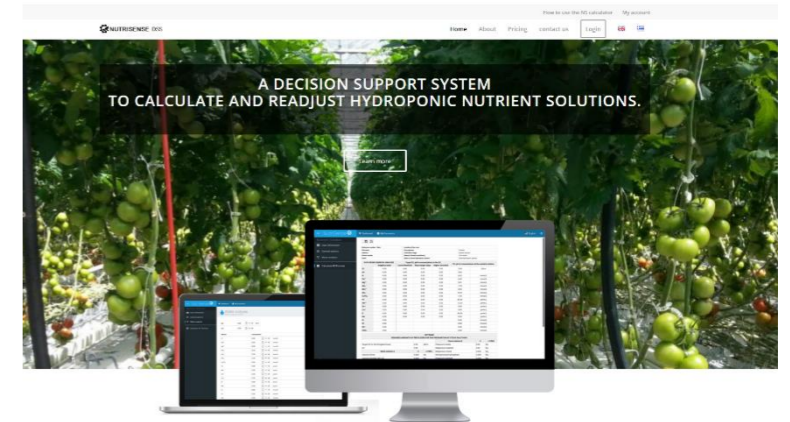
Agricultural University of Athens

ALAGRO E.E.

Cyprus University of Technology (CUT)

Wageningen Plant Research, department “Greenhouse Horticulture”

**Project webpage:** <https://nutrisense.online>



**Budget:** 156.350€

**Duration:** 36 months

## Research Project Synopsis

Hydroponics, as a technology that decouples plant crops from soil-related constraints (soil pathogens, poor soil fertility, salinity, etc.) provides an enormous potential for increasing production and quality in greenhouse crops. In Greece, due to lack of know-how, hydroponic production in greenhouses does not grow fast enough to maintain the viability of the greenhouse industry in the competitive international market. The improvement of domestic know-how and the upgrading of the technological level of hydroponic cropping systems are therefore the two most necessary prerequisites for the further development of greenhouse cultivation sector in Greece. In this direction, the proposed research project aims to contribute to the development of an innovative technological application for hydroponic vegetable production in the greenhouses. The most innovative objective is the automatic collection and recycling of drainage solution resulting from fertigation in closed hydroponic systems using specialty designed software and ion-specific electrodes operating in real time. More specifically, this project aims to: (a) study the nutritional needs of selected vegetables not yet studied in closed hydroponic systems under Mediterranean climatic conditions; (b) develop specific technology for the automated measurement of the concentrations of selected nutrient ions in the drainage solution; and (c) development of appropriate software for automated replenishment of drainage solutions with water and nutrients thereby enabling its recycling. The software will be based on already existing models and algorithms developed by Agricultural University of Athens after adaptation to the project needs. The results of this research are expected to promote the growth of the domestic hydroponic industry as they will originate from Mediterranean climatic conditions. Consequently, increased productivity, reduced pesticide use, environmental protection from nitrate pollution and better product quality are anticipated. Finally, the project is expected to provide know-how to indigenous companies offering equipment for hydroponic crops in the market, thereby contribute to economic growth.

## Project originality

A core task in the proposed research program is the development of a novel software for hydroponic crops and especially for closed hydroponic systems (D.3.1 & D.3.2), which enables proper recycling of the drainage effluents (DS), thereby contributing to considerable savings of water and fertilizers and reduced contamination of water resources by nitrates. This software includes algorithms developed by the principal investigator of NUTRISSENSE and his research team, which have been accepted as novel by the international scientific community as they were published as original papers in international scientific journals (Savvas and Manos, 1999; Savvas and Adamidis, 2001; Savvas, 2002; Savvas et al., 2005; Savvas et al., 2007; Savvas et al., 2008; Varlagas et al., 2010; Neocleous et al., 2013, 2015, 2017, 2018; Savvas et al., 2017; Katsoulas et al., 2015; Ropokis et al., 2018; Savvas and Gruda, 2018). Now, the ambition of this project is to contribute to the utilization of all these research efforts of the past, to establish a software, which will be novel not only for Greece but also for the international horticultural community.

The envisaged technology for automatic measurement of nutrient ions in solutions using ion selective electrodes (ISE) and the NUTRISSENSE software are pioneering techniques for Mediterranean countries and especially for Greece, as such technologies have so far only been tested in North-Europe (e.g. in The Netherlands). However, the project is innovative worldwide, first because the research team of NUTRISSENSE will test the newest generation of ISE and second because the NUTRISSENSE software is an original work with many novel aspects and not just a standard software similar to existing ones.

## Expected results & Research Project Impact

NUTRISENSE aims to cover the existing gap of knowledge in the international and Greek bibliography regarding optimal uptake ratios. At the same time, research results will be obtained on the suitability of decontamination methods which do not leave residues in plants ( $O_3$  and  $H_2O_2$  decompose in harmless  $O_2$ ) to control pathogens in the recycled DS, focusing mainly on dosages and application techniques, as well as on the safety of the produced vegetables. The technology for automatic measurement of nutrient ions in solutions using ISE and the NUTRISENSE SW are pioneering techniques for Mediterranean countries and especially for Greece, as such technologies have so far only been tested in North-Europe. A core task of NUTRISENSE is the development of a novel software for hydroponic crops and especially for closed hydroponic systems which enables proper recycling of the drainage effluents (DS), thereby contributing to considerable savings of water and fertilizers and reduced contamination of water resources by nitrates.

Socially the dissemination activities are anticipated to increase the general level of know-how in the sector of hydroponic industry. As a result, higher productivity and competitiveness, reduced pesticide use and better product quality can be achieved in the sector of greenhouse vegetable production, which is very dynamic in Greece due to the favorable climatic conditions. The activities planned within the framework of NUTRISENSE include the development of the project platform, media campaign (social media accounts, press releases), organization of four open workshops at four local communities in different regions of Greece and several smaller-scale dissemination activities. These activities will be very helpful to local communities in which the greenhouse production sector is important for the local economy. Active engagement of researchers, producers, industry, and practitioners at each stage of the project will stimulate new networks.

## The importance of this funding

NUTRISENSE is a research project envisaged by prof. Dimitrios Savvas aiming at utilizing the results of his research activity in the field of hydroponic crops for over than 30 years. These results, as well as further information published by other researchers in this scientific field, will be used to establish a software useful for everybody who is involved in the hydroponic production and supply chain of vegetables and cut flowers. NUTRISENSE aims to fill the gap of knowledge between growers and technology by implementing a Decision Support System and ready-to use technology with ion-selective electrodes to determine in-situ the nutrient status in in the fertigation effluents, thereby contributing their recycling in a safe manner. Last but not least, NUTRISENSE will provide the opportunity for qualified research work to two professors of AUA and four junior researchers.



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