Japan International Research Center for Agricultural Sciences

# Annual Report 2009

**(April 2009-March 2010)**

**Japan International Research Center for Agricultural Sciences**
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686
JAPAN

# EDITORIAL BOARD




Telephone +81-29-838-6313
Facsimile +81-29-838-6316
www http://www.jircas.affrc.go.jp

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## Message from the President

President
*Dr. Kenji Iiyama*

Nature, one of the most definitive and comprehensive scientific journals in the world, has carried many articles and reports on the present situation of hunger and malnutrition, food security issues, development of agricultural technologies and effects of climate changes on agriculture in its recent editions. These documents would be due to the "Annual Report for the United Nations Millennium Development Goals (MDGs)" published in June 2010 by the United Nations. Although the UN has fixed a goal to reduce by half the population under extreme poverty and hunger by 2015, the populations in extreme poverty and hunger in many countries of Africa and South Asia are still increasing up to now.

The United Nations set up the accomplishment of projects for the MDGs as the major agendum of the Annual General Assembly in September 2010 and organized a high level meeting just before the assembly. "Eradication of Extreme Poverty and Hunger", which is the first goal of the MDGs, has been cleared or nearly cleared in developing countries of Southeast Asia, as reported in the Annual Report of MDGs. We, all the staff of JIRCAS, are proud that the activities of JIRCAS and TARC, the predecessor of JIRCAS, contributed to these accomplishments especially in Southeast Asia. JIRCAS has become one of the major institutes offering Global Rice Science Partnership or GRiSP, one of the Mega Programs of CGIAR based on activities in developing areas.

Prices of major crops have jumped up globally from 2007 to 2008 because of climate functions and also speculation in crops. The prices are again rising sharply from the end of 2010. Extraordinary weather in major crop-exporting countries such as severe drought in Russia in the summer of 2010 and widespread flooding in Australia in January, 2011 directly affected the supply of crops. Radical changes in the eating habits of Newly Industrializing Economies (NIES) countries are taking significant increases in the demand for crops. This may stand on the edge of the precipice of realization of MDG's goal to halve the population in extreme poverty and hunger by 2015. The G20 Meeting in February, 2011 in Paris was discussing the recent sharp jump of crops as the most pressing topic, taking the recent steep rise of wheat at 1.8, maize at 2.0 and soybean at 1.9 times the prices in 2005. In addition, the inclusion of arable lands in backward countries in Africa and also Southeast Asia by some Newly-Industrializing Economies or NIES countries and Middle Eastern countries which serves as a look at new developments has been promoted.

Maintaining self-sufficiency in food crops is becoming quite an important issue in developing countries, especially in sub-Saharan Africa. JIRCAS is contributing as one of the members of the Steering Committee of the Coalition for African Rice Development (CARD), which is the international consortium aiming at the promotion of rice farming in sub-Saharan Africa and established during the Fourth Tokyo International Conference on African Development (TICAD IV) in Yokohama in May, 2008. More than 25% of the total human and financial resources of JIRCAS have been flung to agricultural development in Africa, focusing especially on the development of plant resistance/tolerance technologies for biotic and abiotic stresses.

The abiotic stress-tolerant crops produced utilizing DREB genes are strongly being looked forward to globally as very practicable in the near future. We are convinced that the application of the abiotic stress-tolerant crops with DREB genes is steadily advancing with the elucidation of the functions of DREB genes, and field examinations through the collaborative projects with the International Rice Research Institute (IRRI), International Maize and Wheat Improvement Center (CIMMYT) and International Tropical Agriculture Center (CIAT).

JIRCAS organized a satellite seminar for the current achievements and challenges of CARD led by various organizations at the Third CARD Assembly held at Arusha, Tanzania on the 17th of May, 2010. The aim of this seminar was to provide the 4,000 year-history for the sustainable development of rice cropping in the Asian monsoon regions, which sustains the densest populations in the world. The fact proves that paddy rice cropping has a great and highly sustainable capacity for supporting mass populations as well as for developing a peaceful community. In addition to our common awareness of its benefits such as environmental adaptation and yield capacity, two basic advantages of rice cropping have been pointed out; first, rice has excellent nutrition and flavorful taste and second, paddy rice cropping generates a necessarily strong network of farmers' communities because rice cropping system includes many kinds of collective activities among village farmers, such as management of water facilities, land preparation and transplant of seedlings, joint pest control and so on.

JIRCAS aims, not only to develop innovative new technologies, but also to utilize the deep traditional experiences on rice cropping accumulated around the Asian monsoon region. The efficient and sustainable technologies for rice systems are harmonious and friendly to policymakers, scientists, technicians and farmers around Africa. Furthermore, if we consider efforts to guarantee food security, not only in Africa but also in the entire world, it will become necessary to firmly establish paddy rice cropping systems, which would be harmonized with indigenous resources, society and culture.

JIRCAS is actively and constantly throwing its resources into research and development on agricultural, forestry and fisheries technology geared towards providing solutions to international food and environmental problems in the Second Medium-Term Plan (FY 2006-2010). Specific research projects are classified under three major objectives, which are (a) Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments as described above, (b) Development of management technologies for environmental resources and production systems for sustainable agriculture, forestry and fisheries, and (c) Elucidation of the impact of global environmental changes on agriculture, forestry and fisheries and development of mitigating technologies.

The major research subjects included in the first objective (a) are;

(i) Elucidation of the mechanism of tolerance to abiotic stress and production of tolerant crops,
(ii) Improvement of abiotic stress tolerance of rice in Africa,
(iii) Identification of pathogenic races for important diseases and selection of resistant germplasm in major crops,
(iv) Development of biomass utilization technology suited to Southeast Asia,
(v) Elucidation of the functionality and quality parameters of traditional food and agricultural products in Asia and development of effective utilization technology,
(vi) Effective utilization of genetic resources in tropical and subtropical crops, and
(vii) Sustainable utilization of tropical and subtropical marine resources and development of aquaculture technology.

The major research projects under the second objective (b) are;

(i) Development of sustainable management technologies for tropical soils,

JIRCAS Main Building.

(ii) Integrated management system for improved water utilization aiming at increasing economic options and reducing environmental impact,
(iii) Improvement of feeding technology for livestock in the tropics and the subtropics and establishment of sustainable agro-pastoral systems in the Asian dry areas,
(iv) Elucidation and exploitation of biological nitrification inhibition (BNI),
(v) Development of environmental management technology for sustainable crop production in tropical and subtropical islands,
(vi) Development of nurturing techniques for beneficial indigenous tree species in Southeast Asia, and
(vii) Development of productive low-input cultivation technology for fruit trees in the tropics

Research projects under the third objective (c) are;

(i) Developing an impacts assessment model and formulation of a food supply stabilization plan,
(ii) Utilization of Geographic Information System (GIS) for the development of a land information monitoring technology in developing regions,
(iii) Developing a pest control management technology for major pests in the tropics and subtropics

This Annual report is composed of major accomplishments produced from activities in FY 2009-2010 of the JIRCAS staff. We really hope that the contents of this report will contribute some academic and technical resolutions for complicated agricultural issues in the developing regions.

# HIGHLIGHTS FROM 2009

## JIRCAS/JICA Workshop on African Rice Cultivation Research

On June 5, 2009, in the International Conference Hall of the Japan International Cooperation Agency (JICA) Research Institute in Tokyo, Japan, 146 participants joined in the "JIRCAS/JICA Workshop on African Rice Cultivation Research", which was jointly sponsored and organized by the Japan International Research Center for Agricultural Sciences (JIRCAS) and the Japan International Cooperation Agency (JICA). Other co-sponsoring organizations were the National Agriculture and Food Research Organization (NARO), and the Japan Forum on International Agricultural Research for Sustainable Development (J-FARD).

The workshop drew researchers, administrative officers and overseas aid workers; private sector experts such as consultants; academic instructors and students. The participants, 146 in total, exchanged ideas on the current state of rice cultivation in Africa, and possible contributions of Japanese rice research.

Dr. Kenji Iiyama, President of JIRCAS, representing the host institution, reported on international affairs in relation to agricultural support in Africa. Dr. Ralph von Kaufmann, the head of human resource development at the Forum for Agricultural Research in Africa (FARA), a cooperative organization devoted to agricultural research in Africa, then stressed the importance of collaboration between universities in Japan and Africa in the development of human resources for the promotion of rice cultivation in Africa, and provided suggestions for a possible organizational framework. In the keynote speech, Dr. Ariyuki Matsumoto, Vice President of JICA, presented an extensive outline of the history of JICA's focus on rice farming, the nature and role of the Coalition for African Rice Development (CARD), the concept of educating African researchers and promoters of rice farming in Japan, and the qualifications expected of agricultural researchers dispatched to Africa. In addition, Dr. Kiyoaki Maruyama, Vice President of NARO, discussed relevant technologies available in Africa, based on comparisons between the developmental stages of rice farming technologies in Africa and Japan respectively.

The workshop comprised 8 presentations in total, covering a wide range of topics, including breeding (2), lowland development (2), cultivation (2), soil fertilizer (1), and farming management (1). Most of the presentations were delivered by researchers who either currently work in, or had recently worked in, Africa, and therefore provided the latest information regarding actual conditions of ecotype-specific (dry rice, irrigation rice field, inland valley, or flood plain) rice farming technologies in Africa, and action principles of farmers initiating rice farming. Among significant potential research subjects, two were highlighted: (a) marker assisted selection of rice blast- or low phosphate-tolerant rice strains, and (b) the systematic identification of land areas suitable for rice farming, through the use of geographic


JIRCAS senior administrators pose for a group photograph at the JIRCAS lobby.
Front row: Y. Maeno, Y. Mori, O. Ito, K. Iiyama, O. Koyama, A. Takenaka, Y. Mitomi, H. Azechi,
Back row: M. Ando, R. Tabuchi, Y. Egawa, M. Yasunaka, S. Matsui, K. Suenaga, M. Nakatani, T. Ohta.

information systems (GIS).

With regard to human resource development, it was severally noted that the activities of on-site researchers and promoters often ended up as a desk plan . In this regard, a comparative superiority was noted in the development of field-oriented human resources in Japan. Meanwhile, Nagoya University proposed to found a Japan-Africa agricultural education research center in Africa, where both Japanese and African researchers may be trained on site, which attracted the attention of the conference participants.

Finally, the panel discussion investigated topics relating to qualifications expected of researchers, and useful technologies, and the participants agreed on the creation of mailing lists and councils for exchanging research information, in order to sustain support for CARD.

## JIRCAS International Symposium 2009

On November 4–5, 2009, in the Yayoi Auditorium, Ichijo Hall of the University of Tokyo in Tokyo, Japan, 172 participants joined in the “JIRCAS International Symposium 2009 -Roles of Social Sciences in International Agricultural Research and Development”, which was jointly sponsored and organized by the Japan International Research Center for Agricultural Sciences (JIRCAS), the University of Tokyo and the International Food Policy Research Institute (IFPRI). The symposium was also co-sponsored by the Japan Forum on International Agricultural Research for Sustainable Development (J-FARD).

In the Opening Remarks of the symposium, Dr. Kenji Iiyama, President of JIRCAS, noted that agricultural development and agricultural technology development demand special attention in circumstances of food insecurity, and emphasized the importance of the role of the Social Sciences. Dr. Shinichi Shogenji, Dean of the Faculty of Agriculture at the University of Tokyo, then drew an analogy between the current situation of global warming and ‘the tragedy of the commons’ (Garett Hardin, 1968) and suggested that agricultural societies provide important lessons to be learned. In the keynote lecture, Dr. Maximo Torero, Division Director of IFPRI, offered a trend analysis of food price changes in recent years and Dr. Takashi Kurosaki, a professor at Hitotsubashi University, outlined the latest case studies in poverty reduction and agricultural practices in India and other countries.

Regarding the theme-specific sessions, Dr. Masuo Ando, Director of the Development Research Division of JIRCAS, delivered a brief outline of the sessions, and then the participants delivered their presentations with discussion on the following themes: (1) Impact of the Globalized Economy and Climate Change, (2) Participatory Research and Development and (3) Impact Assessment of Agricultural Technology.

Discussion in Session 1 suggested that (a) forecast changes in global food prices may have a significant effect on developing countries, (b) social scientific approaches are crucial to climate change research and (c) discussion of the results of research at international institutions should be reflected in government aid policies.

In Session 2, it was emphasized that (a) the experience of promoting agricultural developments in Japan offers many valuable lessons, (b) farmer-led development is especially effective, as it provides opportunities for sustainable self-growth and (c) social scientists are capable of uniting a diverse range of parties involved in agricultural development.

Session 3 stressed that (a) diverse perspectives are necessary for proper evaluation of agricultural technologies, (b) the process of accepting new technologies at field sites is profoundly connected to cultural and traditional factors present at the sites and (c) scientists must be accountable to the broader society.

Finally, in the general discussion session, the chairpersons from each session summarized their session’s activities and discussed with participants (a) strategies aimed at reflecting research results in government aid policies, (b) the importance of research method development, (c) policies regarding collaboration with technical researchers and (d) significant prospective research topics.

## The Japan International Award for Young Agricultural Researchers

On November 4, 2009, the Commendation Ceremony of the Japan Award for Young Agricultural Researchers (sponsored by the Agriculture, Forestry and Fisheries Research Council) was held at the Yayoi Auditorium, Ichijo Hall in the University of Tokyo. In this Awarding Ceremony, which was held for the third time last year, the Chairman of the Agriculture, Forestry and Fisheries Research Council extended his commendation to young foreign researchers who have distinguished themselves by achieving excellent performances in research and development in agriculture, forestry, fisheries and other related industries for developing countries. The winners and their achievements were as follows:

**Dr. Junemie Hazel Leonida Lebata-Ramos**
(Southeast Asian Fisheries Development Center Aquaculture Department - SEAFDEC/AQD, Republic of the Philippines)
Stock enhancement of commercially important and threatened marine invertebrates in tropical areas

**Dr. Amos Adeyinka Onasanya**
(Africa Rice Center – AfricaRice, Federal Republic of Nigeria)
Molecular and pathotyping characterization of blast, rice yellow mottle virus, bacterial leaf blight and African rice gall midge in West Africa

**Dr. Kevin Kit Siong Ng**
(Forest Research Institute Malaysia – FRIM, Malaysia)
Spatial structure and impact of logging on genetic diversity of selected tropical tree species

# NEW RESEARCH COLLABORATION

## JICA-JST-JIRCAS-Embrapa Joint Project: Development of Genetic Engineering Technology of Crops with Stress Tolerance against Degradation of Global Environment

Gradual warming of the earth raises global problems such as aridification of cropland and reduction of crop yield. Development of drought-tolerant crops such as soybean is now considered as the important target of genetic engineering technology. Based on such conditions, the project entitled "Development of Genetic Engineering Technology of Crops with Stress Tolerance against Degradation of Global Environmental Stress" was approved under Science and Technology Research Partnership for Sustainable Development (SATREPS) of Japan. The Record of Discussions was signed on December 28th, 2009 between the representatives of Brazil and Japan. To implement the project, JIRCAS and the National Soybean Research Center of the Brazilian Agricultural Research Corporation (Embrapa Soybean) further signed the Work Plan on January 5th, 2010 under the MOU. The five-year project has been formally started on March 4th, 2010. Embrapa Soybean, the University of Tokyo, RIKEN and JIRCAS joined the project with the support of Japan International Cooperation Agency (JICA) and Japan Science and Technology Agency (JST). Dr. Alexandre Lima Nepomuceno, researcher at Embrapa Soybean, in coordination with Dr. Kazuko Yamaguchi-Shinozaki, the project leader, of JIRCAS lead the project.

This project intends to develop the genetic engineering technology of soybean adapted to tolerate drought and heat aiming at the stabilization of soybean production in Brazil. The research group firstly takes steps in isolating useful genes related to environmental stress tolerance and stress-inducible promoters in soybean on the basis of the research outcome on genes involved in environmental stress tolerance and rapidly evolving soybean genome research. It selects candidate combinations of such genes and promoters, and then introduces them to soybean plant. It further evaluates environmental stress tolerance of transgenic soybean plants in greenhouse and field conditions, feedback the results to improve the combination of useful genes and promoters, and select elite transgenic lines with improved tolerance to environmental stresses. The final objective is the establishment of techniques for the development of genetically-modified soybean plants tolerant to environmental stresses aiming to reduce problems due to drought.

Field test of soybean in Embrapa, Brazil.

## Renewal of MOU with Africa Rice Center

A new MOU between JIRCAS and Africa Rice Center (AfricaRice) was signed by Dr. Papa Abdoulaye Seck, Director General of AfricaRice and Dr. Kenji Iiyama, President of JIRCAS in February, 2010. JIRCAS started collaboration with West Africa Rice Development Association (WARDA; now known as AfricaRice) in 1998. The initial target areas were genetic and eco-physiological characterization of tolerance to drought and soil acidity of rice. Socio-economics in relation to sustainability of lowland rice cultivation in West Africa was another target of collaboration. When the MOU was renewed in March, 2004, the target was narrowed down to drought tolerance. Thus, the new MOU is third generation and under this, the new collaboration titled, "Improving Stress Tolerance and the Productivity of Rice for Africa" started, based on new five year-work plan signed by Dr. Marco Wopereis, Deputy Director General (Research), AfricaRice and Dr. Takashi Kumashiro, Director (Former), Biological Resources Division, JIRCAS. The significant difference of the new collaboration from the previous two is its aim to contribute to the goal set by the Yokohama Action Plan that was announced at the Fourth Tokyo International Conference on African Development (TICAD IV) in 2008. One of the goals in that plan was to increase rice production through developing capacities to adopt systematic crop management and new methodologies including wider use of New Rice for Africa (NERICA), aiming at doubling the rice production in African countries in ten years. JIRCAS and AfricaRice have reviewed the research needs in Africa and discussed a set of new research themes related to genetic improvement of rice varieties for Africa. By taking into account some research assets accumulated in both institutes, tolerance to phosphorus deficiency and resistance to rice blast have been identified as new target traits. Drought tolerance and evaluation of agronomic traits of NERICA are also included in the work plan. Our contribution to TICAD IV goal may be small for the coming ten years but we also aim at consistent and sustainable contribution to rice production in Africa.

Is everybody ready for seeding? (Danyl Elavagnon, Togo)

# ACADEMIC PRIZES AND AWARDS

Dr. Marcy Wilder, Senior Researcher in the Fisheries Division, received the "Award for Persons of Merit in Industry-Academia-Government Collaboration (category: Award of the Minister of Agriculture, Forestry, and Fisheries)" from the Japanese government in a ceremony in Kyoto on June 20, 2009. Dr. Wilder, along with her two collaborators, Mr. Setsuo Nohara, International Marine Technology (IMT) Co., Ltd., and Dr. Takuji Okumura, Fisheries Research Agency, National Institute of Aquaculture, was recognized for her work on the development of land-based recirculating shrimp culture technology. Dr. Wilder's group at the Japan International Research Center for Agricultural Sciences (JIRCAS) conducted research on the reproductive biochemistry and physiology of the newly-popular "vannamei" shrimp (or Pacific white shrimp, *Litopenaeus vannamei*), and IMT, an aquaculture engineering company, developed the hardware for an "Indoor Shrimp Production System" (ISPS) based on the results of the above research. The first commercialized plant has now been in operation in Niigata Prefecture for three years. It utilizes 2 pools of 600 tons of water each, can produce up to 8 crops of shrimp per year, and minimizes impact to the environment. The ISPS technology can be implemented anywhere regardless of geographical conditions, and its use in developing regions is also being considered. The award ceremony was held in conjunction with the 8th Forum on Scientific Collaboration in Industry-Academia-Government which was attended by over 2000 people.

Left to right: Dr. Okumura, Dr. Wilder, Mr. Nohara.



**Dr. Kazuko YAMAGUCHI-SHINOZAKI**, Project Leader of the Biological Resources Division, was awarded the "Top Five Articles" of the 20th anniversary of *The Plant Cell* in January 2009, among primary research articles published in 20 years of the journal.

This award was given for the paper entitled "Two transcription factors, DREB1 and DREB2, with an EREBP/AP2 DNA binding domain separate two cellular signal transduction pathways in drought- and low-temperature-responsive gene expression, respectively, in Arabidopsis" which appeared in the 1998 edition (Vol. 10). An award lecture was made at the annual meeting of the American Society of Plant Biologists held in July 2009 in Hawaii, USA.

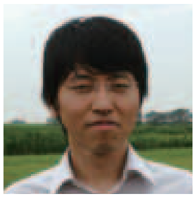
This article firstly showed that DREB transcription factors and DRE element function in regulation of gene expression in response to low temperature and dehydration stresses. It opened a new strategic door to improve plant tolerance to environmental stresses by DREB gene transfer, followed by a number of research using these genes. Challenges to figure out transcriptional regulatory networks in plants in response to abiotic stresses are continued, and collaborative activities with international institutes and universities are ongoing to develop useful crops tolerant to environmental degradation in the world.

**Dr. Hideto FUJII**, Project Leader of Crop Production and Environment Division, received the "International Contribution Award" from the Japanese Society of Irrigation, Drainage and Rural Engineering in August 2009. This award was given for his research on "Evaluation of flood mitigation function of Cambodian floodplain in the Mekong River." In this research, the hydrological roles of the Cambodian floodplain of the Mekong River including Tonle Sap Lake, from the Kompong Cham downstream to the Vietnam border was assessed through intensive observation of water levels in the floodplain at 20 locations, discharge measurements by ADP and ADCP in the main/floodplain channels and analysis of the satellite images (RADARSAT) to estimate inundated areas and storage volume and has shown that the flood peak discharge of the Mekong mainstream at Phnom Penh was reduced 20 to 25 percent from the analysis for year 2002.

**Dr. Ryuichi YAMADA**, Senior Researcher of the Development Research Division, JIRCAS, received the Academic Award from the Farm Management Society of Japan in September 20, 2009 for his book entitled, “Diagnosis, design and evaluation of diversified farming in the Mekong Delta of Vietnam: Based on the farming systems research approach.” This award is given to members of the Farm Management Society of Japan whose publications are recognized as significant academic contributions to progress in the research field of Farm Management. Dr. Yamada is the author of the book which was published in March 2008. This book consists of eight chapters.

Dr. Yamada clarified the direction of technology development of farming in the Mekong Delta of Vietnam based on the farming systems research approach. In this approach, the TN-Method, DEMATEL-Method and AHP-Method were applied in the comparison of farmers, extension officers, and researchers. It led the technology selection and on-farm trial in a comprehensive research project. Dr. Yamada made economic evaluation for practical technologies such as the biogas-digester technology, row seeding technology, rice straw manure technique and optimum fish density technology, and then presented optimum integrated farming systems based on linear programming model.

In developing countries, solution-oriented research has been more and more required. His research contributed to technology development and dissemination of developed technologies in tight cooperation with technology research in a comprehensive research project titled “Development of New Technologies and their Practice for Sustainable Farming Systems in the Mekong Delta.”



**Dr. Shintaro KOBAYASHI**, Researcher of the Development Research Division, received the Prize for Promising Young Scholar from Japan Section of the Regional Science Association International in October 2009. This award is given to an exploratory article with great potential in the field of regional science.

The award-winning article is titled "Economic Structure of Cambodia and Strategies for Pro-Poor Growth: Results from a Computable General Equilibrium Analysis" and was published in *Studies in Regional Science*, Vol. 38, No. 1, 2008, pp. 137-154.

With a view to considering development policies in Cambodia, this study estimated a social accounting matrix (SAM), which represents the transactions of goods and services and the flow of funds in an economy, and constructed a computable general equilibrium (CGE) model, multi-sectoral economic simulation model. Based on the CGE model, basic strategies for pro-poor growth were discussed. Attempts to develop an economic model suitable for a developing country were highly evaluated.

**Mr. Shigeki YOKOYAMA**, Project Leader of the Development Research Division, Ms. Ma Victoria C. Rodriguez, Research Assistant of International Rice Research Institute (IRRI) and Dr. Kumi Yasunobu, Associate Professor of Tottori University, received the Agricultural Extension Society of Japan’s Best Journal Prize on March 5, 2010.

This prize was given to the best paper which appeared in the 2009 edition of the Journal of Agricultural Extension Research, Vol. 79, No. 1, which was titled “Technology Adoption and Social Networks: Introducing Alternate Wetting and Drying (AWD) Technology in Deep Well Irrigation Systems, Tarlac, Philippines.” For the award-winning article, a social network analysis was applied to trace the diffusion process of water-saving irrigation technology (AWD) in the Philippines. A star-like network was identified when treating the early adopters as one actor. Early adopters played three supplemental roles as follows. “Gatekeepers” introduced formal knowledge from outside professionals to the community. “Coordinators” acted as reference persons to spread it within the community. “Transmitters” transferred it to outside peers. However, there is a risk of limited diffusion of that knowledge and farm-specific technology such as AWD via farmer-to-farmer communication. Filling a gap separating formal knowledge transfer and interpersonal information flow is necessary to avoid misunderstandings and improper use related to new technology. Creation of a semi-formal group comprising adopters and expected adopters is recommended.

# 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 by 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 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' Second Medium-Term Goals in FY 2006, including the enhancement of research efficiency and the improvement of the quality of research programs and financial performance. Based on the Second Medium-Term Goals, JIRCAS drafted and began to implement a detailed five-year plan, the Medium-Term Plan (FY 2006-FY 2010).

## 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 necessary to the modifications of the operational and financing systems for subsequent fiscal years. To meet the requirements of this rigorous evaluation, JIRCAS has modified the in-house evaluation system in the initial year of the Second Medium-term Plan. The in-house evaluation in FY 2009 was carried out as follows.

1) Each Project evaluated its own research activity and prepared its own summary report.
2) These reports were collectively evaluated at the meeting for the evaluation of sub-programs of the Medium-Term Plan by external reviewers (specialists from other universities or institutes) and internal reviewers (the President, the Vice-President, an Executive Advisor and Auditor, Directors of each section and Project Leaders) in February, 2010.
3) Comprehensive evaluation of all JIRCAS activities, which also include administrative operations, was performed during the External Reviewers' Meeting in March, 2010.

The external reviewers present at both of the above meetings 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, 2010.

## 5. Medium-Term Plan

JIRCAS is implementing four main programs for research activities under the Medium-Term Plan. Each main program has a number of sub-programs, each of which includes several projects. Major accomplishments and research highlights of the main programs in FY 2009 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 Second Medium-Term Plan (FY 2006-FY 2010).

| Research Approach | Main Program | Sub-program (Total) |
|---|---|---|
| A | A-1 | 7 |
| | A-2 | 7 |
| | A-3 | 4 |
| B | B | 3 |

## Second Medium-Term Plan (FY 2006-FY 2010)

### [Research Approach A] Research and development on agricultural, forestry and fisheries technology geared towards providing solutions to international food and environmental problems

#### Main Program A-1 Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments

Sub-programs

1. Elucidation of the mechanism of tolerance to abiotic stress and production of tolerant crops
2. Improvement of abiotic stress tolerance of rice in Africa
3. Identification of pathogenic races for important diseases and selection of resistant germplasm in major crops
4. Development of biomass utilization technology suited to Southeast Asia
5. Elucidation of the functionality and quality parameters of traditional food and agricultural products in Asia and development of effective utilization technology
6. Effective utilization of genetic resources in tropical and subtropical crops
7. Sustainable utilization of tropical and subtropical marine resources and development of aquaculture technology

#### Main Program A-2 Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

Sub-programs

1. Development of sustainable management technologies for tropical soils
2. Integrated management system for improved water utilization aiming at increasing economic options and reducing environmental impact
3. Improvement of feeding technology for livestock in the tropics and the subtropics and establishment of sustainable agropastoral systems in the Asian dry areas
4. Elucidation and exploitation of biological nitrification inhibition (BNI)
5. Development of environmental management technology for sustainable crop production in tropical and subtropical islands
6. Development of nurturing techniques for beneficial indigenous tree species in Southeast Asia
7. Development of productive low-input cultivation technology for fruit trees in the tropics

#### Main Program A-3 Elucidation of the impact of global environmental changes on agriculture, forestry and fisheries and development of mitigating technologies

Sub-programs

1. Developing an impact assessment model and formulation of a food supply stabilization plan
2. Utilization of Geographic Information System (GIS) for the development of a land information monitoring technology in developing regions
3. Formulation of agricultural development methodologies to tackle the environmental changes of global warming and desertification
4. Developing pest control management technology for major pests in the tropics and subtropics

### [Research Approach B]

#### Main Program B Collection, analyses and dissemination of information to grasp trends related to international food, agriculture, forestry and fisheries and rural areas

Sub-programs

1. Collection and dissemination of information related to global food, agriculture, forestry and fisheries
2. Elucidation of the direction of technology development in developing regions and analysis of socioeconomic conditions of the development in rural areas
3. Establishment of techniques and methodologies for the reconstruction of agriculture and rural communities affected by natural disasters, etc.

