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Utilization of Organic Farming for *In Situ* Conservation of Biodiversity

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Abstract

Organic farming is potentially useful approach for in situ conservation of biodiversity when the farming technologies are effective and economically sound. Functional rate of arthropod biodiversity as an index of biodiversity quality was assessed according to some organic farming methods, such as landscape management and using companion plants in rice and soybean fields. In this study, it is important to select effective farming technologies for in situ conservation and utilization of functional biodiversity even in organic farm.

Introduction

Conservation of biodiversity is an international norm and issue. Korean government also joined the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). FAO Global Plan of Action emphasizes the conservation of biological species as well as *ex situ* and *in situ*, especially on farm (ITPGRFA Secretariat, 2011). However, practical policies and technologies for the conservation on farm have not been developed properly. *In situ* conservation of biodiversity will be available when the landscape management of organic farm is effective and the productivity is economically sound (Altieri and Nicholls, 1999; Fuentes-Quezada, et. al., 2000). We investigated impact of organic farming technologies, especially landscape management and push-pull strategy using companion plants, on arthropod biodiversity in farm land. Thus, more effective organic farming technologies are suggested for *in situ* conservation of arthropod biodiversity in this study.

Material and methods

Impact of the management of paddy field levee on arthropod biodiversity in rice cultivation

Width of rice paddy field levee was compared between 0.6m and 1.0m in order to investigate the impact of the landscape management on arthropod biodiversity in organic rice cultivation. In addition, weeds on the levee were managed differently by various companion plants and treated control. Monitoring of arthropod species and densities of each species were conducted with sweeping method (20 sweeping times per plot) or vacuum pumping (0.5x0.5m^2) on each levee plot. Biodiversity of arthropod was assessed by functional groups; natural enemy, pest and neutral insect. Biomasses of total plant on each levee plot and of rice were investigated after harvesting.

Impact of companion plants on arthropod biodiversity in soybean cultivation

Monitoring of arthropod biodiversity was investigated over 2 years among the non-chemicals (fertilizer and pesticides) and minimal input farming (Organic I), the companion planting using marigold near field border line and crop rotation with winter rye (Organic II), and the conventional farming for soybean. Biodiversity index of arthropod was assessed by functional groups such as natural enemy, pest and neutral insect. Each species was monitored and analyzed as potential indicator for biodiversity balance influenced by farming management.

Results

Impact of the management of paddy field levee on arthropod biodiversity in rice cultivation

Increase of levee space was act as biotope or habitat for many arthropod species (Figure 1). Rate of neutral insect species was over 22% higher in the wider levee (1m) than the smaller (0.6m). Thus, rates of insect pest and natural enemy were decreased respectively 17% and 4% according to increasing the width of levee. According to decreased rate of insect pest, damage of rice plant by *Lissorphoptrus oryzophilus*, was significantly low in the wider levee and healthy rice grains were produced more near to the wider levee than the narrow levee (Table 1).

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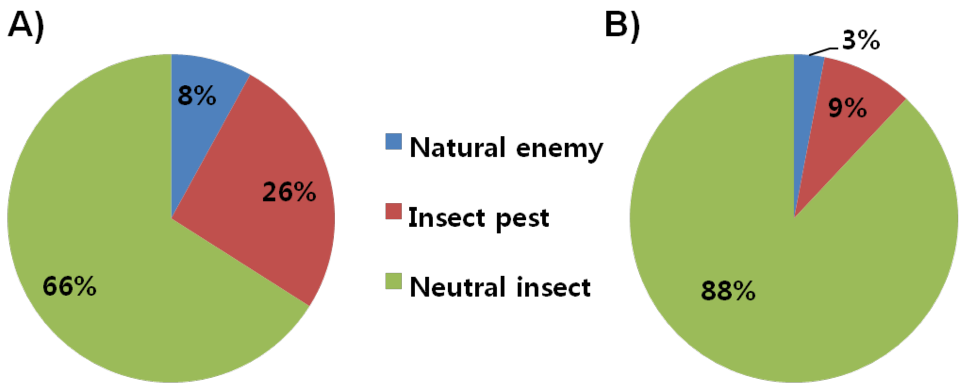

Figure 1. Rate of arthropod species number by functional group (%) between the narrow (A, 0.6m) and the wider (B, 1m) paddy field levee in organic rice cultivation.

Table 1. Damage rate of rice plant (leaves) by insect pests, rate of healthy grains and density of spider according to width of levee in organic rice paddy field*

Width of levee	Damage rate (%) of rice plant by *L. oryzophilus*	Rate (%) of healthy rice grain	Density of spider (N/plant)
0.6m	8.8±5.8a	87.1±0.8b	0.3±0.1b
1m	6.3±3.3b	95.8±0.6a	1.0±0.1a

*P<0.05.

Impact of companion plants on arthropod biodiversity in soybean cultivation
Even the non-chemicals (fertilizers and pesticides) and minimal input management is one of the organic farming, it caused arthropod biodiversity decline (Table 2). More active organic practices for nutrient and pest management, such as crop rotation with winter rye and field border management using companion plants, increased arthropod biodiversity. In relation to increased arthropod biodiversity which means the relative decrease of insect pest rate, healthy soybean productivity was increased (Table 3).

Table 2. Total number of arthropod species collected in each soybean farm field investigated

Farming method	Number of arthropod species				
	Class	Order	Family	Genus	Species
Conventional	2	10	102	115	116
Organic I	1	9	43	96	97
Organic II	2	11	108	139	139

Table 3. Yield and infection rate of soybean in each farming*

Farming method	Weight of 100 soybean seeds (g, mean±SE)		Infection rate (%, mean±SE)
	Total	Healthy soybean	
Conventional	32.9±0.2a	28.6±0.2a	14.5±0.7a
Organic I	27.2±0.3b	22.6±0.3c	16.2±0.5a
Organic II	26.5±0.2b	24.1±0.1b	10.4±0.6b

*P<0.05, **Most damages of soybean seeds were caused by 2nd infection from Hemiptera such as *Riptortus clavatus*, *Paraplesius unicolor,* etc.

Discussion

In conclusion, rate of arthropod species by functional group is important as an index of biodiversity quality and it is able to be managed by organic farming methods (Gurr, et. al., 2003) for biodiversity conservation and crop productivity. However, it is needed to select effective farming technologies for *in situ* conservation and utilization of functional biodiversity even in organic farm. In organic rice cultivation system, it is suggested that increase of levee space is an effective method of landscape management for biodiversity conservation and productivity of high quality rice, combined with planting companion plants impacting on the rate of arthropod functional group on the levee. Especially, in this study, *Ocimum basillicum* decreased rate of insect pest and increased rates of natural enemy and neutral insects on the levee of rice paddy field (data omitted). Managements for functional biodiverisity and in situ conservation of biodiversity were synergistic also in organic soybean farm. Crop rotation with winter rye as green manure and field border management using companion plants were effective for increasing arthropod biodiversity and productivity of high quality soybean. Thus, it is important for each organic farming method to be assessed on biodiversity impact.

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