Japan International Research Center for Agricultural Sciences

Annual Report 2013

(April 2013-March 2014)

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CONTENTS

Annual Report JIRCAS 2013

Message from the President 2013

President
Dr. Masa Iwanaga
(FY2011-)

Food and nutrition security is an essential fabric of any sustainable human society. Unfortunately, more than 800 million people worldwide are still classified as undernourished, i.e., their daily food intake is inadequate in terms of quantity (calories) and quality (micronutrients). This human tragedy takes a high toll, mostly on women and young girls in developing countries.

Dealing with global hunger issues raises the obvious question: Can we produce enough food sustainably and at a price affordable to all? The 2012 Global Hunger Index (GHI), published jointly by the International Food Policy Research Institute and others, showed that progress in reducing the proportion of hungry people in the world has been tragically slow.

Recent events around the world-droughts, land rush (investing in foreign farmlands), and shocks in energy supplies and prices-underline the scarcity of resources we depend on to produce the world's food supply. According to a recent FAO estimate, we will have 9.6 billion people by 2050-an increase of 2.6 billion people from 2013. It is increasingly clear that sustainably feeding an ever-increasing number of people requires a much more careful and integrated approach to the use of land, water, and energy than we currently apply. It is an absolute must that we start now to produce more food using fewer resources and to use the harvest more efficiently. Demographic changes, rising incomes (and associated consumption patterns), and unstable climatic conditions, alongside persistent poverty and inadequate policies and institutions, are all placing serious pressure on the natural resource base that supports current and future societies. This presents a 'perfect storm' scenario, especially in light of the recent trends in and increased likelihood of extreme weather events.

The year 2013 was highly significant for JIRCAS because it was the middle of the 5-Year Business Plan for 2011-2016. We have started seeing verifiable evidence of successful implementation of the Projects and delivery of expected outputs under our four newly formed Programs (Fig. 1). This annual report describes how JIRCAS has carried out the major activities that have produced proud moments and highlights.

Let me recap the main points of our Program-based management and strategy:

Introducing the four Programs

The four Programs developed using the mission-based principles are as follows:

1) Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions (Environment and natural resources management)
2) Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments (Stable food production)
3) Technology development for income and livelihood improvement of the rural population in developing regions (Rural livelihood)
4) Information gathering, analysis, and dissemination of domestic and overseas data of the agricultural, forestry and fishery industries in developing regions (Information analysis)

Program-based management

We now have 17 "Projects" that are placed under "Programs" (see Fig. 1). The programs will enable us to clarify our overall goals that need to be achieved and the manner by which we attempt to accomplish our research. Especially assigned Program Directors are in charge of budget, personnel, goal achievement management, and evaluation. Programs A to C have their own so-called flagship projects, representing the most important activity in each program. Projects under each program collectively and coherently contribute to the major goal of their respective programs.

Partnership is the center of our activities

Most of our activities are carried out together with our partner institutions around the world. Effective partnership makes it possible for us to conduct joint research activities that would be of value for social impact for our target beneficiaries in developing regions. The map (Fig. 2) shows locations of our current activities based on formal institutional Memorandums of Understanding. We value such partnerships and place it as our organization's core value. In 2013, we consulted our partners for their feedback on our research activities, and we made the necessary adjustments in our planned research, accommodating our partners' suggestions and our own reflections: this was needed as a mid-course adjustment for better impact delivery. JIRCAS's operational cycle (Fig. 3) illustrates our focus towards impact-oriented research for development. Consequently, we were able to develop a clear impact pathway for the delivery of our research outputs to the respective target beneficiaries of each project.

Strive for impacts

By introducing the program-based system for output development and delivery, JIRCAS shall be able to depict more succinctly, not only to tax-payers and Japanese citizens but also to people in developing countries, what it essentially does and for whom. Promotion of more efficient and accountable research will further be feasible. Accordingly, it is important for every researcher, manager, and support staff to work together to produce well-considered outputs that will be deemed suitable, acceptable, and adaptable for users. We will keep striving to take advantage of this new structure with the undying passion of our 43-year-old "research for development" tradition, hoping to produce deliverables that will be used by our target beneficiaries.

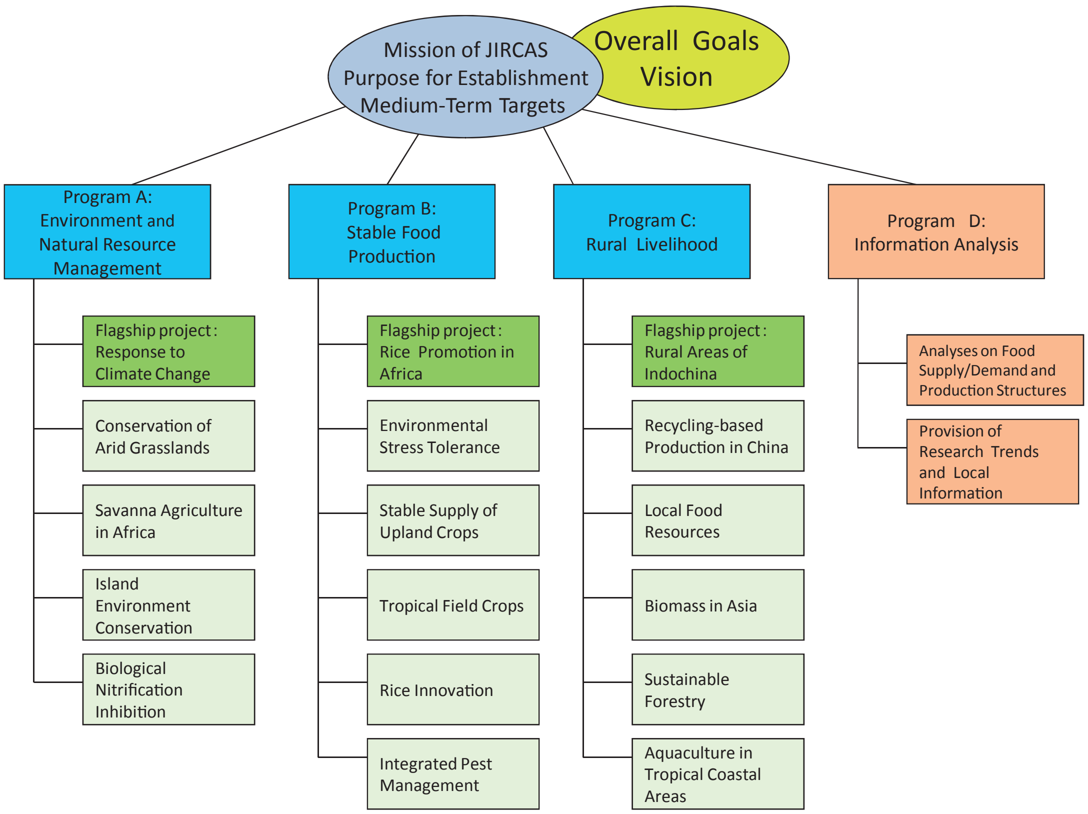

Fig. 1. Program-Project Research Framework

Fig. 2. Locations of our current activities based on 95 MOUs with partner institutions

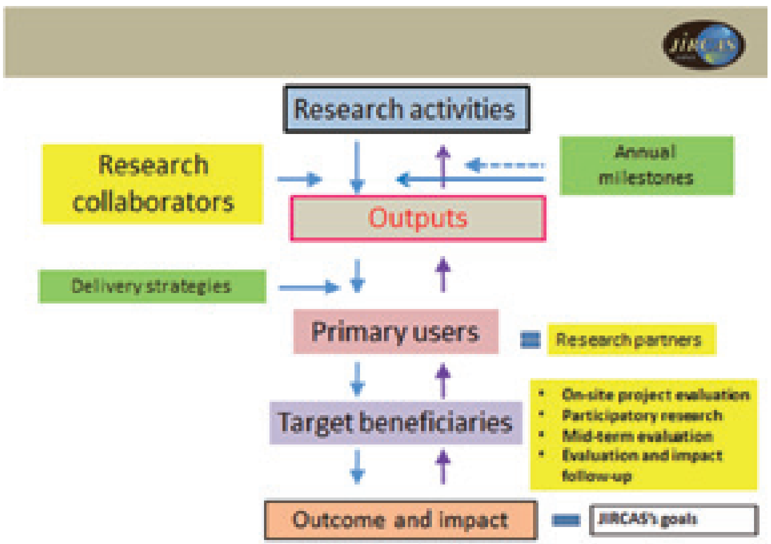

Fig. 3. Impact-oriented research for development (Operational Cycle)

HIGHLIGHTS FROM 2013

JIRCAS International Symposium 2013

JIRCAS International Symposium 2013, titled "New Direction of Sustainable Technology Development in Asia: Changing Rural Livelihood and Japanese Advantage," was held at the U Thant International Conference Hall, United Nations University, Tokyo on Nov. 20 and 21, 2013.

Because the year 2013 marked the 20th anniversary of JIRCAS, we reviewed our milestones over the past 20 years and sought the opinions of participants from related organizations on the future direction of research activities in Asia by JIRCAS and other Japanese researchers. We also tried to identify effective ways to share research results in the region and linked them with current strategies for sustainable development of Japanese agriculture and related industries.

On behalf of the symposium organizers, JIRCAS President Masa Iwanaga opened the gathering and emphasized the importance of Japanese contribution for sustainable agriculture in the region. In the opening session, a keynote speech titled "Outlook of global and regional food security, and its impact to Japan" was delivered by Mr. Hiroyuki Konuma, assistant director-general and regional representative for Asia and the Pacific, FAO.

The symposium had four thematic sessions: first, changes in food demand and corresponding technologies of Lao PDR, China and Japan were reported; second, Japanese potential for new technology demands such as rice mechanization, controlled-release fertilizers and novel food processing were presented; third, sustainable rural income sources such as new technologies on prawn co-culture, teak timber production and biomass utilization, as well as the role of biomass utilization on recycling-based management of the resources, were introduced; and fourth, the role of research networks on food and agriculture technology development was discussed.

On the basis of these presentations, the panelists discussed strengthening Japanese agriculture's competitiveness through collaboration with Asia and creating a so-called win-win situation. It was noted that agriculture, forestry and fisheries should be positioned as new growth industries in Japan, with research and development acting as the driving force. Through research and development, Japan has produced numerous cutting-edge technologies in agriculture, and these technologies are also expected to contribute to rural development and in improving rural incomes in developing regions. We will use our learned knowledge and past experiences with JIRCAS to discuss effective methods which can be beneficial for promoting agriculture, forestry and fisheries not only in developing regions but in Japan as well.

JIRCAS International Symposium 2013
U Thant International Conference Hall, United Nations University, Tokyo, Japan

Panel discussion

TICAD V Pre-event Workshop

The 5th Tokyo International Conference on African Development (TICAD V) was held in Yokohama, Japan on June 1-3, 2013. JIRCAS was an active participant and organized, among others, a pre-event workshop, titled "New Stages of Agricultural Research in Africa," at Yayoi Auditorium, the University of Tokyo on May 31. The workshop, co-organized by the Consultative Group on International Agricultural Research (CGIAR) Fund Office and supported by the Agriculture, Forestry and Fisheries Research Council Secretariat, MAFF, as well as the Graduate School of Agricultural and Life Sciences, the University of Tokyo, was officially registered as a TICAD V partner event.

Photo 1. A scene at the pre-event workshop

Photo 2. Group photo of the participants

The workshop attracted a wide range of participants (169 attendees) including researchers, policy makers, NGO members, and private sector workers as well as students interested in agricultural development in Africa, in addition to TICAD participants. Research activities on international agriculture by JIRCAS and partner organizations were introduced, and workshop participants discussed new ways of agricultural technology development that can contribute to the TICAD process.

Mr. Akihiko Uchikawa, director of International Research Division, MAFF, gave the opening remarks. Session 1 (CGIAR Research Activities in Africa) followed with Dr. Papa Seck, director general of AfricaRice, delivering a special lecture titled "Conducting rice science for impact in Africa." Speakers from the CGIAR Fund Office, International Center for Tropical Agriculture (CIAT), and the Center for International Forestry Research (CIFOR) also introduced their activities and future directions for Africa.

In Session 2, research activities conducted by JIRCAS in various African countries were presented. The topics included rice development, research on yams and cowpeas, water use technologies as well as afforestation CDM (Clean Development Mechanism) projects. A general discussion took place after the two sessions. Many questions were raised, particularly on ways to relate the research results with actual social impacts. Students, on the other hand, wanted to know the attitudes and mindsets required for persons to become engaged in international research for development.

The pre-event workshop provided a valuable opportunity for generating ideas that will further international cooperation between JIRCAS and partner institutions. This will enhance agricultural research, which in turn will be a key ingredient towards achieving social impact in Africa. However, a lot of work remains to be done to advance the research agenda for increasing food production.

Apart from the workshop, JIRCAS opened a booth at the TICAD venue in Yokohama to highlight its activities. JIRCAS also played important roles in other side events such as the workshop organized by the Coalition for African Rice Development (CARD) as well as the special lecture made by Tunisian President Mohamed Moncef Marzouki.

2013 Japan International Award for Young Agricultural Researchers

In cooperation with the Agriculture, Forestry and Fisheries Research Council (AFFRC) Secretariat, the 2013 Japan International Award for Young Agricultural Researchers was presented for the seventh consecutive year. The award recognizes and honors young foreign researchers (under 40 years of age) who are highly recommended by their institutes, and whose outstanding achievements promote research and development of agricultural, forestry, fishery and other related industries in developing regions. Each awardee is given a testimonial and a USD 5,000 cash prize.

This year's selection committee (composed of seven members) conducted a document review, and the chairman of the AFFRC determined three winners from among 28 candidates.

The 2013 commendation ceremony was held last November 20 at the U Thant International Conference Hall of the United Nations University (UNU) in Tokyo. AFFRC Chairman Eitaro Miwa welcomed the awardees and guests, and congratulatory remarks were delivered by UNU Senior Vice-Rector Kazuhiko Takeuchi, Council for Science and Technology Policy (Cabinet Office) Executive Member Yuko Harayama, and Japan International Cooperation Agency (JICA) Senior Special Adviser Fumito Mizuma. Selection Committee Chair Keiji Kainuma explained the selection process.

This year's awardees and their research achievements are as follows:

Dr. Lee Hong Tnah
Nationality: Malaysia
Institute: Forest Research Institute Malaysia
Research Achievement: Timber tracking system of an important Malaysian timber species, *Neobalanocarpus heimii* (Dipterrocarpaceae) using DNA approach

Dr. Nouhoun Belko
Nationality: Burkina Faso
Institute: Senegalese Agricultural Research Institute
Research Achievement: High-throughput phenotyping and selection for drought tolerance in cowpea (*Vigna unguiculata L.* (Walp.))

Dr. Panuwan Chantawannakul
Nationality: Thailand
Institute: Chiang Mai University
Research Achievement: Honey bee pathology and development of beekeeping in Asia

Awardees, members of the selection committee and other officials

NEW RESEARCH COLLABORATION

New relationship with the Agricultural Research Institute of Mozambique

JIRCAS signed a Memorandum of Cooperation (MOC) with the Agricultural Research Institute of Mozambique (IIAM) on January 12, 2014 at the Presidential Office in Maputo City, Mozambique. The signing was witnessed by President Armando Emílio Guebuza of Mozambique and Prime Minister Shinzo Abe of Japan. Prior to this memorable event, Mozambique's Agriculture Minister José Pacheco and IIAM Director General Inácio Maposse visited JIRCAS headquarters in April 2013 to observe its research activities and facilities.

JIRCAS is currently involved in a JICA project on research capacity building in the savanna region of northern Mozambique. Besides the research activities in the JICA project, supplemental researches have been planned and conducted with collaborators from IIAM. To date, a number of useful results supporting the introduction of a resource-efficient, soybean-maize intercropping system have been identified mainly through field experiments.

With this MOC, JIRCAS has officially established a new relationship with IIAM under the authorization of both governments. JIRCAS and IIAM will jointly identify and implement more collaborative research topics on various crops and livestock. The first workplan was concluded in July 2014.

Photo 1. Signing ceremony in Mozambique

Photo 2. Visit of Mozambique's Agriculture Minister to JIRCAS

OPEN RESEARCH FACILITIES (Lysimeters)

Open research facilities (lysimeters) were constructed at the Tropical Agricultural Research Front in 2003 to accelerate activities on reducing soil erosion and water deterioration, and to increase water use efficiency in island environments. The facilities consist of outdoor weighing and non-weighing lysimeters as well as indoor non-weighing lysimeters, artificially prepared sloping fields, and artificially constructed waterways. These are used for analyzing evapotranspiration, fertilizer and water release, water use by plants, the extent of soil erosion, and water quality, among others.

The lysimeters are attached to a sump for capturing drained water and nutrients, and to irrigation pipes from the bottom to supply water. Rhizotrons were constructed to observe rooting behavior, and the latest sensors and instruments were installed to measure environmental conditions under the ground. The equipment for water observation, soil physics analysis, water quality and root development measurement, transpiration and soil erosion estimation as well as plant water measuring operation are also linked to the lysimeter system.

The facilities are open to researchers interested in the environmental conservation of agricultural ecosystems. JIRCAS Newsletter No.64 (September 2012 issue) highlighted the results of our recent research projects using the facilities. Collaborative research programs were also carried out with outside research organizations. In 2013, three universities and one private sector entity utilized the facilities under the collaborative research programs of JIRCAS. In addition, three universities and one private sector entity also used the facilities for their own research purposes.

We hold operating committee meetings four times a year to discuss effective utilization and extensive publicity campaigns for the facilities. We have started collecting fees for using the equipment (collaborative research organizations are free of charge) in accordance with the operating regulations revised in 2012.

Outdoor (weighing and non-weighing) lysimeters

Indoor (non-weighing) lysimeters

Artificial field slopes

Underground instrumentation

ACADEMIC PRIZES AND AWARDS

Certificate of appreciation for contribution to collaborative research on wild sugarcane

Dr. Akira Sugimoto, former principal plant breeder for development of tropical crops at JIRCAS-TARF, received a certificate of appreciation from the Department of Agriculture (DOA), Thailand, for his long-term contribution (from 1997-2013) to the collaborative research between JIRCAS and DOA on the collection and utilization of wild sugarcane.

The certificate and plaque were presented by Dr. Thongchai Tangpremsri, director of the Field and Renewable Energy Crops Research Institute, on behalf of the director general of the DOA, during the "DOA/JIRCAS Collaborative Workshop on Future of Multi-Purpose Sugarcane (MPS)" on 9 September 2013 in Khon Kaen City, Thailand.

Dr. Sugimoto has collected more than 500 accessions of *Saccharum spontaneum* (wild sugarcane) and 150 accessions of *Erianthus* (a wild relative of sugarcane) from all over Thailand. They are conserved at Khon Kaen Field Crops Research Center, DOA, and used for breeding of sugarcane by interspecific and intergeneric hybridization. Three promising lines of progeny from hybrids between sugarcane varieties and *Saccharum spontaneum* have already been submitted for variety registration in Thailand.

Dr. Sugimoto (left) accepts the plaque from Dr. Tangpremsri.

"Friendship Award" from the Chinese Government

Dr. Masayoshi Saito, director of JIRCAS's Rural Livelihood Improvement Program, was among the 50 foreigners who received this year's prestigious "Friendship Award" from China's State Council. This award is the highest honor given to foreign experts working in China, including researchers and educators who have made valuable contributions in various fields.

JIRCAS has been promoting collaborative activities with China for many years. Research activities with China Agricultural University have resulted in the improvement of food processing technology and physiological functionality of traditional Chinese food, as well as in providing guidance to young researchers. Accordingly, Dr. Saito's award was made possible because of the recommendation he received from China Agricultural University.

On September 29-30, 2013, a series of ceremonies related to the awards was held at the Great Hall of the People in Beijing, with Premier Li Keqiang and Vice Premier Ma Kai of the State Council of the People's Republic of China (PRC) in attendance.

Dr. Masayoshi Saito (left) accepts his medal and plaque from Vice Premier Ma Kai of the State Council of the People's Republic of China.

Certificate of Appreciation and Medals from Vietnam's Ministry of Agriculture and Rural Development

JIRCAS Project Leader Yoshimichi Fukuta was awarded a certificate of appreciation and a medal by the Minister of Agriculture and Rural Development (MARD) in Vietnam on 5 September 2012. Dr. Fukuta was among the 28 individuals working for international organizations who were honored for their "great contributions to agriculture and rural development in Vietnam."

A medal was likewise awarded to JIRCAS during the international workshop, "Direction of blast studies in Asia, Africa, and Japan," in JIRCAS Tsukuba on 25 September 2013. Dr. Nguyen Thi Lang, principal scientist at the Cuu Long Delta Rice Research Institute (CLRRI) in Vietnam, brought and presented the medal.

Certificate of appreciation and medal from the Ministry of Agriculture and Rural Development (MARD), Vietnam

Certificate of Appreciation from Kasetsart University, Thailand

On November 25, Kasetsart University in Thailand awarded JIRCAS a certificate of appreciation and souvenir for its long-term promotion of joint research projects and pursuit of human resources development through fellowship and academic research support programs.

JIRCAS has been implementing joint research with Kasetsart University since 1994 on a number of projects related to food science, microbiology, biomass utilization and aquaculture, among others. These projects have generated significant results, and both organizations are looking forward to a more fruitful relationship in the future.

JIRCAS Program Director Masayoshi Saito (left) receives the shield trophy from Kasetsart University Vice President Sornprach Thanisawanyangkura.

Certificate of Appreciation from King Mongkut's University of Technology Thonburi, Thailand

On 29 November 2013, King Mongkut's University of Technology Thonburi (KMUTT) in Thailand awarded JIRCAS a certificate of appreciation and souvenir for its long-term promotion of joint research projects and pursuit of human resources development through fellowship and academic research support programs. In addition, Project Leader Dr. Akihiko Kosugi was personally commended for his tremendous support in promoting the projects.

JIRCAS has been implementing joint research with KMUTT since 2002 on projects related to the development of biomass utilization technologies. These projects have generated significant results, and both organizations are looking forward to a more fruitful relationship in the future.

JIRCAS Program Director Masayoshi Saito (left photo, R) and Project Leader Akihiko Kosugi (right photo, R) receive the shield trophies from KMUTT Vice Presidents Bundit Thipakorn and Solot Suwanayuen, respectively.

"Research Encouragement Award" from the Japanese Society for Tropical Agriculture

Dr. Naoko Kozai, researcher of the Tropical Agriculture Research Front, received the Research Encouragement Award from the Japanese Society for Tropical Agriculture in March 2014. This award was given for her research titled "Studies on fruit set characteristics under tropical and subtropical condition -Especially on peach and durian-."

Dr. Kozai's research focused on the reproductive physiology of peach and durian cultivated in tropical areas. Peach cultivated in tropical highlands frequently encounter yield fluctuations due to marginal climatic conditions. She observed the patterns of bud burst and flowering, the development embryo sac, and the fruit set in peach at the northern highlands of Thailand. In durian, erratic fruit set occurs occasionally even when flowers are artificially pollinated. She carried out morphological observations of pollen-tube growth and ovule development as affected by pollen source or night-temperature in durian at eastern Thailand. Her achievement was highly appreciated and is expected to contribute to the stable production of peach in tropical highlands and durian in tropical lowlands.

RESEARCH OVERVIEW

OVERVIEW OF JIRCAS' RESEARCH STRUCTURE

1. History

The Japan International Research Center for Agricultural Sciences (JIRCAS) was first established in 1970 as the Tropical Agriculture Research Center (TARC), one of the research institutes of the Ministry of Agriculture and Forestry of Japan. TARC was reorganized into JIRCAS in 1993.

On April 1, 2001, JIRCAS became an Incorporated Administrative Agency (IAA) under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF), in accordance with the administrative reforms of the Government of Japan to facilitate the reorganization of national government-affiliated research organizations.

2. Mission

Through research and development (R&D) and dissemination of information related to agriculture, forestry and fisheries in developing regions, JIRCAS contributes to the improvement of the international presence of Japan and towards a secure and stable supply of food worldwide including Japan.

3. The IAA System

An IAA is an organization responsible for key public services that the government is not required to provide, but which the private sector is likely to neglect for various reasons. The IAA system was introduced in 2001, as part of central government reforms based on the scheme that the planning sectors and the implementing sectors should be separated. Under the IAA system, MAFF defined JIRCAS' Third Medium-Term Goals in FY 2011, including the enhancement of research efficiency and the improvement of the quality of research programs and financial performance. Based on the Third Medium-Term Goals, JIRCAS drafted and began to implement a detailed five-year plan, the Third Medium-Term Plan (FY 2011- FY 2015).

4. Evaluation

The performance and budgeting management of research activities conducted by JIRCAS undergo regular evaluation by the IAA Evaluation Committee established within MAFF. As for the activities of each fiscal year, the Committee investigates and analyzes the progress towards achieving the Medium-Term Plan, and the results of this evaluation shall be applied as deemed necessary to the modifications of the operational and financing systems for subsequent fiscal years. To meet the requirements of the general guideline concerning evaluation of the national research and development (a decision of the Prime Minister in 2008) which require efficient evaluation, JIRCAS has modified the in-house evaluation system in the initial year of the Third Medium-Term Plan. The in-house evaluation in FY 2013 was carried out as follows:

1) Research activities were evaluated, and summary reports were prepared for each Research Program.
2) These reports were then collectively evaluated at the meeting for the evaluation of research programs of the Medium-Term Plan by external reviewers (government officials from the Ministry of Agriculture, Forestry and Fisheries and specialists from other research institutes) and internal reviewers (the President, the Vice-President, an Executive Advisor and Auditor, the Program Directors and the Directors of each research division) in February 2014.
3) Comprehensive evaluation of all JIRCAS activities, which also include administrative operations, was performed by external reviewers of the JIRCAS External Evaluation Committee in March 2014.

The external reviewers are listed in the Appendix. The results of the in-house evaluation and a summary of all activities were submitted to the IAA Evaluation Committee established within MAFF in June 2014.

5. Medium-Term Plan

JIRCAS implements four programs for research activities under the Medium-Term Plan. Each program consists of several projects. Major accomplishments and research highlights of the programs in FY 2013 are described in the following sections. The contents of the Medium-Term Plan are also described in the Appendix.

Table 1. Number of Programs in the Third Medium-Term Plan (FY 2011 - FY 2015)

Program	Project
A (Environment and Natural Resource Management)	5
B (Stable Food Production)	6
C (Rural Livelihood)	6
D (Information Analysis)	2

Third Medium-Term Plan (FY 2011 - FY 2015)

[Research Approach 1]
Research and development on agricultural, forestry and fishery technologies geared towards providing solutions to international food and environmental problems

Program A
Development of agricultural technologies based on sustainable management of environment and natural resources in developing regions

Projects:
1. Development of agricultural technologies in developing countries to respond to climate change
2. Development of resilient agro-pastoral systems against the risks of extreme weather events in arid grasslands in Northeast Asia
3. Development of technologies for sustainable agricultural production in the African savanna
4. Development of environment-friendly agricultural production technology in islands
5. Utilization of Biological Nitrification Inhibition (BNI) function for the development of breeding materials and application to cropping systems

Program B
Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments

Projects:
1. Development of rice production technologies in Africa
2. Development of genetic engineering technologies of crops with environmental stress tolerance
3. Development of breeding technologies toward improved production and stable supply of upland crops
4. Evaluation and utilization of diverse genetic materials in tropical field crops
5. Rice innovation for environmentally sustainable production systems
6. Development of integrated pest management (IPM) techniques for stabilization of agricultural and livestock production in developing areas

Program C
Technology development for income and livelihood improvement of the rural population in developing regions

Projects:
1. Establishment of sustainable and independent farm household economy in the rural areas of Indochina
2. Design and evaluation of a recycling-based agricultural production system in upland farming areas of Northern China
3. Advanced application of local food resources in Asia
4. Development of biofuel and biomaterial production technologies using biomass resources in Southeast Asia
5. Development of forest management and conservation techniques through sustainable use in Southeast Asia
6. Development of aquaculture technologies for sustainable and equitable production of aquatic products in tropical coastal areas

[Research Approach 2]

Program D
Collection, analyses and dissemination of information for grasping trends of international agriculture, forestry and fisheries

Projects:
1. Collection and analysis of international food supply and demand as well as production systems
2. Dissemination of research trends and local information

6. Collaborative Research

JIRCAS is required to cover a wide range of research fields. Human resources at JIRCAS, however, are limited. This makes collaborative research with other institutes or universities necessary towards achieving JIRCAS' project objectives. Whenever JIRCAS and its collaborators reach an agreement on the commencement of collaborative research after exchanging ideas and opinions, a Memorandum of Understanding (MOU) or a Joint Research Agreement (JRAs) is usually concluded. JIRCAS developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular research subject and with a fixed term. A total of 103 MOUs or JRAs remained in force at the end of FY 2013.

In 2004, JIRCAS was given a Certificate of Recognition by CGIAR as a key partner and as the CGIAR focal point institution in Japan. JIRCAS has been playing an important role in promoting mutual understanding and collaboration between CGIAR and the Japanese government. It has also been intensively implementing collaborative research with several CGIAR research centers.

JIRCAS has been regularly dispatching researchers and research managers to promote research in the developing regions. In FY 2013, 144 JIRCAS researchers or administrators were dispatched abroad for a total of 566 duties. Likewise, we have been dispatching researchers from other institutes and universities to promote the effective implementation of JIRCAS' projects with the cooperation of such organizations. JIRCAS has likewise implemented several invitation programs for overseas researchers and administrators at counterpart organizations. These programs facilitate not only the promotion of international collaborative research but also related exchanges of information and opinions.

7. Organization of JIRCAS

The organizational structure of JIRCAS for the Third Medium-Term Plan period is summarized in the figure below.

Four Program Directors, whose positions were newly-established, are responsible for the implementation of individual programs during the Third Medium-Term Plan period.

The directors of divisions, offices, and the Tropical Agriculture Research Front (TARF) are responsible for managing staff and enhancing the capabilities of researchers.

TARF (formerly the Okinawa Subtropical Station), located in Ishigaki Island in the southernmost part of Japan, is JIRCAS's sole substation. It focuses on agricultural, forestry, and fisheries research being carried out in overseas regions with highly similar climatic and geographic conditions as Okinawa, taking full advantage of its subtropical weather and geographic location.

MAIN RESEARCH PROGRAMS

PROGRAM A
Environment and Natural Resource Management

"Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions"

The Environment and Natural Resource Management Program focuses on impact analyses and the development of adaptation and mitigation technologies to cope with progressing climate change. The program also deals with sustainable resource management and environmental conservation technologies in regions vulnerable to climate change.

【Response to climate change】

The impact of climate change is being analyzed by modeling. Analysis of spatiotemporal dynamics of crop production in Bangladesh using the 11-year (2000-2010) net primary production (NPP) dataset derived from products of the high-frequency earth observation satellite, MODIS, revealed that NPP tends to decrease in the southwest and southeast of the country, but tends to increase in the northwest.

One research outcome relating to adaptation measures for climate change was the discovery of a rice gene, *SPIKE*, in an Indonesian tropical Japonica landrace. Because *SPIKE* can increase grain yield by 13-36% in Indica rice varieties, this discovery could significantly contribute to food security in the Asian region.

Full-dyke systems were constructed for triple rice cropping in flood-prone rice areas in Mekong Delta. Analysis of the effect of full-dyke systems on the hydrological environment revealed that flooding period became longer downstream and upstream of the full-dyke area, and that the water level became higher downstream.

Regarding mitigation measures, monitoring of methane emission from ruminants using the respiration analysis system is being continued, and baseline survey on methane emission from grazing cattle using the SF6 tracer method has been initiated. Meanwhile, the introduction of a water-saving technology in paddy fields has resulted to a reduction in the magnitude of the methane emissions and an increase in crop yield compared with the previous year.

In August 2013, the CDM Executive Board of the UNFCCC issued 6,819 tCO_2 of CER to the afforestation/ reforestation (A/R) CDM project of JIRCAS in Paraguay. The CDM project was developed as a model for sustainable rural communities with low GHG emissions. Manuals for the implementation of an A/R CDM project—from formulation to implementation including the results of monitoring activity—were developed specifically for small-scale farmers.

【Utilization of Biological Nitrification Inhibition function】

Research on biological nitrification inhibition contributes to mitigation strategies related to global warming. The secretion mechanism of the biological nitrification inhibitors (BNIs) from sorghum root was analyzed and the interplay among NH_4^+ uptake, rhizosphere-pH, and plasma membrane H^+-ATPase activity were identified in regulating the release of BNIs.

【Resilient agro-pastoral systems in Northeast Asia】

Resilient agro-pastoral systems against the risks of extreme weather events are being developed in Mongolia. Dry matter intake was quantified in each season, both in forest steppe and steppe regions, and used as basis in developing a carrying capacity map. A prototype carrying capacity map was constructed for the forest steppe research site in winter 2012.

【Sustainable agricultural production in the African Savanna】

Regarding the development of conservation agriculture (CA) in the African savanna, evaluations of CA cropping systems are being continued in Burkina Faso and Ghana, and watershed-level data was collated for the development of a zoning feasibility map for CA adoption.

【Island environment conservation】

For the development of efficient water resource management technologies in islands, estimation of nitrogen loads on soil surface were conducted. Studies revealed that the major nitrogen sources polluting underground water are fertilizers in applied crop fields in Negros, Philippines, and manure from pig pens in the Marshall Islands. A three-dimensional simulation model estimated that excessive water pumping was one of the major causes of upconing during the 1998 drought in the Marshall Islands.

Establishment of an implementation methodology for an afforestation/ reforestation clean development mechanism project targeting small-scale farmers

The Clean Development Mechanism (CDM) is a system that reduces or removes greenhouse gases (GHGs) in the atmosphere by carrying out GHG emission reduction projects in developing countries. The carbon dioxide stored by these projects are converted to carbon credits which can be added to the emission reduction targets of the Annex I countries (developed countries) under the Kyoto Protocol. Accordingly, an afforestation/ reforestation CDM (A/R CDM) project targeting small-scale farmers (SSFs) in Paraguay was implemented as part of rural development and for establishing a practical methodology to obtain carbon credits.

In August 2013, the CDM Executive Board of UNFCCC issued CERs amounting to 6,819 tCO_2-equivalents, the first to be issued in Latin America, to JIRCAS's A/R CDM project, titled "Reforestation of croplands and grasslands in low income communities of Paraguarí Department, Paraguay" (Table 1, Fig. 1). This CDM project used SSFs' lands effectively by introducing agroforestry and silvopasture practices based on the needs of SSFs (Photo 1).

