Nitrogen dynamics in soils amended with composts from decentralised urban composting models

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Introduction

In recent years, the European Union has been a driving force for change in waste management models through the development of legislation in line with the principles of the circular economy (UE, 2018). In this context, community composting and decentralised urban composting are new composting scenarios for a sustainable organic waste management. Thus, the organic fraction of municipal waste selectively collected and the pruning from parks and gardens are managed to obtain a compost with properties that can be compatible with their use in agriculture and for soil improvement (Policastro et al. 2022). However, it is important to be aware of the characteristics and added value of these new composts in order to avoid potential risks to human health and to the environment. Therefore, the aim of the study was to evaluate the N mineralization processes in soils amended with these composts to analyse their potential use in agriculture as a substitute for conventional fertilisers.

Material and methods

The treatments used in the experiment were four composts obtained from the organic fraction of municipal waste selectively collected, mixed with urban pruning waste, by community composting (CC1 and CC2) and by decentralised urban composting (DC1 and DC2). The main characteristics of these composts are shown in Table 1.

Table 1: Main characteristics of the composts used on a dry weight basis.

Parameters	CC1	CC2	DC1	DC2
pH	8.2	8.7	7.7	8.1
EC (dS m^{-1})	3.2	6.1	1.1	5.2
OM (%)	38.4	38.1	41.0	56.6
TOC (%)	23.6	25.5	24.8	31.7
TN (%)	1.8	2.1	1.9	2.9
TOC/TN	13.3	12.0	13.0	11.1
K (g kg^{-1})	8.9	20.9	7.2	11.2
P (g kg^{-1})	9.2	7.5	6.3	9.6
Na (g kg^{-1})	3.3	7.0	1.3	5.5
Cu (mg kg^{-1})	20.8	56.9	32.0	39.1
Zn (mg kg^{-1})	66.1	83.7	104	102
Cr (mg kg^{-1})	22.0	54.2	70.7	52.8
Cd (mg kg^{-1})	0.4	0.3	0.3	0.5
Pb (mg kg^{-1})	9.1	20.6	15.1	15.9
Ni (mg kg^{-1})	7.3	18.2	19.4	18.6

CC1 and CC2: composts from the community composting scenario; DC1 and DC2: composts from the decentralized urban composting scenario. EC: electrical conductivity; OM: organic matter; TOC: total organic carbon; TN: total nitrogen.

In 500 ml polyethylene bottles, 200 g of soil was mixed with 4.5 g of each compost equivalent to 50 t ha^{-1}, dry weight (Bustamante et al., 2010). Each compost was tested in triplicate and unamended soils were used as control treatment. The moisture content of the soil-waste mixtures was maintained at 50% of the water holding capacity of the soil throughout the experiment by adding distilled water once a week. Incubation was carried out in a

controlled incubation chamber at 25 °C under aerobic and non-leaching conditions for 120 days. The different forms of nitrogen (Kjeldahl total nitrogen, organic nitrogen, nitrate nitrogen and ammonium nitrogen) were analysed in destructive samples on days 0, 2, 8, 10, 15, 37, 63 and 120 of the incubation, according to the methods described by Bustamante et al. (2007).

Results and discussion

The soils amended with the composts from community composting and decentralised urban composting showed an adequate rate of nitrogen mineralisation, with a progressive release of this nutrient, thus showing an adequate availability for crop development, avoiding losses in the soil-plant system (Diacono et al. 2010). Inorganic nitrogen increased during the incubation period in all the composts studied, but differences were observed in the final values obtained, which were higher or lower than the control for the community composting and decentralised urban composting composts, respectively. The general trend for organic nitrogen was also an increase with incubation time, although in this case the final values were higher than the control in all cases (Masunga et al. 2016), with no differences between the composting models. Residue + microbial organic nitrogen also increased in all the composts studied, with the final values being higher in the soil amended with the compost DC2.

Conclusions

The N dynamics in the soils amended with the composts obtained from the different decentralized models has shown the feasibility of these stabilized organic materials as a more sustainable option than the use of mineral fertilisers due to their progressive liberation of this nutrient, avoiding its losses in the soil-plant system. Furthermore, these materials constitute not only a source of nutrients but also of organic matter, which improves soil properties, increasing the circularity and sustainability of the agricultural sector.

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