学位論文内容の要旨

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学位論文題名

Significance of life-history strategies of arbuscular mycorrhizal fungi in a coastal dune ecosystem

海岸砂丘生態系におけるアーバスキュラー菌根菌の生活史戦略の重要性

Soil disturbance causes serious environmental issues. Arbuscular mycorrhizal (AM) fungi form symbiotic associations with most land plants and play a significant role in the establishment of terrestrial vegetation. Soil disturbance has a serious impact on AM symbiosis by destructing extraradical hyphal networks in the soil, which inhibits nutrient exchange between the symbionts. AM fungi that regenerate rapidly after disturbance may play a significant role in vegetation resilience. Vegetation in Ishikari coastal sand dunes show typical zonal distribution between the seaward and landward slopes along a disturbance gradient created by tides and wind. In this study, Ishikari sand dunes were employed as a model ecosystem, and the significance of life-history strategies of AM fungi in the resilience of the fungi and the native C_4 grass were assessed.

1. Characterization of life-history strategies of AM fungi along a disturbance gradient

Root-soil samples were collected from the seaward and landward slopes, and the native grass *Miscanthus sinensis* (donor plants) were grown in the soil samples. From a half of the plants, disturbance-tolerant fungi that regenerate from spores and extraradical hyphae (soil propagule-mediated regenerators, SP) and those that regenerate from the colonized roots (root-direct regenerators, RD) were trapped separately with new seedlings (assessment plants). The other half of the donor plants were further grown without destruction together with assessment plants, during which the fungi trapped by the plants were categorized as disturbance-sensitive slow regenerators (SL). DNA was extracted from the roots for molecular identification. The RD strategy was prevalent in all the fungi in the seaward samples. In the landward samples diverse taxa with diverse strategies occurred, and among them, Gigasporaceae fungi showed a distinct preference for the SP

strategy. These observations suggest that not only SP but also RD strategies play a key role in the rapid regeneration of the fungi after disturbance.

2. Selection of AM fungal partners by juvenile C_4 grass under low-light conditions

Cost of AM association affects the establishment success of juvenile plants, particularly under the canopy of adult plants that restricts their photosynthesis. AM fungi have diverse life-history strategies, including the SP strategy and those that colonize mainly via hyphal networks (network competitors, NC). Under low-light conditions, juvenile plants may associate preferentially with NC fungi of which carbon cost would partially be covered by the adult host. Intact root-soil-core samples (NC inocula) and root-zone-soil samples (sieved before inoculation, SP inocula) were collected from the landward slopes, and *M. sinensis* was grown in the presence of both inocula (NC+SP, main experiment) with or without shading and also grown either with the NC or SP inocula to assign the strategies of the fungi occurred in the main experiment. DNA was extracted from the roots for molecular identification. Shading increased AM fungal diversity, in particular, genus richness of SP fungi, but not that of NC fungi, suggesting that cost of SP fungi is lower than that of NC fungi.

These findings provide a new insight into the life-history strategies of AM fungi in the ecosystems where soil disturbance occurs frequently and will contribute to the practical application of AM fungi for the restoration of post-disturbed ecosystems.