Effects of Chicken Manure Compost on the Production of Dissolved Organic Carbon and the Degradation of p, p′-DDT in Loam Soil

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Abstract. Using pot experiment to study the effects of chicken manure compost (CM) on the production of dissolved organic carbon (DOC) and the degradation of p, p'-DDT in loam soil under three different water conditions. The objective of this study was providing theoretical basis for the remediation of pesticide contaminated soil and the clean production of agricultural products. The results showed that CM could effectively accelerate the production of DOC and the degradation of p, p'-DDT in loam soil under three different water conditions. After adding 1%~3% CM in loam soil, the concentrations of DOC were respectively increased by 4.05%~40.8%, 6.84%~45.1% and 8.40%~260% under the conditions of flooded, maximum moisture capacity and 60% relative water content, and the degradation rates of p, p'-DDT were respectively increased by 4.92%~38.0%, 4.92%~34.9% and 0.42%~33.5% under the conditions of flooded, maximum moisture capacity and 60% relative water content. Which indicated that the improving effect of CM on the degradation of p, p'-DDT in loam soil was best under flooded.

Introduction

The Dissolved organic carbon (DOC) has higher effectiveness in soil, and is considered one of the most sensitive indicators on reflecting the effects of agricultural management measures on changes of soil organic matter [1]. Many studies had shown that the long term application of organic manure could increase the concentration of DOC in soil [2]. DDT (dichlorodiphenyltrichloroethane) belongs to the organochlorine insecticide. It has stable physical and chemical properties and is very difficult to degrade. It can promote chronic poisoning and cause certain teratogenic, carcinogenic and mutagenic effects. And it is easily enriched in the body through the food chains [3]. So it is the priority control compound of the environmental protection departments in every country [4]. Although it was forbidden for over 20 years, it still can be largely detected in the water, soil and sediment. And it still poses a potential threat to the safety of agricultural products. At present, there are many researches on the degradation of pesticide in soil. However, it is still a lack of simple, practical and efficient way on how to accelerate the degradation of pesticides in soil. Some researchers have found that fertilization could affect the degradation of pesticide in soil [5-7]. However, the studies were less on the influence of chicken manure compost (CM) on the production of DOC and degradation of DDT in soil at home and abroad. So it is necessary to strengthen the research in this area. The objective of this study was to determine the CM can accelerate whether or not the degradation of p, p'-DDT in soils.

Materials and Methods

The tested soil was collected from cowpea plantation (N19°37′11″, E109°20′40″) of Wangwu Town in Danzhou City of Hainan Province. Soil samples were taken from 0~20 cm tillage layer soil by applying five point sampling method. Each point sampling volume is largely the same, then mixing collection. Samples were stored in a sealed plastic bag and taken to the laboratory on the same day, the plant roots and stones were removed, and samples were passed through a 2 mm sieve. The tested chicken manure

compost (CM) was made in our laboratory. The basic physical and chemical properties were listed in table 1.

Table 1 The basic physicochemical property of CM and loam soil

	pH	Organic matter [%]	Available P [g•kg^{-1}]	Available K [g•kg^{-1}]	Total N [g•kg^{-1}]
CM	9.97	9.40	5.86	5.70	15.8
Loam soil	5.90	1.29	799.54	157.0	1.85

The pot experiment was carried out to study the effects of CM on the production of DOC and the degradation of p, p'-DDT in loam soil under three different water conditions of flooded, maximum moisture capacity and 60% relative water content. The 3 treatments of this study were as follows: the addition amount of CM was 1%, 2% and 3% of soil dry weight, respectively. And set a group of blank controls (CK), which only add the concentration of p, p'-DDT to 1mg•kg^{-1} but not adding CM. Each treatment was repeated 3 times. Each pot was added 1.5kg air dried soil and the final concentration of p, p'-DDT was 1mg•kg^{-1}. Respectively controlled soil moisture to flooded, maximum moisture capacity and 60% relative water content. After the soil and CM were fully mixed in pots, then collected soil samples with 7d, 14d, 21d, 28d, 35d, 42d, 49d, 56d and 63d to analyze the concentration of DOC and p, p'-DDT in loam soil. The extraction and detection of P, P ′-DDT in soil were used the method described in Wu et al. [8]. The extraction and detection of DOC in soil were used the method described in Ghani et al. [9].

