



Multi-year grassland bio-based fertiliser trial, Johnstown Castle, Co. Wexford.

Reducing nutrient losses and fertiliser use

TEAGASC researchers have spent many years looking at alternative nutrient sources to reduce chemical fertiliser demand on farms.

In the EU Farm to Fork Strategy for a fair, healthy and environmentally friendly food system, one of the key targets is to act to reduce nutrient losses by at least 50 %, while ensuring that there is no deterioration in soil fertility. This is likely to affect the quantity and type of nutrient inputs farmers use to produce grass and crops, and the European Commission has indicated that a reduction in fertiliser use of at least 20 % by 2030 will be needed to achieve these targets across the EU. Under Farm to Fork, the Commission aims to develop, in conjunction with member states, an integrated nutrient management action plan to address nutrient pollution at source and increase the sustainability of the livestock sector. They will also want member states to promote the application of precise fertilisation techniques and sustainable agricultural practices, notably in nutrient hotspot areas of intensive livestock farming, and to recycle organic wastes into renewable fertilisers.

Research support for agri-industry and farmers

Achieving these targets for reducing nutrient losses and fertiliser use on farms may present challenges for conventional methods of farming. However, in Ireland, the Teagasc, Crops, Environment and Land-use Programme at Johnstown Castle has been conducting research and innovation in the area of soils and nutrient efficiency for many decades. This research knowledge and the technologies developed are available to support farmers through the transition

period and to guide new technology transfer in the area of smart, sustainable and climate-friendly agricultural production systems. For example, the Nutrient Management Planning Online (NMP Online) decision support tool harnesses the latest research to enable farm advisors and agronomists to tailor fertiliser and organic manure advice to individual fields on farms. NMP Online recognises spatial and temporal variability in nutrient demand and risks for nutrient losses.

Farmers have the potential to displace a portion of their conventional mineral fertiliser usage with new bio-based and recycled fertilisers, and to build soil health.

Soil fertility limiting N efficiency on grassland farms

A recent study across dairy farms in Ireland highlights suboptimal soil fertility as a limitation to herbage production, leading to unbalanced nutrient uptake and grass nutrition. Across the 446 grassland fields

studied, the general nutrient limitation followed the order phosphorus (P) > potassium (K) ≥ nitrogen (N) from most limiting to least limiting (Nikoloski *et al.*, 2019). The mean N use efficiency for P Index 1 soils of 50 % was significantly lower than the mean N use efficiency for P Index 3 soils at 59 %. Similarly, this study found that the mean N use efficiency for K Index 1 soils of 44 % was significantly lower than both K Index 3 and 4 at 57 % and 60 %, respectively. Across the fields nutrient supply was limiting grass growth through suboptimal background soil fertility levels and/or unbalanced fertiliser and nutrient applications. In general, these findings indicate that grassland swards are often undersupplied with some nutrients, while being adequately or oversupplied with others, depending on the levels of grass production achieved. Overall, the supply of N across these fields was often least limiting; however, given the pH, P and K limitations detected, the fertiliser and organic manure N sources were less efficiently used by the grassland than they could have been.

Sustainable alternative nutrient sources

The EU Farm to Fork Strategy highlights that the “circular bio-based economy is still a largely untapped potential for farmers”, for example, “to produce bio-based fertilisers”. Farmers have the potential to displace a portion of their conventional mineral fertiliser usage with new bio-based and recycled fertilisers, and to build soil health. Consequently, providing agronomic advice for these fertilisers requires urgent attention as significant knowledge gaps exist surrounding nutrient release, field performance and the economics of these new bio-based fertilisers. These knowledge gaps need to be filled before these new fertilisers can be employed as strategies to meet the ambitions of a 20 % reduction in fertiliser use and to reach “at least 25 % of the EU’s agricultural land under organic farming by 2030”.

New research on bio-based fertiliser sources

The importance of crop quality as well as yield and economics has resulted in arable farmers becoming leaders in tailoring nutrient rates and timing to precisely meet crop requirements and in actively managing their soil resource. Mineral fertilisers have proven to be a convenient and consistent source of nutrients for many years. However, there is a growing interest in the potential long-term soil health benefits of including other sources of nutrients such as organic or recycling-derived fertilisers. These fertilisers often deliver other nutrients to soil in addition to N, P and K, along with carbon. As part of the EU H2020-funded Nutri2Cycle project, a multi-year research and demonstration study in collaboration with Teagasc tillage specialists and advisors has been established. In this research the agronomic performance, practicality, economics and soil health effects of using organic nutrients recaptured via processing are currently being evaluated and demonstrated to farmers (Figure 1).

Performance of organic manures and recycled residues to date

In 2019, silage maize, which has a high nutrient demand, was grown. Fertiliser programmes incorporating poultry manure, broiler



FIGURE 1: The Nutri2Cycle on-farm arable site where fertiliser programmes incorporating organic and recycled nutrient sources are being applied for each rotational crop (spring wheat 2020).

manure, cattle slurry, and two types of dairy processing sludge were applied and compared to a nutrient programme using mineral fertiliser only. These initial results indicate that the manure- and sludge-based nutrient sources performed similarly to mineral fertiliser and all treatments produced maize yields of c. 25 t/ha dry matter. Using these bio-based fertilisers, significant cost savings of 23-37 % on mineral fertiliser were achieved without compromising yield. Soil health effects and the benefits of recurring applications of organic manures will be measured and demonstrated over the coming years of this experiment.

References

- Nikoloski, S., Murphy, P., Koccev, D., Džeroski, S. and Wall, D.P. (2019). ‘Using machine learning to estimate herbage production and nutrient uptake on Irish dairy farms’. *Journal of Dairy Science*, 102: 10639-10656.
- NMP Online is an online system for developing nutrient management plans for environment and regulatory purposes. Available from: <https://www.teagasc.ie/environment/soil/nmp/>.

Authors

David Wall

Research Officer – Soil Science, Teagasc Crops, Environment and Land Use Programme, Johnstown Castle, Co. Wexford
Correspondence: david.wall@teagasc.ie

Patrick Forrestal

Research Officer – Soil Science Agronomy, Teagasc Crops, Environment and Land Use Programme, Johnstown Castle, Co. Wexford

