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Activities of the Core

Jan. 2, 2021	Mr. Matsumura's comment was published in the Chugoku Shimbun.
Jan. 13, 2022	The98th Hiroshima University Biomass Evening Seminar (co-organized)
Jan. 15, 2022	Keynote lecture by Prof. Nishida at "Webinar Organized by Mechanical Engineering ITATS : Recent Research to Achieve Net-Zero Emission by 2050 for Automotive Sector" "Characteristics of Diesel Spray Flame of Multi-Hole Injector with Micro-Hole under Ultra-High Injection Pressure -Toward Blue Flame Diesel Combustion- " held online.
Jan. 19-20, 2022	Prof. Matsumura gave a keynote speech at the Biomass Science Conference.
Jan. 24, 2022	The67th HU-ACE Steering Committee Meeting.
Jan. 26, 2022	The68th HU-ACE General Meeting.
Jan. 31, 2022	The96th HU-ACE Seminar was held.

We held the HU-ACE Seminar in online.

On January 31st 2022, we held the HU-ACE Seminar in online. The speaker was Dr. Masakatsu Sasada, the chairman of Geo-Heat Promotion Association of Japan. Totally 33 people attended. In recent years, ground source heat pumps (GSHPs) have attracted attention as an energy-saving measure for air-conditioning applications. The association has conducted a wide range of activities to spread the GSHPs in Japan for more than 20 years. In the seminar, valuable information on basic classification, recent trends, case studies in zero energy buildings (ZEBs), initial costs, and subsidy information were provided. Activities aiming at inclusive utilization of renewable thermal energy, including biomass and solar heat, seem to be interesting toward a decarbonized future. After the lecture, we had a lively question and answer session. Dr. Sasada suggested a several solutions against the cost problem such as effective utilization of subsidies, application to buildings with high heat demands and improvement of the operating rate of excavators, while the initial cost of excavation was still high and few drastic solutions have been provided yet.

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Research Topics No. 28

A wide variety of chemotaxis sensors in bacteria - Tools for efficient biological interaction?-

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Research fields: Bioengineering, Environmental Biotechnology, Microbiology
Keywords: Chemotaxis, Biological interaction, Ecological engineering

Abstract

Background

Bacteria can sense concentration gradients surrounding cells and move to their favorite environments. This function is called “chemotaxis”. Although bacterial cells are quite small (several microns), their genome data reveal that they have dozens of chemotaxis sensors. Most of sensors sense chemicals that can be utilized as growth substrates. But it has been found that several sensors sense chemicals that are not utilized for growth. Bacteria do not live alone in environments, but they live with other organisms (called biological interaction). It is thought that chemical sensing functions are used for seeking and moving to their partners (hosts of symbiosis, parasitism, and infection, etc.) to efficiently establish biological interaction.

Methods

Ralstonia solanacearum is a plant pathogen causing bacterial wilt in many plant species. It has twenty-two chemotaxis sensors. Some of the sensors sense growth substrates such as amino acids and organic acids. We found some sensors sensing chemicals that are not utilized by this bacterium, such as boric acid and formic acid. Genome data analysis revealed that many bacterial species have chemotaxis sensors homologous to a boric acid sensor in *R. solanacearum*. Interestingly, all of them are plant pathogens. Boric acid is a ingredient essential to higher plants. Therefore, we speculate that plant pathogens sense boric acid as a surrogate of plants. If the speculation is correct, this is a finding of the novel infection strategy of plant pathogens. In this study, we investigated involvement of a boric acid sensor in invasion into tobacco leaves by plant pathogen *Pseudomonas syringae* causing tobacco wild fire disease. We compared leaf invasion rate by the wild type strain, its mutant deficient of boric acid sensor gene, and the mutant harboring the wild-type boric acid sensor gene.

Results

P. syringae also has a chemotaxis sensor sensing boric acid (McpB). The wild type *P. syringae* (WT), a mutant deficient of boric sensor gene (ΔmcpB), and the mutant harboring the normal boric acid sensor gene (ΔmcpB+mcpB) were subjected to leaf invasion assays using punctured tobacco leaves. Disruption of boric acid sensor gene (ΔmcpB) was resulted in decreased invasion rate. The introduction of the normal boric acid sensor gene restored the invasion rate of ΔmcpB strain (ΔmcpB+mcpB). In ΔmcpM+mcpB strain, boric acid sensor was strongly expressed, causing higher invasion rate than did in the wild type strain. This result demonstrates that boric acid sensing is involved in efficient infection (leaf invasion in this case) in *P. syringae.*

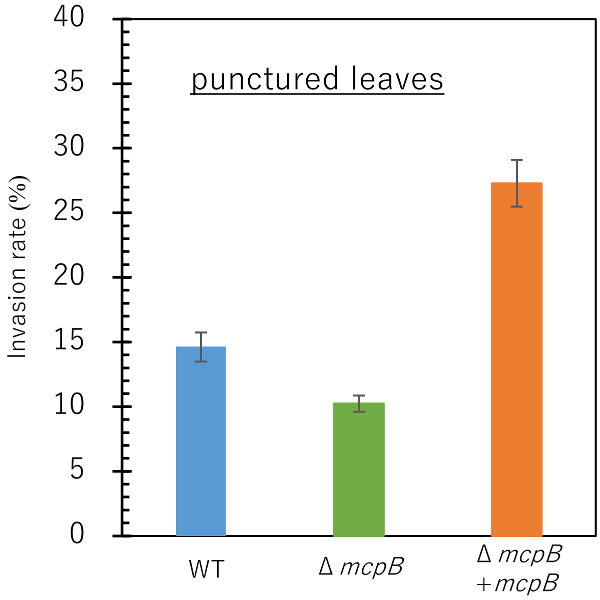

Fig. Tobacco leaf infection analysis. *Pseudomonas syringae* wild type (WT), boric acid chemotaxis sensor gene mutant (ΔmcpB), and ΔmcpB strain complemented by wild type *mcpB* gene (ΔmcpB+mcpB)

References

Hida, A., et al. Identification of boric acid as a novel chemoattractant and elucidation of its chemoreceptor in *Ralstonia pseudosolanacearum*. Sci. Rep. 7:8609 (2017).