

Recent Trends in the Nutrient Status of the Paddy Field Soil in Japan and Related Topics(Frontiers in Rice Science -from Gene to Field-,The 100th Anniversary of Tohoku University, International Symposium)

著者	Nanzyo Masami, Takahashi Tadashi, Kanno Hitoshi
journal or publication title	Tohoku journal of agricultural research
volume	57
number	3/4
page range	31
year	2007-03
URL	http://hdl.handle.net/10097/40423

Recent Trends in the Nutrient Status of the Paddy Field Soil in Japan and Related Topics

Masami Nanzyo, Tadashi Takahashi and Hitoshi Kanno

Graduate School of Agricultural Science, Tohoku University, Sendai, Japan

Paddy rice production is important for Asian people because rice is their traditional staple diet and it is a reliable crop for them. Rice shows second highest yield per ha next to maize and sustainability of paddy rice production is excellent. High sustainability of paddy rice production is at least partly due to flooding and nutrient supply through irrigation water. Yield and quality of paddy rice are better than those of upland rice. In this paper, we review characteristics of the paddy field soils and recent trends in the nutrient status of Japanese paddy field soils, and then we introduce our recent research topics on N, P, S and Cd in the paddy field soil.

1. Characteristics of the paddy field soils

The conventionally tilled A_p horizon, 10–15 cm thick, of paddy field soils in Japan has many similarities even though soil classification names are different. An upper 1 or 2 cm layer of the A_p horizon is kept oxidative due to O_2 diffusion through flooded water. The major part of the A_p horizon underlain the thin oxidative layer is reduced during the rice growing season. Manganese, nitrate, iron, sulfate, etc. are reduced, soil pH rises, organic N is partly mineralized, availability of P increases, and sulfides and carbonates of heavy metals may precipitate. Organic matter with low humification tends to accumulate in comparison with upland soils due to restriction of O_2 supply. On the other hand, morphological properties of subsoils are different due to many factors such as topography, groundwater level, drainage, soil texture, and so on.

2. Recent trends in nutrient status of Japanese paddy field soils

Nation-wide soil test data of agricultural lands have been collected in Japan since 1960's. As a general view, little deterioration has been found in the paddy field soil during these 3 or 4 decades. Soil pH slightly increased, exchangeable Ca content, organic C content and cation exchange capacity were almost constant, exchangeable K content and available N content showed slight increase and available P content tended to increase. The increase in exchangeable K is probably due to recent changes in harvesting method of rice. Unlike N and P, a major part of K does not translocate to ear and remains in the straw. After widespread of combine harvest, straw is cut and returned to the paddy field soil. The slight increase in available N content may be due to application of rice straw and animal wastes. The increase in available P is due to fixation of applied P in the soil although the rate of the increase is lower than those in upland and orchard soils. Concentration of Si in the irrigation water appears declining.

3. Increase in available N of soil for rice after soybean cultivation

It is well-known that available N content increases after soybean cultivation although the reason is not yet fully understood. We determined the available N content of the shifted soybean field soil every month using an incubation method and it was turned out that the available N content increased during August. The increase in the available N content in August was confirmed also with rice plant cultivation.

4. Mobility of P and K applied to the row side of transplanted rice seedlings

Machinery transplanting of rice seedling is now common in Japan and fertilizers (P, K and N) are automatically applied to the row side of the rice seedling using nozzles equipped with the rice transplanter. We determined distribution of available P (modified Bray 2 P method) and exchangeable K content of the soils around the site of fertilizer application. High available P content was found at the site of the fertilizers application after rice harvest whereas effect of K application was not detected in the vertical distribution of the exchangeable K content in the plow layer soil.

5. S deficiency symptom of rice observed in the middle course plane of the Nihasama river

As sulfur is generally supplied as a solute in irrigation water and an accessory ingredient of N or P fertilizers, S deficiency was little observed so far. However, S deficiency symptom was observed in the middle course plane of the Nihasama river, Miyagi prefecture. With an enough application of $CaSO_4 \cdot 2H_2O$, the symptom was ameliorated almost completely.

6. Effect of removing Cd partially from a contaminated soil by $CaCl_2$ washing and its persistence

Cd-contaminated soil was washed with 0.1 M $CaCl_2$ at pH 4. The content of Cd extractable in 0.1 M HCl reduced to one third. After removal of excessive $CaCl_2$, pH was adjusted to about 7 using dolomite powder and paddy rice was cultivated for 3 years using pots. Although removal of Cd is not complete, Cd content of the polished rice was kept below 0.2 mg kg^{-1} for at least 3 years whereas it was more than 0.5 mg kg^{-1} when grown in the contaminated soil without washing.