

## 学 位 論 文 要 旨

### Effects of tillage systems and cover crop managements on soil nematode community structure 耕うんシステムとカバークロップの利用が土壌線虫群集構造に及ぼす影響

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The anthropogenic impacts on cropland caused by farming practices change the soil health and quality. However, the effects of farming practices on soil health and quality were not discussed. In particular, studies of soil food web structure were limited. We evaluate the soil food web structure, using the soil nematode community. Because of soil nematode has widely habitat and various behavior, soil nematode community provides a good indicator to soil food web structure, We examined the effects of three tillage systems, moldboard plow/rotary harrow (MP), rotary cultivator (RC), and no-tillage (NT); three winter cover crop managements (fallow, rye and hairy vetch); and two nitrogen (N) fertilization rates (0 and 100 kg N ha<sup>-1</sup> for upland rice and 0 and 20 kg N ha<sup>-1</sup> for soybean production) on changes in soil nematode community structure. The objectives of this study were (1) comparing the effects of tillage and cover cropping on nematode community composition and diversity, (2) to determine whether there is a relationship between nematode community structure and the degree of surface soil translocation (DTL). In addition, cover cropping and manure application may also influence nematode community structure. Thus, we hypothesized that DTL and cover cropping can synergistically affect soil nematode community structure, (3) to determine whether NT and cover cropping could prevent rice cyst nematode (*H. elachista*) infection by enhancing the health of soil ecosystem under continuous upland rice cultivation and reduce nematode populations more rapidly than conventional cultivation methods after conversion to soybean, (4) comparing the effects of tillage and cover crops on nematode community structure and indices in long term, (5) to determine whether there is a relationship between nematode community indices and soil carbon (C) sequestration.

The abundance of total nematodes (ALL), bacterial feeders (BAC), predators (PRD), omnivores (OMN), and obligatory root feeders (ORF) were greater in NT than in MP and RC, but fungal feeders and facultative root feeders (FFR) was greater in RC. Cove crop also influenced on nematode community, rye and hairy vetch were always higher in ALL, BAC, FFR, ORF, and OMN than fallow. Tillage significantly influenced DTL. Overall, NT showed

lower DTL than RC and MP. DTL significantly negatively correlated with nematode abundances for BAC, OMN, and ORF, and structure index (SI).

Densities of *H. elachista* markedly increased in MP and RC after 4 years of continuous upland rice cultivation, but not in NT. *H. elachista* were 52.8 individuals per 20 g soil in MP and 72.7 in RC, but 2.1 in NT in 2006. However, in the fifth year of continuous cultivation of upland rice, *H. elachista* densities increased in NT; therefore, no differences were observed between tillage systems. After conversion to soybean, *H. elachista* densities decreased in all treatments, although NT showed a more rapid decrease than the other tillage systems. Cover cropping and N fertilization did not affect *H. elachista* densities during the 9 years, but cover cropping reduced the proportion of *H. elachista* to ALL and N fertilization reduced rice yield with increasing *H. elachista*.

In 2003-2011, ALL, BAC, PRD, OMN, and ORF were greater in NT, but FFR was great in RC. Cove crops markedly increased ALL, BAC, FFR, ORF, and OMN. Seasonal changes in nematode community were also significant, in particularly, as increase soil C, nematode densities were also increased. The relationship between nematode indices and soil C was significant only in NT, but not for MP and RC. In NT, as increase soil C, enrichment index and SI were positively significant. Seasonal difference of nematode community between summer and autumn was bigger in upland rice rotation, but that was small in soybean rotation. For 9 years experiment, SI increased not only for NT but also MP and RC. These results suggest that increase of soil C would have a great impact to develop the more diverse nematode community structure.

In this research, SI values increased in all plots after converting to soybean cultivation as a summer crop, suggesting soybean cropping showed more benefits to develop the nematode community structure. In this regards, the further research would be desirable to determine the effects of tillage system and cover cropping with the combination of summer crop on nematode community structure. In addition, DTL showed a significant negative correlation with SI, suggesting that DTL could be useful to evaluate the level of ecosystem disturbance not only regarding soil translocation but also in relation to soil ecosystem development.

This paper discusses the significance of nematode community indices to evaluate the agro-ecosystems and the effects of farming practices such as tillage systems and cover cropping on nematode community structure. Nematodes will be used as bio-indicators of soil health significantly because they are ubiquitous and have diverse feeding behaviors and life strategies. The information regarding soil nematode community structure and farming practices will be helpful to design the sustainable agriculture.