

学 位 論 文 要 旨

氏 名

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題 目

Application of photosynthetic bacteria: biocontrol of pathogenic root rot fungus
and other applications

(光合成細菌の応用に関する研究)

In this study, purple non-sulfur photosynthetic bacteria (PNSB), were isolated and its application in wastewater treatment and biological control of pathogenic root rot fungus (RRF) were investigated. Samples from swine sewage wastewater and lake sediment were applied to isolate PNSB. First, the biological and biochemical characterization of the isolates were investigated. Then, one typical PNSB isolate was applied to treat with swine wastewater, a standard strain, *Rhodospseudomonas palustris* NBRC-100419T was used as a comparison. Furthermore, antagonistic effects of PNSB and other isolated microorganisms on pathogenic RRF was investigated. Finally, the effects of the different microorganisms to the rhizosphere bacterial community shifts were determined by PCR-denaturing gradient gel electrophoresis (DGGE).

PNSB were isolated from swine sewage wastewater and lake sediment. Phylogenetic analysis revealed that PSB isolates were most closely related to *Rhodospseudomonas* species. The results of pigments analyses showed the isolates contain bacteriochlorophyll a, bacteriopheophytin a and carotenoid-like substances. Growth of the isolates under photoautotrophic, photosynthesis heterotrophic, and heterotrophic condition was investigated. Compared with photoautotrophic condition, better growth was observed in all strains under photosynthesis heterotrophic, and heterotrophic condition. Furthermore, compared with NBRC strain, PSB isolates showed better growth in all conditions. Five isolates showed solid-liquid separation ability.

One typical strain, PSB Strain A was selected for the following biological and biochemical study. The effectiveness of utilizing carbon sources was studied by applying variety of organic acid components. The potential of PSB Strain A to treat with wastewater was also examined. The removal effects of volatile fatty acids (VFAs), TOC and ammonia nitrogen by applying PSB Strain A and NBRC Strain in swine sewage wastewater were investigated. Compared with standard strain, PSB Strain A showed almost the same removal effects of VFAs and TOC. The results suggest a possibility to treat with swine sewage wastewater with the isolated strain.

A pathogenic RRF was isolated from a sweet potato farm. Antifungal bacteria (AB) were also isolated from the infected farm soil by a plate-spreading method and 7 strains were preliminary chosen as antagonistic candidates. An antagonistic test by using the mycelial disk placement method revealed that one AB strain inhibited the RRF growth alone, which was identified as *Bacillus polyfermenticus* based on phylogeny of 16S ribosomal RNA genes, while two AB strains, identified as *Bacillus aerophilus* need coexistence of PSB Strain A, identified as a purple non-sulfur photosynthetic bacterium, *Rhodospseudomonas faecalis*.

Effect of addition of isolated microorganisms (PSB Strain A, AUT3, AUT9) to the rhizosphere microbial communities shift was determined by PCR-denaturing gradient gel electrophoresis (DGGE) of 16S ribosomal RNA genes (16S rDNA) as well as traditional bacterial counts. All the microcosms showed decreased bacterial counts at Day 7. In PCR-DGGE analysis, bacterial community shifts in all microcosms from Day 0 to Day 7 were minimal. PSB and AUT9 had better survival, which were detected at Day 7, while AUT8 was only detected at Day 0. In the microcosms amended with PSB, a distinct band was detected. The phylogenetic analysis showed the band related to *Catenulispora yoronensis*, one species of actinobacteria.