## 6. Collaborative Research

JIRCAS is required to cover a wide range of research fields. The human resources at JIRCAS, however, are limited. This makes collaborative research with other institutes or universities important towards achieving JIRCAS' project objectives. When JIRCAS and its collaborators agree on the beginning of collaborative research after exchanging ideas and opinions, a Memorandum of Understanding (MOU) or a Joint Research Agreement (JRAs) is usually concluded. We developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular research subject and with a set duration. A total of 111 MOUs or JRAs remained in force at the end of FY 2009.

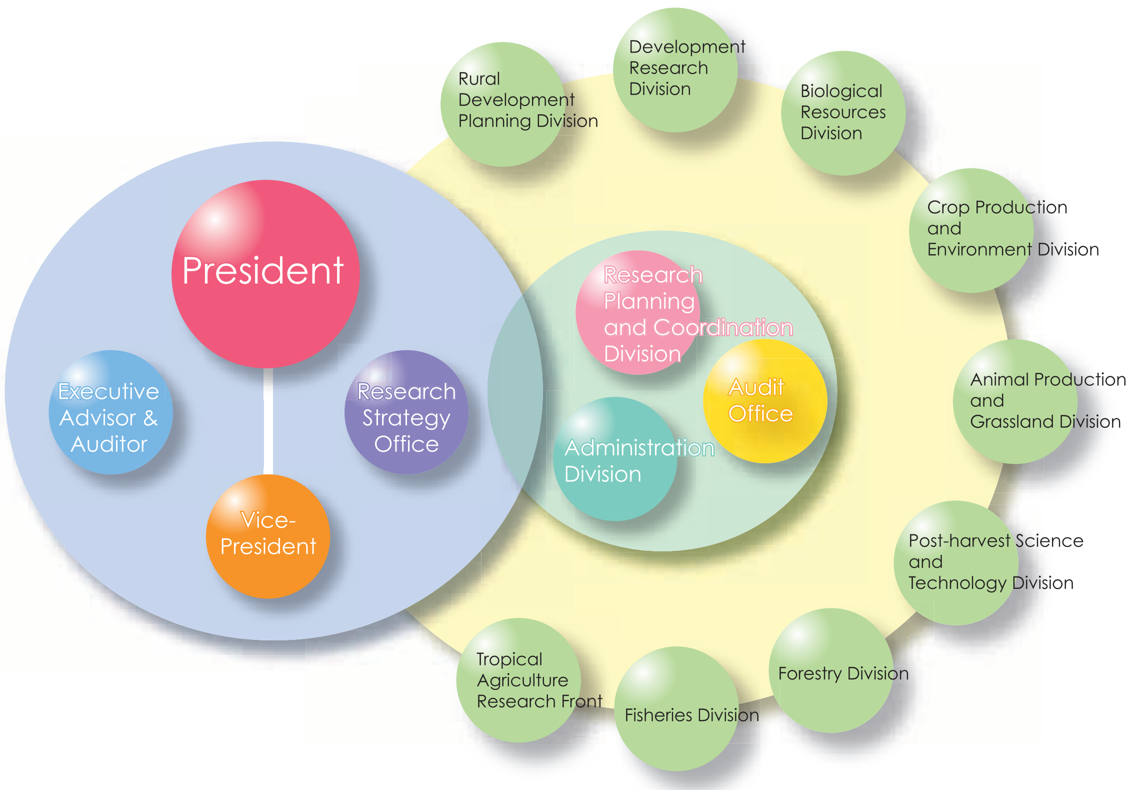
In 2004, JIRCAS was given a Certificate of Recognition by CGIAR as a key partner and as the CGIAR Focal Point Institution in Japan. JIRCAS is playing an important role in mutual understanding and collaboration between CGIAR and the Japanese government. JIRCAS has also been intensively implementing collaborative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

JIRCAS has been regularly dispatching researchers and research managers to promote research in the developing regions. In FY 2009, 160 JIRCAS researchers or administrators were dispatched abroad for a total of 16,164 days. We have been also 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 in the Second Medium-Term Plan period is summarized in the figure below.

The directors of each research or planning division, including the Research Strategy Office and the Tropical Agriculture Research Front, hold the responsibility for the management of individual sub-programs in the Second Medium-Term Plan. JIRCAS' Tropical Agriculture Research Front (formerly the Okinawa Subtropical Station) focuses on agricultural, forestry and fisheries research carried out in overseas regions with highly similar climatic and geographic conditions as Okinawa, taking full advantage of its subtropical weather and geographic location in Ishigaki Island, in the southernmost part of Japan.




Organization of JIRCAS.

# MAIN RESEARCH PROGRAMS

## Theme A-1 Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments

In developing regions where abiotic stresses such as drought and salinity, and biotic stresses caused by pests and diseases act as major constraints on agricultural production, there is an increasingly urgent need to develop technologies that enable not only stable but also sustainable production.

Theme A-1 aims at the stable production of various agricultural products encompassing agriculture, forestry and fisheries. In this theme, research projects that include the elucidation of mechanisms of stress tolerance in plants, development of abiotic stress-tolerant crops using both conventional and molecular approaches, and development of technologies to utilize various biological resources in tropical and sub-tropical regions have been conducted.

The following items can be listed as the highlights among the many outputs of this research theme in the year 2009:

1. A molecular approach to elucidate mechanisms of abiotic stress tolerance has identified a unique protein interacting with DREB2A gene. Since DREB2A protein which is involved in drought and high temperature tolerance in plants is not stable by itself, we have previously constructed an active form of DREB2A gene. Through a study on the stabilization mechanism of the DREB2A protein, we have identified DREB2A interacting proteins (DRIP1, DRIP2). Overexpression of DRIP delayed the expression of DREB2A-regulated drought responsive genes, while a double mutant of DRIP1 and 2 enhanced gene expression of drought responsive genes.
   Meanwhile, an international collaborative project covering rice and wheat has been ongoing to find out to what extent the candidate genes for stress tolerance, such as DREB1, DREB2 and others, are effective in practical field conditions.

2. Our efforts to search chromosomal regions responsible for abiotic stress tolerance have successfully identified QTLs for salt tolerance of soybean as well as ozone tolerance of rice. Through continuous study on QTL with strong effect on salt tolerance of soybean (*Glycine max*), including its wild species (*Glycine soja*), the QTL region has been narrowed down, rendering candidate DNA markers associated to the salt tolerance for breeding. For ozone tolerance of rice, a wide range of genetic variability has been found among rice germplasm. Using a mapping population between Nipponbare (sensitive) and Kasalath (tolerant), several QTLs associated with leaf bronzing and with biomass have been identified.

3. For biotic stresses, we have been dealing with rice blast and soybean rust both of which are very destructive diseases for the respective crops. Inside the Rice Blast Research Network in which several Southeast Asian countries are participating, standardization in terms of evaluation for disease severity, nomenclature method and designation system for each race of blast fungus have been postulated using monogenic differential varieties with genetic background of LTH. In soybean rust, there are so many different races, which makes it difficult to develop a soybean variety with stable resistance. Inoculation of a set of standard varieties carrying several race-specific resistant genes with rust isolates from Japan and Brazil revealed quite different disease reactions, indicating the diversification of rust races between these two countries, as well as inside Brazil.

4. In the field of research on functionality of foods, a bacterial strain, *Bacillus subtilis*, derived from a Chinese traditional fermented “Okara” was found to exhibit a special activity which strongly inhibits α-glucosidase, the key enzyme in increasing blood glucose level. The active component for this inhibition was identified as 1-deoxynojirimycin based on the results of HPLC analysis and NMR.

5. In the area of bio-fuel research, JIRCAS scientist found that old oil-palm trunks contain more than 10% of fermentable sugar in the sap and, furthermore, the sugar contents were increased up to 16 % during the storage period of 60 days, confirming our earlier observations that oil palm trunks are potentially a good source for the production of bio-ethanol. Cassava pulp corresponding to 10 – 30% of original tuber contains a large amount of starch. Using an arming yeast which displays two amylolytic enzymes and three cellulolytic

enzymes, starch and fiber components in cassava pulp were saccharified, resulting in 10.5 g/l ethanol from 5% pulp.

6. In Laos, although local waters are rich in freshwater fishes, most of these fishes are not well utilized by inland communities. Moreover, the people of the region have recently been under pressure from environmental change and the impact of invading exotic species. However, production techniques for seed of important native food fishes, including the climbing perch, *Anabas testudineus* and snakeskin gourami, *Trichogaster pectoralis*, have now been developed by preventing cannibalism and improving feeding conditions. The application of advance technologies to the aquaculture of these species should shift local culture systems, which currently depend on exotic fishes, toward the sustainable production of indigenous species.

## *TOPIC 1*

# Reaction of landraces to nitrogen was more sensitive than those of improved varieties at early vegetative growth stage

The objective of this study was to investigate varietal differences in dry matter production and physiological nitrogen use efficiency (PNUE) using a wide range of rice (*Oryza sativa* L.) varieties at an early growth stage. The results provided useful information for breeding suitable varieties for cultivation under conditions of low soil fertility or with reduced fertilizer use for sustainable agriculture. No previous studies of varietal differences in nitrogen response have accounted for the factors of agro-ecotype, geographic adaptation, and degree of improvement. Furthermore, although it is necessary to establish control for the effects of embryo and/or endosperm size on initial growth in order to investigate varietal differences at early growth stages, most studies of varietal differences in nitrogen response have not considered these effects.

We selected 31 varieties based on 3 criteria: agro-ecotype (Indica- or Japonica-type), adaptation to lowland or upland, and degree of improvement (from landrace to modern variety). Furthermore, we used the relative dry weight (RDW, %) of plants treated with nitrogen in comparison to nitrogen-free controls to investigate for differences in growth resulting from seed attributes.

The seedlings of rice varieties were grown under eight (8) nitrogen treatment conditions. The effects of natural variations in embryo and/or endosperm size on initial growth were controlled by comparing the relative dry weight (RDW) of nitrogen-treated samples and controls.

These varieties were classified into five groups, I to V, through cluster analysis of RDW under different nitrogen concentration conditions.

Table 1. Varieties used in the nitrogen response experiments and their classifications.

| Group | Variety (Origin)[b] | | | |
|---|---|---|---|---|
| | Indica- type | | Japonica- type | |
| | Landrace | Improved | Landrace | Improved |
| I | 1. Kasalath (IN) | | | |
| II | 2. Dular (IN) | | 3. Basmati217(IN) | |
| III | | | 4. Azusena (PH)<br>5. Davao (PH)<br>6. Kibi (JP)<br>7. Moroberekan (GN)<br>8. Oiran (JP)<br>9. Trembese (ID) | 10. Kotobukimochi (JP,1948)<br>11. Owarihatamochi (JP,1951)<br>12. Dontokoi (JP, 1995) |
| IV | 13. Surjamkuhi (BD)<br>14. Tadukan (PH)<br>15. Tetap (VN) | 16. Mahsuri (MA, 1956)<br>17. Hokuriku 143 (JP, 1987)<br>18. Takanari (JP,1990) | 19. Kamenoo (JP) | 20. Koshihikari (JP, 1956)<br>21. Reiho (JP, 1966) |
| V | | 22. Taichung Native1 (TW, 1956)<br>23. IR8 (PH, 1966)<br>24. IR24 (PH, 1974)<br>25. IR36 (PH, 1976)<br>26. Milyang 23 (KR, 1976)<br>27. IR64 (PH, 1985) | | 28. Aichiasahi (JP, 1922)<br>29. Nipponbare (JP, 1963)<br>30. Toride No.1 (JP, 1970)<br>31. Akihikari (JP1976) |

[a] Classification of cultivars based on responses to nitrogen.
[b] Letters and dates in parentheses indicate country or region of origin and year of release.
BD: Bangladesh, GN: Guinea, IN: India, ID: Indonesia, JP: Japan, KR: Korea Republic, MA: Malaysia, PH: Philippines, TW: Taiwan, VN: Vietnam.

The Indian landrace variety Kasalath (comprising cluster I) was seen to be the most sensitive to nitrogen as indicated by both RDW and PNUE, and the improved varieties in cluster V were the most insensitive to nitrogen. Clusters II, III, and IV were intermediate between clusters I and V. Cluster III included mainly upland varieties and differed from cluster IV in PNUE values.

The results suggest that variations may originate from the degree of improvement, from among landraces to recent varieties developed by cross-breeding, and adaptations to irrigated lowland or upland soil conditions.

The landrace, Kasalath, showed good performance with its reaction to nitrogen; it might grow well under low fertilizer condition and can be used for the development of high dry matter rice production.

The responses of these rice varieties to different nitrogen sources, ammonium and nitrate, should be confirmed, and the effect and influence of the nitrogen responses will have to be investigated at the next stage of rice growth, such as the reproductive stage.

*(S. Senoh-Namai, K. Toriyama, and Y. Fukuta)*

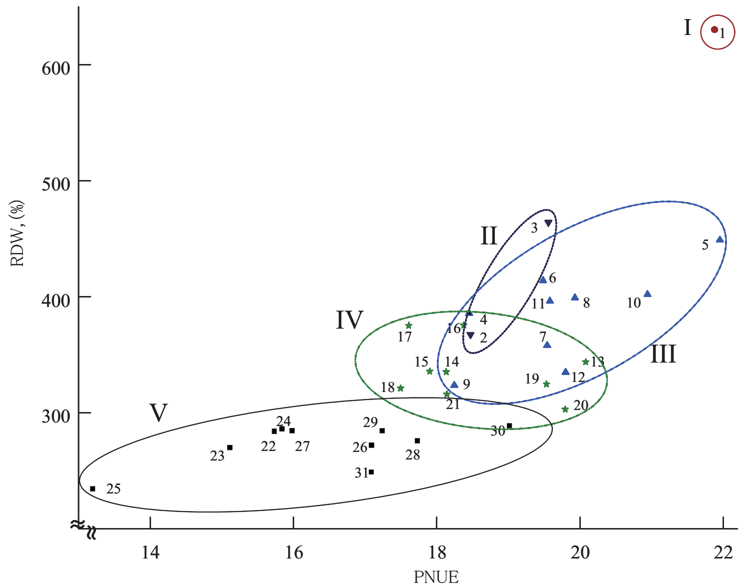



Fig. 1. Relationship between PNUE and RDW for all varieties at 20 mg N $L^{-1}$ treatment. PNUE: Physiological nitrogen use efficiency of dry matter production per 1 mg absorbed nitrogen. PNUE = Dry matter weight of the leaves and stems (DW, mg) of N treatment − DW of non-N control/

*TOPIC* **2**

## Metabolic networks involved in cold acclimation identified by integrated analysis of metabolites and transcripts regulated by DREB1A and DREB2A

Low temperature and dehydration are adverse environmental conditions that affect plant growth and productivity. Many genes have been described that respond to both stresses at the transcriptional level, and their gene products are thought to function in stress tolerance and response even though these stresses are quite different. These genes include key metabolic enzymes, late embryogenesis-abundant (LEA) proteins, detoxification enzymes, chaperones, protein kinases, and transcription factors.

Overexpression of DREB1/CBFs driven by the *CaMV 35S* promoter increases stress tolerance to freezing, dehydration, and high salinity in transgenic *Arabidopsis*. More than 40 downstream targets of DREB1A/CBF3 have been identified by microarrays. Overexpression of the constitutively active form of DREB2A (*35S:DREB2A-CA*) significantly increases dehydration tolerance but only slightly increases freezing tolerance. Microarray analyses of the *35S:DREB2A-CA* plants revealed that DREB2A regulates expression of many dehydration-responsive genes. However, some genes regulated by DREB1A are not regulated by DREB2A.

DREB1A/CBF3 and DREB2A are transcription factors that specifically interact with a *cis*-acting dehydration-responsive element (DRE), which is involved in cold- and dehydration-responsive gene expression in *Arabidopsis*. Overexpression of *DREB1A* improves stress tolerance to both

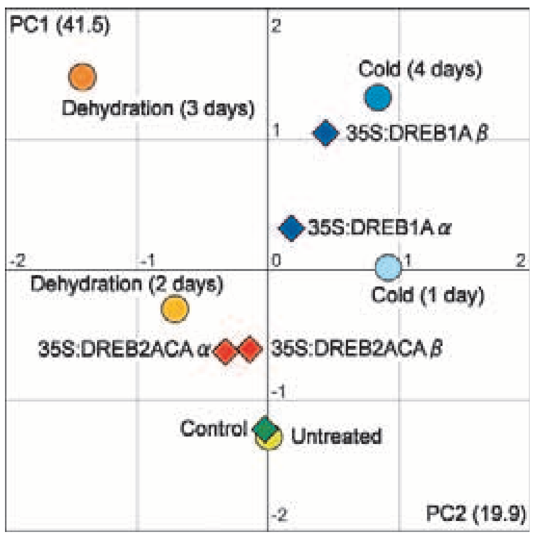



Fig.1. Statistical analyses of metabolite profiles: We analyzed two independent lines of *35S:DREB1A* (α and β) and *35S:DREB2A-CA* (α and β) plants. The levels of metabolites for both DREB1A and DREB2A in each β line were higher than those in each α line. Principal component analysis of metabolites: The *y*- and *x*-axes are PC1 and PC2, respectively. The solid circles indicate untreated, cold-exposed, and dehydration-exposed plants. The solid diamonds represent control, *35S:DREB1A* and *35S:DREB2A-CA* plants.

freezing and dehydration in transgenic plants. In contrast, overexpression of an active form of DREB2A results in significant stress tolerance to dehydration, but only slight tolerance to freezing in transgenic plants. The downstream gene products for DREB1A and DREB2A are reported to have similar putative functions, but downstream genes encoding enzymes for carbohydrate metabolism are very different between DREB1A and DREB2A. We demonstrate that under cold and dehydration conditions, expression of many genes encoding starch-degrading enzymes, sucrose metabolism enzymes, and sugar alcohol synthases changes dynamically, and consequently many kinds of monosaccharides, disaccharides, trisaccharides and sugar alcohols accumulate in *Arabidopsis*. We also show that *DREB1A* overexpression can cause almost the same changes in these metabolic processes and that these changes seem to improve freezing and dehydration stress tolerance in transgenic plants. In contrast, *DREB2A* overexpression did not increase the level of any of these metabolites in transgenic plants. Strong freezing stress tolerance of the transgenic plants overexpressing *DREB1A* may depend on accumulation of these metabolites.

*(K. Maruyama and K. Yamaguchi-Shinozaki)*

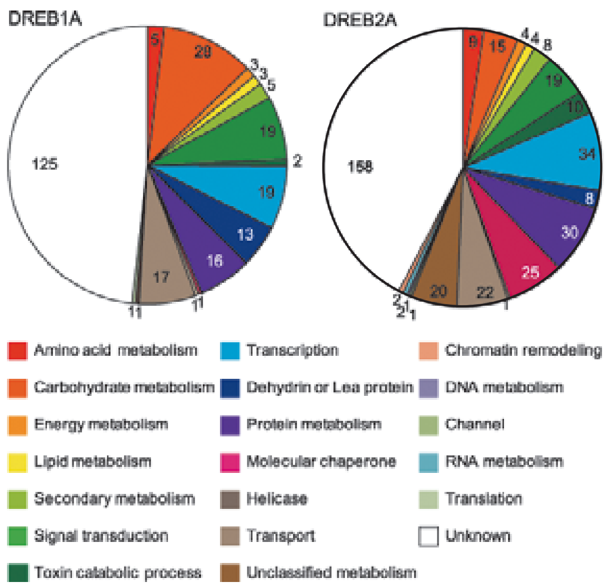



Fig. 2. Functional categorization of DREB1A and DREB2A-CA downstream genes. Shown are 20 functional categories of DREB1A and DREB2A-CA downstream genes.

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## *TOPIC* 3

# SnRK2 protein kinases are essential for the control of drought tolerance and germination

Plants are inevitably confronted during their life cycle with numerous environmentally determined stresses such as drought that can be detrimental to their survival. Abscisic acid (ABA) is an important phytohormone regulating various plant processes, including drought tolerance, seed development, and germination. We aim to elucidate the molecular mechanism of ABA-mediated drought tolerance, seed development, and germination. SRK2D/SnRK2.2, SRK2E/SnRK2.6/OST1 and SRK2I/SnRK2.3 (SRK2D/E/I) are redundant ABA-activated SNF1-related protein kinases 2 (SnRK2s) in *Arabidopsis thaliana*. In this study, we examined the role of these protein kinases in drought tolerance, seed development, and germination.

Expression analysis showed that *SRK2D* and *SRK2I* were expressed in leaf and root tissues, whereas *SRK2E* was expressed strongly in the guard cells of leaves. We assessed the effect of *srk2d*, *srk2e*, and *srk2i* mutations on drought tolerance. After reducing the relative humidity (RH) from 95 to 60 ± 5%, unlike *srk2d*, *srk2e*, and *srk2i* single and double mutants, *srk2d srk2e srk2i* (*srk2d/e/i*) triple mutant plants drastically withered and collapsed within 30 minutes.

In the drought tolerance test, our results showed that unlike the single and double mutants, the *srk2d/e/i* triple mutants exhibited greatly reduced tolerance to drought-stress (Fig. 1A). These findings are consistent with the increased rate of water loss observed in the *srk2d/e/i* triple mutant, compared with other mutants and wild-type (WT) plants (Fig. 1B). The triple mutant was also sensitive to desiccation. Siliques of the *srk2d/e/i* mutant plants contained viviparous seeds when grown in high humidity conditions (95 ± 5% RH; Fig. 2A).

In contrast to the other mutant and WT plants, green cotyledons were observed three days after stratification in all *srk2d/e/i* mutant seedlings grown on agar plates containing various concentrations of ABA (0~300 μM). In the vegetative growth stage, the seedling growth of *srk2d/e/i* triple mutant plants was strongly ABA-insensitive.

These results suggest that the triple mutant is highly insensitive to ABA. Under water-stress conditions and seed maturation stage, ABA- and water stress-dependent gene expressions, including those of transcription factors, were globally and drastically impaired in *srk2d/e/i* triple mutants, but not in other single and double mutants. Expression of dehydration-responsive late embryogenesis abundant (LEA) protein genes and ABA-related 2C-type protein phosphatase (PP2C) genes were strongly repressed in the *srk2d/e/i* triple mutants. Together, our results indicate that SRK2D/E/I function as the main positive regulators for the control of drought tolerance and germination (Fig. 3).

These results likewise suggest that manipulation of gene expression or function of SnRK2 protein kinases might be effective for the improvement of drought tolerance and the control of germination.

*(K. Nakashima, Y. Fujita and K. Yamaguchi-Shinozaki)*

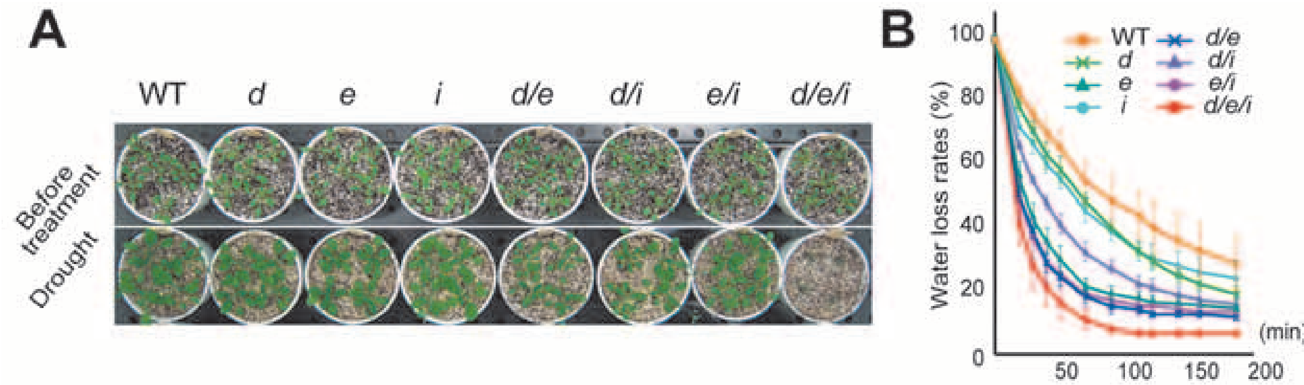



Fig. 1. Growth and drought-tolerant phenotypes of *srk2d*, *srk2e* and *srk2i* single mutants and all combinations of multiple mutants: (A) Photographs of plants before and after stress treatment. Watering was withheld from 3-week-old plants for seven days, then plants were rewatered for five days before the photograph was taken. (B) Rates of water loss from 4-week- old plants at 25 ºC and 20 % RH.

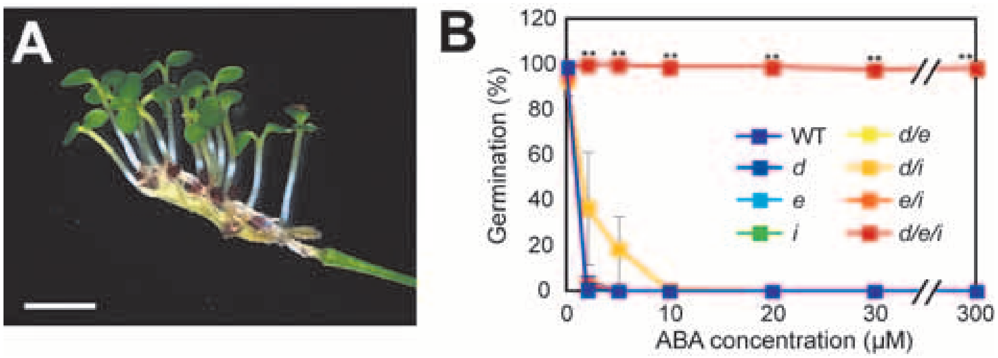
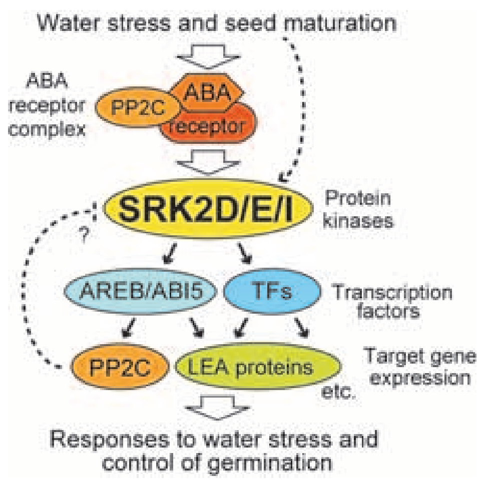



Fig. 2. Extreme ABA-insensitivity of *srk2d/e/i* triple mutant plants. (A) Viviparous seeds in attached siliques of *srk2d/e/i* mutant grown at high humidity (95 ± 5% RH). Scale bar = 2 mm. (B) Dose-response of germination to ABA. Seeds were germinated on agar plates containing various concentrations of ABA and 1% sucrose, and seedlings with green cotyledons were counted after three days. Germination curves of mutants except *srk2d/i* and *srk2d/e/i* overlap with that of WT.

Fig. 3. Model for SRK2D/E/I regulation of ABA signaling in response to water stress and seed maturation: In response to water stress, ABA appears to trigger activation of SRK2D/E/I via the ABA receptor complex. Then, SRK2D/E/I positively regulates downstream genes such as PP2Cs and LEA protein genes via transcription factors (TFs) which include AREB/ABI5. Consequently, PP2Cs are assumed to bind to the SRK2D/E/I to fine-tune ABA signaling in response to water stress.



