Anaerobic digested residues as fertiliser in spring-wheat -Effects on soil and crop-

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Objectives

The production of renewable energy is subsidised in Germany. Especially farmers are encouraged to produce and sell electricity and thermal energy from biogas. As a result, a rapidly growing number of biogas plants were build since 2004. Currently, approximately 3500 of them exist in Germany. But apart from energy a valuable residue is produced which can be used as fertiliser. In the presented study, the effect of agricultural biogas fermentation residues on soil and spring-wheat was investigated in a field-experiment.

Material and Methods

Experimental design

- The field experiment was located in Berlin-Dahlem on a Albic Luvisol (silty sand soil)
- The experiment was designed as a two-level split-block with four replications
- Fertiliser was applied at once in spring

Characteristics of anaerobic digested residues

- Fermented substrates: silage from maize and rye
- Dry Matter (DM) = 6 %; 77 % of this is organic dry matter
- Plant nutrients in Fresh Matter (FM): N = 0.34 %, P = 0.08 %, K = 0.33 %
- 67 % of nitrogen occurs as ammonium
- pH-value = 8

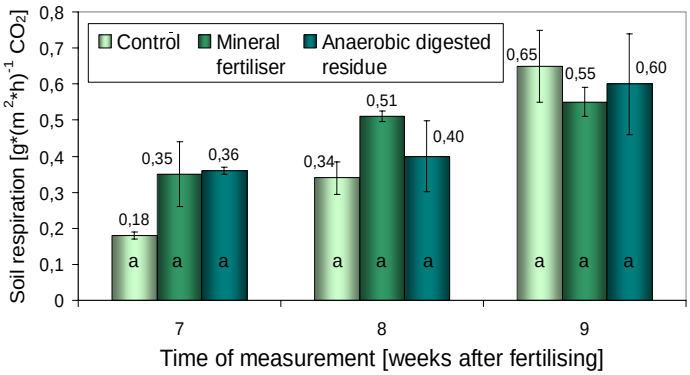
Soil respiration

Soil respiration was measured with the closed system "Environmental Gas Monitor" (EGM-4) with a "Soil Respiration Chamber" (SRC1) from the company PP-Systems (UK) on the field. Each measuring-point was marked with a 10 cm long tube in the soil. Data were collected each week during the vegetation period.

Environmental Gas Monitor with Soil Respiration Chamber

Results

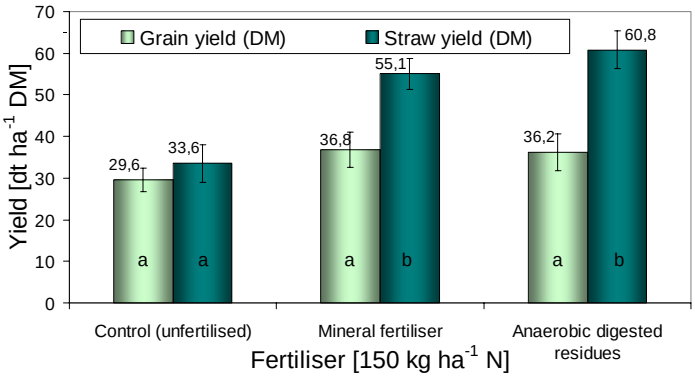
Soil respiration



Soil respiration under spring-wheat fertilised with anaerobic digested residues in comparison with mineral fertilised and unfertilised treatments
(Using Tukey test at alpha=0,05 values at one measuring time with same letters are not significantly different)

Seven weeks after fertilising and sowing the spring-wheat, in the plots fertilised with 150 kg ha^{-1} N from mineral fertiliser and anaerobic digested residues about 100 % more CO_2 ($g*(m^2*h)^{-1}$) was measured compared to unfertilised plots. One week later the fertilised treatments reached only 50 % (mineral fertiliser) and 18 % (anaerobic digested residues) more than unfertilised variants. Nine weeks after fertilising all three variants exhaled mainly the same amounts of CO_2.

Yield of spring-wheat



Yield of spring-wheat (grain and straw) fertilised with anaerobic digested residues in comparison with minerally fertilised and unfertilised variants
(Using Tukey test at alpha=0,05 grain / straw yield with same letter(s) are not significantly different)

At the unfertilised control, a grain yield of 29.6 dt ha^{-1} (DM) was harvested. Wheat fertilised with mineral nitrogen (150 kg ha^{-1}) reached a 24 % higher yield, but almost the same amount was gained from the plots treated with 150 kg ha^{-1} N of anaerobic digested residues. The straw yield reached 33.6 dt ha^{-1} (DM) in the control and was 64 % and 81 % higher in the fertilised variants with mineral fertiliser and anaerobic digested residues, respectively.

Conclusions

Anaerobic digested residues are valuable organic fertilisers with inorganic properties. They can enable yields as high as mineral fertilisers. The high content of ammonium-N makes them to be fast acting.

Anaerobic digested residues as well as mineral fertiliser support the microbiological processes in the soil which result in a higher soil respiration. A few weeks after fertilising, the soil respiration can be up to 100 % higher than respiration of unfertilised soil. This effect lasts about nine weeks.

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