Effects of winter-flooding on soil nutrients and rice yield in paddy field with organic farming (Biological Interactions in Arable Land-Grassland-Forest Continuums and their Impact on the Ecosystem Functions, 7th International Symposium on Integrated Field Science)

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K. AKITA, T. ITO and T. UNO

Graduate School of Agricultural Science, Tohoku University

In Japan, more than half of natural wetlands have been lost in the last century primarily through draining for agriculture (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 it may cause risks of food shortage or disease spread.

Flooding rice fields during winter might function as alternative wetlands for waterfowl. Winter flooding is conducted worldwide, in California in the United States, Ebro delta in Spain, Cheonsu bay in South Korea, Miyagi, Sado and Toyooka in Japan and so on.

We researched the effects of winter-flooding on soil nutrient availability and rice yield in the organically managed ricefields.

Material and Methods

The field experiment was conducted in 2008 in the paddy field of the Field Science Center, Graduate School of Agricultural Science, Tohoku University, Miyagi prefecture. Treatments were three; organic rice farming with and without winter flooding (WF and NWF) and conventional farming (CF), with no replication. Each plot area is 280 m^2 to 380 m^2. Winterflooding was begun in December 11th, 2007. Inorganic fertilizer and agrochemicals were used in the CF plot and were not used in the WF and NWF plots. Organic or inorganic nitrogen fertilizer were incorporated into plow layer with the application rate of 7g N m^{-2} in WF and NWF plots, or CF plot, respectively. Transplanting and harvest were conducted at May 27 and October 10 in all plots.

Concentrations of NH_4^+-N, available P_2O_5 (modified Bray 2 method) and Fe^{2+} in the plow layer soil, and number of tiller and SPAD value were measured periodically during the growing season. Rice yield and yield components were determined at the harvest time.

Results and Discussion

WF plot showed greater concentration of NH_4^+-N in the plow layer soils than NWF and CF plots throughout the growing season. Available phosphate contents did not show significant difference among three treatments. Reduction of ferric iron to ferrous iron is index of oxidation-reduction condition of submerged soils. Ferrous iron contents of soils were larger in WF than NWF and CF. It showed that reductive condition of soils developed more rapidly and strongly in WF plot than NWF and CF plots probably due to longer flooding period and organic fertilizer application in WF plot.

Number of tillers of rice in CF plot was the highest among three treatments because rice plants can uptake more rapidly nitrogen from chemical fertilizer than organic fertilizer. Brown rice yields were 535, 440 and 600 g m^{-2} in WF, NWF and CF plots, respectively. The yield and nitrogen uptake of rice plants was significantly higher ($p<0.05$) in the WF plot than the NWF plot. Panicle number and grain number per head of WF plot showed greater tendency than those of NWF plot. The total grain number of rice was significantly different between WF and NWF.

From the preliminary results of one year research obtained, the winter-flooding management (longtime flooding) probably accelerates the mineralization of soil organic nitrogen and added organic fertilizer and increases rice yields compared to common water management.