

# Prediction of in situ soil nitrogen mineralisation using artificial neural networks: a promising way to improve model accuracy

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## Towards a better efficiency in N use



Themes of the workshop

### Opening session: 25 Years Nitrogen workshop.

*Keynote lecture: Dr. J.J. Neeteson. Plant Research International B.V. Wageningen. The Netherlands.*

### Theme 1: Approaches to N management in order to improve N-use efficiency

*Keynote lecture: Dr. G. Lemaire. INRA. Lusignan. France.*

*Chair: Rodney Thompson. University of Almeria. Spain.*

#### 1.1. Diagnostic tools for N fertilisation recommendation and fertilisation strategies

Methods of N fertilisation recommendation are diverse and based on different soil or plant determinations and also upon usage of simulation models. To know which is the system best adapted to each crop, soil and agronomic context requires the knowledge of soil-water-plant relationships, physiology of orchard and management system (dryland, irrigated land). Precision agriculture is an option playing and increasingly important role, since it can also help fulfil environmental demands.

#### 1.2. Management practices to reduce environmental impact of nitrogen fertilisation

Increasing environmental demands from society as well as the search for optimal and profiting resource management in agricultural production has led to new or renewed specific cropping and N management practices, involving cover crops, catch crops, vegetated strips, enriched atmospheres in greenhouses, recirculation of the fertigation solution, nitrification inhibitors use, and managing C/N dynamics among others.

#### 1.3. N and water management in Mediterranean climate

Available water in Mediterranean climate usually gets scarce during grain filling of most crops. This makes irrigation a key point for social and economical sustainability of the agricultural system. Increasing the amount of water in the system also increases the risk of water contamination by soluble nutrients. Drip irrigation and fertilisation fractionation are powerful tools to minimise the negative impacts and improve sustainability. However, knowledge lacks, for example, on the optimised nitrogen needs of horticultural crops, which fertilisation prediction method is better suited for some crops such as almond trees, how to interpret soil analysis when fertilising with organic wastes, etc...

### Theme 2: N flows in agricultural systems, grassland and forest systems

*Keynote lecture: Dr. Claudio O. Stockle. Washington State University. USA.*

*Chair: Carlos Ramos. Valencian Institute for Agricultural Research. Spain.*

#### 2.1. N flows. The role of micro-organisms

Management practices such as crop rotation, residue management and fertilisation affect the quality and quantity of soil organic matter. Microbial biomass and microbial activity are closely related to soil organic matter content. They are positively influenced by organic amendments such as crop residues and animal manures .

After application of pig slurry to soil, part of the ammonium is immobilised due to microbial activity. Immobilisation and the following remineralisation influence the fertiliser value of slurry nitrogen as well as the amount of organic nitrogen that is or is not stored in soil. Mineralisation of crop residues releases large amounts of mineral nitrogen. At the same time, organic wastes with a high C/N ratio and low lignin content, seem to have an important nitrogen immobilisation potential. Organic farming may be an option to obtain and maintain an internal cycling of nutrients, ideally by a tight coupling between roots and mineralising microorganisms.

## **2.2. N flows. Gaseous nitrogen losses**

Gaseous nitrogen losses from agricultural land are an economic loss and have a negative environmental impact. Nitrous oxide contributes to the greenhouse effect and is involved in the destruction of stratospheric ozone. Nitrous oxide and N<sub>2</sub> emissions depend on physical, chemical, and biological attributes of soil, on weather conditions, and on complex interactions among these factors. More recently, denitrification is regarded as a means to help achieving the target nitrogen standards in ground and surface waters. Regarding ammonia volatilisation, it is strongly influenced by the timing and mode of fertiliser application among other factors. Perhaps the major uncertainty is about the effect of rainfall on ammonia volatilisation. In another context, the welfare of pigs can be increased by reducing ammonia emissions from housing. Moreover, a negative impact on the environment caused by emissions from animal husbandry has been observed for some years.

## **2.3. N flows. Components of the N balance**

N leaching (nitrate and ammonia movement in the soil profile)

Missing N

Leguminous fixation

The role of roots

15N

## **2.4. Nitrogen flows. Adaptation to different scales: field, farm, region**

Nitrogen flow studies lead to different types of conclusions depending on the scale at which they are tackled. The regional variation in agricultural practices and nitrogen efficiency throughout Europe is substantial, and therefore, challenges to improve it are different. Nitrogen use efficiency is about optimising application and minimising uncontrolled losses. Best Available Techniques (BATs) to be applied at farm and field level have been developed in different regions. Effective transfer of BATs to farmers and applicability of some of them is not yet accomplished. On the other hand, the nitrogen cycle, and even more the combined carbon and nitrogen cycle, is also not yet fully mastered.

