Research activities

■Tropical Bioresources Lab.

Development of flood-adaptive rice cultivation technology

The world has witnessed a rapid increase in major flooding events. In flood-prone regions, rice must be planted during the deepwater flood phase of the rainy season in order to prevent rice crops from sustaining damage from dryness during the late stage of growth. Inevitably, this puts the rice crops at risk of flood damage during the early stage of growth

In addition to reevaluating the double-transplanting technique that has been used in the low-lying swamps along the east coast of Sumatra and the west coast of Peninsular Malaysia, we have been investigating the growth response of the locally grown rice varieties to floods to identify the traits associated with flood adaptation of rice varieties that are grown in several different regions with varying water depth levels and varying periods of deepwater flood phase. Our goal here is to ensure stable production of rice crops in flood-prone regions through the use of traditional techniques, and to improve cultivation technology that not only help mitigate the harmful effects of submergence stress but also facilitate recovery from flood damage.


First transplanting (second transplanting will be done after 20 days)

Development International Sago Palm Project for food security improvement

Agricultural production must increase by 70% globally to feed the world's population that is projected to reach 9 billion by 2050. Climate change and diminishing underground resources (including oil) also pose serious challenges to food security, and we need to focus on how we can enhance agricultural production/productivity in a sustainable way while minimizing post-harvest biomass losses. In view of this, our research group focused its attention on sago palms that grow naturally in Southeast Asian and South Pacific regions.

This palm adapts well to infertile/acid soils or brackish-water regions that are generally unsuited for crop cultivation. Furthermore, one palm can yield approximately 300 kg of starch. Sago is a staple food for local residents, and is used as an ingredient in biscuits, noodles, and other food products. Sago flour is used as bench flour for udon noodle making in Japan. As an ingredient of choice for people with food allergies, sago has recently been used in a number of cosmetics as well. With only 10% of the wild and semi-cultivated sago palm stands believed to be harvested for use today, there is much room left for further exploitation of this economic plant.

In our laboratory, we are investigating the mechanism through which sago palms adapt to saline and acidic soils. Furthermore, we are carrying out field surveys to monitor the growth of sago palms to inform our efforts to develop an effective cultivat ion management strategy that enables stable growth of sago palms.

(Hiroshi EHARA)


Measurement of physiological parameters at the pilot farm of sago palm in Southeast Sulawesi, Indonesia


Sagopalm field in Southeast Sulawesi, Indonesia

Evaluation of root adaption to soil environments with water and nutrient stress in rice

To establish stable and sustainable crop production under unfavorable soil environments is an important issue. As a trait related to crop stress tolerance, in recent years attention has been focused on root traits, which have been retrenched requiring a great deal of time and effort. The root system architecture and anatomy change in response to changing soil environments. We are undertaking research on root system structure and its physiological function for adaption to soil environmental stress such as drought and nitrogen deficiency, mainly focusing on rice. We are also investigating the methods for evaluating root traits from hydroponic conditions to soil culture conditions using root box and tubes.

(Mana KANO-NAKATA)


Root-system architecture in rice


Field experiment in Philippines


Root length measurement by image analysis

■Genetic Information for Bioresources Lab.

Genetic improvement of rice to secure stable rice production in unfavorable environments

In addition to the conventional cross breeding and mutation breeding technologies, novel breeding techniques, such as quantitative trait locus (QTL) analysis (which identifies QTLs associated with stress tolerance) and marker-assisted selection (MAS) (which can quickly and accurately identify the presence of a specific quantitative trait locus) are now available to breed improved rice varieties with a greater efficiency, thanks to the recent research advancements in the field of agricultural sciences. Novel techniques, such as next generation sequencing (NGS) (which quickly and inexpensively provides genome-wide genetic information on living organisms) and new plant breeding techniques (NBT) (new approach to genome editing) have also been developed. We are using these technologies to achieve genetic improvement of rice with the goal of securing stable rice production in unfavorable environments.

(Yoshiaki INUKAI)


Growth inhibition of rice under unfavorable environments


Research activities for development of new rice varieties with tolerance to environmental stresses

■Practical Studies in Africa Lab.

Improvement of rice productivity under environmental stress conditions in Africa

In many sub-Saharan African countries, it is fundamental to boost rice production because the increased rice consumption exceeds the growth in domestic rice production. However, rice yields in sub-Saharan Africa have remained low due to various biotic and abiotic stresses. The Laboratory of Practical Studies in Africa is making comprehensive efforts to increase and stabilize rice yield under such unfavorable environments. Our research activities include development of new varieties suitable for the local environments, evaluation of gene-expression and local adaptability of rice varieties carrying useful genes/QTL, development of cultivation technologies to maximize the potential of rice varieties, elucidation of socio-economic conditions for technology dissemination.

https://rice-africa.agr.nagoya-u.ac.jp/


Cold weather damage on rice panicles (Mwea, Kenya)


Photosynthesis measurement in a paddy field (Mwea, Kenya)

Combatting root-parasitic weed *Striga* using suicide germination stimulant in Africa

The root-parasitic weed *Striga hermonthica* has been causing huge problems on cereal production in sub-Saharan Africa. *Striga* seeds germinate in response to plant hormones called strigolactones released from the roots of host plants, and then infest the host. In the absence of host plants, *Striga* dies within 4 days after germination. Recently, our collaborators developed a *Striga*-selective suicide germination stimulant called Sphinolactone-7 (SPL7). It can induce germination of *Striga* without host plants. The Laboratory of Practical Studies in Africa is working with researchers inside and outside our university to develop a *Striga* control method using SPL7. Our research activities include verification of the effects of SPL7, evaluation of the genetic diversity of *Stiga*, and elucidation of socio-economic conditions for technology dissemination.

(Daigo MAKIHARA)


Maize infested with Striga (a plant with purple flowers) in Kenya