Acidic fertilizer

Is acidification of manure worthwhile? Results from practice

Practical systems from the model and demonstration project "Acid+ in Field" show how the acidification of liquid farm manure can have an impact on yield, quality and efficiency.

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The acidification of farm manure reduces ammonia emissions enormously during application. (Image source: Lurz)

Ammonia emissions from the application of liquid farm manure lead to air pollution, impairing the environment and reducing the efficiency of nitrogen fertilization with liquid manure and fermentation residues. At the same time, farm manure is becoming increasingly important against the backdrop of rising mineral fertilizer prices due to the Middle East conflict , so that it is crucial to exploit the nutrients they contain with as little loss as possible.
Also, regarding the requirements of the NEC Directive on the reduction of ammonia, There is a need for additional action, as emissions in Germany must be reduced with 29% by 2030 compared to 2005, according to the Federal Environment Agency

Quick read

- The acidification of liquid farm manure can be used under practical conditions have predominantly positive effects on yield and tend to have positive effects on crude protein content.
- The results of the overall project to date are currently being prepared for a detailed presentation on the project website .
- In addition to the advantages of crop cultivation, acidification can also be economically worthwhile under certain conditions.
- The potential for grassland is to be examined in more detail under further practical conditions.

One approach to reducing these losses is the acidification of slurry and digestate during application. By lowering the pH value, the balance is shifted in favor of plant-available ammonium, which can significantly reduce gaseous nitrogen losses. Since the end of 2022, the Chambers of Agriculture, among others, have been applying acidification technology.

North Rhine-Westphalia and Schleswig Holstein have developed acidification technology as part of the model and demonstration project "Säure⁺ im Feld" in cooperation with several model farms in demonstration plants on practical areas. The aim is to test the acidification of liquid farm manure during application in growing crops under customary practical conditions and to demonstrate it to practitioners during field days.

On-farm trials

Since the start of the project, a total of 21 trails comparing acidification with non-acidification have been created in North Rhine-Westphalia and 19 in Schleswig-Holstein. Demo variants with and without acidification were directly compared with each other. Positive yield differences indicate an additional yield due to acidification. The farm manure used by the model farms was cattle and pig manure as well as fermentation residues. The application with the acidification technology is carried out by a contractor using 96 % sulphuric acid. A pH value of 6.4 is targeted. Acid quantities should not exceed 3 l/m³ for conventional slurry and 5 l/m³ for fermentation residues. Where possible, agronomic need for Sulphur as a fertilizer should be targeted.

Positive effects in eight federal states

In the eight federal states involved in the project, acidification has so far been used in arable crops in a total of 67 demonstration trials. Compared to the non-acidified demo variants, additional yields were found in 61% of the cases, with the differences being significant in 4 cases. In the trails with positive yield effects, the average additional yield was about 3.8%.

In 60% of cases, higher values were also found in the crude protein content in the acidified demo variant. In 8 cases, the differences were significant. On average, the crude protein content was increased by about 0.4 percentage points in these comparisons.

In the on-farm trials, the farm manure applied is mixed with sulphuric acid. (Image source: Lurz)

It should be considered that acidification was also carried out in the context of the project under conditions under which only low levels of ammonia losses were to be assumed. This is because the establishment of the test trails and the implementation of live demos during field days often must be planned well in advance.

This is partly due to the lack of yield effects. In principle, the use of acidification is particularly useful under loss-prone conditions such as high temperatures, intense sunlight and wind, as this is where the technology effects are to be expected.

Does acidification pay off?

A simple calculation example can be used to clarify this: With an average yield expectation of 95 dt/ha in winter cereals, an additional yield of around 5% corresponds to an additional yield of around 4.5 to 5 dt/ha. With average producer prices for the years 2019 to 2025, this will result in potential additional

revenues of around €21/dt for A-wheat, €18/dt for rye and €24/dt for barley (Plant-based market prices 2019-2025, lw.landwirtschaft-bw.de), this will result in potential additional revenues in the order of around €90 to €120/ha.

On the other hand, there are additional costs for acidification. These are essentially made up of a machine flat rate and the costs for sulfuric acid used. The actual amount of the additional costs varies depending on the farm, region, type of farm manure and current acid price. On average, you can expect from about € 0.55 per l sulphuric acid and a flat rate for the system of approx. 30 € per ha or 1 € per m3.
The average amount of acid required per m3 depends on the buffer capacity of the slurry and is therefore higher for digestate (about 3-5 l) than for cattle (approx. 1-2 l) or pig manure (approx. 1-3 l). For economic reasons, no more than 4 l per m 3 is usually used, even if the optimal pH value of 6.4 is not reached. However, emission reductions can be assumed in the case of a pH value reduction from e.g. 8 to 7. In many cases, the additional revenues can offset or exceed the additional costs. This does not consider possible savings in mineral nitrogen and Sulphur fertilizers, so that further economic potential may arise depending on the farm.

The sulphuric acid container is well protected in the front hydraulics.
(Image source: Lillie, Landwirtschaftsverlag GmbH)

It should be noted that the application of sulphuric acid also add plant available Sulphate onto the surface. About 0.6 kg of Sulphur is applied per liter of sulphuric acid used, which can result in a corresponding lime requirement in the long term. However, this relationship must be assessed independently of the acidification itself and generally results from the amount of Sulphur applied.

Potential in grassland

In addition to the previous investigations into arable farming, the acidification of farm manure in grassland has been investigated. In the evaluations to date, a positive yield effect could be found in 78 % of the demonstration trails (44 in total), with an average additional yield of 13 % in these cases.

In grassland, application is often carried out at later times and under warmer weather conditions, which significantly increases the risk of ammonia losses. In contrast to other low-emission application techniques such as the grass injection method, acidification can also cover the Sulphur requirements of the grassland. In practice, the process also enables larger working widths and thus higher area output.

Since this year, two more companies from North Rhine-Westphalia have joined the project (see red dots). (Image source: LWK NRW)

Against this background, a stronger focus will also be placed on grassland in North Rhine-Westphalia in 2026. Corresponding practical facilities will be established on a total of three model farms, two of which have been part of the project since this year, to further demonstrate the effects of acidification on yield and nutrients.

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