Effects of silicate fertilizer application on growth and yield of organically managed rice

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PC system for evaluating groundwater pollution by agricultural activities in a wide area by a combination of statistical and GIS data, modified existing numerical model (LEACHM, Leaching Estimation And Chemistry Model, Hutson, 2003; Asada et al., 2011) and a newly developed GIS model (MacT, Mixing areal chemical Transport, Itahashi et al., 2011).

The application of the system to an agricultural watershed where standard cultivation methods were supposed to be adopted for each crop types revealed almost 100 % risk to groundwater pollution below farmlands. Two alternative treatments were suggested to reduce such groundwater pollution effectively while maintaining desired crop production; that is introduction of cleaning crops after harvest of the major crops to recover excess N still remaining in the soil, and reduction of total N inputs by both chemical fertilizer and manure with a careful look at carbon and nitrogen dynamics in soil-plant systems using LEACHM.

Although the groundwater pollution by NO_3-N is one of the persistent environmental problems in Japan, this system will help constructing more environmental friendly fertilization systems, and moreover conserving healthy water environment.

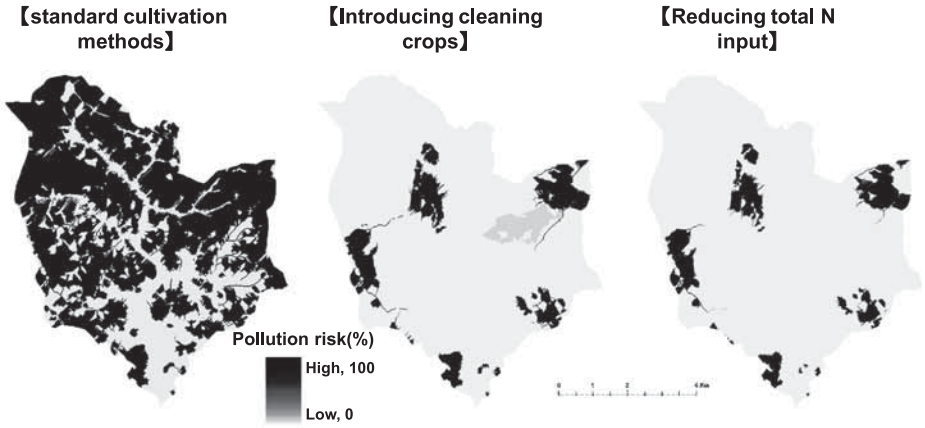

Fig. Risk evaluation maps to groundwater pollution by agriculture in an agricultural watershed.

Effects of silicate fertilizer application on growth and yield of organically managed rice

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Organic rice farming without chemical fertilizer and agrochemicals is expected to have merits of ecosystem conservation and reduction of environment pollution, but the yield level is low. It has a number of technically problems, for example, unestablishment of weed control technique and low yield by low nitrogen nutrient. In previous studies, it was shown that silicon (Si) can enhance photosynthetic ability and increase growth and yield of rice with conventional farming. In this study, we examine effects of silicate fertilizer application on growth and yield of organically managed rice.

Material and Methods: The field experiment was conducted in 2010 in the paddy field of the Field Science Center, Graduate School of Agricultural Science, Tohoku University, Miyagi prefecture, Japan. We use three silicate fertilizers; calcium silicate (CS), silica gel (SG), Poly-Silicate Iron sludge (PSI). PSI sludge includes large amount of silicon and iron derived from the flocculant. Main treatment was organic farming and four treatments were composed by no silicate fertilizer (control, CON), CS, SG, and PSI application. Application rate of each

silicate fertilizers were decided to correspond to 200g m^{-2} of CS, which is conventional application rate in Japan. All of three silicate fertilizer treatments can supply same amount of 0.5 HCl soluble silicate.

Number of tiller was measured periodically during the growing season. Rice yield and yield components were determined at harvest time. Then concentration of nitrogen and silicate in rice plant was measured.

Results and Discussion: Number of tiller of organically managed rice was lower than that of rice with conventional culture. Brown rice yield of organically managed rice reduced. Compared with CON, silicate fertilizer (CS, SG, PSI) increased percentages of ripened grain and brown rice yield by 4 to 8%. Silicate fertilizer application did not increased nitrogen uptake, but concentration of silicate in rice plant in silicate fertilizer plots was higher than that in CON plots. These results suggest that increase of silicate uptake enhanced photosynthetic ability and rice ripening. From these results, it is suggested that silicate fertilizer application can increase rice yield in organic farming system.

Aquatic Biota in Winter Flooded Paddy Field with Organic Farming -Case Study in Field Science Center, Tohoku University, Japan-

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In Japan, more than a half of natural wetlands have been lost in the last century primarily due to land reclamation by drainge (Geographical Survey Institute, 2000). On the other hands, waterfowl, for example white-fronted goose (*Anser albifrons* Scopoli) migrating to Japan are increasing. Waterfowl habitat environments are getting worse and may increase risks of food shortage and disease infection.

Winter flooded rice fields have potential as alternative wetlands for waterfowl. Winter flooding is conducted worldwide, for example, in Sichuan province in China (Qiu, 1962), California in the United States (Day and Colwell, 1998), Ebro delta in Spain (Serra *et al.*, 2007), Cheonsu bay in South Korea, Oosaki City, Sado and Toyooka City are famous for scarce water bird conservation using winter flooded rice fields, in Japan. Winter flooding is often conducted in combination with organic farming and is expected to increase biodiversity of aquatic life. We researched the effects of winter-flooded and organic farming on the aquatic biota in paddy field.

Material and Methods

The field experiment was conducted in 2009 and 2010 in the paddy fields of the Field Science Center, Tohoku University. In 2009, treatments were organic farming without winter flooding (OF plot) and conventional farming (CF plot) with chemical fertilizers and pesticides. Organic farming is characterized by no use of chemical fertilizer and pesticides and use of organic fertilizer. In 2010, the OF plots were shifted to organic farming with winter flooding (WF plot). These experiments were conducted with three replications with area of 900 to 1200 m^2.

To determine the data on aquatic animal density, aquatic animals were collected using a square sampler (1×1m) and a sample net (mesh size: 2 mm) with three times in each year.

Results and Discussion

A total of 15,867 individuals and 32 taxa of aquatic animals were found in all fields in two years. The density and taxa number of aquatic animals were higher in OF and WF fields than CF fields throughout the growing season, but the biodiversity index of OF and WF plots were sometimes lower than CF plots, mainly due to large number of Chironomidae larvae in OF and WF plots.

The densities of 18 taxa were higher in OF or WF plots than in CF plots. The density of only one taxon was higher in CF plot. The possible reasons for the aquatic biota richness in the fields with organic and/or winter-flooded farming are no use of insecticide (Mesleard *et al.*, 2005), Lemnaceae richness due to no use of herbicide that increase hiding space for some Pyralidae, and applyication of organic fertilizer supplying nutrients to Chi-