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Effect of paddy cultivation on nematode community in Jinchuan Wetland of Changbai Mountain area, China

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ABSTRACT

Soil nematode community composition could change following the conversion of wetlands to agricultural fields. In Jinchuan Wetland of Changbai Mountain area, China, we investigated the soil nematode community in different types of wetland-farmland interaction. Our results suggest that the Shannnon–Weaver diversity index in OW, R30, R1, KN, KP and PF are 2.48, 1.65, 1.70, 1.68, 1.39, 1.98, respectively, which means the native wetland had great biodiversity abundance. The genus of nematodes initially increased upon recovery from farmland, and nematode densities decreased in the tillage and cropping wetlands. *Wilsonem* and *Prismatolaimus* were sensitive to tillage. The bacterial-feeder nematodes increased after the first tillage treatment, while the nematode community was in a relatively stable state after a return to wetland following 30 years of agriculture. Plant parasite index (PPI) had about tenfold reduced in paddy farmland in comparison to the original wetland, and the values were positively associated with the change extent of recovery to reclamation of wetland. The study showed that agricultural activities disturbed the diversity of soil nematodes in Jinchuan Wetland. Certain kinds of genus and trophic diversity of the nematode community could indicate the effects of paddy cultivation on the wetland soil ecosystem.

1. Introduction

Nematodes have been called the most abundant soil mesofauna on earth, and nematode community structure is sensitive to changes in the surrounding environment within a short time (Neher, 2001; Neher and Darby, 2009), which can provide important insights into many aspects of ecosystem function (De Ruiter et al., 2005; O'Connell et al., 2013). As an important biological factor in the soil, soil nematodes are considered to be sensitive indicators of a natural ecological system that is disturbed by agricultural management and thus they can be employed to assess soil environmental health and ecological risk (Popovici, 1992; Yeates et al., 1993). Nematodes have been considered good environmental indicators because of their strong correlation with land management (Todd, 1960; Neher and Campbell, 1994; Donegan et al., 2001; Fiscus and Neher, 2002), including changes from cultivated field to meadowland (Háněl, 2003; Kardol et al., 2005) and from wetland to reclaimed land (Wu et al., 2005).

Wetlands have been globally recognized as important ecosystems (Luo et al., 1999; Brinson and Malvárez, 2002; O'Connell et al., 2012). Agricultural and other forms of development of former wetlands can result in reduced plant species richness and cover in embedded wetlands (O'Connell et al., 2012; Tsai et al., 2007), a situation that is commonly seen all over the world (Brinson and Malvárez, 2002; O'Connell et al., 2012; Takanose et al., 2013). Jinchuan Wetland is a crater lake forming a marsh, located in the middle of Changbai Mountain on the upstream tributaries of the Second Songhua River, northeast of China. Since the 1950s, following land reclamation, the majority of China's wetlands have been replaced by farmland. Agricultural disturbance has been shown to be a major determinant of wetland plant communities (Johnston et al., 2009). The vegetation is proportional to soil nematode community composition, and less diversified vegetation implies less