Despite high expectations in terms of social significance, tree growth turned out poor or irregular due to low technical capabilities and degraded lands that were susceptible to drought. Carbon stocks were quantified by establishing sample plots not with a unit area but with a certain number of trees to correspond to the irregularity of SSFs' forests. The study subsequently clarified that the project generated considerably less carbon stocks or CERs than planned (Table 2).

The implementation methodology of an A/R CDM project targeting SSFs -- from formulation to implementation, including the results of monitoring activity conducted in 2012 -- was recommended and developed as manuals, which were then uploaded to the JIRCAS homepage. In addition, the necessary documents for the issuance of CERs such as project design document and monitoring report as well as validation and verification reports prepared by the designated operational entity were published on the web site of the UNFCCC.

Expecting high sustainability, the methodology of JIRCAS is intended to promote reforestation by self-responsibility and beneficiary pays principle, and can be applied to carbon sequestration projects such as A/R CDM, REDD+ and voluntary carbon offset systems involving unorganized SSFs in Latin America.

If an A/R CDM project is proposed, its break-even CER unit value is calculated by financial analysis, after which it is compared to an assumed market value or the minimum unit cost obtained by JIRCAS to ensure the viability of CER acquisition. The keys for realizing sustainable reforestation projects adopting the 'beneficiary pays' principle are to select project areas that are most in need of tree planting and to promote self-help efforts by means of awareness-raising activities.

(E. Matsubara, M. Watanabe, S. Shiraki)

Table 1. Increase of GHG removals by sinks at the A/R CDM project site in Paraguay

Item	Tree species	Carbon stock (tC)	Baseline (tC)	Leakage (tC)	Net carbon stock increase (tC or tCO2)(1)
Carbon stocks					
	Eucalyptus grandis	882.2	263.2	132.3	486.7
	Eucalyptus camaldulensis	2,471.2	557.6	370.7	1,542.9
	Grevillea robusta	74.5	57.7	11.2	5.6
	Sub total	3,427.8	878.5	514.2	2,035.2
Deduction(2)		∆ 205.9	-	∆ 30.6	∆ 175.3
Total					1,859.8
Convert to tCO_2 (3)					6,819.4

Note (1) Net carbon stock increase= Carbon stock - Baseline - Leakage.
Note (2) Deduction rate is determined according to margin of error. The margin of error of the project is 11.4 %, which corresponds to 6% of deduction rate.
Note (3) The conversion rate of tC to tCO2 is 44/12 (or 3.667).

Table 2. Comparison of planned reforestation area with monitored reforested area

Stratum	Tree species (Planted year)	Plan (2009)		Monitoring (2012)		Baseline (2009)	
		Planted Area (ha)	No. of Parcel	Crediting Area (ha)	No. of Parcel	Cropland (ha)	Grassland (ha)
S1	*Eucalyptus grandis* (2007)	30.05	56	13.59	23	11.61	1.99
S2	*Eucalyptus grandi* s (2008)	31.17	41	9.59	15	3.80	5.79
	Sub total	61.22	97	23.18	38	15.41	7.78
S3	*Eucalyptus camaldulensi* s (2007)	16.36	17	7.71	9	2.75	4.96
S4	*Eucalyptus camaldulensis* (2008)	64.48	21	45.63	17	1.91	43.72
	Sub total	80.84	38	53.34	26	4.66	48.68
S5	*Grevillea robusta* (2007)	5.59	9	0.67	2	0.67	0.00
S6	*Grevillea robusta* (2008)	15.16	14	2.13	1	2.13	0.00
S7	*Grevillea robust* a (AF) (2007)(1)	14.05	28	1.13	1	1.13	0.00
S8	*Grevillea robusta* (AF) (2008)	38.30	54	1.06	2	0.08	0.97
	Sub total	73.10	105	4.99	6	4.01	0.97
Total		215.16	240	81.51	70	24.08	57.43

Note (1) AF: Agroforestry

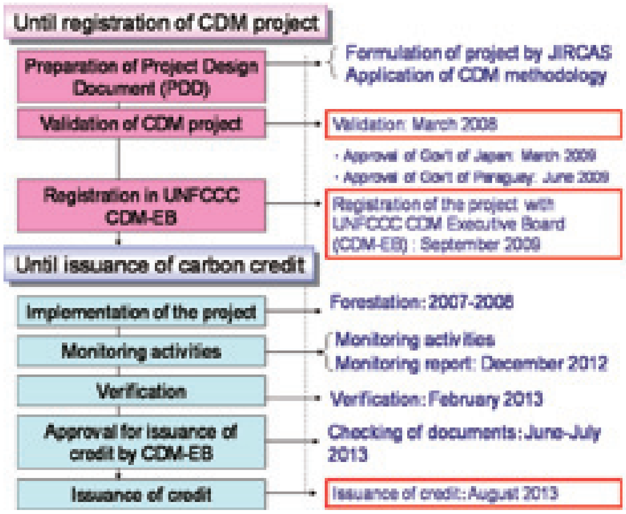

Fig. 1. Process flow of the A/R CDM project in Paraguay, from the start to the acquisition of CER

Photo 1. Established forest at the A/R CDM project site in Paraguay

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TOPIC 2

A QTL for total spikelet number per panicle is detected on chromosome 7 in the genetic background of an *Indica*-type rice cultivar

IR64 is a high quality *Indica*-type rice cultivar noted for good eating quality and high yield in many countries. To improve its yield potential, we studied quantitative trait locus (QTL) information for total spikelet number per panicle (TSN). TSN is one of the most important traits responsible for increasing grain productivity in rice (*Oryza sativa* L.). In this research, a Japanese high-yielding cultivar, Hoshiaoba, was backcrossed to IR64 for three times. We attempted to detect QTLs for TSN using the developed introgression line. Furthermore, we developed a near isogenic line (NIL) to characterize the effect of the QTL for increasing the TSN.

A putative QTL, *qTSN7.1*, was detected between two markers, RM1132 and RM505, on the long arm of chromosome 7 (Figs. 1A and 1B). For developing NILs, plants that have an introgression in the target chromosomal region of *qTSN7.1* were selected from 144 F2 plants derived from a cross between IR64 and its introgression line used for the QTL mapping. A whole-genome survey was conducted using 480 simple sequence repeat (SSR) markers distributed throughout the 12 rice chromosomes to generate the graphical genotype of NIL with *qTSN7.1* (Fig. 1C).

To characterize the agronomic traits of NIL, 11 traits were evaluated and compared with those of IR64 (Table 1). NIL showed significantly higher TSN than IR64. In contrast, NIL had significantly shorter seed length (SL) than IR64. There was no significant difference between IR64 and NIL in other agronomic traits across the seasons (except grain weight in 2012 dry season).

In this study, we successfully detected a QTL for TSN, *qTSN7.1*, using a Japanese high-yielding cultivar, Hoshiaoba, as a donor parent. The developed NIL for TSN with tagged DNA markers would be useful in improving the yield potential of *Indica*-type rice cultivars through an increase in TSN.

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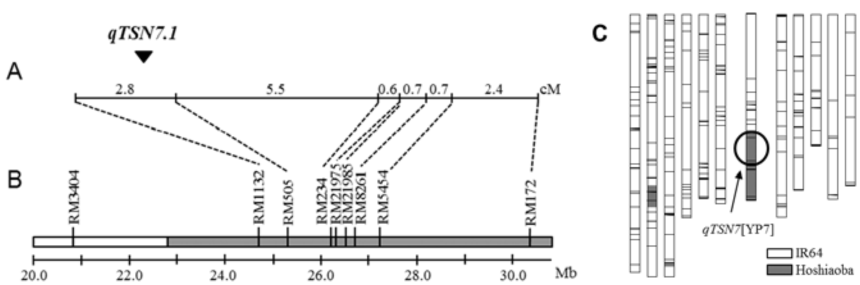

Fig. 1. Chromosomal location of *qTSN7.1* and graphical genotype of NIL with *qTSN7.1*

(A) Genetic map of the marker on chromosome 7. ▼ : LOD peak
(B) Physical map of the DNA markers. The physical chromosomal position is based on Nipponbare genome sequence.
(C) Graphical genotype of the NIL with *qTSN7.1*. White boxes show the chromosomal segments of IR64, while grey boxes show the chromosomal segments of Hoshiaoba.

Table 1. Characterization of agronomic traits of IR64 and NIL with *qTSN7.1* in the wet season of 2010 and the dry season of 2012

Line	Season	TSN	DTH	CL (cm)	PL	LW (cm)	LL (cm)	PN
IR64	2010WS	141.8 ± 30.1	88.8 ± 1.8	78.6 ± 3.0	25.2 ± 1.5	1.3 ± 0.1	38.2 ± 5.3	18.0 ± 5.3
NIL		176.4 ± 21.4**	86.0 ± 1.0	77.8 ± 2.5	25.1 ± 1.2	1.3 ± 0.0	39.7 ± 5.4	22.6 ± 6.8
IR64	2012DS	106.9 ± 18.9	79.8 ± 3.4	65.5 ± 1.9	23.5 ± 1.1	1.3 ± 0.2	26.1 ± 4.0	19.2 ± 4.4
NIL		150.0 ± 34.2**	78.5 ± 2.1	69.7 ± 5.2	23.0 ± 1.7	1.5 ± 0.1	28.6 ± 3.3	14.6 ± 5.6

Line	Season	GW (g)	SL (mm)	SW (mm)	ST (mm)
IR64	2010WS	2.7 ± 0.1	10.0 ± 0.4	2.5 ± 0.1	2.0 ± 0.0
NIL		2.6 ± 0.1	9.7 ± 0.4**	2.6 ± 0.1	2.0 ± 0.0
IR64	2012DS	2.8 ± 0.1	9.9 ± 0.5	2.4 ± 0.1	2.0 ± 0.1
NIL		2.5 ± 0.1**	9.3 ± 0.5**	2.4 ± 0.1	1.9 ± 0.1

TSN: total spikelet number; DTH: days to heading; CL: culm length; PL: panicle length; LW: leaf width; LL: leaf length; PN: panicle number; GW: 100-grain weight; SL: seed length; SW: seed width; ST: seed thickness.

**, significant difference at 1% by *t*-test

TOPIC 3

Gene discovery of *SPIKE* -A unique gene from a rice landrace increases grain yield of *Indica*-type cultivars-

Increasing crop production is essential to securing the future supply of food in developing countries. Total spikelet number per panicle (TSN), one of the most important traits that determine grain productivity in rice (*Oryza sativa L.*), is being evaluated with regard to the presence of a quantitative trait locus (QTL) for high TSN. We previously reported the detection of *qTSN4*, a QTL for increasing the TSN on the long arm of chromosome 4 derived from new plant type (NPT) cultivars with the genetic background of IR64 (JIRCAS Research Highlights, 2012). In this study, we attempted to clone the gene for *qTSN4*. We also characterized the agronomic traits of a near isogenic line (NIL) with the gene. To understand the effect of the gene in different genetic backgrounds, we introduced it by marker-assisted selection into six *indica* cultivars popular in South and Southeast Asian countries.

We successfully identified a causative gene for *qTSN4*, designated here as *SPIKE* (*SPIKELET NUMBER*), by map-based cloning using 7996 BC_4F_3 plants of an NPT cultivar as a donor and IR64 as a recurrent parent (Fig. 1A). NIL for *SPIKE* had higher TSN (Fig. 1B), wider flag leaf (Fig. 1C), and heavier root dry weight (Fig. 1D) than those of IR64. Rate of grain filling was also higher, but panicle number per plant and 1000-grain weight were lower in the NIL (data not shown). Notably, the grain appearance of the NIL was significantly improved (Fig. 2A), presumably owing to a strengthening of assimilate supply to the larger number of spikelets by an increase in vascular bundle number (Fig. 2B). Consequently, the grain yield of the NIL was consistently higher by 13-36% than that of IR64 over four cropping seasons, significantly so in three of the four seasons (Fig. 2C). *SPIKE* also increased TSN in six cultivars popular in South and Southeast Asia (Fig. 3), confirming its effectiveness in various genetic backgrounds.

In conclusion, the detection and identification of *SPIKE*, a unique gene, is significant because it would lead to increased grain yield of *indica* cultivars in South and Southeast Asia through molecular marker-assisted breeding, thus contributing to food security in these regions.

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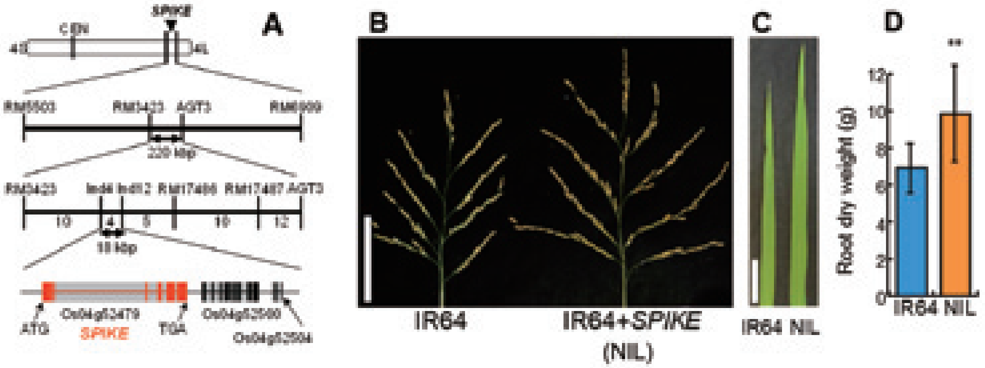

Fig. 1. Chromosomal location of *SPIKE* (A), panicle architecture (B), flag leaf width (C) and root dry weight (D). Values are mean ± SD. **Significant at 1% level by *t*-test.

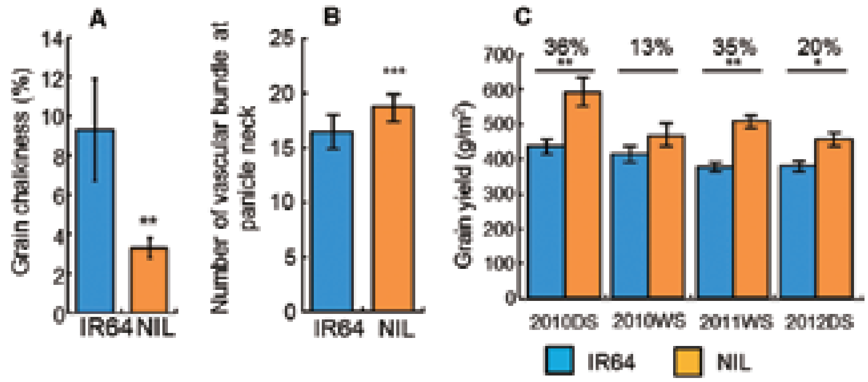

Fig. 2. Percentages of grain chalkiness (A), number of vascular bundle at panicle neck (B) and grain yield (C). Values are mean ± SD (A, B) or SE (C). Significant at ***0.1%, **1% and *5% levels by *t*-test.

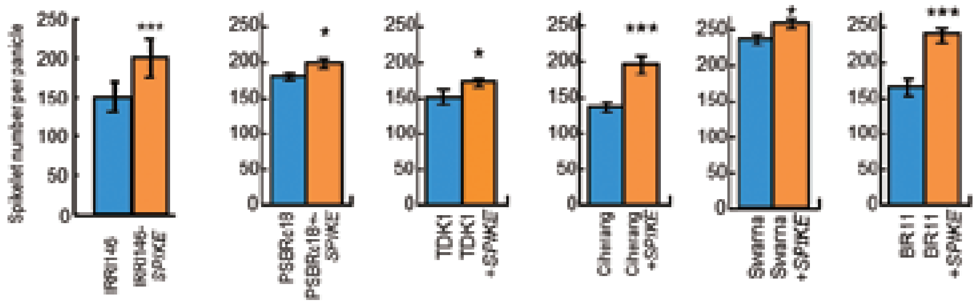

Fig. 3. Total spikelet number per panicle between *Indica-type* cultivars with and without *SPIKE*. Values are mean ± SE. Significant at ***0.1%, **1% and *5% levels by *t*-test.

TOPIC 4

Hydrological impacts of full-dyke systems in flood-prone rice granary areas in the Mekong Delta

Mekong Delta, Vietnam's rice granary, produces 90% of its rice exports, making the country the world's second largest rice exporter. However, it is feared to be at high risk to the adverse effects of climate change. To reduce flood vulnerability and enable triple-cropped rice cultivation, full-dyke systems were constructed around flood-prone rice areas in the Mekong Delta. The objective of this study, therefore, was to clarify the effect of full-dyke systems on the hydrological environment in the region, through interviews with government officials and residents, and through analysis of river water levels and satellite images. The research data will provide the basic knowledge needed to ensure sustainable rice cultivation that could cope with the increased flood risk under climate change.

Two types of dyke systems were constructed to reduce vulnerability in high-flood areas adjacent to the Cambodian border in the Mekong Delta: a high embankment called "full-dyke", which completely prevents farmland from flooding (August – November); and a low embankment called "semi-dyke", which prevents flooding only up until the harvest period (August) of spring-summer rice (Fig. 1). Triple rice cropping became possible in farmlands enclosed by full-dykes, as rice can grow even during peak flood season from September to October. In response to farmers' request, the Vietnamese government has promoted the construction of full-dykes, hence areas with full-dyke systems expanded rapidly in the past 10 years especially in An Giang Province (Fig. 2).

MODIS Terra images were compared between floods in 2011 (with a 10-year return period), when full-dykes have become widespread in the study area, and floods in 2000 (with a 60-year return period), when there were only a few full-dykes around. The inundated area was larger and the flood period longer in 2011 than in 2000 at Kien Giang province, downstream and west of An Giang Province (point A), and at the Cambodian border, upstream of the full-dyke area (point B) (Fig. 3). Three points in Fig. 3 were selected for verification: (a) the point with significantly prolonged inundation, (b) with slightly prolonged inundation, and (c) with little change in inundation. Interview surveys with the farmers were subsequently conducted. The results showed that the farmers' recollection of flood events were in good accordance with the delineated flood area using satellite images. In recent years, the water level at CanTho station in Hau River, one of the major tributaries of the Mekong River, has shown a rising trend. The annual maximum water levels between CanTho and ChauDoc were compared, from 1979 to 2011, separated into two periods: before 2004, and after 2005. An upward trend in water level was observed in CanTho after 2005, compared with the water level before 2004 (Fig. 4).

The research output will be utilized for studying adaptation measures in megadeltas with progressive flood risk. It will also be useful as validation data in hydrologic and hydraulic modelling of flood inundation areas caused by the expansion of full-dyke systems in the Mekong Delta. It should be noted that land subsidence in urban areas and sea level rise due to global warming are also major factors contributing to water level rise in CanTho, thus a more detailed investigation is required to separate the impact of full-dyke systems.

(H. Fujii, Y. Fujihara [Ishikawa Prefectural University], K. Hoshikawa [Center for Integrated Area Studies, Kyoto University] and S. Yokoyama)

Fig. 1. Semi-dykes and full-dykes (Top: both sides are semi-dyke areas; Middle: semi-dyke [left] and full-dyke areas [right] ; Bottom: both sides are full-dyke areas)

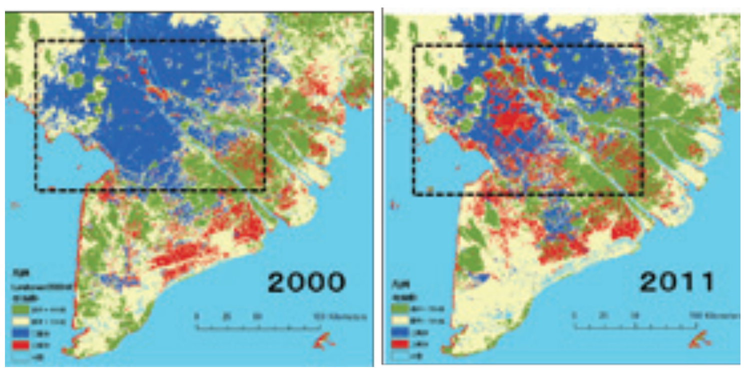

Fig. 2. Increase in triple rice cropping in the flood-prone area. (Blue : double cropping, Red : Triple cropping, Green : Forest and others; dashed line shows the area of Fig.3)

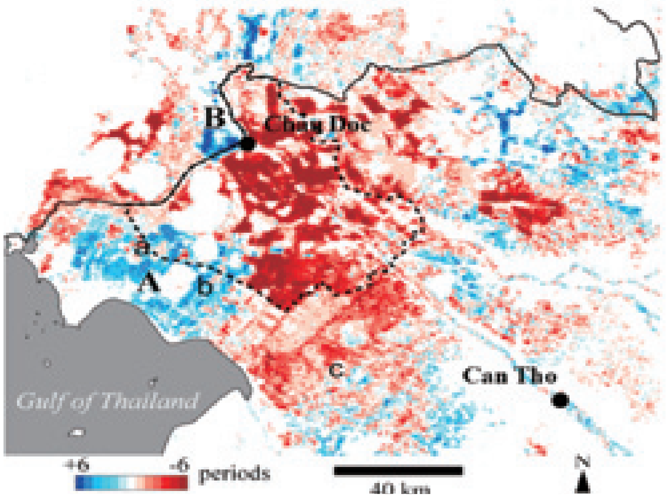

Fig. 3. Comparison of inundation duration between 2000 and 2011 flood evaluated by NDWI of MODIS. Dashed line shows the border of An Giang Province and solid line shows Vietnam-Cambodia border. (Blue: inundation period in 2011 is longer than in 2000; Red: 2011 is shorter than 2000: White: little difference between the two years.)

Prolonged inundation was observed in Cambodia (point B) and in Kien Giang Province (point A) located upstream and west of An Giang Province, respectively. Verification points: a- prolonged, b- slightly prolonged, c- slight change/no change

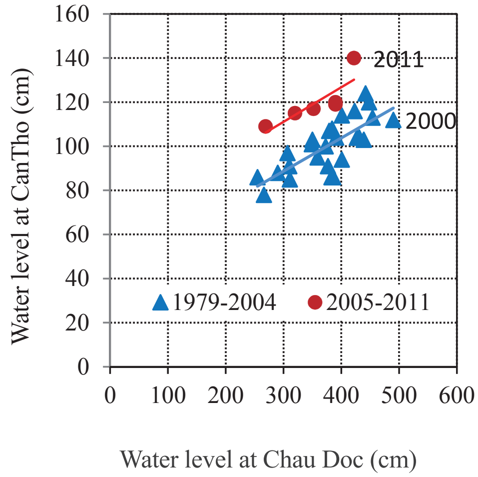

Fig. 4. Relationship of yearly maximum water level at ChauDoc and CanTho (2007: missing data)

TOPIC 5

Effects of no-till maize cultivation after leguminous hairy vetch cropping on fertilizer saving and nitrogen leaching

No-till cultivation associated with residue mulch after leguminous cropping has several advantages such as a decrease in water runoff and soil erosion as well as fertilizer saving (JIRCAS Research Highlights, 2006). However, reducing surface runoff also has disadvantages. It increases water percolation into the soil, increasing the risk of nitrogen leaching if nitrates generated due to decomposition of organic matter are not effectively taken by plant. In the present study, we elucidate nitrogen leaching and balance, taking into account the relationship between water runoff and percolation in a sloping field when no-till maize is cultivated in a residue mulch of hairy vetch (*Vicia villosa* Roth) cropped during fallow period.

As shown in Fig. 1, maize yield with 50-kg dose of nitrogen after hairy vetch cropping, either tilled or no-tilled, was equal to or more than that after fallow (conventional treatment; nitrogen dose: 100 kg ha^{-1}). These results confirmed possible nitrogen fertilizer saving. In addition, at zero dose of nitrogen, maize yield after natural fallow recorded almost zero yield, while that after hairy vetch cropping obtained 70% of conventional yield (nitrogen dose: 100 kg ha^{-1}). No-till cultivation after hairy vetch cropping turned the residue into mulch. Table 1 shows water movement and nitrogen leaching at major rainfall events. The concentration of nitrate-nitrogen in the percolated water at the hairy vetch treatment increased 23.5 times compared with natural fallow treatment while the amount of percolated water increased only 1.5 times, resulting to a 37-fold increase in leached nitrogen. This means that the increase in nitrogen leaching was mainly due to the increase in the concentration of nitrate-nitrogen, while the increase in percolation resulting from no-till cultivation associated with the residue mulch was limited. Available nitrogen provided (total amount of nitrogen derived from fertilizer, hairy vetch, and soil) is almost equal to the sum of the amount of nitrogen taken up by maize and the amount that was leached. It can be explained, therefore, that generating excess nitrogen results to leaching. Regarding nitrogen balance at harvest time, it was much positively higher for no-till cultivation after hairy vetch cropping than that for conventional cultivation, suggesting that hairy vetch cropping increases soil fertility in a sustainable way. (Note: Nitrate-nitrogen output associated with water runoff was not considered in nitrogen balance computations since it was not detected in the runoff water.)

This cropping system shows some advantages such as decreased water runoff and fertilizer saving as described. Therefore, it is expected to be adopted in regions experiencing short duration, high intensity rainfall, and where dose of fertilizer application is limited. Excess turnover of biomass into the soil, however, pose a groundwater pollution risk due to nitrogen leaching as shown in the present study. It is necessary to consider the quantitative relationship between the amount of nitrogen derived from fertilizer and the amount derived from hairy vetch in order to adjust the dose of nitrogen fertilizer.

This study is being conducted at 14-m-long sloping fields (2º, 3.5º, 5º) in one of the open research facilities of Japan International Research Center for Agricultural Sciences (JIRCAS), Tropical Agriculture Research Front (TARF) in Ishigaki Island, Okinawa Prefecture, Japan.

(F. Nagumo, K. Nakamura [National Institute for Agro-Environmental Sciences])

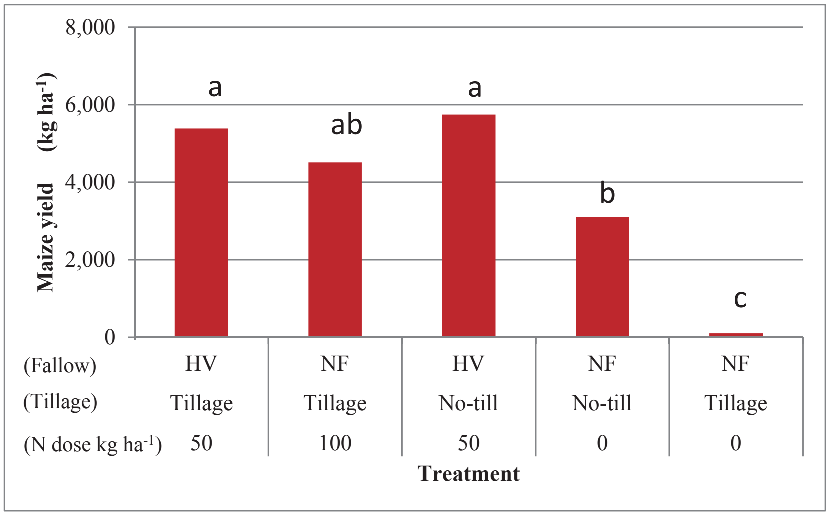

Fig. 1. Effects of treatment combination on maize yield.
HV: hairy vetch cropping during fallow period, NF: natural fallow.
Different letters above the bar indicate significant differences at 5%

Table 1. Runoff and percolation at study site during a major rain event
(Slope: 5º, 27-28 days after planting)

Treatment		NF	HV
	(Fallow)	NF	HV
	(Tillage)	Tillage	No-till
	(N dose: kg ha^{-1})	100	50
Rainfall mm		145.0	145.0
Water runoff mm		30.6	7.1
Deep percolation mm		86.0	130.3
NO_3-N Concentration g m^{-3}		1.1	25.8
NO_3-N leached kg ha^{-1}		0.9	33.6

Note: Percolated water was collected by a lysimeter installed at 60 cm deep.
HV: hairy vetch cropping during fallow period, NF: natural fallow

Table 2. Nitrogen balance for maize cropping (kg ha^{-1})

Treatment	(Fallow) (Tillage) (N dose: kg ha^{-1})	NF Tillage 100		HV No-till 50	
Biomass-N		13.2	(weeds)	150.1	(HV)
Fertilizer-N		100.0		50.0	
Input-N		**113.2**		**200.1**	
Available-N		**108.7**		**133.7**	
Uptake N		95.6		96.2	
Leached N		11.1		36.5	
Output-N		**106.7**		**132.7**	
Available N-Output N		**2.0**		**1.0**	
N balance		**6.5**		**67.4**	

TOPIC 6

Identification of fatty acids and fatty acid methyl esters as new nitrification inhibitors

The tropical pasture grass, *Brachiaria humidicola* (Rendle) Schweick, produces nitrification inhibitory compounds (termed biological nitrification inhibitors or BNIs) in its shoot and root tissues, and releases BNIs from its roots. During this study, two BNI compounds were isolated and identified from the shoot tissue of *B. humidicola* using activity-guided fractionation.

The BNI compounds in the shoot tissue were identified as linoleic acid (LA) and linolenic acid (LN) using authentic chemicals (ED_{80} 16.0 µg ml^{-1} for both LA and LN) for verification (Fig. 1). None of the other tested free fatty acids, namely, stearic acid, oleic acid, arachidonic acid, and vaccenic acid, showed any inhibitory effects on nitrification. Among the fatty acid methyl esters (FAME) evaluated [methyl oleate, methyl linoleate (LA-ME), and methyl linolenate (LN-ME)], only LA-ME showed any inhibitory effect (ED_{80} 8.0 µg ml^{-1}) (Figs. 1, 2). The inhibitory effect of LA, LN and LA-ME on soil nitrification was stable for 120 days at 20ºC (Fig. 3). Soil treated with LA, LN and LA-ME showed a very low accumulation of NO_3^- and the maintenance of soil inorganic N in NH_4^+ form (Fig. 3). The inhibitory effect of LA-ME on soil nitrification was greater than that of LA, LN or nitrapyrin (commercial nitrification inhibitor) (Fig. 3). Both LA and LN suppressed soil nitrifier activity by blocking AMO (ammonia monooxygenase) and HAO (hydroxylamine oxidoreductase) enzymatic pathways in *Nitrosomonas europaea*. Commercial nitrification inhibitors such as nitrapyrin or dicyandiamide (DCD) are not effective. (Nitrapyrin is volatile at temperatures >5C, thus is not effective in tropical environments. Likewise, DCD is highly soluble in water and leaches out of fertilizer zone, making it ineffective and not suited for production agriculture in tropical field environments.)

LA, LN and LA-ME can be produced from vegetable oils such as soybean, flax, or sunflower oils. Because these compounds are bound to the soil, they do not leach out from the point of application to the fertilizer zone. Thus, they are more effective and stable in tropical soils, and have the potential for use as nitrification inhibitors in production agriculture in tropical environments.

(G. V. Subbarao, K. Nakahara, T. Ishikawa, T. Yoshihashi, Y. Ono [National Food Research Institute], M. Kameyama [National Food Research Institute], M. Yoshida [National Food Research Institute])

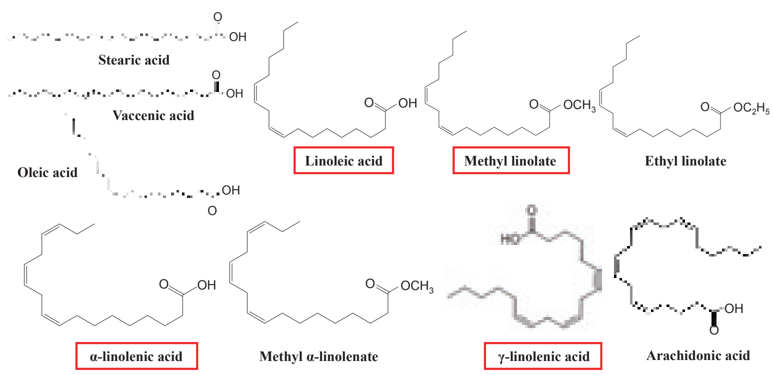

Fig. 1. Structure formulae of various fatty acids and fatty acid esters. Substances with enclosures exhibit nitrification inhibitory activity.

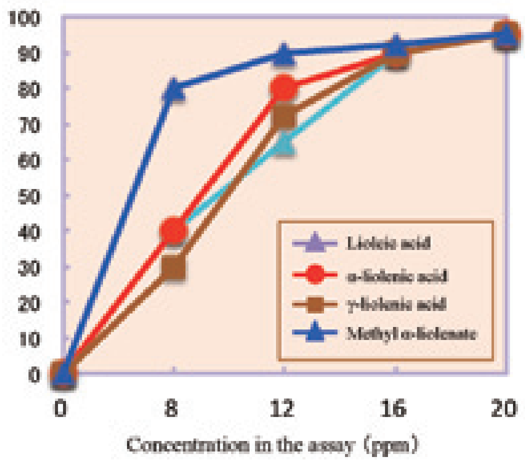

Fig. 2. Relative effectiveness of substances in inhibiting *Nitrosomonas europaea* activity in an in vitro assay

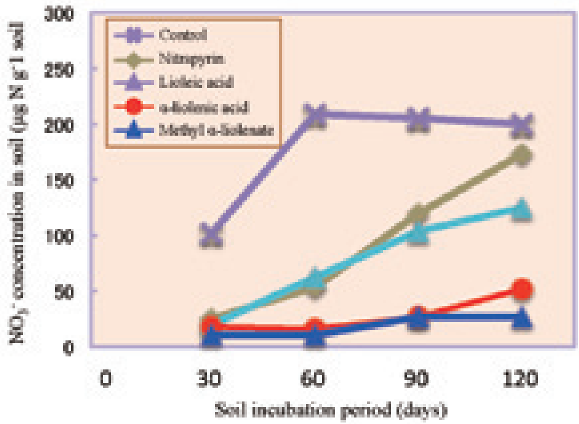

Fig. 3. Relative stability of the inhibitory effects on soil nitrification from linoleic acid (1,000 µg g^{-1} soil), linolenic acid (1,000 µg g^{-1} soil), methyl linoleate (1,000 µg g^{-1} soil), and nitrapyrin (4.5 µg g^{-1} soil) during 120-day incubation period at 20°C

TOPIC 7

Analysis of the secretion mechanism of biological nitrification inhibitors from sorghum roots

The ability to suppress soil nitrification by releasing nitrification inhibitors from plant root systems is termed ‘biological nitrification inhibition’ (BNI). We have reported earlier that sorghum roots release higher BNI activity when grown with NH_4^+, but not with NO_3^-, as N source. Also, for BNI release, rhizosphere pH of <5.0 is needed; beyond this, a negative effect on BNI release was observed with nearly 80% loss of BNI activity at pH ≥7.0. This study is aimed at understanding the inter-functional relationships associated with NH_4^+ uptake, rhizosphere-pH and plasma membrane H^+-ATPase (PM H^+-ATPase) activity in regulating the release of biological nitrification inhibitors (BNIs).

