Recycled fertilizer for organic farming – assessing the effect on soil fertility and associated risks with potentially toxic elements

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Poster or X Oral

Introduction

There is a large political motivation goal in the EU to increase organic farming area to 25%. However, for this, additional nutrients, preferably from recycled sources are needed. Before their wide use in organic farming concerns about contamination with potentially toxic elements (PTEs) and their influence on soil fertility must be assessed. In this study, the effect of recycled fertilizers from urban waste on crop yield, nutrient balances, soil fertility (especially soil nitrogen and carbon), and risk of contamination with PTEs were examined. Therefore, data from three long-term (>20 years) were analysed and combined with a model simulation exercise to gain more insight into the nitrogen (N) and carbon (C) cycle.

Methodology

Data from three long-term field trials using different recycled fertilizers, including compost from household and green waste, human urine, and sewage sludge was analysed. The first trial investigates different compost application rates in combination with mineral fertilization and was established in 1997 at the research station Heidfeldhof, South Germany. The second trial compares different application rates of sewage sludge and was established 1981 in Speyer, Germany. The third trial is called CRUCIAL and was established in 2002 at the station Taarstrup, Denmark. It compares compost from household and green waste, human urine, and sewage sludge to mineral fertilization and cattle manures. Crop yield, and soil parameters like soil carbon, soil N, phosphorus, potassium, and PTE content were collected and analysed. The results of the CRUCIAL trial were used to calibrate the soil-plant-atmosphere model DAISY which in turn was used to estimate water, C and N flows.

Results and discussion

Recycling urban waste into fertilizers can serve as a viable source of nutrients. In terms of nitrogen recovery rates, sewage sludge and human urine performed similarly to cattle slurry with N recovery rates of about 0.5 – 0.6, while household waste compost showed similar values to straw-rich animal manures with N recovery rates of about 0.3. After field application, the model simulation estimated nitrogen losses ranging from 34-55% with nitrate leaching being the primary loss pathway. Compost and cattle manure resulted in slightly smaller total nitrogen losses. Further, higher soil nitrogen accumulation of about 25% of the applied nitrogen were associated with compost and manure application. Compost also had the highest soil carbon sequestration of about 0.36, while cattle manure showed 0.12, sewage sludge 0.09, and cattle slurry 0.02. Concerns about contaminants, such as PTEs, exist, particularly with compost and sewage sludge fertilization, which can increase PTE levels in the soil. Yet, not above the precautionary threshold levels. Additionally, significant changes in crop PTE uptake were rare probably due to low PTE bioavailability.

Conclusion

The organic nutrient management in Europe requires more external nutrient inputs, and recycled fertilizers from urban wastes are an adequate source to close the nutrient gap and substitute animal manures from conventional origin. They additionally can increase soil carbon and nitrogen levels. Overall, the use of recycled fertilizers from urban waste is a promising solution, with negligible risks associated with PTEs to human health and the soil environment.

Acknowledgements

This study was conducted within the RELACS project 'Replacement of Contentious Inputs in Organic Farming Systems', which has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 773431.