学　位　論　文　審　査　の　要　旨

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学　位　論　文　題　名

Characterization of arbuscular mycorrhizal fungal communities with respect to soil disturbance in a volcanic ecosystem

（土壌撹乱に着目した火山生態系におけるアーバスキュラー菌根菌群集の特徴付け）

This thesis consists of 12 figures, 4 tables, 61 references, General Introduction, two Chapters, General discussion, and Supplementary Information in a total of 99 pages with an accompanying publication.

Slopes of active volcanoes are a harsh habitat for plants; soil disturbance due to ash falling and erosion occurs frequently, and thus vegetation is generally poor, particularly near the crater (i.e. at higher elevations). Arbuscular mycorrhizal fungi play a significant role in the establishment and resilience of pioneer vegetation in harsh environments. In this study, AM fungal communities associated with *Miscanthus sinensis,* a pioneer grass species, in a volcanic slope of Mt. Tarumae was characterized with respect to soil disturbance.

1. Distribution of disturbance-tolerant AM fungi along a volcanic slope

In this Chapter, the author addressed hypothesized that the fungi that are more tolerant to soil disturbance are selected at higher elevations based on the idea that levels of disturbance are more severe at higher elevations. Paired-soil-core samples were collected from 10 individuals of *M. sinensis* grown in each of the three types of habitats grassland, gully, and slope between the vegetation limit and forest limit on a volcanic slope of Mt. Tarumae and used for trap culture with *M. sinensis* seedlings. One of the paired samples was sieved to destruct hyphal networks (disturbance treatment), while the other was not (intact treatment). After two months, DNA was extracted from the roots, and fungal rDNA

was amplified and sequenced to determine community compositions. AM fungal diversity was decreased with increasing elevation, where nested structure was observed. Compositional dissimilarity between the disturbed and intact communities was decreased with increasing elevation, suggesting that communities at higher elevations were more robust against soil disturbance. These observations suggest that AM fungi that are more tolerant to soil disturbance are more widely distributed across the ecosystem, that is, they are generalists. The wide distribution of disturbance-tolerant fungi may have significant implications for rapid resilience of vegetation after disturbance in the ecosystem.

2. Periodic disturbance as selection pressure for AM fungi

In this Chapter, the impact of periodic soil disturbance on the fungal community was evaluated in a one-year-pot experiment. Three soil-core samples containing rhizosphere soil and roots were collected from each of four *M. sinensis* plants grown in a grassland above the boarder of forest limit in Mt. Tarumae. DNA was extracted from the roots in one of the three samples. The second sample was sieved on a 2-mm mesh to destruct hyphal networks of the fungi (disturbance treatment), while the third one was not (intact treatment). *M. sinensis* was grown in these soils in a greenhouse for 12 months, during which the soils in the disturbance treatment were sieved once a month. A small part of roots was collected every two months for DNA extraction. Fungal rDNA was amplified from the DNA and sequenced. AM fungal richness was consistently decreased during the culture period in both treatments. Community compositions diverged and converged periodically between the disturbance and intact treatment, in which different taxa responded differently. For example, one of *Rhizophagus* sp. disappeared after several months in both treatments, but reappeared only in the intact treatment in later stages. Whereas the most abundant taxon that belongs to the genus *Acaulospora* was unresponsive to disturbance, gradually increased and dominated in both treatments. These observations suggest that not only soil disturbance but also soil stability act as selection pressure for the fungi. The results indicated that community succession (i.e. periodic divergence and convergence of the composition) occurred within a year, and the impact of disturbance on the community is larger during the time of community divergence.

Therefore, we acknowledge that the author is qualified to be granted the Degree of Doctor of Philosophy in Agriculture from Hokkaido University.