

Nitrogen efficiency in a ryegrass crop using nitrification inhibitor DMPP on mineral fertilizer and pig slurry under rainfed and irrigated conditions in Catalonia (Spain)

J.M. Villar ¹, M.R. Teira ¹, C. Nabau ¹, F. Fonseca ², G. Murillo ¹, P. Villar ¹, A. Roselló ³, F. Domingo ³, N. Teixidor ³, and F. Ferrer ²

¹ Departament de Medi Ambient i Ciències del Sòl, University of Lleida (UdL) ² Lab- Ferrer ³ IRTA- Mas Badia

November 4-8 • New Orleans, Louisiana A Century of Integrating Crops, Soils & Environment ASA CELEBRATING 100 YEARS



Torreneral (Lleida) Site Typic Calcixerept and irrigated



| 1st year | | | CONTROL | ENTEC® | PS & PS+DMPP | | | | |
|----------------------|------------------------------|--------------------------|---------|---------------|-----------------|--------|--|--|--|
| | Applicat | ion date | | | | | | | |
| | | | | & ASN | Total-N | NH4+-N | | | |
| | Sowing date | 26/09/2005 | 0 | 125 | 241,8 | 179,57 | | | |
| | After 1st cut | 13/03/2006 | 0 | 125 | 258,56 | 187,55 | | | |
| | After 2 nd cut | 02/05/2006 | 0 | 125 | 263,36 | 187,25 | | | |
| | Total Napp | lied (kg/ha) | 0 | 375 | 763,72 | 554,37 | | | |
| | | | | | | | | | |
| 2 nd year | Applicat | lon data | CONTROL | ENTEO® | PS & PS | -DMPP | | | |
| | Applicat | ion date | CONTROL | & ASN | Total-N | NH.+-N | | | |
| | | | | | | | | | |
| | Sowing date | 28/09/2006 | 0 | 125 | 98,27 | 77,65 | | | |
| | Sowing date After 1st cut | 28/09/2006 21/12/2006 | 0 | 125 125 | 98,27 257,57 | | | | |
| | | | - | | | 77,65 | | | |

The objective of this research was to study the effect of DMPP on mineral nutrition, and to determine the suitability of using the passive capillary lysimeter to estimate how much drainage water moves through the instrument and how much N (nitrates, nitrites and ammonium) is lost through leaching. Nitrification inhibitors, as DMPP, can play an important role in maintaining soil N in the form of ammonium, as they inhibit activity of the Nitrosomonas bacteria. Ammonium is less susceptible to losses (leaching, denitrification,...) than nitrate. In addition, enhancing the supply of ammonium can also increase nitrogen efficiency and yields. The compound 3.4dimethylpyrazole phosphate (DMPP) is a nitrification inhibitor developed by BASF (Germany) in cooperation with a number of universities and research institutes. Two field experiments were carried out during the 2005-2007 growing season. The experimental design was a randomized complete block with three replications. Individual plots were 10 m wide and 24 m long in Torreneral and 5 m wide and 8 m long in Mas Badia (Slurry applied by hand). Treatments were (1) unfertilized control, (2) ammonium sulfate-nitrate (26%N), (3) Entec (ASN+DMPP) (26%N) (4) pig slurry (5) pig slurry + DMPP.

Measurements:

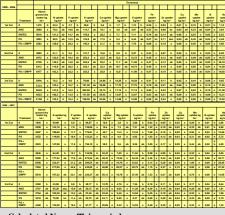
- · Soil properties and hydraulic characteristics
- · Initial and final soil fertility
- NH₄-N and NO₃-N soil content (0-90 cm)
- Dry matter (hand harvested, 1 m²)
- Macronutrients and micronutrients plant content
- NH₃-N volatilization in selected plots
- Deep drainage
- NH4, NO3, NO2 content in water from sampling reservoir
- Water table depth
- · Soil water content

