

## Assessment of Bioavailability of P from Animal Manures

PTDC/AGR-PRO/112127/2009



## Animal Manures Applied to Soil: Phosphorus Bioavailability, Losses to Water and Erosion

Carmo Horta\*, Paulo Ribeiro, Marta Batista, João Paulo Carneiro, António Duarte, Marta Robredo José Torrent and Andrew Sharpley.

\*corresponding author: [carmoh@ipcb.pt](mailto:carmoh@ipcb.pt)

**FCT** Fundação para a Ciência e a Tecnologia  
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA



Instituto Politécnico de Castelo Branco  
Escola Superior Agrária





## Objectives

Evaluate the partition of applied P between plant uptake, losses to water and by erosion when using different P sources, in Mediterranean conditions.

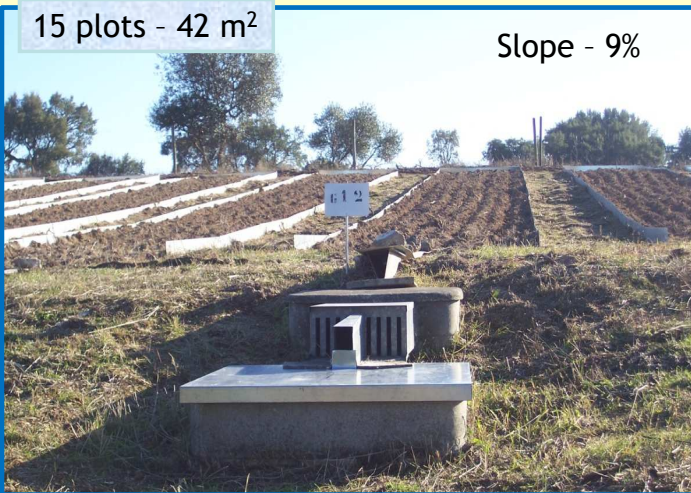


The experiments were carried out in Castelo Branco, Portugal, at Escola Superior Agrária.

### 1- Experimental erosion field

15 plots - 42 m<sup>2</sup>

Slope - 9%



### 2- P Desorption Experiment

Simulate P losses to runoff waters  
1:1000



Suspension samples were taken from 4 to 270 days

After centrifugation  $P_d$  was quantified

### Tank to collect the sediments and runoff water

5 treatments X 3 repetitions; completely randomized  
Regosol (IUSS;2006); Granitic rock



Instituto Politécnico de Castelo Branco  
Escola Superior Agrária

## Materials and Methods

### Treatments:

**C** - Control without P fertilization

**F** - Mineral fertilizer

**M** - Manure (cattle)

**D** - Duck effluent (dry matter)

**P** - Pig slurry (dry matter)

Fertilization 50 kg P/ha



1- Ryegrass sown in november; N fertilization in all treatments.

2- Desorption experiment:

Samples of each treatment were incubated 3 months (25°C and 70% FC)

and then soil suspension  $2 \times 10^{-3}M$   $CaCl_2$  (1:1000 ~ runoff water).

Experimental data of the year 2012-13



Instituto Politécnico de Castelo Branco  
Escola Superior Agrária

## Materials and Methods

### Analysis

- (1) Yield (dry matter) and P uptake by ryegrass;
- (2) Soil bioavailable P before and after harvest (Olsen-P);
- (3)  $P_d$  desorption experiment and runoff waters  $P_d \text{ } \varnothing < 0.45\mu\text{m}$  and  $P_d < 0.023 \mu\text{m}$  and  $P_t$  sediments of field experiment





Instituto Politécnico de Castelo Branco  
Escola Superior Agrária

## Results

---

### Yield and P uptake by ryegrass

- Fertilization with organic manures increases significantly yield and P uptake
- **D** treatment shows the highest values ( $p \leq 0.05$ ).

### Soil bioavailable P (Olsen-P)

P fertilization increases significantly soil bioavailable P irrespective of P source.

#### At the end of the experiment

**D** increases significantly bioavailable soil P

P fertilization increases significantly the most labile P fractions,

The increase in **D** is due to  $P_{CB}$ : P in calcium phosphates (feed origin).



Instituto Politécnico de Castelo Branco  
Escola Superior Agrária

## Results

### $P_d$ desorption experiment (1:1000)

- 1- After 14 days P desorption exceed the  $P_d$  threshold level in runoff waters to prevent eutrophication ( $P > 0.05 \text{ mg/L}$ ) in all fertilized samples but in manure treatments.
- 2- Duck treatment shows very high potential to desorb P to runoff water.

### $P_d$ in runoff waters collected in the field experiment

$P_d \varnothing < 0.023 \mu\text{m}$ ;  $P_i > 0.05 \text{ mg/L}$  ;  $P_o \leq 10 \%$

The experiment highlights the significance of soil profile characteristics in the behavior of P losses to water.

### Sediments in the field experiment

Sediments losses by erosion had mainly a very small size  $\varnothing < 2\text{mm}$  and a high  $P_t$  level.



Instituto Politécnico de Castelo Branco  
Escola Superior Agrária

## Results

---

### Partition of applied P

P losses by runoff and erosion represent 1% of the applied P;

P uptake by ryegrass ranges from 5 to 11% of the applied P.

---

Questions? [carmoh@ipcb.pt](mailto:carmoh@ipcb.pt)