Introduction

In recent years, recycling agriculture has developed quickly in China, especially in suburban areas. In order to manage the increasing amount of manure and increase the soil organic matter, many farmers are using composted manure such as chicken manure, cattle manure as fertilizer for vegetable cropping systems, in the Beijing area. However substantial differences between manure compost types result in a very wide range of mineralization rates from 2% to 39% for C (Moral *et al*., 2009). Some researchers have also shown that the carbon decomposition is related to the C to N ratio (Seneviratne, 2000; Cabrera *et al*., 2005). The soil organic matter must vary following different compost application. This research was thus set up to answer the following questions: Which is the best compost for improving soil organic matter under field conditions? What are the soil residual Nmin performances after long term applications of the different composts?

Materials and methods

A field experiment was conducted from April 2006 to November 2008 in Liuminying Village, Beijing. It was a sandy loamy soil, with soil organic matter of 12.3 g kg^{-1}, Olsen-P 108 mg kg^{-1} and exchangeable-K 183 mg kg^{-1} at the beginning. The treatments with 3 replications were as follows: 1) chicken compost, 2) cattle compost, 3) biogas residue, 4) control, no fertilizer input. The chemical characteristics of different manure were showed in Table 1. All the treatments except 4) applied manure once with 630 kg N ha^{-1} for 1 vegetable system every half a year in keeping with farmers' practice, which, given two vegetable crops every year translated into two manure application annually. The irrigation and other management methods were the same in all treatments.

The vegetable crops and cultivars in this field were decided by the local farmers according to the market demands. The crop data shown in this paper is for celery, which was the sixth crop in the field experiment.

Table 1 The chemical characteristics of the different manure

Manure	Source	OM	Total-N	Total-P	Total-K	C/N
		%	%	P_2O_5%	K_2O	
① Chicken-Compost	Chicken manure + Mushroom residual	40.4	2.01	2.36	2.02	11.66
② Cattle-Compost	Cattle manure + Maize straw	35.6	1.22	2.31	1.37	16.93
③ Biogas-Compost	Biogas ferment residua	31.8	1.36	5.1	0.9	13.56

Results

Nitrogen, carbon input and crop yield

The celery was the sixth crop in this field and the total N input was 3780 kg N ha^{-1} in the whole experimental stage for the fertilized treatments. However the carbon input among the treatments was different due to the different C/N ratio. The total C applied was 44.1 t ha^{-1}, 64.0 t ha^{-1} and 51.3 t ha^{-1} by organic manure for chicken,

cattle and biogas compost, respectively. As with the N input, there was no carbon added to the control treatments.

There was no significant difference in yields among the chicken manure compost, cattle manure compost and biogas residue compost treatments (Fig.1). The mean dry matter yield of those three treatments was 4.8 t ha^{-1}. All three were higher than the control plot.

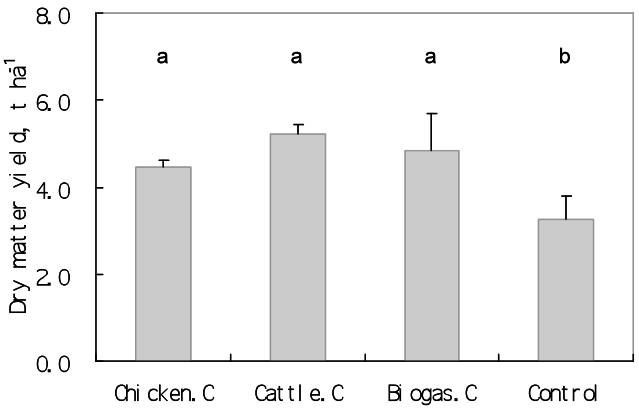

Fig.1 The yield of the different treatments

Soil organic matter

Compared with the control treatment, the soil organic matter (0-30cm depth) of the other three treatments increased year by year (Fig.2). However different compost shad different decomposition rates in the field. The chicken manure compost treatment had the highest final soil organic matter, increasing 85% compared to the control. The cattle manure compost treatment had nearly the same soil organic matter content as the biogas residue compost. Both treatments increased more than 20% compared to the control treatment level.

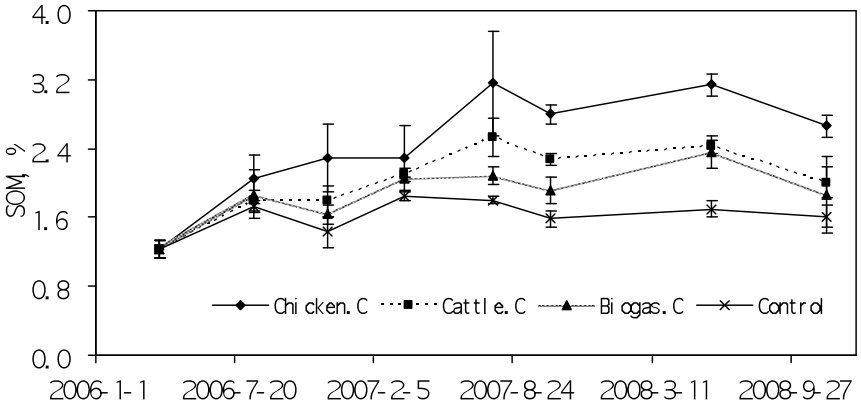

Fig.2 The soil organic matter dynamic of the different treatments

Soil Nmin after crop harvest

The soil residual Nmin after celery harvest showed large variations among the different treatments. The biogas residue compost had higher residual Nmin than other treatments at 0-180 cm soil depth (Fig.3). The chicken manure compost had the same

soil Nmin residue as cattle manure compost. All three treatments were higher than the control. It was also proved that the organic manure had high N-leaching risk at a high input level. The Nmin from biogas compost got 808 kg N ha^{-1} at soil 90-180cm depth.

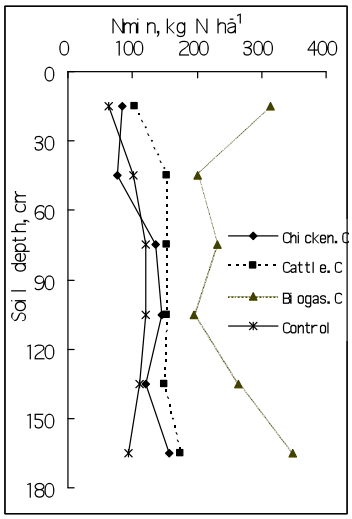

Fig.3 The residual Nmin in 0-180cm soil depth after sixth crop harvest

Conclusion

The soil organic matter content can be increased following the long-term application of manure compost. Chicken manure compost showed the highest soil organic matter when compared to cattle manure compost and biogas residue compost. Higher soil Nmin residue can be found in 0-180 cm soil depth after crop harvest in biogas residue compost treatment.

Acknowledgment

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References

Moral R, Paredes C, Bustamante M, Marhuenda-Egea F and Bernal M 2009. Utilisation of manure composts by high-value crops: Safety and environmental challenges. Bioresource Technology. Doi: 10.1016/j.biortech.2008.12.007.

Seneviratne G 2000. Litter quality and nitrogen release in tropical agriculture: a synthesis. Biology and Fertility of Soils. 31(1): 60-64.

Cabrera M, Kissel D, and Vigil M 2005. Nitrogen mineralization from organic residues: research opportunities. Journal of Environmental Quality. 34:75-79.