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Cattle slurry variability: tools for improving precision of nutrient advice

Key external stakeholders:

- Advisors
- Farmers
- Agri-contractors

Practical implications for stakeholders:

The nutrient content of cattle slurry is known to be highly variable. Knowledge of the slurry nutrient content through laboratory analysis helps to improve the precision of slurry nutrient applications. However, obtaining a representative slurry sample is difficult without complete agitation of the tank, due to stratification of slurry in storage. Slurry agitation is usually carried out immediately prior to land spreading and this means that laboratory results would not be available in time for spreading. A reliable method of sampling slurry prior to agitation would facilitate more timely availability of laboratory results.

The results of this project provide an increased understanding of the variability in cattle slurry on farms, and aid in identifying tools that can help to better quantify slurry nutrient content and to improve the precision of slurry allocation within a nutrient management plan.

Main results:

1. The nutrient concentrations in samples of slurry taken from unagitated slurry tanks using a tube sampler were not significantly different than those of samples taken with conventional sampling methods after agitation. A tube sampler can be used to take a representative slurry sample prior to agitation so that laboratory analysis results can be received in time to make slurry application rate adjustments based on actual nutrient values, rather than relying on imperfect average values.
2. The adoption of quick tools on farms can permit on-the-spot estimates of nutrient concentrations in slurry. Farmers perceived the slurry hydrometer to be the most useful quick tool and the one they would be most likely to purchase.
3. Cattle slurries on Irish farms have a wide range of nutrient contents, and the average nutrient contents found in slurry were lower than those assumed in previous advice and in the GAP regulations. The farm system, management system and diet did not predict slurry nutrient content based on the data collected. However, slurry dry matter content was a good predictor; therefore the slurry hydrometer shows potential to improve the estimation of slurry nutrient content on farms.

Opportunity / Benefit:

Sampling pre-agitation for laboratory analysis using a tube sampler, or assessing dry matter and nutrient concentration on site using a quick tool such as the slurry hydrometer has potential to improve the precision with which slurry can be utilised within a nutrient management plan.

Collaborating Institutions:

AFBI, QUB

Contact Stan Lalor Email: Stan.Lalor@teagasc.ie.

Teagasc project team: Stan Lalor (PI)
Patricia Berry
Dr. David Wall

External collaborators: Dr. Peter Frost, Agri-Food and Biosciences Institute, Hillsborough, Co. Down.
Dr. John Quinn, School of Biological Sciences, Queens University, Belfast.

1. Project background:

The nutrient content of cattle slurry is known to be highly variable. This affects the precision and reliability of nutrient management planning on farms in terms of nutrient supply requirements for crops when chemical fertilizers are replaced with slurry applications. Slurry nutrient advice is usually based on standard average values of total nutrient concentrations. The standard total nutrient content values assumed by the Good Agricultural Practice (Nitrates) Regulations are higher than slurry often contains in reality.

Knowledge of the slurry nutrient content through laboratory analysis helps to improve the precision of slurry nutrient applications. However, obtaining a representative slurry sample is difficult without complete agitation of the tank, due to stratification of slurry in storage. Slurry agitation is usually carried out immediately prior to land spreading and this means that laboratory results would not be available in time for spreading. A reliable method of sampling slurry prior to agitation would facilitate more timely availability of laboratory results.

2. Questions addressed by the project:

The objective of this study was to investigate methods for improving the estimation of total nutrient content in slurry. Three issues were investigated as follows;

1. Sampling methods for laboratory analysis allowing farmers to overcome the time delay between sampling and the availability of laboratory results.
2. On-farm quick assessment tools for analysing slurry enabling the estimation of slurry nutrient content quickly and on-site
3. Factors affecting nutrient content in slurry to improve the accuracy of assumed average nutrient contents

3. The experimental studies:

1. Comparing slurry sampling methods

The nutrient content in slurry sampled post agitation (using a bucket inserted into the tank and retrieved using an attached rope) was compared with a 'tube-sampler' method used a number of days prior to agitation (Figure 1). Seven slurry tanks were sampled in/near Teagasc, Johnstown Castle, Co Wexford. The tube sampler consisted of a 6 cm diameter plastic pipe which was inserted to the full depth of the unagitated slurry tank. A ball stopper attached to a rope was then applied to the base of the pipe as a seal by pulling the rope up through the centre of the pipe. Three full columns of slurry were extracted from the tank and sub-sampled for analysis.

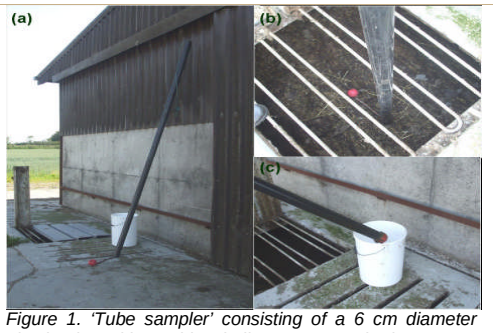

Figure 1. 'Tube sampler' consisting of a 6 cm diameter plastic pipe with a rubber ball stopper attached to a rope that runs through the centre of the pipe (a). The tube is inserted to the full depth of the unagitated slurry tank (b) and the ball stopper is applied to the end of the pipe by pulling the rope. The full column of slurry is then extracted from the tank by securing the rope to hold the ball stopper in place. The extracted column of slurry can be collected in a vessel by releasing the ball stopper (c).