*TOPIC 4*

# Development of a sap squeezing system from felled oil palm trunks for bioethanol production

*Background*

Oil palm trees are felled and young trees are replanted in their place at an interval of approximately 25 years because of their decreased productivity. Consequently, the enormous amounts of felled trunks are disposed as wastes in the palm oil producing countries. We found that large quantity of fermentable sugars comparable to sugars taken from other sources such as sugar cane, etc. are accumulated in felled oil palm trunks during maturation. There is no available apparatus which can efficiently squeeze the sap from oil palm trunks, although some portions of old felled trunks are utilized for plywood manufacturing. So, we developed this new system to squeeze sap efficiently from oil palm trunks.

*Results*

The squeezing system is a combination of the existing rotary lathe, a new shredder, and a new press mill. The inner part of the palm trunk (palm trunk core), whose bark and outer cover are removed, is crushed into small chips by the shredder, and then, the sap is squeezed from the small chips by the press mill (Fig.1).

The shredder is composed of two parts; the stage part, which rolls the palm trunk core and sends it to the cutting part (Fig. 2-1A), and the cutting part, which shreds the palm trunk core into small chips (Fig. 2-1B). The trunk core, which is sent to the cutting part, is stably supported by the receiving roller and roller press, and is shredded into small chips by rotary cutter.

The press mill has double mills (Fig. 2-2). Each mill is composed of three rotary-hydraulic-press rollers. The small chips, which enter into the slots of the press mill, are squeezed in the first mill, and compressed chips from the 1st mill are squeezed again in the 2nd mill. The squeezed sap is collected in a pan under each mill, and the compressed residues are discharged via the eject chute to the outside of the press mill.

Since the fibers of the oil palm trunks are shorter and thicker than the ones of sugar cane, we improved the following points; (1) the press rollers of the mills have large grooves to apply to short and thick fibers, therefore, there were able to enhance the loading of the shredded chips; (2) the press rollers of the mill have low-cut chevron for efficient squeezing, therefore, these are able to suppress the slipping of the shredded chips in between the press rollers.

When the palm trunk core (15-20 cm in diameter, and 1.2m in length) was crushed into small chips in the shredder, and the shredded chips were squeezed by the press mill, the sap yield was maintained at around 80% under slow rolling speed (2.1 rpm on the 1st mill and 2.4 rpm on the 2nd mill) and high pressure (29.5 MPa on the 1st mill, and 32.5 MPa on the 2nd mill) (Table 1: Conditions 1 and 2). The press mill has a water jet pump between the 1st mill and the 2nd mill, therefore, it is able to increase the sap yield by adding water during pressing (Table 1: Condition 3 and 4). This system can maintain high sap yield (around 80% of sap recovery), and can process approximately 500kg of trunk per hour.

*Application*

Although our shredder supports small size core (20cm in diameter, and 1.2m in length) after plywood manufacture, it is able to shred larger palm trunk cores by scaling-up the stage and cutting part of the shredder.

*(Y. Murata, Y. Mori, M. N. Mohd Yusoff and W. A. Ibrahim [Forest Research Institute Malaysia (FRIM)])*

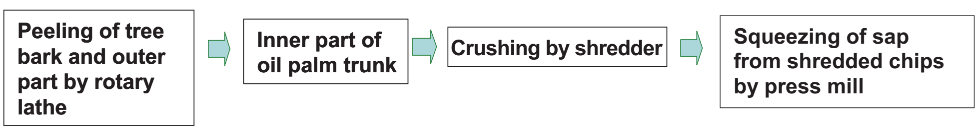



Fig.1. Flow chart of the sap squeezing system from felled trunks of old oil palm trees

Fig.2. The shredder which crushed the inner parts of palm trunks (palm trunk core) into small chips (2-1), and the press mill which squeezed sap from the small chips (2-2).

Table 1. Conditions of the press mill for efficient sap squeezing

| Mill condition | Round on shredder | Round on 1st mill and 2nd mill | Pressure on 1st mill and 2nd mill | Sap yield, % |
|---|---|---|---|---|
| 1. Low-speed round | 290 rpm | 2.1rpm, 2.4 rpm | 17.7MPa, 23.6MPa | 80.9 |
| 2. High-speed round | 290 rpm | 7.3 rpm, 7.9 rpm | 29.5MPa, 32.5MPa | 66.0 |
| 3. Medium-speed round | 290 rpm | 3.2 rpm, 3.4 rpm | 29.5MPa, 32.5MPa | 68.9 |
| 4. Medium speed round with water supply | 290 rpm | 3.2 rpm, 3.4 rpm | 17.7MPa, 23.6MPa | 79.2 |

*TOPIC* 5

## A facultatively anaerobic bacterium, *Paenibacillus curdlanolyticus* B-6, produces a novel xylanolytic multi-enzyme complex

Plant biomass contains a complex mixture of polysaccharides such as cellulose, hemicellulose (xylan and galactomannan), pectic substances (galacturonan and arabinogalactan) and other polysaccharides (e.g. type II arabinogalactan and fuco-xyloglucan). The hemicellulose and pectin polysaccharides, as well as the aromatic polymer lignin, interact with the cellulose fibrils, creating a rigid structure strengthening the plant cell wall. Therefore, complete and rapid hydrolysis of these polysaccharides requires not only β-1,4-glycosidic chain-cleaving enzymes such as endo-β-1,4-glucanase, cellobiohydrolase, and β-glycosidase, but also the cooperation of many enzymes such as xylanolytic enzymes and side chain-cleaving enzymes such as β-1,4-xylanase and α-L-arabinofuranosidase.

A facultatively anaerobic bacterium *Paenibacillus curdlanolyticus* B-6, isolated from an anaerobic digester fed with pineapple wastes is a true cellulolytic/xylanolytic organism, as it could grow on xylan, microcrystalline cellulose and α-cellulose as a sole source of carbon under aerobic conditions. *P. curdlanolyticus* B-6 grown on xylan under aerobic conditions produced two extracellular multienzyme complexes with high molecular weights estimated at 1,450 kDa and 400 kDa. To characterize the multienzyme complexes, we purified the complexes from culture supernatants using four kinds of chromatography.

The purified multienzyme complex was composed of a 280 kDa protein with xylanase activity, a 260 kDa protein that was a truncated form on the C-terminal side of the 280 kDa protein, two xylanases of 40 kDa and 48 kDa, and 60 kDa and 65 kDa proteins having both xylanase and CMCase activities. Cloning of the 40 kDa major xylanase subunit named Xyn11A revealed that Xyn11A contained two functional domains which belonged to glycosyl hydrolase family-11 and to carbohydrate binding module family-36, respectively, and a glycine and asparagine-rich linker. However, an amino acid sequence similar to a dockerin domain, which is crucial to cellulosome assembly, was not found in Xyn11A. These results suggest that the multienzyme complex produced by *P. curdlanolyticus* B-6 could have assembled through a mechanism distinct from the cohesin-dockerin interactions known in cellulosomes.

*(A. Kosugi, P. Pason, and Y. Mori)*

Table 1. Enzymatic activities of multienzyme complex protein with 1,450kDa from gel filtration.

| Enzymes | Activity (U/mg protein) |
|---|---|
| Xylanase | 3.17 |
| β-Xylosidase | 0.06 |
| Arabinofuranosidase | 0.05 |
| Acetylesterase | 0.11 |
| Avicelase | 0.01 |
| Carboxymethylcellulase | 0.12 |
| Cellobiohydrolase | 0.01 |
| β-Glucosidase | 0.07 |

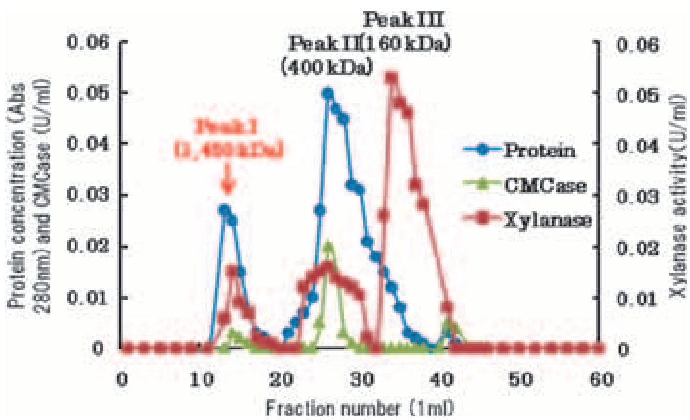
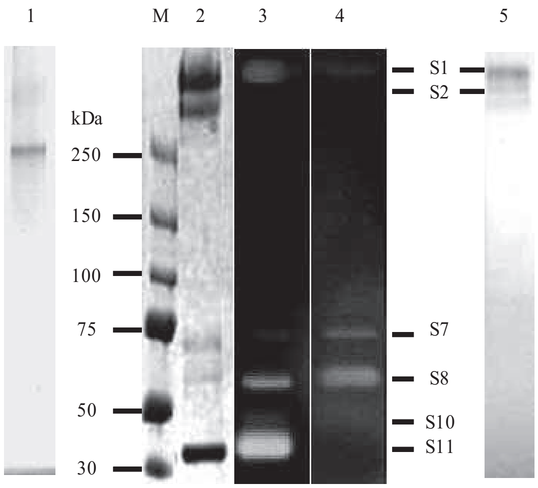



Fig. 1. Gel filtration chromatography using culture supernatant of *P. curdlanolyticus* B-6.

Fig. 2. Xylanosome of *P. curdlanolyticus* B-6
M; Molecular marker: Lane 1, Native-PAGE: Lane 2, SDS-PAGE; Lane 3, Xylanase active staining analysis, Lane 4, endoglucanase active staining analysis. The S1, S2, S7, S8, S10, and S11 indicated subunits with enzymatic activities.



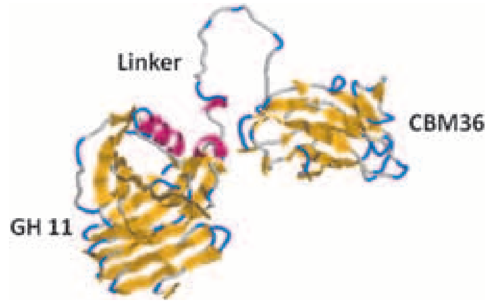




Fig. 3. Protein structure model of XynA (S11) of xylanosome of *P. curdlanolyticus* B-6.
Protein structure of Xyn11A revealed glycoside hydrolase family-11 (GH11), linker sequence (Linker) and carbohydrate binding module family-36 (CBM36) from gene sequence. Yellow and red colors indicate β-sheet structure and α-helix structure, respectively.

*TOPIC* 6

## Simple and Selective Quantification of 1-Deoxynojirimycin, an Antihyperglycemic Component in Foods

1-Deoxynojirimycin (DNJ) occurs in mulberry or other plants and several traditional foods in Asia, such as fermented Okara (Meitaoza) in China, and is a highly potent glycosidase inhibitor reported to suppress blood glucose levels, thus preventing diabetes. Derivatization is required for quantification of DNJ upon use of spectral detection methods. Because of this difficulty, the DNJ contents of mulberry-based or DNJ-containing traditional food products are rarely established, even if DNJ is their active component.

A simple, selective and rapid method of high-performance anion-exchange chromatography with pulsed amperometric detection (HPAEC-PAD) to quantify DNJ in food products was developed. A water extract of mulberry or DNJ-containing food sample was subjected to HPAEC-PAD in a CarboPac MA1 column with a sodium hydroxide gradient of flow rate 0.3 ml / min. DNJ was clearly separated at a retention time of 7.26 min without interference and was selectively detected in the water extract. (Fig. 1) The detection limit was 5 ng and showed a wider range of quantification. (Fig. 2) Heat stability studies suggested that DNJ was heat-stable. The method was applied to various mulberry-based food products from China and Thailand, and DNJ contents were obtained as shown in Table 1.

HPAEC-PAD was not subject to interference, was highly selective for DNJ, and was superior to other HPLC techniques in terms of sample preparation, resolution, and sensitivity. The

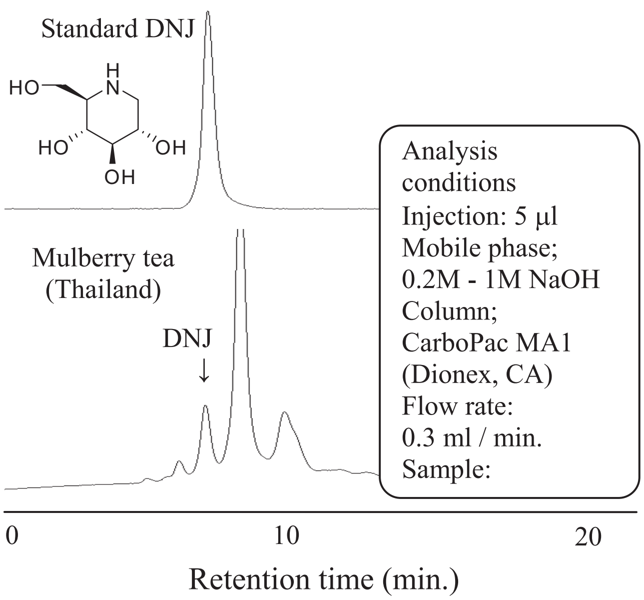



Fig. 1. HPAEC-PAD chromatogram of DNJ standard and mulberry tea bag from Thailand.

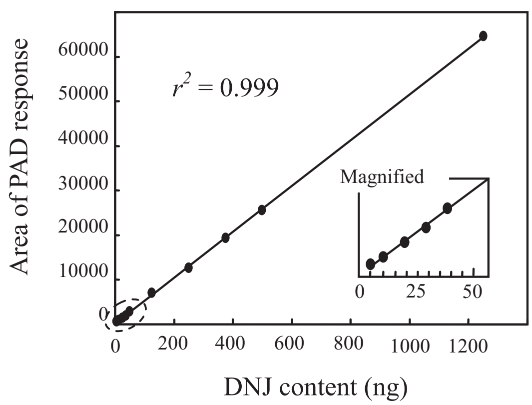



Fig. 2. Calibration curve for DNJ quantification by HPAEC-PAD.

Table 1. 1-Deoxynojirimycin (DNJ) content of mulberry leaf products in Chinese and Thai markets.

| Product | Origin | DNJ content (% DW)[a] |
|---|---|---|
| Mulberry tea bag | China | 0.221 ± 0.0092 |
| Mulberry tablet | Japan | 0.129 ± 0.0026 |
| Mulberry leaf tea | Thailand | 0.092 ± 0.0086 |
| Mulberry tea bag | Thailand | 0.234 ± 0.0073 |
| Puffed snack | Thailand | 0.007 ± 0.0004 |
| Thai-style cookie | Thailand | 0.011 ± 0.0005 |
| Drink powder (A) | Thailand | 0.023 ± 0.0011 |
| Drink powder (B) | Thailand | 0.007 ± 0.0014 |
| Mulberry tea bag containing bael fruit | Thailand | 0.214 ± 0.0034 |
| Mulberry tea bag containing safflower | Thailand | 0.236 ± 0.0088 |

[a] Values are means ± SD, n = 3.

method did not require derivatization, and the chromatogram was simpler and more selective than that provided by the general detector, ELSD. The method achieved more sensitive DNJ quantification, with no obstruction of the sample matrices. Therefore, the simple, selective, and rapid analysis of DNJ in food matrices by HPAEC-PAD might be useful for the development of mulberry-based or traditional food products containing DNJ. Heat treatment could be an option for sterilizing mulberry-based products.

*(T. Yoshihashi, H.T.T. Do, P. Tungtrakul [Institute of Food Research and Product Development, Kasetsart University], S. Boonbumrung [Institute of Food Research and Product Development, Kasetsart University] and K. Yamaki [National Food Research Institute, National Agricultural Research Organization])*

*TOPIC 7*

## Furanocoumarins in leaves of kaffir lime (*Citrus hystrix*) prohibit mutagenic DNA damages

It is possible to reduce the risk of carcinogenesis by ingesting sufficient amounts of antimutagenic food components. Thus, antimutagenicity is recognized as an important food functionality. Aiming to look for a good source of antimutagen, we examined several hundreds of Southeast Asian local edible plants using Ames' pre-incubation technique. Their industrial uses as materials of functional foods or medicines may help improve the economic value of such local agricultural products. Among the tested local edible plants, kaffir lime (*Citrus hystrix*) leaves showed one of the highest antimutagenic activities. Kaffir lime leaves have a unique fresh aroma and are widely consumed as an ingredient of food in Southeast Asia, especially in Thailand (Fig. 1).

The methanolic extract of kaffir lime leaves shows a strong antimutagenicity against heterocyclic amines (food-originating mutagens). The extract obtained from 1 mg of fresh leaves

Fig. 1. Kaffir lime leaves (left and middle); a Thai food which uses kaffir lime leaves, "ho-mok"- steamed fish paste with coconut milk (right).

inhibit 90 – 100% of mutagenesis induced by 1 ng / plate of Trp-P-1. There are rather small variations of antimutagenicity between samples obtained from different production areas or seasons. And, the antimutagenicity of kaffir lime leaves doesn't deteriorate even after high temperature cooking at 100°C for 10 minutes. Major antimutagenic compounds in kaffir lime leaves are epoxybergamottin and oxypeucedanin (Fig. 2 and 3). These compounds are furanocoumarin derivatives having an epoxylated prenyl group in their molecule. Both compounds show antimutagenicity by inhibiting the liver cytochrome P450 enzymes that activate the mutagens' effects. Epoxybergamottin is a more promising compound, since its content in raw material is higher than oxypeucedanin, and shows lower $IC_{50}$ value (higher antimutagenicity).

Antimutagenic compounds in kaffir lime leaves are insoluble in water. Therefore, it is necessary to arrange the cooking recipe to make it possible to eat the leaves, e.g. slicing in small pieces, frying, etc. It is already known through other studies that prenylated furanocoumarins are absorbed into the human body.

*(K. Nakahara, M. Yoshida [National Food Research Institute], G. Trakoontivakorn and P. Tangkanakul [Kasetsart University])*

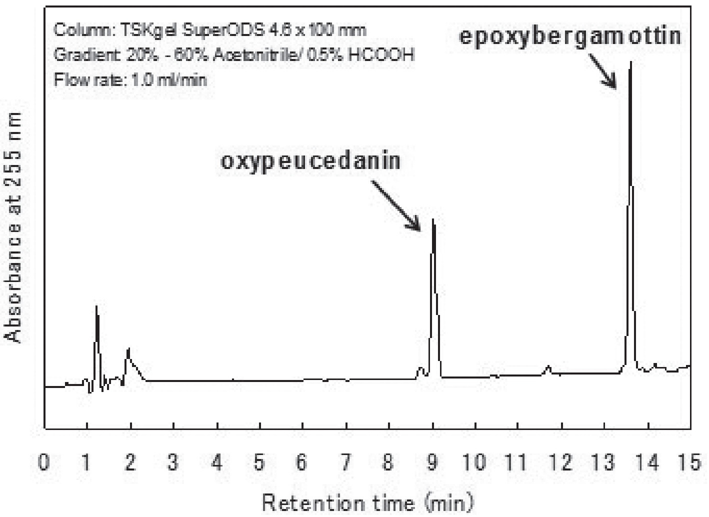



Fig. 2. HPLC profile of methanol-ether extracts of kaffir lime leaves. Two dominant peaks are of antimutagens.

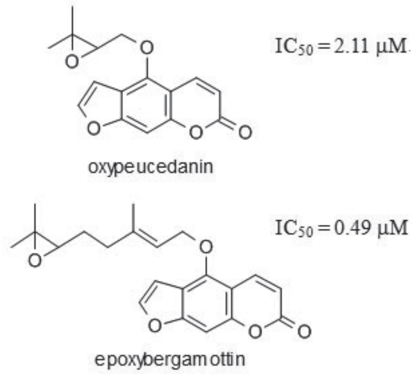



Fig. 3. Antimutagens of kaffir lime leaves. $IC_{50}$ value is the 50% inhibitory concentration of each compound against ethoxyresorufin O-deethylase activity of liver cytochrome P450s.



*TOPIC 8*

## Development of land-based recirculating aquaculture systems for domestic production of the whiteleg shrimp *Litopenaeus vannamei*

At present, marine shrimp farming has become a world-wide industry. According to the FAO's statistics from 2007, culture activity now amounts to a total annual production of over 3 million tons, which is more than half of the world's total production of shrimp. Approximately 75% of this production occurs in Asian countries. However, with this dynamic expansion of the industry, we have witnessed the occurrence of myriad environmental problems such as the destruction of mangrove forests for the purpose of shrimp-pond construction, and the deterioration of the coastal environment due to the efflux of waste products from coastally-located shrimp farms. In this regard, it has been recognized by workers in the field that it is necessary to promote new culture technologies that minimize the impact of shrimp farming to the environment.

Along these lines, with funding from the Bio-oriented Technology Research Advancement Institution (BRAIN) of Japan, we have been carrying out an integrated research project "Development of land-based recirculating aquaculture systems for domestic production of the whiteleg shrimp *Litopenaeus vannamei*" since August, 2004. To this end, JIRCAS formed a research consortium with International Mariculture Technology (IMT) Co. Ltd., an aquacultural engineering firm; Higashimaru, K.K., an aquaculture feed company; and the National Research Institute of Aquaculture. The roles of the respective partners and the project output are depicted conceptually in Fig. 1.

One of the main pillars of this project was to obtain basic physiological data pertaining to osmoregulation, oxygen demand, and ammonia excretion levels of *L. vannamei* under conditions of re-circulating culture, and to optimize shrimp growth based on the control of water temperature, salinity, and flow rates. For example, in a small-scale experiment, we found that shrimp growth in low-salinity/high-hardness water was equivalent to or better than that in full-strength seawater (Fig. 2). We used this result to develop low-salinity rearing methods, and applied this successfully to commercial large-scale production using IMT's pre-existing shrimp production facility (commercial-size *L. vannamei* shown in Fig. 3). At present, our first commercial facility (Indoor Shrimp Production System: ISPS) has been established in Myoko City, Niigata Prefecture, and has been in operation since September, 2007. The facility produces 40 tons shrimp per year, and the product is being marketed under the trade name, "Myoko Snow Shrimp".

Since this system is based totally on the use of recirculating water, the impact to the environment is virtually nil. Moreover, an ISPS facility can be established inland, without dependence on the use of fresh seawater, and can be operated based on the usage of a manual. It is expected that the implementation of this technology in developing regions where shrimp farming is a major industry should contribute to the sustainability of aquaculture production and amelioration of the environment.

*(M.N. Wilder, T. Okutsu, B-J. Kang, K. Matsuda, S. Jasmani, V. Jayasankar [JIRCAS], K. Mikami, S. Nohara, T. Nomura [International Mariculture Technology (IMT), Co., Ltd.], T. Okumura [National Research Institute of Aquaculture], T. Fukusaki, K. Keida [Higashimaru, K.K.])*

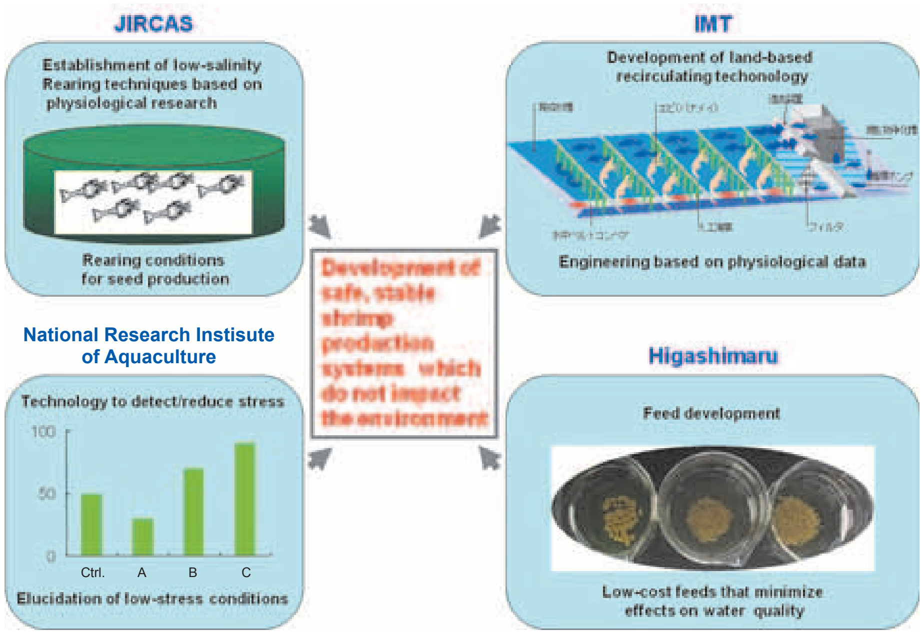



Fig. 1. Conceptual diagram of the *vannamei* research consortium showing roles of respective research partners and project output.

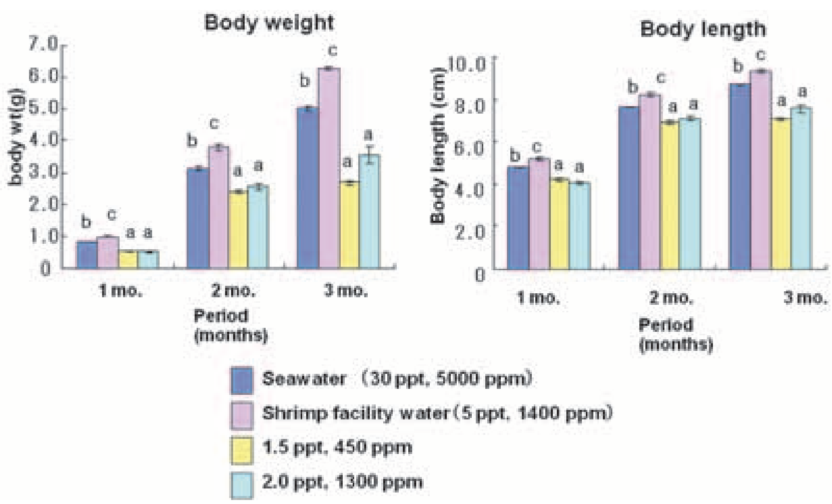



Fig. 2. Results of a small-scale experiment to determine optimal salinity and hardness of the rearing water. Using 60-L aquariums, it was found that low-salinity (5 ppt)/high-hardness (1400 ppm) water provided excellent growth rates in terms of body weight and length.

Fig. 3. Commercial-sized *Litopenaeus vannamei*. In the ISPS facility, shrimp can be reared to market size of 16-20 g within 4 months.

# Growth of giant tiger prawn under co-culture with *Chaetomorpha ligustica* at aquarium scale

Over the past two decades, the giant tiger prawn, *Penaeus monodon* Fabricius, has become an important aquatic export product for Southeast Asian countries. In Thailand, which has pioneered the intensive giant tiger prawn culture, production was valued at 15.1 billion Thai Baht (1 THB = 0.024 USD: 2000) in 2000 (Fisheries Information Technology Center 2006). However, prawn aquaculture has generated some negative impacts, such as environmental deterioration, eutrophication, and frequent outbreaks of bacterial and viral diseases. Declining prawn growth rate is also a major problem. Thus, the production of intensively cultured prawns can lead to a number of difficulties in the producer countries.

We have been developing a closed co-culture system of giant tiger prawn and seaweeds since 2004, which is simple, low-cost, with low negative environmental impact and can be operated by small-scale shrimp farmers. In our co-culture system, we encourage the growth of *Chaetomorpha ligustica* (Kützing) Kützing, which consists of dark green to yellowish brown thin filaments that are unbranched series of cylindrical cells. This alga is abundant in aquaculture ponds and irrigation canals in the brackish water areas in Thailand. This plant is ordinarily removed and discarded from rearing ponds by shrimp farmers since they believe that shrimp growth is suppressed when it is abundant.

