

BENEFITS OF COMPOST AND COVER CROPS FOR SOIL HEALTH AND YIELD

Summary

The benefits for crop yields and soil health of adding green compost to fields and growing cover crops depends on how the soil is cultivated and the local soil texture. The amount of clay in the soil determines the availability of nutrients released and how much additional soil organic carbon is retained.

The need

The rising cost of synthetic fertilisers and their negative impact on the environment through greenhouse gas emissions and leaching has focussed attention on organic amendments as a possible nature-based solution for providing crops with nutrients and improving soil health. Sources of organic material include green municipal waste ('compost') and /or growing cover crops over winter but the benefits for crop yield and soil health will depend on other properties of the cropping system and the local environment.

If the benefits of organic substitution for synthetic fertilisers are to be fully realised, farmers and advisors need evidence for the expected response of crops and soils in their local context. This can help inform adaptation of management in a way that improves efficiencies of input use and builds resilience to extreme weather and climate change through healthier soils. Because these benefits can accrue over many years, we also need evidence for the long-term benefits of organic amendments to manage expectations in the short term and underpin long term decision making.

Finally, the benefits of organic amendments and cover crops will depend on how they are combined with other nature based solutions, including crop rotations and reduced tillage. This 'systems level' understanding will further inform locally optimised decision making.



The benefits

Adding compost to the soil and growing cover crops (especially if they are nitrogen fixing legumes) provides a source of nutrients, including nitrogen and phosphorus, to following crops. This additional nutrition has the potential to reduce the need for applications of synthetic fertiliser, reducing costs and the environmental impacts of its manufacture and use.

Compost and cover crops are also a source of additional organic carbon. The loss of soil organic carbon over recent decades as a result of the reliance on inorganic fertilisers has been identified as a potential threat to the sustainability of crop production. Specifically, the degradation of soil structure as a result of the loss of organic carbon has compromised the hydraulic properties of soils, exacerbating the negative impacts of floods and droughts. Cover crops can also benefit the hydraulic conductivity of soils by creating connected macro pores through root growth.

Finally, the use of compost and cover crops has the potential to facilitate the adoption of other nature based solutions that have environmental and agronomic benefits. Specifically, reduced tillage systems can also improve soil structure and function and reduce costs. However, the transition to reduced tillage systems is often associated with short term soil compaction and the build up of weeds. By combining reduced tillage with compost and cover crops, these negative impacts can be mitigated.



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trans4num solution

Compost (at 30 t/ha wet weight) has been added to two trials in the UK on contrasting soil types alongside the growing of over winter cover crops for eight years. The compost and cover crops solution is implemented in different cropping rotations and either in an annually ploughed or reduced tillage system.

Where compost was applied preceding winter wheat, yield increased by an average of 4% and 9% on the sites with sandy loam and clay loam soil respectively. There is, therefore, potential to reduce autumn fertiliser applications at both sites. On the site with a sandy loam, residual nitrogen measured in the spring remained higher on winter wheat plots where compost had been applied, providing a further opportunity to reduce spring applied fertiliser. However, on the site with a higher clay content any remaining additional nitrogen released from the compost over winter was locked up in mineral aggregates and not available to the crop.

Spring barley yields only benefitted from compost at the sandy loam site, with average increases of 18% - there were no benefits for spring crops at the clay loam site. This reflected the fact that bioavailable nitrogen was reduced on the soil with a higher clay content because of a higher proportion of mineral associated organic matter (MAOM). Potential for organic substitution of synthetic fertiliser in spring crops was, therefore, limited to the sandy-loam site. However, this potential is greater on plots with reduced tillage as there was a synergistic effect of tillage and compost + cover crops.

A high biomass of over winter cover crops had a negative impact on spring barley yields at the clay-loam site. Again, this reflects the fact that a larger proportion of soil organic matter is protected in mineral aggregates; by acting as a catch crop, over winter biomass soaks up any remaining bioavailable nutrients at this site, limiting access for a following spring crop. Cover crops may not, therefore, be beneficial on heavier soils.

Soil organic carbon has increased on plots with reduced tillage and additions of compost at both sites but increases are larger and more consistent at the clay-loam site reflecting the contrasting capacity of the soils to protect carbon in mineral aggregates. Associated longer term benefits for soil function are expected to result in better yield resilience in future analyses.

What were the challenges / limitations in the implementation process?



- The main challenge to the implementation of this solution is the availability of compost and the cost of transport.
- The potential for reducing rates of synthetic fertiliser will also vary between fields and years depending on the cycling of nutrients and growth of cover crops. Robust decision support is required to support this opportunity.

What kind of resources do you need to implement the proposed solution?



- A field level digital twin or decision support tool that combines modelling with in field monitoring of nutrient cycling, soil moisture and crop growth would be a valuable tool for adapting crop nutrition strategies and reducing synthetic fertiliser use.

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