

Soil and Nutrient Network



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Helping farmers improve soil and nutrient management

Case study: Bogindollo, Angus

Bogindollo Farm is a mixed arable and suckler cow unit, run by Euan Crichton. The arable rotation includes winter and spring barley, spring oats, winter wheat and winter oilseed rape. The business also lets out land for potatoes on a seasonal basis. The farm has a herd of 130 suckler cows and followers which are grazed on permanent grassland, with all progeny finished. All farm yard manure (FYM) is spread back on the arable fields in order to increase the organic matter (OM) content from its current average of 4.19%.

The farm has a mix of soils, including humus iron podzols from the Forfar series, brown forest soils from the Balrownie series, and a strip of Alluvial soil next to the river. The soil pH ranges from 5.7 to 6.6, with a range of moderate to low phosphate and potash. Interestingly, several fields were identified as having low boron levels. The farm has an average rainfall of 790mm, an average annual temperature of 12°C and lies within the Strathmore, Fife and Angus Nitrate Vulnerable Zone.

Farm Yard Manure and Soil Analysis

FYM is a valuable source of nutrients and organic matter, which will reduce the need for artificial inputs and increase the soil water holding capacity. The FYM at Bogindollo was analysed from both the cows and young stock. The analyses highlighted the variability from standard figures which can be influenced by cattle diet, bedding materials and livestock type.

Manure Analysis	Dry Matter %	Total N kg/t	Total P ₂ O ₅ kg/t	Total K ₂ O kg/t
Standard (TN650)	25	6	3.2	8
Bogindollo Young Stock	24	6.5	2.9	15.1
Bogindollo Cows	30	5	3.27	17.2

The results above show that Bogindollo's stock manure has very high levels of potash. This is believed to be a result of cattle being bedded on oat straw and as a crop, oats take off a large amount of potash.

The soil analysis that was inspected highlights the variability in soil organic matter (OM) with a range from 3.49% to 9.56%. The lower OM was found in the fields furthest from the steading leading to less FYM having been spread on them over the years with the exception of the long term grass ley (9.56% OM). Soil analysis also indicated variation in the P and K levels which will have a detrimental effect on crop yields. These results have given Euan a starting point for his nutrient budgeting for the next cropping season.



Assessing the soil structure in a soil pit at Bogindollo



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Valuing your manure

It is not a secret that manures are valuable, but how much are they really worth?

To value FYM, firstly, it is important to get up to date fertiliser prices. This can be quoted from your fertiliser merchant or accessed online at <https://ahdb.org.uk/publications/Fertiliser.aspx>

The next step is to work out the price per kilo of nutrient. This is achieved by dividing the cost of the fertiliser by the nutrient content.

For example:

Ammonia Nitrate (34.5% N) at £226/t

AN £/kg N = $\text{£}226/\text{t} \div 345\text{kg/t} = \text{£}0.66/\text{kg N}$

This should be repeated for P and K.

MOP 46% $\text{£}263/\text{t} = \text{£}0.57/\text{kg P205}$

TSP 60% $\text{£}290/\text{t} = \text{£}0.48/\text{kg K20}$

These values can then be used to calculate the value of the manure by multiplying the price per kg nutrient by the nutrient content in the manure.

However, for N, only the crop available N should be used as this is what is left once losses through volatilisation have been considered. This is typically 10% of the total N for cattle FYM with a high straw content.

As shown by the table below, Euan's manure is much more valuable than the standard figures.

This would suggest, both the cow and young stock manures are worth over £3/t more.

Value of nutrients per tonne of cattle FYM				
	N (10% available)	P	K	Total
Standard	£0.39	£1.82	£3.84	£6.05
Young Stock	£0.43	£1.65	£7.25	£9.33
Cows	£0.33	£1.86	£8.26	£10.45

Once the value of the manure has been determined, the value per hectare can be calculated by multiplying the value of the manure by the application rate. In this case the standard application rate of 25t/ha has been used. However the value of organic matter is difficult to quantify.

Value per ha = $25\text{t/ha} \times \text{standard manure value}$
= £151.25/ha.

Value per ha = $25\text{t/ha} \times \text{Bogindollo cow manure}$
= £261.25/ha

The significant difference between values indicates the importance of manure analysis and nutrient budgeting.

Manure application rates

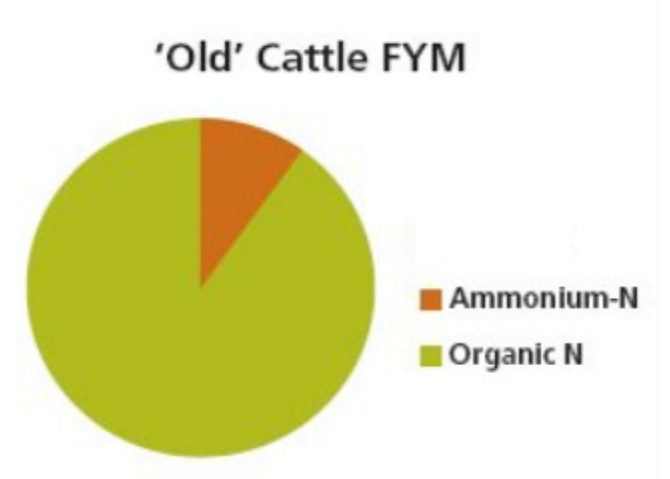
A demonstration was set up to show FYM application rates. One meter quadrants were measured and the manure was applied at three rates: over the NVZ maximum at 41t/ha; the standard rate of 25t/ha; and a low rate of 5t/ha. (Based on standard manure analysis of 6kg/tonne of Nitrogen (N)). It should be noted that an application of 41t/Ha is not recommended due to the over supply of nutrients, in particular Potash.