Results and Discussion

Fig.1 showed that adding CM can accelerate the production of DOC and the degradation of P, P′-DDT in loam soil under flooded conditions. The concentration of DOC was obviously increased after 0d~63d adding CM in soil, and increased with the increasing of the adding proportion of CM in soil. The concentrations of DOC increased 4.05% ~ 21.7% in the treatment on 1% addition amount. The concentrations of DOC increased 5.15% ~ 26.0% in the treatment on 2% addition amount. The concentrations of DOC increased 10.9% ~ 40.8% in the treatment on 3% addition amount.The degradation effect of P, P′-DDT was no obvious after 0d~14d adding CM in loam soil. After 21d~63d adding CM in soil, the degradation rates of P, P′-DDT increased by 4.92% to 26.3% in the treatment on 1% addition amount; the degradation rates of P, P′-DDT increased by 5.04% to 29.2% in the treatment on 2% addition amount; the degradation rates of P, P′-DDT increased by 8.61% to 38.0% in the treatment on 3% addition amount.

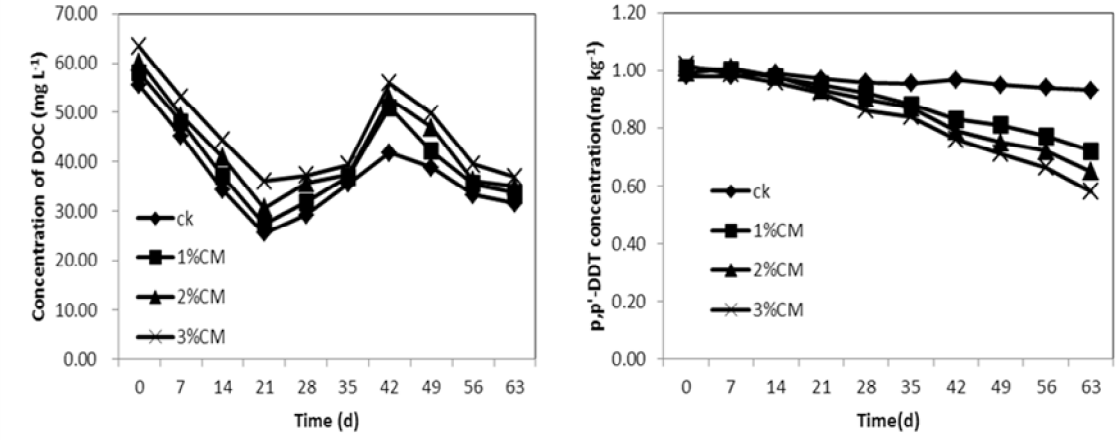

Fig.1 the concentrations of DOC and p, p'-DDT in loam soil under flooded conditions

Adding CM could also accelerate the production of DOC and the degradation of P, P′-DDT in loam soil under conditions of maximum moisture capacity(Fig.2). The concentration of DOC was obviously increased after 0d~63d adding CM in soil, and increased with the increasing of the adding proportion of CM in loam soil. The concentrations of DOC increased 6.84% ~18.0% in the treatment on 1% addition

amount. The concentrations of DOC increased 14.4% ~ 27.7% in the treatment on 2% addition amount. The concentrations of DOC increased 24.4% ~45.1% in the treatment on 3% addition amount. The degradation effect of P, P′-DDT was no obvious after 0d~14d adding CM in loam soil. After 21d~63d adding CM in soil, the degradation rates of P, P′-DDT increased by 4.92% to 22.6% in the treatment on 1% addition amount; the degradation rates of P, P′-DDT increased by 3.02% to 27.2% in the treatment on 2% addition amount; the degradation rates of P, P′-DDT increased by 5.80% to 34.9% in the treatment on 3% addition amount. These results demonstrated that the degradation effect was the best when added 3% CM in loam soil.

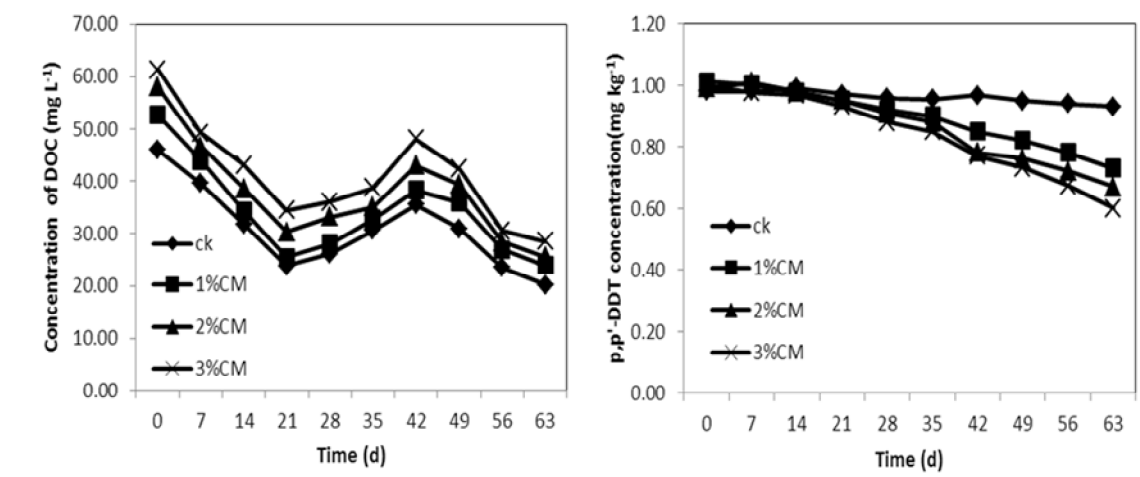

Fig.2 the concentrations of DOC and p, p'-DDT in loam under conditions of maximum moisture capacity

