Dynamics and function of secondary metabolites in rhizosphere

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Rhizosphere is a small area around the root defined as " the soil influenced by plant roots " and is important for plant growth and crop production. Researches on rhizosphere microbiota have been active worldwide. However, the dynamicss and functions of low-molecular-weight compounds that play key roles in the interaction between plants and rhizosphere microorganisms, especially secondary metabolites (specialized metabolites), have not been elucidated thus far. It is essential to understand the dynamics and functions of rhizosphere metabolites at the molecular level in order to utilize the functions of the rhizosphere microbiota for sustainable agriculture. We study the dynamics and functions of secondary metabolites both in the laboratory and in the field using soybean as a model plant.

Daidzein and genistein are major secondary metabolites secreted from soybean roots into the soil. Biochemical transport analysis using cell membrane vesicles revealed that the secretion of genistein from soybean roots is mediated by ATP-Binding Cassette (ABC) type transporters. Isoflavone secretion from soybean root showed the developmental regulations, i.e. daidzein secretion is higher during the vegetative stages than reproductive stages [3]. We attempted to model the dynamics of daidzein in the rhizosphere. We adopted a fluid model that has been used for the analysis of water and ion daynamics. Simulation of the movement of daidzein in the rhizosphere showed that the distribution of daidzein was limited to a small area from the root. To validate the results of simulation, we used soybean grown in a rhizobox, and found that the movement of daidzein was observed only within 2 mm from the root [1]. It was reported that daidzein functions as a signal for nodulation. We showed rhizosphere isoflavone secretion occur throughout the growth period and daidzein concentrations in the rhizosphere were maintained until late growth. We speculated that daidzein has functions other than nodulation signal in soybean rhizosphere. It was shown that the microbiota of daidzein-treated soil became closer to the microbiota of soybean rhizosphere [1].

We employed metabolome analysis of rhizosphere soil. From the analysis of five soil samples from different field, okaramine, which is an insecticidal compound biosynthesized by *Penicillium simplicissimum* cultured in okara medium, in the rhizosphere of hairy vetch. Okaramine was also detected in the rhizosphere of soybeans cultivated after hairy vetch, suggesting that the biosynthetic ability of insecticidal compound is transferred from the hairy vetch rhizosphere to the soybean rhizosphere as a "heritage" [2].

References

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