



# **Scottish Farming Innovation Network** **Soil Association Scotland**



*Supported by the Duchy Originals  
Future Farming Programme*



## **FIELD LAB REPORT:**

### ***Farm-Scale Anaerobic Digestate in an Organic Dairy System***

### ***Meeting 3 – Tuesday 10<sup>th</sup> September 2014, Rainton Farm (Cream o' Galloway)***

*The AD field lab will run until spring 2015, and will look at the practical, environmental and economic implications of using anaerobic digestate as an integral part of an organic dairy system.*

The focus of the third meeting of the AD field lab was to look at silage yield after being fertilised with digestate, and to discuss the farm's soil and digestate nutrient quality in the context of making most efficient and effective use of digestate.

The group started with a walk around the farm for a look at the digester, and to discuss some of the practicalities of running a small self-contained system such as this. They also discussed feedstocks, and the impact different types of feedstock might have on the fertiliser value of digestate.

The farm's 25kw digester is currently the smallest in Scotland, which brings a number of benefits as well as some challenges. One of the attractions of this size of digester was that it can be operated by just one person and feeding/maintenance can be slotted into a busy farming week. Currently manual feeding & mixing are carried out once a week by 2 farm workers.

The kit was half grant-funded, at a total cost of £200k, with a payback of 3-4 years. It was very straightforward to set up, and has been fed with slurry and silage toppings. It is connected to the national grid, and the farm currently uses 25% of the electricity generated (in future the creamery could be set up to use the remainder), reducing running costs and improving the farm's carbon footprint.



On the down side there have inevitably been some teething and technical issues, and helpful advice and skilled experience have proved difficult to find at times, since much of the technology in the UK

is on a larger or commercial scale. However despite this the Rainton team have become experienced in producing a reliable supply of digestate and gas.

The digestate produced this year was used to fertilise the silage crop during the summer. At harvest 40% more volume was cut compared to 2013; however the main cause for this is difficult to determine as there were considerable differences in weather compared to the previous year. No discernible difference was found in the volume of silage harvested from slurry-treated areas compared to digestate-treated areas; and again this is likely to have been influenced by the exceptional growing conditions. Slurry and digestate (from the same source) will actually have the same N content, but the difference is that the N in digestate is more readily available. Choice of the most appropriate spreading equipment can also significantly reduce the N losses from applied digestate or slurry. Therefore David Finlay has pledged to continue to apply digestate with bandspreading equipment because of the practical benefits described in meeting 2.

The digestate produced at Rainton was used whole as a fertiliser, and has 7-8% dry matter content. It is low in phosphorus (which are half that of typical UK cattle manure digestate, SRUC 2013), because the soils on the farm have a low P status which is therefore probably reflected in both the silage and the slurry. It is possible that a little P could be coming into the system from concentrates fed to the cows, but this is not likely to make a noticeable difference to soil P status in the short to medium term. Figure 1 below shows the digestate analysis carried out by Marches Biogas, and Table 1 shows the soil analysis for the 6 silage fields used.

### Nutrient value of Rainton digestate (kg/m<sup>3</sup> fresh weight) (typical values)

Major Nutrients	Total	Readily available	Potential value £/t
Nitrogen (N kg/t)	2.5 (2.6)	2.0 (80%)	£1.74
Phosphate (P <sub>2</sub> O <sub>5</sub> kg/t)	0.6 (1.2)	0.3 (50%)	£0.43
Potash (K <sub>2</sub> O kg/t)	2.7 (3.2)	2.4 (90%)	£1.35

#### Potential value

£3.52/m<sup>3</sup> (or 30m<sup>3</sup>/ha application = £106/ha)

<sup>a</sup>Assumes N = 87p/kg, P<sub>2</sub>O<sub>5</sub> = 71p/kg, K<sub>2</sub>O = 50p/kg

Figure 1: Rainton digestate analysis results, courtesy of Audrey Litterick (WRAP / Earthcare Technical)

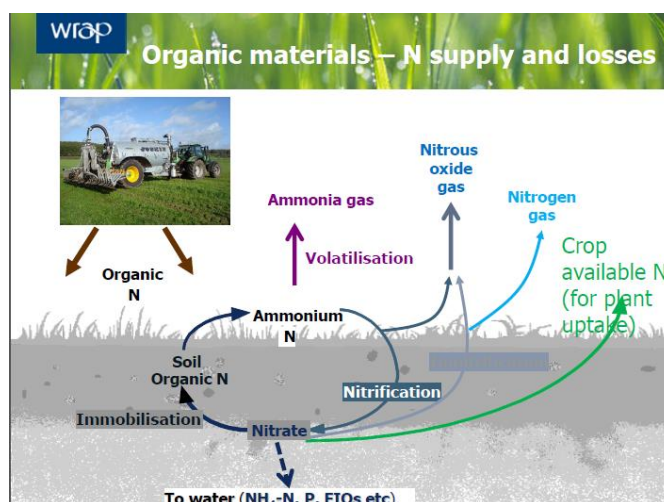
Field	Organic Matter (%)	pH	Lime Required (t/ha)	P (mg/l)	K (mg/l)	Mg (mg/l)
Silage Field 1	13.8	5.8	2	4.7	106	251
Silage Field 2	15.3	5.8	2	4.3	78.7	229
Silage Field 3	15.4	6.2	0	3.7	97.5	189
Silage Field 4	13.8	6.5	0	10	61.6	194
Silage Field 5	13.8	6.1	0	3.5	103	202
Silage Field 6	14.1	6.1	0	4.0	124	194
				(LOW)	(MED)	(HIGH)

Table 1: Rainton soil analysis results

The group then heard from organic fertiliser specialist Audrey Litterick and discussed the merits of calculating and using nutrient figures, followed by a quick demonstration of nutrient budgeting software. The presentation was dedicated to the memory of Brian Chambers, DC-Agri project leader and a central figure in the organic materials to land sector, whose recent passing will be mourned by many.

