

Relationship between mineral composition or soil texture and available silicon in alluvial paddy soils on the Shounai Plain, Japan

Abstract

To evaluate the relationship between the amount of available Silicon (Si) in paddy soils and their mineral properties on the Shounai Plain in Japan, which is formed from several parent materials, we evaluated the amount of available Si, the particle size distribution, the oxide composition of crystalline minerals and the amount of oxalate-extractable Si (Sio), iron (Feo) and aluminum (Alo) in the soil. The amount of available Si in the soil and the oxide content of the crystalline minerals differed among four soil groups that were distinguished by their clay mineral composition. There was no difference in the particle size distribution among the soil groups. The amount of available Si was positively related to the SiO₂/Al₂O₃ ratio of clay, the CaO concentration of silt and fine sand, and the amounts of Sio, Feo and Alo in the soil. The amount of available Si in the soils was negative correlated with the Na₂O and K₂O concentrations of silt, the K₂O concentration of fine sand, and the coarse sand content. These results suggest that the amount of available Si in soils is affected by the weathering resistivity of their minerals and that the particle size distribution and mineral composition are related to the available Si of the soils. Mineralogical properties, including the particle size distribution and mineral composition such as the SiO₂/Al₂O₃ ratio × clay fraction content and the amounts of CaO and MgO in silt-sized particles, were positively correlated with the amount of available Si in the soil, but these correlations were not found for fine sand-sized particles. The Sio, Feo and SiO₂/Al₂O₃ ratio × clay fraction contents contributed approximately 50% to the amount of available Si in the soils. The amount of available Si in the soil was divided into two groups according to the location of the paddy field. The amount of soil-available Si in the alluvial plain was affected by the geology upstream through the mineral composition.

Key words: alluvial paddy soil, available silicon, crystalline mineral, particle size distribution, sesquioxides.