Sorghum was grown hydroponically and root exudate was collected from intact plants using a pH-stat system to separate the secondary acidification effects from NH_4^+ uptake on BNIs release. A recombinant luminescent *Nitrosomonas europaea* bioassay was used to determine BNI activity. Root plasma membrane was isolated using a two-phase partitioning system. Hydrolytic H^+-ATPase activity was determined. Split-root system was used to understand the localized responses to NH_4^+, H^+-ATPase-stimulator (fusicoccin) or H^+-ATPase-inhibitor (vanadate) on BNI release by sorghum. The results presented suggest that the presence of NH_4^+ in the rhizosphere stimulated the expression of H^+-ATPase activity and enhanced the release of BNIs from sorghum roots compared to NO_3^- (Fig. 1a, b). NH_4^+ levels (in rhizosphere) positively influenced BNIs release and root H^+-ATPase activity in the concentration range of 0 - 1.0 mM, indicating a close relationship between BNIs release and root H^+-ATPase activity with a possible involvement of carrier-mediated transport for the release of BNIs in sorghum (Fig. 2). Split-root system studies showed that part of the root system exposed to NH_4^+ released substantially higher levels of BNI activity than the root system that was exposed to NO_3^-; similarly, part of the root system which was exposed to fusicoccin stimulated BNI release, whereas the part of the root system exposed to vanadate suppressed BNI release (Fig. 3a, b). These results indicate that NH_4^+ uptake, PM H^+-ATPase activity, and rhizosphere acidification are functionally interconnected with BNI release in sorghum, and a hypothesis is proposed (Fig. 4).

Such knowledge is critical to gaining insights into why BNI function is likely to be more effective in light-textured and mildly acidic soils [such as Alfisols (of SAT regions), Ultisols (predominant in South America) or Sandy-loams (of West-African SAT region)] compared to heavy-textured soil types such as Vertisols.

(Y. Zhu, H. Zeng [Nanjing Agricultural University], Q. Shen [Nanjing Agricultural University], T. Ishikawa, G. V. Subbarao)

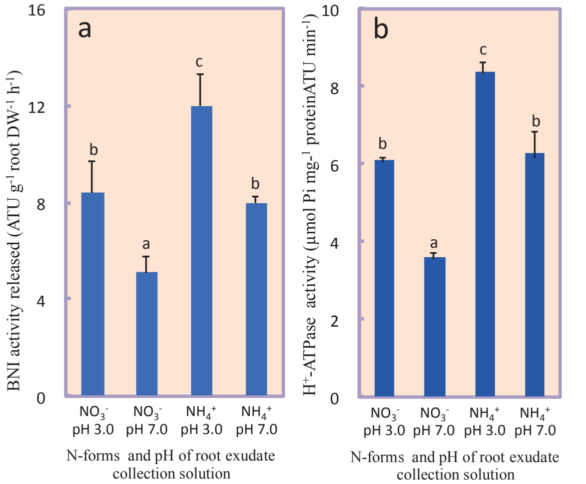

Fig. 1. Influence of N-forms (i.e., 1 mM N as NH_4^+ vs. NO_3^-) and root exudate collection solution pH (solution pH 3.0 vs. 7.0) on biological nitrification inhibition (BNI) release and root plasma membrane (PM) H+-ATPase in sorghum grown hydroponically for 14 days with NH_4^+ or NO_3^- as N source

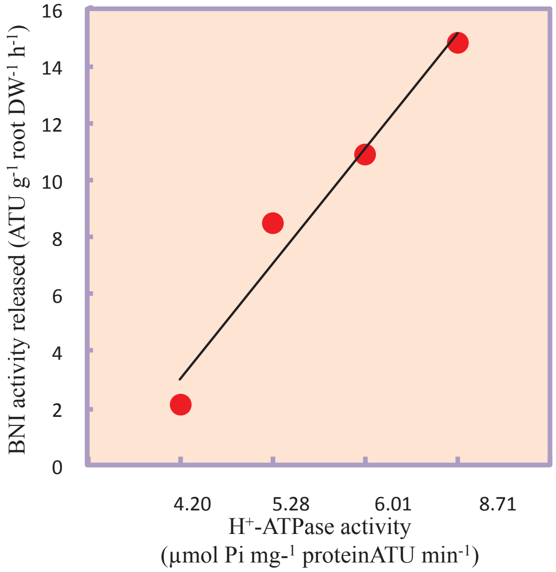

Fig. 2. The relationship between BNI release from sorghum roots and root PM H+-ATPase activity at various concentrations of NH_4^+ (0 to 1.0 mM) in the root exudate collection solutions

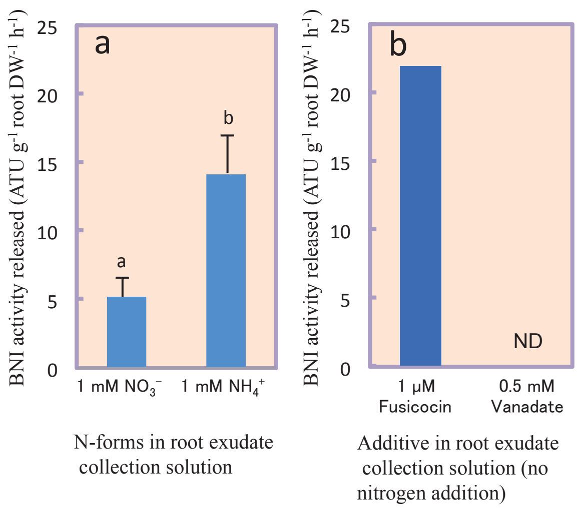

Fig. 3. Influence of N-forms (1 mM N as NH_4^+ vs. NO_3^-) and H+-ATPase stimulator, fusicoccin (1 µM) or H+-ATPase inhibitor, vanadate (0.5 mM) on BNI release in sorghum in a split-root system setup

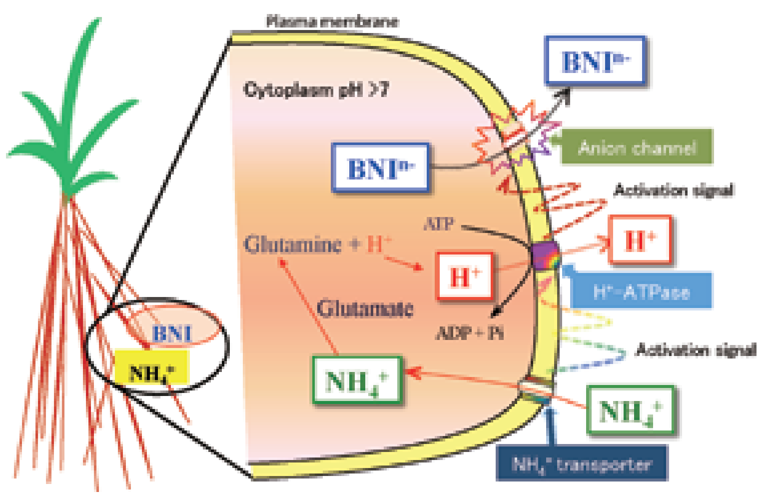

Fig. 4. Hypothesis on the transport of biological nitrification inhibitors (BNIs), driven by plasma membrane H+-ATPase, associated with NH_4^+ uptake and assimilation in sorghum

PROGRAM B
Stable Food Production Program

"Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments"

The Stable Food Production Program is aimed at developing technologies that will improve and sustain productivity through collaborative research with local institutions and international research centers in specific research fields wherein Japan has shown predominant comparative advantage, especially for areas under adverse environments such as those found in tropical regions. Research outcomes are expected to contribute to global food security and help reduce starvation and malnutrition which remain serious problems in developing regions.

[Development of rice production technologies in Africa]

The program's flagship project, "Development of rice production technologies in Africa," will try to fulfill the main target of the Coalition for African Rice Development (CARD) to double rice production in Sub-Saharan Africa within ten years (by 2018). A workshop titled "Improvement of Soil Fertility with Use of Indigenous Resources in Rice Systems in Ghana" was held in Tamale, Ghana, and a guidebook titled "Manual of Soil Fertility Improvement Technologies in Lowland Rice Ecologies of Ghana" was published. Additionally, multi-site agronomic characterization of rainfed upland NERICA varieties (Ver.1) was uploaded to the JIRCAS website. In this version, primary datasets of agronomic traits of NERICAs collected in Tsukuba, Japan, and some characterization results were provided as downloadable files.

The effect of direct application of phosphate rocks produced in Burkina Faso (BPR) on rice production under two agro-ecological conditions (the Guinea Savanna and Equatorial Forest zones) was examined in Ghana. Based on studies, its effect on rice yield was observed to be comparable to chemical P fertilizers. [Topic1]

Shoot elongation rate after germination was improved by priming the seed in a wide range of soil water content in sandy substrate. If this technology becomes applicable to rainfed lowland, it can be expected to contribute to the establishment and expansion of a stable rice production system. [Topic 2]

[Rice innovation for environmentally sustainable production systems]

A low-input and environment-friendly variety of rice and a new cultivation technology in Asia that ensures stable productivity in poor environmental conditions will be advanced. Based on JIRCAS "Blast Research Network for Stable Rice Production," two research studies below, as well as the research on the development of the differential system for blast pathogen and resistance genes in rice varieties in Asia and Africa, have progressed.

Blast isolates collected from Cambodia revealed wide variation and were classified into 3 groups — I, IIa, and IIb — using data from the reaction patterns of differential varieties. [Topic3]

A Myanmar rice landrace, Haoru, has broad-spectrum resistance controlled by three resistance genes. Two of them were mapped on chromosomes 12 and 6, and were designated as *Pi58*(t) and *Pi59*(t), respectively. *Pi58*(t) and *Pi59*(t) were differentiated from other reported resistant genes using the standard differential system. [Topic4]

[Development of genetic engineering technologies of crops with environmental stress tolerance]

Development of genetic engineering technologies as tools to improve crop cultivation in developing countries is important, especially in areas under unstable environments where drought or poor natural conditions affect stable crop production.

We revealed that a rice stress-inducible CCCH-type zinc finger protein OsTZF1 binds to RNA, and is involved in the regulation of growth, senescence, and stress tolerance. OsTZF1 may serve as a useful biotechnological tool for the improvement of stress tolerance in various plants through the control of RNA metabolism of stress-responsive genes. [Topic5]

Rice *Oshox24* promoter was strongly induced by stresses, but showed low activity under normal growth conditions. The *Oshox24* promoter is useful for overexpressing stress-tolerance genes without adversely affecting growth. [Topic6]

[Development of breeding technologies toward improved production and stable supply of upland crops]

In South America, soybean production has been threatened since the early 2000s by Asian soybean rust (ASR) caused by *Phakopsora pachyrhizi.* ASR, along with drought, is currently the most serious threat to stable soybean production. To cope with ASR, we evaluated its pathogenicity and are developing resistant soybeans using backcrossing and marker-assisted selection. BC_5F_3 lines are now ready for field evaluation. The experimental protocols for evaluating the pathogenicity, the ASR resistance, and the marker-assisted selection in soybean, have been organized and uploaded as "Laboratory Manual for Studies on Soybean Rust Resistance" to the JIRCAS website.[Topic7]

The QTL region responsible for NaCl tolerance in soybean is being fine-mapped toward gene isolation. Alkaline tolerance is also being studied to explore candidate genes. Rice genes involved in aerenchyma formation are being isolated toward molecular breeding for water-logging tolerance in field crops. Using the new hydroponic method [Topic8], which can clearly differentiate the mechanisms of aerenchyma formation in rice into constitutive or inducible (further, by nitrogen or oxygen deficiency), seven aerenchyma variants were selected, and the mechanism of aerenchyma formation of two previously isolated genes was characterized.

[Evaluation and utilization of diverse genetic materials in tropical field crops]

This project is aimed at developing effective evaluation and breeding techniques to utilize a wider range of germplasm for genetic improvement in tropical field crops, especially in yam, cowpea, tropical fruits, and sugarcane.

Yam (*Dioscorea* spp.) is a traditional staple food crop of significant economic and socio-cultural importance in West Africa. To develop technologies using genomic information and molecular techniques to facilitate yam breeding in West Africa, generating a reliable reference sequence is a prerequisite. We have been gathering efforts to obtain the first whole genome sequence of *D. rotundata*, and the on-going de novo assembly is currently in its final stage. Next-generation sequencing allows large-scale genome-wide discovery of genetic markers that are important for genomic and genetic applications such as construction of genetic and physical maps, and analysis of genetic diversity. As a component of the on-going efforts, we selected a subset of experimental materials called Diversity Research Set (DRS) to develop genotyping and phenotyping tools as well as protocols for germplasm evaluation. Accordingly, 106 out of over 2,000 accessions of IITA's *D. rotundata* collection have been selected for inclusion in the DRS based on 21 key morphological traits, ploidy levels, and SSR polymorphisms.

Cowpea (*Vigna unguiculata*) is an important protein and micronutrient source for the poor and a good cash crop for small farmers in Africa. To develop high-valued cowpea varieties with better nutritional value and commercial quality to meet markets'/consumers' preferences, we are investigating germplasm to identify useful breeding materials and strategic breeding approaches. Twenty cowpea grain varieties were analyzed for various nutritional components. It was confirmed that free sugar content, β-amylase activity, and flour pasting properties were especially diverse among the tested varieties and considered to be the traits linked with markets'/consumers' preferences. To understand local preference on cowpea, continuous market surveys focusing on the relationship between the variety characteristics and its price are being carried out in Nigeria, the biggest cowpea producer and consumer in the world. Based on Hedonic price analyses with 4,350 samples collected from 19 markets in 2012 and 2013, it was shown that cowpea variety names have significant effects on the price. The result implies that cowpea prices are influenced not only by observable characteristics but also by unobservable characteristics, such as taste, cooking properties, etc.

To better utilize the tropical fruits germplasm collection conserved at JIRCAS, characterization and evaluation of the germplasm collection are steadily ongoing. Selection of SSR markers for diversity analysis and varietal identification of 80 mango accessions is also in progress. A promising passion fruit breeding line selected by JIRCAS is undergoing local network trials in different prefectures in Japan from this year.

Sugarcane is widely cultivated as food and energy source in the tropics. However, inferior environmental conditions such as poor soil and rainfall deficiency hinder stable production. We are attempting to utilize wild relatives, especially *Erianthus*, to improve biomass productivity of sugarcane even under unfavorable environments. Morphological characterization and evaluation of major agronomic traits of 150 accessions of the Thai *Erianthus* germplasm were completed in 2013. In addition, a set of SSR markers were selected for further genetic diversity study of the collection. To facilitate intergeneric crosses between sugarcane and *Erianthus*, development of artificial flowering regulation techniques is also in progress. Using these techniques, hybrids between sugarcane and different types of *Erianthus* were successfully obtained.

[Development of integrated pest management techniques for stabilization of agricultural and livestock production in developing areas]

Multi-purpose sugarcane (MPS), which was developed during JIRCAS' Second Medium-Term Plan period, is expected to help address global food and energy issues because it can be used for both food (sugar) and energy (ethanol) production purposes. However, a phytoplasma disease, sugarcane white leaf (SCWL), is an obstacle to field production in developing areas. We examined the primary factors in the spread of SCWL occurrence in Northeast Thailand, and results of the epidemiological study suggested that the most important factor was the planting of infected seed-canes in the field. The "DOA/JIRCAS Collaborative Workshop on Future of Multi-Purpose Sugarcane" was held in September 2013 in Khon Kaen, where we proposed the creation of the MPS research network to exchange information on the utilization of MPS.

TOPIC 1

Direct application of Burkina Faso phosphate rock is highly effective on lowland rice cultivation

Phosphorus (P) is a critical nutrient for crop production all over the world. In Sub-Saharan Africa (SSA), soil P deficiency is one of the most serious constraints on crop production. This shortfall has resulted from the high P fixation capacities of highly weathered acidic soils. The lack of soil P impacts on a range of agricultural lands, including paddy soils for rice cultivation. However, few farmers in SSA can use commercial water-soluble P fertilizers to cope with this P deficiency. Resource-poor farmers especially find it difficult to apply these chemical fertilizers because of very limited accessibility and affordability.

Phosphate rock (PR) is being considered as a cheaper alternative to water-soluble P fertilizers such as triple super phosphate (TSP), and it has been verified that PR deposits exist in SSA. It is therefore imperative to propose a proper PR application method using these local PR resources.

Generally, PR produced in SSA has low solubility, and thus is considered less effective especially for upland crop production. However, for direct application on paddy fields it seemed that PR solubility is affected by the paddy fields' unique soil properties and conditions. Hence, it cannot be denied that PR direct application has a positive effect on lowland rice production. Observations from elucidating the effects of PR direct application will be used as fundamental information for PR utilization in SSA.

This study examined the impact of direct application of fine ground sedimentary PRs produced in Kodjari, Burkina Faso (BPR) on rice production under two agro-ecological conditions of the Guinea Savanna and Equatorial Forest zones of Ghana at several application levels, as shown in Table 1. Effects of BPR direct application on rice grain yield were observed to be comparable to TSP in both agro-ecological zones (Fig. 1). In BPR direct application plots, rice grain yield increased with increasing BPR application rates. These results suggest that BPR direct application is effective on lowland rice production in Ghana. Furthermore, a positive correlation between plant P uptake and rice grain yield has been noted (Fig. 2). It means that applied P has increased rice grain yield effectively. Moreover, BPR direct application has shown a high residual effect on lowland rice production (unpublished data).

Results shown in this study will have great impact on lowland rice cultivation in SSA because BPR reserves, estimated at 100 million tons (as P_2O_5), exist in Burkina Faso, with an estimated 600 million tons more in neighboring countries. Moreover, BPR are sold at 1/4 the price of TSP in the Burkina Faso markets, which makes it more affordable to farmers.

(S. Nakamura, M. Fukuda, S. Tobita)

Table 1. Summary of fertilizer application rates for each PR direct application treatment

Treatment	P source	Savanna zone			Equatorial forest zone		
		P_2O_5	N	K_2O	P_2O_5	N	K_2O
Zero†	None	0	0	0	-	-	-
Control	None	0	60	30	0	90	60
PR-L	BPR*	67	60	30	67	90	60
PR-M	BPR*	135	60	30	135	90	60
PR-H	BPR*	270	60	30	270	90	60
TSP	TSP**	270	60	30	270	90	60
TSP-rec†	TSP**	-	-	-	60	90	60

†In the Savanna zone, absolute zero application (Zero) plot was set up, while in the Equatorial Forest zone, TSP at the recommended rate (60 kg P_2O_5 ha^{-1}) was set up (TSP-rec).
*BPR: Burkina Faso phosphate rock (P_2O_5 26%, Ca 32%, Si 6%)
**TSP: Triple Super Phosphate

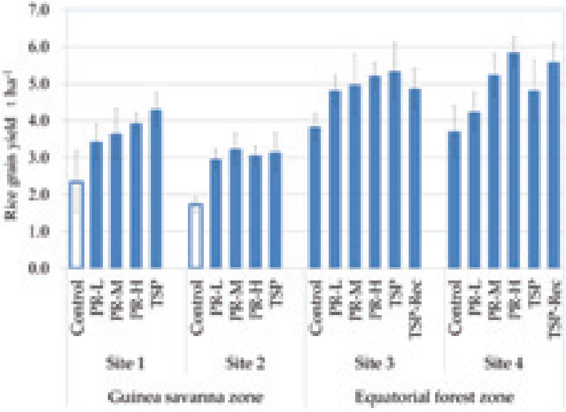

Fig. 1. Effect of BPR direct application on lowland rice yield in Ghana.
Error bars indicate standard error (n=3). Soil pH in each site were as follows: Site1 5.60, Site 2 5.83, Site 3 4.53, and Site 4 5.70.

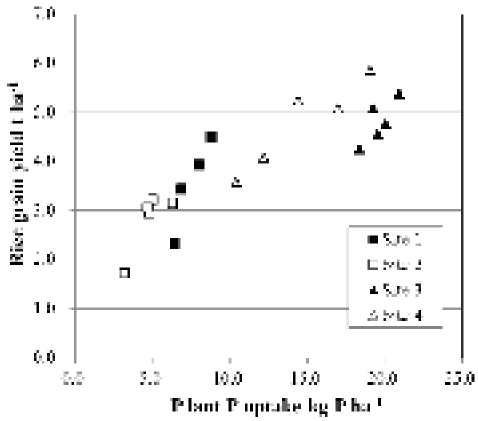

Fig. 2. Relationship between plant P uptake and rice grain yield under BPR direct application.
Plant P uptake was calculated by multiplying P concentration in flag leaf determined by dry combustion method and above-ground biomass.

TOPIC 2

Rice seed priming improves germination speed, germination uniformity, and seedling emergence

Improving seedling establishment and emergence rates is extremely important in the development of a direct seeding rice cultivation technology and for maintaining sustainable production for the rainfed lowlands of Africa. However, individual differences in initial growth rates due to variations in seedling emergence affect the dry matter production and light-receiving posture of rice. These defective conditions decrease rice yield. Strategies involving techniques for good seedling establishment in a wide range of soil moisture condition are thus required because controlling soil moisture at the time of seeding is difficult, particularly in rainfed lowlands. Seed priming, a treatment method that allows artificial germination to proceed by soaking the seeds in water over a certain period and drying them back to their initial weight, has demonstrated that germination and emergence rates are accelerated and that seedling vigor is enhanced. If this technology becomes applicable to rainfed lowlands, it can contribute greatly to the establishment and expansion of a stable rice production system.

Shortened germination time was more pronounced when seeds were soaked at 24h and 48h at 20 ℃ water temperature, and at 12h at 30 ℃. Soaking the seeds for 12h at 30 ℃ water temperature (similar to African conditions) reduced germination time by about 18 hours compared with non-priming (Table 1). With priming, shoot elongation rates after germination improved 1.2 times in sandy soils with moisture content from 3 to 20% (field capacity = 22.2%) inside growth chambers (Fig. 1). Emergence time, meanwhile, was shortest at 8% soil moisture content, equivalent to dry conditions (Fig. 2). Emergence uniformity was also improved by seed priming except at soil moisture contents equal to 6% and 20% (Fig. 3). These results indicate that emergence speed is improved and stabilized by increasing the growth rate of the seedlings and thus accelerating germination.

Seed priming is practical because it can be accomplished by simply soaking and re-drying the rice seeds, eliminating the need for dedicated facilities. In conclusion, this study has shown that stabilization of emergence with fast germination rates can be obtained in the rainfed lowlands of Africa, and that primed seeds can be stored for several months as they have already been pre-soaked.

(K. Matsushima, J.-I. Sakagami)

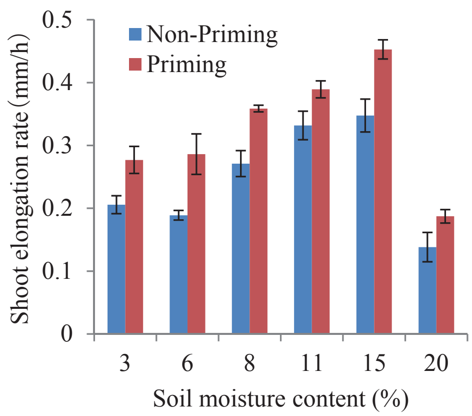

Fig. 1. Effect of seed priming on shoot elongation rate
**, *: Significantly different at P<0.01, 0.05 (*T*-test)

Table 1. Germination time (h) after seed priming at varying temperatures and soaking times

Soaking time (h)	Soaking temperature (℃) 15	20	25	30
6			39.7 ± 4.6 ns	35.5 ± 1.7 **
12	46.0 ± 0.5 ns	37.7 ± 2.3 *	35.6 ± 0.8 **	34.4 ± 0.7 **
24	39.0 ± 0.7 **	34.4 ± 1.3 **	35.6 ± 1.0 **	35.6 ± 1.8 **
36	41.6 ± 2.0 *	36.7 ± 1.2 **	39.7 ± 0.7 **	
48	36.0 ± 0.5 **	34.3 ± 0.3 **	-	
60	37.9 ± 1.7 **	36.5 ± 1.2 **		
96	36.2 ± 1.4 **	44.1 ± 3.8 ns		
120	40.0 ± 2.0 *	-		
Control	51.9 ± 2.4			

The time to achieve 50% germination is germination time. "-" in the tables indicates less than 50% germination. Mean±SE. **, *: Significantly different at P<0.01, 0.05 (T-test). After soaking at several temperatures and at multiple time points, the seeds were dried back to attain initial seed weight before submerging in water at 25 ℃. Germination was investigated below 30 ℃ under dark conditions.

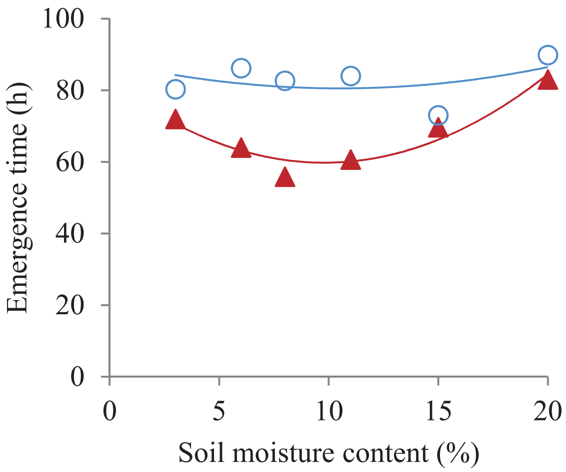

Fig. 2. Shortened emergence time caused by seed priming
Non-priming：○, $y = 0.066x^2 - 1.385x + 87.814$, r=0.395
Priming：▲ $y = 0.237x^2 - 4.630x + 82.442$, r=0.957**

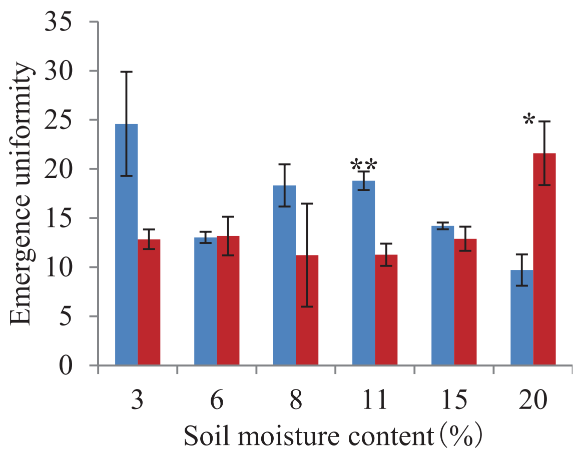

Fig. 3. Effect of seed priming on germination uniformity (formula shown at right)
※Emergence is uniform when'priming' value is lower

Germination Uniformity (GU) is the standard deviation of the mean of germination time. The formula used to calculate is:

$$GU=\sqrt{\frac{\Sigma\{(\bar{D}-D)^2\times n\}}{\Sigma n-1}}$$

where
$\bar{D}$: mean of germination time, D: time after sowing, and n: number of germinate at the time of D

TOPIC 3

Pathogenicity of rice blast (*Pyricularia oryzae* Cavara) isolates from Cambodia and its geographical distribution

Evaluation of 122 blast (*Pyricularia oryzae* Cavara) isolates collected from the Tonle Sap and Mekong River regions of Cambodia revealed a wide variation.

Using a new designation system, the blast isolates were categorized into 92 races based on the reaction patterns of rice differential varieties (DVs) harboring 23 resistance genes and of 1 susceptible cultivar, Lijiangxintuanheigu (LTH).

Cluster analysis was used to classify the blast isolates into 3 groups — I, IIa, and IIb — using data from the reaction patterns of the DVs and LTH (Fig. 1). We used the classification method established under the new designation system, alongside cluster analysis and the geographical distribution of blast isolates, to investigate the diversity and differentiation of blast races in the

Tonle Sap and Mekong River regions.

The distribution of the blast races differed between the 2 regions. Blast isolates of group IIa were distributed commonly in both regions, and groups I and IIb occurred at higher frequencies in the Tonle Sap region rather than in the Mekong region. The blast isolates in groups I and IIb were also less diverse than those in group IIa. Accordingly, Group II blast isolates overall were distributed in both regions with high diversity, but some modified blast isolates were additionally distributed in the Tonle Sap region (Fig. 2).

(Y. Fukuta [TARF, JIRCAS])

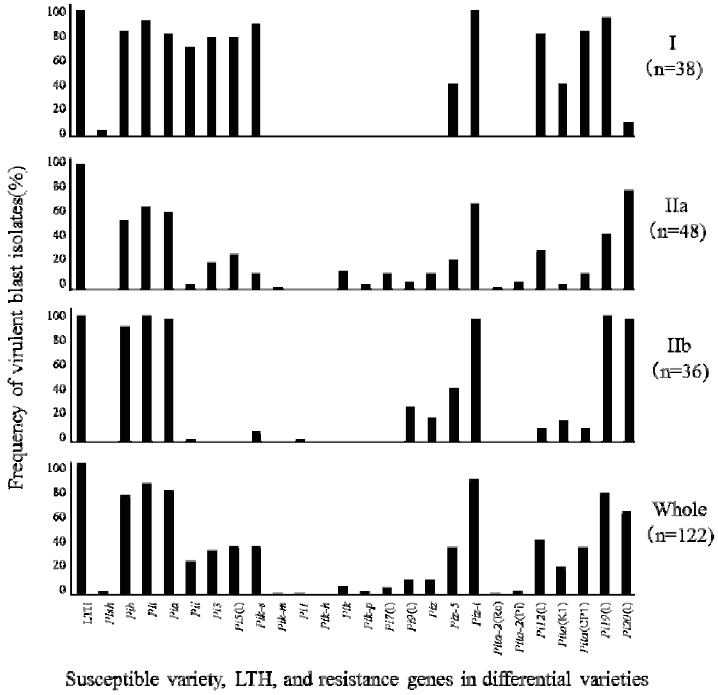

Fig. 1. Frequency of virulent blast isolates from Cambodia against differential varieties.

Blast isolates from Cambodia were classified into three groups--I, IIa, and IIb--by cluster analysis based on the reaction pattern data of differential varieties harboring 23 resistance genes and of 1 susceptible cultivar, Lijiangxintuanheigu (LTH).

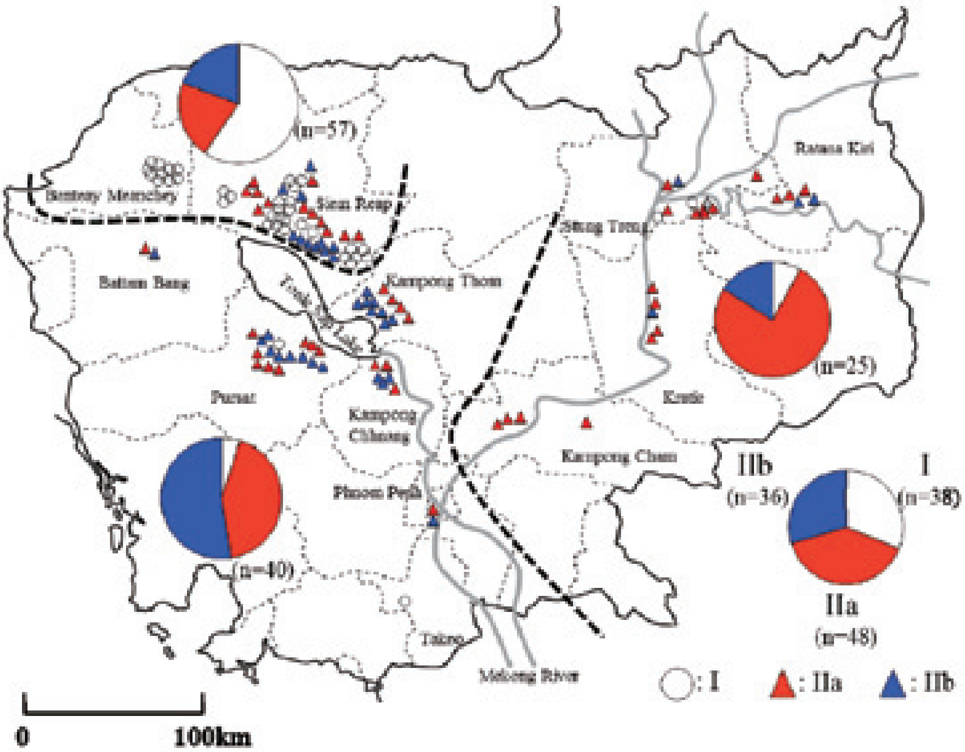

Fig. 2. Distribution of blast isolates classified into three groups--I , IIa, and IIb--in Cambodia.
Blast isolates of group I was distributed at a high frequency in Siem Reap. In the Mekong River region, group IIa was found at a high frequency, whereas groups I and IIb were at low frequencies. In the Tonle Sap region, the frequency of groups IIa and IIb were similarly high. High diversity group IIa probably comprises the basic population of blast races in Cambodia and that groups I and IIb were modified from IIa. These unique distributions of blast races among the 3 regions might occur and be attributable to differences in genotypes of blast resistance genes in the cultivated rice varieties.

Novel blast resistance genes from a landrace rice variety in Myanmar

The use of broad-spectrum resistance genes is an effective way to achieve durable resistance against rice blast (*Pyricularia oryzae* Cavara) in rice (*Oryza sativa* L.).

We previously surveyed the diversity of blast resistance in 948 rice varieties and found Haoru (International Rice Research Institute genebank acc. no. IRGC33090), a Myanmar rice landrace with broad-spectrum resistance against blast.

We examined the genetic basis of Haoru's broad-spectrum resistance using the standard blast differential system consisting of the standard isolates and differential varieties.

For genetic analysis, we used the BC_1F_1 population and BC_1F_2 lines derived from crosses of Haoru with a susceptible variety, US-2. Co-segregation analysis of the reaction pattern in the BC_1F_1 population against the 20 standard isolates suggested that Haoru harbors three resistance genes.

Using bulk-segregant and linkage analysis, we mapped two of the three resistance genes on chromosomes12 and 6, and designated them as *Pi58*(t) and *Pi59*(t), respectively.

Pi58(t) and *Pi59*(t) were differentiated from other reported resistance genes using the standard differential system. The estimated resistance spectrum of *Pi58*(t) corresponded with that of Haoru, suggesting that *Pi58*(t) is primarily responsible for Haoru's broad-spectrum resistance.

In addition, *Pi59*(t) and the third gene were also proven to be new and useful genetic resources for studying and improving blast resistance in rice.