Working with digestates has both plusses and challenges – nitrogen in digestate is in a very readily available form and therefore more of it can potentially be accessed by growing crops; however this means there is a risk of higher losses, so timing of application is crucial. If spread at the wrong time (i.e. when the crop is not actively growing or during very wet weather) benefits to crops can be minimal – with crop uptake potentially as low as 10%.

Harnessing the true value of digestate depends on several factors: application timing, soil type, weather conditions, method of application and crop type (influences uptake rates) all play a part. Damaging losses (digestate can have losses of up to 80% RAN) can be minimised by applying digestate in favourable conditions.



Of these factors, timing is perhaps the most crucial. N use efficiency is highest in spring, and leaching increases in autumn because less N is utilised by growing crops. Up to 90% of autumn-applied N can be lost; while only 40% may be lost in spring because the plant will be more actively taking up nutrients as it grows. Therefore much of the N in late season applications tend to be wasted as crops won't use most of it - effectively meaning expensive disposal of a valuable N resource.

Audrey also described recent work done by the [WRAP DC-Agri](http://www.wrap.org.uk) Project, which has worked over a number of sites across the UK to quantify the effects of applying different types of slurries and digestate on N losses & efficiency of N use. In addition to the points emphasised above, the work confirmed that bandspreading digestate (rather than surface broadcast using a splash-plate) can significantly reduce nitrate leaching & ammonia losses; and shallow injection reduces these further still.

Cross-site data showed that losses of nitrate and ammonia were consistently lower when digestate was applied with a bandspreader compared to splash-plate. There was no significant difference in total nutrient content between digestate and slurry, but the digestion process makes nitrogen more readily available so when used in optimal conditions can have a higher fertiliser value.

Timing of incorporation was also shown to be a very important factor, especially in an arable situation - incorporation within 6 hours of spreading was found to be key to reducing N losses, as was getting the next crop in the ground as soon as possible after spreading. Digestate which was incorporated in the spring was found to have a 65% uptake of nitrogen by crops, compared to just 10% in winter if surface broadcast and not incorporated.

The WRAP DC-Agri project will continue until March 2015 – further details can be found at [www.wrap.org.uk/content/digestate-compost-agriculture](http://www.wrap.org.uk/content/digestate-compost-agriculture).

The group saw two nutrient management software packages, [PLANET](#) and [MANNER-NPK](#), to estimate fertiliser values from Rainton's soil and digestate nutrient analyses. These are both practical software tools that provide farmers and advisers with a quick estimate of crop available nitrogen, phosphate and potash supply from applications of organic manure, as well as potential losses. The potential financial value of the manure application(s) in £/ha is also calculated, using current fertiliser prices. Figure 1 below shows a nitrogen use efficiency of 43%, based on digestate which was bandspread on a dry day and not incorporated.

There are a number of tools available to help farmers plan manure/slurry/digestate use and calculate how much is needed. [MANNER-NPK](#) and [PLANET](#) are both free software packages which calculate values automatically, and the popular [SAC Technical Note TN650](#) allows users to calculate values manually. When planning manure use farmers are also encouraged to consider crop type and requirements, soil & digestate values, get FACTS advice, and check NVZ legislation.

Nitrogen		Phosphate, Potash, Sulphur & Magnesium	
Total N (kg/ha)	130	Total P <sub>2</sub> O <sub>5</sub> (kg/ha)	130
Mineralised N (kg/ha)	3	Crop available P <sub>2</sub> O <sub>5</sub> (kg/ha)	65
<b>Nitrogen losses</b>		Total K <sub>2</sub> O (kg/ha)	1100
Nitrate-N (kg/ha)	0	Crop available K <sub>2</sub> O (kg/ha)	990
Ammonia-N (kg/ha)	13	Total SO <sub>2</sub> (kg/ha)	35
Denitrified-N (kg/ha)	4	Total MgO (kg/ha)	30
<b>Crop available N</b>		Potential financial value of manure application(s) <b>£814/ha</b>	
Current grass crop (kg/ha)	56		
Next grass crop - current year (kg/ha)	0		
Following crop - year 2 (kg/ha)	2		
Nitrogen efficiency (%)	43		



Figure 2: Example output table from MANNER-NPK software

**The final meeting of this field lab will take place in late spring/early summer 2015, and is open to all who are interested. To book a place or for further information, please contact Colleen McCulloch at [cmcculloch@soilassociation.org](mailto:cmcculloch@soilassociation.org) or call 0131-666-2474. You can also find more details on [our website](#), including reports from Meeting 1 and Meeting 2.**

**Scottish Farming Innovation Network**  
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