2. On-farm quick assessment tools

Having a tool for making a quick, on-the-spot assessment of slurry nutrient content would help farmers to adjust slurry application rates on the move, and to achieve better utilization of the available nutrients. In this study, three commercially available tools were demonstrated to groups of farmers. These farmers were subsequently surveyed for their opinions on the usability and/or value to them of each tool. The tools selected were: a slurry hydrometer that estimates the slurry dry matter content (Figure 2), and two tools that estimate the ammonium-N content of slurry.

3. Factors affecting nutrient content

A total of 75 slurry samples were collected from dairy and beef farms along with supporting data on animal type, animal housing and animal diet. Samples were collected by Teagasc advisors.

Contact Stan Lalor Email: Stan.Lalor@teagasc.ie.

4. Main results:

1. Comparing slurry sampling methods

There was a wide range in nutrient and slurry dry matter contents between the seven tanks sampled in the study. For example, the dry matter content ranged from 1.7 to 10.3 %. The sampling method did not have a significant effect on the dry matter or nutrient content within each tank. This shows that the tube sampler can be used to take a representative slurry sample in advance of agitation leaving enough time for laboratory analysis results to be available on the day of slurry application.

Figure 2. Slurry hydrometer with graduated scale used to estimate the slurry dry matter content in a well mixed slurry sample.

2. On-farm quick assessment tools

Of the tools selected, the slurry hydrometer (Figure 2) showed the highest potential for adoption on farms, as the slurry dry matter could be used to estimate the concentrations of all nutrients (N, P, K), whereas the other two tools only gave an estimate for ammonium-N.

3. Factors affecting nutrient content

The mean and range of dry matter, N, P and K contents in the 75 samples are shown in Figure 2. The mean content of N, P and K were lower than those assumed by the GAP regulations and in previous advice. Analysis of this dataset found no definitive relationships between slurry nutrient content and the farming system variables that were recorded. However, the slurry nutrient content was correlated with slurry dry matter content (Figure 3), indicating that the slurry dry matter can be used to estimate the nutrient content.

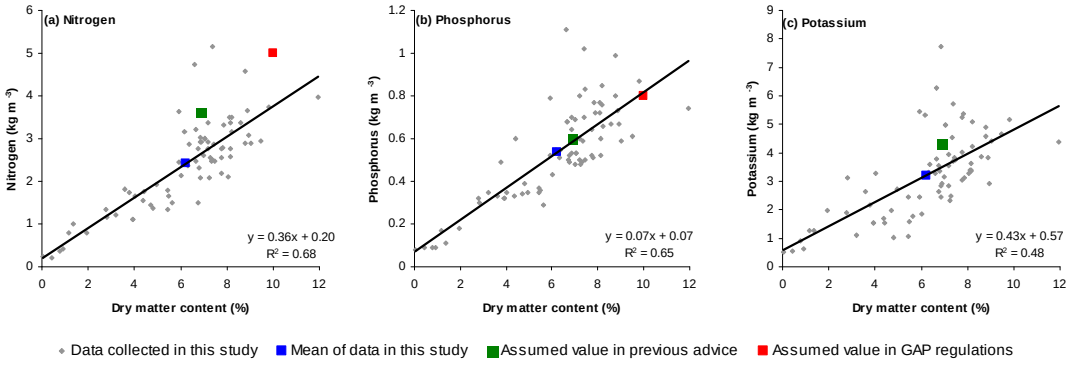

Figure 3. Relationship between slurry dry matter and nitrogen (a), phosphorus (b) and potassium (c) in the 75 slurry samples collected on farms. Values assumed in previous nutrient advice and current GAP regulations are also shown. (Note that no value is assumed for potassium in the GAP regulations).

5. Opportunity/Benefit:

The following opportunities and benefits can be concluded based on the results of this study:

1. A tube sampler can be used to take a representative slurry sample prior to agitation so that laboratory analysis results can be received in time to make slurry application rate adjustments based on actual nutrient values
2. The adoption of quick tools on farms, is more likely if the tool can estimate a range of nutrients. Farmers perceived the slurry hydrometer to be the most useful quick tool and the one they would be most likely to purchase.
3. Cattle slurries on Irish farms have a wide range of nutrient contents, and the average nutrient contents found in slurry were lower than those assumed in previous advice and in the GAP regulations. The farm system, management system and diet did not predict slurry nutrient content based on the data collected. However, slurry dry matter content was a good predictor; therefore the slurry hydrometer shows potential to improve the estimation of slurry nutrient content on farms.

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6. Dissemination:
The work of this project has been disseminated to farmers and advisors through the demonstrations and surveys of quick assessment tools. The results of this study have been presented at the Agricultural Research Forum, 2012, and published in TResearch.

Main publications:
Berry, P.B., Lalor, S.T.J., Wall, D.P., Quinn, J.P. and Frost, J.P., 2012b. Comparison of different methods for obtaining representative samples of cattle slurry, Agricultural Research Forum, Tullamore. pp. 31.

Popular publications:
Berry, P., Lalor, S., Wall, D., Frost, P. and Quinn, J., 2012a. Cattle slurry variability: tools for improving precision of nutrient advice, TResearch Vol. 7, No. 4. Teagasc. 22-23 pp.

7. Compiled by: Stan Lalor, David Wall, Patricia Berry

Contact Stan Lalor Email: Stan.Lalor@teagasc.ie.