(Y. Fukuta [TARF, JIRCAS])

Table 1. Reaction patterns of Haoru and segregation lines harboring new resistance genes to standard differential blast isolates

Line	Resistance gene	Chr.	Reaction patterns																			
			Standard differential blast isolates from the Philippines																			
			PO6-6	CA89	43	CA41	M64-1-3-9-1	M39-1-3-8-1	M39-1-2-21-2	M36-1-3-10-1	JMB8401	IK81-25	IK81-3	BN111	V850256	V850196	V86010	JMB840610	BN209	M101-1-2-9-1	B90002	C923-49
Haoru	-	-	R	R	S	R	R	R	R	R	R	S	S	R	R	R	R	R	R	R	R	R
US-2	-	-	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
BC_1F_2 line (US-2/Haoru//US-2)	***Pi58* (t)**	**12**	**R**	**R**	**S**	**R**	**R**	**R**	**R**	**R**	**R**	**S**	**S**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**	**R**
IRBL12-M	*Pi12* (t)	12	S	S	S	S	S	S	S	S	S	S	S	S	S	M	M	R	R	R	R	R
IRBL19-A	*Pi19* (t)	12	S	S	S	M	S	S	S	M	M	S	S	S	S	S	S	S	S	S	S	S
IRBLta-CP1	*Pita*	12	S	S	S	R	M	M	S	S	M	R	R	S	R	R	S	S	S	S	M	S
IRBLta2-Pi	*Pita-2*	12	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S
IRBL20-IR24	*Pi20* (t)	12	S	S	S	S	S	S	R	R	S	M	M	R	S	S	R	S	S	S	R	R
BC_1F_2 line (US2/Haoru//US2)	***Pi59* (t)**	**6**	**S**	**S**	**S**	**S**	**R**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**R**	**R**	**S**	**S**	**R**	**R**
IRBLz-Fu	*Piz*	6	R	M	R	M	R	R	R	R	R	R	R	S	M	R	R	M	R	R	M	R
IRBLz5-CA-1	*Piz-5*	6	R	M	M	R	M	R	R	R	R	R	R	R	R	R	M	R	M	S	M	M
IRBLzt-T	*Piz-t*	6	S	S	S	S	R	R	S	S	S	S	S	S	S	S	R	R	S	S	R	R
IRBL9-W	*Pi9*	6	R	R	R	R	R	M	R	R	R	R	R	R	R	R	S	R	R	R	R	R

R: Resistant, M: Moderately resistant, S: Susceptible

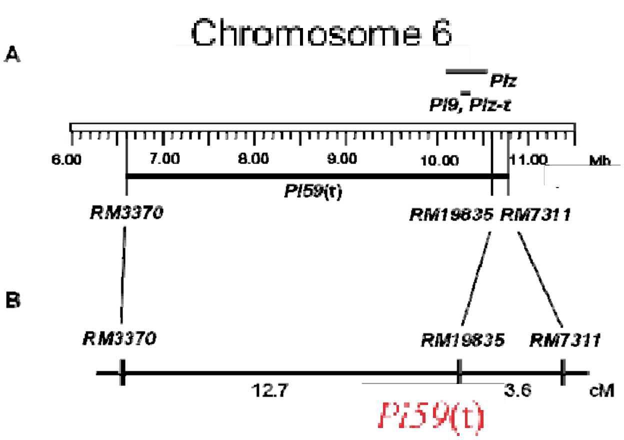

Fig. 1a. Position of resistance gene, *Pi59*(t), on chromosome 6.
A: Physical map. Position based on the Nipponabare's genome sequence.
B: Genetic map. Genetic distances between the gene and markers were estimated using the BC1F2 lines of US-2/Haoru//US-2 (n=55).

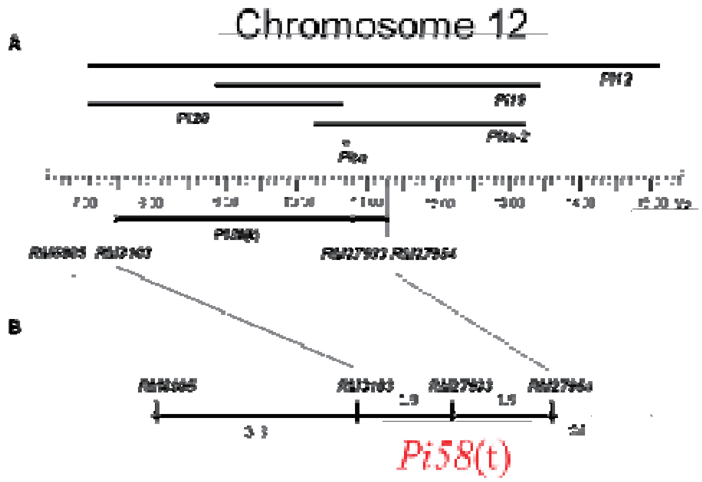

Fig. 1b. Position of resistance gene, *Pi58*(t), on chromosome 12.
A: Physical map. Position based on the Nipponabare's genome sequence.
B: Genetic map. Genetic distances between the gene and markers were estimated using the BC1F2 lines of US-2/Haoru//US-2 (n=106).

TOPIC 5

Identification of RNA-binding protein that regulates growth, senescence, and stress tolerance in rice

Because plants cannot move freely, they must grow and live in place even under environmental stress conditions such as drought. Thus, plants have developed a mechanism to survive under such conditions by controlling the function of various genes. Under drought conditions, expression of the gene coding hydrophilic proteins, transcription factors, and various proteins involved in stress tolerance is induced. The role of stress-induced CCCH-type zinc finger proteins was not well understood. In this study, we revealed that a stress-inducible CCCH-type zinc finger protein OsTZF1 binds to RNA, and is involved in the regulation of growth, senescence, and stress tolerance.

Expression of *OsTZF1* was induced by drought, high-salt stress, hydrogen peroxide, abscisic acid, methyl jasmonate, and salicylic acid (Fig. 1A, B). The expression was observed in callus, coleoptile, young leaf, and panicle tissues under normal growth condition. OsTZF1-green fluorescent protein localization was observed in the cytoplasm and cytoplasmic foci under stress condition (Fig. 1C). OsTZF1 binds to RNA, suggesting that OsTZF1 might be associated with RNA metabolism (Fig. 1D). Transgenic rice plants overexpressing OsTZF1 (OsTZF1-OX) exhibited delayed seed germination, growth retardation at the seedling stage, and delayed leaf senescence (Fig. 2A, B). OsTZF1-OX plants also showed improved tolerance to high-salt and drought stresses (Fig. 2C). Microarray analysis revealed that genes related to stress were regulated in the OsTZF1-OX plants.

OsTZF1 may serve as a useful biotechnological tool for the improvement of stress tolerance in various plants through the control of RNA metabolism of stress-responsive genes. Since the delay-like growth was observed when we overexpressed OsTZF1 constitutively, it might be necessary to utilize the suitable promoters such as stress-responsive promoters to improve environmental stress tolerance without causing growth retardation.

(A. Jan, K. Maruyama, D. Todaka, S. Kidokoro [The University of Tokyo], M. Abo [Meiji University], E. Yoshimura [The University of Tokyo], K. Shinozaki, [RIKEN], K. Yamaguchi-Shinozaki and K. Nakashima)

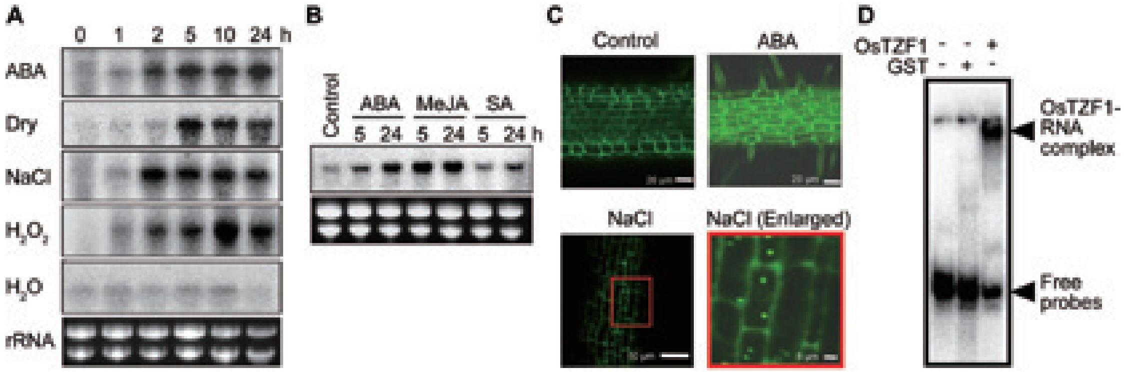

Fig. 1. Expression of *OsTZF1*, subcellular localization, and RNA-binding activity of OsTZF1.
(A) RNA gel-blot analysis of *OsTZF1* expression under different stress conditions. Expression was induced by abscisic acid (ABA), dry, high-salt (NaCl), and hydrogen peroxide (H_2O_2). Water (H_2O) was used as the control.
(B) Hormone-dependent expression analysis of OsTZF1. Expression was induced by methyl jasmonate (MeJA) and salicylic acid (SA) as well as ABA.
(C) Subcellular localization of OsTZF1-green fluorescent protein (GFP).
(D) Binding analysis of the RNA fragment of stress-related gene and OsTZF1-GST fusion protein. OsTZF1-GST can bind to RNA but GST protein does not bind to RNA.
These pictures were adopted from Jan et al. (2013) [1)] (Copyright American Society of Plant Biologists; www.plant-physiol.org).

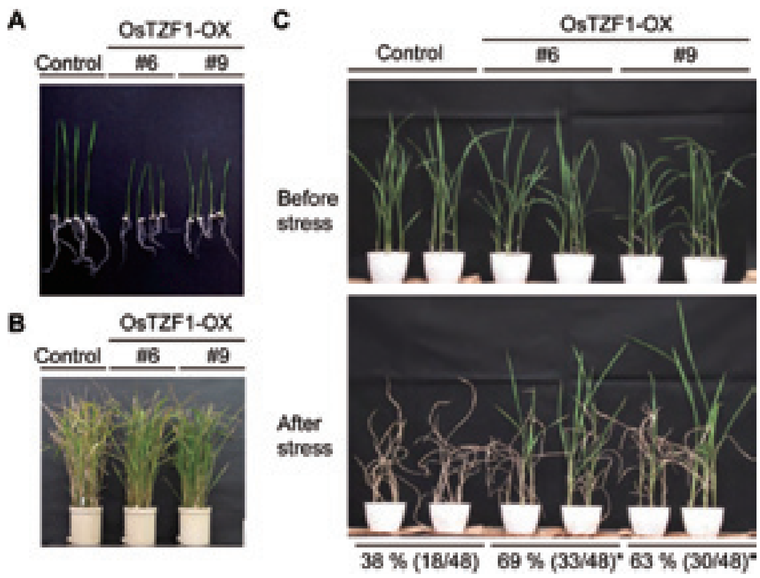

Fig. 2. Phenotypes of transgenic rice plants overexpressing OsTZF1 (OsTZF1-OX).
(A) Growth retardation observed in seedling stage.
(B) Delayed senescence observed in matured plants.
(C) Improved drought tolerance. Survival rates were shown below the pictures. Asterisks showed significantly higher survival rates than the control (P<0.01).
These pictures were adopted from Jan et al. (2013) [1)] (Copyright American Society of Plant Biologists; www.plantphysiol.org).

1) A. Jan, K. Maruyama, D. Todaka, S. Kidokoro, M. Abo, E. Yoshimura, K. Shinozaki, K. Nakashima, K. Yamaguchi-Shinozaki (2013) OsTZF1, a CCCH-Tandem Zinc Finger Protein, Confers Delayed Senescence and Stress Tolerance in Rice by Regulating Stress-Related Genes. Plant Physiology 161:1202-16.

TOPIC 6

Development of stress-tolerant rice plants without growth defect using *Oshox24* promoter

Rice production is largely inhibited by environmental stresses such as drought and high salinity. Developing transgenic rice plants with enhanced stress tolerance is therefore necessary. Stress-responsive promoters with low expression under normal growth conditions are needed to minimize the adverse effects of stress-tolerance genes on rice growth. We aim to find stress-inducible promoters with low expression levels under normal growth conditions, and develop the technology to produce rice plants showing enhanced stress tolerance without growth inhibition.

We conducted expression analyses of drought-responsive genes in rice plants using a microarray, and selected *Oshox24* for promoter analysis. Transient assays using the rice promoters indicated that AREB/ABF (abscisic acid (ABA)-responsive element-binding protein/ABA-binding factor) transcription factors enhanced expressions of the gene. We generated transgenic rice plants containing the *Oshox24* promoter and the β-glucuronidase (GUS) reporter gene. GUS assays revealed that the *LIP9* and *OsNAC6* promoters that have been used were induced by drought, high salinity, and ABA treatment, and both promoters showed strong activity under normal growth conditions in the root (Fig. 1A). The *Oshox24* promoter was strongly induced by stresses and ABA, but showed low activity under normal growth conditions (Fig. 1A). In seeds, GUS staining showed that *Oshox24* expression was low and expressions of the other genes were high (Fig. 1B). Transgenic rice plants overexpressing a stress-tolerant gene under the control of the *Oshox24* promoter showed increased tolerance to drought and high salinity, and no growth defects (Fig. 2).

These data suggest that the *Oshox24* promoter is useful for overexpressing stress-tolerance genes without adversely affecting growth. Verification of the transgenic plants expressing stress-tolerant genes and the *Oshox24* promoter in fields is required.

(K. Nakashima, A. Jan, D. Todaka, K. Maruyama, S. Goto, K. Shinozaki [RIKEN], K. Yamaguchi-Shinozaki)

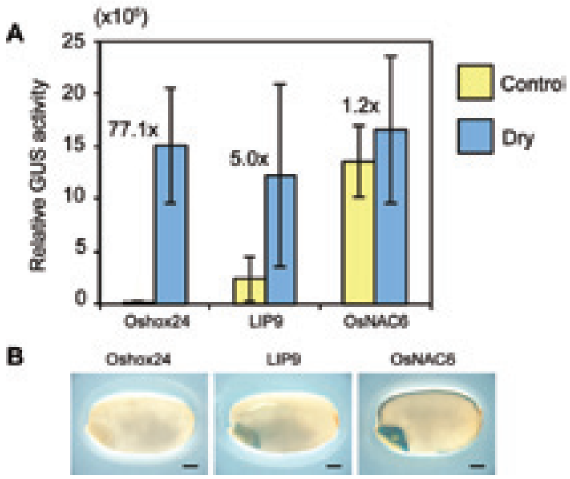

Fig. 1. Expression analysis of the newly isolated rice *Oshox24* promoter and rice *LIP9* and *OsNAC6* promoters that have been used.
We generated transgenic rice plants containing each promoter and the β-glucuronidase (GUS) reporter gene.
(A) GUS activity at 0h (Control) and 5h drought (dry) condition in the shoot. Error bars: SD.
(B) GUS staining in seeds of transgenic plants. Bars: 1mm.
These were adopted from Nakashima et al. (2014) (Copyright Springer; http://link.springer.com/journal/425).

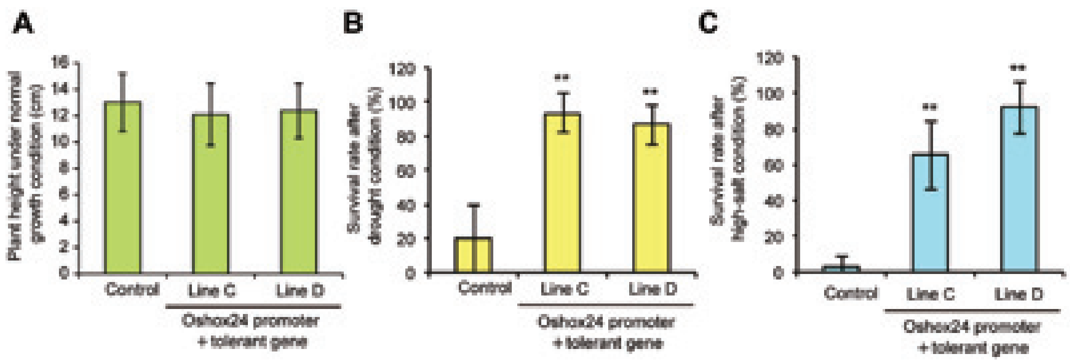

Fig. 2. Phenotype of transgenic plants expressing a stress-tolerant gene using the *Oshox24* promoter.
(A) Plant heights of 14-day-old plants under normal growth condition.
(B) Drought tolerance of 14-day-old plants.
(C) High-salinity tolerance of 14-day-old plants.
Error bars: SD. Asterisks indicate significant increase compared with the control (P<0.01).
These were adopted from Nakashima et al. (2014) (Copyright Springer; http://link.springer.com/journal/425).

1) K. Nakashima, A. Jan, D, Todaka, K. Maruyama, S. Goto, K. Shinozaki, K. Yamaguchi-Shinozaki. (2014) Comparative functional analysis of six drought-responsive promoters in transgenic rice. Planta. 239:47-60.

TOPIC 7

Laboratory manual for studies on soybean rust resistance

Soybean [*Glycine max* (L.) Merrill] is an economically important legume crop, with more than 80 million tons exported to the world market mainly from North and South American countries. Asian soybean rust (ASR), caused by *Phakopsora pachyrhizi* Sydow & P. Sydow, is one of the biggest threats to stable soybean production in South America and in other tropical and sub-tropical regions.

Various studies related to the pathogenic variations of ASR and the development of ASR-resistant cultivars in each country have been done. Since ASR pathogens are widespread across borders, each country has had to cope with this disease based on information using a common resistance evaluation method. However, it was difficult to compare the pathogenicity of ASR pathogens and the degree of ASR resistance in soybean genotypes among countries because the evaluation method related to ASR resistance was not standardized.

First, we standardized the experimental protocols – i.e., 1) multiplication of ASR urediniospores, 2) single-lesion isolation, 3) inoculation of soybean with spore suspension, 4) evaluation of ASR pathogenicity, 5) evaluation of ASR resistance in soybean genotypes, and 6) evaluation of ASR tolerance of soybean genotypes (Fig. 1, Table 1) -- to obtain experimental results that are reproducible. South American ASR pathogens and the differential varieties were utilized for this work (Table 2). Then, we optimized the experimental protocols related to SSR marker analysis for marker-assisted selection (MAS) so that domestic institutions in South America can carry out their soybean breeding programs for ASR resistance. Finally, we compiled these standardized experimental protocols into a single manual, titled “Laboratory manual for studies on soybean rust resistance,” which can be accessed from the JIRCAS website: http://www.jircas.affrc.go.jp/english/manual/soybean_rust/JIRCAS_manual_soybean_rust.pdf

The data for the pathogenicity of ASR pathogens and for the degree of ASR resistance in soybean genotypes obtained by following this manual can be compared with previously obtained data (Akamatsu et al., 2013). Therefore, this manual is expected to promote research related to pathogenic variations of ASR pathogens and marker-assisted soybean breeding for ASR-resistant cultivars.

(N. Yamanaka, H. Akamatsu, Y. Yamaoka [University of Tsukuba])

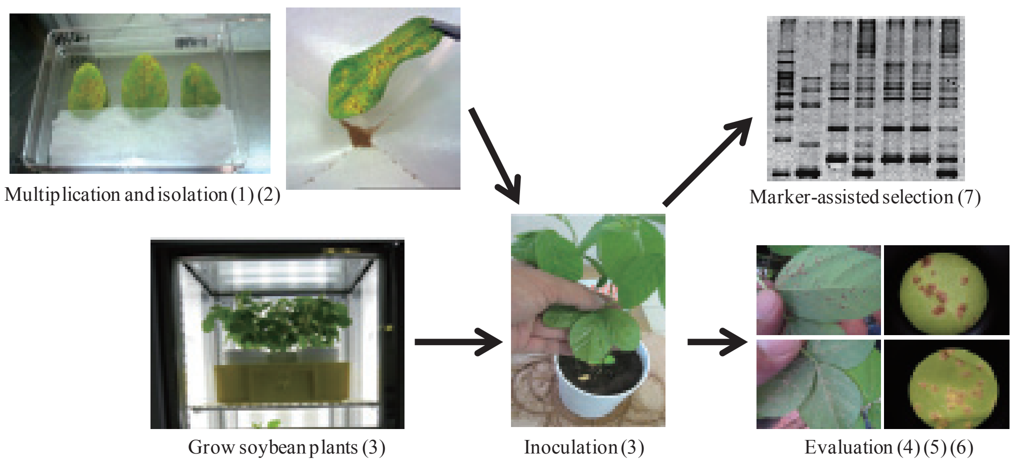

Fig. 1. Evaluation process for Asian soybean rust (ASR) resistance. The numbers in the figure correspond to that of Table 1.

Table 1. Contents of the manual for Asian soybean rust (ASR) resistance

No.	Item	Details
1	Multiplication of ASR urediniospores	Method to multiply ASR urediniospores for the following experiments
2	Single-lesion isolation	Method to isolate ASR pathogens from the ASR population that may contain various races
3	Inoculation of soybean with spore suspension	Methods to grow soybean plants, to prepare urediniospore suspension, and to inoculate urediniospore suspension to soybean plants
4	Evaluation of ASR pathogenicity	Method to evaluate virulence of ASR pathogens based on the lesion type
5	Evaluation of ASR resistance in soybean genotypes	Method to evaluate resistance of soybean genotypes based on the lesion type
6	Evaluation of ASR tolerance of soybean genotypes	Method to evaluate tolerance of soybean genotypes based on infection index and degree of leaf-yellowing
7	Marker-assisted selection of ASR resistance	Method of SSR marker analysis for the marker-assisted soybean breeding of ASR resistance

Table 2. Example of pathogenic data for Asian soybean rust (ASR) pathogens based on the resistance reactions of the differential varieties

Country	Location	Season	Differential varieties* No.	PI 200492 1	PI 368039 2	PI 230970 3	PI 417125 4	PI 462312 5	PI 459025 6	PI 200562 7	PI 416764 8	PI 587855 9	PI 587880A 10	PI 587886 11	PI 587905 12	PI 594767A 13	BRS 154 14	TK5 15	PI 548628 16
Argentina	Pergamino,	2007/2008		S	S	S	S	nd	S	R	R	nd	R	S	R	R	nd	S	S
	Buenos Aires	2009/2010		S	S	S	S	S	R	IM	S	I	R	S	S	IM	S	S	S
Brazil	Passo Fundo,	2007/2008		S	S	R	IM	S	S	R	IM	IM	S	S	IM	R	S	S	S
	Rio Grande do	2008/2009		S	S	IM	S	I	IM	R	S	I	I	S	I	R	S	S	S
		2009/2010		S	S	S	IM	I	R	R	S	I	I	S	R	R	S	S	S
Paraguay	Capitán Miranda,	2007/2008		S	S	S	S	S	S	R	S	I	R	S	I	R	S	S	S
	Itapúa	2008/2009		S	R	S	S	S	R	R	R	I	I	S	I	R	S	R	S
		2009/2010		IM	S	IM	IM	I	IM	R	IM	I	I	S	I	R	S	R	S
Japan	Tsukuba	2007		R	R	S	S	R	R	R	R	nd	I	S	R	R	nd	S	S
		2008		I	I	R	R	R	R	I	I	nd	R	R	R	nd	nd	S	R

I: Immune; R: Resistant; IM: Intermediate; S: Susceptible; nd: no data
* Latest set includes 17. PI517602B and 18. No6-12-1.

TOPIC 8

Enhancement of porosity and aerenchyma formation by nitrogen deficiency in rice roots (*Oryza sativa* L.)

Lysigenous aerenchyma is formed by cell collapse accompanied with cell death. The aerenchyma in roots provides oxygen from the ground portion to the roots, and is concerned with waterlogging tolerance in plants. Field crops such as wheat show generally poor tolerance to water logging, whereas semiaquatic crops such as rice show high tolerance to water logging. One of the major reasons for the difference in tolerance levels is the initiation of aerenchyma formation between these crops. In wheat, aerenchyma is inducibly formed by multiple environmental factors such as oxygen and nutrient (N, P, K) deficiencies. On the other hand, rice forms two kinds of aerenchyma: constitutive and inducible aerenchyma. Thus, the mechanism of aerenchyma formation in rice is more complicated compared with field crops. Moreover, the mechanism of aerenchyma formation induced by nitrogen deficiency has remained unknown, although the resulting aerenchyma is likely to reduce energy loss. In this study, we attempted to (1) establish reliable growth conditions to estimate aerenchyma formation, and (2) reveal the pattern of aerenchyma formation induced by nitrogen deficiency in rice roots.

Before evaluating aerenchyma formation, we modified the growth conditions, e.g., hydroponic solution and growth period, to estimate precisely the response by nitrogen deficiency alone. We could then establish precise growth conditions demonstrating the recovery of growth vigor caused by pH reduction in hydroponic solutions (Fig. 1). Compared with nitrogen sufficiency, nitrogen deficiency facilitated the formation of air space in whole roots, i.e., an increase in porosity (Fig. 2). In order to determine the spatial and temporal patterns of aerenchyma formation induced by nitrogen deficiency, cross-sections from seminal roots of seedlings grown only on nitrogen-deficient and oxygen-deficient conditions were prepared at several positions, from the root tip to the root base. Microscope observations revealed that aerenchyma formation was enhanced in both nitrogen- and oxygen- deficient conditions compared with reference condition (Fig. 3). In nitrogen-deficient conditions, aerenchyma formation initiated close to root base. Conversely, in oxygen-deficient conditions, the initiation was observed close to root tip (Fig. 3).

As far as we know, this is the first evidence that nitrogen deficiency in rice roots enhances porosity and aerenchyma formation. It strongly distinguishes the physiological roles of nitrogen deficiency and oxygen deficiency on induced aerenchyma formation, demonstrating the different initiation patterns of aerenchyma between nitrogen and oxygen deficiency. Aerenchyma induced by nitrogen deficiency may function in reducing respiration and remobilization of nitrogen, or both. Furthermore, our established growth condition is expected to isolate causal genes associated with aerenchyma (formed either constitutively or induced) toward developing molecular breeding techniques for conferring waterlogging tolerance in field crops in the near future.

(M. Obara, T. Abiko)

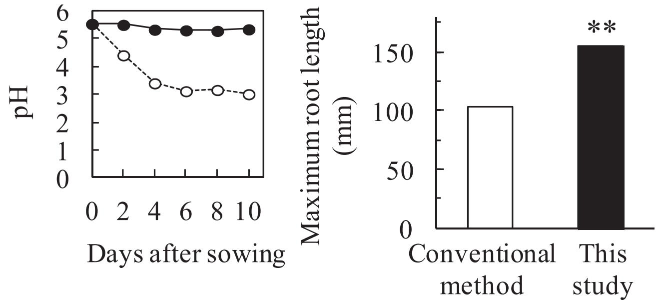

Fig.1. pH maintenance of nutrient solutions (left) and recovery of root elongation (right) in this study (improved method).
○: conventional method, ●: this study
Asterisks (**) represent a significant difference in maximum root length between conventional method and improved method at P-value of 1% level (one-way ANOVA).

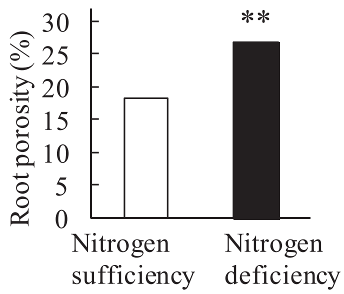

Fig. 2. Increased root porosity by nitrogen deficiency.
Root porosity refers to the size of air space including aerenchyma. Ten-day-old seedlings were used. Asterisks (**) represent a significant difference in root porosity between nitrogen-sufficient conditions and nitrogen-deficient conditions at P-value of 1% level (one-way ANOVA).

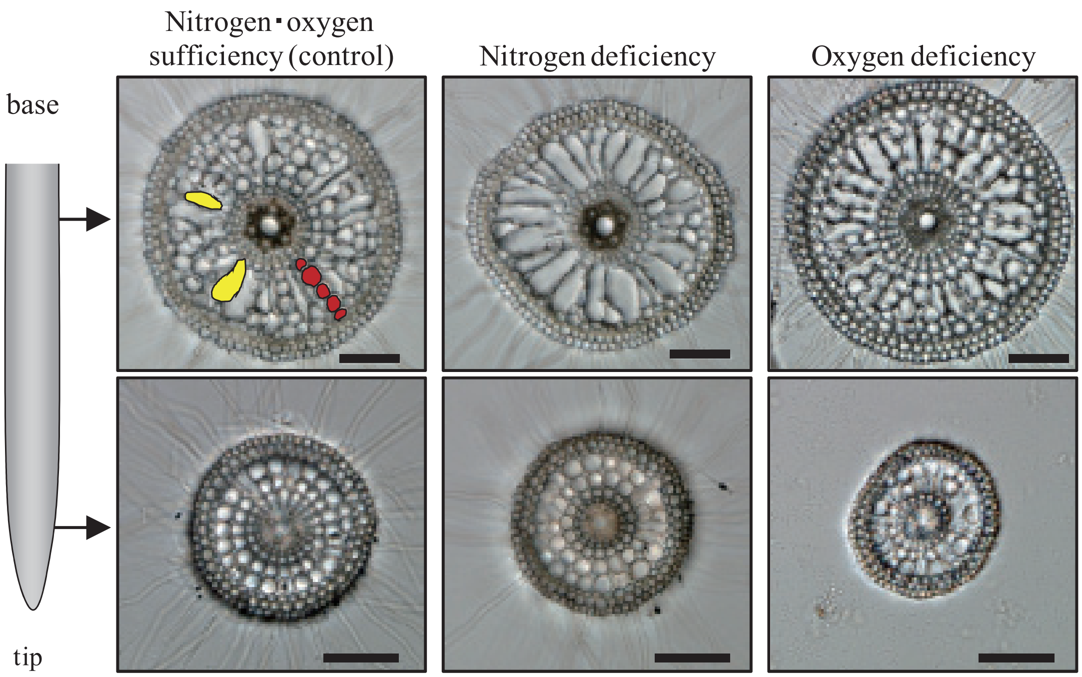

Fig. 3. Root aerenchyma in rice.
Increased aerenchyma was formed by nitrogen deficiency or oxygen deficiency. Examples of cortical cell, which are living cells, were illustrated in red. Examples of aerenchyma, which are dead cells, were illustrated in yellow. Scale bar in individual pictures indicates 100 μm.

PROGRAM C
Rural Livelihood Improvement Research Program

“Technology development for income and livelihood improvement of the rural population in developing regions”

JIRCAS’s Rural Livelihood Improvement Program is aimed at developing technologies that generate income and improve the living conditions of rural populations in developing regions, mainly in countries such as Lao PDR, Thailand, Malaysia, the Philippines, and China.

[Sustainable and Independent Farm Household Economy in IndoChina Project]

The research site is in Nameuang Village, in the mountainous areas of Vientiane Province in Lao PDR. In this project, it was made clear that conventional, extensive land use should be changed into an intensive one, depending on land conditions, in order to improve the farmers’ livelihoods. The farmers in Nameuang Village are classified into five types using three criteria: paddy landholding, upland rice planting area, and location. We have found that farmers who own paddies enjoyed better economic conditions compared with farmers who only have upland areas for cultivation. Based on this finding, we are trying to develop new technologies that will promote the year-round use of paddies. We have also introduced cash crops, fruits, and cattle in the upland, where agriculture is now based on stable upland rice and non-timber forest products for self-sufficiency, so that a diversified farming system can be established.

Annual meetings in Vientiane City, Laos

Two annual meetings were held in Vientiane to promote the collaborative research between JIRCAS and the National Agriculture and Forestry Research Institute (NAFRI) in Laos. The first was a workshop, held at the Agricultural Research Center on 17-18 December 2013, to enable researchers to share the research outputs and plans. The second was the meeting of the steering committee, which consists of executives from NAFRI and the Ministry of Agriculture and Forestry, at NAFRI headquarters on 25 March 2014 to manage the implementation of the project.

Annual workshop in December 2013

Steering committee meeting in March 2014

[Recycling-based Agricultural Production in China Project]

Regarding the medium- to long-term evaluations of grain production and environmental load in China, factors that can impact maize yield were clarified, and the apparent balances of nutrients in agricultural production based on the use of chemical fertilizer and animal manure were estimated. For introducing and establishing a recycling-based agricultural production system, we performed comparison studies on the supporting policies of western countries and Japan. Technology developments were carried out for minimum tillage wheat cultivation in the corn-wheat cropping system of Hebei province and for organic vegetable planting system for small-scale dairy farmers in semiarid areas.

Workshop on “Current situation and issues of recycling-based agricultural production system in upland farming areas of Northern China”

This workshop, held at JIRCAS Tsukuba on 5 September 2013, was attended by 25 participants. Nine reports were presented, including some of our research results on maize yield and its influence factors, pollution of ground water by nitrate, minimum tillage practice for wheat cropping, manure use in Inner Mongolia and its availability for vegetable production, marketing research for value-added agricultural products in semiarid areas, and Chinese organic food consumption behavior.

Workshop at JIRCAS in September 2013

[Food Resource Utilization Project]

JIRCAS and Kasetsart University co-organized an international symposium on microbial technology in Bangkok, aimed at using local food resources for advanced applications. A joint declaration on "the Asian Food Resource Network," which called for forging closer cooperation among local scientists, was adopted at the symposium. The network homepage, which introduces the food resource network concept, was launched, and a database of traditional fermented foods in Thailand was uploaded to the internet. Additionally, our group has discovered a Chinese local food resource that exhibits a blood pressure lowering effect. It is currently under 'patent pending' status.

[Asia Biomass Project]

To encourage the production of biofuel and biomaterials from agricultural residues, we successfully developed a new technology named "Biological Simultaneous Enzyme-production and Saccharification (BSES)," a method that uses anaerobic, thermophilic, and cellulolytic bacteria. Pilot-scale fermentation testing has been started in Thailand to demonstrate ethanol production using cassava pulp.

[Sustainable Forestry Production Project]

Technology development on sustainable management and conservation of forest resources was implemented. In Thailand, studies were conducted to improve the suitability of sandy soil for teak plantations. In Malaysia, a pollen dispersal pattern was revealed to enable natural mating important for healthy seed production. Also, we brought forward technology transfer on compressed lumber production using oil palm trunk waste.

[Tropical Coastal Aquaculture Project]

To develop sustainable and environmentally friendly aquaculture technologies in tropical coastal waters, we conducted research on co-culture/polyculture systems and culture-ground management in Southeast Asia. In Thailand, the effects of co-cultured seaweed and snails on the growth of giant tiger prawns were confirmed in large outdoor water tanks. In the Philippines, culture methods for sea cucumber, the key species of a polyculture system, were examined on the field under pompano net cages. In Malaysia, the trend in the blood cockles' catch was investigated in their culture grounds. In addition, substances controlling ovarian maturation of whiteleg shrimp were determined by measuring the vitellogenin gene expression levels.

