Treatment and management of manure in nitrogen surplus areas: adaptation of treatment to the surplus to be managed and agronomic valorisation of the resulting liquid effluents

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01. Rationale

Slurry is characterised by a high quantity of water and a nutrient content (N, P and K) which limits its agricultural application depending on the capacity of crops to absorb these nutrients.

Some current treatment systems make it possible to reduce this surplus of nutrients (especially N) and to obtain effluents with a nutrient content adjusted to the needs of each farm. However, in order to optimise the application of these effluents in the soil, it is necessary to broaden the know-how regarding their characterisation and their agronomic management, from different perspectives: [1] sustainable adjustment of the nutrient content (mainly N) of the effluents to the needs of the crops and to the basic agricultural parameters (chemical characteristics of the soil and crop typology); 2] evaluation of the effect of effluent applications on the production of different crops and crop quality, and [3] evaluation of the effect of effluent applications on the soil in the medium to long term. To obtain this experience and knowledge, collaborative management between the livestock farmer producing the slurry, the farmer that requires the fertiliser for extensive crops and research centres is key.

To achieve this goal, the following partial objectives are proposed:

- To adapt the existing slurry tanks on the farm to carry out a process based on NDN (nitrification – denitrification) that aims to obtain an effluent with the required amount of nitrogen, with a minimum treatment cost and environmental impact.
- To determine the impact of the agronomic application of different types of slurry treatment effluents (1. Liquid Fraction (LF) obtained from the solid/liquid separator, 2. Effluent from intensive NDN treatment and 3. Effluent from the new
- NDN-based treatment).
- Evaluate the changes that applications of pig slurry treatment effluent several times a year can bring about in the chemical and physical characteristics of the soil.

02. Results and conclusions

The NDN system makes it possible to eliminate part of the ammonium present in the LF of the slurry, via partial nitrification (via nitrite). However, several causes can destabilise the system and lead to emissions that must be avoided. NDN via the conventional route (via nitrate) is more stable and makes it possible to minimise emissions.

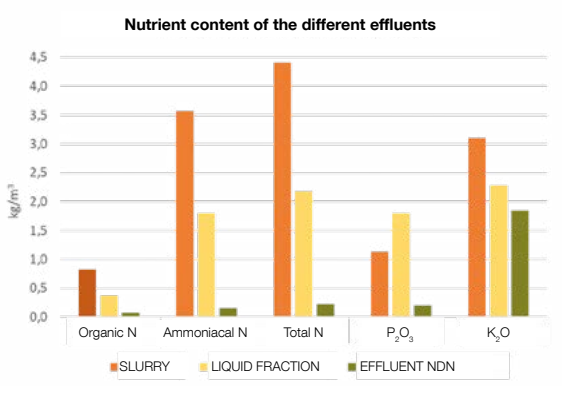
In general, higher yields are obtained in fertilisation strategies where fertiliser is split into pre- and post-sowing applications, both for grain crops (wheat and barley) and for annual forage crops (ryegrass). The application of higher doses of N (100 kg N/ha) in the post-sowing application does not increase crop production compared to lower doses (50 kg N/ha), but it does increase protein content, both in grain and forage production. In crop production, effluent from NDN treatment has a similar agronomic behaviour to the LF from pig slurry, for equivalent doses of N applied.

In the long term, it is observed that the fertilisation history of the plots shows that a continuous application of effluent based on the nitrogen needs of the crops can lead to an excessive accumulation of nutrients (P and K) in the soil. When intensive NDN effluent is repeatedly applied, an accumulation of K_2O is observed, which can become excessive, and an increase in the exchange sodium in the soil is also observed.

Thus, the treatment of manure with an NDN system and the correct agronomic management of effluents has allowed: [1] minimisation of the environmental effects of pig manure; [2] a reduction in the cost of manure treatment compared to existing systems, depending on the needs of each farm; [3] a significant saving in external fertilisers and [4] an increase in the productivity and quality of crops.

Crop fertilisation strategies with different treatment effluents

TREATMENT	PRE-SOWING DOSE (kg N/ha)	MATERIAL TYPE	POST-SOWING DOSE (kg N/ha)	MATERIAL TYPE
T1 - 0/0	0	– – –	0	– – –
T2 - 0/50 LF	0	– – –	50	Liquid fraction
T3 - 0/100 LF	0	– – –	100	Liquid fraction
T4 - 100 LF/0	100	Liquid fraction	0	– – –
T5 - 100 LF/50 LF	100	Liquid fraction	50	Liquid fraction
T6 - 100 LF/100 LF	100	Liquid fraction	100	Liquid fraction
T7 - 170 LF/0	170	Liquid fraction	0	– – –
T8 - 170 LF/50 LF	170	Liquid fraction	50	Liquid fraction
T9 - 170 LF/100 LF	170	Liquid fraction	100	Liquid fraction
T10 - 100 NDNInt/0	100	NDN intensive or total	0	– – –
T11 - 100 NDNInt/50 NDNInt	100	NDN intensive or total	50	NDN intensive or total
T12 - 100 NDNInt/100 NDNInt	100	NDN intensive or total	100	NDN intensive or total
T13 - 100 NDNSoft/0	100	NNDN adjusted or soft	0	– – –
T14 - 100 NDNSoft/50 NDNSoft	100	NDN adjusted or soft	50	NDN adjusted or soft
T15 - 100 NDNSoft/100 NDNSoft	100	NDN adjusted or soft	100	NDN adjusted or soft



Tables and graph: Operational Group.

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