One meter quadrats showing 41t/ha, 25t/ha and 5t/ha manure rates based on standard manure analysis of 25% DM.

Changing the applications at Bogindollo

Cattle FYM can be applied to land at any time of year, even within an NVZ. However, doing so will not maximise the use of the nutrients within the manure. Less than 30% of the N in cattle FYM will be released in the year it is applied, therefore, cattle FYM is not considered to have a high available N content. The availability of N depends upon its chemical formation within the manure. Organic N is extremely complex and therefore takes longer to become available to plants, in contrast ammonium-N is very mobile, readily available, and as a result, is often lost through volatilisation. To gain the biggest benefit from manures it is best applied in the spring to a growing crop, and this is what Bogindollo has started doing.



The N in cattle FYM (Defra, 2018). Note 'old' cattle FYM is manure which has been stored for 3 months or more.

Bogindollo has previously applied all FYM in the autumn, however, Euan has decided to change his method and now applies it to stubbles in the spring and ploughs it all down within 24 hours. This not only improves utilisation of nutrients but reduces the environmental impact through volatilisation and leaching. When ploughing down manure it is important to do so as soon after application as possible and incorporating it no deeper than 30cm. This can reduce the losses of N by up to 10%, and make considerable savings.

Euan has also looked at the application rate he uses. Like many farmers, he has always applied dung at 25t/ha or more.

However the benefits of smaller more frequent applications are:

- A greater area is covered
- Increased plant uptake of nutrients
- Reduced losses
- Increased microbial activity

Application Rate	Area Spread
25t/ha	100%
10t/ha	250%

As shown in the table above, reducing the application rates to 40%, increases the area covered to 250%. This small regular application ensures that there is organic matter to promote microbial activity and worm numbers. This will help to improve soil structure, however, care must be taken not to cause compaction when spreading.

Work rates

One of the perceived disadvantages of spreading a lower rate of FYM is the extra time it takes to cover the ground. This becomes an issue when the field midden is located far away from the field as more time is spent driving back and forth. However, a spreader can only spread its contents at a fixed rate, so it is important that the tractor pulling it has enough power to increase the speed and therefore reduce the application rate. If this is possible the time taken to spread a load will remain constant although the amount of ground covered per hour will increase.



Sampling your FYM

It is advisable to sample your FYM prior to spreading particularly if there are large volumes being applied. The analysis at Bogindollo has illustrated the high level of variation of nutrient levels within dungs.

To sample a manure it is essential to collect a representative sample. This involves taking over 10 sub samples from different points in the midden and at different depths. Following this, the samples should then be mixed together ensuring that any large lumps are broken up and 1kg should be sealed in a bag and sent to the lab. It is important to use a clean bag to reduce the risk of contamination by residues.

Taking multiple samples from different livestock classes, livestock on different feed or bedding will highlight any differences. For example, the young stock at Bogindollo were fed on a different diet from the cows and this is highlighted in the different manure analysis.



Once you have received the manure analysis from the lab, it is advised that the correct figures are used in any nutrient budgeting. Often analysis will show results by dry matter tonne and not fresh weight, moreover, some results are provided as '% of weight', so they must be readjusted to achieve kg/t.

Summary

- Test your manures for accurate nutrient budgeting
- Be careful of the way analysis results are displayed
- 'Little and often' is the best policy when spreading dung

Alternative Manures

Many farmers, particularly in arable areas do not have access to FYM, in these situations growers could look else where for organic manures. A few points to consider:

- Does the manure have a nutrient value which will make it worthwhile applying?

The method on page 2 can be used to calculate the value of any manure, as long as the P, K and crop available N is known. There are several digesters near Bogindollo, however, the nutrient value is not high enough to cover the cost of transport and application.

- When is it available?

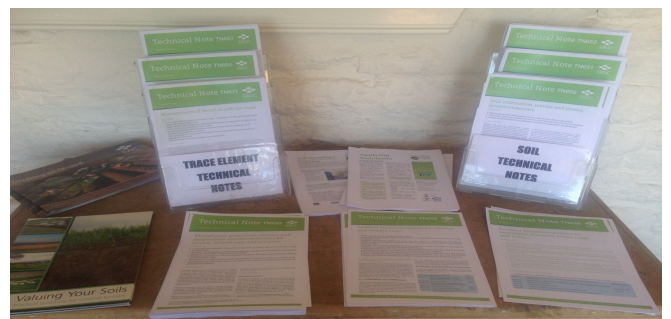
Ensuring that the manure is available when it is required on the farm or that it can be stored safely until it is needed will make sure that this valuable source is not wasted or causes pollution.

- What will it be applied to and how?

Tailoring applications to crop needs is key to befitting from manures. Consider application rates and methods or you could end up causing more damage than good.

- Are there any other benefits?

Some organic manures also have a neutralising value which will reduce the requirements for liming. Additionally, the organic matter contents can vary significantly making some much better soil conditioners than others. Do they also have key trace elements?



More information on all the topics discussed here can be found in the SAC Consulting Technical notes.

We've a series of useful soil management videos on our YouTube channel: <https://bit.ly/2KA5Rr3>