



Universitat de Lleida

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

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Mas Badia (Girona) Site Typic Xerofluvent and rainfed



1 st year	Application date	CONTROL	ENTE [®] & ASN	PS & PS+DMPP
			Total-N	NH ₄ ⁺ -N
	Sowing date	0	100	98,04
	After 1 st cut	0	150	173,85
	After 2 nd cut	0	0	0
	Total N applied (kg/ha)	0	250	271,89

2 nd year	Application date	CONTROL	ENTE [®] & ASN	PS & PS+DMPP
			Total-N	NH ₄ ⁺ -N
	Sowing date	0	100	123,24
	After 1 st cut	0	150	155,03
	After 2 nd cut	0	0	0
	Total N applied (kg/ha)	0	250	278,27

Torreneral (Lleida) Site Typic Calcixcept and irrigated



1 st year	Application date	CONTROL	ENTE [®] & ASN	PS & PS+DMPP
			Total-N	NH ₄ ⁺ -N
	Sowing date	26/09/2005	0	125
	After 1 st cut	13/03/2006	0	125
	After 2 nd cut	02/05/2006	0	125
	Total N applied (kg/ha)	0	375	703,72

2 nd year	Application date	CONTROL	ENTE [®] & ASN	PS & PS+DMPP
			Total-N	NH ₄ ⁺ -N
	Sowing date	28/09/2006	0	125
	After 1 st cut	21/12/2006	0	125
	After 2 nd cut	10/05/2007	0	125
	Total N applied (kg/ha)	0	375	493,47

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 3,4-dimethylpyrazole 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.



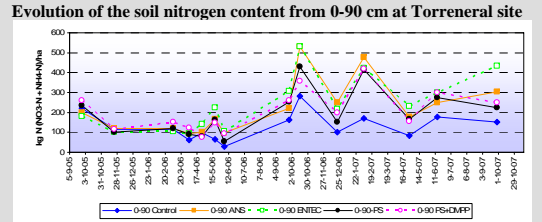
- Measurements:**
- Soil properties and hydraulic characteristics
 - Initial and final soil fertility
 - NH₄-N and NO₃-N soil content (0-90 cm)
 - Dry matter (hand harvested, 1 m²)
 - Macronutrients and micronutrients plant content
 - NH₄-N volatilization in selected plots
 - Deep drainage
 - NH₄, NO₃,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

Preliminary results

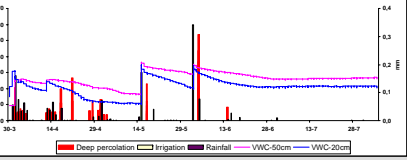
Year	Treatment	Area (m ²)	Plant N (kg)	Plant N efficiency (%)	Plant N recovery (%)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)
2005-2006	Control	100	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16
2006-2007	Control	100	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16



Site	Year	Rainfall (mm)	Irrigation (mm)
Mas Badia (Girona)	1 st year (Growing season)	429	0
	2 nd year (Growing season)	670	0
Torreneral (Lleida)	1 st year (Growing season)	231	190
	2 nd year (Growing season)	277	120



Example of registers for plot 3 at Torreneral



Some modifications were made to the original Ge 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 there was no drainage recorded.

Year	Treatment	Area (m ²)	Plant N (kg)	Plant N efficiency (%)	Plant N recovery (%)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)
2005-2006	Control	100	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16
2006-2007	Control	100	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16

Calculated N use efficiency indexes

Year	Treatment	N applied (kg/ha)	N uptake (kg/ha)	Recovery efficiency (%)	Plant N efficiency (%)	Plant N recovery (%)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)	Plant N recovery efficiency (kg/kg)	Plant N use efficiency (kg/kg)
2005-2006	Control	0	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16
2006-2007	Control	0	10	10	10	10	10	10	10	10	10
	ANS	100	15	15	15	15	15	15	15	15	15
	Entec	100	12	12	12	12	12	12	12	12	12
	Pig Slurry	100	18	18	18	18	18	18	18	18	18
	PS+DMPP	100	16	16	16	16	16	16	16	16	16

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