BEEFCOMPOST: optimisation of the fattening cattle manure composting process

Summary

This project has provided information about manure from fattening cattle. We now have estimates for the amount of manure per calf per stall under real conditions, which are lower than those stipulated in Decree 153/2019. The highest levels of greenhouse gas (GHG) emissions occur during storage. This needs to be remedied either by quick composting, or by the application of treatments such as acidification. The use of short-cropped straw is not advisable as it aggravates the problem of emissions. Finally, to achieve good composting, it is important to increase wetting (more water per turn) and to add a structuring agent (e.g. sawdust). It is also advisable to break down the blocks and homogenise the material to reduce the manure's compactness at the beginning of the procedure.

Objectives

- To seek an outlet for manure from fattening cattle farms other than direct application to the field, by producing high-quality compost to facilitate the export of nutrients to other more remote agricultural areas in the form of organic fertilisers.
- Two specific objectives need to be met to achieve this goal:
  - Reduce the tonnes of manure produced per stall and per year from fattening calves
  - Improve the quality of fertiliser produced by composting manure from fattening cattle.
- Improve the estimates of the tonnage of manure produced per stall per year, the effect of its storage and its evolution over the year.
- Reduce emissions of ammonia and greenhouse gases (nitrous oxide and methane) by means of the aerobic process and N content retention.

Description of the actions carried out in the project

The project was carried out in 3 phases. The tonnage of manure per calf per stall per year was estimated on a real scale in the first phase. In the second phase, the project aimed to reduce the tonnage of manure, model the volume of urine, and work with various types of litter, adjusting the materials and quantities in them. Emissions during storage and the quality of manure during storage according to the quantity and type of material and treatment applied were also assessed in the second phase. Finally, emissions and composting on a real scale on a farm were studied in the last phase.

Final results and practical recommendations

The equation for estimating manure per calf and the loss value of 16% during storage were shown to be consistent with the real data observed, although real production levels were slightly overestimated.

Storage is the phase in which the most N emissions take place, and these could be reduced by applying acid or compost directly, without storage.

We obtained estimates for emissions that we can now compare and use to calculate the environmental impact of our production system.

Conclusions

An average manure production level per stall per year was estimated at around 2,700 kg, which is much lower than the 4,000 kg stipulated in Decree 153/2019 on the management of fertilisation and livestock manure.

On the production scale, there are no benefits to increasing the supply of straw (apart from increasing costs). The increase in the supply of straw during storage did not lead to a significant increase in the C/N ratio. Acidification of the straw with a supply of normal straw was the most efficient method of reducing GHG and NH_3 emissions. The type of straw has a more significant effect than the amount. Short-cropped straw is not recommended, as it has no positive effects on the production phase (on growth, animal welfare or cleanliness) or on the storage phase (it retains a lot of water, possibly increasing emissions). Most changes (moisture, changes in concentration of C, N, etc.) take place during the first 4 weeks of storage, and this is when gas emissions begin. Emissions during storage can be reduced by acidification and the provision of straw. To date, the best strategy for preventing emissions has been to add a ratio of 1.87 or 3.75 kg/year with 0.06 L of acetic acid (80% richness) per kg of manure before storage. Solid applications of acid may facilitate its application and reduce the risk of inhalation in the future. Whether this acidified manure affects the composting process (i.e. if it still contains acid that inhibits bacterial growth) remains to be seen; if so, it could only be applied to fields.

In order to optimise composting, it is important to increase the wetting with more water per turn, and the addition of a structuring agent (sawdust). Furthermore, the material from the storage piles was passed through a manure spreader in order to break down the blocks and further homogenise the material at the beginning of composting to reduce the compactness of the manure.

When these strategies were applied, there was an improvement in the maintenance of high temperatures, the material in each pile was more homogeneous, and the material contained less moisture, with lower speeds in the piles containing crushed material compared to non-crushed material for the same amount of wetting. As a result, the piles subject to the most wetting (only the amount was increased, but not the frequency) are more biologically active. This is reflected in a greater reduction in the mass of matter (weight reduction of 0-10% and a 38-64% reduction in the low irrigation strategy).

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Subject area(s) of application

☐	Agricultural production system
☐	Agricultural practice
☐	Agricultural equipment and machinery
☒	Livestock farming and animal welfare
☐	Vegetable production and horticulture
☐	Landscape / Territorial management
☐	Pest and disease control
☒	Fertilisation and nutrient management
☐	Soil management
☐	Genetic resources
☐	Forestry
☐	Water management
☐	Climate and Climate Change
☐	Energy management
☒	Waste and by-product management
☐	Biodiversity and environmental management
☐	Food quality/processing and nutrition
☐	Supply chain, marketing and consumption
☒	Competitiveness and agricultural and forestry diversification
☐	General

Geographical area(s) of application

PROVINCE(S): LLEIDA

REGIONS: La Noguera, La Segarra

More information on the project

PROJECT DATES	TOTAL BUDGET
Start date: July 2019	Total budget: €151,970.00
End date: September 2021	DARP funding: €61,068.20
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