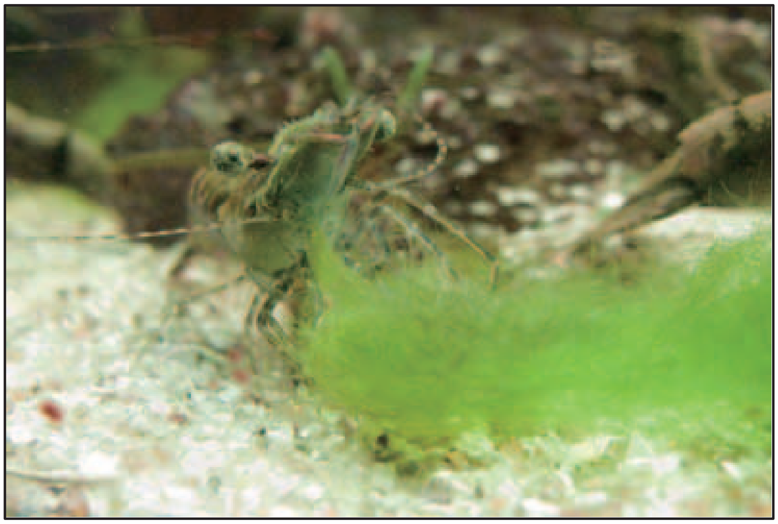


Fig. 1. A giant tiger prawn in a co-culture pond with the algae. Juveniles at every age group grazed directly on live *C. ligustica.*

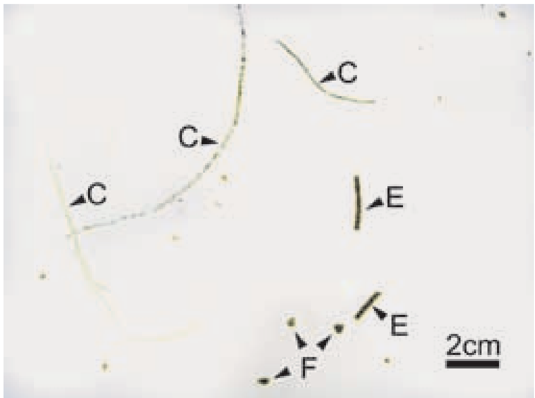



Fig. 2. Stereomicrograph of *Chaetomorpha ligustica* (C), excreta (E) and uneaten food particles (F).

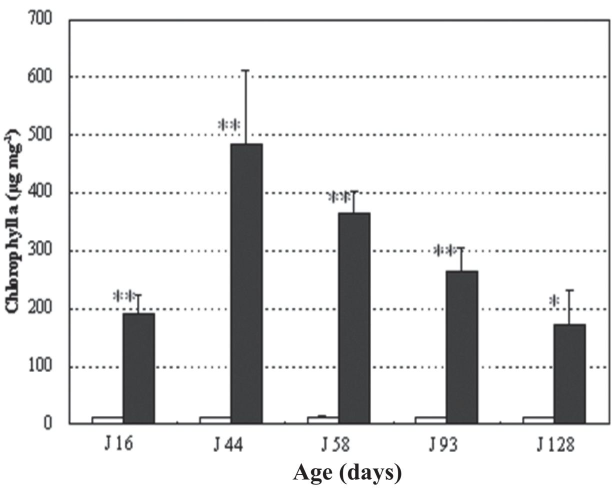



Fig. 3. Chlorophyll a (μg $mg^{-1}$) concentration in excreta of giant tiger prawn juveniles of different age groups: mono-cultured (open bars) and co-cultured with *Chaetomorpha ligustica* (solid bars). Results are given as mean (S.E.) for five juveniles in each group. * $P < 0.05$, ** $P < 0.01$.

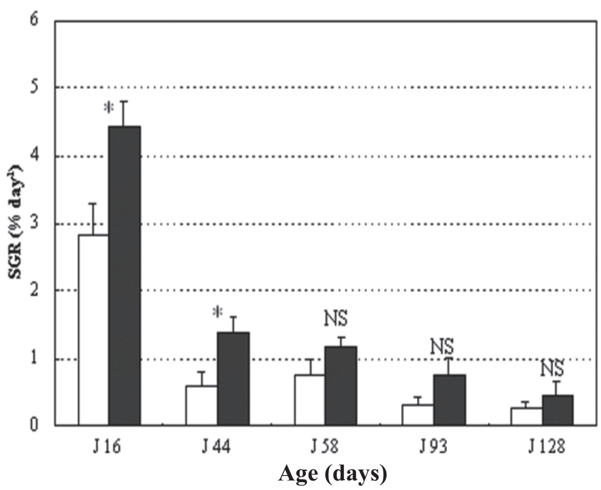



Fig. 4. Specific growth rates (SGR, % $day^{-1}$) of giant tiger prawn juveniles of different age groups: mono-cultured (open bars) and co-cultured with *Chaetomorpha ligustica* (solid bars). Results are shown as mean (S.E.) for five juveniles in each group. *$P < 0.05$, NS: not significant.

Baliao & Tookwinas (2002) recommended the removal of floating masses of benthic and filamentous algae. However, this seaweed may in fact have the function of being an absorber of toxic substances and as part of the diet of co-cultured prawns in our system. The objective of this study was to investigate the dietary effect of this discarded filamentous seaweed on the growth of giant tiger prawn juveniles.

The growth of the juvenile giant tiger prawn was evaluated at aquarium scale in co-culture with *Chaetomorpha ligustica* (Kützing) Kützing. Juveniles at different ages in days were examined, designated J 16, J 44, J 58, J 93 and J 128, where a 1-day-old juvenile (J 1) is equivalent to a 20-day-old post-larva (PL 20). Culture experiments for each age group were conducted over a period of 7 days. Juveniles at every age group grazed directly on live *C. ligustica*, even those fed an artificial shrimp diet to satiation (Fig. 1).

Excreta of the juvenile in each container were carefully collected and examined under a stereo microscope (Fig. 2). Mean chlorophyll a levels in the excreta of mono-culture groups (controls) were low but stable. Levels in co-culture with seaweed groups (treatments), in contrast, were approximately 20–50 times higher than in the controls (Fig. 3). Mean specific growth rate (SGR: % $day^{-1}$) of treatment groups was higher in early-age juveniles (Fig. 4). Compared to mono-culture, significant differences in growth were observed at J 16 (4.44% $day^{-1}$) and J 44 (1.60% $day^{-1}$); however, no significant differences were recorded at J 58 (1.16% $day^{-1}$), J 93 (0.75% $day^{-1}$) or J 128 (0.45% $day^{-1}$). It was concluded that co-culture of giant tiger prawn with C. ligustica has a dietary advantage, especially in early-age juveniles.

## Theme A-2 Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

The natural resources that are the foundation of agriculture and forestry have begun to show signs of deterioration worldwide due to inadequate management and excessive use of agricultural inputs. We therefore need to develop systems for production management that focus more on social and economic conditions, which would enable the systems to be adopted and utilized in the target countries; systems for controlling soil nutrients and water conditions to make them suitable for sustainable production in tropical, subtropical, arid, or semiarid regions; and systems for production management by combining agriculture and animal industry in various ways and by improving individual production methods. To accomplish the effective use of natural resources and development of systems for sustainable production management by combining various practices in agriculture, animal husbandry and forestry, we have launched studies on the optimization of soil, water, and crop management for agricultural, grazing, and forested lands as well as islands.

Major outcomes accomplished in 2009 include:

- In semi-arid regions of Africa with sandy soils, basic research for technology development using experimental fields is almost complete, and the project has moved to the stage of focusing more on demonstrations at the project site of the developed technology. In intensive agricultural areas in Southeast Asia, significant progress was made on simulation of yield and soil carbon using cumulative data from long-term field experiments.
- In water-saving rice cultivation, development of breeding materials and their genetic analysis using near-isogenic lines has further progressed, and the relationship between water and soil management under water-saving conditions has been evaluated. In rainfed agriculture, a simple tool that can be easily operated by local farmers has been developed to make an annual plan for utilization of water in a small pond for a variety of farm operations. This tool is anticipated to make a significant contribution to the project goal, which is diversification of cropping options through effective use of water resources.
- In a study on the development of a sustainable agropastoral system in dry areas of Northeast Asia, grazing experiments with ruminants were started in Mongolia, and investigations

of livestock farming policies, economic conditions of herders' households, and the state of grassland usage, etc., were carried out in China and Mongolia. The metabolizable energy (ME) requirement of Brahman steers for maintenance in Thailand was estimated to be 456.8 kJ/kgBW0.75. This value is similar to that of Japanese black steers raised according to Japanese feeding standards.

- In research on biological nitrification inhibition (BNI), two BNI compounds excreted from sorghum roots were identified and genotypic differences in BNI activity in rice were further confirmed through improvement of analytical accuracy. It was also shown that BNI compounds from *Brachiaria humidicola* have little effect on the population of major microbes in soils.
- It was discovered that non-tilling cultivation reduced soil erosion on sloping fields in the Philippines, the same as on Ishigaki Island. We also found that the mangrove swamps surrounding the mouth of the Miyara River on Ishigaki Island retain 90% of the nitrogen and phosphate carried in the river water.
- Experimental results showed that the self-fertilization rates of the mother trees of Shorea curtisii were considerably higher in selective logged forest than those in natural forest. This evidence indicates that reduction of adult tree density by selective logging was the main factor in the increased self-fertilization rates of mother trees in the selective logged forest.
- We established that cut-back pruning and thinning of primary scaffold limbs in durian brings forward the fruit-bearing age, and girdling the trunks of mangosteen speeds flower bud emergence.

As a whole, the projects under this theme have progressed steadily as planned. Progress with the themes can be summarized by noting that installation of a monitoring system to measure the various items needed for the projects has been completed and accumulation of data has started. The most notable research highlights have been produced by projects related to soil and livestock management: specifically, the development of a method to estimate the available forms of soil organic nitrogen, a mega-database for the project site, a tool to capture soil blown in by wind erosion, and estimation of the metabolizable energy requirements of Brahman steers.

*TOPIC 1*

## Evaluation of nitrogen flow within the framework of farmland and village in the Sahel zone of West Africa

The development of a suitable soil fertility management is of utmost important for the improvement of agricultural production in the Sahel zone of West Africa and effective utilization of locally available organic resources plays a vital role toward promoting appropriate management techniques for the existing low fertile sandy soil. Thus locally available organic resources should be quantitatively evaluated. In this regard, the JIRCAS project site in Niger, West Africa was identified as a benchmark of the study for the evaluation of nitrogen flow.

According to the survey, there are generally three categories in farmland management which are recycling, corralling and extensively managing farmlands. Recycling is the management method with household rubbish and farmyard manure, corralling is a traditional practice for pastoralists in the area to keep their livestock in the farm during the night, and extensively managing farmland is the method of rotation of fallow after certain years of cultivation. The category of recycling is sub-divided into three categories depending on the type of organic resources, i.e. adjacent farmland with household rubbish and human excrements, threshing farmland with threshed residues of millet, and a farmland using transported manure combined with household rubbish and farmyard manure.

Quantitative measurements were carried out on site for the crops' biomass production, crop residues, transported manure and aeolian dust. The total number of livestock was obtained through an interview with pastoralists. A utilization method of harvested products was identified through a questionnaire for local households and other sources of the nitrogen flow were estimated through literature review.

Crop grains, stems and leaves, and wild plants were the removed wastes from farmlands and 66% in nitrogen out of the entire harvest was brought from the extensively managed farmlands. Despite the large amount of nitrogen removal, almost no complement was measured in there except aeolian dust which was in a small amount as compared with the removal. The nitrogen balance in this category was therefore estimated at -65t N $year^{-1}$ (-9kg N $ha^{-1}$ $year^{-1}$).

Household rubbish and farmyard manure were brought mainly to the farmlands with the transported manure-type of recycling management but the use of farmyard manure was found to be ineffective due to the large amounts of nitrogen released to outside of the system. However, those adjacent farmlands were overloaded with nitrogen and the nitrogen balance was 4-13t N $year^{-1}$ (7-245kg N $ha^{-1}$ $year^{-1}$). Therefore, it is imperative to develop a technology to enhance the judicious utilization of potential organic resources in the system.

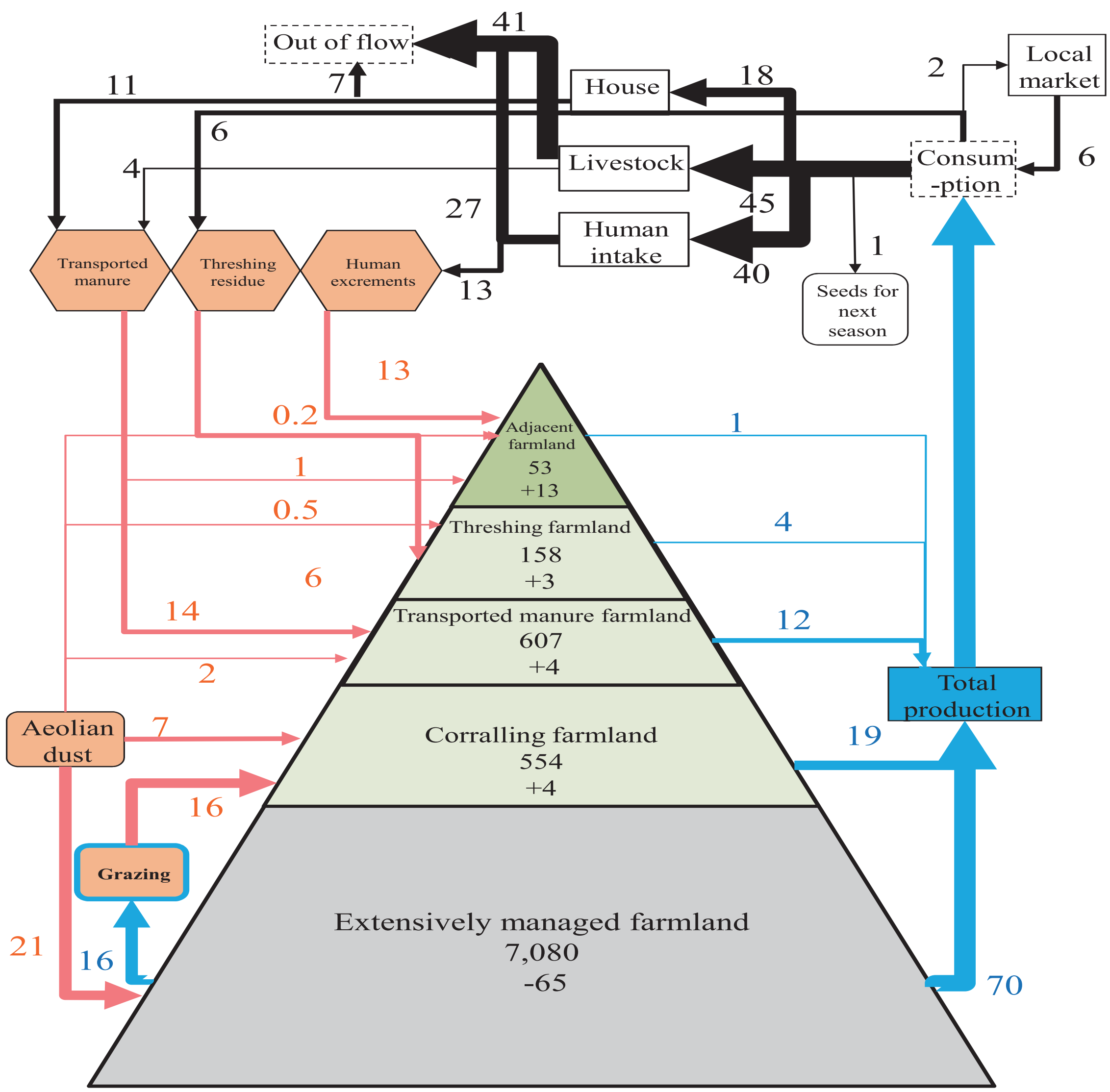



Fig. 1. Nitrogen flow within the framework of farmland and village in the Fakara region of Niger.

*Data for human excrements were estimated based on literature review. Other data were estimated based on the field measurement.

**According to the survey in 2006, the total population in the Fakara region was 5,825, with 100% of the of populace engaged in agriculture. Total number of livestock was 5,874 heads which consisted of 2,564 cows, 1,433 sheep and 1,874 goats (survey in 2006).

***Information written in the diagram above are the categories of farmland (upper), surface area in ha (middle) and nitrogen balance in t $year^{-1}$ (lower). The number beside the arrow indicates nitrogen amount (t $year^{-1}$) which flowed in the framework.

# Annual carbon requirement for sustainable crop production estimated approximately at 0.8 tC ha$^{-1}$year$^{-1}$ in the Sahel, West Africa

Many existing studies have been reported about increasing the crop yield through organic matter application in the Sahel, West Africa. However, they haven't appeared to have been properly evaluated for their sustainability on crop production, because the evaluations were not based on long-term, but only short-term trials. For the evaluation of sustainability on long-term aspects, the model simulation approach is effective. But most of existing SOM (Soil organic matter) models were constructed for temperate zones. And thus, it is essential to test model applicability before leveraging the model for assessment in the Sahel, which is a tropical semi-arid zone.

Therefore, we validated the applicability of the Rothamsted Carbon Model (Roth-C), which is one of the most widely used and convenient models, through a comparison of predicted and observed SOC changes using long-term experiments that were conducted in the International Crops Research Institute for Semi-Arid Tropics, West and Central Africa (ICRISAT-WCA), Niger.

The SOC changes during the years of observation were shown in Fig. 1 and 2. Conformity between the predicted SOC (Soil organic carbon) values and actual values was shown to be generally good in the observed two types of long-term experiments (total of 32 treatments). The LOFIT (Lack of Fit) and RMSE (Root Mean Square Error) values, the statistical indicators of unconformity in model calculation, did not show significant error between the predicted and observed SOC values (Table 1). It means that Roth-C can successfully estimate the long-term SOC changes in the Sahel, regardless of differences in land management methods as tested in these trials.

Moreover, the annual carbon requirement for maintaining SOC contents in the study area was calculated from simple linear regression analysis

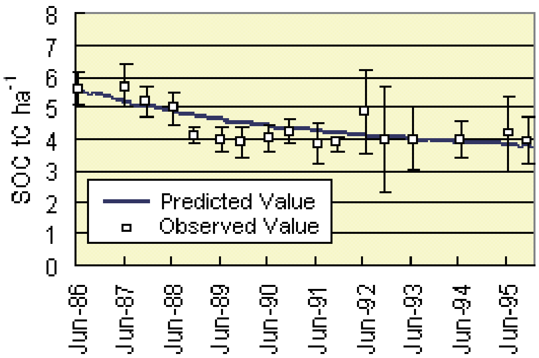



Fig. 1. Predicted and observed SOC changes under local practices without crop residue application in Site 2.

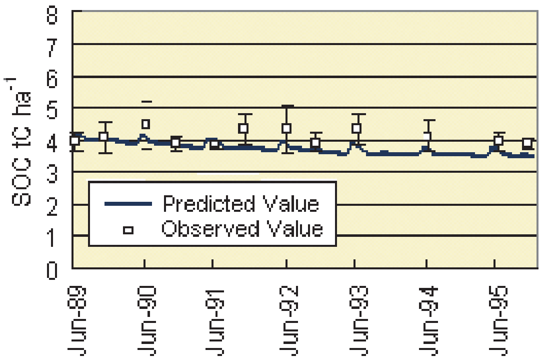



Fig. 2. Predicted and observed SOC changes under local practices with crop residue application in Site 2.

Table 1. Statistical analysis of conformity between predicted and observed SOC values.

| Research Site | Treatment | Without CR | | CR application | |
|---|---|---|---|---|---|
| | | LOFIT | RMSE (%) | LOFIT | RMSE (%) |
| Site 1: Combination application of Chemical Fertilizer and Crop Residue (1983~) | No CF | 45.90 | 29.59 | 11.07 | 12.65 |
| | CF | 34.38 | 22.97 | 32.67 | 17.46 |
| Site 2: Long term cultivation in various management combination of mono cropping and inter cropping, Ridge or Non ridge management, Rotation and No Rotation (1986~, CR1989~) | Int-Rid-NR | 12.28 | 8.73 | 11.36 | 10.34 |
| | Int-Rid-Rot | 44.52 | 14.79 | 3.90 | 5.49 |
| | Int-Flat-NR | 7.18 | 7.53 | 3.00 | 5.64 |
| | Int-Flat-Rot | 14.39 | 10.66 | 6.19 | 8.29 |
| | Sole-Rid-NR | 13.92 | 9.81 | 3.98 | 6.10 |
| | Sole-Rid-Rot | 28.74 | 11.76 | 16.52 | 9.76 |
| | Sole-Flat-NR | 12.16 | 9.51 | 4.23 | 7.60 |
| | Sole-Flat-Rot | 12.01 | 8.62 | 10.25 | 9.75 |

Abbreviations indicate as follow, Int: Intercropping, Sole: Monocropping, Rid: Ridge management, Flat: Non ridge management, NR: No Rotation, Rot: Rotation, CR: Crop residue, CF: Chemical fertilizer, respectively. And the blue bold values indicate significant conformance in Modeval calculation.

between actual annual carbon input and predicted SOC changes after ten years of cultivation, based on 59 treatments (32 from long-term experiment trials, and 27 from technical options suggested by scientists from the JIRCAS project on soil fertility improvement in Niger). The computed annual carbon requirement was about 0.8tC $ha^{-1}$ in this region (Figure 3). In addition, the determination coefficient in this regression equation showed as 0.948 which is statistically significant ($p < 0.01$). Annual input of 0.8tC $ha^{-1}$ can be converted to 1.6 ~ 2.0t $ha^{-1}$ as crop residues, and 2.0 ~ 4.0t $ha^{-1}$ as transferred manures. These values can be filled with crop residues and/or manure applications.

*(S. Nakamura, K. Hayashi, H. Omae, T. Ramadjita, F. Dougbedji, H. Shinjo, A. Kiari Saido and S. Tobita)*

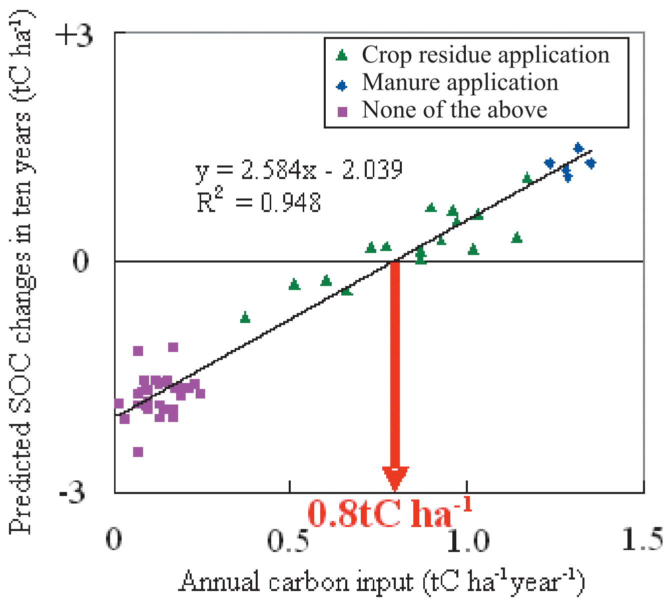



Fig. 3. Relationship between annual carbon input and predicted SOC changes in ten years.

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*TOPIC 3*

## Some African rice (*Oryza glaberrima* Steud.) cultivars survive prolonged complete submergence by shoot elongation

About 90% of rice in Sub-Saharan Africa is cultivated without any adequate water management system. The amounts of rainfall do not coincide, and the region is frequently hit every year by either drought or submergence due to flooding. Therefore, the introduction of a rice cultivation system adaptable to this water environment is important for sustainable improvement of the local rice production.

The objective of this study was to develop a rice cultivation technology under flooding condition which occurs frequently in the lowlands of Africa. We aimed to identify the physiological mechanism that reduces submergence stress by testing the cultivation of the African indigenous rice cultivar, *Oryza glaberrima* Steud. under prolonged complete submergence condition.

A total of 27 genotypes of *O. glaberrima* and 30 genotypes of *O. sativa* were tested. The plants were submerged completely for 31 days during their early to middle growth stages in the field. All *O. glaberrima* cultivars survived, although some of the *O. sativa* cultivars died during the 31-day submergence. The average rate of increase in shoot biomass and shoot length of the completely submerged *O. glaberrima* genotypes was faster than that of *O. sativa* ($P<0.01$) (Table 1).

Submergence tolerance means the trait of certain plants to be able to reduce the damage and maintain their growth despite prolonged submergence. The typical deepwater cultivars Nylon (*O. sativa*) and Yélé1 A (*O. glaberrima*) showed high submergence tolerance and these showed greatly increased shoot biomass and leaf area during complete submergence compared with the submergence-sensitive cultivar Banjoulou (*O. sativa*) in the experiment inside a growth chamber (Table 2). Especially, Yélé1 A showed more increased shoot biomass than Nylon in complete prolonged submergence. The mechanism linked with the superior tolerance of deep-water genotypes to survive prolonged complete submergence appears to be due to their greater photosynthetic capacity as developed by the leaves newly emerging above the floodwater. This mechanism is closely related to the net assimilation rate of leaves during the submergence (Fig. 1).

These results can be applied to the introduction of these cultivars into lowlands in Africa.

*(J. Sakagami and Y. Joho)*

Table 1. Effect of submergence on shoot elongation and shoot biomass in the field experiment.

| Species | Non submergence | | Complete submergence | |
|---|---|---|---|---|
| | Shoot Elongation rate (cm $d^{-1}$) | Shoot biomass increase (g $d^{-1}$) | Shoot Elongation rate (cm $d^{-1}$) | Shoot biomass increase (g $d^{-1}$) |
| *O. sativa* (n=30) | 1.20±0.04 | 0.39±0.02 | 1.63±0.05 | 0.04±0.01 |
| *O. glaberrima* (n=27) | 1.08±0.05 | 0.37±0.02 | 1.97±0.03 | 0.10±0.01 |
| t-test (*O. sativa* x *O. glaberrima*) | NS | NS | ** | ** |

Values indicate the mean of species with standard error, **significant at 1% probability level; NS. Non-significant

Table 2. Effect of submergence on shoot biomass,leaf area and photosynthesis 37 days aftersubmergence.

| Species | Partial submergence | Complete submergence |
|---|---|---|
| Shoot biomass (g $plant^{-1}$) | | |
| Banjoulou | 8.83 ± 1.0 a | 0.74 ± 0.1 a |
| Nylon | 7.25 ± 2.4 a | 2.92 ± 0.5 b |
| Yélé1A | 6.12 ± 0.5 a | 3.75 ± 0.2 b |
| Leaf area ($m^2$ $plant^{-1}$) | | |
| Banjoulou | 8.19 ± 1.1 b | 0.69 ± 0.1 a |
| Nylon | 6.90 ± 1.0 ab | 2.25 ± 0.6 ab |
| Yélé1A | 4.73 ± 0.5 ab | 3.02 ± 0.2 b |
| Photosynthetic rate (μmol $m^{-2}$ $s^{-1}$) | | |
| Banjoulou | 22.3 ± 0.6 b | 11.0 ± 1.0 b |
| Nylon | 23.5 ± 0.4 b | 21.1 ± 3.1 b |
| Yélé1A | 30.3 ± 0.1 a | 34.8 ± 1.5 a |

The values indicate the mean from three replicates with standard error. Different letters indicate statistically significant differences at 5% among genotypes. Partial submergence is defined as plants being submerged for half of the plant height in water at the start of submergence.

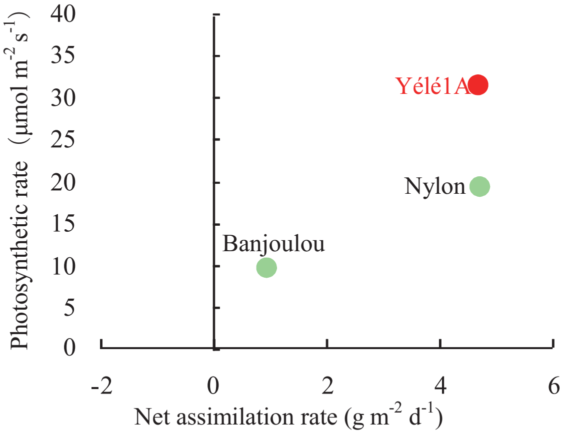



Fig.1. Relationship between net assimilation submergence and photosynthetic rate after 37 d submergence in a pot experiment.

*TOPIC* **4**

## Development of a methodology for self-reliant repair and maintenance of shallow wells by herders in the meadows of Mongolia

Water resources in the meadows of Mongolia are dependent on wells. Deep wells that pump up the water by electric power are continuously maintained by the public administration. On the other hand, shallow wells which are around 10 meters in depth are neither repaired nor maintained, so many of them are out of use. And this constrains the effective use of pastures because herders are not able to get enough water for their livestock. The main reasons of this phenomenon are: 1) Delineation of responsibility among the actors for repair and maintenance plan is not clear; 2) Funding is insufficient for repairs or maintenance; and 3) There is a lack of effective technology in the meadows. Therefore, we have created a system that will solve these problems by empowering the herders who depend on the wells most to be able to repair and maintain the wells by themselves.