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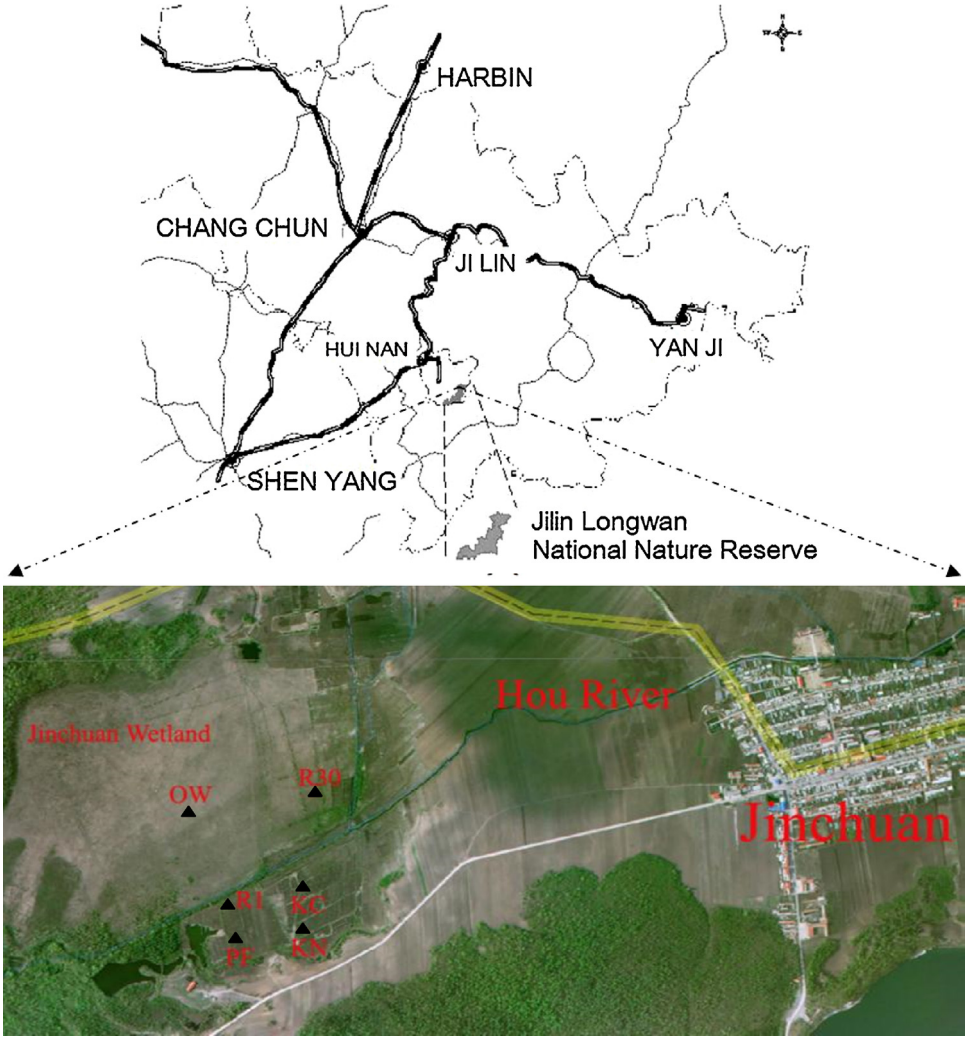

Fig. 1. Location of the study area and sampling sites in Jinchuan Wetland. OW: original marsh; R1: cultivated paddy fields recovered to wetland in 1 year; R30: cultivated paddy fields recovered to wetland in 30 years; KC: wetland reclaimed to paddy land with tillage and cropping; KN: area with only tillage; PF: paddy farmland.

rich nematodes (Kardol et al., 2005). The cultivation of wetlands has also been generally considered a severe physical disturbance to soil and soil biota (Neher and Campbell, 1994; Fu et al., 2000; Neher et al., 2005). Therefore, wetlands converted to agricultural purposes might not only change hydrological and soil profiles, but also could change the soil animal community with new vegetation and cultivation disturbances (Sánchez-Moreno et al., 2006).

In this study, we carried out random sampling and determined the changes in soil nematode community in different types of wetland-farmland interaction in Jinchuan Wetlands. We analyzed the sensitive genus and ecological index, employing the nematode indicator to show the early and late successional stage of interaction between farmlands and wetlands. As expected, nematode trophic group and nematode communities were consistently diverse in different cropping wetlands systems.

2. Methods

2.1. Study area

The study was conducted in a typical freshwater marsh named Jinchuan Wetland, which was in the area of Longwan National Nature Reserve. The Nature Reserve is in Huinan County (42°20′56″ N, 126°22′51″ E) of Jilin Province, Northeast China, and is administered by the State Administration of Forestry, China. Jinchuan Wetland is a peatmire-based volcano landform and has a nearly circular outline, about 100 hm^2 in area, and 613–615 altitude. The main vegetation of Jinchuan Wetland is *Sphagnum palustre* and *Carex tristachya*. This district belongs to the north temperate continental monsoon climate. The annual average temperature and precipitation are 4.1 °C and 704.2 mm, respectively. There are many farmlands around Jinchuan Wetland, following land reclamation that began in the 1950s.

2.2. Soil sampling and nematode identification

In August and September 2012, soil was sampled randomly at the 0–20 depth at typical sites of different wetland-farmland interaction as follows: core of Jinchuan Wetland as an original marsh (OW); cultivated paddy fields recovered to wetland in 1 year (R1) and 30 years (R30); wetland reclaimed to paddy land with tillage and cropping (KP); area with only tillage (KN); as well as paddy farmland (PF) (Fig. 1). Five replications of each site were established. Nematodes were extracted from 100 g subsamples using sugar centrifugation (Jenkins, 1964) and preserved in TAF (triethanolamin formalin) after heat relaxation. After we counted the total number of nematodes, expressed as per 100 g dry soil, we identified all nematodes within a sample to genus level using a compound microscope according to Thorne (1974), Jairajpuri and Ahmad (1992), and De Ley et al. (2003) using an inverted microscope. Trophic groups