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Manure and sewage can provide crops with more phosphorus than chemical fertilisers

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Contact: helena.kahiluoto@luke.fi

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Phosphorus in sewage and manure could be more available to crops than previously thought, suggests new research. The study found that some forms of sewage and manure treatment provided plants with more phosphorus than conventional inorganic fertilisers.

Over the past 50 years, chemical fertilisers containing inorganic phosphorus have boosted crop yields and food production across the globe. However, their use has come at a cost. Phosphorus applied as fertiliser can be lost to waterways leading to the eutrophication of freshwater bodies and oceans.

This loss of phosphorus is not just a pollution concern. Phosphorus is a finite resource with no substitute in food production, and known sources are becoming increasingly depleted. Finding ways to recycle or re-capture phosphorus to fertilise crops is therefore of increasing importance.

The research examined how phosphorus could be usefully recovered from manure and sewage sludge to feed back into the cycle as a fertiliser. A range of different types of treated sewage sludge and manures was compared with chemically produced fertiliser. How sewage and manure are processed or treated can affect the availability of their phosphorus for plants.

The researchers added samples of sewage sludge, manure or chemical fertiliser to plant pots in which Italian ryegrass (*Lolium multiflorum*) was grown, under laboratory conditions. Different types of sewage and manure were applied, which represented a range of European treatment practices.

They measured levels of phosphorus in the soil and in the plants at four and eight weeks after sowing. They also compared the proportion of potentially available phosphorus actually in the plants among the fertiliser treatments.

The results suggested that phosphorus was more plant-available from manure and sewage than from the chemical fertiliser, depending on the treatment. The phosphorus was most available to plants grown in manure and in sludge that had been treated biologically (using microbes which capture phosphate) or with a medium amount of iron coagulant added.

Iron coagulants are sometimes added to sewage to prevent phosphorus from entering waterways and causing eutrophication. However, adding iron brings a risk: iron-bound phosphorus may not be as usable by plants as non-iron bound forms of phosphorus.

However, increasing the amount of sludge used reduced the proportion of phosphorus taken up by plants, even though there was a greater amount of potentially available phosphorus. High levels of iron binding were found to prevent take-up of phosphorus.

There was more plant-available phosphorous in manure that had been anaerobically digested and composted, and in anaerobically digested sludge when combined with acid treatment and an oxidiser.

These findings are contrary to the assumed knowledge that phosphorus recycling from residues, such as manure and sewage, is limited. When treated appropriately, manure and sludge can provide even more plant-available phosphorus than traditional inorganic fertilisers, the research suggests.

While these results are likely to be generally applicable, further research may be needed to investigate whether different crops and soil types lead to changes in the availability or uptake of phosphorus by plants.

The researchers conclude that effective recycling of phosphorus, using appropriate residue treatments such as most of those ones used in this study, should be encouraged, with possible incentives in the form of taxes or subsidies. This would realise the full benefits of phosphorus recycling, and counter the current 'legacy' of phosphorus loss and eutrophication.