The details of this system are described below.

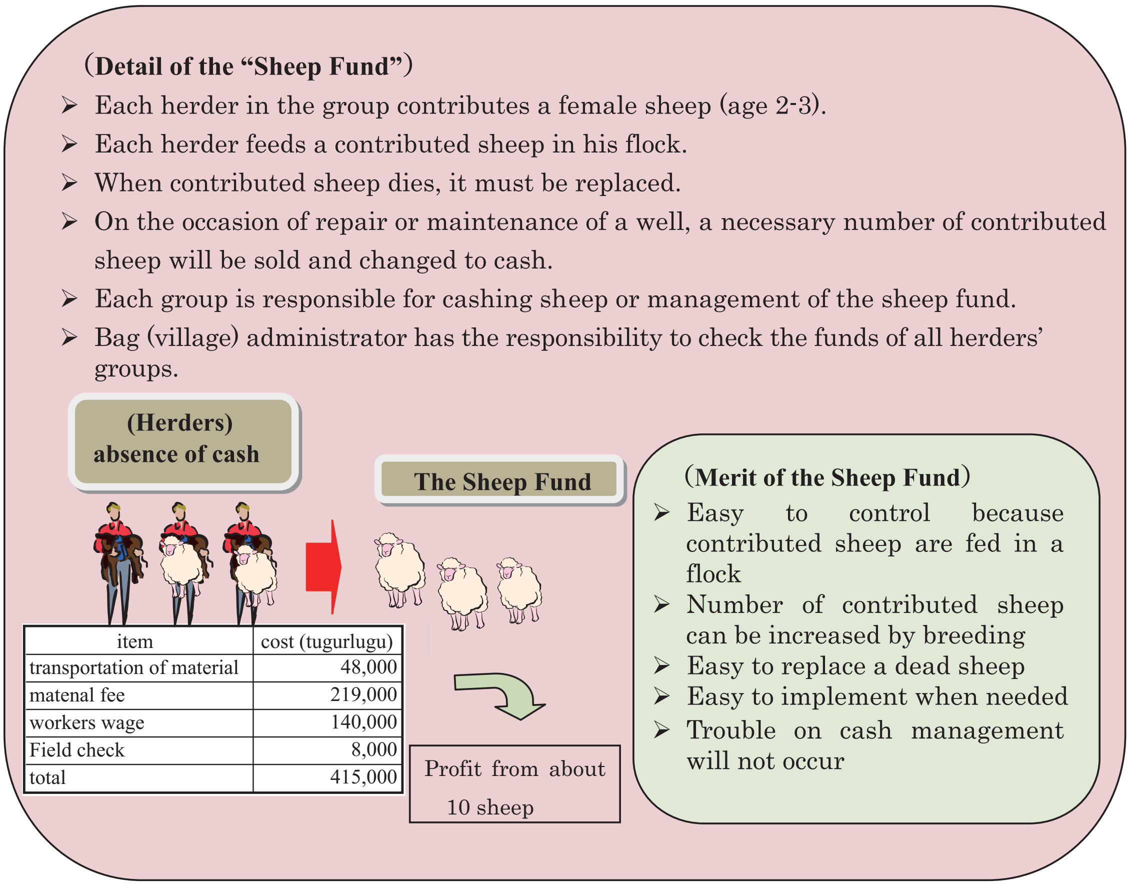
- Herders who use a well together should form a herders' group (consisting of 10 to 20 households) and prepare a "Well Repair Plan". It will give the herders shared ownership of the well and will clarify the responsibility of the members for repair and maintenance.

- It is very difficult for herders to collect the cash needed for the repair or maintenance of a well because of their economic limitation and lack of cash management. Thus, the herders' group will create a "Sheep Fund" with live sheep to use as payment. This Sheep Fund is more acceptable to the herders and can accelerate the repair and maintenance of wells by the herders themselves (Fig. 1).
- Each herder in the group will feed a female sheep as a contributed stock, which must be clearly identified in the flock (Fig. 2). At the time of repair or maintenance of the well, some contributed sheep will be cashed in an order decided beforehand.
- The "Bag" (village) administration will select three herders that are necessary for repair and maintenance from the herders' groups within the bag, and will organizes a "Well Repair Team". They will be trained as professionals through the well repair manual or by technical training.
- The Work Flow of this system is as shown below (Fig. 3);
  a) A herders' group makes a request for repair or maintenance of a well to the "Well Repair Team" through the bag.
  b) The "Well Repair Team" works on the repair or maintenance of the well.
  c) The herders' group will pay for the cost from the "Sheep Fund".

As of December, 2009, 21 herders' groups have been successfully established in Ovorkhangai, Mongolia, and two of them have already repaired their wells. The Mongolian government evaluated this system as very effective, and is taking measures to approve it as the maintenance method for shallow wells.

With this system, wells will be utilized effectively, and the expansion of utilizable pasture areas is expected.

*(I. Yamanaka and T. Matsumoto)*




| item | cost (tugurlugu) |
|---|---|
| transportation of material | 48,000 |
| matenal fee | 219,000 |
| workers wage | 140,000 |
| Field check | 8,000 |
| total | 415,000 |

Fig. 1. Creation of the Sheep Fund.

Fig. 2. Identification of the sheep for the fund by ear-marking or tagging.

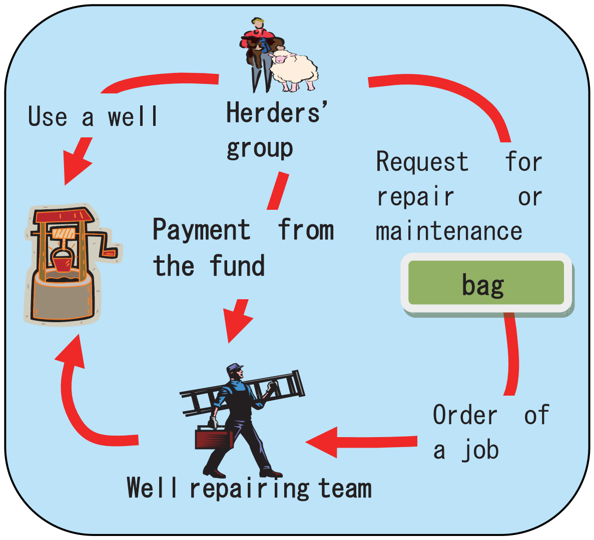



Fig. 3. Workflow of repair or maintenance of a well.

*TOPIC* 5

## Biological Nitrification Inhibition – Dual benefit for agriculture and the environment

Most modern agricultural systems are based on large inputs of nitrogen (N) with ammonium ($NH_4^+$) being the primary N source. In addition, current crop management practices result in the development of highly nitrifying soil environments. Nitrification results in the transformation of the relatively immobile $NH_4^+$ to highly mobile nitrate ($NO_3^-$), making inorganic N susceptible to losses through leaching of $NO_3^-$ and/or gaseous N emissions, initiating a cascade of environmental and health problems. Nitrous oxide ($N_2O$), a powerful greenhouse gas contributes to global warming, produced primarily from nitrification and denitrification processes. Though nitrification is one of the critical processes of the nitrogen cycle, unrestricted and rapid nitrification in agricultural soils can result in major N losses from the plant-soil systems. The low agronomic N-use efficiency (NUE) found in many agricultural systems, is largely the result of these N losses. Most plants have the ability to assimilate both $NH_4^+$ and $NO_3^-$; therefore nitrification does not need to be a dominant process in the N cycle for efficient N use.

The ability of certain plant species to release organic molecules/compounds from their roots that specifically inhibit the function of nitrifying soil bacteria is a phenomenon termed "biological nitrification inhibition" (BNI). A schematic presentation of the BNI concept along with various processes of the soil N-cycle that are impacted is presented in Fig. 1. We adopted a very sensitive bioassay using a recombinant luminescent *Nitrosomonas europaea* to detect biological nitrification inhibition (BNI) in plant-soil systems, with the inhibitory activity of roots expressed in allylthiourea units (ATU). Such BNI capacity appears to be relatively widespread among tropical pasture plants, with *Brachiaria* species showing the highest capacity among the pasture grasses tested.

Here we report the discovery of an effective nitrification inhibitor in the root exudates of a tropical grass *Brachiaria humidicola* (Rendle) Schweick. Named "brachialactone", this inhibitor is a recently discovered cyclic diterpene with a unique 5-8-5-membered ring system and a γ-lactone ring (Fig. 2). It contributed 60-90% of the inhibitory activity released from the roots of this tropical grass. Unlike nitrapyrin (a synthetic nitrification inhibitor), which affects only the ammonia monooxygenase (AMO) pathway, brachialactone appears to block both AMO and hydroxylamine oxidoreductase (HAO) enzymatic pathways in *Nitrosomonas*. Release of this inhibitor is a regulated plant function, triggered and sustained by the availability of ammonium ($NH_4^+$) in the root environment. Brachialactone release is restricted to those roots that are directly exposed to $NH_4^+$. Within three years of establishment, *Brachiaria* pastures have suppressed soil nitrifier populations (determined as *amoA* genes; ammonia-oxidizing bacteria and ammonia-oxidizing archaea), along with nitrification and nitrous oxide emissions (Fig. 3a,b).

These findings provide the direct evidence for the existence and active regulation of a nitrification inhibitor (or inhibitors) release from tropical pasture root systems. Development of improved forage grasses for low nitrifying pasture-based production systems is possible given the significant variability found for the BNI function within the *Brachiaria* spp (Fig. 3a,b). A fundamental shift towards $NH_4^+$-dominated crop nutrition can thus be achieved by using crops and pastures that have high BNI-capacity or integrating annual crop production with a high BNI-capacity forage component, resulting in low-nitrifying agronomic production systems, benefiting both agriculture and the environment.

*(G. V. Subbarao, T. Ishikawa, K. Nakahara, T. Yoshihashi, and O. Ito)*

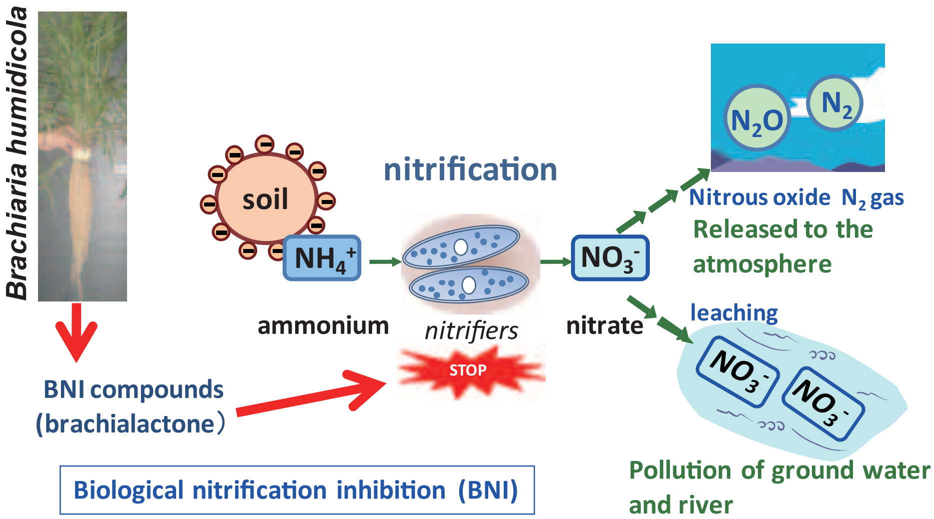



Fig. 1. Schematic representation where biological nitrification (BNI) interfaces with the nitrogen cycle.

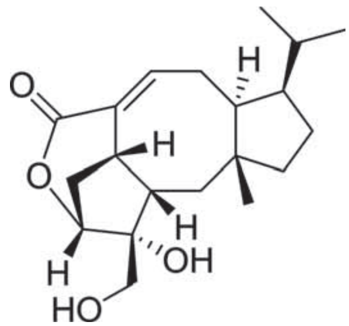



Fig. 2. Chemical structure of brachialactone (PNAS 2009;106:17302-17307).

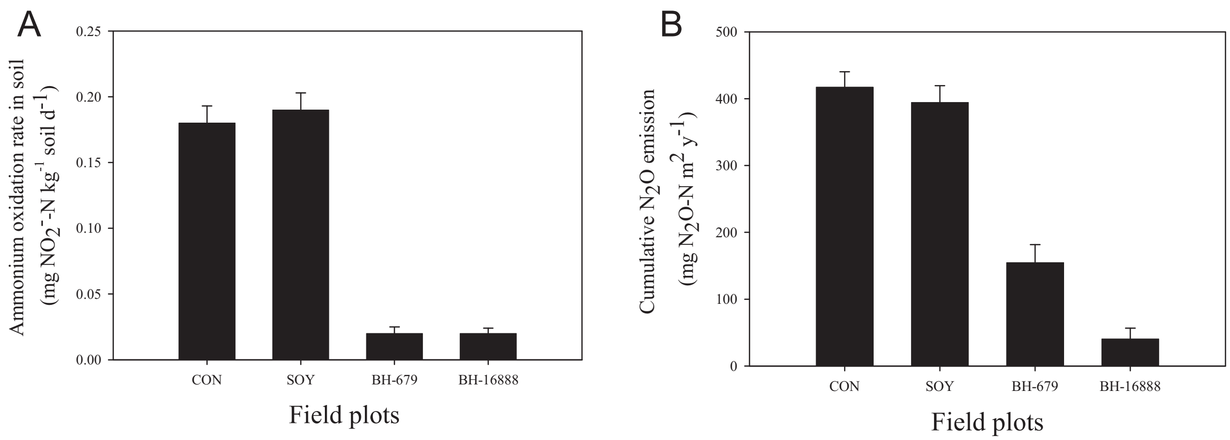



Fig. 3. Influence of tropical pasture grass cultivation on soil nitrification and nitrous oxide emissions.
(A) Soil ammonium oxidation rate in field plots planted with tropical pasture grasses and soybean
(B) Cumulative $N_2O$ emissions from field plots of tropical pasture grasses (monitored monthly over a 3-year period, from September 2004 to November 2007). [CON, control (plant-free) plots; SOY, soybean; BH-679, *B. humidicola* CIAT 679; BH-16888, *B. humidicola* CIAT 16888; (PNAS 2009;106:17302-17307)].

## "Ishigaki Wondrous"- A new variety of semi dwarf papaya with larger fruits and high quality

Papaya (*Carica papaya* L.) is one of the most widely grown fruit crops in the tropics and subtropics. In Japan, papaya is produced in the southernmost region of Japan from southern Kyushu to Okinawa. The unripe fruit is also consumed as a vegetable aside from the ripe fruit which is a table fruit. The "Sunrise" fruit-type family is highly regarded both globally and in the Japanese market. However, this family takes the form of relatively tall trees, and at high temperatures, fruit abscission occurs due to male sterility. These two characteristics constrain papaya production in Japan's growing area in both summer, when temperatures are high, and autumn, due to frequent typhoons. We therefore embarked on a program to breed a new heat-tolerant dwarf papaya tree for sub-tropical regions, with fruit quality equal to or better than the "Sunrise" family fruit.

A new variety, "Ishigaki Wondrous," was discovered by chance from a seedling of "Wonder Bright" in 1997. We planted it together with other crossed seedlings in 1998 and selected it as a promising tree in 2000. The selections were made of the plants showing high fruit quality, early bearing and shorter lengths of the internodes. Between 2001 to 2008, it had been subjected to the same characteristic tests as "Ishigaki 1." In 2009, we applied to Japan's Ministry of Agriculture, Forestry and Fisheries for the registration of this new variety.

"Ishigaki Wondrous" is a hermaphrodite plant and has a semidwarf tree form (Fig. 1, 2). The type of flowering is only inflorescences. The number of nodes from the ground to the first flowering node is 21 and smaller than the 25 seen in "Sunrise". The length of each internode is 24 mm, much shorter than the 35 mm seen in "Sunrise" (Table 1). Therefore, "Ishigaki Wondrous" can be easily harvested for a considerably long time due to its lower height. The average size of leaves is the same as the common papaya and the tertiary lobe is absent in its leaf blade. Furthermore, there is no anthocyanin coloration in the petiole.

The fruit is obovoid-shaped and the average weight is 1,796 g (Table 1 and Fig. 3). Fruit enlargement is affected by the season and the range of fruit weight is from 1,515 g to 2,124 g. The skin color of the ripe fruit is vivid orange (Japanese Horticultural Plant Standard Color Chart: No. 1605) and the flesh is light red (No. 0713). The fruit has no ridges and the flesh thickness is 25.8 mm, much thicker than other varieties. Thus, "Ishigaki Wondrous" is easier to handle for peeling. The average sugar content is 13.9% on Brix. It is much higher than that of "Wonder Flare", the most important dwarf variety cultivated in the island of Ishigaki, and approximately the same as that of "Sunrise" and "Ishigaki Sango", a heat-tolerant dwarf variety developed at JIRCAS. Aside from being very sweet, the flavor and taste are excellent.

Fig. 1. Fruiting of the "Ishigaki Wondrous" potted tree.

Fig. 2. Flowering of "Ishigaki Wondrous".

The average period from planting to first flowering is 100 days. "Ishigaki Wondrous" is able to produce fruits throughout the year. But a few flower abscissions occur due to male sterility under high temperature. Hand pollination with the pollens of a male flower is necessary to prevent it.

*(H. Kato, H. Fukamachi and T. Fushimi)*

Table 1. Fruit and tree characteristics of "Ishigaki Wondrous".

| | "Ishigaki Wondrous" | "Ishigaki Sango" | "Sunrise" | "Wonder Flare" |
|---|---|---|---|---|
| Sexing | Hermaphrodite | Female | Hermaphrodite | Female |
| First flowering node | 21 | 15 | 25 | 16 |
| Intemode length (mm) | 24 | 12 | 35 | 11 |
| Average fruit weight (g) | 1796 | 840 | 540 | 620 |
| Skin color | Vivid orange | Vivid orange | Vivid orange | Vivid reddish yellow |
| Flesh color | light red | Bright reddish orange | Bright yellowish red | Vivid reddish yellow |
| Flesh thickness (mm) | 25.8 | 21.9 | 22.8 | 18.4 |
| Sugar content (Brix%) | 13.9 | 13.8 | 14.2 | 13.1 |
| Flavor* | 5 | 5 | 5 | 2 |
| Ridges | absent | Weak | Absent | Moderate |

(JIRCAS-TARF, 2001 ~ 2005)
* Flavor: 1 (least) ~ 5 (strong)

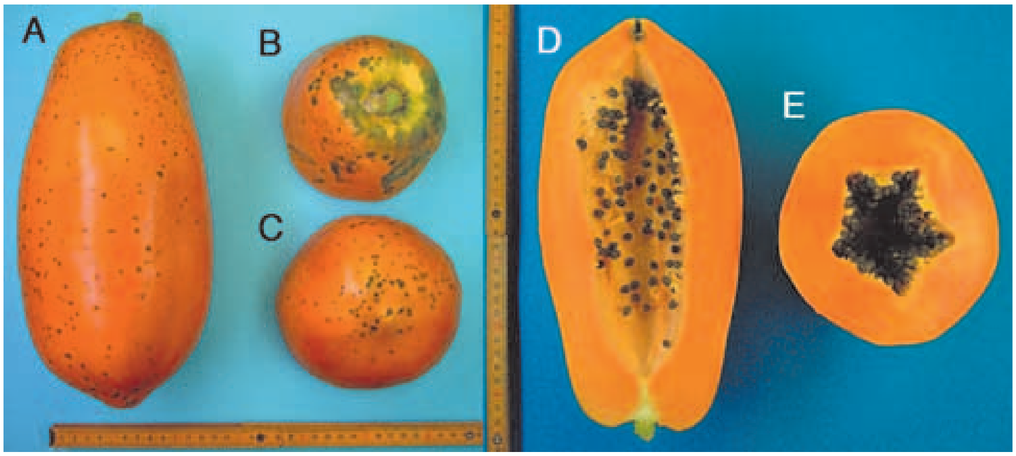



Fig. 3. Fruit of "Ishigaki Wondrous".
A: Whole fruit side view, B: Stem end, C: Fruit apex, D: Longitudinal cross section,
E: Transverse cross section.

## Theme A-3 Elucidation of the impact of global environmental changes on agriculture, forestry and fisheries and development of mitigating technologies

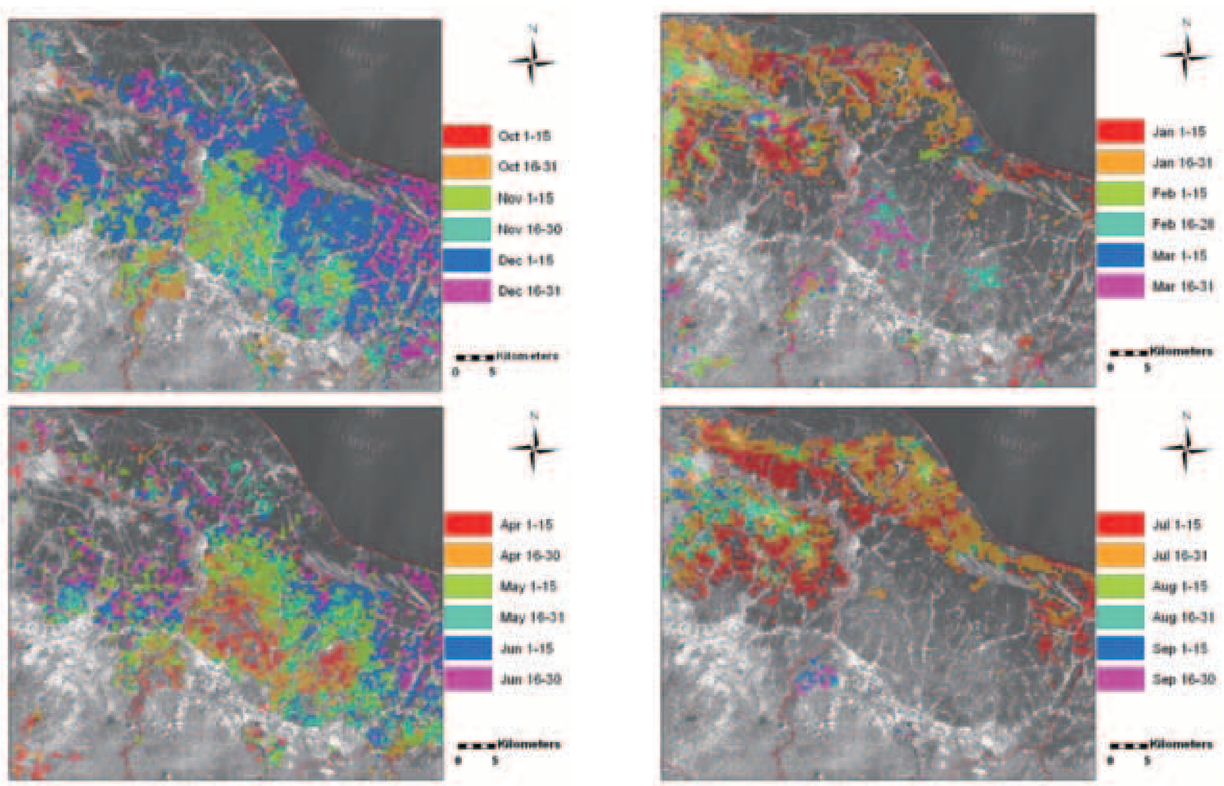
Global warming is predicted to cause disasters due to climate change and the spread of insect pests; there is also the risk of undermining the stability of agricultural production and shifting of suitable agricultural areas. This theme aims to clarify the phenomena of interdependence between global environmental changes such as water cycle changes and agricultural production activities, and to enhance the methodologies for estimating their influences on agriculture, as well as to clarify the damage caused to agriculture and forestry products by insect pests resulting from global warming, and to develop technologies to prevent them. In FY 2006, five projects were launched to study the interdependent influences of environmental changes with agricultural production, to develop GIS methodologies and supply and demand models of foods, and to develop institutional and technological measures for alleviating the detrimental effects on agriculture of climate change and harmful insects.

The main results are as follows:

■ **Enhancement of GIS applications for agricultural land information on local to regional scales:** We launched a research project on monitoring technology to capture changes in agricultural land use on a quasireal-time basis in collaboration with an agricultural land resources research institute in Indonesia. These technologies can be applied to assess the productivity of economically significant crops and also to estimate the spatial and temporal characteristics of hazardous conditions caused by agricultural disasters (See satellite imagery below).

■ **Stable food supply systems for mitigating the fluctuations in production and markets in China:** We established early warning systems on climatic natural disasters, incorporating mesh data on temperature and precipitation, in Heilongjiang Province, and developed a technology for ensuring that field servers operate reliably. In addition, a farm management model which incorporates risk factors was developed, and institutional approaches toward risk reduction were launched.

■ **Water supply fluctuations in Indochina:** We completed the construction of a supply and demand model of rice which incorporates water supply fluctuation as one of the factors affecting changes in rice production in Vietnam, Thailand, Laos, and Cambodia, allowing simulations to be based on various scenarios in natural environ-




Monitoring Transplanting Time in Rice Production around Karawang District in the West Java Province of Indonesia, using MODIS data.

ments and social conditions.

■ **Development of management techniques for citrus greening disease in severely affected areas:** Citrus greening disease (CG) is spreading worldwide, partly due to global warming. We launched an on-farm experiment in integrated pest management (IPM) of CG in Vietnam to establish techniques for managing the disease in severely infested areas. We also started field experiments to prove the efficacy of *Feronia limonia and Feroniella oblata* as rootstocks resistant to CG. To reproduce the transmission process of CG by adult psyllids in a closed environment, we successfully grew adult psyllids which were carrying CG bacteria from eggs on infected citrus trees in a greenhouse environment.

■ **Development of biological control of invasive insect pests on coconut trees:** We completed a distribution map of *Brontispa longissima*, an insect pest of coconut trees spreading in Southeast Asia and the Pacific region, based on field surveys and information provided by overseas research institutes. This project also aims to develop a biological control method against the insect. We have embarked on the development of an artificial feeding method and are analyzing the insect's basic ecological behavior.

*TOPIC 1*

## Development of a new method to produce cloud-free land use data for tropical humid climate regions using multi-temporal satellite data

Land use is a basic information that is used to characterize agricultural activities for the site of interest. Land use data which discriminated the major agricultural land use types such as paddy, upland, and so on were provided, for example, by interpretation of aerial photos in combination with ground surveys.

In the case of developing regions, however, land use data could not be produced owing to the lack of appropriate coverage by aerial photos as well as the difficulty of ground surveys. Therefore, satellite data which could be used to observe repeatedly the ground surface conditions for any selected area were expected as a promising tool to overcome this deficit.

A number of attempts were performed to produce land use data using satellite data, but these were not able to obtain satisfactory results especially for the areas located in the tropical humid climate region, due to the major constraints of 1) high probability of being usually covered with clouds, and 2) existence of complex cropping patterns in terms of planting time. In this study, we aimed at the development of a method of producing cloud-free land use data with a pixel size of 30 meters for the area located in the tropical humid climate region using multi-temporal Landsat data. The study site was selected in a western part of Java Island, Indonesia.

This method applied a concept that each land use type shows specific changing patterns of ground surface conditions within a year. For example, a paddy field may exhibit a cover type of either water, vegetation or bare soil at different instances, but the annual maximum conditions would be uniform as shown in Figure 1 (in case of Paddy). We employed five indices, of which two were represented as the conditions of coverage by soil, one by vegetation, and two by water, calculated from Landsat-TM or ETM+ data.

The probability of obtaining a cloud-free scenery was very low as only about once a year on average, so that the data employed here were taken within a period from 1994 to 2003. After conversion to reflectance values and performing geometric correction of all the scenes, we firstly removed the cloud-affected areas from each scene, and then calculated the maximum value of each index at every pixel. Five parameters composed of the maximum values of five indices could be used to characterize the annual pattern of changes of ground surface conditions.

