京都大学	博士（工　学）	氏名	PRAPAMON SEEPRASERT
論文題目	The Influence of Soil Fungi on the Sorption of Cesium and Strontium within Organic Layer of Soil（土壌有機層中でのセシウムおよびストロンチウムの収着に及ぼす土壌菌類の影響）		

（論文内容の要旨）

This thesis presents the influence of soil fungi on the sorption of Cesium and Strontium within organic layer of soil, and consists of eight chapters.

Chapter 1: Introduction describes the concept of this research. The research background, topic development and hypothesis are elucidated. In addition, the research objective and scope are provided to clearly understand the state of argument.

Chapter 2: Literature review described the current state of research in the defined area and considers whether there are any closely related areas. In addition, this chapter identifies the gaps in the literature and discusses what is required to attend to those particular research gaps. This chapter outlines the general information followed by the chemical characteristics of Cs and Sr, the fate and transport of both elements in the soil system, and the interaction between the elements and soil microorganisms.

Chapter 3: This chapter elucidates experimental and data interpretation approaches for the isolation and identification of soil fungi. This chapter aims to determine the microorganism community in forest soil and to specify the microorganisms used in this research. Highly sensitive and specific molecular techniques were applied, such as the sequence variability of the internal transcribed spacer (ITS) region of fungi, which is a potentially useful method for rapid and accurate diagnosis of fungal isolation. In the present study, representative fungi were selected and assigned to three genera: *Fusarium*, *Trichoderma*, and *Aspergillus*. C1 shared 98% similarity with the genus *Trichoderma*, D1 shared 97% similarity with the genus *Aspergillus*, and the others shared 78%–91% similarity with the genus *Fusarium*.

Chapter 4: In the previous chapter, the representative soil fungi are described. They are significantly affected when the ambience of their environment changes. Therefore, they should be able to sense and respond to these changes to survive. Beyond some limits, the existence of fungi tends to decrease as a result of inhibition to growth because of toxicity caused by the occurrence of Cs and Sr in the environment. In this chapter, the growth kinetics of the soil fungi affected by two elements Cs and Sr are investigated using statistical evaluation of mathematical models to describe the fungal growth. The inhibitory effects of Cs and Sr on the growth of soil fungi are studied. The study further indicated that Cs exerted significant direct inhibition on the fungi, with an EC_{50} of 80 mM—160 mM, whereas Sr exerted less significant direct inhibition on the fungi, with an EC_{50} of 171 mM—222 mM. However, the natural levels of Cs and Sr in soil were lower than EC_{50} values 600 to 650 times.

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Chapter 5: Previous investigators have studied various fungal species to define responsive signaling to the presence of Cs and Sr in the environment. The sorption process mostly influences the fate in the environment of both Cs and Sr. Aims of this chapter are to apply a kinetic model of nonlinear regression for the main purpose of explaining the rate of the sorption process. The kinetic expressions are commonly used. In this chapter, both stable and radioactive isotopes of Cs and Sr are investigated, with experiments performed under various conditions. Therefore, the sorption equilibrium was rapidly reached within 60 min, and no further sorption was observed, even when each of the solutions with the different elements was mixed for a further 2 h. On the other hand, the experimental data for the radioactive isotopes (^{134}Cs and ^{85}Sr) were better described by the pseudo second-order model, as indicated by the values of the corresponding correlation coefficients.

Chapter 6: This chapter intends to clearly understand how a soil fungi accumulates Cs and Sr as both stable and radioactive isotopes. The Langmuir and Freundlich isotherms are used to describe the sorption characteristics and to quantify the sorption capacity. Batch experiments described in this chapter were performed under various conditions. The results showed that the monolayer sorption capacity for Cs ions was as follows: *Aspergillus* sp. >*Fusarium* sp. >*Trichoderma* sp. and *Fusarium* sp. >*Trichoderma* sp. > *Aspergillus* sp.

Chapter 7: This chapter intends to determine the contribution of microbial activity to the sorption of Cs and Sr in the organic material, which is necessary to compare the non-sterile systems with sterile systems. This chapter highlights the need to develop a new experimental approach to characterize the full potential of soil fungi to accumulate Cs and Sr in the soils. The results for the system inoculated with soil solution to provide the biotic treatment show the percentage of Cs extracted by the mixed cation solution was lower than abiotic system, 15%, 18%, 13%, and 18% of the initial Cs concentration for localities IWT1–IWT4. In the system inoculated with single fungal cultures, approximately 18%–39% of the initial Cs was extracted compared to 28%–50% of the initial Cs extracted from the abiotic system. The treatment inoculated with *Aspergillus* sp. showed a slightly higher ability to retain Cs than those inoculated with *Fusarium* sp. and *Trichoderma* sp. correspond with the result from the previous chapter which shows *Aspergillus* sp. has more ability to adsorb Cs than other genera. However, for Sr in biotic systems only 7%–17% of the initial Sr was extracted, compared to 10%–20% of the initial Sr extracted for the abiotic system. The results for an experimental system comparing biotic and abiotic systems conclusively demonstrate that soil fungi play a role to restrict the mobility of Cs and Sr. In all experiments, the retention

of both elements was greater in biotic systems than in abiotic systems. Soil microorganisms especially the saprotrophic fungi make a contribution to influence the retention of Cs and Sr in organic systems and may account in part for the strong, irreversible binding observed in biotic systems. This finding may account for the high level of radioactive Cs and Sr retention in the in situ contaminated site, which cannot be satisfactorily accounted for by physicochemical processes.

Chapter 8: The final chapter summarizes the main finding of the dissertation and the contributions of this study. Moreover, a suggestion for future works is provided.