【Grant-in-Aid for Scientific Research (S)】

Broad Section G

Title of Project： **The prototype, and evolution, of the system which adapt plant growth to its environment through the signaling molecule, strigolactone.**

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Keyword：Plant hormone, Strigolactone, AM symbiosis, Rhizosphere signaling molecule

【Purpose and Background of the Research】

Strigolactones (SLs), carotenoid-derived signaling molecules, are unique. They play dual roles, as a class of phytohormones, regulating a wide spectrum of plant growth and developmental processes, and as allelochemicals, where they are secreted to the rhizosphere and induce symbiosis with soil arbuscular mycorrhizal (AM) fungi. This AM symbiosis can be traced back 450 million years. It is widely accepted that symbiosis with AM fungi was crucial for early plant terrestrial colonization (Fig. 1). Despite the importance of SLs in the evolution of land plants, their function outside seed plants is largely unknown.

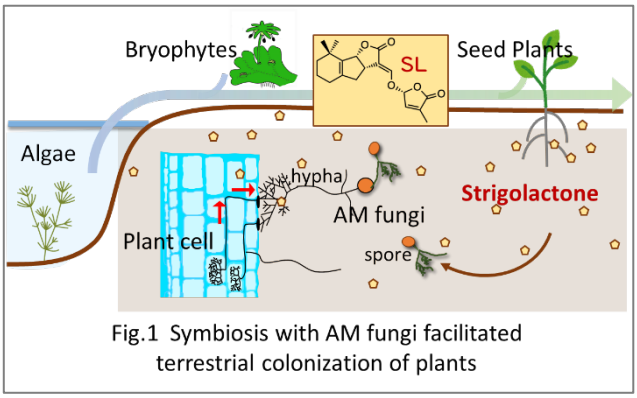

Fig.1 Symbiosis with AM fungi facilitated terrestrial colonization of plants

【Research Methods】

Our research methods include molecular genetics, imaging technologies using molecular markers and organic chemistry. Bryophytic plants are our main research material. Most liverwort species, one of the three groups of bryophytes, form a symbiotic interaction with AM fungi, while *Marchanthia polymorpha*, the model bryophyte species used in molecular genetic studies, does not. Therefore, we mainly use *M. paleacea*, which forms an AM symbiotic relationship, as well as *M. polymorpha*, and compare these two species (Fig. 2). We analyze the function of SLs in *M. paleacea* in detail and test the hypothesis that the function of the ancestral SL is as a rhizosphere-signaling chemical. In addition, we will verify that the novel SL we identified (Bryosimbiol) is an ancestral type of SL. We will reveal where and when it is synthesized, and secreted, in plants. We will also isolate the transporter of Bryosimbiol and clarify the mechanisms by which SL is externally secreted. The role of the KL signaling pathway, the original pathway from which the signaling pathway of SL as a plant hormone evolved, will be elucidated.

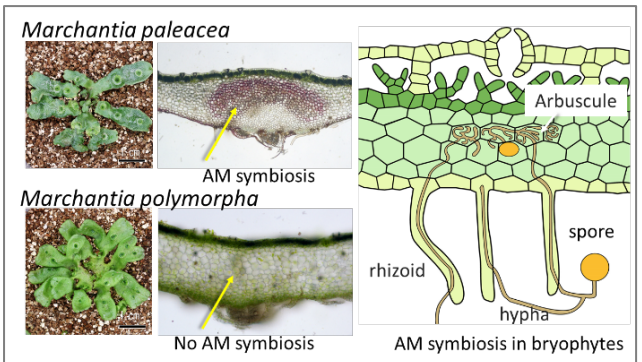

Fig. 2. AM symbiosis occurs in *M. paleacea*

【Expected Research Achievements and Scientific Significance】

This study is expected to reveal: **1.** the prototype, and evolution, of compound-mediated communication between organisms, **2.** mechanisms in the evolution of phytohormones, **3.** the origins of phytohormone synthesis and signal transduction, and the basis for diversification, and **4.** the prototype of the system which balance nutrient absorption and plant growth.

This study will provide a breakthrough in our knowledge of the regulation of nutrient uptake and growth through symbiosis with AM fungi, which enabled plants to flourish on land.

【Publications Relevant to the Project】

- Kameoka H, **Kyozuka J** (2018) Spatial regulation of strigolactone function. J. Exp. Bot. 69:2255
- Umehara M, Hanada A, Yoshida S, Akiyama K, Arite T, Takeda-Kamiya N, Magome H, Kamiya Y, Shirasu K, Yoneyama K, **Kyozuka J**, Yamaguchi S. (2008) Inhibition of shoot branching by new terpenoid plant hormones. ***Nature*** 455: 195

【Term of Project】 FY2020-2024

【Budget Allocation】 151,400 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.lifesci.tohoku.ac.jp/PlantDev/