Figure 2 shows the result of the discrimination of land use type using the developed method. It depicts a map consisting of 30 meter-sized pixels with complete removal of the effect of cloud cover over the site. The accuracy of the discrimination of land use was examined by means of comparison with the interpreted result of very high resolution spatial satellite data (QuickBird). Table 1 shows the percentage of correctly discriminated land use class in the case of the results obtained by this method in the left column and the case of classification using mono-temporal Landsat data as typical conventional method in the previous study in the right column. This table concluded that substantial improvement especially for agricultural land use was attained in terms of the accuracy of data discrimination as provided by the method developed in this study.

The developed method would be applicable to various instances of producing land use data for the area where details and reliable information are insufficient. The spatial resolution of the output data should first be harmonized with recently published global digital elevation data. Then, it can be used for the evaluation of location of different land uses in association with agro-environmental problems. We should be aware, however, that although this method could adequately discriminate significant types of agricultural land uses, it can only discriminate rather poorly other land use types, because it could not fully employ the spectral variations of the original satellite data in the process of discrimination.

*(S. Uchida)*

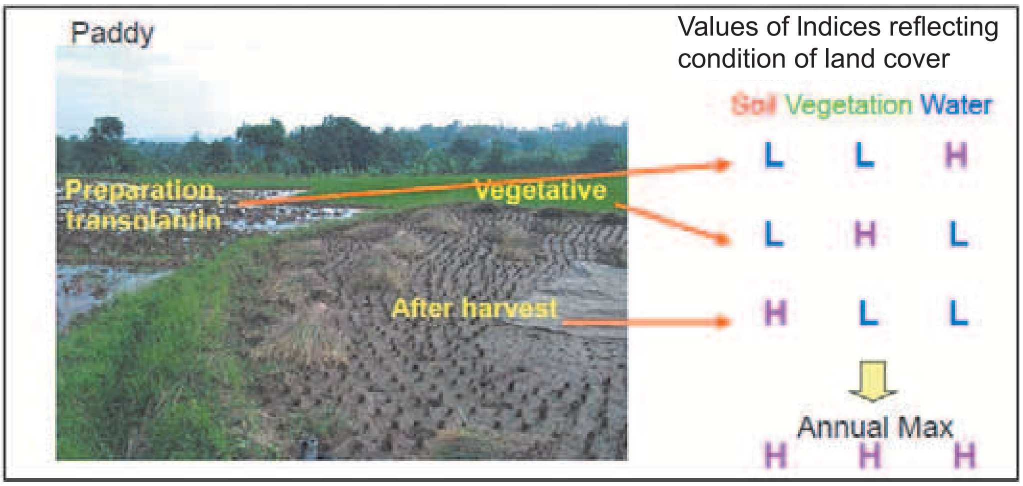



Fig. 1. Simultaneous land cover conditions and annual maximum values of indices reflecting the conditions of land cover in case of paddy areas.

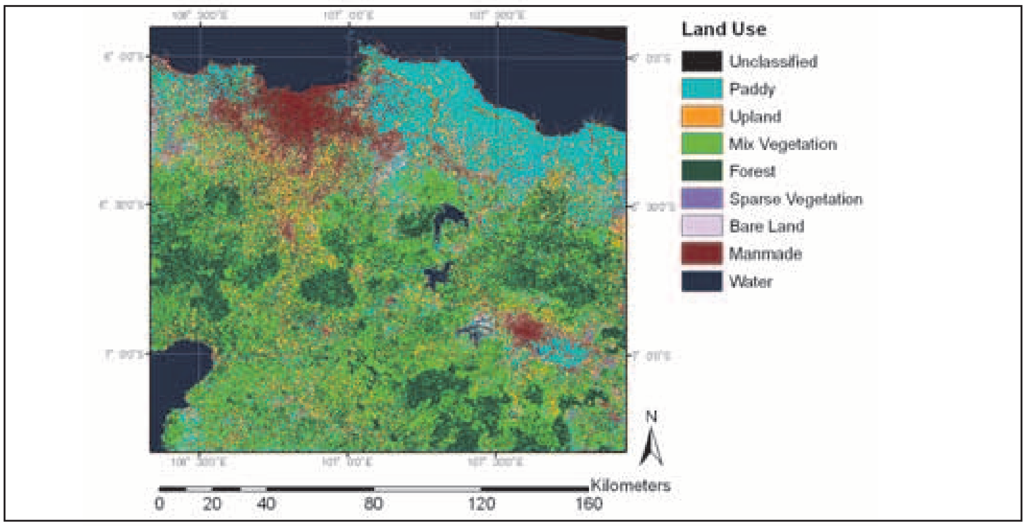



Fig. 2. Produced land use map of the study site in the western part of Java Island, Indonesia.

Table 1. Comparison of percentages of correctly discriminated land use classes between developed method and classification using mono-temporal data.

| Land Use Class | Developed Method | Using Mono-Temporal Data |
|---|---|---|
| Paddy | 87.9 | 63.6 |
| Upland | 48.5 | 20.6 |
| Mix Vegetation | 65.6 | 45.3 |
| Forest | 61.2 | 76.0 |
| Sparse Vegetation | 100.0 | 16.4 |
| Bare Land | 17.0 | 20.0 |
| Manmade | 90.3 | 85.7 |
| Water | 66.7 | 0.0 |
| Overall | 59.9 | 45.1 |

## B. Collection, analysis and dissemination of information to grasp trends related to international food, agriculture, forestry and fisheries and rural areas

Information relating to the middle- to long-term trends in global food supply and demand were collected and examined at meetings organized by international organizations. To formulate future plans for collaborative research in African regions, a strategic survey on key technologies for innovation in African agriculture was completed and a report published.

Recommendations for domestic collaboration and human resource development were compiled and issued to enhance agricultural research for international development in Japan by organizing an international symposium entitled "Roles of Social Sciences in International Agricultural Research and Development."

Regarding socioeconomic analyses of technology development and rural development, two projects—a study on the factors determining the adoption of new water management technologies in Southeast Asia, and a study on the impacts of regional and economic integration on agricultural structure and farm income—were continued. Meaningful results were presented as several case studies such as on corrective activities for irrigation systems in the Philippines and the impacts of trade liberalization on garlic trade in Indochina region.

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*TOPIC 1*

## Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in the Greater Mekong Subregion

We have conducted comparative case studies on the impacts of economic integration on agriculture in three (3) representative border sites in the least developed regions of the Greater Mekong Sub-region (GMS) and placed emphasis on the diversification of farmers' incomes and job opportunities through crop diversification, high value-added products, production-market linkages as well as policy measures with positive implications valuable for the alleviation of negative impacts.

The GMS covering Thailand, Lao PDR, Vietnam, Myanmar and Southern China (Yunnan) and the international river, Mekong River, has recently shown significant changes in trade structure due to the development of new infrastructures (e.g. trans-boundary transportation systems, deregulation and facilitation of border trade systems) and trade liberalization (lowering and removing tariffs in ASEAN-AFTA and ASEAN-China FTA).

Between northeastern Thailand and northern Lao PDR (Case 1): Lao farmers had produced feed corn with considerably lower production cost than Thai farmers due to less material inputs. The Thai feed industry has shifted the contract farming operations of feed corn to the Laotian regions and has exported the products back to Thailand. On the other hand, Thai farmers have shifted their crop production from feed corn to more profitable resource crops such as Para rubber, sugarcane and cassava (Table 1).

Between northern Thailand and southern China (Yunnan) (Case 2): Due to the high cost of agricultural management and very much lower yield in Thailand, Yunnan has the higher price competitiveness. Northern Thai farmers have been forced to shift from garlic to other crops which have less competition from China. But, some farmers have failed to convert their crops and have fallen in considerable income reduction (Fig. 2).

Between southern China (Yunnan) and northern Lao PDR (Case 3): Yunnan farmers have very limited owned farm land resources, so the number of border farmers going over to the Laotian area and growing more crops there has tripled in 2008 as compared from the previous year, and Chinese migrants has increased one and a half times. Moreover, Chinese companies increased their contract farming for sugarcane and Para rubber at Laotian areas and promoted crop production by Laotian farmers, Lao people's employment opportunity, and finally more opportunity for household income.

Our comparative case studies revealed that each country took policy measures to promote the production of comparatively advantageous crops on one hand; but, on the other hand, took countermeasures to support their own farmers to sustain and/or convert comparatively disadvantageous crops to limit the negative effects and strengthen non-tariff barriers. The Thai government implemented alleviation measures for garlic and feed corn but with very limited effects. The Thai government and

Chinese local governments have strengthened their plant quarantine inspection practices toward imported products resulting in some conflicts. Our study also implies that it would be very important to emphasize a concept of ‘regional cooperation’ more in the framework of ASEAN-China FTA and other FTAs and that every country’s experiences should bring benefit to the development of regional agreements on technical and financial support for crop diversification, harmonization of non-tariff barriers, export and production promotion measures based on regional consensus.

*(H. Chien, S. Miyata and M. Ando)*

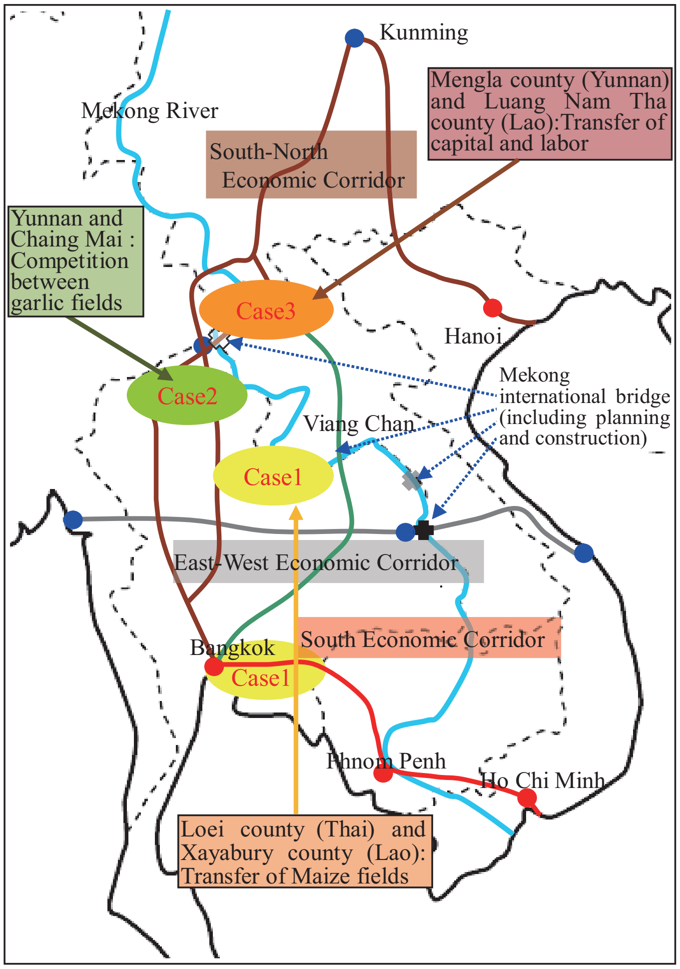


Fig. 1. GMS and Research sites.
Note: GMS (The Greater Mekong Sub-region) comprises Thailand, Cambodia, Vietnam, Laos, Myanmar and China (Yunnan).

Table 1. Comparison of maize cost between Laos and Thailand.

| | Laos (n=48) | Thai (n=43) |
|---|---|---|
| Material cost(US$/ha) | 260.1 | 480.4 |
| Hired labor(US$/ha) | 243.7 | 113.1 |
| Interest(US$/ha) | 71.4 | 23.7 |
| Farm expense(US$/ha,A) | 575.2 | 617.2 |
| Yield(ton/ha,C) | 5.6 | 4.9 |
| Local price*(US$/ton,B) | 140.7 | 143.6 |
| Income(US$/ton,B-A/C) | **38.0** | **17.7** |
| Change of main crops planted areas (ratio of change from 2006 to 2008) | **Maize(5)** Paddy rice(23) Adlay(-93) Cassava(new crop) | **Maize(-6)** Sugarcane(14) Cassava(33) Rubber(49) |

Data source: Field survey.
*Average price of 2006 and 2007.

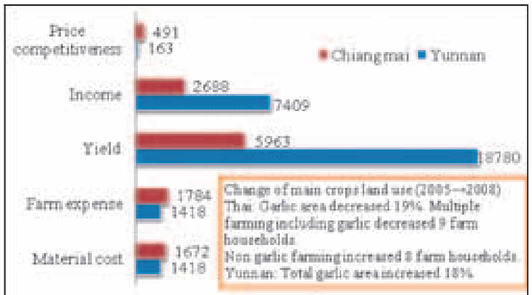


Fig 2. Comparison of garlic cost of Northern Thai and Yunnan, China
(Units: Yield kg/ha,
Material cost･Farm expense･Income US$/ha)
Notes: Sample number of farm households,
Northern Thai 45, Yunnan 116
Price competitiveness=cost/tonne(US$/t)

Table 2. Issues, policy measures and possible policy directions to cope with them.

| Issues | Policy Measures Implemented on FTA | Possible Policy Directions |
|---|---|---|
| ･Preceded by promotion policies for commodities having comparative advantages<br>･Low effects of polices (ex. One-off compensation program) for commodities having comparative disadvantage<br>･It is necessary to support the crops conversion system.<br>･Non-tariff barriers | ･Garlic diversion program and stricter monitoring of over-TQ import(Thailand)<br>･Emergent government corn mortgage program (Thailand)<br>･Stricter plant quarantine inspection (Thailand, China)<br>･Support to foreign direct investment and special export tax exemption to qualified exporters (China)<br>･Encouragement of contract cultivation by foreign firms(Laos)<br>･Farm land concession to foreigners(Laos) | ･Technical and financial support for crop diversification<br>･Regional harmonization of non-tariff trade regulations including quarantine inspections<br>･Export and production promotion policies under regional consensus<br>･Implementation rules for mitigation policies based on regional conditions, More emphasis on regional cooperation |

# TRAINING AND INVITATION PROGRAMS

# AND 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, and their implementation and administration, and at the same time 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. Twenty individual visits to JIRCAS were made during FY 2009 under the Administrative Invitation Program. Invited administrators and their home institutions are listed below.

Administrative Invitations, FY 2009

| | | |
|---|---|---|
| Lai Maoliang | Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Mei Xurong | Institute of Environment and Sustainable Development in Agricultural, Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Guan Hui | Tobacco Research Institute, Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Li Shifang | Institute of Plant Protection, Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Han Longzhi | Institute of Crop Science, Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Zhai Lim | Department of International Cooperation, Chinese Academy of Agricultural Sciences, P. R. China | Apr.14-19, 2009 |
| Irsal Las | Indonesian Center for Agricultural Land Resources Research and Development, Indonesia | Jun.29-Jul.3, 2009 |
| Jirakorn Kosaisawee | Department of Agriculture, Thailand | Aug.23-27, 2009 |
| Somjate Pratummintra | Department of Agriculture, Thailand | Aug.23-27, 2009 |
| Direke Tonpayom | Office of Agricultural Research and Development, Region 2, Department of Agriculture, Thailand | Aug.23-27, 2009 |
| Nipat Sukhvibul | Chiang Mai Horticultural Research Center, Department of Agriculture, Thailand | Aug.23-27, 2009 |
| Praphan Prasertsak | Field Crops Research Institute, Department of Agriculture, Thailand | Aug.23-27, 2009 |
| Rattan Lal | Carbon Management & Sequestration Center, The Ohio State University, USA | Sep.15-19, 2009 |

| | | |
|---|---|---|
| Werner Stür | International Center for Tropical Agriculture (CIAT), Colombia | Nov.2-6, 2009 |
| Maximo Torero | International Food Policy Research Institute, USA | Nov.3-6, 2009 |
| William Henry Meyers | Food and Agricultural Policy Research Institute at University of Missouri Columbia (MU-FAPRI), USA | Nov.3-6, 2009 |
| Sushil Pandey | International Rice Research Institute IRRI), Phillipines | Nov.3-6, 2009 |
| Nguyen Huu Chiem | College of Environment and Natural Resources, Can Tho University, Vietnum | Nov.13-21, 2009 |
| Sinthavong Viravong | Living Aquatic Resources Research Center (LARReC), Lao PDR | Jan.17-28, 2010 |
| Uchada Sukchan | Agricultural Production Sciences Research and Development Center, Thailand | Mar.21-29, 2010 |

## 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 both to enhance the quality of research conducted overseas and to facilitate exchanges of individual research staff between JIRCAS and the counterpart institutions. Nineteen researchers were invited under this program during FY 2009. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

**Counterpart Researcher Invitations, FY 2009**

| | | | |
|---|---|---|---|
| Gavino Isagani P. Urriza | Department of Agriculture/ Bureau of Soil and Water Management, Soil Conservation Management Division, Philippines | Effects of no till farming on soil erosion | Jun.20-Aug.1, 2009 |
| Moch Zainal Abidin | Indonesian Center for Agricultural Land Resources Research and Development, Indonesia | Analysis of seasonal features of planting and growth of major crops using remote sensing | Jun.22-Aug.21, 2009 |
| Nguyen Loc Hien | College of Agriculture and Applied Biology, Can Tho University, Vietnam | Analysis of 2-acetyl-1-pyrroline productivity in ydcW knock out E.coli and establishment of HPLC analysis of 2-acetyl-1-pyrroline by FMOC derivatization | Jul.15-Aug.15, 2009 |
| Pitthaya Wongchang | Biotechnology Research and Development Office, Department of Agriculture, Thailand | Training on genebank management | Sep.7-19, 2009 |
| Kiari Saidou Addam | Institut National de la Recherche Agronomique du Niger, Niger | Quantification and verification of nutrient budgets (C, N and P) in the cropping systems adopting double-purpose cowpea cultivars | Sep.9-20, 2009 |
| Jennifer T. Niones | Philippine Rice Research Institute, Philippines | Development of differential system in Philippines | Sep.30-Dec.26, 2009 |

| | | | |
|---|---|---|---|
| Phetmanyseng Xangsayasane | Rice & Cash Crop Research Center, Lao PDR | Development of differential system in Laos | Sep.30-Dec.26, 2009 |
| Pham Thi Thu Ha | Cuu Long Delta Rice Research Institute, Vietnam | Development of differential system in Vietnam | Oct.1-Dec.26,2009 |
| Arnaldo B. Alvarez | Bureau of Soil and Water Management, Soil Conservation and Management Division, Philippines | Evaluation of yield increasing effect on nitrogen leaching reduction | Oct.5-Nov.15, 2009 |
| Krailert Taweekul | Khon Kaen University, Thailand | Expansion of technology development through farmer exchange | Oct.8-Nov.7, 2009 |
| Somrutai Tancharoen | Soil Physics Research Subgroup, Soil Science Group, Departmentof Agriculture, MOAC, Thailand | Mid- and long-term prediction of soil organic matter based on soil experiment | Oct.11-17, 2009 |
| Nguyen Thanh Hieu | Southern Fruit Research Institute (SOFRI), Vietnam | Development of management for citrus greening | Oct.12-22, 2009 |
| Woraphun Himmapan | Silvicultural Research Division, Forest Management and Forest Products Research Office, Thailand | Exchange of views on techniques for constructing a system yield table of teak in northeast Thailand | Oct.25-31, 2009 |
| Tosporn Vacharangkura | Silvicultural Research Division, Forest Management and Forest Products Research Office, Thailand | Exchange of views on techniques for constructing a system yield table of teak in northeast Thailand | Oct.25-31, 2009 |
| Tan He | Cultivation and Planting Institute, Heilongjiang Academy of Agricultural Sciences , P.R. China | Follow up of "Early warning system for predicting cool weather damage to rice production" of Chinese food project | Nov.5-24, 2009 |
| Zhang Haifeng | Information Research Institute, Heilongjiang Academy of Agricultural Sciences , P.R. China | Follow up of "Early warning system for predicting cool weather damage to rice production" of Chinese food project | Nov.5-24, 2009 |
| Suwan Tangmitcharoen | Silvicultural Research Division, Forest Management and Forest Products Research Office, Thailand | Meeting on techniques for forest tree breeding | Nov.8-21, 2009 |
| Ernan Rustiadi | Bogor Agricultural University, Indonesia | Study on spatial planning for agricultural areas in Indonesia using geographical information systems | Nov.8-27, 2009 |
| Safiah Jasmani | Institut Akuakultur Tropika Universiti Malaysia Terengganu, Malaysia | Development of organ culture techniques for the study of yolk protein production | Mar.16-30, 2010 |

## 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. Under this program, 43 researchers were invited and implemented their research in FY 2009 as listed below.

| Project Site Invitations, FY 2009 | | | |
|---|---|---|---|
| Kang Yunhan | Economic Research Institute, Yunnan Academy of Social Science, P. R. China | Participation in the project meeting, "Impact Analysis of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | May 17-21, 2009 |
| Henny Mayrowani | Indonesian Center for Agriculture Socio-Economic and Policy Studies, Indonesia | Participation in the project meeting, "Impact Analysis of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | May 18-22, 2009 |
| Antonio Juan Gerardo Ivancovich | Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Pergamino), Argentine | Annual Project meeting on evaluation for soybean rust resistance (at CNPSo), Brazil | Oct.12-16, 2009 |
| Hernán Russian | Estación Experimental Agropecuaria Pergamino, Instituto Nacional de Tecnologia Agropecuaria (INTA-EEA Pergamino), Argentine | Annual Project meeting on evaluation for soybean rust resistance (at CNPSo), Brazil | Oct.12-16, 2009 |
| Wilfrido Morel Paiva | Centro Regional de Investigación, Agrícola (CRIA), Ministerio de Agricultira y Ganaderia (MAG), Paraguay | Annual Project meeting on evaluation for soybean rust resistance (at CNPSo), Brazil | Oct.13-16, 2009 |
| Vu Tien Khang | Cuu Long Rice Research Insitute, Vietnam | The 4th Good Soil Care Project meeting, Thailand | Nov.3-7, 2009 |
| Luu Hong Man | Cuu Long Rice Research Insitute, Vietnam | The 5th Good Soil Care Project meeting, Thailand | Nov.3-7, 2009 |
| Wiwik Hartatik | Indonesian Agency for Agricultural Research and Development, Indonesia | The 6th Good Soil Care Project meeting, Thailand | Nov.4-6, 2009 |
| Diah Setyorini | Indonesian Agency for Agricultural Research and Development, Indonesia | The 7th Good Soil Care Project meeting, Thailand | Nov.4-6, 2009 |
| Henny Mayrowani | Indonesian Center for Agriculture Socio-Economic and Policy Studies, Indonesia | Participation in the project workshop, "Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | Nov.10-12, 2009 |
| Tahlim Sudaryanto | Indonesian Center for Agriculture Socio-Economic and Policy Studies, Indonesia | Participation in the project workshop, "Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | Nov.10-12, 2009 |
| Yang Xiqing | Agriculture Bureau of Dali City in Yunnan Province, P.R. China | Participation in the project workshop, "Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | Nov.10-12, 2009 |

| | | | |
|---|---|---|---|
| Zou Yahui | Yunnan Academy of Social Sciences, P.R. China | Participation in the project workshop, "Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | Nov.10-12, 2009 |
| Khonesavanh Vongxay | Department of Planning and Investment, Ministry of Agriculture and Forestry, Laos PDR | Participation in the project workshop, "Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia", Thailand | Nov.10-12, 2009 |
| Yacouba Sere | Africa Rice Center (Africa Rice), Benin | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.11-22, 2009 |
| Taher Mia | Bangladesh Rice Research Institute, Bangladesh | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.13-20, 2009 |
| Suwarno | Indonesian Center for Rice Research (ICRR), Indonesia | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Santoso | Indonesian Center for Rice Research (ICRR), Indonesia | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Jian-li Wu | The China National Rice Research Institute, P.R. China | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Cailin Lei | Institute of Crop Sciences(CAAS), P.R. China | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Luong Minh Chau | Genetic and Plant Breeding Division (CLRRI), Vietnam | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Loida M. Perez | Philippine Rice Research Institute, Philippines | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| LI Chengyun | Yunnan Agricultural University, P.R. China | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Phoumi Inthapanya | Rice and Cash Crop Research Center (RCCRC), Laos PDR | Workshop on Blast Research Network for Stable Rice Production, Philippines | Nov.14-20, 2009 |
| Addam Kiari Saidou | Institut National de Recherches Agronomiques du Niger (INRAN), Microbiology and Fertility of Soils, Niger | Quantification and verification of nutrient budgets (C, N and P) in the crop rotation adopting of double-purpose cowpea cultivars, Cameroon | Nov.20-30, 2009 |
| Viengsakoun Napasirth | Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Laos PDR | 2009 Annual Meeting of Research Project for "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", Thailand | Nov.25-26, 2009 |
| Daovy Kongmanila | Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Lao PDR | 2009 Annual Meeting of Research Project for "Establishment of Feeding Standard of Beef Cattle and Feedstuff Database in Indochina", Thailand | Nov.25-26, 2009 |
| Hoang Minh TAM | Agricultural Science Institute for Southern Coastal Central of Vietnam (ASISOV), Vietnam | Workshop titled "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.1-6, 2009 |

| | | | |
|---|---|---|---|
| Vo-Tong Xuan | An Giang University, Vietnam | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.1-6, 2009 |
| Phan Thanh Hai | Agricultural Science Institute for Southern Coastal Central of Vietnam (ASISOV), Vietnam | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.1-6, 2009 |
| Nguyen Thi Lien | Department of Agriculture and Rural Development of Binh Dinh Province, Vietnam | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.1-6, 2009 |
| Bounneuang Douangboupha | Haddockeo Horticulture Research Center (HHRC), NAFRI, Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Phoumy Inthapanya | Rice and Cash Crop Research Centre (RCCR), National Agricultural and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF), Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Chanphasouk Tahthaphone | Rice and Cash Crop Research Centre (RCCR), National Agricultural and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry (MAF), Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Siriphonh Phithaksoun | Plant Quarantine Division, Department of Agriculture, Ministry of Agriculture and Forestry, Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Viengkham Chanthavong | Department of Plant Science, Faculty of Agriculture (Nabong Campus), National University of Laos, Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Mahanakhone Souriya | Department of Livestock and Fishery, Ministry of Agriculture and Forestry, Lao PDR | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Myint Thaung | Yezin Agricultural University, Ministry of Agriculture and Irrigation, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Maung Maung Yi | Project Planning, Management and Evaluation Division, Myanmar Agriculture Service, Ministry of Agriculture and Irrigation, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |

| | | | |
|---|---|---|---|
| Ye Tint Tun | Rice Research Farm (Hmawbi), Hmawbi Township, Yangon Division of Myanmar Agriculture Service, Ministry of Agriculture and Irrigation, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Ohn Win | University of Forestry, Ministry of Forestry, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Hla Tin | Soil Science and Agricultural Engineering Section, Department of Agricultural Research, Ministry of Agriculture and Irrigation, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |
| Myo Nyunt | Plant Quarantine Section, Plant Protection Division, Myanmar Agriculture Service, Myanmar | Workshop titled, "Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina", Thailand | Dec.2-5, 2009 |

# 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' 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 2009, a total of ten researchers were invited to conduct research at JIRCAS HQ.

JIRCAS Visiting Research Fellowships at Tsukuba and Okinawa
(October 2009 to September 2010)

Tsukuba

| | | |
|---|---|---|
| Theophile Odjo | Faculty of Agricultural Sciences, University of Abomey-Calavi, Benin | Development of differential system for rice blast disease for Africa |
| Noelle Giacomini Lemos Torres | Agronomy Department, Maringa State University, Brazil | Development of soybean lines having multiple resistance genes against soybean rust using DNA markers |
| Do Duc Tuyen | Department of Genetic and Plant Breeding, Cuulong Delta Rice Research Institute, Vietnam | Development of DNA markers associated with tolerance to environmental stresses in soybean |
| Nang Myint Phyu Sin Htwe | Plant Biotechnology Laboratory, Myanmar Agriculture Service, Ministry of Agriculture and Irrigation, Myanmar | Identification of useful genes that function in environmental stress tolerance in soybean |
| Nguyen Thi Huong | Department of Quality Testing of Horticulture Products, Fruits and Vegetables Research Institute, Vietnam | Ecological and behavioural studies on parasitoids as biological control agents |
| Zhu Yiyong | College of Resources and Environmental Sciences, Nanjing Agricultural University, P.R. China | Evaluation of biological nitrification inhibition by sweet sorghum |
| Ahmed Galal Elgharably | Soil and Water Sciences Division, Assiut University, Egypt | Improvement of nitrogen uptake and assimilation efficiency in sorghum |
| Salah El-Hendawy | Agronomy Department, Faculty of Agriculture, Suez Canal University, Egypt | Ecological and physiological evaluation of rice better adapted to the low-input condition of African wet lowland |
| Waraporn Apiwatanapiwat | Nanotechnology and Biotechnology Division, Kasetsart Agricultural and Agro-Industrial Product Improvement Institute, Thailand | Development and utilization of yeast to produce bio-ethanol from tropical crop residues |
| Rattiya Waeonukul | Biochemical Technology, King Mongkut's University of Technology Thonburi, Thailand | Efficient saccharification of lignocellulose using highly active microbial enzymes |

## 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 FY 2009, three researchers were invited to Niger (1) and Philippines (2). The fellows and their research subjects are listed below.

