

Selected themes for JIRCAS Fellowship Program FY2026

Theme 1: BNI-Release Mechanisms in Maize – Analyzing the role of plasma membrane H⁺-ATPase activity in genetic differences for BNI-capacity in maize

Toward the development of BNI-enabled maize, research has been conducted using maize lines with contrasting BNI capacities: the high-BNI line CML-133 and the low-BNI line CML-484. A total of 164 doubled haploid (DH) lines have been developed from these parental lines. These parental lines differ in rhizosphere nitrogen dynamics and growth responses, and the release of BNI compound is enhanced primarily under NH₄⁺ conditions. We hypothesize that the activation of plasma membrane H⁺-ATPase plays a key role in this release mechanism and aims to elucidate the functional relationship between H⁺-ATPase activity and BNI compound release.

This research will provide fundamental knowledge for the development of BNI-enabled maize. The JIRCAS Fellow is expected to contribute to ongoing BNI research activities and to the evaluation of the DH population being conducted by the host researcher. Therefore, we propose to conduct this research with the active participation of the invited researcher.

Host Scientist: Guntur Venkata Subbarao

Location: Tsukuba, Japan

Theme 2: Development of Methanogenic Microbial Consortia Adapted to Microbial Saccharification Conditions and Stable Cultivation Technology

This project aims to develop an integrated saccharification-methane fermentation biogas platform by combining microbial saccharification with methane fermentation. As part of this project, we are screening methanogens that can function under conditions suitable for saccharifying microorganisms. This evaluation aims to identify new methanogenic microbial communities and to determine methanogenic systems that are more compatible with the saccharification process. In addition, this project investigates technologies for the immobilization and stable cultivation of methanogens, with the goal of establishing an efficient technological foundation that links the decomposition of solid biomass with methane production.

The invited fellow will conduct screening and characterization of methanogenic strains and methanogenic microbial communities derived from environmental samples. The fellow will assess their suitability for operation under saccharification conditions, evaluating interactions with saccharifying microorganisms, measure methane-production performance, investigating

immobilization and granule formation characteristics, and assessing the stability of methane production during cultivation.

Host Scientist: UKE Ayaka

Location: Tsukuba, Japan

Theme 3: Screening and Mechanistic Evaluation of Mungbean Emergence under Soil Crust Conditions

This proposed invited fellowship program focuses on identifying mungbean (*Vigna radiata*) genetic resources with superior emergence ability under soil crust conditions and elucidating the underlying physiological and genetic mechanisms involved. Soil crusting is a major constraint to stand establishment in legume cultivation in the semi-arid tropics, where heavy rainfall followed by rapid drying forms a hard surface layer that mechanically impedes seedling emergence. During this program, a core collection of 96 mungbean accessions will be screened under controlled crust conditions, with emergence rate, hypocotyl thrust, and seedling vigour evaluated alongside related seed traits, including phytic acid content, which will be quantified using a simplified assay. Accessions showing contrasting responses will be examined in detail to determine the traits governing crust penetration, and the results will be compared with parallel soybean data to assess whether these mechanisms are conserved across legume species. This fellowship is expected to generate validated screening protocols and promising germplasm for breeding varieties adapted to crust-prone soils.

Host Scientist: NAKAGAWA Andressa

Location: Tsukuba, Japan

Theme 4: Isolation of Elite Phosphate-Solubilizing Rhizosphere Microorganisms and Elucidation of Their Synergistic Interactions with Rhizobia in Tropical Cropping Systems

This proposed fellowship program focuses on the isolation and selection of elite phosphate-solubilizing microorganisms from the rhizosphere of tropical legume and cereal crops, and to evaluate their capacity to promote plant growth in combination with rhizobia. The study will assess phosphate-solubilizing activity, examine the effects of co-inoculation with rhizobia, and elucidate the molecular and physiological mechanisms underlying superior microbial

performance and plant–microbe interactions. The expected outcomes will provide fundamental knowledge for improving the functionality of microbial materials for sustainable soil fertility management. This research is closely aligned with the B6 project on African rice-based agriculture, which aims to develop sustainable technologies using beneficial microbial resources. JIRCAS provides the necessary facilities for nutrient analysis, molecular biological experiments, greenhouse trials, and growth chamber experiments, while the required budget will be secured through the B6 project.

Host Scientist: Papa Saliou Sarr

Location: Tsukuba, Japan

Theme 5: Evaluation of physiological and genetic responses of sugarcane under multi-stress conditions

Climate change is intensifying compound abiotic stresses — namely salinity, drought, and flooding—across Southeast Asia, posing a growing threat to sugarcane production in Thailand and neighboring countries. This research evaluates the growth, physiological, and genetic responses of sugarcane under combined stress conditions to develop robust evaluation indices essential for strengthening multi-stress tolerance in breeding programs. Working in collaboration with researchers from JIRCAS and the Khon Kaen Field Crops Research Center (KKFCRC), the fellow will conduct comparative assessments of sugarcane responses under single-stress and multi-stress conditions to accelerate progress in identifying tolerance mechanisms. In addition to generating scientific insights, this initiative aims to develop core human resources capable of leading regional sugarcane research networks across Southeast Asia.

Applicants should have foundational knowledge and experience in conducting cultivation trials and genetic analysis, with a background in plant physiology genetics, or a related field. Prior experience with gas exchange measurements is preferred.

Host Scientist: TAKARAGAWA Hiroo

Location: Thailand