## **Theme 3: External constraints to N fertilisation**

*Keynote lecture: Dr. A.E. Johnny Johnston. Rothamsted Research. UK.*

*>Chair: Dolores Quilez. Agri-food Research and Technological Center of Aragon. Spain.*

### **3.1. Nitrogen fertilisation economy**

The price of nitrogen fertilisers has increased about 20% in the period 2000-2004, and more than the price of the other main nutrients for the same period. The recent political and economic developments in the world have changed the configuration and perspectives of raw materials and consequently, the fertiliser market. Fertilisation is an important production cost of some relevant crops such as maize. From another point of view, the cost of mineral N production is large both in currency terms as well as from the environmental point of view (fossil fuel consumption and CO<sub>2</sub> emission).

### **3.2. Contribution of "border disciplines" to a better N management**

Soil technology (minimum or no-tillage, direct sowing)

Biotechnology

Animal feeding

Treated organic wastes/ organic wastes treatment

### **3.3. Nitrogen fertilisation and product quality**

Nitrogen fertilisation has already been evaluated from several points of view, according to different factors: production, economy and environment. However, postharvest technology needs, direct processing for fresh consumption, and food industry requirements as well as functional aspects of food pose new challenges to fertilisation management.

Programme

## **Aim of the workshop**

International exchange of knowledge on the current state of research and extension on N management in agricultural systems, specially in Mediterranean agricultural systems.

**Sunday, 27th May**

16.30 - 19.00 Reception and registration at the Conference Center  
18.00 Walk and guided visit to Seu Vella (12th Century monument)  
Meeting point: Conference Center

## **M o n d a y, 2 8 t h M a y**

8.00 - 9.00 Registration, Coffee & Tea  
9.30 - 10.15 Opening Conference

Theme: Approaches to N management in order to improve N use efficiency

10.15 - 11.00 Keynote Speaker Conference  
11.00 - 11.30 Coffee Break  
11.30 - 13.00 Invited papers  
13.00 - 14.00 Lunch break

Theme: N flow in agricultural systems, grassland and forest systems

14.00 - 14.45 Keynote Speaker Conference  
14.45 - 16.45 Invited papers  
16.45 - 17.15 Coffee Break  
17.15 Posters

## **T u e s d a y, 2 9 t h M a y**

7.30 Excursions

All buses leave from main entrance of the Conference Center.  
The outdoor program will be introduced for each excursion

Theme: External constraints for nitrogen fertilization

16.00 - 16.45 Keynote Speaker Conference  
16.45 - 18.15 Invited papers

Tuesday Evening (20h 30): Workshop dinner (included in the fee).

Dinner will take place (see map) in: Restaurant Alari. Av. Josep Tarradellas 45-47. Lleida Tel: + 34 973 212340

## **W e d n e s d a y, 3 0 t h M a y**

9.00 - 11.30 Working Groups. Coffee will be available  
11.30 - 13.00 Plenary presentations of the results of the workshops  
13.00 - 13.15 Closing session

Lunch

### **E x c u r s i o n s**

#### **E x c u r s i o n 1 . Irrigated agricultural systems**

1. Experiment in commercial peach orchard for processing (Torres de Segre, Segria)
2. Field experiments from IRTA-UdL (Gimenells, Segria)
3. Vineyard experiments in Raimat

#### **E x c u r s i o n 2 . Dryland agricultural systems**

Running fertilization field experiments on cereal crops will be introduced. A visit to Actel's logistic fruit section will be included.

#### **E x c u r s i o n 3 . Mixed agricultural systems**

A visit to a private intensive animal farm will be combined with the introduction to running field experiments on fertilization.

## **Working Groups**

1. Application problems of N15 technique. WG 1 will be convened by Dryes Huygens (Ghent University, Belgium) and Francisco Legaz (IVIA, Spain).
2. Nitrification inhibitors: why are the results non-consistent?. WG2 will be convened by Shabtai Bittman (Agriculture and Agri-Food, Canada) and Jose M. Estavillo (University of the Basque Country, Spain).
3. Where is the nitrogen not accounted for in field studies?. WG3 will be convened by Luis Lopez-Bellido (University of Cordoba, Spain) and Bernard Nicolardot (INRA, France).
4. This working group (4) has been deleted.
5. Leguminous and cover crops. Are they always advantageous?. WG5 will be convened by Francesc Domingo (FMB - IRTA, Spain) and Glyn Francis (Crop and Food Research, New Zealand).
6. Interpretation of different N-efficiency indices. WG6 will be convened by Peter J. Thorburn (CSIRO, Australia) and Jose M. Villar (University of Lleida, Spain).
7. What is the optimum N application recommendation system for each agricultural system?. WG7 will be convened by Paquita Santiveri (University of Lleida, Spain) and John Williams (ADAS, UK).
8. Which policies are actually effective to reduce nitrates in water? Shortcomings and challenges. WG8 will be convened by Jaume Boixadera (DAR, Spain) and William Deen (University of Guelph, Canada).
9. What are the key issues for N modelling?. WG9 will be convened by John F. Angus (CSIRO, Australia) and Miguel Quemada (Polytechnic University of Madrid, Spain).
10. The importance of gaseous N emissions in future N management legislation. WG10 will be convened by Robert M. Rees (SAC, Scotland) and Antonio Vallejo (Polytechnic University of Madrid, Spain).