Advanced Course

Integrated Nutrient Management: present challenges and future opportunities

Zaragoza (Spain) • 15-20 February 2027

CIHEAM ZARAGOZA

Objectives

Nutrient management is now central to discussions on agricultural sustainability, as decades of intensification have often depended on mineral fertilisers applied without sufficient attention to nutrient cycles, resulting in low nutrient use efficiency, soil degradation, water pollution, greenhouse gas emissions, and dependence on costly, geopolitically vulnerable inputs. In response, Integrated Nutrient Management (INM) has emerged as a more comprehensive approach, combining mineral and organic sources, leveraging soil biological processes, recovering nutrients from circular resources, and using indicators such as nutrient use efficiency and nutrient balances to guide decisions. These challenges are especially acute in the Mediterranean, where low organic matter, salinity, limited water, and climate extremes demand region-specific solutions. The course is designed to equip professionals with the knowledge and tools to apply INM through soil science, plant nutrition, microbiology, water management, circularity, and advanced research methods in a practical, interdisciplinary way.

The course aims to give participants a solid, region-specific grounding in INM—covering conceptual frameworks, nutrient cycles and performance indicators (NUE, PUE, KUE, etc.)—and to equip agricultural professionals, researchers, policymakers and practitioners with practical tools to design and implement INM strategies adapted to local farming contexts. It will examine how soil properties, organic matter and microbial communities drive nutrient dynamics and plant–microbe interactions under Mediterranean stress, and will highlight water–nutrient–climate linkages, circular use of organic resources, and advanced research methods. Learning will combine lectures, guided debates, case studies and group work to ensure applied understanding and readiness for field or policy application.

The course will enable participants to:

- Acquire a comprehensive understanding of the foundational principles and scope of INM and their significance within Mediterranean contexts.
- Interpret nutrient cycles and balances at plot, farm and territory scales, and apply nutrient use efficiency indicators to evaluate the performance of Mediterranean cropping systems.
- Understand the physical, chemical and biological properties of Mediterranean soils and the role of organic matter and microbial communities in nutrient retention, mineralisation, solubilisation and stabilisation.
- Understand nutrient pathways from soil to plant, their transport, assimilation and remobilisation, and the relationships between mineral nutrition, metabolism and plant-microbe interactions under stress.
- Analyse the coupling between irrigation, soil physical status, nutrient mobility and crop uptake under the variability caused by climate change.
- Evaluate the use of organic resources and circular nutrient management strategies, considering their quality, variability, contaminants, sanitary risks and territorial logistics.
- Become familiar with methods and tools in INM research, including long-term trials, tracers and isotopes, omics, modelling and decision-support tools.
- Integrate the knowledge acquired through Mediterranean case studies and adapt it to inform sound, context-specific nutrient management decisions and policy perspectives.

Organisation

The course is organised by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) through the Mediterranean Agronomic Institute of Zaragoza (CIHEAM Zaragoza).

The course will be held for one week, in morning and afternoon sessions at CIHEAM Zaragoza, from 15 to 20 February 2027. The course can also be followed online.

Qualified lecturers from research centres, universities, private companies and the European Commission in different countries will deliver the programme. The course requires personal work and interaction among participants and with lecturers. The international characteristics of the course favour the exchange of experiences and points of view.

The programme has an applied approach. Lectures are complemented by guided debates and group work. Participants will be invited to present a case study about their experience in INM in their country of origin.

Programme

1. Official opening. Course presentation, objectives, participants & working approach (1 h)

2. Conceptual frameworks and indicators (5 h)

2.1. Definitions and scope of INM in relation to soil fertility management, plant nutrition and sustainable agriculture.
2.2. Nutrient cycles (N, P, K and micronutrients) at plot, farm and territory scales. Nutrient balances.
2.3. Performance indicators: NUE, PUE, KUE, partial factor productivity and surplus indicators.
2.4. Guided debate & case study: Are indicators operational in Mediterranean systems?

