Japan International Research Center for Agricultural Sciences

Annual Report 2006

(April 2006-March 2007)

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JIRCAS 2006 ANNUAL REPORT

Message from the President

President
Dr. Kenji Iiyama

The missions of the Japan International Research Center for Agricultural Sciences (JIRCAS) is set based on the policies of the Japanese government and also on the needs of scientists and inhabitants in developing areas.

The United Nations Millennium Summit in September 2000 adopted the United Nations Millennium Declaration, which appealed to the international community for actions for peace and security, development and eradication of poverty, protection of global and regional environments, and human rights, with a particular focus on African issues. Based on the agreements of the General Assembly of the United Nations in the summit, the United Nations Millennium Development Goals (MDGs) were put together in 2001. The MDGs are composed of eight goals, among which are the following "eradicate extreme poverty and hunger", "ensure environmental sustainability", and "develope a global partnership for development." We as agricultural scientists are aware that emancipation from extreme poverty and hunger and ensuring sustainable crop production based on global environmental sustainability are urgent tasks. We also recognize that progress in solving these problems will be realized through collaboration with scientists in developing areas based on earnest global partnership. The eight MDGs - which intend to the halve extreme poverty by the target date of 2015 - form a blueprint agreed to by all the world's countries and all the world's leading development institutions. At this halfway point to the 2015 deadline, there has been clear progress towards implementing the MDGs; but their overall success is still far from assured, as an MDG progress report by the United Nations has found, and will depend in large part on whether developed countries will make good on their aid commitments.

The Council for Science and Technology Policy, a Cabinet Office of the Japanese government, adopted the Third Science and Technology Basic Plan in 2006. A core policy under this plan is to emphasize the importance of science and technology based on public support, while pursuing the goal of providing social benefits, with a close focus on education and success within a globally competitive environment. The plan also points out to the need to establish a strategic focus for science and technology in areas such as basic research, as well as the need for progress in the training and recruitment of qualified personnel, the development of innovations, and the strategic promotion of international activities as systematic reforms to facilitate the uses of science and technology.

The Japanese government also finalized a long-term strategic initiative known as "Innovation 25" at a Cabinet Council Meeting held on June 1, 2007. "Innovation 25" sets out a plan to realize a future for Japan full of hope and prosperity over a set time frame leading up to 2025. To achieve this plan, the initiative outlines steps to be taken in the short term and medium-to-long term in such areas as research and development, the reform of social systems, and education. Specific measures to be implemented include the strategic promotion of international activities and the training and recritment of qualified personnel.

In addition to the above, we will also keep our eyes focused on the implementation of the Kyoto Protocol, which took effect in February 2006, and on many issues suggested by the Pacific Island Leaders Meeting (PALM) in May 2003 such as soil erosion and fertility.

Researchers at JIRCAS are also involved in international collaborations with scientists of parther governmental and scientific institutes to develop agricultural, forestry, and fisheries technologies geared to providing solutions to international food and environmental problems in developing areas worldwide, such as Asia, especially Southeast Asia, as well as West Africa and South America. The research projects are decided on the basis of the collection, analyses and dissemination of information to grasp trends related to international food, agriculture, forestry, and fisheries, and rural areas in developing regions. The major projects extend over quite wide areas such as (1) developing an impact assessment model and formulation of a food supply stabilization plan, (2) elucidation of the impact of global environmental changes on agriculture, forestry and fisheries and development of mitigating technologies, (3) development of management technologies of environmental resources and production systems for sustainable agriculture, forestry, and fisheries, and (4) development of technologies to utilize biological resources for stable production and multi-purpose applications under adverse environments.

Other reseach areas are; (5) improvement of abiotic stress tolerance of crops, (6) effective utilization of genetic resources in tropical and subtropical crops, (7) development of biomass utilization technology suited to Southeast Asia, (8) developing pest control management technology for major pests in the tropics and subtropics, (9) identification of pathogenic races for important diseases and selection of resistant germplasm in major crops, (10) development of sustainable management technologies for tropical soils, (11) integrated management system for improved water utilization aiming at increasing economic options and reducing environmental impact, (12) sustainable utilization of tropical and subtropical

JIRCAS Main Building

marine resources and development of aquaculture technology, (13) improvement of feeding technology for livestock in the tropics and the subtropics and establishment of sustainable agro-pastoral systems in Asian dry areas, (14) development of nurturing techniques for beneficial indigenous tree species in Southeast Asia, and (15) development of environmental management technology for sustainable crop production in tropical and subtropical islands.