For inquiries on the JIRCAS Visiting Research Fellowship Program, please contact the International Relations 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 Site
(October 2009 to September 2010)

| | | |
|---|---|---|
| Addam Kiari Saidou | Microbiology and Fertility of Soils, Institut National de Recherches Agronomiques du Niger (INRAN), Niger | Quantification and verification of nutrient budgets (C, N and P) in the cropping systems using double-purpose cowpea cultivars |
| S. M. A. Jabbar | On-farm Research Division, Bangladesh Agricultural Research Institute, Bangladesh | Evaluation of impacts of continuous rice cultivation under alternate wetting and drying (AWD) irrigation managements on the soil environment |
| Jacques Morales Zarate | Research Division, Southeast Asian Fisheries Development Center, Aquaculture Department (SEAFDEC/AQD), Philippines | Elucidation of relationship between nutritional conditions and body constituents in sea cucumber |

## Other fellowships for visiting scientists

The Government of Japan sponsors a postdoctoral fellowship program for both Japanese and 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 that resided at JIRCAS in FY 2009 are listed below.

JSPS Postdoctoral Fellowships for Foreign Researchers
(September 2007 to September 2011)

| | | | |
|---|---|---|---|
| Michael Frei | University of Hohenheim, German | Physiological and genetic factors associated with tolerance of Zinc deficiency in rice | June 25, 2007 - June 24, 2009 |
| Terry James Rose | University of Western Australia, Australia | Investigation into physiological mechanisms and molecular biology of P-deficiency tolerance in rice | Oct. 13, 2008 - Oct. 12, 2010 |
| Qin Feng | JIRCAS Visiting Research Fellow, Japan | Functional analysis of DREB2 transcription factors involved in drought and salt stress in plants | Nov. 1, 2007 - Oct. 31, 2009 |

| | | | |
|---|---|---|---|
| Charles P. Chen | University of Illinois, USA | Characterization of the physiological mechanism and genetic basis of ozone tolerance in rice | Nov. 1, 2008 - Oct. 31, 2010 |
| Pierfrancesco Nardi | Regional Agency of Agriculture Improvement and Innovation in Latium, Italy | Inhibition of soil nitrification from root exudates | Sep. 1, 2009 - Sep. 1, 2011 |
| Michael Timothy Rose | University of Sydney, Australia | Investigations into biological nitrification inhibition to improve nitrogen-use efficiency in forage and biofuel crops | Sep. 1, 2009 - Sep. 1, 2011 |

# WORKSHOP

## International Conference on Science and Technology for Sustainability

On September 17–18, 2009, in the auditorium of the Science Council of Japan, in Tokyo, Japan, 150 participants joined in the "International Conference on Science and Technology for Sustainability", which was jointly sponsored and organized by the Science Council of Japan and the Japan International Research Center for Agricultural Sciences (JIRCAS). Other co-sponsoring organizations were the United Nations University (UNU), the United Nations University Institute of Advanced Studies (UNU-IAS), and Nikkei Inc.

The International Conference on Science and Technology for Sustainability has been organized every year since 2003 by the Science Council of Japan, with each year's specific theme based upon the fundamental concept of sustainability. The theme of the 7th conference, this year, was "Global Food Security and Sustainability", complementing past themes such as "Energy and Sustainability Science", "Global Innovation Ecosystem", "International Cooperation for Development", and "In Search of Sustainable Well-Being".

In the opening speech, Dr. Ichiro Kanazawa, President of the Science Council of Japan, noted that food security is a critical concern, from the viewpoint of both national interests and the continued existence of humankind; and that, to properly address this concern, the equity not only between generations but also within generations must be achieved. Dr. Rattan Lal, a professor at Ohio University, then emphasized, in the keynote speech, the importance of soil management and conservation to food security, and the effectiveness of soil as a carbon sink. Next, Dr. Keijiro Otsuka, Director of the Foundation for Advanced Studies on International Development (FASID), described trends in, and perspectives on, global food prices; the influence of biofuel demand on the market; and the importance of adaptation strategies in the face of global warming.

Subsequently, three sessions were organized, focusing respectively on "Sustainable Development of Animal Production", "Seafood Security and Marine Ecosystem Sustainability", and "Food Security and Sustainable Crop Production". Experts from Japan and overseas, who have close ties with JIRCAS, presented their latest research results and political contribution plans, and exchanged ideas with conference participants.

In the concluding session, key issues from each session were summarized and reaffirmed, particularly regarding the need for strategies aimed at the promotion and acceptance of technologies, the effectiveness of multidisciplinary interactions, and the importance of international communication and collaboration.

As a co-host institution, JIRCAS welcomed Professor Lal of Ohio University, as the conference's keynote speaker; and Dr. Osamu Koyama, Director of the Research Strategy Office in JIRCAS, made a presentation entitled "Food Security under Globalized Economy—Roles of Science and Technology Cooperation."

Reference: http://www.scj.go.jp/ja/int/kaisai/jizoku2009/index.html

## Workshop on "Yam Agronomy" Organized by IITA and JIRCAS

Yam (*Dioscorea* spp.) is a widely cultivated tuber crop throughout the humid and sub-humid tropics in Africa, Caribbean and the South Pacific Islands, with some production in the subtropics and temperate zone. Especially, about 90% of the world production i.e. 49 million tons are produced annually in West and Central African countries. Yam plays key roles in food security and income generation in the region. Due to consumer preference for yam over other roots and tubers in the region, there is greater demand for it with increasing incomes. However, the yield is slowing down because of low soil fertility, increased pest problems, and the slow pace of getting new technologies to farmers. An urgent need is recognized for more investments in yam research to tackle declining productivity.

JIRCAS started research collaboration on this crop from July, 2009 with the International Institute of Tropical Agriculture (IITA), which has been providing continuous leadership and efforts to research for development of this "orphan crop" over several decades for Africa.

The workshop on yam agronomy research, which drew experts from Africa and Japan, was held with 30 participants at IITA-Ibadan, Nigeria from 25-26 August, 2009. Ten reports, as listed below, were presented to review past research activities and recent needs on yam cropping systems and management practices in each region. In the following discussions, the participants sought to fashion out the research needs and the way forward for increased yam production by prioritizing definite actions needed to be taken in the next 10 years.

**Presentations at the workshop:**

1. Towards increased productivity and sustainability of yam-based systems: M.O. Akoroda *(University of Ibadan, Nigeria)*
2. Yam cropping systems in the Federal Capital Territory, Abuja, Nigeria: B. Aighewi *(University of Abuja, Nigeria)*
3. Research on Yam Cropping Systems in Northern Ghana – Past, Present and Future: S.S.J. Buah, C. Osei and A.Y. Alhassan *(Savanna Agricultural Research Institute, Ghana)*
4. Yam cropping Systems in Ghana : E. Otoo *(Crops Research Institute, Ghana)*
5. Research on yam cropping systems-past, present and future at the University of Agriculture Makurdi, Benue State: B.A. Kalu, E.J. Ekefan, J.K. Okoro, T. Avav, and J. Oluwatayo *(University of Agriculture, Makurdi, Benue State, Nigeria)*
6. Recherche sur les systèmes de culture de l'igname au Togo – passé, présent et futur: Y.D. Sunu *(Institut Togolais de Researche Agronomique, Togo)*
7. Yam cropping systems in Japan: H. Shiwachi *(Tokyo University of Agriculture, Japan)*
8. Establishment of off-season yam cropping systems during the dry season: H. Kikuno *(IITA, Nigeria)*
9. Research on yam cropping systems in NRCRI, Umudike - Past, present and future: J. Ikeorgu *(National Root Crops Research Institute, Nigeria)*
10. Assessing and Improving Nutrient Use Efficiency in Yam-based Systems: O. Dare *(University of Agriculture, Abeokuta, Nigeria)*


In the welcome address, Dr. Robert Asiedu (Director, IITA) stressed the need for agronomists to fashion out ways to improve yam production in order to enhance food security.

International Symposiums and Workshops, FY 2009

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| 1 | JIRCAS/JICA Workshop on Africa Rice Cultivation Research | Jun. 5, 2009 | Tokyo, Japan |
| 2 | Workshop on African rice varieties | Jun. 14, 2009 | Africa Rice Center, Benin |
| 3 | La Ceremonía por el Día del Arbol organizado por el Proyecto JIRCAS | Jun. 19, 2009 | San Roque Gonzalez de Santa Cruz, Paraguay |
| 4 | Workshop on Yam Agronomy | Aug. 25-26, 2009 | International Institute of Tropical Agriculture (IITA), Nigeria |

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| 5 | International Conference on Science and Technology for Sustainability 2009 | Sep. 17-18, 2009 | Tokyo, Japan |
| 6 | Workshop for Improved Citrus Greening Management - SOFRI, Vinh Long and JIRCAS - | Sep. 28, 2009 | Southern Fruit Research Institute (SOFRI), Vietnam |
| 7 | Seminar on laser land leveling technology Exhibition of secondary crops in experimental plot | Sep. 30 – Oct. 1, 2009 | Syr Darya, Uzbekistan |
| 8 | 3rd Seminar on Rural Development based on Clean Development Mechanism | Oct. 15, 2009 | Can Tho, Vietnam |
| 9 | Seminar on Conservation of Fresh Water Lens | Oct. 16, 2009 | Majuro, Marshall |
| 10 | JIRCAS International Symposium | Nov. 4-5, 2009 | Tokyo, Japan |
| 11 | Research Highlights: Economic Integration of Asia | Nov. 11, 2009 | Bangkok, Thai |
| 12 | JIRCAS International Seminar: Rural Development and Countermeasures against Global Warming in Mekong Delta - Potential of Rural Development Utilizing Local Resources | Nov. 15, 2009 | Tokyo, Japan |
| 13 | Sixth Biomass-Asia Workshop | Nov. 18-20, 2009 | Hiroshima, Japan |
| 14 | Seminar on Remote Sensing and GIS Research in Indonesia | Nov. 20, 2009 | Tsukuba, Japan |
| 15 | Africa Seminar: Environmental Stress and Rice Cultivation in Africa | Nov. 26, 2009 | Akita Prefectural University, Japan |
| 16 | Exploitation of Research Theme for Further Agricultural Development under Economic Integration in Indochina | Dec. 3-4, 2009 | Khon Kaen University, Thai |
| 17 | Symposium on Agroforestry | Dec. 16, 2009 | Tokyo, Japan |
| 18 | The Seminar for Verification Study on Integrated Agricultural and Rural Reconstruction Support through Participatory Approach in Tsunami-Affected Area | Feb. 25, 2010 | Matara, Sri Lanka |
| 19 | Ⅲ Seminario “Forestación y Reforestación en Pequeña Escala relacionadas al Desarrollo Rural en el Contexto del Mecanismo de Desarrollo Limpio (MDL) | Mar. 5, 2010 | San Lorenzo, Paraguay |
| 20 | International Workshop Technologies of Measures against Salinization to be challenged by Farmers | Mar. 22, 2010 | Syr Darya, Uzbekistan |
| 21 | 4th Seminar on Rural Development based on Clean Development Mechanism (CDM) | Mar. 25, 2010 | Can Tho, Vietnam |

# APPENDIX

# PUBLISHING AT JIRCAS

## OFFICIAL JIRCAS PUBLICATIONS

**In English**

1) JARQ (Japan Agricultural Research Quarterly)

Vol. 43 No. 2, No. 3, No. 4

Vol. 44 No. 1

2) Annual Report 2008

3) JIRCAS Newsletter No. 57

4) JIRCAS Working Report Series

No. 65 Evaluation and Development of Methods for Sustainable Agriculture and Environmental Conservation in China

No. 66 Development and Characterization of Introgression Lines of an Indica-type Rice Variety, IR64, for Unique Agronomic Traits

No. 67 Application of Small-scale Afforestation and Reforestation CDM ethodology to Low-income Rural Communities in Paraguay

No.68 Development of Supply and Demand Models of Rice in Lower Mekong River Basin Countries : REMEW-Mekong

No.69 Impact Analyses of Economic Integration on Agriculture and Policy Proposals toward Poverty Alleviation in Rural East Asia



**In Japanese**

1) JIRCAS News No. 57, No. 58

## RESEARCH STAFF ACTIVITY 2009-2010

**Journals articles, book chapters, and monographs**

Akagi, Y., Akamatsu, H., Otani, H. and Kodama, M. (2009). Horizontal chromosome transfer, a mechanism for the evolution and differentiation of a plant-pathogenic fungus. Eukaryotic Cell, 8(11): 1732-1738.

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(J) Denotes articles written in Japanese; (C) Denotes articles written in Chinese.

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# Second Medium-Term Plan of the Japan International Research Center for Agricultural Sciences

The Japan International Research Center for Agricultural Sciences (JIRCAS) was established in April, 2001 as an Independent Administrative Agency (IAA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF), for the purpose of contributing to the improvement of technologies related to agriculture, forestry, and fisheries in tropical and subtropical areas as well as other overseas developing regions (hereinafter referred to as "developing regions") by conducting research and development in these areas.

During the First Medium-Term Goal period, 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 by taking both domestic and overseas situations into account, such as the adoption of the U.N. Millennium Development Goals and the announcement of the Policy for the Promotion of International Agricultural Research (decided by the Agriculture, Forestry and Fisheries Research Council in September 2003). In managing its operations, JIRCAS took advantage of its new status as an IAA and embarked on making flexible changes in its organization and system, and promoted the improvement of the quality of research and support work and their efficiency.

During the Second Medium-Term Goal period, JIRCAS plans to contribute to improving technologies for agriculture, forestry and fisheries in the developing regions through "Research and development on agricultural, forestry, and fisheries technology geared towards providing solutions to international food and environmental problems" and "Collection, analysis and dissemination of information to grasp trends related to international food, agriculture, forestry, fisheries and rural areas." To make these global contributions smooth and stable, JIRCAS further promotes operations such as the creation of a multilateral collaborative research system, promotion of collaborative research with world-class research organizations led by the Consultative Group on International Agricultural Research (CGIAR), establishment of a dynamic research system, strategic development of human resources, and enhancement of public relations.

Optimized allocation of research resources and improvement of various systems are implemented to carry out these activities efficiently and effectively, and to generate high-quality outputs for the international community. Major researches at JIRCAS are implemented as projects, and all the necessary budgets for achieving results are allocated on a project basis. Efforts will also be made to improve the system for overseas activities and to simplify administrative procedures.

For efficient and effective promotion of these operations, exchange activities are enhanced by utilizing the Japan Forum for International Agricultural Research for Sustainable Development (J-FARD), which was initiated by JIRCAS and others in 2004 to build a new partnership between Japan's international researchers and organizations in agriculture, forestry and fisheries, and to promote cross-organizational cooperation and collaboration nationwide. JIRCAS also aims to build flexible personnel and business management systems.

With the dissolution of the Japan Green Resources Agency on April 1, 2008, its international activities were transferred to JIRCAS which is smoothly executing these activities.

Through this series of activities, JIRCAS is committed to making international contributions and promoting national interests by fulfilling its responsibilities as Japan's only research institution mandated to carry out international researches in agriculture, forestry, and fisheries comprehensively.

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

As for administrative operations implemented by operational grants, operations are reviewed and efficiency is further promoted. General and administrative expenditures are cut by at least 3% from the previous year and research expenditures by at least 1% from the previous year during the Medium-Term Goal period each year.

In line with the key policy of administrative reform (decided at the Cabinet meeting on December 24, 2005), personnel expenditures will be cut by more than 5% over the next five years (except for retirement allowances and welfare expenditures (but not applying to legal and non-legal welfare expenditures) and part of salaries revised in accordance with the recommendation by the National Personnel Authority). Necessary reviews of salaries of personnel in managerial positions are also made by taking into account the structural reform of salaries of government officials.

1. Implementation and feedback from evaluations and checks

(1) JIRCAS will use external specialists and experts to ensure its objectivity and reliability; and operations and research are evaluated and reviewed by JIRCAS itself prior to releasing its Annual Report to the IAA Evaluation Committee established within the Ministry of Agriculture, Forestry and Fisheries (MAFF).

(2) Numerical goals and indicators for major research projects are set as concretely as possible, and inputs of research resources and obtained results are analyzed from the viewpoint of ensuring their contribution to the improvement of technologies concerning agriculture, forestry, and fisheries in the developing regions. JIRCAS will also make efforts to diffuse its research achievements and monitor the status of their utilization.

(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 when necessary.

(4) To allocate research resources on a priority basis, JIRCAS will clarify basic ideas and concrete methods of feeding evaluation and feedback the results of the in-house evaluation to the administrative management along with the evaluation results from the IAA Evaluation Committee.

(5) JIRCAS will make comprehensive performance evaluations of its research personnel, all the while ensuring the fairness and transparency of the evaluation items and standards. The results will be appropriately fed into the priority allocation of research resources and the treatment of research personnel.

(6) A new evaluation system will be introduced to assess the performance of general administrators in light of the need to revitalize the organization and achieve better results.

2. Effective use of research resources and their improvement and upgrading

(1) Research funds

1) Evaluation results are appropriately fed through to budget allocations, and the effective use of operational grants for administration is promoted.

2) The planning system for acquiring competitive funds is enhanced. Efforts will be made to increase research funds and accelerate research activities by positively applying for external funds useful for achieving our Medium-Term Goals.

(2) Research facilities and equipment

1) Research facilities and equipment will be shared to ensure their efficient utilization. Information on machinery available for joint use and open laboratories will be widely disclosed via the internet.

2) Planned renovation and upgrading of old facilities essential for research promotion laid out in the Medium-Term Plan will be implemented in line with JIRCAS' research prioritization.

(3) Organization

1) JIRCAS will be reorganized as necessary to gain optimal insight into problems in the developing regions.

2) A leader will be assigned to each research project. Responsibility and authority is given to the leader concerning the management of the progress of the research and the allocation of research resources in the project.

3) The functions of the local offices are strengthened in regions such as Southeast Asia where research activities are concentrated.

(4) Improvement of staff qualifications and development of human resources

1) We will create a program aimed at developing human resources, including young researchers, to enable us to nurture personnel and improve their qualifications in a well-planned manner.

2) Efforts will be made to improve the qualifications of researchers who play a key role in international collaborative research through their dispatch abroad or by collaborative studies with invited overseas researchers.

3) We 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 and conduct smooth personnel exchanges with research organizations, including other IAAs.

4) We will make efforts to improve our personnel's qualifications by having the administrative and technical staff actively participate in various training sessions needed for the pursuit of their duties and help them acquire qualifications useful for their jobs. Efforts will also be made to improve the system that allows technical staff to engage positively in research support.

5) The management ability and leadership of research project leaders will be improved utilizing various training systems.

3. Promotion of efficiency, improvement, and upgrading of research support sector

(1) Maintenance of facilities and machinery will be outsourced depending on the type of job.

(2) Details of work at the General Affairs Section will be reviewed to ensure an efficient implementation system and to promote the efficiency of clerical management work by speeding up and simplifying clerical procedures.

(3) JIRCAS will provide efficient local support to researchers dispatched abroad for their experimental and accounting work.

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

(5) Efforts will also be made to rationalize staffing for research support by reviewing overall support work and promoting outsourcing as much as possible.

(6) The Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) will be utilized to streamline, upgrade and enhance work on the collection and provision of research information along with efforts to promote information-sharing across JIRCAS and streamline operations by utilizing groupware.

4. Promotion and enhancement of collaboration and cooperation between industry, academia and government

(1) While taking into account our sharing of roles with other IAAs, we will positively pursue collaborative research and alliances, including personnel exchanges and cooperation between other IAAs and JIRCAS.

(2) To promote collaborative research and researcher exchange more actively, efforts will be made by utilizing J-FARD to improve information exchanges and alliances with national and public research organizations, universities, the private sector, overseas organizations, international organizations and the Japan International Cooperation Agency (JICA).

(3) Opinions will be exchanged with related IAAs, the government departments concerned, and national and public research institutes concerning the forms that alliances and cooperation should ideally take in carrying out research projects undertaken by JIRCAS.

(4) To move ahead with research projects efficiently, we will seek alliances with the government.

(5) Cooperation will be provided to the National Agriculture and Food Research Organization (NARO) as necessary in implementing comprehensive research that features a fusion of expert knowledge in diversified fields.

**II. Measures to achieve the goals of improving the quality of services and other duties provided to the public**

1. Research and investigations

(1) Promotion of international collaborative research and international contributions

1) To promote collaborative research and researcher exchange more actively, efforts will be made by utilizing J-FARD to improve information exchange and alliances with national and public research organizations, universities, the private sector, overseas organizations, international organizations, and JICA.

2) To contribute to problem-solving in developing regions and the improvement of technologies for agriculture, forestry, and fisheries, more than 1,000 researchers and research managers, mainly from JIRCAS but including those from other IAAs and universities, will be dispatched to research organizations in the developing and developed countries and international research organizations affiliated with CGIAR during the Second Medium-Term Goal period to promote smooth international collaborative research and to actively participate in international contributions.

3) Research managers will be invited from research organizations in developing regions to enhance collaboration and cooperation through consultation on the course of collaborative research promotion.

4) More than 500 collaborative researchers and research managers will be invited from agricultural, forestry and fisheries research organizations in the developing regions during the Second Medium-Term Goal period to conduct collaborative research or improve the capacity of the researchers concerned.

5) At least 80 effective Memoranda of Understanding (MOUs) and other similar contracts on research implementation between JIRCAS and overseas research organizations will be constantly maintained during the Second Medium-Term Goal period.

6) In an effort to contribute to the promotion of international collaborative research in agriculture, forestry, and fisheries, a project will be launched through tie-ups with the government sector to provide financial incentives to researchers at agricultural, forestry and fisheries research organizations in developing regions.

(2) Direction of research promotion

In line with the course of research indicated in the "Promotion Policy of International Agricultural Research" and the "Basic Plan for Agriculture, Forestry and Fisheries Research" (decided at the meeting of the Agriculture, Forestry and Fisheries Research Council on March 30, 2005), JIRCAS will carry out the following priority research projects by utilizing J-FARD and taking into account the "Strategy for International Collaborative Research [JIRCAS's role]", summarizing the results of JIRCAS international symposia and researches with overseas research organizations, and the opinions of external experts.

1) Research projects targeting the developing regions will be launched to help reduce by half the world's hungry population, as indicated in the U.N. Millennium Development Goals. For this purpose, crops tolerant to unfavorable environmental conditions that make crop production unstable, such as drought, salinity, and disease, will be jointly developed by research organizations affiliated with CGIAR.

2) Many problem-solving research projects will be enhanced, with a focus on the utilization of biological resources, environmental resources management and measures to address environmental and food problems in Asia, designated as an area in which the strategic alliance in science and technology needs to be strengthened according to a new "Science and Technology Basic Plan."

3) JIRCAS will support international contributions to Africa as indicated in the Progress Report by the G8 Africa Personal Representatives on implementation of the Africa Action Plan at the Gleneagles G8 summit (held in July 2005) in the field of research and development. Technologies related to crops and the soil will be developed to increase crop production in Africa.

4) To contribute towards achieving the target of CO2 reductions imposed by the Kyoto Protocol, research into biomass will be undertaken by JIRCAS in Southeast Asia, as a research institute capable of developing a technology for biomass utilization on-site.

5) There are many large and small islands in the Asia-Pacific area. They are vulnerable to environmental changes, and production activities tend to affect their surrounding environment. Concerning the protection and sustainable utilization of environmental resources on the islands, JIRCAS will also tackle problems with the production environment on such islands by making the most of the geographical advantages of the Tropical Agriculture Research Front and by working in line with the collaborative action plan adopted at the Third Pacific Islands Leaders' Meeting (PALM) (held in May 2003).

A. Research and development on agricultural, forestry and fisheries technology geared towards providing solutions to international food and environmental problems

(1) Development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments

1) Elucidation of the mechanism of tolerance to abiotic stress and production of tolerant crops

This project aims at developing an evaluation method for tolerance to abiotic stress such as drought, screening of a wide range of germplasms of rice, wheat and soybean to identify tolerant germplasms, and acquiring DNA markers linked to this tolerance that can be efficiently used in breeding programs. In parallel with these conventional approaches, we will search for new genes through elucidation of the molecular mechanisms of stress tolerance, and will introduce these candidate genes into crops. The resultant transformants will be evaluated for their adaptability to adverse environments and their agronomic performance.

2) Improvement of drought and submergence tolerance of rice in Africa, including NERICA

To improve the drought and submergence tolerance of rice varieties in Africa such as NERICA (New Rice for Africa), a wide range of rice germplasms will be evaluated for such tolerances to select tolerant types, and then from these, DNA markers linked to the tolerance will hopefully be acquired. The selected tolerant germplasms and the DNA markers can be used in breeding programs to improve their tolerance. As a molecular approach to drought tolerance, genes which confer abiotic stress tolerance, such as DREB, will be introduced into a NERICA variety.

3) Identification of pathogenic races of important diseases and selection of resistant germplasm in major crops

To deal with rice blast, which is extensive in tropical Asia; Fusarium head blight of wheat and soybean rust, which is currently spreading in South America, a system to identify the predominant races of each pathogen and sources of resistance in the host crops will be built, novel resistant germplasms will be identified, and breeding materials will be developed.

4) Development of biomass utilization technology suited to Southeast Asia
We will develop a system to efficiently produce ethanol fuel from unutilized biomass, such as cassava residues and the wastes of oil palm trees mass grown in East Asia, as well as a technology for producing useful material such as biodegradable composites.

5) Elucidation of the functionality and quality parameters of traditional food and agricultural products in Asia and development of effective utilization technology
We will clarify the functionality of the antioxidization and antimutagenic characteristics of traditional Asian foods and tropical farm products such as vegetables and their quality factors, including texture. We will also develop a process technology that allows the improvement and effective utilization of such functionality and quality.

6) Effective utilization of genetic resources in tropical and subtropical crops
To improve the productivity of crops in tropical and subtropical areas such as sugarcane and beans, and to promote their diverse utilization, we will evaluate the characteristics of extensive crop genetic resources, including wild relatives, and develop a technology to utilize valuable genetic resources and produce breeding materials. We will also cooperate with the project of the National Institute of Agrobiological Sciences Genebank, which has been set up as the central national gene bank.

7) Sustainable utilization of tropical and subtropical marine resources and development of aquaculture technology
In Southeast Asian waters, we will make a trophodynamic analysis, clarify the biological characteristics of target fish species such as their maturity and growth, as well as their interaction with other living organisms; estimate stock abundance of commercially important fish and propose stock management policies suited to the region. We will also develop aquaculture technologies for fish, crustaceans, and algae suitable for current conditions in the developing regions.

(2) Development of management technologies of environmental resources and production systems for sustainable agriculture, forestry and fisheries

1) Development of sustainable management technologies for tropical soils
We will analyze the main materials applied to soils such as organic matters and fertilizers in the agropastoral areas in the Sahel region of West Africa, where production of organic matters is low, and will clarify the dynamics of key elements such as nitrogen in the soil-plant ecosystem. In Southeast Asia, which has a higher production of organic matters, we will also clarify soil nutrient dynamics, physical properties and changes in the biota of soil in response to the input of organic materials. Based on the results of this analysis and clarification, we will develop a technology for improving the fertility of tropical soils through proper management of organic matter.

