

Realization of a low carbon society through game changing technologies

Reconstruction of symbiotic nitrogen fixation

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Summary :

Nitrogen sources are key nutrients for plant growth. Some plant species, well-known in Legumes (Fabaceae), can gain the nitrogen sources by establishing a nitrogen-fixing nodule symbiosis with nitrogen-fixing bacteria. Plant species that possess the nitrogen-fixing nodule symbiosis trait are distributed in the taxonomic orders Fabales, Rosales, Cucurbitales, and Fagales, collectively known as the nitrogen-fixing clade. Even in the nitrogen-fixing clade, non-nodulating species are identified in many lineages. Recent comparative genome analysis supported “single gain-parallel loss” idea, *i.e.* nodulation originated ~100 Mya in a common ancestor of the nitrogen-fixing clade followed by multiple parallel losses of this trait.

Inspired by this evolutionary view, we are taking the “reconstruction” approach to transfer the nitrogen-fixing nodulation trait toward non-nodulating species in the nitrogen-fixing clade by surveying a core set of symbiosis genes that have been lost during evolution, and re-introducing functional set of these core genes. By engineering biological nitrogen fixation in crops belonging to nitrogen-fixing clade, we aim to contribute to the reduction of CO₂ emission through reduction of chemical fertilizer usage and establishment of sustainable farming.