TOPIC 1

Evaluation of genetic diversities and population structures of two small-sized fishes in Laos using microsatellite DNA markers

In Indochinese countries including Laos, greatly diversified indigenous fish fauna is present, and many are important food materials, particularly in remote rural areas. In recent years, however, the introduction and spread of invasive alien fishes as well as overfishing and urbanization have become major problems in such areas as they have contributed to the decline in species diversity / stock level of indigenous fishes and increased the risk of inbreeding among similar or closely related species. This situation necessitates the investigation of genetic diversities and soundness of each species in the region.

Among indigenous fish species, the *Esomus metallicus* (Cyprinidae) and *Parambassis siamensis* (Ambassidae) are the most common and widely distributed species over the Indochinese Peninsula (Fig. 1). Both of them are small-sized (60 – 70 mm in maximum standard length) and often consumed in fermented and dried forms. In the present study, we developed microsatellite DNA markers for these two species, whose samples were collected from 2 sites in Vientiane City and from 4 sites in the west coast of Nam

Gum River.

Twenty-four and forty microsatellite DNA markers were developed for *E. metallicus* and *P. siamensis*, respectively (Fig. 1). Using these markers, the genetic diversities of the two species (evaluated based on the number of alleles and heterozygosity) in the investigated area were confirmed to be high enough as of this moment (Fig. 3), and the efficiency of the markers was verified. In addition, based on the genetic cluster analysis of the genotype data for each specimen, the presence of three distinct genetic clusters for *E. metallicus* and two for *P. siamensis*, was estimated.

Further applications of microsatellite DNA markers over widespread areas would help confirm and provide a more detailed genetic characterization of local populations of the species. The network situation between genetic clusters by migration and breeding can also be estimated. Furthermore, this method is applicable not only for the two species above but also for various other species, including endangered species and the ones for aquaculture. Proper understanding of their strains and their management would be significant to its conservation and sustainability.

(S. Morioka, N. Koizumi [National Institute of Rural Engineering], B. Vongvichith [Living Aquatic Resources Research Center])

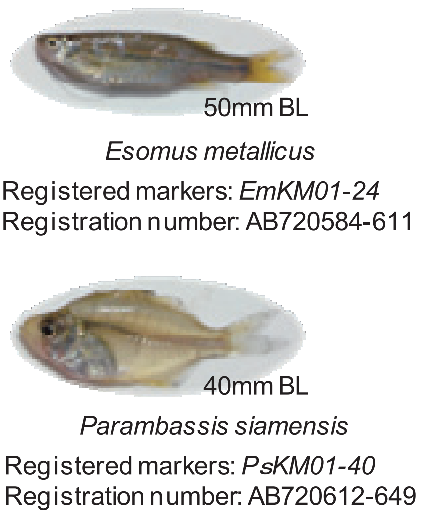

Fig. 1. Two fish species used in this study and their registered DNA markers

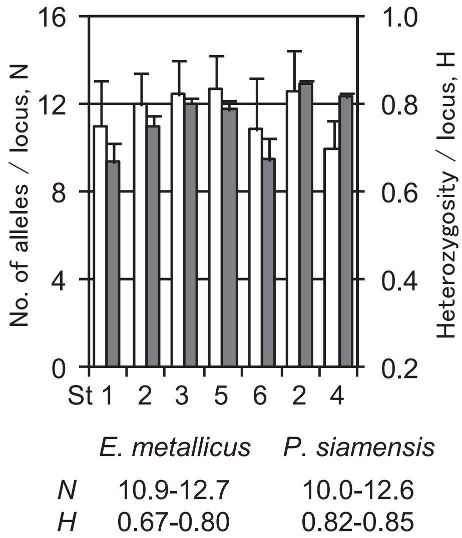

Fig. 2. Genetic diversities of two species based on number of alleles (white bars) and heterozygosity (grey bars)

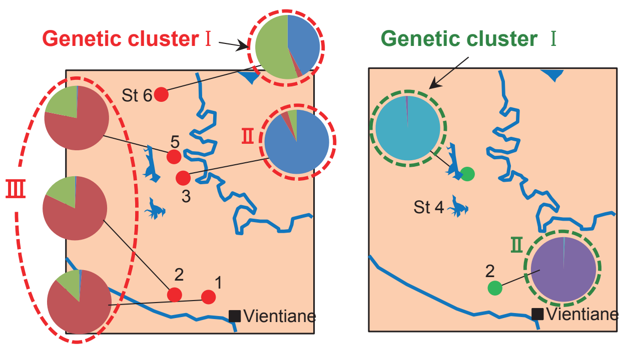

Fig. 3. Structures of genetic clusters of *E. metallicus* (left) and *P. siamenssis* (right)

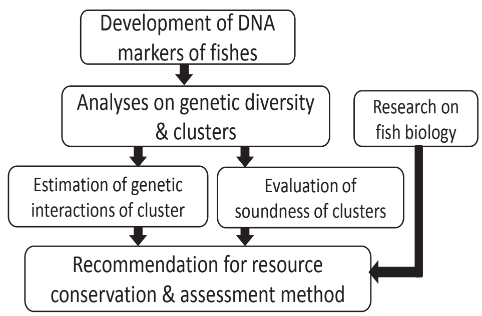

Fig. 4. Significance in usage of DNA markers for resource conservation & sustainable exploitation

Local farmers employ bat guano to overcome soil acidity in a semi-mountainous area of Lao PDR

Rainfed paddy soils in a semi-mountainous area in Lao PDR show strong acidity, i.e., pH(KCl) <4, despite belonging to a calcareous zone. Under such conditions, aluminum injury often becomes a major constraint in cultivating non-rice crops in rice-based cropping systems (Fig. 1). To remedy this situation, local farmers collect bat guano from limestone caves and mix them with soil down to the planting hall at seed sowing depth of upland crops. This study was conducted to clarify the effect of such practice.

Application of bat guano to the soil decreases the soil pH(H_2O) but increases pH(KCl). Also, it markedly reduces exchangeable aluminum in acidic soils (Fig. 2), which corresponds to the results of soil surveys in farmers' fields that received bat guano treatment. In spite of low aluminum-bound phosphorus (Al-P) content in bat guano itself, there is a marked increase of Al-P in soils treated with bat guano regardless of small variations in Ca-P or Fe-P (Fig. 3), which suggests the fixing of exchangeable aluminum with the phosphorus present in bat guano. Through such effects, plant growth in the early stages of tested upland crops are commonly enhanced even when the soils are enriched in exchangeable aluminum with aluminum chloride treatment (Fig. 4). These observations confirm that the bat guano improves soil fertility and mitigates aluminum toxicity.

Bat guano is collected from limestone caves in the neighboring village; however, depletion of this natural resource within a few decades is expected. Therefore, methods for efficient utilization based on the knowledge of its effectiveness must be established.

(K. Matsuo, N. Ae [Rakuno-gakuen Univ.], S. Vorachit [Agriculture Research Center, NAFRI, Lao PDR])

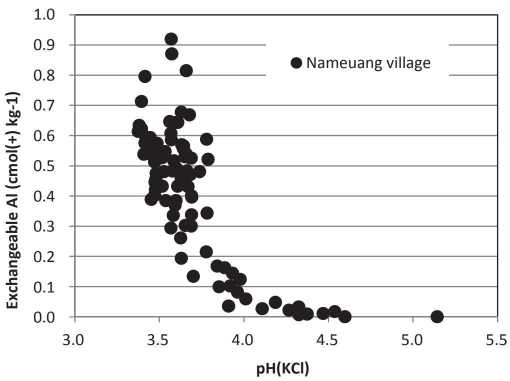

Fig. 1. Relationship between soil pH(KCl) and exchangeable Al in the paddy soil.

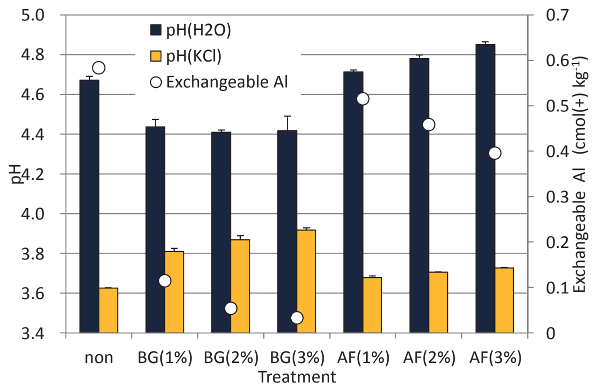

Fig. 2. Effects of bat guano(BT) and animal feces(AF) application on soil pH(H2O), pH(KCl) and exchangeable Al in the soil.

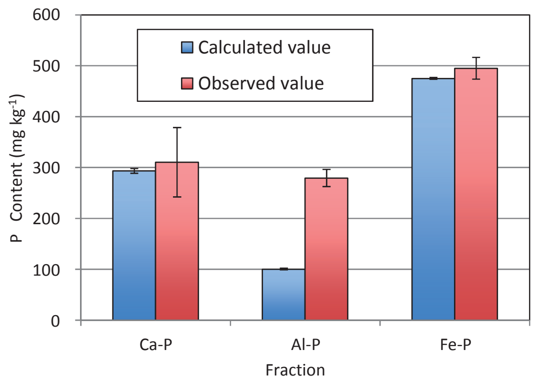

Fig. 3. Composition of inorganic phosphorus in the soil applied bat guano.

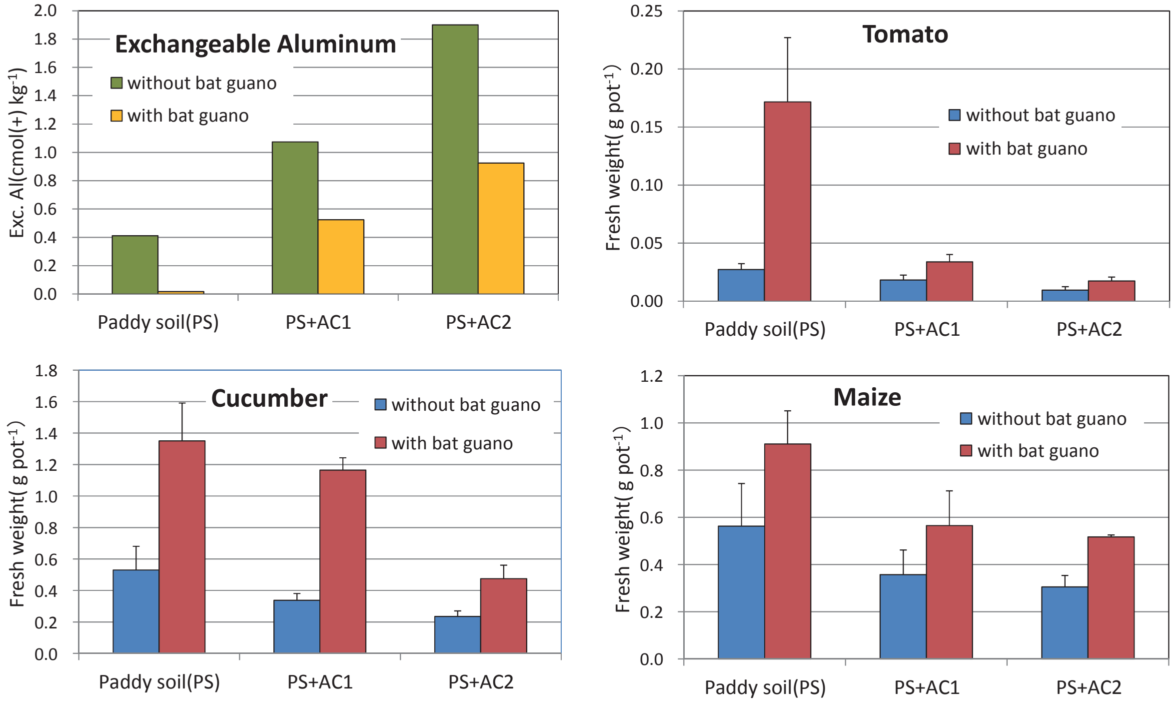

Fig. 4. Effect of bat guano application on exchangeable Al on the soil and on the growth of upland crops in early stage under different aluminum chloride treatment conditions. AC1: aluminum chloride@0.74 cmol kg^{-1}; AC2:aluminum chloride@1.48cmol kg^{-1} soil.

TOPIC 3

The effectiveness of introducing organic vegetable cultivation to small dairy farms in China's semi-arid regions

The cost of feed grains had risen sharply in recent years, leaving the viability of small dairy farms in China's semi-arid regions in a critical situation. To deal with this problem, some dairy farmers have started planning to become independent corn growers using dairy manure as fertilizer. However, there are apprehensions that extensive farming would result to wasting of water resources and increased erosion rates in conditioned soils (i.e., improved by application of manure) due to strong winds.

Cultivating organic vegetables as high value-added products is an effective method against rising feed grain prices, and for dairy farming to be sustainable, it is necessary for dairy farmers living far from the markets to introduce a cost-saving and labor-saving cultivation system. This idea came about following a survey where 1,200 consumers from four large cities (Beijing, Shanghai, Guangzhou and Ha'erbin) were asked how much they are willing to pay for organic vegetables over conventionally grown products. Results showed that only 11.9% of those surveyed were willing to pay over twice as much for organic vegetables.

We have introduced a low-cost multi-functional system utilizing regional resources for cultivating organic vegetables in Suniteyouqi, Inner Mongolia (Fig. 1). Fig. 1 shows heat released from fermenting manure, promoting germination of vegetable seeds; barrier of piled manure protecting seedlings, which have just sprouted, from strong wind; and PVC pipe preventing cutworms from damaging the plants. This cultivation system saves cost without building a greenhouse for raising seedlings and planting a forest to create windbreaks. This also results in labor-saving and relieves the dairy farmers of additional heavy burden as daily operation only requires the on-off switching of an irrigation pump.

We cultivated 170 mini pumpkin (Beibei) plants in a 500m^2 experimental field, and harvested 993 kg (9 pieces per plant, 649g per piece on average) using composted dairy manure and liquid fertilizer in 2012 (Table 1). The mini pumpkins harvested in 2012 and 2013 were sold to consumers through a company in Beijing that is involved in producing and selling organic vegetables, with 65.8% of its customers willing to pay more than 16.0 RMB/kg. The income derived from cultivating organic mini pumpkins can be evaluated based on the consumers' willingness to pay and the production and marketing costs (Table 2), that is, growing organic vegetables is expected to generate revenues of about 1021.4RMB/100m^2.

The significant points to consider when introducing this system are to keep the irrigation water delivered on dairy manure under the toxic level of sodium for plants, and to adopt a low-cost monitoring system for providing information about the organic farming practice to customers.

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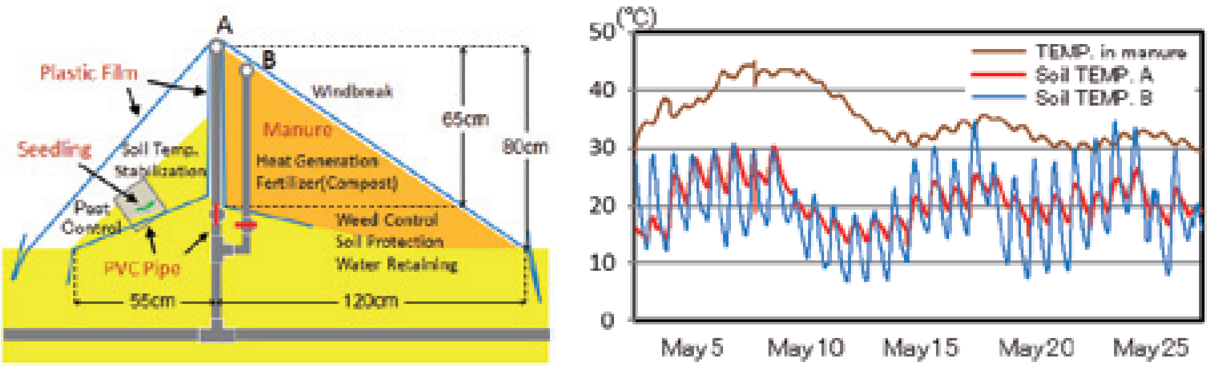

Fig. 1. Multifunctional vegetable cultivation system utilizing dairy manure.
* To minimize the effects of strong winds in spring, the system should be built against west-northwest, which is the direction of the heavy winds in Suniteyouqi, Inner Mongolia.
* Vegetable plants will be supplied fresh water when the valve of pipe A is opened, and will be applied liquid fertilizer through fermented manure when the valve of pipe B is opened.
* In the graph, Soil TEMP. A refers to the temperature at 5cm below the surface of the nursery in the system, and Soil TEMP. B refers to the temperature at 5cm below the surface of the ground outside the system.

Table 1. Components of dairy manure as a fertilizer resource (%)

	N	P_2O_5	K_2O
Composted dairy manure			
Upper parts of compost	1.65	0.98	0.40
Lower parts of compost	0.87	0.56	0.34
cf. Fresh dairy manure	1.50	1.02	1.12
Liquid fertilizer from manure			
Applied on July 24	0.01	0.05	0.11
Applied on July 29	0.01	0.03	0.10
Applied on July 31	0.01	0.03	0.12
Applied on August 4	0.01	0.01	0.05
Applied on August 8	0.01	0.02	0.07

* Only 5 application dates, with measured amounts, were presented in this table, though liquid fertilizer was applied 18 times while cultivating the mini pumpkins.

Table 2. Production and selling cost of mini pumpkins

	RMB/100m^2	Ratio
Materials cost	734.1	34.0
Seed	166.2	7.7
Fertilizer	0.0	0.0
Pesticide	0.0	0.0
Energy	47.3	2.2
Supply	482.9	22.4
Machine rental	37.6	1.7
Land rent	61.9	2.9
Labor cost	209.9	9.7
Transportation cost	514.5	23.9
Selling cost (estimated)	635.8	29.5
Total	2156.2	100.0

* Expected earnings (RMB/100m^2) can be calculated as (Expected selling price x Quantity – Total cost), that is, 16.0RMB/kg x 198.6kg/100m^2 – 2156.2RMB/100m^2 = 1021.4RMB/100m^2.

Potassium deficiency in fertilizer budget for crop production in China

There are several concerns about the negative environmental impact of excessive fertilizer use, especially nitrogen use, on Chinese agricultural production systems. Therefore, we calculated the nutrient intake by crops and the nutrient budget in China to obtain information on fertilizer demand and its effective use, food production, and the management of fertilizer resources from the view point of apparent nutrient (nitrogen (N), phosphorus (P) and potassium (K)) balance.

Data sets on chemical fertilizer types, crop production, livestock population, and human population came from "China Agriculture Yearbook," with 2000, 2005, and 2010 chosen as the target years. In this study, we assumed the rural population as half of total population. Basic unit values of N, P, and K excretion by human and livestock were obtained from "China Organic Fertilizer Ingredients"; N, P, and K concentration in crops were from "China Fertilizer"; and chemical fertilizer application rates for cereals were from "Fertilizer Guideline for Crops."

The budgets of chemical N and P fertilizers are larger than that of chemical K but smaller than that of organic fertilizers. Also, based on the output or crop yield, K output of cereal by-products (stems and leaves) occupies a significant portion of total K output.

The apparent N, P, and K balance shows a large surplus of N, an even amount of P, and a deficiency of K. For K, the crop K output was larger than the K budget; therefore, it is believed that the K deficiency will reduce soil K fertility.

The cereal K output includes by-products, leaving the farmland soil largely deficient in K fertilizer. However, if only the product part is removed and the by-products returned to the soil, then the amount of N, P, and K would be enough. Therefore, K deficiency for cereal will disappear when the by-product is sown back into the soil or used for mulching.

In this study, basic units of excretion, crop N-P-K contents, and statistical data were entered into a Microsoft Excel spreadsheet so the apparent nutrient balance in each province can be calculated. The results can be used for the effective management of fertilizer resources and for policy-making. On the other hand, we did not calculate the loss of N, P, and K during storage and composting and during volatilization of N when N was applied to alkali soils. We may incorporate these factors in future studies to obtain a more accurate balance measurement and a quantitative assessment of its environmental impact.

(S. Mishima [National Institute for Agro-Environmental Sciences], Chien H.)

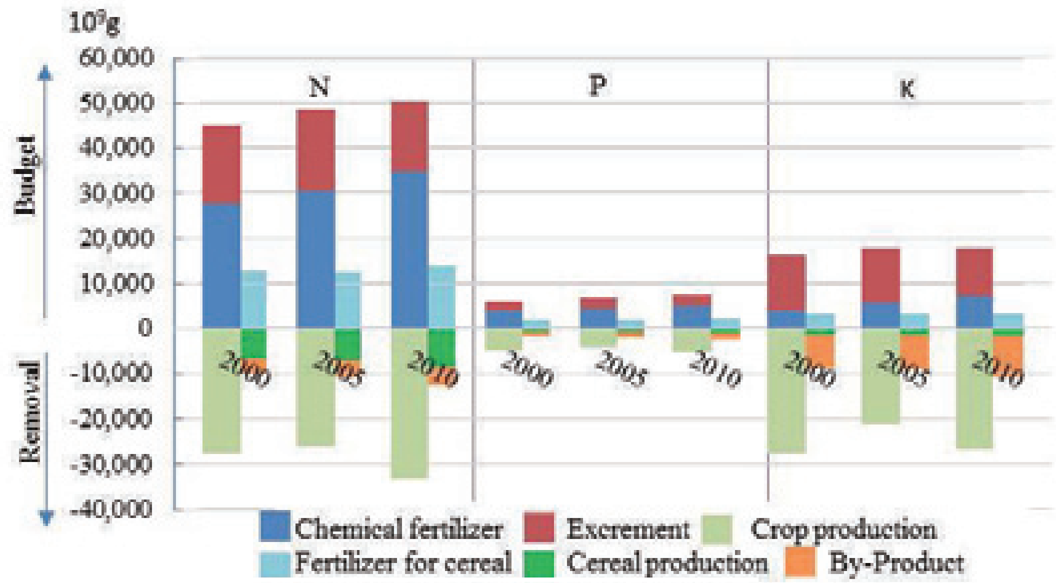

Fig. 1. Nutrient budget and removal

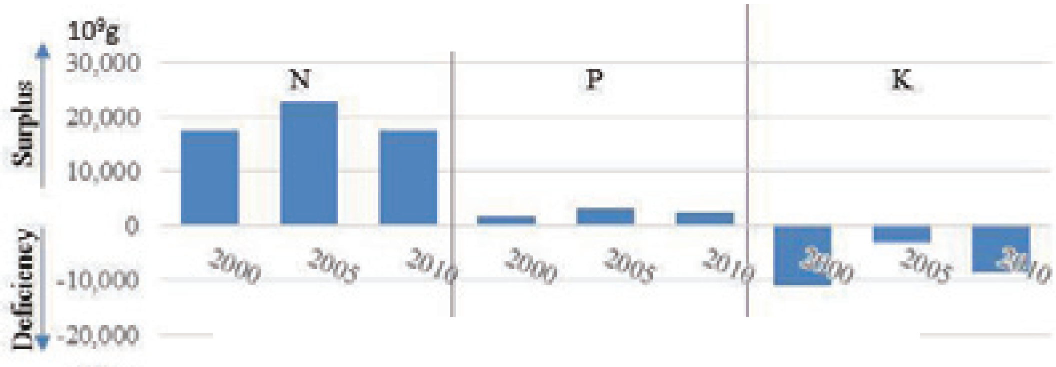

Fig. 2. Apparent N, P, and K balance for all crops

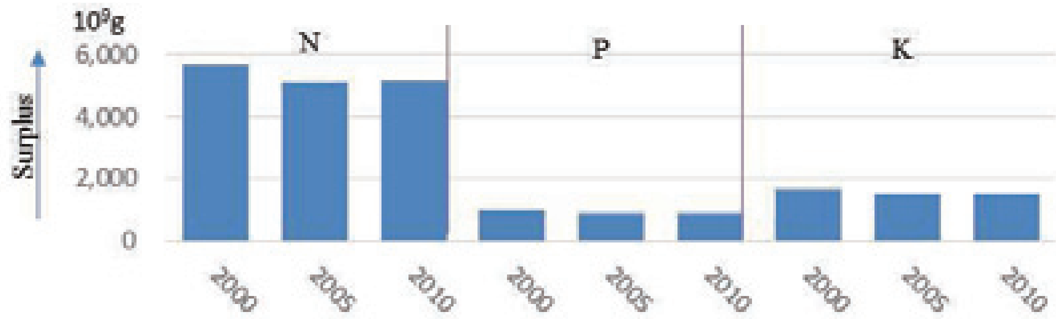

Fig. 3. Nutrient balance for cereals without by-product removal

TOPIC 5

Renin and chymase inhibitory activities of edible lichens, *Sulcaria sulcata* and *Lobaria kurokawae*

There is a wide variety of food resources, such as native agricultural and marine products as well as traditional fermented foods, in East and Southeast Asia. These food resources are being used as materials for functional foods and new processed foods. Unknown physiologically active substances may be found in foods produced from regionally specific materials, production methods and microorganisms. If we utilize these active substances as materials for functional foods, we can promote high value-addition to traditional agricultural products or conventional processed foods. In recent years, there has been a large-scale migration from farming villages to the cities and an increase in the number of middle-income groups in the cities in these regions. Accordingly, diversification and improved agricultural product quality are in increasing demand. In this study, renin and chymase inhibitory activities in foods were investigated. The activity promises inhibitory effect on elevated blood pressure.

We performed screening of the inhibitors on foods from East Asia. Results have clearly shown that the edible lichens, *Sulcaria sulcata* and *Lobaria kurokawae* (Fig. 1), contained the active substances. *S. sulcata and L. kurokawae* are consumed as foods in parts of Japan and China. Strong renin and chymase inhibitory activities exist in methanol, ethanol and water extracts of *S. sulcata* and *L. kurokawae* (Table 1). On the other hand, their extracts do not inhibit angiotensin converting enzyme (ACE). The inhibitory activities of the water extracts were retained after boiling or autoclave treatment (Table 1). Therefore, the inhibitory substances of the water extracts are very thermostable. Moreover, the water extracts decreased blood pressure in spontaneously hypertensive rats (Table 2).

These results showed that newly functional food materials with renin and chymase inhibitory activities could be produced using the edible lichens *S. sulcata* and *L. kurokawae.* These food materials may be used in manufacturing nutritious foods with inhibitory effects on elevated blood pressure levels.

(S. Nirasawa, Y. Q. Cheng [China Agricultural University] and S. Takahashi [Akita Research Institute for Food and Brewing])

Sulcaria sulcata *Lobaria kurokawae*

Fig. 1. Pictures of *Sulcaria sulcata* and *Lobaria kurokawae*

Table 1. Renin, chymase and ACE inhibitory activities of *Sulcaria sulcata* and *Lobaria kurokawae* extracts

Material (Origin)	Solvent	Inhibitory activities		
		Renin	Chymase	ACE
Sulcaria sulcata (Japan)	Methanol	+++	+++	±
Sulcaria sulcata (Japan)	Ethanol	++	+++	±
Sulcaria sulcata (Japan)	Water (boiling)	++	+++	±
Sulcaria sulcata (Japan)	Water (autoclave)	+++	+++	±
Sulcaria sulcata (China)	Methanol	++	+++	±
Sulcaria sulcata (China)	Water (autoclave)	+++	+++	±
Lobaria kurokawa (China)	Methanol	++	+	±
Lobaria kurokawa (China)	Water (autoclave)	+++	+++	-

Table 2. Effects of *Sulcaria sulcata* and *Lobaria kurokawae* extracts on the blood pressure levels of spontaneous hypertensive rats (SHR)

Material (Origin)	Relative blood-pressure value	
	Administered group	Control group
Sulcaria sulcata (Japan)	94% ± 2	101% ± 2
Sulcaria sulcata (China)	94% ± 2	102% ± 2
Lobaria kurokawa (China)	94% ± 1	102% ± 2

Data refer to mean ± standard error. Blood pressure of SHR was measured 4 or 6 hours after administration.

TOPIC 6

Bioethanol production from oil palm trunk fiber

Oil palm (*Elaeis guineensis*) used in palm oil production must be replanted at 20 to 25-year intervals in order to maintain oil productivity (Yamada et al. 2010). Consequently, the felled palm trunks represent one of the most important biomass resources in Malaysia and Indonesia (Shuit et al. 2009; Sumathi et al. 2008). To utilize the felled palm trunks specifically for bioethanol production, we characterized the sugars in the sap of the felled trunks and found large quantities of sap with high glucose content (Kosugi et al. 2010). This study reports on ethanol production using separated parenchyma (PA) and vascular bundle (VB) from oil palm trunk (Fig. 1). For efficient utilization of cellulosic materials as well as starchy materials, oil palm trunk was separated into PA and VB. Separated PA, alkali-pretreated starch-free PA (sfPA) and VB resulted in high ethanol conversion yields (Table 1). Separated PA and VB from oil palm trunk is a promising fermentation strategy for producing ethanol, without loss of starchy and cellulosic materials (Prawitwong et al. 2012).

(A. Kosugi)

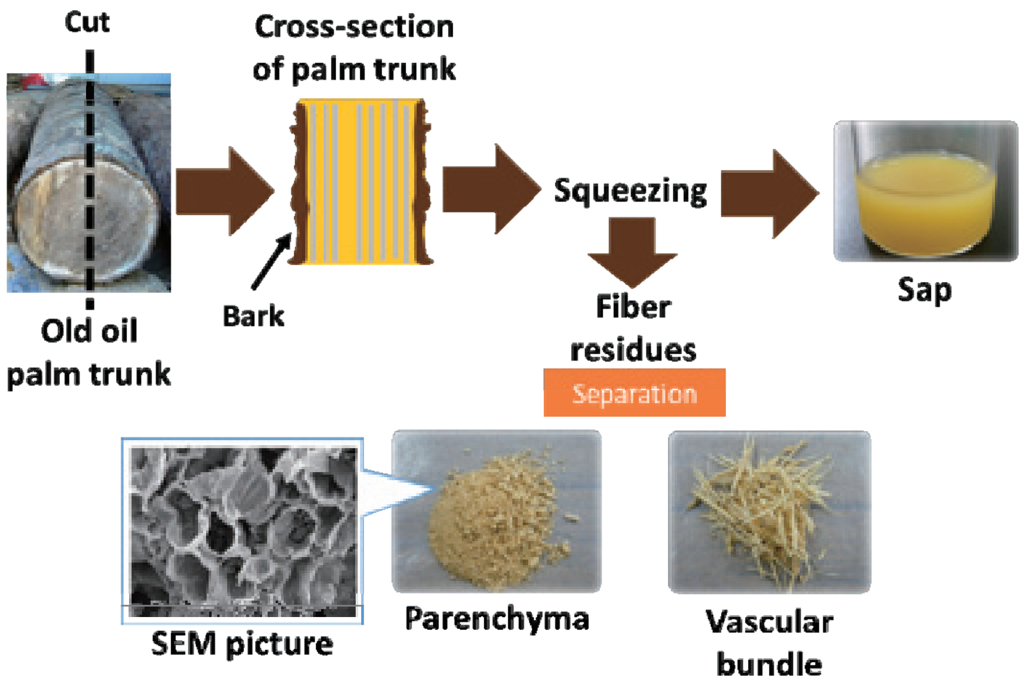

Fig. 1. Sap and fiber residues from oil palm trunk. Oil palm trunk was separated into parenchyma (PA) and vascular bundle (VB) components. The fractions were easily and distinctly separated. The ratio of PA and VB in the trunk was estimated at approximately 55:45 (dry weight %).

Table 2. Potential ethanol production from oil palm trunk fiber using a separation process (Prawitwong et al. 2012)

Source material	Input[a] (g)	SR[b] (g)	Pretreatments	Available sugars[d] (g)		Ethanol[e] (g)
				Starch	Glucan	
Trunk fiber	100.0	-	-	25.8	34.0	-
Separated PA	55.0	29.3	Autoclave	25.7	-	11.2
Pretreated sfPA	-	16.9	5% NaOH	-	13.1	5.1
Separated VB	45.0	44.9	-	0.08	-	0.03
Pretreated VB	-	27.1	5% NaOH	-	22.0	8.6
Total						25.0

[a] Calculated assuming 100 g of squeezed oil palm trunk is used in the separation process
[b] SR (solids remaining) after each pretreatment, calculated from the data in Table 1
[d] Available sugars calculated from the data in each component
[e] Ethanol, calculated from theoretical maximum yield for each saccharification and fermentation

Kosugi A, Tanaka R, Magara K, Murata Y, Arai T, Sulaiman O, Hashim R, Hamid ZA, Yahya MK, Yusof MN, Ibrahim WA, Mori Y (2010) Ethanol and lactic acid production using sap squeezed from old oil palm trunks felled for replanting. J Biosci Bioeng 110:322-5 doi:10.1016/j.jbiosc.2010.03.001

Prawitwong P, Kosugi A, Arai T, Deng L, Lee KC, Ibrahim D, Murata Y, Sulaiman O, Hashim R, Sudesh K, Ibrahim WAB, Saito M, Mori Y (2012) Efficient ethanol production from separated parenchyma and vascular bundle of oil palm trunk. Bioresource technology 125:37-42

Shuit SH, Tan KT, Lee KT, Kamaruddin AH (2009) Oil palm biomass as a sustainable energy source: A Malaysian case study. Energy 34:1225-1235 doi:10.1016/j.energy.2009.05.008

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Yamada H, Tanaka R, Sulaiman O, Hashim R, Hamid ZAA, Yahya MKA, Kosugi A, Arai T, Murata Y, Nirasawa S, Yamamoto K, Ohara S, Mohd Yusof MN, Ibrahim WA, Mori Y (2010) Old oil palm trunk: A promising source of sugars for bioethanol production. Biomass Bioenergy 34:1608-1613 doi:10.1016/j.biombioe.2010.06.011

Net energy ratio of ethanol production from sap squeezed from old oil palm trunks

In this study, a method was developed to estimate the NER or net energy ratio (i. e., ratio of output energy to input energy) of ethanol production from sap squeezed from oil palm trunks. A bench-scale shredder and compressed mill apparatus was constructed to squeeze the sap containing fermentable sugars from oil palm trunks. Energy input and energy output for squeezing sap were estimated through squeezing trials, and the NER was calculated.

Old oil palm trunks (30-45cm in diameter, 12m in length) were processed into trunk cores (20cm in diameter, 1.2m in length) by peeling the bark and the outer parts. The total amount of energy spent for processing was estimated to be the input energy (Table 1). Output energy, meanwhile, was estimated from the sum of calories derived from ethanol produced from sap and squeezed residues (50% moisture) (Fig. 1). From the study, it was determined that the ratio of input energy to output energy was 4.8 (Fig. 2A).

