Effects of tubificid worms on soil properties in ricefields with organic farming

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Introduction

Tubificid worms (aquatic oligochaetes) are one of the major benthos in lake bottom sediments and are known to disturb lake sediments (Davis, 1974) and influence lake ecosystems through increasing nutrient release to water from the bottom sediments (Fukuhara and Sakamoto, 1987). It is also known that tubificids present at high density in the ricefield rich in organic matter (Simpson *et al*., 1993) and increase nitrogen and phosphate in the submerged soil and the overlying water (Kikuchi and Kurihara, 1977). However, bioturbation and nutrient change by tubificid worms have not been quantitatively determined in ricefield soils.

In this study, we investigated the effects of tubificids on physical and chemical properties of ricefield with organic farming by field survey and in vitro experiments.

Key words

Tubificid, bioturbation, nitrogen mineralization, available phosphate, organic farming

Materials and methods

We measured the population density of tubificids in the winter-flooded and organically managed ricefield of Miyagi, Japan. Bioturbation by tubificids was estimated by soil thickness and weight transported over rice straw left last autumn in two no-tillage paddy fields with organic farming.

In order to analyze quantitative change of soil nutrients induced by tubificid activity, incubation experiment were conducted under continuous dark and dark/light (12/12 hours) at 30^{o}C for 4 weeks using 300 mL vials with 7 cm depth of alluvial soil and 5 cm depth of overlying water. Concentrations of ammonium, phosphate and ferrous iron were measured in the soil with and without tubificids (*Branchiura sowerbyi*) (0-78 g/m on the basis of wet weight).

Results

The major species of tubificids were *Limnodrilus socialis* and *Branchiura sowerbyi* in the ricefields surveyed. The population densities of tubificids were higher in the two ricefields with organic farming (maximum densities: about 40,000 ind/m) than those of the conventional ricefields with application of agrichemicals. Surface soils were disturbed by feeding and excretion action of tubificids. Some 60 mm in thickness and 35 kg/m in dry weight of soils were transported over decayed rice straws left last autumn in the two no-tillage ricefields with high densities of tubificids.

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Concentrations of ammonium nitrogen and available phosphate (Bray 2 extraction) in the soils significantly increased in proportion to tubificid densities under continuous dark and dark/light. Ferrous iron formation also increased in proportion to tubificid densities. It means that soil reduction through soil organic matter decomposition was stimulated by tubificid activity. Tubififids increased bioavailable nitrogen and phosphate in the submerged soil probably due to accelerating soil organic matter decomposition.

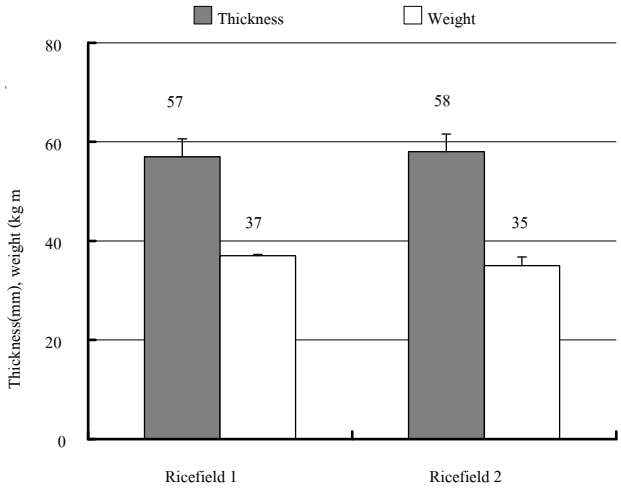

Figure 1. Soil mass transported over rice straws left on last autumn in the no-tilled ricefields.

Conclusion

Aquatic earthworm, tubificids increased in the ricefields with organic farming. Tubificid worms significantly disturbed surface soils and changed soil chemical properties in ricefields.

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