Fig.3 showed that adding CM could also accelerate the production of DOC and the degradation of P, P′-DDT in loam soil under conditions of 60% relative water content. The concentration of DOC was obviously increased after 0d~63d adding CM in soil, and increased with the increasing of the adding proportion of CM in soil. The concentrations of DOC increased 8.40%~205% in the treatment on 1% addition amount. The concentrations of DOC increased 8.48%~252% in the treatment on 2% addition amount. The concentrations of DOC increased 74.1%~260% in the treatment on 3% addition amount. The degradation effect of P, P′-DDT was no obvious after 0d~7d adding CM in soil. After 14d~63d adding CM in soil, the degradation rates of P, P′-DDT increased by 0.42% to 18.4% in the treatment on 1% addition amount; the degradation rates of P,P′-DDT increased by 1.01% to 25.3% in the treatment on 2% addition amount; the degradation rates of P, P′-DDT increased by 5.06% to33.5% in the treatment on 3% addition amount. These results demonstrated that the degradation effect was the best when added 3% CM in loam.

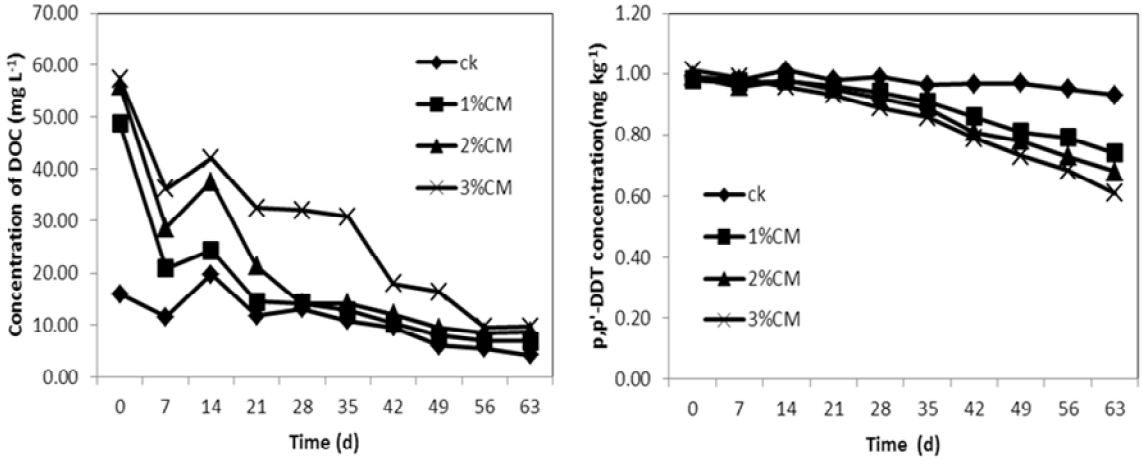

Fig.3 the concentrations of DOC and p, p'-DDT in loam under conditions of 60% relative water content

Table 2 showed significantly positive correlation between the concentrations of DOC and the concentrations of p, p' – DDT in loam soil after adding CM under three different water conditions. The concentrations of DOC decreased gradually in loam soil at middle and late period after adding CM. And the degradation of p, p' – DDT gradually accelerated in this period, which indicated that DOC from CM could promote the degradation of p, p' – DDT.

Table 2 Correlation analysis between DOC concentration and p, p' –DDT concentration in loam soil (** significant at $P < 0.01$)

Water conditions	Regression equation	Correlation coefficient
Flooded	Y=0.6593+0.0349X	0.5111**
Maximum moisture capacity	Y=0.6270+0.0785X	0.5096**
60% relative water content	Y=0.7536+0.0052X	0.6953**

Conclusions

CM could effectively accelerate the production of DOC and the degradation of p, p'-DDT in loam soil under three different water conditions of flooded, maximum moisture capacity and 60% relative water content. The concentrations of DOC gradually increased with increasing of the added proportion of CM in clay soils. And the degradation rate of p, p'-DDT gradually increased with increasing of the added proportion of CM in clay soils.

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