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学 位 論 文 要 旨
SUMMARY OF DOCTORAL THESIS

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題目 **Title:** The Biological Nitrogen Absorbed by Rice Plant in a Waste-amended Soil

土壌改良資材を施用した土壌において水稲に吸収される微生物起源窒素

Agricultural wastes constitute a major environmental problem upon disposal. One of the measures advocated for relieving such a problem it is to recycle animal manures and other organic products as fertilizers and soil amendments. A series of investigations was therefore carried out to evaluate and recycle some of these wastes as soil amendments. in the first investigation, the effect of soil amendments and bacterial nitrogen sources on the bacterial nitrogen absorbed by rice plant and proportion of plant nitrogen derived from free living bacteria ($P_{bact.N}$) under two types of soils {Gley Fluvic lowland soil (GFS) and Haplic Regosols soil (HRS)}with different fertility level. Maximizing nitrogen content in rice plant through using of the free living nitrogen-fixing microbes and endophytic bacteria not only entails maximizing biological nitrogen fixation and the nitrogen decayed from the bacteria itself but also requires that recovery of nitrogen is optimized. With the aim of evaluating the potential use of native microorganisms of paddy soil as natural biofertilizer for rice plant, bacterial nitrogen in paddy soil has been the subject of some studies. A series of investigations were therefore carried out to improve the rice growth and study the nitrogen dynamics with three bacterial nitrogen sources under two soils. In this study, the potential use of these microorganisms as a natural bio-fertilizer under GFS and HRS were evaluated. Four nitrogen treatments were applied: (i) sludge derived from municipal solid waste manures, (ii) rice straw composted with animal manure, (iii) a basal dose of N-P_2O_5-K_2O (denoted as NPK 14-14-14) applied at the rate of 20g per pot shortly after thinning, and (iv) control (no- nitrogen application). Three treatments of biological nitrogen sources were also applied as follows; (i)uninoculated (sterilized) pot(ii) blue green algae (BGA) (iii) bacteria, and (iv) BGA+bacteria.

Knowledge to increase the total bacterial nitrogen (Atmospheric nitrogen fixed + the nitrogen decayed from bacteria biomass) as a bulk of free living bacteria in acidic paddy soil is limited. The potential use of these microorganisms as a natural bio-nitrogen source under two soils (GFS and HRS) was evaluated in this study. The optimum soil pH and NH_4 under sludge manure treatment had a significant effect on the potential of bacterial nitrogen sources under GFS lowland and HRS. Pots amended with straw manure exhibited a lower bacterial nitrogen forming ability than those amended with sludge under both soils. Nitrogen mineralization (NH_4) rate was significantly affected by both soil amendments and bacterial nitrogen sources. The ammonium concentration accelerated more with straw manure application at tillering stage, which was depressing the utilization of bacterial

nitrogen sources in the rice culture. BGA+bacteria treatment showed higher bacterial nitrogen rate and $P_{bact.N}$ than cultures inoculated separately with bacteria especially under HRS. A positive correlation was found between the $P_{bact.N}$ and the amount of nitrogen in rice shoot under both soils. The results showed that free living bacteria in acid soils were governed not only by the soil nitrogen content but also by the type of soil amendment. The addition of sludge to BGA+bacteria inoculated soil increased total bacterial nitrogen and consequently could be beneficial to rice production.

In the Second investigation, the ability of soil amendments and bacterial nitrogen sources to increase rice grain yield and enhance the availability of soil N, P and K, in GFS and their uptake by rice plant were evaluated. The same three soil amendments above were applied with three bacterial nitrogen sources. The plant N and K uptake increased significantly with sludge and BGA+bacteria inoculation. The availability of P and K in the soil was not affected by bacterial nitrogen sources. The yield components increased significantly with sludge amended pots, but decreased thereafter, an exception was the number of panicles, with straw manure. These characters were also significantly affected by inoculation with bacterial nitrogen sources except 100 grain weight and filled grain percentage. The combination of sludge manure and BGA+bacteria improved the rice yield components and consequently grain yield (138 g pot^{-1}) compared with sludge treatment only (132 g pot^{-1}).

However continues application of sludge manure to acid soil could be favored without ignoring the heavy metals effect in grain quality. Under acidic paddy soil, not all soil amendments can promote native soil free living bacteria, increase the availability of soil NPK pool as well as enhance rice production. Free living bacteria in addition to providing nitrogen to paddy soil, increases the P and K uptakes, which might be the reason for higher yield by 15 % due to application of biofertilizer associated with sludge amended soil.