The energy ratio in ethanol from sugar cane was 8.3 because of self-sufficient energy from bagasse. The energy ratio in ethanol from oil palm sap was also high enough for practical use.

We can estimate the energy from large trunks (40cm in diameter, 10m) by using a multiplying factor of 33.74 on the trunk core.

Energy for transportation was estimated to be 47.2MJ, based on the assumption that the distance from plantation to ethanol plant was 8km (Fig. 2B). On the other hand, energy for cultivation of oil palm was not counted because the materials used were waste products of palm oil production. Likewise, energy for transportation of trunk cores was not counted because the materials used were wastes from the timber factory.

(Yoshinori Murata, Takamitsu Arai, Akihiko Kosugi)

Table1. Input energy involved in squeezing sap (core: 20cm in diameter, 1.2m in length)

	core
Peeling, kWh	0.24
Shredder, kWh	0.17
Mill, kWh	0.23

	core
Sum of energy, kWh	0.64
Sum of energy, MJ*1	2.3
Total sum of energy, MJ*2	5.8

*1Conversion kWh to MJ: Wh x 3,600s h^{-1}
*2MJ = (Sum of energy : 2.3MJ) x (100/40)

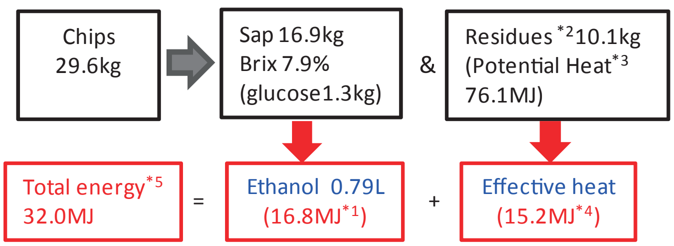

Fig. 1. Energy flow in ethanol production and in sap-squeezed residues.
Blue: production Red: energy from production *1 Ethanol: 21.2 MJ L-1, *2 Recovery of the residues is 80%, *3 Low heat value (LHV) of residues (50% moisture) is 7.5 MJ kg-1, *4 Effective heat is estimated as 20% of potential heat. *5 Total energy = (EtOH, MJ)+(the residues, MJ)

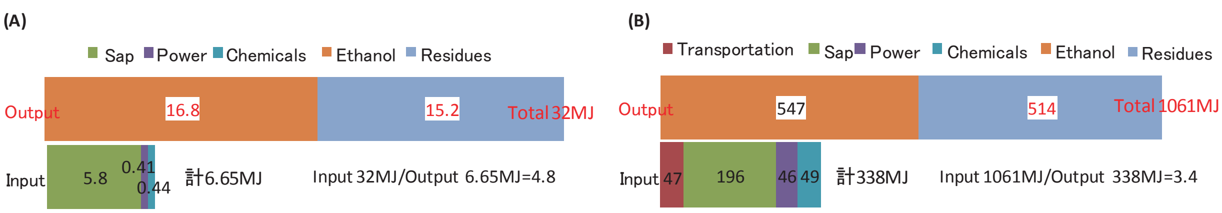

Fig. 2. The energy involved in sap squeezing. (A) Trunk core (20cm in diameter, 1.2m in length); (B) Total trunk (40cm in diameter, 10m in length). The energy for transportation from plantation to mill is needed in the case of total trunk.

References: 1) Mori, et al. Patent no. 2009-238779
2) Y Murata, et al. Biomass and Bioenergy 21 (2013): 8-16

TOPIC 8

Production of binderless particleboard and compressed lumber using oil palm trunk as feedstock

Palm oil, produced from the fruit of oil palm (*Elaeis guineensis*), is one of the most important agricultural products in Southeast Asia, particularly in Malaysia and Indonesia. Oil palm is replanted every 25 to 30 years to maintain fruit production, and a large amount of biomass, mainly oil palm trunk (OPT), is generated when they are felled. At present, this trunk is not efficiently used. On the other hand, for wood-based industries, the shortage of wood from natural forests is becoming a major concern. Hence, research on unutilized biomass has been actively undertaken to find alternative uses and decrease the demand for limited natural resources. Consequently, we have developed two types of products, namely binderless particleboard and compressed lumber, using OPT as feedstock.

A binderless particleboard is a particleboard manufactured without the addition of adhesives (i.e., self-binding). It is produced simply by hot pressing formed particles at appropriate temperature and pressure. Since it does not use synthetic adhesives, raw material costs and impact toward environment are smaller compared with typical particleboards with synthetic adhesives. Also, by reducing feedstock to particles, it is assumed to overcome heterogeneity of OPT depending on the section that is used (interior or exterior; bottom or top). A binderless board produced by laboratory scale experiment is shown in Fig. 1. Under the conditions we have tried, the board's physical properties reach the maximum at press temperature equal to 200 °C.

Compressed lumber is the densified board produced by hot pressing a block of feedstock. Normally in the case of wood, the strength of the product is enhanced by the densification process. The same holds true for compressed lumber made from OPT. The compressed lumbers produced are shown in Fig. 2. OPTs that underwent steam process in a closed chamber at a temperature of 130 °C before compression exhibited better physical properties and dimensional stability than those that did not undergo the process.

Unlike wood, the main components of which are cellulose, hemicellulose and lignin, OPT also contains sugars and starch at certain levels as sap or in parenchyma tissues. When binderless particleboards were produced with monomeric and dimeric sugars extracted from OPT, the properties of the board obtained was inferior to the board made from non-extracted samples (Fig. 3). On the other hand, addition of glucose and sucrose enhanced the properties of the produced board. Since such effects were not observed with the starch-added sample, it is suggested that such sugars in sap contribute to the self-binding mechanism of binderless particleboard and probably to some features of compressed OPT lumber.

However, one weak point noted regarding OPT binderless particleboard is water durability. So, at the moment, the board should only be used indoors, such as for interior finishing or furnitures.

(Tomoko Sugimoto, Rokiah Hashim [Universiti Sains Malaysia (USM)], Othman Sulaiman [USM], Masatoshi Sato [the University of Tokyo])

Fig. 1. Binderless particleboard made from oil palm trunk. Inset shows the magnified image of the surface.

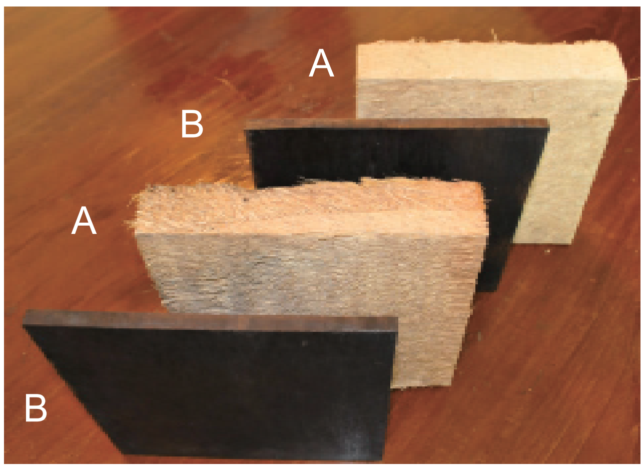

Fig. 2. Raw material before compression (A) and compressed lumber (B) made from oil palm trunk

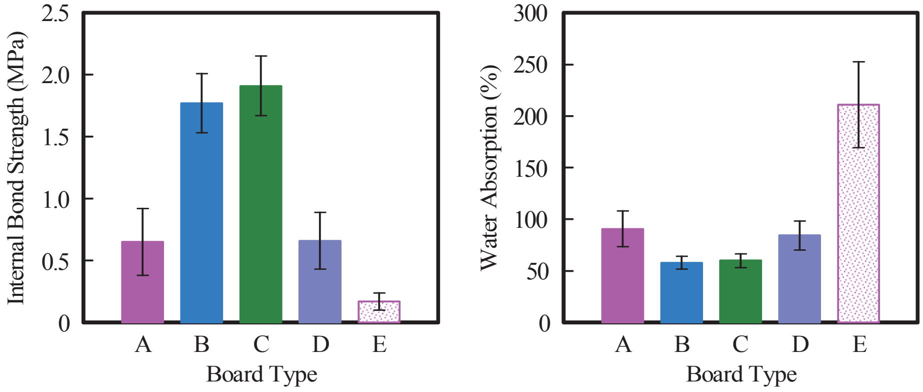

Fig. 3. Internal bond strength (left) and water absorption (right) of various types of board (A: unextracted OPT board [control], B: unextracted + 20% glucose board, C: unextracted + 20% sucrose board, D: unextracted + 20% starch board, E: extracted OPT board)

TOPIC 9

Selective logging criteria to ensure healthy seed production for dipterocarp species whose pollination depends on strong flyer insects

Timber in Malaysia has been produced from tropical rainforests that are recognized as one of the highest biodiversity hotspots in the world. Trees of timber species larger than 50 cm in trunk diameter at breast height (dbh) are being harvested in ongoing selective logging operations in Malaysia. The harvesting has lowered remaining adult tree density, which might inhibit pollen travel from one tree to another by pollinating insects. This is a critical issue affecting the production of healthy seeds. Healthy seeds are the source of forest regeneration, but it has been reported that mother trees at areas with lowered population density show frequent self-fertilization, resulting to less vigorous seeds. A group within the genus *Shorea* (known as 'red meranti' in forestry trading name) under sections *Mutica, Brachypterae*, etc., are found to be most abundant in lowland and hill dipterocarp forests. These species produce small-sized flowers and share a symbiotic relationship with weak-flying insects called thrips, which are its main pollen vectors. However, despite a healthy reproductive system ensured by thrip pollination, the rainforest remains vulnerable to a reduction in tree density because of selective logging activities.

On the other hand, recent studies on pollen dispersal pattern of dipterocarps have revealed that pollen dispersal patterns are mainly regulated by pollinator and conspecific tree density. Another group within genus *Shorea* (known as 'balau' in forestry trading name) belonging to section *Shorea* produces the second most valuable timber in Peninsular Malaysia. The species belonging to this section produces relatively larger flower than 'red meranti' species and commonly attracts small beetles belonging to Chrysomelidae. The small beetles are generally characterized as energetic strong flyers, which should represent a different pollen dispersal pattern from 'red meranti' (with thrip pollination). We estimated pollen dispersal pattern by using paternity analysis of seeds and a reproductive model (JIRCAS Research Highlight No. 15, 2011), and evaluated selective logging criteria by simulating pollen dispersal before and after selective logging for *S. maxwelliana*, one of the 'balau' species.

When the pollen dispersal pattern was compared between mass flowering season (in 2005) and sporadic flowering season (in 2002), the strong flying ability of small beetles achieved active pollen dispersal even though flowering tree density was reduced in the sporadic flowering season (Fig. 1). However, seeds with higher genetic diversity were produced in the mass flowering season because more flowering trees in the mass flowering seasons contributed as pollen donors, as shown by the number of effective pollen donors (N_{ep}) in Table 1. We calculated the pre- and post-harvest pollen dispersal and outcrossing rates over the mother trees. The criterion for selective logging was increased incrementally by 1 cm (from 40 cm to 100 cm dbh) in the simulation. While only trees greater than 80 cm dbh can be harvested to conserve 50% of outcrossing pollen over the mother trees in *S. curtisii* (one of the 'red meranti' species), our results showed that trees greater than 60 cm dbh can be harvested for 'balau' because of the small beetles' stronger flying ability (Fig. 2).

Our results have shown that selective logging criterion should be determined for every timber trading group of dipterocarps because reproductive characteristics within the timber trading group are similar. However, our reproductive model and the simulation assumed similarity of pollinators and conspecific tree densities.

When the results are applied to different types of forests, the simulation results do not relate to actual conditions or practices.

(Naoki Tani, Yoshihiko Tsumura [FFPRI], Soon Leong Lee [FRIM], Norwati Muhammad [FRIM])

Table 1. The comparison of number of effective pollen donors between 'balau' and 'red meranti'

Species	Section	Timber trading name	Flowering year	Flowering magnitude	Effective number of pollen donors (N_{ep})	Effective number of pollen donors per tree (N_{ep}/N)
Shorea maxwelliana	*Shorea*	Balau	2002	Sporadic	28.808	0.200
	Shorea	Balau	2005	Mass	44.154	0.307
Shorea leprosula	*Mutica*	Red meranti	2002	Sporadic	8.817	0.134
Shorea parvifolia	*Mutica*	Red meranti	2002	Sporadic	11.042	0.133
Shorea curtisii	*Mutica*	Red meranti	1998	Mass	27.210	0.189
	Mutica	Red meranti	2002	Sporadic	24.349	0.169
	Mutica	Red meranti	2005	Mass	34.411	0.239

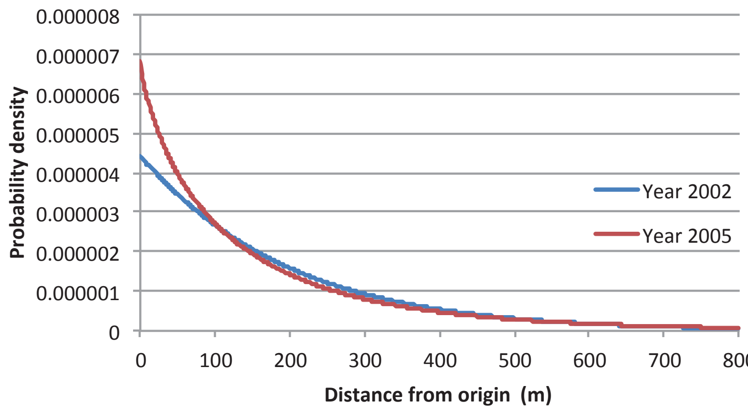

Fig. 1. Pollen dispersal pattern of *Shorea maxwelliana* recognized as 'balau' in two flowering events with different flowering magnitudes

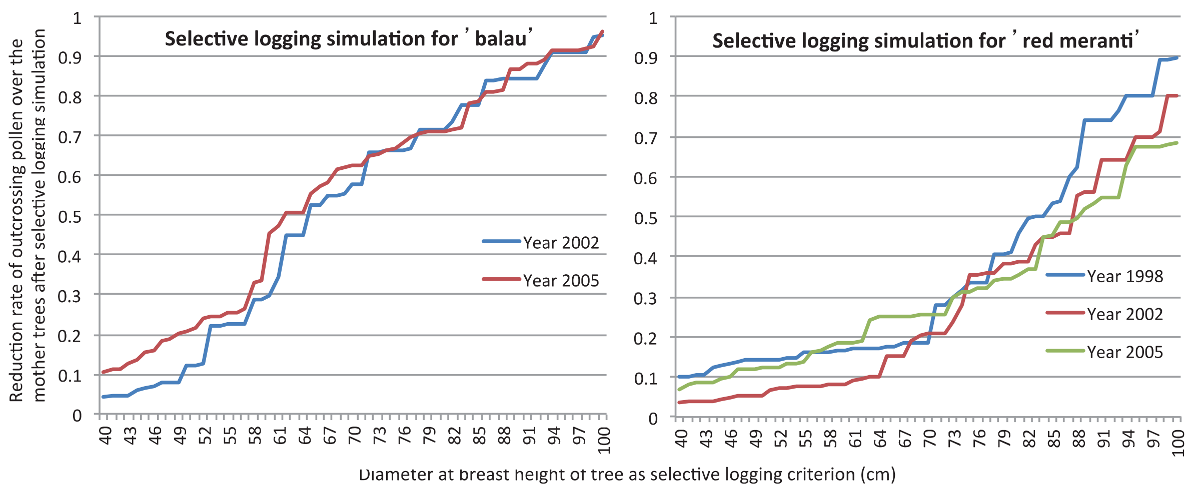

Fig. 2. Reduction rate of outcrossing pollen over the mother trees after selective logging simulation with every 1cm increment of cutting limit from 40 to 100cm

TOPIC 10

Digestibility of animal-based and plant-based diets in the tropical sea cucumber, *Holothuria scabra*

The population of many sea cucumber species has been dwindling due to intensive fishery and trading in Southeast Asian countries, hence there is a need to artificially produce sea cucumbers by hatchery production and aquaculture. *Holothuria scabra,* commonly known as sandfish, has been the most actively produced among tropical sea cucumbers, but production efficacy remains low partly owing to the lack of information on its diet. *H. scabra* is a benthic deposit feeder, and it ingests a mixture of organic matter with sea sediment for feeding. It is, therefore, difficult to determine what important nutrient sources are actually in the sediment. This study aimed to elucidate the relative importance of animal- and plant-based diets for juvenile *H. scabra* by analyzing the digestibility of different feed ingredients.

Apparent digestibility coefficient (ADC) of shrimp meal and mussel meal (animal-based), and diatom and powdered seaweed (plant-based) was determined by tank rearing experiments. Compared to plant-based diets, the animal-based diets contained a higher fraction of organic matter and crude protein; on the other hand, the plant-based diets contained a higher fraction of crude carbohydrate. ADC of organic matter was significantly higher in the animal-based diets (77.1 – 86.2%) than in plant-based diets (32.3 – 55.1%). ADC of protein ($ADC_{protein}$) was significantly higher in shrimp meal, mussel meal and diatom (75.2 – 88.7%) than in seaweed (34.4%), indicating that animal diets are more reliable sources of digestible proteins. ADC of carbohydrate (ADC_{carbo}) was generally lower than $ADC_{protein}$, and diatom and mussel meal (58.3 – 58.5%) had significantly higher ADC_{carbo} than shrimp meal and seaweed (28.0 – 31.6%) (Fig. 1). The high ADC_{carbo} in mussel meal may be attributable to its high content of glycogen that is readily digestible by animals unlike hard-digestible cellulose contained in large amounts in seaweed. Total assimilated nutrient (TAN) was estimated as the product of daily diet ingestion rate (IR) and ADC. The mean body weight of the experimental *H. scabra* was 10 g. TAN was largely affected by ADC since IR did not vary significantly among the diets. Shrimp meal had the highest TAN for organic matter (390 mg/day) and protein (347 mg/day) among the four diets, and diatom had the highest TAN for carbohydrate (247 mg/day) (Fig. 2).

H. scabra hatcheries commonly use diatoms and seaweeds as feed. This study indicates that there is a possibility that effective artificial feeds can be formulated by adding animal proteins to diatoms. High digestibility of animal-based diets also indicates that *H. scabra* is a good candidate for use in polyculture with finfish where feeds with high fish meal content are used.

(S. Watanabe, Z.G.A. Orozco [University of Tokyo], J.G. Sumbing [SEAFDEC/AQD], Ma. J.H. Lebata-Ramos [SEAFDEC/AQD])

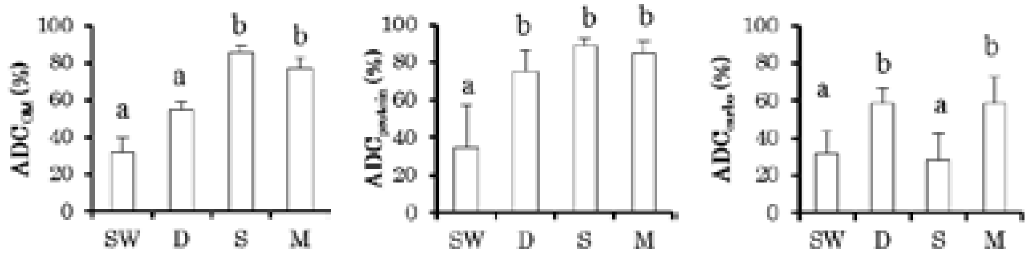

Fig. 1. Apparent digestibility coefficient of organic matter (ADC_{OM}), crude protein ($ADC_{protein}$) and crude carbohydrate (ADC_{carbo}) of seaweed (SW), diatom (D), shrimp meal (S) and mussel meal (M) in juvenile *Holothuria scabra*. ADC was obtained from the difference in nutrient contents between diet and feces. Different letters (i.e., a and b) indicate statistically significant difference (p<0.05).

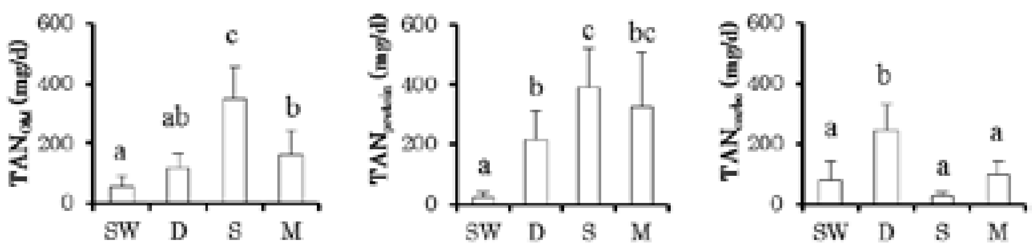

Fig. 2. Daily total assimilated nutrients (TAN) in juvenile *H. scabra* was obtained as the product of ADC and daily feed ingestion rate; assimilated organic matter (TAN_{OM}), crude protein ($TAN_{protein}$) and crude carbohydrate (TAN_{carbo}). The mean body weight of *H. scabra* was 10 g. Different letters (i.e., a, b and c) indicate statistically significant difference (p<0.05).

PROGRAM D
Information Analysis

"Collection, analysis and dissemination of information for grasping trends of international agriculture, forestry and fisheries"

Under the Third Medium-Term Plan of JIRCAS, activities for the collection, analysis, and dissemination of information for identifying trends related to international agriculture, forestry, and fisheries were separately specified from their research and investigation activities. These activities were divided into two main subjects: A) the analyses of the current situation and forecasts concerning food supply and demand and the production structure of agriculture, forestry, and fisheries in foreign countries, and B) the collection, analysis, and dissemination of information and materials related to the international food situation, to the agricultural, forestry, and fishery industries as well as to rural areas.

Subject A was made in order to contribute to the solution of global food and environmental problems. Subject B was made in order to formulate and conduct research and other projects related to agriculture, forestry, and fisheries in developing regions.

Information was collected in a regular, institutional, and systematic manner through collaboration with related organizations in Japan and overseas, and through long-term dispatch of staff to priority areas of activities. The respective information and materials were provided to a broad range of researchers, government agencies, and private companies.

Evaluation of fiscal year 2013 accomplishments showed that Program D performed well in comparison with the original annual implementation plan. Below is a summary of Program D's outputs, among others.

Under Subject A, JIRCAS developed a standard econometric model framework for assessing food supply-demand situation at country level through the ASEAN Food Security Information System (AFSIS) Project. This was achieved in collaboration with AFSIS, which is being implemented by the ASEAN Secretariat and the Statistics Department of the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan, and a Technical Cooperation Program (TCP) of the UN FAO's Regional Office for Asia and the Pacific. A prototype model was introduced at a co-organized workshop held in Bangkok in July 2013. For Laos and Cambodia, where not enough study on the subject has been made so far, multi-commodity food supply-demand models were developed, and they showed that improving the milling rate would substantially influence the change in rice price. In Northern China, the environmental impact of nitrogen induced by livestock production and consumption was evaluated by modifying a provincial model on Chinese food supply-demand developed in 2011. Continuous efforts were also made to collect information on agricultural market projections through participation in meetings such as the World Outlook Conference, where subject-matter experts congregate. Information on agriculture and water was also collected and cooperation with water-issue organizations, such as the World Water Council and the International Commission on Irrigation and Drainage, was enhanced. The situation of water users' associations in Indonesia was also investigated as part of research on agricultural water use services. In addition, a staff member of JIRCAS has been sent on a long-term assignment to the International Renewable Energy Agency (IRENA) to conduct bio-energy resources and supply cost assessments. The results were utilized in the "Remap 2030" report.

Under Subject B, JIRCAS actively participated in the Global Rice Science Partnership (GRiSP), a Consultative Group on International Agricultural Research (CGIAR) research program, and the Coalition for African Rice Development (CARD), playing an important role in contributing to technology development and in connecting related national and international stakeholders. At the 5th Tokyo International Conference on African Development (TICAD V), JIRCAS, together with the CGIAR Fund Office and others, co-organized a pre-event workshop titled "New Stages of Agricultural Research in Africa." JIRCAS also participated in G20-related networks for agricultural research, such as the Meeting of Agricultural Chief Scientists (MACS), the Wheat Initiative (WI), and the Tropical Agricultural Platform (TAP), and contributed to international consensus building on agricultural development. Using an internal competitive fund known as the "President's Incentive Budget," various innovative activities including incubation researches, need-finding surveys, and networking events were carried out. Among others, research needs in Myanmar were examined by organizing several visits in 2013. Also, the situation of silica deficiency in rice-producing areas in Africa was studied and analyses were made on the influential factors on silica content in soils.

In November 2013, JIRCAS organized an international symposium titled “New Direction of Sustainable Technology Development in Asia: Changing Rural Livelihood and Japanese Advantage” to identify new research subjects, which could harness Japanese competitiveness at the same time, in rapidly changing Asia. At the symposium, JIRCAS looked back at its 20-year history in order to foresee into its future. Besides, JIRCAS continuously gathered local information on agricultural research priorities in Southeast Asia and Africa by maintaining liaison offices. Regional representatives also attended various meetings and events to exchange ideas on current and future collaborations.

TOPIC 1

Limited Si-nutrient status of rice plants in relation to plant-available Si of soils, nitrogen fertilizer application, and rice-growing environment across Sub-Saharan Africa

Rice is a specific silica-accumulator among higher plants. The Si in rice enhances resistance to biotic and abiotic stresses. The booming demand for rice in Sub-Saharan Africa (SSA) requires rapid increases in rice production, and hence more Si supply will be needed from soils, irrigation water, and external inputs. However, there have been no Si management practices or any extensive surveys conducted to identify the nature and magnitude of the problems with plant Si nutrient status and Si availability in the soils for rice production in SSA. Therefore, an extensive survey is conducted for evaluating variability of Si concentration in rice straw in relation to soil properties, fertilizer management practices, and rice-growing environments across a wide range of local farmers’ fields in SSA.

The Si concentration in straw ranges 1.7-8.4% among the harvest samples at 99 local farmers’ fields in Benin, Ghana, Guinea, Kenya, Madagascar, Mozambique, and Nigeria, and the values in 68% of the fields are below the critical deficiency level of 5%* (Fig. 1; Fig. 2). The amounts of water-soluble Si in soils after 1-week anaerobic incubation at 40 °C sufficiently explain the variability in Si concentration in straw among the samples, and thus can be used for assessing the plant-available Si for wide-range of the SSA soils (Fig. 2). The plant-available Si and Si concentration in straw are both particularly low in the acidic soils of Highland and Humid Agro-ecological zones, mainly consisting of weathered Oxisols and Ultisols (Table 1). The mean Si values become lower with more unfavorable water conditions in the order of upland (3.4%) < rainfed lowland (4.3%) < irrigated lowland (5.3%) among different rice-growing environments (Fig. 3). There is a negative correlation between N application rate and Si concentration in straw (Fig. 3).

*The critical deficiency level of Si is referred to IRRI Handbook Series (Dobermann and Fairhurst, 2000)

The extensive dataset from local farmers’ fields indicate that poor Si nutrient status of rice plants is widespread across SSA, which is largely attributable to limited plant-available Si in soils. The amounts of water-soluble Si after 1-week anaerobic incubation can be an appropriate index of plant-available Si in soils for rice fields in SSA. The application of Si management practices such as straw incorporation can be accelerated by matching vulnerable fields to biotic stresses and the Si-deficient factors in the current study. Further studies should demonstrate quantitative effect of improving Si nutrient status on rice productivity such as through the reduction of blast infection.

(Y. Tsujimoto, S. Muranaka, H. Asai, K. Saito [Africa Rice Center])

Table 1. Si concentration in straw, N application rate, and soil properties among different AEZ zones.

AEZ zone means	n	Si conc. in straw	Amount of N applied	Soil water soluble Si	Soil pH
		%	kg ha^{-1}	mg kg^{-1}	
Semi-Arid	8	4.9^{ab}	26^{a}	51.0^{a}	7.0^{a}
Sub-Humid	68	4.6^{a}	37^{a}	43.8^{a}	6.0^{b}
Humid	11	3.9^{b}	42^{a}	28.7^{ab}	5.7^{bc}
Highland	12	3.4^{b}	36^{a}	23.9^{b}	5.4^{c}
SSA total	99	4.4	36	40.3	6.0

Values of the same alphabets do not differ at 5% (Tukey HSD)

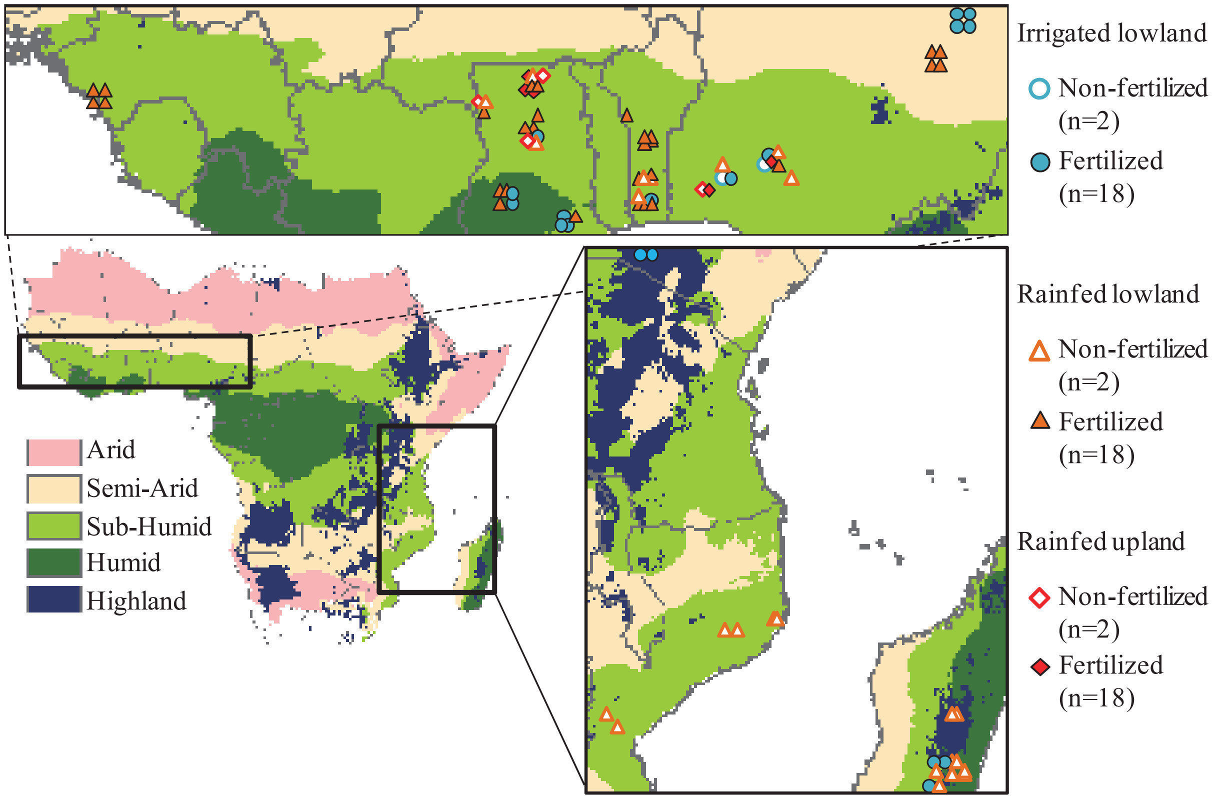

Fig. 1. Location of the 99 farmers fields in plant and soil samples across SSA

'Fertilized' consist of 3 fields with organic materials and 61 fields with chemical fertilizer. A 5-class agroecological zone (AEZ) map is derived from Harvest Choice (http://harvestchoice.org)

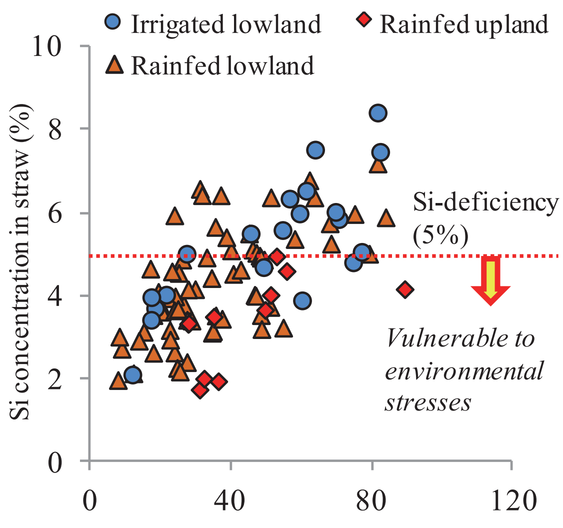

Fig. 2. Relationship between the amounts of water-soluble Si in soil and Si conc. in straw

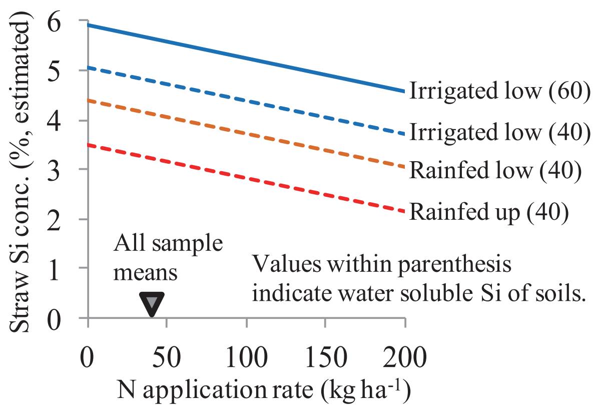

Fig. 3. Estimated Si concentration in straw against N application rate in different rice-growing environments and water soluble Si of soils.

The sensitive analysis was performed using multiple regression model with observed variables to explain the variability of Si concentration in straw (R =0.59).

TRAINING AND INVITATION PROGRAMS

INFORMATION EVENTS

INVITATION PROGRAMS AT JIRCAS

In keeping with its role as an international research center, JIRCAS has implemented several invitation programs for foreign researchers and administrators at counterpart organizations. These programs facilitate the exchange of information and opinions on agriculture, forestry, and fisheries research. At the same time, their implementation and administration serve as an opportunity to strengthen research ties among scientists and administrators in participating countries, mostly in the developing regions. Current programs are described in detail below.

Administrative Invitation Program

Under the Administrative Invitation Program, JIRCAS invites administrators from counterpart organizations to its Tsukuba premises to engage in discussions and reviews of ongoing researches to ensure that collaborative projects run smoothly. In addition, the program exposes administrators to the current activities at JIRCAS and other MAFF-affiliated Incorporated Administrative Agencies (IAAs). Furthermore, the program provides opportunities for the exchange of information and opinions concerning policy-making and project design at the administrative level, thereby contributing to deeper mutual understanding and international collaboration. Thirty-nine individual visits to JIRCAS were made during FY 2013 under the Administrative Invitation Program. Invited administrators and their home institutions are listed below.

