Molecular-genetic study of hormogonia differentiation of filamentous cyanobacteria

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Cyanobacteria form a morphologically diversified group. Particularly in filamentous cyanobacteria of subgroups IV and V (former orders Nostocales and Stigonematales), vegetative cells can mature in four developmental directions (vegetative cells, heterocysts, akinetes, and hormogonia), in response to the environmental conditions. Hormogonia are transiently differentiated small-celled filaments lacking heterocysts and are often capable of gliding and/or buoyant motility. The function of hormogonia is to provide immotile strains with a means of dispersal in response to environmental triggers. They also play an important role as infective units in the establishment of symbiotic association with various plant hosts. In the hormogonia formation, cell division occurs rapidly and synchronously in all cells without cell growth and DNA replication.

To identify the genes involved in hormogonia differentiation, transposon mutants of Nostoc punctiforme ATCC 29133 were screened. Six clones were isolated as mutants that do not or seldom respond to plant exudates. The transposon and flanking DNAs were recovered, cloned and sequenced. Predicted functions of the identified genes are involved in membrane protein, sugar transport, and signaling pathways. The isolated mutants produced hormogonia and established symbiotic association not at all or with much less frequency than wild type, when they were co-cultured with a host plant Blasia pusilla. Most mutants showed similar growth rate to wild type, while a mutant of a two component regulatory pathway did not grow at all in a medium without combined nitrogen.

Continuing study of hormogonia formation will provide us a clue in an understanding not only of the cyanobacterial morphological evolution but also of mechanisms that control cyanobacteria-plant symbioses.