Mas Badia (Girona) Site Typic Xerofluvent and rainfed



| 1 st year | Application date | | CONTROL | ENTEC® | PS & PS+DMPP | | | | | |
|----------------------|---------------------------|------------|----------|--------------|---|--|--|--|--|--|
| | дриса | ion date | CONTINUE | & ASN | N Total-N NH ₄ *-N 98,04 86,84 173,85 110,19 0 0 271,89 197,03 | | | | | |
| | Sowing date | 29/09/2005 | 0 | 100 | 98,04 | 86,84 | | | | |
| 2 nd year | After 1st cut 12/01/20 | | 0 | 150 | 173,85 | 110,19 | | | | |
| | After 2 nd cut | - | 0 | 0 | 0 | 0 | | | | |
| | Total Napplied (kg/ha) | | 0 | 250 | 271,89 | 197,03 | | | | |
| | | | | | | | | | | |
| | Application date | | | ENTECR | PS & PS+DMF | | | | | |
| z year | Annliant | lan data | CONTEDO | ENIEUR | FOOR | I-N NH ₄ *-N 04 86,84 85 110,19 0 89 197,03 8 PS+DMPP I-N NH ₄ *-N 24 68,97 | | | | |
| 2 year | Applicat | ion date | CONTROL | & ASN | | | | | | |
| 2 year | Applicat Sowing date | 06/09/2006 | CONTROL | | | NH ₄ +-N | | | | |
| 2 year | | | | & ASN | Total-N | NH ₄ +-N | | | | |
| z year | Sowing date | 06/09/2006 | 0 | & ASN 100 | Total-N 123,24 | NH₄+-N 68,97 | | | | |

Preliminary results



| 2005-2006 | | | | | | | | | | | | | | | |
|------------------|-----------------------------|-----------------------------|----------------------------------|--|-----|--------------------------------|---------|---|--------------------------|-------|----------------------------|-----------|--------------------------------|------------|---------------------------------------|
| | TORRENERAL | | | | | | | | | | | | | | |
| TREATMENT | N applied (kg Nha) | N uptake (kg Niha) | Biomass (kg dry materha) | Appare recov efficie ANREO | ery | Physiolo efficienc (kg/k | y PhE | effic | inomi ciency kg/kg | effic | use lency UE (kg) | effi N | ptake lency UpE p(kg) | ettti N | N zation ciency UtE g/kg) |
| Control | 0 | 160 | 10.115 | | | | Т | | Т | | Т | Т | П | 63,3 | |
| ANS | 375 | 347 | 15.696 | 49,5 | ab | 29,9 | - | 14,2 | - | 41,9 | ab | 0,2 | ab | 45,3 | ab |
| Entec (ANS+DMPP) | 375 | 409 | 17.500 | 66,5 | | 30,0 | | 19,3 | | 46,9 | | 1,1 | | 43,0 | ab |
| Pig Slurry | 579 | 316 | 15.087 | 27,0 | ۵ | 31,9 | | 8,6 | Ŀ | 26,1 | С | 0,5 | ь | 47,8 | ab |
| PS+DMPP | 531 | 414 | 16.868 | 45,0 | ab | 26,5 | | 12,7 | - | 31,8 | bc | 0,5 | ab | 40,7 | |
| 2005-2007 | | | | | | TORR | ENER | AL | _ | • | • | _ | _ | • | _ |
| TREATMENT | N applied (kg Nha) | N uptake (kg N/hs) | Biomass (kg dry matterfus) | Apparent N recovery Physiolog efficiency Lefficienc ANREC (%) PhE (ke/k | | icy | efficie | Agronomic efficiency NUE AE (kalka) (kalka) | | cy | NUpE | | N utili efflici NUcE (| iency | |
| Control | 0 | 189 | 9.031 | | | | - | | | - 1 | | | | 47,2 | |
| ANS | 375 | 416 | 11.790 | 60,5 | | 12,2 | | 7,4 | | 31,4 | - | 1,1 | | 28,4 | ь |
| Entec (ANS+DMPP) | 375 | 524 | 13.939 | 89,5 | | 14,5 | | 13,1 | | 37,2 | - | 1,4 | | 26,6 | ь |
| Pig Slurry | 456 | 400 | 13.356 | 45,4 | | 19,6 | | 2,5 | | 29,3 | | 0,9 | | 32,6 | ь |
| PS+DMPP | 521 | 445 | 13.324 | 49,7 | | 16,6 | | 8,2 | | 25,6 | | 0,9 | | 29,8 | ь |

Exemple of registers for plot 3 at Torreneral

429

Evolution of the soil nitrogen content from 0-90 cm at Torreneral site

Some modifications were made to the original Gee Passive Capillary Lysimeter (Decagon Devices Inc.) to adapt it to the soil physical constraints (poor drainage and shallow water table with high salt content) found in Torreneral. For this reason only partial results have been obtained on nitrate leaching. The amount of N leached was much more lower in the Entec treatment than in the ANS treatment. But we can't do statistical analysis. We will continue this field experiment one more year. At Mas Badia Site there was no drainage recorded.

Preliminary results provide useful information on DMPP effect on biomass production, and nutrient efficiency. The N efficiency ndexes support that DMPP use with fertilizer or pig slurry enhanced the recovery and profitability of Nitrogen.