Administrative Invitations, FY 2013		
Vongvilay Vongkhamsao	National Agriculture and Forestry Research Institute (NAFRI), Lao PDR	May 11-18, 2013
Papa Abdoulaye Seck	Africa Rice Center (AfricaRice), Benin	May 30-Jun. 3, 2013
Marco Cletus Sebastiaan Wopereis	Africa Rice Center (AfricaRice), Benin	May 30-Jun. 6, 2013
Savitri Mohapatra	Africa Rice Center (AfricaRice), Benin	May 29-Jun. 4, 2013
Robin Arani Buruchara	International Center for Tropical Agriculture (CIAT), Kenya	May 28-Jun. 5, 2013
Chen Yongfu	China Agricultural University (CAU), P.R. China	Sept. 4-8, 2013
Li Ninghui	Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Sept. 4-8, 2013
Yin Changbin	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Sept. 4-8, 2013
Jin Ke	Department of International Cooperation, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Sept. 4-11, 2013
Lei Cailin	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Sept. 24-28, 2013
Li Jinbin	Yunnan Academy of Agricultural Sciences (YAAS), P.R. China	Sept. 24-Oct. 1, 2013
Li Chengyun	Yunnan Agricultural University (YAU), P.R. China	Sept. 24-Oct. 1, 2013

Nguyen Thi Lang	Cuu Long Delta Rice Research Institute (CLRRI), Ministry of Agriculture and Rural Development (MARD), Vietnam	Sept. 23-29, 2013
Chu Duc Ha	Agricultural Genetics Institute (AGI), Vietnam	Sept. 24-29, 2013
Ha Minh Thanh	Plant Protection Research Institute (PPRI), Vietnam	Sept. 24-29, 2013
Chanthakhone Boualaphanh	Rice and Cash Crop Research Center (RCCRC), National Agriculture and Forestry Research Institute (NAFRI), Lao PDR	Sept. 23-29, 2013
Mohammad Ashik Iqbal Khan	Bangladesh Rice Research Institute (BRRI), Bangladesh	Sept. 23-28, 2013
Maganti Sheshu Madhav	Directorate of Rice Research, Indian Council of Agricultural Research (DRR-ICAR), India	Sept. 23-28, 2013
Acharaporn Na Lampang Noenplab	Phitsanulok Rice Research Center, Thailand	Sept. 23-28, 2013
Poonsak Mekwatanakarn	Ubon Ratchathani Rice Research Center, Thailand	Sept. 24-28, 2013
Dwinita Wikan Utami	Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development (ICABIOGRAD), Indonesia	Sept. 23-28, 2013
Anggiani Nasution	Indonesian Center for Rice Research (ICRR), Indonesia	Sept. 23-28, 2013
Kshirod Kumar Jena	International Rice Research Institute (IRRI), Philippines	Sept. 24-28, 2013
Thelma F. Padolina	Philippine Rice Research Institute (PhilRice), Philippines	Sept. 23-29, 2013
Loida M. Perez	Philippine Rice Research Institute (PhilRice), Philippines	Sept. 23-29, 2013
Bo Zhou	International Rice Research Institute (IRRI), Philippines	Sept. 24-28, 2013
Jung-Pil Suh	National Institute of Crop Science, Rural Development Administration (RDA), Republic of Korea	Sept. 24-28, 2013
Zhou Yingheng	Nanjing Agricultural University (NAU), P.R. China	Nov. 17-24, 2013
Linkham Douangsavanh	National Agriculture and Forestry Research Institute (NAFRI), Lao PDR	Nov. 19-22, 2013
Othman Bin Sulaiman	Universiti Sains Malaysia (USM), Malaysia	Nov. 18-23, 2013
Robert Josef Holmer	AVRDC - The World Vegetable Center, Thailand	Nov. 19-22, 2013
Warunee Varanyanond	Institute of Food Research and Product Development (IFRPD), Kasetsart University (KU), Thailand	Nov. 16-22, 2013
Martinus Cornelis Theodorus Scholten	Institute for Marine Resources & Ecosystem Studies (IMARES), The Netherlands	Nov. 20-24, 2013

Hiroyuki Konuma	FAO Regional Office for Asia and the Pacific, Food and Agriculture Organization of the United Nations (FAO), Thailand	Nov. 19-21, 2013
Françoise Ruget	INRA, UMR 1114 EMMAH (Modelling Agricultural and Hydrological Systems in the Mediterranean Environment), France	Nov. 30-Dec. 7, 2013
Myriam Yvonne Odette Adam	CIRAD Regional Office for Continental West Africa, Burkina Faso	Nov. 29-Dec. 7, 2013
Inez Hortense Slamet-Loedin	International Rice Research Institute (IRRI), Philippines	Dec. 10-13, 2013
Manabu Ishitani	International Center for Tropical Agriculture (CIAT), Colombia	Dec. 9-12, 2013
Carolina Saint Pierre	International Maize and Wheat Improvement Center (CIMMYT), Mexico	Dec. 9-12, 2013

Counterpart Researcher Invitation Program

The Counterpart Researcher Invitation Program provides invitations for periods of up to six months to researchers engaged in collaborative work with JIRCAS research staff. Counterparts conduct in-depth research at JIRCAS, at other MAFF-affiliated IAAs, at prefectural research institutes, or at national universities. This invitation program aims to enhance the quality of research conducted overseas and to facilitate exchanges of individual research staff between JIRCAS and the counterpart institutions. Thirty-six researchers were invited under this program during FY 2013. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

Counterpart Researcher Invitations, FY 2013

Junjarus Sermsathanaswadi	Enzyme Technology Laboratory, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (KMUTT), Thailand	Functional analysis of carbohydorate binding domain involving a xylanosome, a multicomponent enzyme (cellulase/ hemicellulase) complex	Jun. 16-Nov. 8, 2013
Samuel Keyes	Engineering Sciences Unit, Engineering and the Environment, University of Southampton, United Kingdom	Evaluation of root traits for enhanced P uptake	Jun. 20-Jul. 4, 2013
Alias bin Man	FRI Kampung Acheh, Fisheries Research Institute, Malaysia	Environment, biota survey and statistical data collection for the modeling in Selangor area	Jun. 30-Jul. 12, 2013
Khaled Masmoudi	International Centre for Biosaline Agriculture (ICBA), United Arab Emirates	Discussion about future collaboration on environmental stress tolerance in plants	Jun. 30-Jul. 4, 2013
Theophile Odjo	Faculty of Agricultural Sciences, University of Abomey-Calavi, Benin	Improving productivity of Rice for Africa by introducing useful traits which confer tolerance to biotic and abiotic stresses	Jul. 1-Sept. 29, 2013
Singty Voradeth	Agricultural Research Center (ARC), National Agriculture and Forestry Research Institute (NAFRI), Lao PDR	Development and application of a differential system for rice blast resistance in Laos	Jul. 2-Sept. 29, 2013
Yang Xiaomei	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Development of a recycling technology for organic material inputs in corn-wheat cropping system	Aug. 18-Sept. 27, 2013
Tana	Grassland Production and Management Division, Institute of Grassland Research, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Development of cultural practices with environmentally-sound material cycle in locations with unfavorable conditions	Sept. 3-9, 2013
Zhou Ying	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Workshop on China Recycling-based Project	Sept. 4-8, 2013
Li Ninghui	Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Development of organic matter applicaton technologies that preserve the environment of the maize-wheat cropping system	Sept. 4-8, 2013

Lou Yilai	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences (CAAS), P.R. China	Estimation of the present state of fertilizer use and livestock production and their environmental load	Sept. 4-8, 2013
Chonlada Meeanan	Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand	Study on culture, molecular sequencing techniques and quality analysis of giant tiger prawn under co-culture conditions with brackish water shrimp	Jul. 28-Aug. 13, 2013
Md. Abdus Salam	Agricultural Economics Division, Bangladesh Rice Research Institute (BRRI), Bangladesh	Impact assessment of climate change on production and supply and demand of rice in Bangladesh	Aug. 18-Dec. 21, 2013
Asad Jan	Institute of Biotechnology and Genetic Engineering (IBGE), Khyber Pakhtunkhwa Agricultural University Peshawar, Pakistan	Search for novel genes conferring abiotic stress tolerance in plants	Aug. 12-Sept. 2, 2013
Josefine Nestler	Laboratory of Frank Hochholdinger, University of Bonn, Landwirtschaftliche Fakultät, INRES, Crop Functional Genomics, Germany	Investigation of root traits and candidate genes associated with P uptake efficiency	Sept. 6-28, 2013
Hoang Hoa Long	Division of Molecular Plant Pathology, Agricultural Genetics Institute (AGI) Vietnam	Development of a differential system for rice blast resistance in Vietnam	Aug. 26-Sept. 29, 2013
Nguyen Ba Ngoc	Division of Molecular Biology, Agricultural Genetics Institute (AGI), Vietnam	Development of a differential system for rice blast resistance in Vietnam	Aug. 26-Sept. 29, 2013
Sathya Khay	Plant Protection Office, Cambodian Agricultural Research and Development Institute (CARDI), Cambodia	Development of a differential system for rice blast resistance in Cambodia	Sept. 16-29, 2013
Orathai Sawatdichaikul	Institute of Food Research and Product Development (IFRPD), Kasetsart University, Thailand	Computational analyses of the interaction between renin protein and active compounds in Thai's functional foods	Oct. 3-Nov. 1, 2013
Liliane Marcia Mertz Henning	Empresa Brasileira de Pesquisa Agropecuária, Embrapa Soja, Brazil	Technical learning of physiological experiments for evaluating drought resistance of soybean and expression analysis	Oct. 28-Dec. 21, 2013
Antika Boondaeng	Enzyme Technology and Waste Management Research Unit, Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), Thailand	Improvement of a thermotolerant yeast to produce ethanol from tropical crop residues	Nov. 1, 2013-Mar. 31, 2014
Glenn Gregorio	Plant Breeding, Genetics and Biotechnology Division, International Rice Research Institute (IRRI), Philippines	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 24-29, 2013
Philippe Hinsinger	National Institute for Agricultural Research (INRA), *INRA*UMR Eco&Sols Montpellier SupAgro-CIRAD-INRA-IRD, France	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-28, 2013

Alan Edward Richardson	Farming Systems & Functional Soils, Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-Dec. 2, 2013
Alain Maurice Joseph Mollier	Ecology & Soil Unit, National Institute for Agricultural Research (INRA), France	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-Dec. 2, 2013
Eva Oburger	Rhizosphere Ecology and Biogeochemistry Group (RHIZO), Department of Forest and Soil Sciences, BOKU - University of Natural Resources and Life Sciences, Austria	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-Dec. 1, 2013
John Peter Hammond	School of Agriculture, Policy and Development, University of Reading, United Kingdom	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-30, 2013
Michael Timothy Rose	School of Chemistry, Monash University, Australia	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 24-Dec. 10, 2013
Mirosław Kwaśniewski	University of Silesia, Poland	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-30, 2013
Stephan Marcus Haefele	Australian Centre for Plant Functional Genomics, School of Agriculture Food and Wine, Plant Genomics Centre, University of Adelaide, Australia	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 23-Dec. 1, 2013
Terry James Rose	Southern Cross Plant Science Y Block, Southern Cross University, Australia	Workshop, "Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes"	Nov. 24-29, 2013
Rattiya Waeonukul	Pilot Plant Development and Training Institute (PDTI), King Mongkut's University of Technology Thonburi (KMUTT), Thailand	Study of biological saccharification technology using *Clostridium thermocellum*	Dec. 16, 2013-Mar. 28, 2014
Alexandre Grondin	Crop and Environmental Sciences Division, International Rice Research Institute (IRRI), Philippines	2013 Anunual Meeting for MAFF-Funded Project, "Development of Drought-Tolerant Crops for Developing Countries"	Dec. 10-13, 2013
Yan Yongliang	Institute of Crop Germplasm Resources, Xinjiang Academy of Agricultural Sciences, P.R. China	Evaluation of soybean for environmental stress tolerance under field conditions and development of soybean elite breeding lines	Feb. 5-Mar. 6, 2014
Pulletikurty Venkata Satish	International Crops Research Institute for Semi-Arid Tropics (ICRISAT), India	Development of sustainable soil fertility management for sorghum and sweet sorghum through effective use of biological nitrification inhibition (BNI)	Mar. 24-Apr. 25, 2014
Nguyen Cong Thuan	College of Environment and Natural Resources, Can Tho University, Vietnam	Study on nitrogen and carbon supply from a biogas digester for freshwater fish farming	Mar. 15-31, 2014

Project Site Invitation Program

In FY 2007, JIRCAS launched this invitation program to invite researchers from developing countries to the project sites in developing countries where JIRCAS researchers are engaged in JIRCAS-funded collaborative research activities on various research themes relevant to the projects on site, and other countries where workshops or planning meetings are held. Fifty invited researchers implemented their programs during FY2013 as listed below.

Project Site Invitations, FY 2013

Werapon Ponragdee	Khon Kaen Field Crops Research Center (KKFCRC), Department of Agriculture (DOA), Thailand	28th International Society of Sugar Cane Technologists (ISSCT) Congress, Brazil	Jun. 22-Jul. 1, 2013
Hirendra Nath Barman	Plant Pathology Division, Bangladesh Rice Research Institute (BRRI), Bangladesh	Training program on decision support system for rainfed lowland rice production, Indonesia	Aug. 20-24, 2013
Anita Boling	Crop and Environmental Science Division, International Rice Research Institute (IRRI), Philippines	Training program on decision support system for rainfed lowland rice production, Lao PDR, Indonesia	Aug. 17-25, 2013
Lizzida Llorca	Crop and Environmental Science Division, International Rice Research Institute (IRRI), Philippines	Training program on decision support system for rainfed lowland rice production, Lao PDR, Indonesia	Aug. 17-25, 2013
Jessa Perez	Crop and Environmental Science Division, International Rice Research Institute (IRRI), Philippines	Training program on decision support system for rainfed lowland rice production, Lao PDR, Indonesia	Aug. 17-25, 2013
Sangkhom Inthapanya	Faculty of Agriculture and Forest Resource, Souphanouvong University, Lao PDR	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Daovy Kongmanila	Faculty of Agriculture, National University of Laos, P.O. Box 7322, Vientiane, Lao PDR	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Viengsakoun Napasirth	Faculty of Agriculture, National University of Laos, Lao PDR	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Kongsackda Inthaphouthone	Savannakhet Provincial Department of Agriculture and Forestry, Lao PDR	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Nguyen Thanh Van	Institute of Animal Science for Southern Vietnam, Vietnam	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Ho Thanh Tham	College of Agriculture and Applied Biology, Can Tho University, Vietnam	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013

Asih Kurniawati	Faculty of Animal Science, Universitas Gadjah Mada, Indonesia	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Luming Ding	International Centre for Tibetan Plateau Ecosystem Management, School of Life Sciences, Lanzhou University, P.R. China	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Mohd Azlan Bin Pauzi	Malaysian Agricultural Research and Development Institute (MARDI), Malaysia	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Ahmad Wahyudi	Faculty of Agricultural and Animal Production, Muhammadiyah Malang University, Indonesia	Establishment of a monitoring technique for methane from livestock and development of a reduction technology, Thailand	Aug. 26-30, 2013
Alias bin Man	Fisheries Research Institute (FRI) Kampung Acheh, Malaysia	JIRCAS International Workshop, "Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas", Philippines	Oct. 8-11, 2013
Ibrahim Bin Johari	Fisheries Research Institute (FRI) Batu Maung, Malaysia	JIRCAS International Workshop, "Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas", Philippines	Oct. 8-11, 2013
Mohd Asfarizal Bin Mohd Masmok	Selangor State Fisheries Department, Malaysia	JIRCAS International Workshop, "Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas", Philippines	Oct. 8-11, 2013
Dusit Aue-umneoy	Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang Thailand	JIRCAS International Workshop, "Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas", Philippines	Oct. 8-11, 2013
Phaythoune Mounsena	Horticultural Research Center, Lao PDR	Development of a sustainable fruit production technology in Indo-China, Thailand	Oct. 27-Nov. 2, 2013
Veopaseuth Khamphaphongphane	Horticultural Research Center, Lao PDR	Development of a sustainable fruit production technology in Indo-China, Thailand	Oct. 27-Nov. 2, 2013
Chompoo Juntee	Chanthaburi Horticultural Research Center, Thailand	Development of a sustainable fruit production technology in Indo-China, Thailand	Nov. 12-15, 2013
Orwintinee Chusri	Chanthaburi Horticultural Research Center, Thailand	Development of a sustainable fruit production technology in Indo-China, Lao PDR	Nov. 12-15, 2013

Antonio Juan Gerardo Ivancovich	Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnología Agropecuaria (INTA-EEA Pergamino), Argentina	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust" and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 5-10, 2013
Adrian Dario De Lucia	Estación Experimental Agropecuaria Cerro Azul, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA)-Cerro Azul, Argentina	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust" and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Monica Isabel Heck	Annual Crops Department, Estación Experimental Agropecuaria-Cerro Azul, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Cerro Azul), Argentina	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Alicia Noelia Bogado	Centro de Investigación Capitán Miranda (CICM), Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Anibal Morel	Centro de Investigación Capitán Miranda (CICM), Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Romina Mabel Chávez Jara	Centro de Investigación Capitán Miranda (CICM), Instituto Paraguayo de Tecnología Agraria (IPTA), Ministrio de Agricultura y Ganadería (MAG), Paraguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Miori Uno Shimakawa	Fundacion Nikkei-Cetapar (Cetapar), Republica del Paraguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013

Christian Espinola	Fundacion Nikkei-Cetapar (Cetapar), Paraguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-9, 2013
Rafael Moreira Soares	Empresa Brasileira de Pesquisa Agropecuária, Embrapa Soja, Brazil	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", and Annual Meeting of Project "Monitoring *Phakopsora pachyrhizi* populations in South America" and "Development of resistant cultivars by marker-assisted selection", Brazil	Nov. 6-8, 2013
Fernando Diego Baldelomar Argote	Asociacion de Productores de Oleaginosas y Trigo (ANAPO), Bolivia	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", Brazil	Nov. 5-8, 2013
Noelle Giacomini Lemos	Monsanto, Brazil	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", Brazil	Nov. 6-8, 2013
Sergio Herminio Brommonschenkel	Departamento de Fitopatologia, Universidade Federal de Viçosa, Brazil	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", Brazil	Nov. 6-10, 2013
Silvina Stewart	Instituto Nacional de Investigacion Agropecuaria (INIA), Uruguay	JIRCAS Workshop, "Evaluation and utilization of the resistance to soybean rust", Brazil	Nov. 6-9, 2013
Robert B. Zougmore	CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Mali	Workshop, "Development of Conservation Agriculture based on cropping system for sustainable soil management in West Africa", Burkina Faso	Feb. 4-7, 2014
Du Fulin	College of Economics and Management, Inner Mongolia Agricultural University, P.R. China	GrassRisk Project Workshop at Mongolian State University of Agriculture and field study in Tov Province, Mongolia	Mar. 3-8, 2014
Handewi Purwati Saliem	Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS), Indonesia	International Workshop,"Small-scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -"	Feb. 10-13, 2014
Henny Mayrowani	Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS), Indonesia	International Workshop, "Small-scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -", Thailand	Feb. 10-13, 2014
Supadi	Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS), Indonesia	International Workshop, "Small-scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -", Thailand	Feb. 10-13, 2014
Sunarsih	Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS), Indonesia	International Workshop, "Small-scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -", Thailand	Feb. 10-13, 2014

Bambang Dradjat	PT Riset Perkebunan Nusantara / Indonesian Palm Oil Association (GAPKI), Indonesia	International Workshop, "Small-scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -", Thailand	Feb. 10-13, 2014
Trinh Xuan Hoat	Plant Protection Research Institute (PPRI), Vietnam	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-Mar. 1, 2014
Duong Thi Nguyen	Thai Nguyen Agri-Forestry University, Vietnam	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-Mar. 1, 2014
Chuong Sophal	Faculty of Agronomy, Royal University of Agriculture, Cambodia	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-Mar. 1, 2014
Chhin Sovandeth	Plant Protection, Sanitary and Phytosanitary Department, Ministry of Agriculture Forestry and Fisheries, Cambodia	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-Mar. 1, 2014
Chanthanom Deuanhaksa	Agricultural Research Center (ARC), National Agriculture and Forestry Research Institute(NAFRI), Ministry of Agriculture and Forestry Lao PDR	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-28, 2014
Chanthakhone Boualaphanh	Agricultural Research Center (ARC), National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry, Lao PDR	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-28, 2014
San Thein	Myanmar Sugarcane and Sugar Related Products Merchants and Manufacturers Association, Myanmar	International Workshop, "International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia", Thailand	Feb. 26-Mar. 1, 2014

FELLOWSHIP PROGRAMS AT JIRCAS

JIRCAS Visiting Research Fellowship Program at Tsukuba and Okinawa

The current JIRCAS Visiting Research Fellowship Program has its beginnings in FY 1992 with the launching of the JIRCAS Visiting Research Fellowship Program at Okinawa under which researchers are invited to conduct research on topics relating to tropical agriculture for a period of one year at the Tropical Agriculture Research Front (formerly Okinawa Subtropical Station). Since October 1995, a similar program (JIRCAS Visiting Research Fellowship Program at Tsukuba) has been implemented at JIRCAS's Tsukuba premises, which aims to promote collaborative research that address various problems confronting countries in the developing regions. In FY 2006, these fellowship programs were modified and merged into one. In FY 2013, a total of four researchers were invited to conduct research at JIRCAS HQ.

JIRCAS Visiting Research Fellowships at Tsukuba (October 2013- September 2014)			
Di Tingjun	Bureau of Agriculture of Shuifu County, P.R. China	Analysis of the effect of rhizosphere pH on the release of biological nitrification inhibitors from sorghum roots	Oct. 1, 2013- Sept. 30, 2014
Md. Motaher Hossain	Department of Plant Pathology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh	Development of new soybean breeding materials resistant to soybean rust	Oct. 31, 2013- Jan. 31, 2014
Vu Thi Thu Hien	Department of Molecular Biology, Agricultural Genetics Institute (AGI), Vietnam	Identification of environmental stress tolerance genes in soybean and their application to soybean improvement	Oct. 16, 2013- Sept. 30, 2014
Wichittra Bomrungnok	Department of Food Science and Technology, School of Science and Technology, University of the Thai Chamber of Commerce, Thailand	Development of a process for lactic acid production at high temperature from oil palm trunk	Oct. 28, 2013- Sept. 26, 2014

JIRCAS Visiting Research Fellowship Program at Project Sites

This fellowship program has been implemented since May 2006 at collaborating research institutions located in developing countries where collaborative researches are being carried out by JIRCAS researchers. It aims to promote the effective implementation of ongoing collaborative researches at the project sites through the participation of local research staff. Furthermore, through this fellowship program, JIRCAS intends to contribute to capacity-building of the collaborating research institutions. In FY2013, one researcher was invited to Mongolia. The fellow and her research subject are listed below.

For inquiries on the JIRCAS Visiting Research Fellowship Program, please contact the Research Coordination Section (Tel. +81-29-838-6335; Fax +81-29-838-6337; e-mail: irs-jircas@ml.affrc.go.jp)

JIRCAS Visiting Research Fellowships at the Project Sites
(October 2013- September 2014)

Zolzaya Sed-Ochir	School of Biological Resources and Management, Mongolian State University of Agriculture (MSUA), Mongolia	Development of a technique for processing and conservation of underutilized feed resources in Mongolia and determination of their nutritional values	Oct. 1, 2013-Sept. 30, 2014

Other Fellowships for Visiting Scientists

The Government of Japan sponsors a postdoctoral fellowship program and a researcher exchange program for foreign scientists through the Japan Society for the Promotion of Science (JSPS). The program places post-doctoral and sabbatical fellows in national research institutes throughout Japan according to research theme and prior arrangement with host scientists, for terms of generally one month to three years. Fellowships can be undertaken in any of the ministries, and many fellows are currently working at various IAAs affiliated with MAFF. The visiting scientists who resided at JIRCAS in FY2013 are listed below.

JSPS Postdoctoral Fellowship for Foreign Researchers
(April 2013 to March 2014)

Mary Jeanie Telebanco-Yanoria	International Rice Research Institute, Philippines	Development of IR64 multiline variety and identification of blast resistance genes from NERICA	Nov. 1, 2011 - Oct. 31, 2013
Babil Pachakkil Kalari Thotathil	None	Molecular and cytological genetic studies on diversity of yam genetic resources	Apr. 2, 2012 – Mar. 31, 2014
Salirian Rachael Claff	None	Zinc uptake of rice as affected by interactions of soil zinc pools and iron oxide root plaques	Oct. 9, 2012 - Oct. 8, 2014

JSPS Invitation Fellowship for Research in Japan (April 2013 to March 2014)			
Long-Term			
Ashiq Rabbani Malik	Institute of Agri-Biotechnology and Genetic Resources, National Agricultural Research Center, Pakistan	Functional analysis of genes involved in abiotic stress-responsive gene expression in rice	Jul. 1, 2012 – Apr. 29, 2013
Short-Term			
Wolf Ulrich Blankenhorn	University of Zurich, Switzerland	Clinal variation in body size and associated life history traits in the yellow dung fly	Mar. 17 - Apr. 12, 2013

WORKSHOP

DOA/JIRCAS Collaborative Workshop on Future of Multi-Purpose Sugarcane (MPS)

To discuss the practical utilization of multi-purpose sugarcane (MPS*), which was developed as a result of collaborative research between JIRCAS and the Department of Agriculture (DOA), Thailand, the "DOA/JIRCAS Collaborative Workshop on Future of Multi-Purpose Sugarcane (MPS)" was held in Khon Kaen City, Thailand on 19 September 2013. About 40 participants from Japan and Thailand, including many from local sugar mills, attended the workshop. Alternative uses of MPS were introduced, and several approaches for its practical utilization were discussed.

In the opening session, Dr. Thongchai Tangpremsri, director of the Field and Renewable Energy Crops Research Institute, DOA, expressed thanks to JIRCAS for its long-running collaboration and contribution to the development of MPS. Dr. Masami Yasunaka, vice president of JIRCAS, also expressed his gratitude to the DOA and participants.

DOA/JIRCAS workshop participants

In session 1 (Development of MPS and novel sugar-ethanol production system), the development and characteristics of MPS were presented by JIRCAS and Khon Kaen Field Crops Research Center, DOA. Then, the novel sugar-ethanol production system, in which MPS can be used, was introduced by Asahi Group Holdings, Ltd. Lastly, JIRCAS proposed to establish an "MPS network" to exchange information on the cultivation, evaluation, and utilization of MPS.

In session 2 (New technologies to utilize MPS), the development and utilization of forage sugarcane were presented by NARO Kyusyu Okinawa Agricultural Research Center and Khon Kaen University. Then, the utilization of extracted materials from sugarcane was introduced by Mitsui Sugar Co., Ltd. Finally, risk assessment of sugarcane white leaf disease (SCWL) by epidemiological study, which is one of the achievements of JIRCAS's integrated pest management (IPM) project, was presented.

*MPS was selected from the progeny of hybrids between sugarcane varieties and wild sugarcane lines. It has higher fiber and lower sucrose content than conventional varieties cultivated for sugar production. Because of high biomass production, sugar yield per area is higher than conventional varieties. More MPS ratooning cultivation is possible in Northeast Thailand, where severe dry seasons suppress ratoon cultivation. It is thought that MPS is more suited for sugar and ethanol production and for bagasse cogeneration.

3rd JIRCAS-CTU Climate Change Project Workshop held in Can Tho City, Viet Nam

A workshop titled "JIRCAS-CTU Climate Change Project Workshop 2013" was held in Can Tho City, Viet Nam on 26 September 2013. The workshop is an annual gathering of scientists, engineers, lecturers and researchers, aimed at reporting and discussing the achievements resulting from the activities in Mekong Delta under the "Development of Agricultural Technologies to Respond to Climate Change" flagship project of JIRCAS.

A total of 30 people from Can Tho University, JIRCAS, Cuu Long Delta Rice Research Institute, and Southern Institute of Water Resources Research participated in the workshop.

Dr. Masami Yasunaka, vice president of JIRCAS, and Dr. Nguyen Hieu Trung, dean of the College of Environment and Natural Resources, Can Tho University, delivered the opening remarks. Fourteen researchers presented their research results (to date) in 3 thematic sessions, namely, "Mitigation of GHG emission from rice paddies and livestock," " Adaptation and carbon sequestration," and "Establishment of rural development model with low GHG emission." The participants engaged in active discussions, and opinions were exchanged during the workshop.

The workshop ended successfully with the expectation that all research achievements will be integrated at the end of the project period.

Opening address by Dr. Yasunaka, vice president of JIRCAS

Participants in the workshop

International Workshop: Direction of blast studies in Asia, Africa, and Japan

The international workshop titled "Direction of blast studies in Asia, Africa, and Japan" took place at JIRCAS Tsukuba on 25 September 2013. The workshop was an organized activity under the research subject, "Blast Research Network for Stable Rice Production," of the JIRCAS research project, "Rice innovation for environmentally sustainable production systems."

Around 40 rice scientists from 12 countries (Japan, China, Korea, Vietnam, Laos, Cambodia, Thailand, Bangladesh, India, Philippines, Indonesia, and Benin) and one international organization (the International Rice Research Institute or IRRI) were gathered. Ongoing blast studies in tropical areas of Asia, in temperate regions from Asia to Europe, and in Africa, were demonstrated by scientists from JIRCAS, IRRI, and the Kyushu-Okinawa Agricultural Research Center (ARC) of the National Agriculture and Food Research Organization (NARO), Japan. They also discussed the future direction of blast research.

Dr. K. K. Jena, IRRI scientist, explained the blast studies conducted by Working Group 2 of the Temperate Rice Research Consortium (TRRC), which was organized by IRRI, and mentioned that a new resistance gene, *Pi40(*t), would be useful for rice breeding. Mr. T. Odjo, from the University of Abomey-Calavi, Bennie, showed the results of research on the genetic diversity of blast races and rice germplasm in West Africa. He indicated that these findings were the first information derived from the systematic investigations, using the differential system as basic tool, in this region. Dr. Y. Fukuta, JIRCAS project leader, presented the outline and achievements under the JIRCAS research subject, "Blast Research Network for Stable Rice Production." He recommended the distribution of the differential system for pathogenicity and genetic studies in blast disease and suggested one promising way of developing durable protection methods against blast, through evaluation of genetic diversity among rice varieties, such as multiline varieties. Furthermore, Dr. D. Zhou, from IRRI, reviewed IRRI's research activities concerning host plant resistance to rice blast. Dr. H. Sato, from Kyushu-Okinawa ARC, discussed blast studies in Japan. He also introduced the application of partial resistance genes and the development of a multiline variety with Koshihikari genetic background. Dr. Y. Nakajima, from Aichi Agricultural Research Center, concluded the workshop by giving his comments and stressing the importance of the differential system for pathological studies and of partial resistance gene(s) for the genetic improvement of rice varieties.

The importance of development and application of the differential system for blast research works was reviewed during the international workshop, and the collaboration for its wide-area distribution was also confirmed with other international research networks such as the TRRC by IRRI. "Partial resistance gene(s)" and "multiline

Participants to the international workshop, "Direction of blast studies in Asia, Africa, and Japan"

variety(ies)" were shared as keywords toward developing future technologies related to durable protection systems against blast disease.

The participants visited the Hachimandai experimental field in JIRCAS Tsukuba on 27 September 2013 and observed the international differential varieties that were developed under the JIRCAS-IRRI collaborative research activity.

JIRCAS Workshop on Tropical Coastal Aquaculture Project

JIRCAS, in cooperation with SEAFDEC/AQD, held a workshop on October 9-10, 2013 in Iloilo, the Philippines, as part of the ongoing research project entitled "Development of aquaculture technologies for sustainable and equitable production of aquatic products in tropical coastal areas." This JIRCAS 5-year project, which started in 2011, is an international collaboration between KMITL in Thailand, SEAFDEC/AQD in the Philippines, FRI in Malaysia, and FRA in Japan, to develop sustainable and environmentally friendly aquaculture technologies and to improve the livelihoods of small-scale farmers in Southeast Asian countries through application of these technologies. Since the fiscal year 2013 was the midway of the project, a workshop was conducted to review current research activities and exchange views on how to reach the project goal. A total of 33 participants from 7 organizations in 4 countries attended the workshop.

Thirteen speakers presented their research findings on three subjects, namely, (1) development of co-culture systems of giant tiger prawns in Thailand; (2) development of integrated multi-trophic aquaculture (IMTA) systems in the Philippines; and (3) establishment of a fishery management plan for blood cockles in Malaysia. In the co-culture research, it became clear that a green seaweed species not only absorbed the excess nutrients but also promoted growth and enhanced body color on giant tiger prawns. Similarly, in the IMTA research, it was evident that a sea cucumber species was able to efficiently utilize aquaculture feed and fish feces for its growth. In the blood cockle research, new methods for identifying their planktonic larvae and detecting fatal paralytic shellfish poisoning toxins were developed. Furthermore, various ideas for the dissemination of developed aquaculture technologies and possible future international collaborations were proposed in General Discussion. Thus, the development of sustainable and environmentally friendly aquaculture technologies can be highly expected.

JIRCAS workshop participants

1st International Symposium on Microbial Technology for Food and Energy Security

JIRCAS, together with Kasetsart University of Thailand, co-organized an international symposium entitled “The 1st International Symposium on Microbial Technology for Food and Energy Security” on 25-27 November 2013 in Bangkok, Thailand. One hundred fifty participants, mostly from Thailand, Japan, Indonesia, China and Germany, discussed the application of microbial knowledge and technology to resolve problems related to food and energy production. The symposium held sessions on Food Security (Day 1) and on Energy Security (Day 2).

Four keynote speeches were delivered during the symposium: Dr. Hiroyuki Konuma, FAO assistant director-general and regional representative of the Regional Office for Asia and the Pacific, presented “Policy of Food and Energy Security for Global Prospects”; Dr. Yoshiaki Kitamura, director of the Applied Microbiology Division at the National Food Research Insitute, NARO, Japan, discussed “The Innovation with Smart Microbes towards Bio-Industrialization: Past, Present and Future”; Prof. Dr. Kenji Iiyama, vice chairman of Non-Wood Green Products Association of Japan (an NPO), prelected “Overview of Bio-based Process Technology”; and Dr. Wolfgang Schwarz, assistant professor at the Department of Microbiology, Technical University Muenchen, Germany, explained “Current Developments of Microbial Technology in Bio-fuel and Bio-based Products.”