3. Soil, organic matter and microbiology (7 h)

3.1. Soil health implications in the Mediterranean region linked to INM.
3.2. Physical, chemical and biological properties of Mediterranean soils: determination and relevance to nutrient dynamics (texture, density, CEC, pH, salinity, carbonates).
3.3. Role of organic matter in retention, buffering, aggregation and water holding capacity.
3.4. Microbial communities as drivers of mineralisation, solubilisation, immobilisation and stabilisation; functional groups.
3.5. Guided debate and group work: Biology or chemistry as the limiting factor in each context?

4. Plant nutrition and plant-microbe interactions (6 h)

4.1. Nutrients pathways from soil to plant.
4.2. Transport, assimilation and remobilisation of nutrients within the plant; primary and secondary metabolic pathways.
4.3. Relationships between mineral nutrition, enzyme activity, carbon and nitrogen allocation under Mediterranean stress.
4.4. Plant-microbe interactions: rhizosphere, root exudates, beneficial symbioses and metabolic plasticity.
4.5. Guided debate: biostimulants, stress tolerance and efficiency gains through biotic interactions.

5. Water–nutrient–climate interactions (5 h)

5.1. Coupling between irrigation, soil water status, nutrient mobility and crop uptake (rainfed and irrigated systems).
5.2. Leaching, volatilisation, denitrification and runoff under variable rainfall, fire and extreme events.
5.3. Fertigation, deficit irrigation and precision water-nutrient tools and management; climate change impacts and implications for INM.
5.4. Guided debate and case study: water-nutrient management strategies under Mediterranean conditions.

6. Organic resources, circularity, methods and case studies (6 h)

6.1. Organic resources: types, quality and nutrient content (manure, compost, green manures, biosolids, digestate). Contributions to soil.
6.2. Circular nutrient management: logistics, variability, contaminants, sanitary risks and territorial strategies. Energy and circularity.
6.3. Methods and tools in INM research: long-term trials, tracers and isotopes, omics, modelling and decision-support tools.
6.4. Final debate: Mediterranean case studies, final synthesis, political perspective (future and challenges), evaluation and course closure.

7. Technical Visit (6 h)

Guest lecturers

Álvaro-Fuentes, Jorge - Estación Experimental de Aula Dei-CSIC, Spain
Atarés, Sergio - Fertinagro Biotech, Spain
Ayadi, Sawsen - National Agronomic Institute of Tunisia, Tunisia
Dellagi, Alia - Paris-Saclay University, France
Esposito, Sergio - University of Naples Federico II, Italy
Martínez, Laura - Estación Experimental de Aula Dei-CSIC, Spain
Mayoral, José Antonio - University of Zaragoza, Spain
Moreno, Héctor - Polytechnic University of Valencia, Spain
Sakrabani, Ruben - Cranfield University, United Kingdom
San Bautista, Alberto - Polytechnic University of Valencia, Spain

Admission

The programme is aimed at researchers, PhD candidates, fertiliser companies, advisors, agricultural extension agents, policymakers, NGO professionals and practitioners from Mediterranean countries involved in soil fertility, plant nutrition, sustainable agriculture and nutrient management.

• 25 places will be available for face-to-face participation with access to lectures, guided debates and group work, as well as a technical visit (36 hours).
• 30 places will be available for online participation with access to lectures, guided debates and group work via live streaming (30 hours).

Knowledge of English will be valued in the selection of candidates since it will be the working language of the course.

Registration

- Candidates may apply online at the following address: https//www.admission.iamz.ciheam.org/en/
- Applications must include the curriculum vitae and a copy of the support documents most related to the subject of the course. The deadline for the submission of applications is **2 October 2026**.
- Applications from candidates requiring authorisation to attend the course may be accepted provisionally.
- Registration fees for the course amount to 500 euro for face-to-face participation and 350 euro for online participation. This sum covers tuition fees only.

Scholarships

Candidates from CIHEAM member countries (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Türkiye) may apply for scholarships covering registration fees, and for scholarships covering the cost of travel and full board accommodation.

Candidates from other countries who require financial support should apply directly to national or international institutions.

All applications are subject to a selection process based on the profiles submitted.

Insurance

It is compulsory for participants attending the course in person to have medical insurance valid for Spain. Proof of insurance cover must be given at the beginning of the course. Those who so wish may participate in a collective insurance policy taken out by the Organisation, upon payment of the stipulated sum.

Contact:
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