Greenhouse gas balance of new organic fertilizers derived from anaerobic digestion

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Introduction

Anaerobic digestion is an environmental technology that not only produces biogas to substitute fossil fuel, but also produce digestates that can serve as organic fertilizer. In this project, post-digestion treatment processes produced fertilizer materials with contrasting characteristics (see Fig. 1). Emissions of N_2O, CH_4 and NH_3 were measured during storage, and N_2O emissions after field application. Fertilizer values will be determined after harvest.

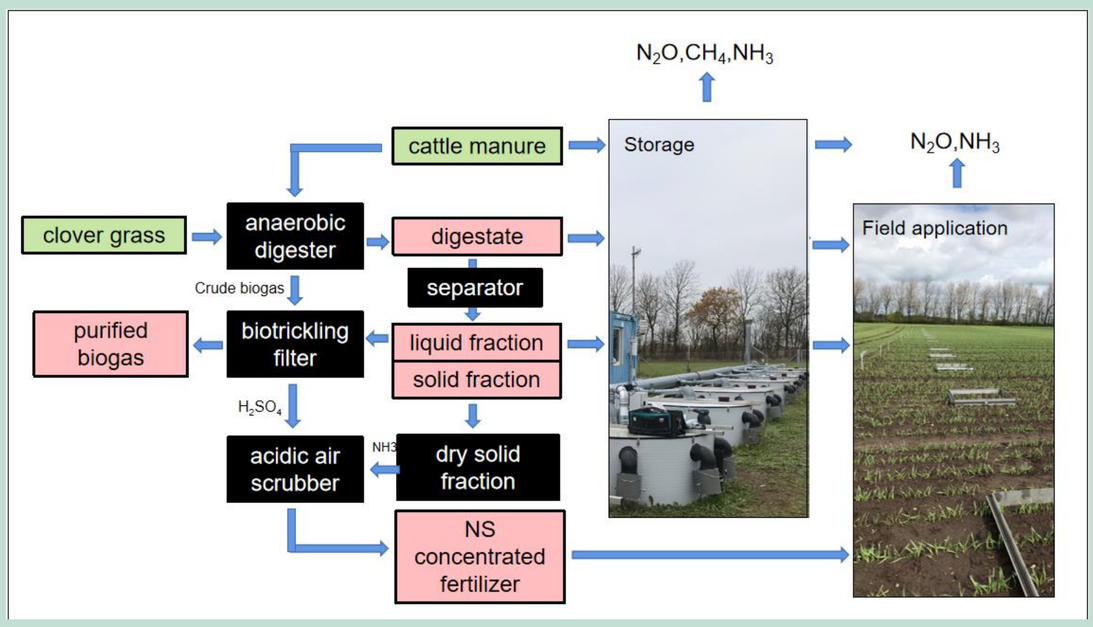

Figure1. A schematic diagram of the products and gases to be investigated.

Methods

Untreated cattle manure (CA), anaerobic digestate (DD) and the liquid fraction after separation of digestate (LF) were stored in tanks from August to November 2020. GHG emission were measured during the storage.
These fertilizers and a concentrated NS fertilizer were directly injected to a spring barley crop and compared with inorganic N fertilizers to assess the GHG effect and N use efficiency.

Results

Table1. Chemical and physical characteristics of fertilizers used for storage. CA: untreated cattle manure; DD: anaerobic digestate of cattle manure; LF: liquid fraction of AD

	Storage			
Slurry type	Dry matter(%)	Total N(%)	NH_4-N/total N (%)	pH
CA	4.90	0.23	48.4%	6.99
DD	3.75	0.31	66.9%	7.75
LF	2.71	0.28	67.9%	7.89

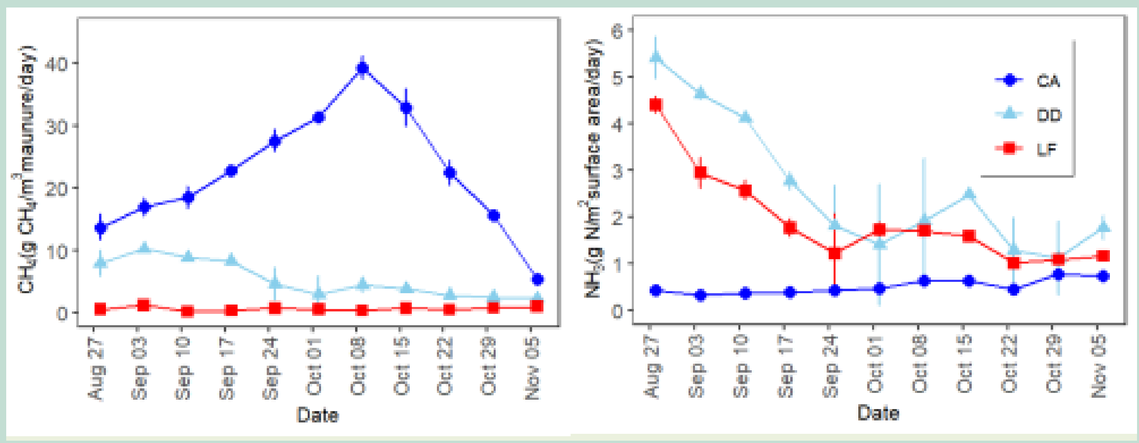

Figure 2. NH_3 and CH_4 emissions from untreated manure(CA; crust formation), anaerobic digestate(DD), and liquid fraction of digestate (LF) during storage.

Table 2. Cumulated gas emission during storage for 11 weeks. Different letters within columns indicate significant differences at $p<0.05$. CO_2 not included.

Treatment	N_2O	CH_4	NH_3	Total GHG (without NH_3)	Total GHG (with NH_3)
	g N m^{-2}	g C m^{-3}	g N m^{-3}	kg CO_2eq	kg CO_2eq
CA	1.1a	1249.2a	58.2b	43.9a	44.2a
DD	1.4a	309.2b	343.3a	11.5b	13.1b
LF	1.2a	37.4c	247ab	2.2c	3.3c

Conclusions

1 Combining anaerobic digestion with separation showed greater potential for GHG mitigation than digestion alone, provided losses from solid fraction are prevented.

2 Overall GHG emissions during storage were dominated by CH_4.

3 To evaluate the overall GHG effects of the new fertilizers at the farm level, a life cycle assessment is needed and will be applied.

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