Experts, researchers and engineers from various Asian countries, in addition to private practitioners and companies, presented more than 27 scientific presentations including JIRCAS project achievements on “Advanced application of local food resources in Asia” and “Development of biofuel and biomaterial production technologies using biomass resources in Southeast Asia.” The general discussions for both sessions were concluded by acknowledging the importance of microbial knowledge and technologies, and the need to share and utilize the research outputs as common resources among countries. Lastly, the joint declaration on the Asian Food Resource Network was adopted by symposium participants during the plenary session.

The 1st International Symposium on Microbial Technology for Food and Energy Security

International Symposiums and Workshops, FY 2013			
1	Seminar on sorghum and biological nitrification inhibition (BNI)	April 22, 2013	Tsukuba, Japan
2	5th Steering Committee Meeting, JIRCAS Islands Environment Conservation Project	April 24, 2013	Majuro Atoll, Republic of the Marshall Islands
3	TICAD V Pre-event Workshop New Stages of Agricultural Research in Africa	May 26, 2013	Yokohama, Kanagawa, Japan
4	TICAD V Pre-event Workshop New Stages of Agricultural Research in Africa	May 31, 2013	Tokyo, Japan
5	Special Lecture by the President of the Republic of Tunisia	June 3, 2013	Tokyo, Japan
6	6th International Workshop on Remote Sensing and Environmental Innovations in Mongolia (Special Session : Assessing agricultural resources in Mongolia)	June 10-11, 2013	Ulaanbaatar, Mongolia
7	Training/ workshop on monitoring of GHG emission from livestock	June 26, 2013	Can Tho City, Viet Nam
8	FAO TCP Facility Project Workshop: Crop Supply and Demand Analysis in Cambodia and Laos	July 8, 2013	Bangkok, Thailand
9	Workshop of SATREPS project “Multi-beneficial Measures for Mitigation of Climate Change in Vietnam and Indochina Countries by Development of Biomass Energy” and Study meeting of *Jatropha curcas* in three SATREPS projects	July 24-25, 2013	Ishigaki, Okinawa, Japan
10	3rd GrassRISK Project Progress Meeting	August 20, 2013	Ulaanbaatar, Mongolia
11	2nd International Symposium “Sustainable Diets, Human Nutrition and Livestock”	August 21-25, 2013	Ulaanbaatar, Mongolia
12	Training/workshop on greenhouse gas (GHG) measurement and carbon footprint (CFP) assessment in ruminants livestock	August 26-30, 2013	Khon Kaen City, Thailand
13	Workshop on Technology Transfer: Binderless board and compressed lumber from Oil Palm Trunk by USM-JIRCAS-UT International Collaboration Research	August 27, 2013	Banting, Selangor, Malaysia
14	Current situation and issues of recycling-based agricultural production system in upland farming areas of Northern China	September 5, 2013	Tsukuba, Japan
15	Meeting on research of biological nitrification inhibition in wheat	September 10, 2013	Yokohama, Kanagawa, Japan
16	DOA/JIRCAS Collaborative Workshop on Future of Multi-Purpose Sugarcane (MPS)	September 19-20, 2013	Khon Kaen, Thailand

17	Workshop: "Direction of blast studies in Asia, Africa, and Japan" for "Blast Research Network for Stable Rice Production" under the JIRCAS research project "Rice innovation for environmentally sustainable production systems" Annual meeting of Blast Research Network for Stable Rice Production Research from 2013 to 2014	September 25-27, 2013	Tsukuba, Japan
18	JIRCAS-CTU climate change project workshop 2013	September 26, 2013	Can Tho City, Viet Nam
19	9th Seminar on rural development based on clean development mechanism (CDM) and key farmers' workshop	September 27, 2013	Can Tho City, Viet Nam
20	JIRCAS Workshop: Development of Aquaculture Technologies for Sustainable and Equitable Production of Aquatic Products in Tropical Coastal Areas	October 9-10, 2013	Iloilo, Philippines
21	Workshop on "Improvement of Soil Fertility with Use of Indigenous Resources in Rice Systems in Ghana"	October 15-16, 2013	Tamale City, Ghana
22	5th Seminar on Conservation and Management of Freshwater Lens, JIRCAS Islands Environment Conservation Project	October 24, 2013	Majuro Atoll, Republic of the Marshall Islands
23	JIRCAS Workshop "Evaluation and utilization of the resistance to soybean rust"	November 7, 2013	Foz do Iguaçu, Brazil
24	Annual Meeting of Soybean Rust Project (Development of breeding technologies toward improved production and stable supply of upland crops)	November 8, 2013	Foz do Iguaçu, Brazil
25	JIRCAS International Symposium 2013 New Direction of Sustainable Technology Development in Asia : Changing Rural Livelihood and Japanese Advantage	November 20-21, 2013	Tokyo, Japan
26	Improving Phosphorus Efficiency in Rice: Novel traits and underlying genes	November 25-27, 2013	Tsukuba, Japan
27	1st International Symposium on Microbial Technology for Food and Energy Security	November 25-27, 2013	Bangkok, Thailand
28	4th Progress Meeting on the Project "Development of sustainable soil fertility management for sorghum and sweet sorghum through effective use of biological nitrification inhibition (BNI)"	November 28, 2013	Patancheru, India
29	JIRCAS International Seminar: Situation of GRiSP and implication to Japan	December 9, 2013	Tsukuba, Japan
30	MAFF-Funded Project: Development of Drought-tolerant Crops for Developing Countries; Annual Meeting 2013	December 11, 2013	Tsukuba, Japan
31	Seminar on Porous Structure and Use of Biomass	December 20, 2013	Tsukuba, Japan

32	2014 Seminar for the JIRCAS-Tigray project "Establishment of sustainable rural society with low GHG emission"	January 14, 2014	Mekelle City, Ethiopia
33	Development of Conservation Agriculture based cropping system for sustainable soil management in West Africa	February 5, 2014	Ouagadougou, Burkina Faso
34	International Workshop: Small scale oil palm farmers in Southeast Asia - Partnerships for sustainable production -	February 11, 2014	Krabi, Thailand
35	JIRCAS-CTU AWD project workshop 2014	February 20, 2014	Long Xuyen City, Viet Nam
36	International Workshop on the International Network Development and Information Sharing for Management of Sugarcane White Leaf Disease in Southeast Asia	February 27-28, 2014	Khon Kaen, Thailand
37	ICASEPS-JIRCAS Seminar: How we realize win-win situation between large scale oil palm companies and smallholders ? -Summary of ICASEPS-JIRCAS collaborative study-	March 4, 2014	Bogor, Indonesia
38	Workshop of the GrassRISK Project 2014	March 5, 2014	Ulaanbaatar, Mongolia
39	3rd Steering Committee Meeting of the GrassRISK Project	March 6, 2014	Ulaanbaatar, Mongolia
40	2nd Seminar of Project JIRCAS-Caaguazú	March 7, 2014	Coronel Oviedo City, Paraguay
41	Research meeting on the ICT-related technologies which are possible to apply at pastoral regions in Africa	March 25, 2014	Tsukuba, Japan
42	Research network meeting for the reduction of greenhouse gas emissions from livestock sector	March 29, 2014	Tsukuba, Japan

APPENDIX

PUBLISHING AT JIRCAS

OFFICIAL JIRCAS PUBLICATIONS

English		
1) JARQ (Japan Agricultural Research Quarterly)		
	Vol. 47	No. 3, No. 4
	Vol. 48	No. 1, No. 2
2) Annual Report 2012		
3) JIRCAS Newsletter	No.68, No.69, No.70	
4) JIRCAS Working Report Series	No. 81	Identification of Stable Resistance to Soybean Rust for South America
5) JIRCAS International Agriculture Series		
	No. 23	Farm Management and Environment of Rainfed Agriculture in Laos

Japanese	
1) JIRCAS News	No.68, No.69, No.70

RESEARCH STAFF ACTIVITY 2013-2014

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THIRD MEDIUM-TERM PLAN OF THE JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

The Japan International Research Center for Agricultural Sciences (JIRCAS) has been contributing to the improvement of technologies for agriculture, forestry, and fisheries, in tropical and subtropical areas as well as other overseas developing regions (hereinafter referred to as "developing regions"), by performing technical trials and research activities.

During the First Medium-Term Goal period (FY2001 to 2005), JIRCAS worked on research and development (R&D) for the sustainable development of agriculture, forestry, and fisheries, as well as on the expansion of international research exchanges and networks, taking into account both domestic and overseas situations, such as the adoption of the U.N. Millennium Development Goals for the eradication of poverty and hunger in the world.

During the Second Medium-Term Goal period (FY2006 to 2010), JIRCAS created a multilateral collaborative research system, promoted collaborative research with world-class research organizations led by the Consultative Group on International Agricultural Research (CGIAR), established a dynamic research system, and implemented major research activities as projects at JIRCAS. In fiscal 2008, JIRCAS took over international activities from the dissolved Japan Green Resources Agency and strengthened its field activities.

Based on the outcomes of JIRCAS's research strategy and in accordance with the Basic Plan for Agriculture, Forestry and Fisheries Research (determined at the meeting of the Agriculture, Forestry and Fisheries Research Council on March 30, 2010), three research agendas have been identified over the course of this Medium-Term Goal period, namely: (1) the development of agricultural technologies in developing regions, based on sustainable management of resources, (2) the development of technology for increased productivity and stable production of agricultural products in the tropics and other unstable environments, and (3) the development of technology for income and livelihood improvement of the rural population in developing regions. Research resources will be allocated to these agendas on a priority basis, and a system that will allow the research results to be to put into practice most effectively in developing regions will be established. To best understand the highly diverse subjects and goals of technological development in developing regions, JIRCAS will also strengthen its capability related to the collection, analysis, and dissemination of information on international agriculture, forestry, and fisheries.

Through this series of activities, JIRCAS is committed to fulfill its responsibilities as Japan's only research institution mandated to carry out comprehensive international research in agriculture, forestry, and fisheries, and to contribute to the enhancement of food security in the country by solving global food problems.

I. Measures to be taken to achieve the goal of efficient business management

A) Cost reduction

1. Reduction in costs such as general and administrative expenditures

a) Administrative operations implemented by operational grants will be reviewed and efficiency will be further promoted. Average annual reduction targets are at least 3% with respect to the previous year for general and administrative expenditures (excluding personnel expenditures), and at least 1% with respect to the previous year for research expenditures. The general and administrative expenditures will be thoroughly examined and reviewed to determine whether there is any further room for cost reduction.

b) With regard to pay standards, the salaries including allowances for directors and staff will be carefully scrutinized in light of the general pay standards for government employees. As JIRCAS's payment level for fiscal 2009 was 104.7 against a base figure of 100 for government employees (for administrative/technical personnel, age considered), its pay standards will be reviewed and reduced to the equivalent level for government employees by fiscal 2011; and in succeeding years the payment level will be in accordance with the pay regulations for government officials. The results of the assessment and progress of implementation will be made public. With regard to total personnel expenses, ongoing cost reduction efforts of more than 5% over a period of five years from fiscal 2006, according to the Act on Promotion of Administrative Reform for Realization of Small and Efficient Government (Act No. 47 of 2006), are to be consistently maintained through fiscal 2011. The reduction target for JIRCAS's total personnel expenses for this fiscal year (excepting retirement allowances, welfare expenditures [legal and non-legal welfare expenditures], and salaries revised in accordance with the recommendation of the National Personnel Authority) is more than 6% with respect to the fiscal 2005 level. Based on the Treatment Related to Salary Revisions for Government Officials (determined at the Cabinet meeting on November 1, 2010), and in accordance with the government's personnel cost-cutting efforts, JIRCAS will conduct a rigorous review of its personnel expenses as part of the planned fundamental review of the incorporated administrative agency (IAA) system. Personnel expenses related to staff taken on from the Japan Green Resources Agency, which had already achieved a personnel expenses reduction of more than 5%, are not subject to the current personnel expenses reform, in accordance with the Treatment of Across-the-board Personnel Cost Cuts for Organizations such as Incorporated Administrative Agencies Which Cooperate in Accepting Staff from Dissolved Agencies (notice of June 9, 2008 from the Administrative Reform Promotion Office, and other government departments, to personnel in charge at the ministries).

Personnel expenses related to the following permanent staff are not included in the reduction targets:

(i) Fixed-term staff employed by means of competitive or contracted research funds, or external funds from the private sector for collaborative work.

(ii) Fixed-term researchers (a) employed by means of government commission fees or subsidies; or (b) engaged in important research agendas (strategically important science and technologies designated in the Third Basic Program for Science and Technology [determined at the cabinet meeting on March 28, 2006], in line with national policy), who are employed by means of operational grants; or (c) 37 years of age or younger as of the end of fiscal 2005.

2. Review of Contracts

a) According to the Inspection and Review of Contracts of Incorporated Administrative Agencies (determined at the cabinet meeting on November 17, 2009) and other related policies, and based on the plan to review free contracts, a thorough review will be conducted on uncompetitive free contracts, and improvements will be made on biddings involving only one bidder/applicant in general competitive biddings.

b) Contract methods (such as the use of multi-year vs. single-year contracts) will be reviewed from a cost-saving viewpoint, with reference to other IAAs.

c) With regard to contracts with organizations deemed to be in close relation to JIRCAS, information provision will be reviewed to enhance transparency.

B) Implementation and feedback from evaluations and checks

1. To ensure work priority and transparency, JIRCAS will conduct evaluations and checks on its operations and research activities in a fair manner by utilizing external specialists prior to annual evaluation by the IAA Evaluation Committee. To allocate research resources on a priority basis, JIRCAS will clarify the basic policy and specific methods of supplying the respective results, along with the results from the IAA Evaluation Committee, to the administrative management. Research activities in particular will be reviewed on a flexible basis, with their necessity and progress taken into account. Evaluation and feedback results will be made available on JIRCAS's website.

2. For the purpose of evaluating research activities, a process sheet enumerating the annual goals will be prepared prior to the start of research. The process sheet is important for two main reasons: First, it ensures the improvement of technologies concerning agriculture, forestry, and fisheries in developing regions to address their food problems, thereby contributing to Japan's food security; Second, it becomes the basis for conducting evaluations at high international standards. Numerical goals and specific indicators will be set wherever possible. Research resource input and obtained results will be analyzed and utilized to evaluate research activities.

3. JIRCAS will endeavor to streamline and upgrade its evaluation methods by ensuring the mutual utilization of data needed for a multiple evaluation system. It will also improve this evaluation system where necessary.

4. Based on third-party evaluation, including that of administrative departments, each of the 10 or more research outcomes which are useful to developing regions will be designated as a 'Major Outcome for Dissemination' within the Third Medium-Term Goal period. The dissemination and use of such designated and other research results will be understood, analyzed, and utilized for the improvement of administrative management.

5. JIRCAS will make performance evaluations of its personnel and appropriately integrate the results into their treatment.

C) Effective use, improvement, and upgrading of research resources

1. Research funds

a) Research activity evaluation results will be appropriated into budget allocations for the effective and efficient promotion of the Medium-Term Goals research programs supported by operational grants.
b) To further promote research and development, efforts will be made to obtain external funds, such as funds for commissioned projects and competitive funds, and to utilize them more efficiently.

2. Research facilities and equipment

Research facilities and equipment are classified into three categories based on their age-related condition and JIRCAS' research prioritization, as follows: (i) facilities that will not conduce to research promotion without renovation and upgrading, (ii) facilities that will hamper the progress of research without renovation due to their severe age-related condition, and (iii) facilities required to be renovated by law or regulations. Planned renovation and upgrading of facilities essential to research promotion will be implemented while the use of such facilities will be promoted to increase the rate of utilization. With regard to the Island Environment Technology Development Laboratories, which are open facilities located at Tropical Agriculture Research Front, research proposals will be made to other research centers and publicity activities will be augmented to encourage the use of the facilities.

3. Organization

To achieve the Third Medium-Term Goals, the administrative and research organizations will be reviewed in a flexible manner, based on research evaluation results, to promote collaborative work with other IAAs in the agricultural field.

4. Improvement of staff qualifications and development of human resources

a) JIRCAS will revise its human resource development program in accordance with the Act on Enhancement of Research and Development Capacity and Efficient Promotion of Research and Development by Advancement of Research and Development System Reform (Act No. 63 of 2008), as well as changes in the surrounding environment of research and development, and other factors.
b) Efforts will be made to improve the qualifications of researchers who play key roles in international collaborative research, by dispatching them abroad and conducting collaborative studies with invited overseas researchers.
c) JIRCAS will create a competitive and cooperative environment for research personnel, provide them with effective incentives, develop their career path by utilizing a range of employment systems, conduct effective personnel exchanges with other research organizations including IAAs, and promote various forms of human resource exchange with governmental departments. JIRCAS will also cooperate with other agricultural IAAs in developing the international skills of their staff.
d) JIRCAS will make efforts to improve its personnel's qualifications by mandating that administrative and technical staff actively participate in various training sessions organized and implemented by external organizations or other IAAs. Efforts will also be made to improve the system that allows

technical staff to engage positively in research support.

e) The management ability and leadership of research project leaders will be improved through the implementation of various training systems.

D) Improvement, upgrading, and promotion of the efficiency of the research support sector

1. Research support work will be streamlined wherever possible by conducting work in conjunction with other agricultural IAAs, such as the joint implementation of training programs and joint creation of manuals.

2. The work of the General Affairs Section will be reviewed to ensure efficiency in the operational system. The efficiency of clerical management will be promoted by speeding up and simplifying clerical procedures.

3. JIRCAS will provide efficient local support to researchers dispatched abroad when they perform experimental and accounting work.

4. Efforts will be made to streamline, upgrade and enhance technical support activities by reviewing work and focusing on areas that require highly specialized technology and knowledge that meet the needs of advanced experimental and research work.

5. The Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) will be utilized to streamline, upgrade and enhance work on the collection and dissemination of research information; and efforts will be made, both to promote information-sharing across JIRCAS and to streamline operations, through the use of groupware.

6. Efforts will also be made to rationalize research support staffing by reviewing overall support work and continuing to promote outsourcing.

E) Promotion and enhancement of collaboration and cooperation between industry, academia, and government

1. To further promote collaborative research and researcher exchange, efforts will be made to improve information exchange and alliances with national and public research organizations, universities, and the private sector.

2. JIRCAS will actively support alliances and cooperation with other agricultural IAAs, including personnel exchanges, keeping in mind the division of roles.

3. Cooperation will be provided to the National Agriculture and Food Research Organization (NARO), as necessary, in implementing breeding research and other work.

II. Measures to improve the quality of service and execution of other duties relating to the public

A) Research and investigations

1. Priority research promotion

The research activities described in the attachment will be promoted on a priority basis.

a) To fulfill JIRCAS's responsibilities as Japan's only research institution mandated to carry out comprehensive international research in agriculture, forestry, and fisheries for developing regions, efforts will be made to improve information exchange and alliances with related organizations in Japan, through close coordination with the Japan Forum for International Agricultural Research for

Sustainable Development (J-FARD) and other organizations for sustainable development. JIRCAS will also actively strive to make international contributions, utilizing Japan's technology in these areas by collaborating with developing and developed nations, international research institutes, private organizations such as NGOs, and international research networks, to effectively promote international collaborative work. Questionnaires on joint research will be sent to related overseas research institutes to further the effective performance of such activities.

b) To ensure the prompt and practical application of research results, JIRCAS will make efforts to encourage the beneficiaries of technologies and research results to participate in research projects from the planning stages, and to conduct such research activities focusing on the utilization, diffusion, and commercialization of research results.

c) At least 525 collaborative researchers and research managers will be invited from agricultural, forestry, and fisheries research organizations in developing regions during the Third Medium-Term Goal period to conduct collaborative research or improve the capability of the researchers concerned. At least 85 effective Memoranda of Understanding (MOUs) will be maintained per year.

d) Collaborative research utilizing research resources owned by respective organizations will be promoted efficiently by further strengthening alliances with other IAAs in the field of agricultural research and development.

e) As a sub-bank in the NIAS Genebank Project implemented by the National Institute of Agrobiological Sciences (which serves as the central bank), JIRCAS will efficiently collect, store and characterize gene resources in close cooperation with the central bank.

2. Collection, analysis and dissemination of information for identifying trends related to international agriculture, forestry and fisheries

a) To help solve global food and environmental problems, JIRCAS will analyze the current situation and make forecasts concerning food supply and demand and the production structure of agriculture, forestry, and fisheries in foreign countries

b) To contribute to research and other projects related to agricultural, forestry, and fisheries in developing regions, JIRCAS will collect, analyze, and disseminate information and materials related to the international food situation, to the agricultural, forestry, and fishery industries as well as to rural areas. It will be carried out in a regular, institutional, and systematic manner, through collaboration with related organizations in Japan and overseas, and through the long-term dispatch of staff to priority areas. The respective information and materials shall be provided to a broad range of researchers, government agencies, and private companies.

3. Flexible response to government needs

JIRCAS will flexibly respond to government needs that will arise during the Third Medium-Term Goal period, and carry out necessary research and development in a consistent manner

B) Reinforcement of ties with government departments

1. JIRCAS will appropriately reflect the opinions of the departments of the Ministry of Agriculture, Forestry and Fisheries in its research activities and dissemination of research outcomes. At every stage during development, from research design to dissemination of outcomes and practical applications, JIRCAS will make efforts to seek a common awareness of issues with related governmental departments, through close exchange of information, and will welcome them to participate in annual meetings to examine research results and plans. Alliances with government departments will be assessed on a yearly basis with the respective departments' participation, and the results will be utilized to further strengthen ties.

2. Keeping in mind the division of roles with other IAAs, JIRCAS will provide technical information and dispatch experts to governmental departments and related committee meetings, including emergency response, and will hold symposiums and other forums.

C) Promotion of the release and dissemination of research results

1. Securing interactive communication with the public

a) To fulfill accountability to the public, JIRCAS and its researchers will make efforts to secure interactive and continuous communication with the public by effectively utilizing various forms of information media.
b) The research staff will actively pursue community outreach activities such as open lectures for citizens, and their efforts will be conscientiously evaluated.
c) JIRCAS will seek the understanding of residents in areas where research is implemented, through cooperation with research partners and local governments concerned.

2. Promotion of utilization of research results

JIRCAS regards PR and the dissemination of new knowledge and technologies, along with their integration into government policy, as important activities. Researchers and related departments will make efforts to promote such activities.

In light of these aims, JIRCAS will first combine research results obtained during the Third Medium-Term Goal period with those already obtained in the previous Medium-Term Goal period, compile them in a database, and create manuals for proper utilization. At the same time, JIRCAS will conduct PR activities in countries where research facilities are located and actively promote the dissemination and utilization of research outcomes in developing regions by conducting collaborative research with international research or cooperation institutions.

3. Public relations and the release of research results

a) Research results will be released at academic meetings in Japan and overseas. At least 560 refereed papers will be published in academic journals and bulletins during the period covered by the Medium-Term Goals. In addition, at least 35 international symposiums and workshops will be held during that period, and the respective research results will be widely released in Japan and overseas.
b) Details of research results and other activities will be released on JIRCAS's website and through exhibitions. JIRCAS will also issue more than 11 press releases of major research results during the period covered by the Medium-Term Goals.

4. Acquisition of intellectual property rights and promotion of their utilization

a) JIRCAS considers important the generation of results beneficial to the entire world, transcending national and regional borders (global public goods). When promoting practical application and utilization of research results, special attention will be paid to find balance between contributing to the progress of developing regions and promoting Japan's industries, including agriculture.
b) JIRCAS will implement intellectual property management to promote research and development, with the ultimate aim of promoting practical application and utilization. Obtaining rights to research results and handling licenses will be carried out in an integrated manner, from the design stage of research and development onwards.
c) JIRCAS will aim to win patent rights in a strategic manner, including filing and licensing overseas, for possible patent licensing in the future or for the protection of research results. JIRCAS will file at least 20 patent applications in Japan and abroad during the period covered by the Third Medium-Term Goals.
d) JIRCAS will review its own patents, as needed, in light of licensing and the development of alternative technologies. It will waive rights to less important patents.
e) Bred materials applicable to Japan will be registered in the Registry of Plant Varieties to promote their dissemination and utilization.
f) JIRCAS will grant at least three licenses for domestic or international patents each year within the Third Medium-Term Goal period.
g) JIRCAS will actively provide information related to patent rights to outside parties, and strengthen efforts necessary for technological transfer.
h) JIRCAS will review its own Basic Intellectual Property Policy as necessary, in line with the Strategy for Agricultural, Forestry and Fisheries Intellectual Property (decided by the Agriculture, Forestry and Fisheries Research Council in March 2007).

D) Other social contributions in specialized fields

1. Analyses and appraisals

On request from the government, relevant organizations, or universities, JIRCAS will perform analyses and appraisals that require its highly specialized knowledge and/or are difficult for other organizations to carry out.

2. Training sessions and seminars

a) JIRCAS will hold training sessions and seminars as often as possible, and actively cooperate in events sponsored by the government and other organizations.
b) JIRCAS will actively welcome participants and trainees from other IAAs, universities, national and public institutions, and the private sector, to develop human resources, raise technical standards, and disseminate technical information. JIRCAS will also welcome trainees from abroad.
c) JIRCAS will dispatch young researchers of universities to overseas countries, and promote the development of researchers engaged in international agriculture, forestry, and fisheries research.

3. Cooperation with international organizations and academic societies

a) As an organization that carries out comprehensive research on agriculture, forestry, and fisheries, JIRCAS will dispatch its staff to committee meetings and conferences held by related international organizations and academic associations. It will also provide domestic and overseas technical information on request.
b) JIRCAS will plan and hold international symposiums jointly with international organizations, with the aim of contributing to the development of agriculture, forestry, and fisheries in developing regions.
c) JIRCAS will implement a commendation program for young researchers at agricultural, forestry, and fisheries research organizations in developing regions.

[Attachment] Directions related to research and investigations

1. Development of agricultural technologies based on sustainable management of the environment and natural resources in developing regions

To overcome current global environmental problems, as well as maintain and expand the agricultural, forestry, and fishery industries in developing regions, JIRCAS will aim to develop sustainable resource management and environmental conservation technologies in relevant areas through collaboration with local and international research centers. More specifically, the following priority research projects will be carried out:

a) Projects addressing global warming including (1) the development of global warming mitigation technologies such as those for the reduction of greenhouse gas emissions from livestock and agricultural land and by soil carbon sequestration, (2) the development of adaptation technologies such as nutrient management technology to reduce stresses imposed by climate change, (3) the assessment and analysis of global warming impacts (and its countermeasures) on the food market by employing a global food supply and demand model, and (4) the development of a sustainable rural community model with low GHG emission by employing clean development mechanism (CDM) project activities.
b) JIRCAS will establish a sustainable farming system for dry and semi-dry areas by developing anti-desertification technologies and by optimizing soil and grazing management as well as employing a cropping system that conserves soil in agriculture (conservation agriculture) through the use of non-tilling farming and cultivation of cover crops suitable to the African Savanna. JIRCAS will also develop water-saving cultivation and groundwater resource conservation technologies on islands in developing regions which are highly susceptible to abnormal climate conditions caused by global warming.
c) JIRCAS will strive to develop technologies that will enhance nitrogen use efficiency by utilizing the biological nitrification inhibition function of certain crops, thereby promoting sustainable agricultural systems and resource management.

2. Technology development for increased productivity and stable production of agricultural products in the tropics and other unstable environments

This program seeks to develop technologies to improve and sustain productivity through collaborative research with local institutions and international research centers, in specific research fields wherein Japan has shown predominant comparative advantage, focusing especially on adverse environments such as those found in tropical regions. The program also aims to reduce starvation and malnutrition, which remain serious problems in developing regions, and to contribute to food security in the world and in Japan. More specifically, the following priority research will be carried out:

a) To help fulfill the goal of the Coalition for African Rice Development (CARD) to double rice production in Africa by 2018, JIRCAS, as the implementing institute for the flagship project "Development of rice production technologies in Africa", will evaluate rice genetic resources, introduce biotic/abiotic stress tolerance into rice strains suitable to African environmental conditions, develop an Asian-type low life-cycle cost paddy infrastructure technology, and establish a cultivation system for low-input rice production in flood plains which have previously been considered unsuitable for rice production.
b) Stable crop productivity shall be attained in unstable environments by overcoming adverse factors such as drought, submergence, salinity, diseases, and pests. This research will be done by (1) establishing genetic engineering technologies to develop crops suitable to developing regions, (2) developing breeding technologies and materials to secure sustainable production against factors that inhibit the production of main upland crops such as soybean, (3) developing technologies for the evaluation and utilization of diverse genetic materials and breeding lines in tropical field crops such as sugarcane, (4) improving Asian-type rice cultivation by utilizing low-input/high-yield cultivation technology and greater genetic diversity, and (5) developing integrated pest management techniques to stabilize agricultural and livestock production in developing regions.

3. Technology development for income and livelihood improvement of the rural population in developing regions

This program aims to improve income in rural areas by (i) promoting their appropriate development in line with the respective natural conditions and cultural background, and (ii) evaluating the multilateral values of various agricultural, forestry, and fishery products. To achieve this objective, JIRCAS will develop key production technologies for sustainable agriculture, forestry, fisheries, and rural development. JIRCAS will also develop modern processing, distribution, and storing technologies through collaborations with local and international research centers to effectively utilize the products. More specifically, the following priority research projects will be carried out:

a) In rural areas in Indochina, JIRCAS will establish stable production systems for rice and field crops, livestock, forest, and fish culture, which can adapt to diverse geographical environments (forests, open fields, rice fields, and rivers), to encourage self-sufficiency, eradicate poverty, and enhance the economic independence of farmers.
b) In East and Southeast Asia, where the structures of food supply/demand and rural communities are changing due to rapid economic growth, JIRCAS will examine and propose measures to support sustainable agriculture, forestry, and fisheries. The project aims to develop food processing technologies by utilizing varied traditional food resources in these areas, as well as biofuel production technologies that do not compete with food production by utilizing the unused biomass resources in Southeast Asia. To help boost the forestry and fisheries industries in Southeast Asia, JIRCAS will develop techniques for the sustainable use of forest resources by taking advantage of forest multi-functionality. JIRCAS will also develop sustainable aquaculture technologies while preserving habitats through co-culture techniques.

FINANCIAL OVERVIEW

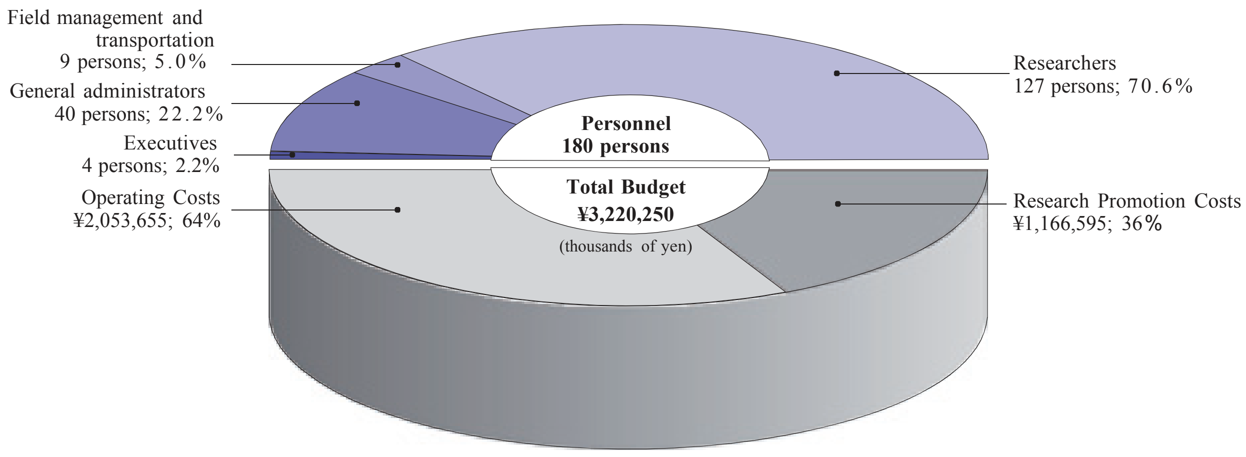
Fiscal Year 2013

thousands of yen

TOTAL BUDGET	**3,220,250**
OPERATING COSTS	**2,053,655**
Personnel (180)	1,719,707
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (40)	
Field management (9)	
Researchers (127)	
* Number of persons shown in ( )	
Administrative Costs	333,948

RESEARCH PROMOTION COSTS	**1,166,595**
Research and development	473,297
Overseas dispatches	227,855
Research exchanges/invitations	13,405
Collection of research information	74,858
International collaborative projects	357,423
Fellowship programs	19,757

Budget FY 2013 (Graph)



MEMBERS OF THE EXTERNAL EVALUATION COMMITTEE

Members of the JIRCAS External Evaluation Committee

Hiroto ARAKAWA	Former Special Advisor, JICA Research Institute
Kiyoko IKEGAMI	Professor, Graduate School of Social and Cultural Studies, Nihon University
Hiroko ISODA	Director, Alliance for Research on North Africa, University of Tsukuba
Toshihiko KOMARI	Vice President, Corporate Strategy Division, Japan Tobacco Inc.
Shin-ichi SHOGENJI	Professor, Graduate School of Bioagricultural Sciences, Nagoya University

JIRCAS STAFF in FY 2013

President
Masa Iwanaga

Vice-President
Masami Yasunaka

Executive Advisor & Auditor
Hitoshi Nakagawa
Hitoshi Yonekura

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Shun-ichi Nakada, Bioenergy Policy

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Haruyuki Dan, Representative of Africa Office (Ghana)

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Marcy N. Wilder, Crustacean Biochemistry
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Tsutomu Fushimi, Public Relations Officer

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Yoshimichi Fukuta, Rice Breeding
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Takuma Ishizaki, Plant Molecular Biology
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Masato Shimajiri, Machine Operator
Masakazu Hirata, Machine Operator
Yasuteru Shikina, Machine Operator
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THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

The Japanese Fiscal Year and the Annual Report 2013

The Japanese fiscal year is defined as the period of fiscal activity occurring from April 1 through March 31 of the following year. Thus, Fiscal Year (FY) 2013 covers the period from April 1, 2013 through March 31, 2014. The Annual Report 2013 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2014 through March 31, 2015 (FY 2014).

Buildings and campus data

Land	(units: m^2)
Tsukuba premises	109,538
Okinawa Tropical Agriculture Research Front	294,912
Total	404,450

Buildings	(units: m^2)
Tsukuba premises	10,766
Okinawa Tropical Agriculture Research Front	9,485
Total	20,251

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About JIRCAS' symbol mark (shown on front/back cover): The mark was conceived by Takayuki Ishikawa of the Crop Production and Environment Division, and Toshifumi Murakami, former Senior Researcher in the Research Planning and Coordination Division. The Earth enveloped in a revolving swirl of clouds represents the dynamics of international research and JIRCAS' aim to target all world areas. The star was added to serve as a polestar for international agricultural research and to represent the importance of cooperation.

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