2) Integrated management system for improved water utilization aiming at increasing economic options for farmers' incomes
In the rain-fed farming areas of Indochina, we will develop a management technology for catchment and drainage that can be adopted efficiently and widely in existing cultivation systems for cash crops through a farmer-participatory approach. We will also propose technical guidelines for increasing farmers' incomes by diversifying and combining farming business operations through the efficient utilization of water resources and effective application of local resources. In addition, we will develop rice breeding materials suitable for water-saving cultivation in the irrigated paddy fields that stretch across Asia, and propose an environmentally sound technology for soil and crop management under conditions of reduced water availability.

3) Improvement of feeding technology for livestock in the tropics and the subtropics and the establishment of sustainable agro-pastoral systems in Asian dry areas
We will identify the nutrient demand of beef cattle in tropical and subtropical areas and develop rational management technologies for feeding aimed at the effective utilization of local feed resources. We will also shed light on land degradation and the actual conditions of farming to prevent the advance of desertification due to excessive cultivation and overgrazing in the arid and semi-arid regions from Northeast Asia to West Asia, and create a sustainable agro-pastoral production system. We will also develop technologies for sustainable management of farmland and grassland, effective utilization of water resources, and advanced utilization of little-used feed resources. A model of sustainable farming will be produced by combining all these efforts to

raise farmers' incomes. A study will likewise be conducted to establish adaptable and effective technologies for water resource utilization and vegetation restoration and to present a method to enhance the capacities of local government personnel and the local people to formulate a management plan for rangelands, as countermeasures for yellow sand in Southeast Asia.

4) Elucidation and exploitation of biological nitrification inhibition (BNI)
Biological nitrification inhibition (BNI) is a natural phenomenon in which certain plant species have the capability to control nitrification in soils by releasing inhibitory compounds from their roots. The development of next-generation crop/pasture varieties that have a built-in ability to self-regulate nitrification through inhibition will have a dramatic impact on minimizing nitrogen losses that are associated with nitrification. We aim to (a) develop the genetic and physiological tools necessary for genetically exploiting the BNI attribute in crops and pastures and assess inter- and intra-specific variability of BNI, (b) characterize the physiological and biochemical mechanisms of BNI and isolate BNI compounds followed by the elucidation of their biosynthetic pathways, and (c) clarify their interaction with environmental factors, particularly soil conditions, and its effect on modulating the functionality of BNI.

5) Development of environmental management technology for sustainable crop production in tropical and subtropical islands
We will develop a technology for effective utilization of water resources and fertilizer and an environmental management technology for reducing soil loss. These technologies are essential for sustainable crop production in the context of the environmental systems on tropical and subtropical islands. We will also produce prediction models of environmental pollution such as those of river soil loss and nutrient salt loss, and then evaluate the effectiveness of the environmental management technology scheduled for development.

6) Development of nurturing techniques for beneficial indigenous tree species in Southeast Asia
We will propose a combined management of agricultural and forestry operations based on the utilization of useful indigenous tree species, while at the same time developing a technology for tree cultivation needed to promote the production of timber from useful indigenous trees in the tropical monsoon regions of Southeast Asia where forests have decreased sharply. We will also propose a method for selective logging while maintaining the genetic diversity of useful indigenous tree species in natural dipterocarp forests on tropical hills.

7) Development of productive low-input cultivation technology for fruit trees in the tropics
We will develop a cultivation technology for low-tree-height cultivation aimed at low input and effective prevention of diseases such as rot disease in the production of tropical fruits, including durian, in Southeast Asia. We will also develop a technology for high-quality, high-yield production, including improved pollination efficiency and fertilizer management.



(3) Elucidation of the impact of global environmental changes on agriculture, forestry, and fisheries and development of mitigating technologies

1) Developing an impact assessment model and formulation of a food supply stabilization plan
To conduct medium- and long-term evaluations of how environmental changes, such as changes in water supply and global warming, affect the supply and demand of major agricultural products in East and Southeast Asia, we will improve the world food supply and demand model, and create a scenario of measures for food production such as rice aimed at minimizing the impact of such environmental changes. We will also develop early warning systems to mitigate damage to agriculture from meteorological disasters and clarify specific measures to stabilize food supply.

2) Utilization of Geographic Information System (GIS) for the development of a land information monitoring technology in developing regions
We will obtain past history data on land utilization, cropping, and growth patterns of agricultural products, land degradation, and the occurrence of disasters to gain an understanding of spatial environmental changes in the developing regions and to quantitatively clarify the relationship between such changes and agricultural production. We will also develop technologies to monitor the phenomena of various spatial scales using geographic information such as satellite data to gain a better understanding of environmental changes in quasi-real time.

3) Formulation of agricultural development methodologies to tackle the environmental changes of global warming and desertification
We will conduct a field study and develop a methodology that combines different techniques of soil erosion prevention on farmlands or hillsides as well as techniques of water use and management to prevent desertification by soil degradation or salt accumulation in developing areas. Likewise,

we will establish a methodology for rural development in a guideline that will meet the needs of rural people in developing countries such as livelihood improvement by applying the international mechanism of greenhouse gas emission reduction trading.

4) Development of management technology for major pests of tropical and subtropical crops
We will develop management techniques for major pests to stabilize crop production in the tropics and subtropics. We will focus our efforts on the development of a control technology to prevent citrus greening disease, which hampers sustainable production of citrus fruits in Southeast Asia and other regions.

B. Collection, analyses and dissemination of information to grasp trends related to international food, agriculture, forestry and fisheries and rural areas

(1) Collection and dissemination of information related to global food, agriculture, forestry, and fisheries
By strengthening ties with related organizations at home and abroad and through on-site investigations, we will collect extensive information on supply and demand trends in food and agricultural, forestry, and fisheries products worldwide, including the developing regions; and on research and development, institutions, and policies, as well as industrial structures, relating to agriculture, forestry, fisheries, and their associated industries. The information collected will be provided to the public through the expansion of databases, symposia and other means.

(2) Elucidation of the direction of technological development in developing regions and analysis of socioeconomic conditions influencing development in rural areas We will clarify the direction of technology development necessary for developing regions through managerial and social evaluation of the selection, introduction, and establishment of technologies such as those for rice cultivation in Asia. We will also clarify the socioeconomic conditions and development methods that will encourage effective rural development in Asian countries where rapid changes are taking place in trade and distribution.

(3) Establishment of techniques and methodologies for the reconstruction of agriculture and rural communities affected by natural disasters, etc.
We will undertake a farmers' participatory study on techniques and methodologies for the reconstruction of agricultural and rural communities affected by natural disasters, etc, and present the supporting reconstruction method as a guideline.

2. Promotion of the release and dissemination of research results

(1) Securing interactive communication with the public

1) We will hold wherever possible open seminars and workshops on international collaborative research projects, disclose research results collected and analyzed through multi-media information, publish the results of research evaluations, engage in interactive communication with the public regarding collaboration on international research projects implemented by JIRCAS, and ensure public understanding and transparency of JIRCAS' activities.
2) The research staff will work positively on outreach activities via open lectures for citizens. Their efforts will be conscientiously evaluated.
3) We will establish a system for receiving and answering questions from the public on our Web site.
4) We will conduct questionnaire-based surveys of our collaborative research partners to identify research needs and exchange information.
5) We will adopt a participatory approach in international collaborative research projects to incorporate the needs of local residents and seek their understanding of and cooperation with our research activities.

(2) Promotion of utilization of research results

1) To ensure the prompt and practical application of research results, we 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 by focusing on the utilization, diffusion, and commercialization of research results.
2) To promote the dissemination of our research achievements, we will hold symposia related to the research projects on site.
3) To implement agricultural development effectively and efficiently in developing areas, we will establish and publish the method of collaborative technology transfer performed by local government organizations, local and international NGOs, universities, etc.
4) Of the research results concerned with international research on agriculture, forestry and fisheries,

we will select at least 20 research results that can be transferred to the developing regions for diffusion based on external evaluations within the period covered by the Second Medium-Term Goals.

(3) Public relations and the release of research results

1) Research results will be released at academic meetings and symposia in Japan and overseas. At least 560 refereed papers will also be published in academic journals and bulletins during the period covered by the Medium-Term Goals. At least 30 international symposiums and workshops will also be held during that period, and research results will be widely released in Japan and overseas.

2) Details of research results will be released on Web sites and through exhibitions. To publicize the roles of JIRCAS in solving problems facing world food and agriculture, we will also actively take advantage of the mass media by making more than 30 press releases of major research results during the period covered by the Medium-Term Goals.

3) We will prepare various manuals and brochures for research results, and conduct public relations on such research achievements in the developing regions through international collaborative research activities.

(4) Acquisition of intellectual property rights and promotion of their utilization

1) In our efforts to acquire intellectual property rights, we will file at least 20 patent applications in Japan and abroad during the period covered by the Second Medium-Term Goals, and will aim to win patent rights in consideration of the potential for patent licensing. We will also endeavor to widen the scope of patent licensing, stressing the practicality and utility of intellectual property such as patents.

2) We will review registered patents as needed in the light of licensing revenue, and the development and invention of alternative technologies. If necessary, we will waive the patent rights.

3 ) Breeding research results which are applicable in Japan will be positively applied to the registration of varieties based on the Seed and Seedling Law to promote their dissemination and utilization.

4 ) We will provide information on the intellectual property rights of JIRCAS through the internet, and promote their utilization through the Technology Licensing Organization (TLO) certified by the Ministry of Agriculture, Forestry and Fisheries.

3. Other social contributions in specialized fields

(1) Analysis and appraisal

1) On request from the government, various organizations, and universities, JIRCAS will perform analyses and appraisals that will require the highly specialized knowledge it possesses and which are difficult for other organizations to carry out.

(2) Training sessions and seminars

1) We will hold training sessions and seminars as often as possible, and actively cooperate in events sponsored by the government and other organizations.

2) We will actively welcome trainees from other IAAs, universities, national and public institutions, as well as the private sector to develop human resources, raise technical standards, and transfer technical information. We will also actively welcome trainees from abroad.

3) We will, when commissioned by the government, promote the nurturing of researchers engaged in international agriculture, forestry, and fisheries research.

(3) Collaboration with the government

We will send our staff to government committee meetings and conferences, and provide domestic and overseas technical information upon request. We will also help with international cooperation and exchanges on scientific technology provided by the government.

(4) Cooperation with international organizations and academic societies

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.

# FINANCIAL OVERVIEW

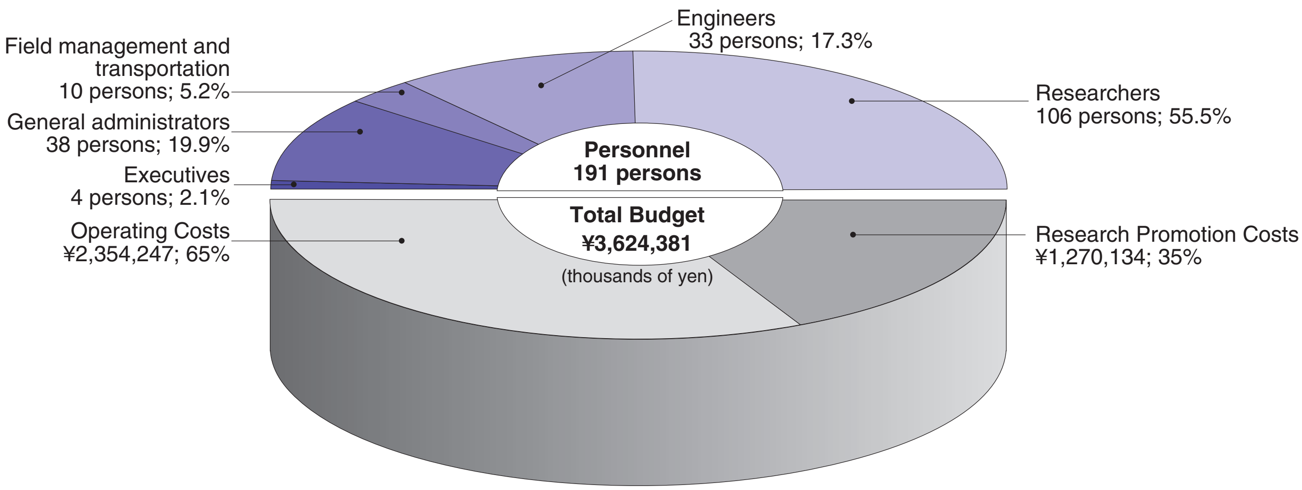
Fiscal Year 2009

*thousands of yen*

| | |
|---|---|
| **TOTAL BUDGET** | **3,624,381** |
| **OPERATING COSTS** | **2,354,247** |
| Personnel (191) | 2,029,145 |
| President (1), Vice-President (1), Executive Advisor & Auditor (2) | |
| General administrators (38) | |
| Field management and transportation (10) | |
| Engineers (33) | |
| Researchers (106) | |
| * Number of persons shown in ( ) | |
| Administrative Costs | 325,102 |

| | |
|---|---|
| **RESEARCH PROMOTION COSTS** | **1,270,134** |
| Research and development | 549,316 |
| Overseas dispatches | 209,144 |
| Research exchanges/invitations | 13,313 |
| Collection of research information | 85,467 |
| International collaborative projects | 367,106 |
| Fellowship programs | 45,788 |

**Budget FY 2009 (Graph)**



# MEMBERS OF THE EXTERNAL EVALUATION COMMITTEE AND PROGRAM REVIEW MEETINGS

## Members of the JIRCAS External Evaluation Committee

| | |
|---|---|
| Hiroto ARAKAWA | Senior Special Advisor, Japan International Cooperation Agency |
| Toshihiko KOMARI | Vice President, Corporate Strategy Division, Japan Tobacco Inc. |
| Toru MITSUNO | Professor, Department of Environmental Management, Tottori University of Environmental Studies |
| Hajime NAKAMURA | Managing Director, Forest Product Division, Itochu Forestry Corp. |
| Keiko NATSUAKI | Professor, Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture |
| Shin-ichi SHOGENJI | Professor, Graduate School of Agricultural and Life Sciences, University of Tokyo |

## External Reviewers for the JIRCAS Program Review Meetings

**[Agro-environment]**

| | |
|---|---|
| Toshiaki IMAGAWA | Director, Department of Planning and General Administration, National Agricultural Research Center for Western Region, National Agriculture and Food Research Organization |
| Nobuyuki KURAUCHI | Associate Professor, College of Bioresource Sciences, Nihon University |
| Takashi NISHIO | Director, Soil Environment Division, National Institute for Agro-Environmental Sciences |
| Kenji HATA | Professor, Center of Field Education and Research, Faculty of Bioresource Sciences, Akita Prefectural University |

**[Crop Production]**

| | |
|---|---|
| Hiroaki INOUE | Professor, College of Bioresource Sciences, Nihon University |
| Masaaki NAKANO | Research Manager, National Institute of Fruit Tree Science, National Agriculture and Food Research Organization |

**[Agro-biological Resources]**

| | |
|---|---|
| Ikuo ANDOU | Team Leader, Marker-Asisted Rice Breeding Research Team, National Institute of Crop Science, National Agriculture and Food Research Organization |
| Tatsuhito FUJIMURA | Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba |
| Kyuya HARADA | Team Leader, Soybean Genome Research Team, Division of Genome and Biodiversity Research, National Institute of Agrobiological Sciences |
| Hitoshi NAKAGAWA | Director, Institute of Radiation Breeding, National Institute of Agrobiological Sciences |

**[Animal Production & Grassland]**

| | |
|---|---|
| Hitoshi NAKAGAWA | Director, Institute of Radiation Breeding, National Institute of Agrobiological Sciences |

| | |
|---|---|
| Fuminori TERADA | Director, Department of Planning and General Administration, National Institute of Livestock and Grassland Science, National Agriculture and Food Research Organization |
| Kunihiko YOSHINO | Professor, Graduate School of Systems and Information Engineering, University of Tsukuba |

**[Fisheries]**

| | |
|---|---|
| Yukimasa ISHIDA | Director, Tohoku National Fisheries Research Institute, Fisheries Research Agency |
| Takashi MINAMI | Professor, Graduate School of Agricultural Sciences, Tohoku University |
| Toshio TAKEUCHI | Vice President, Tokyo University of Marine Science and Technology |

**[Development Research]**

| | |
|---|---|
| Masao TSUJI | Professor, Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture |
| Ryuichi SHIGENO | Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba |
| Ryuichi MASUBUCHI | Research Manager, National Agriculture Research Center, National Agriculture and Food Research Organization |

**[Post-harvest Science & Technology]**

| | |
|---|---|
| Yoshiaki KITAMURA | Director, Food Engineering Division, National Food Research Institute, National Agriculture and Food Research Organization |
| Tohjiro TSUSHIDA | Professor, School of Food, Agricultural and Environmental Sciences, Miyagi University |

**[Biomass Utilization]**

| | |
|---|---|
| Mitsutoshi NAKAJIMA | Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba |
| Koichi YAMAMOTO | Director, Tohoku Research Center, Forestry and Forest Products Research Institute |

**[Forestry]**

| | |
|---|---|
| Naoto MATSUMURA | Professor, Graduate School of Bioresources, Mie University |
| Akira SATO | Professor, Faculty of Regional Environment Science, Tokyo University of Agriculture |

**[Rural Development]**

| | |
|---|---|
| Tetsuro MIYAZATO | Principal Research Coordinator, Japanese Institute of Irrigation and Drainage |
| Yoshihiko NISHIMURA | Professor, Faculty of Tourism Sciences and Industrial Management, University of the Ryukyus |
| Yasutami SHIMOMURA | Professor, Faculty of Humanity and Environment, Hosei University |

# JIRCAS STAFF in FY 2009

## President

Kenji Iiyama

## Vice-President

Masami Yasunaka

## Executive Advisor & Auditor

Shigeo Matsui
Hitoshi Yonekura

## Research Strategy Office

Osamu Koyama, Director
Kensuke Okada, Senior Researcher
Hiroko Watanabe, Project Leader

**Regional Research Coordinators**
Tomohide Sugino, Representative of Southeast Asia Office (Thailand)
Tetsuji Oya, Representative of Africa office

## Research Planning and Coordination Division

Makoto Nakatani, Director

Tadahiro Hayashi, Senior Researcher

**Research Planning and Evaluation Office**
Takeshi Kano, Head
**Research Planning Section**
Naruo Matsumoto, Head
Kazuhiro Suenaga, Senior Researcher
Taro Izumi
**Research Evaluation Section**
Koshun Ishiki, Head
Kazuo Ise, Senior Researcher
Mamoru Watanabe
**Field Management Section**
Haruo Tamura, Chief Field Operator
Takashi Komatsu, Field Operator

**Research Support Office**
Kenichi Hatsuse, Head
**Research Coordination Section**
Tokichi Kojima, Head
Kazunari Iwafuchi, Assistant Head
Takeshi Usuku, Coordination Subsection Head
Junichi Irino, International Relations Subsection Head
**Research Support Section**
Hatsui Yashiro, Head
Hiroyuki Watari, Budget Subsection Head
Takao Oga, Support Subsection 1 Head
Ryoichi Mise, Support Subsection 2 Head
Akira Hirokawa, Intellectual Property Expert

**Public Relations Office**
Masanobu Ohura, Head
**Public Relations Section**
Tamao Hatta, Head
Mie Kasuga, Senior Researcher
Yuzo Manpuku
**International Relations Section**
Satoshi Uchida, Head
Kunimasa Kawabe, Senior Researcher
**Publications and Documentation Section**
Misako Nakao, Head
Noriko Yatabe, Managing Subsection Head (Librarian)
Hiromi Miura, Network Subsection Head

**Executive Chief Researchers**
Satoru Miyata
Tadashi Takita

## Administration Division

Tomoichi Mitomi, Director

**General Affairs Section**
Harumi Yakushiji, Head
Koichi Iioka, General Affairs Assistant Head
Koichi Takada, Personnel Management Assistant Head
Yoshihiko Sumomozawa, General Affairs Subsection Head
Katsunori Kanno, Welfare Subsection Head
Gaku Takeda, Personnel Subsection 1 Head
Akemi Nomiya, Personnel Subsection 2 Head

**Accounting Section**
Shigeyoshi Sumita, Head
Nobuhiko Nakamura, Accounting and Examination Assistant Head
Takaaki Shimura, Procurement and Asset Managing Assistant Head
Koichi Fuse, Financial Subsection Head
Shinji Ishizaka, Accounting Subsection Head
Toshiki Kikuchi, Overseas Expenditures Subsection 1 Head
Yukio Konuma, Overseas Expenditures Subsection 2 Head
Yoshinori Kawasaki, Audit Subsection Head
Yasuhiro Onozaki, Procurement Subsection Head
Takashi Kitami, Procurement Officer
Tsuneyoshi Sasaki, Supplies/Equipment Subsection Head
Kuniaki Katsuyama, Facilities Subsection Head

**Administration Section (Tropical Agriculture Research Front)**
Hiroshi Jutori, Head
Tetsuya Hirono, General Affairs Subsection Head

Shuji Hirose, Accounting Subsection Head
Masafumi Sato, Accounting Officer

### Audit Office

Hideo Azechi, Head

### Rural Development Planning Division

Takeshi Ohta, Director

**Project Leaders**
Naoya Fujimoto

**Principal Engineer**
Takeru Higashimaki
Hirofumi Iga
Tsutomu Kobayashi
Mitsuru Marumoto
Eiji Matsubara
Ryo Miyazaki
Kimio Osuga
Hiroshi Suzuki

**Senior Engineer**
Shinji Hirouchi
Hiroshi Inoue
Kazuhisa Kouda
Takeshi Matsumoto
Yasuyuki Nakanishi
Michio Naruoka
Yukio Okuda
Koichi Takenaka
Motomu Uchimura

**Chief Engineer**
Haruyuki Dan
Katsumi Hasada
Chikako Hirose
Hiroshi Ikeura
Taro Izumi
Kenichiro Kimura
Yuzo Manpuku
Masaki Morishita
Naoko Oka
Keisuke Omori
Junya Onishi
Shutaro Shiraki
Toshihide Takeuchi
Mamoru Watanabe
Masakazu Yamada

### Development Research Division

Masuo Ando, Director

**Project Leaders**
Jun Furuya, Agricultural Economics
Kazuo Nakamoto, Agricultural Economics
Satoshi Uchida, Geographic Information Systems
Shigeki Yokoyama, Agricultural Economics

**Senior Researchers**
Fumika Chien, Agricultural Economics
Akira Hirano, Geographic Information Systems
Hiroshi Komiyama, Development Economics
Shunji Oniki, Agricultural Economics
Ryuichi Yamada, Agricultural Economics
Toru Hisazome, Agricultural Economics
Yukiyo Yamamoto, Geographic Information Systems

**Researcher**
Shintaro Kobayashi, Agricultural Economics

### Biological Resources Division

Takashi Kumashiro, Director

**Project Leaders**
Yoshimichi Fukuta, Rice Breeding

**Senior Researchers**
Hajime Akamatsu, Plant Pathology
Xu Donghe, Plant Molecular Genetics
Yasunari Fujita, Plant Molecular Biology
Masanori Inagaki, Wheat Breeding
Takuma Ishizaki, Plant Molecular Biology (Tropical Agriculture Research Front)
Norihito Kanamori, Plant Molecular Biology
Nobuya Kobayashi, Physiology and Breeding
Kyonoshin Maruyama, Plant Molecular Biology
Kazuo Nakashima, Plant Molecular Biology
Takahito Noda, Rice Breeding
Naoki Yamanaka, Plant Molecular Genetics

(Kazuko Yamaguchi-Shinozaki, Plant Molecular Biology)

### Crop Production and Environment Division

Osamu Ito, Director

**Project Leaders**
Satoshi Nakamura, Insect Ecology
Masato Oda, Crop Management
Junichi Sakagami, Crop Improvement
Satoshi Tobita, Plant Physiology and Nutrition
Hideto Fujii, Agricultural Hydrology

**Senior Researchers**
Keiichi Hayashi, Soil Management
Yasukazu Hosen, Environmental Soil Science
Takayuki Ishikawa, Plant Physiology
Hide Omae, Crop Science
Guntur V. Subbarao, Crop Physiology and Nutrition
Takeshi Watanabe, Soil Chemistry
Matthias Wissuwa, Physiology and Genetics

**Researcher**
Yoichi Fujiwara, Hydrology

### Animal Production and Grassland Division

Akio Takenaka, Director

**Project Leaders**
Kazuhiro Suenaga, Genetics and Breeding
Kazunobu Toriyama, Soil Science

**Senior Researchers**
Yasuo Ando, Plant Microbiology
Makoto Otsuka, Animal Nutrition
Kazumasa Shindo, Pasture Management
Seishi Yamasaki, Animal Nutrition

### Post-harvest Science and Technology Division

Yutaka Mori, Director

**Project Leader**
Kazuhiko Nakahara, Food Chemistry

**Senior Researchers**
Takamitsu Arai, Molecular Microbiology
Tamao Hatta, Mineralogy and Geology
Akihiko Kosugi, Molecular Microbiology
Yoshinori Murata, Applied Microbiology
Satoru Nirasawa, Food Functionality
Tadashi Yoshihashi, Food Evaluation

### Forestry Division

Tadao Gotoh, Director

**Senior Researchers**
Naoyuki Furuya, Forest Management
Iwao Noda, Forest Chemistry
Tatsuya Otani, Forest Ecology
Atsushi Sakai, Silviculture
Tomoko Sugimoto, Forest Soil Science
Naoki Tani, Forest Genetics
Akihiko Yokota, Forest Products

### Fisheries Division

Yukio Maeno, Director

**Project Leader**
Marcy N. Wilder, Crustacean Biochemistry

**Senior Researchers**
Kaoru Hamano, Aquatic Animal Physiology
Yukio Hanamura, Marine Biology
Sayaka Ito, Aquatic Ecology
Shinsuke Morioka, Fish Biology
Katsuhisa Tanaka, Marine Chemistry
Satoshi Watanabe, Marine Ecology
Toshihiro Yamamoto, Fish Ecology

**Researcher**
Tomoyuki Okutsu, Aquatic Animal Physiology

### Tropical Agriculture Research Front

Yoshinobu Egawa, Director

**Islands Environment Management Group**
**Group Head, Project Leader**
Kiyoshi Ozawa, Agrometeorology

**Senior Researchers**
Shinkichi Gotoh, Soil Science
Yoshiko Iizumi, Water Management
Fujio Nagumo, Soil Science

**Crop Genetic Resources Group**
**Stress-Tolerant Vigna Project Team**
**Group Head**
Mariko Shono, Plant Physiology

**Sugarcane Improvement Project Team**
**Project Leader**
Seiji Yanagihara, Biological Resources Division

**Crop Production and Protection Group**
**Tropical Fruits Production Project Team**
**Group Head, Project Leader**
Tatsushi Ogata, Pomology

**Senior Researchers**
Shinsuke Yamanaka, Molecular Biology

**Citrus Greening Disease Management Project Team**
**Project Leader**
Yasuo Ohto, Plant Pathology

**Senior Researchers**
Katsuya Ichinose, Entomology
Tadafumi Nakata, Entomology

**Researcher**
Youichi Kobori, Entomology

**Technical Support Section**
Tsutomu Fushimi, Head
Masakazu Hirata, Machine Operator
Hirokazu Ikema, Machine Operator
Masahide Maetsu, Machine Operator
Yuho Maetsu, Machine Operator
Yasuteru Shikina, Machine Operator
Masato Shimajiri, Machine Operator
Masashi Takahashi, Machine Operator
Koji Yamato, Machine Operator

**Principal Plant Breeder**
Akira Sugimoto, Plant Breeding

Yoshimitsu Katsuda, Public Relations Officer

# THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

## The Japanese Fiscal Year and the Annual Report 2009

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) 2009 covers the period from April 1, 2009 through March 31, 2010. The Annual Report 2009 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2010, through March 31, 2011 (FY 2010).

## 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 | 10,749 |
| Okinawa Tropical Agriculture Research Front | 9,510 |
| Total | 20,259 |

# Annual Report 2009

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**Japan International Research Center for Agricultural Sciences (JIRCAS)**

1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN

Website  http://www.jircas.affrc.go.jp

Tel.  +81-29-838-6313

Fax. +81-29-838-6316

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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理事長　飯山賢治

〒305-8686 茨城県つくば市大わし1番地1

電話：029-838-6313

FAX：029-838-6316

印　刷　松枝印刷株式会社

〒303-0034 茨城県常総市水海道天満町2438