INTERIM TECHNICAL REPORT

Use of digestate as a fertiliser for grass production

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Interim report

on

Digestate as a fertiliser for grass production

Introduction

This report summarises AFBI research on the 'fertiliser value' of digestate. This work is funded by DARD. The project is ongoing and information presented in this report could differ from that presented in the final report.

When investment in anaerobic digester is being considered it is likely that the financial returns from the sales of electricity and Renewable Obligation Certificates are the key issues. However, storage and sustainable use of the digestate are also very important considerations. Digestate has enormous potential as a bio-fertiliser. Its value in this regard depends, *inter alia*, on the quantity produced, its plant nutrient concentration and on its efficiency of use as a fertiliser. The quantity of digestate produced from a given weight of feedstock depends on the weight of biogas produced. For example, AFBI research has shown digestion of cattle slurry produces approximately 2% less digestate by weight [1] (and volume). In contrast, the equivalent figure for grass silage digestion is a weight reduction of approximately 17%[2]. In terms of plant nutrient concentration, AFBI work has demonstrated that there is little change in the total N, P and K analysis of the digestate, *c.f.* to that of the slurry fed. However, with slurry only feeding, it was found that digestate dry matter concentration was lowered by 20%, available N content was increased by 19 % and the pH was increased by 0.7, relative to that of the cattle slurry fed[3]. It is generally accepted the most cost effective and sustainable use of

[1] 1 tonne of cattle slurry produces approximately 20 kg biogas and 980 kg of digestate
[2] Volume change may be different, depending on density difference of inputted silage versus digestate
[3] For details see:<http://www.afbini.gov.uk/index/services/services-specialist-advice/renewable-energy-2012/re-anaerobic-digestion/re-anaerobic-digestion-year-1.htm>

digestate is through recycling it back to land as a bio-fertiliser. Whilst higher ammonium N concentration gives digestate an enhanced potential as a fertiliser, it could, along with its higher pH, lead to increased ammonia volatilisation after land spreading. In contrast, the lower dry matter content of digestate will aid percolation into the soil and this in turn should lower ammonia volatilisation.

The research programme at AFBI was initiated to provide more information on the above issues.

Experimental Programme

The research work on digestate at AFBI was carried out on grassland to mimic a 3 cut silage system. To date, digestate and cattle slurry have been applied 3 times per year to plots (2m x 4m) at an equivalent application rate of 35 tonnes/ha per application. All applications were applied manually to simulate splash plate and band spreading by slurry tanker. Separate plots had inorganic fertiliser only applied (CAN) at 6 different levels of nitrogen, ranging from 0 to 150 kg N per application. This allowed the 'inorganic fertiliser N replacement value' of the grass dry matter yields from the manure only treatments to be determined. The average amount of total N applied in cattle slurry was 136 kg per application, *c.f.* 127 kg N in digestate (7% less). The respective figures for available N applied were 72 kg and 76 kg in slurry and digestate respectively (5.5% more). Mean cutting dates were 20th May, 12th July and 17th September.

Summary of results to date

The following bullet points summarise interim results and as a consequence they may change slightly as more data become available. The results presented are averages over 9 applications (3 seasons).

- 1 kg cattle slurry N was equivalent to 0.39 kg inorganic fertiliser N
- 1 kg of digestate N was equivalent to 0.43 kg inorganic fertiliser N (10% increase *c.f.* slurry)
- Cattle slurry and digestate produced similar grass dry matter yields per kg of available N applied (51.8 and 50.0 kg grass DM per kg available N applied).
- Over the growing season, following 3 applications of cattle slurry (3 x 35 tonnes/ha equivalent), 11.06 tonnes grass dry matter was produced. The equivalent figure from the same quantity of digestate was 11.43 tonnes grass dry matter.
- Spring was the best time to apply slurry or digestate for improved nitrogen use efficiency. Spring applications of digestate produced 50% more dry matter at 1st harvest, *c.f.* the average of that produced at 2nd and 3rd harvest.

Discussion

Using the results from the current work and assuming the 19% increase in available N in digestate found in previous AFBI work[4], applying digestate three times per year as above would result in a yield increase of 1.7 tonnes grass dry matter per year, *c.f.* to that from cattle slurry applications[5]. Assuming a value of £100 per tonne silage dry matter, the extra herbage yield from digestate applications would be worth £140 per ha of grass (allowing 17% ensiling losses). This would value digestate at an additional £1.33 per tonne of digestate applied *c.f.*

[4] see:<http://www.afbini.gov.uk/index/services/services-specialist-advice/renewable-energy-2012/re-anaerobic-digestion/re-anaerobic-digestion-year-1.htm>

[5] Assuming 3 applications @ 35m^3/ha and a slurry available N of 72 kg NH_3-N/m^3/application

cattle slurry, (gross totals of £10.07 per tonne digestate *c.f.* £8.74 per tonne slurry applied). Using data from the inorganic fertiliser only response curves in the current work, it has been calculated that the yield increase over the growing season following 3 digestate applications was equivalent to an extra 28 kg inorganic fertiliser N/year, or approximately 100 kg of CAN.

Digestate produced from the co-digestion of cattle slurry and grass silage will generally have a slightly higher N content relative to that from cattle slurry only digestate. This is because grass silage usually has a higher N content than cattle slurry. This has been verified by at AFBI research work at laboratory and farm scale. However the available N content was little affected. Hence the 'inorganic fertiliser replacement value' of digestate produced from grass silage co-digested with cattle slurry is likely to be similar or slightly better, compared to the 'inorganic fertiliser replacement value' of digestate from slurry only feedstock. The work at AFBI has shown that the main driver for 'inorganic fertiliser replacement value' of digestate is the amount of available N in the applied digestate, rather than total N content *per se*.

Interim conclusions

Digestate has a higher available N content than the feedstock mix.

The fertiliser value of digestate is enhanced over that of the feedstock.

Digestate should be applied in the early part of the growing season if possible, to maximise nitrogen use efficiency and 'inorganic fertiliser N replacement value'.