All the scientific and technological activities for FY 2006 of JIRCAS are documented in this annual report. We sincerely hope that readers will recognige our activities in this booklet, and suggest further issues to be recolved in the fields of agriculture, forestry, and fisheries in developing areas.

HIGHLIGHTS FROM 2006

IMPORTANT NEW DEVELOPMENTS

Certificates of Recognition for International Research Cooperation

■ In recognition of our contributions to cooperative research, JIRCAS has received four Certificates of Appreciation from overseas governments and research institutions, as shown below.

In July 2006, a Certificate of Appreciation was presented by the National Soybean Research Center, Brazilian Agricultural Research Corporation (EMBRAPA), Brazil, for our contribution to meaningful achievements regarding technologies for sustainable management of agroecosystems.

Embrapa

Embrapa Soybean declares to whom it may concern, that JIRCAS (Japan International Research Center for Agricultural Sciences) has been an important partner in agriculture research for the last years.

JIRCAS through its visiting researchers, jointly with the Brazilian researchers at the National Soybean Research Center, Embrapa Soybean has been contributing to expressive achievements regarding technologies for sustainable management of agroecosystems.

The results achieved in Brazil are also helping the development of agriculture in neighboring countries in South America. The researchers exchange funded by JIRCAS has provided important technical contributions as well as intensified cultural relations between the two countries.

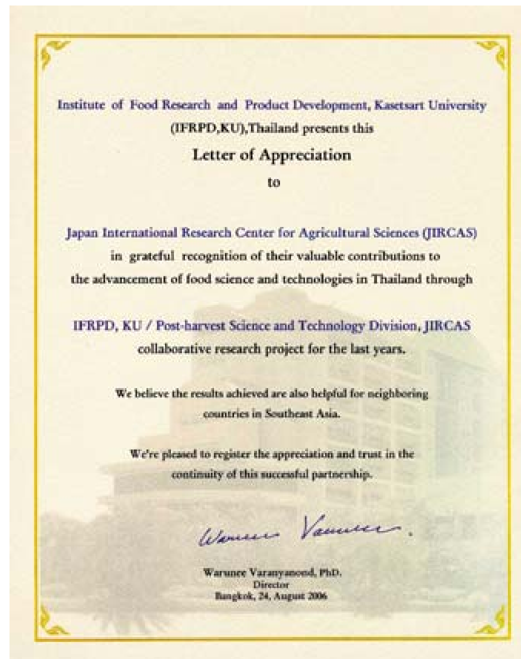
Therefore, we are pleased to register the appreciation that Embrapa Soybean has regarding the cooperation with JIRCAS and we trust in the continuity of this successful partnership.

Vania Beatriz Rodrigues Castiglioni
Head of Embrapa Soybean

Londrina, PR, June 28, 2006.

Certificate of Appreciation from Embrapa, Brazil

■ In August 2006, a Letter of Appreciation was presented by the Institute of Food Research and Product Development, Kasetsart University, Thailand, for valuable contributions to the advancement of food science and technologies in Thailand through IFRPD, KU/JIRCAS collaborative research projects in previous years.



Institute of Food Research and Product Development, Kasetsart University
(IFRPD,KU),Thailand presents this
Letter of Appreciation
to

Japan International Research Center for Agricultural Sciences (JIRCAS)
in grateful recognition of their valuable contributions to
the advancement of food science and technologies in Thailand through

IFRPD, KU / Post-harvest Science and Technology Division, JIRCAS
collaborative research project for the last years.

We believe the results achieved are also helpful for neighboring countries in Southeast Asia.

We're pleased to register the appreciation and trust in the continuity of this successful partnership.

Warunee Varanyanond, PhD.
Director
Bangkok, 24, August 2006

Letter of Appreciation from Kasetsart University, Thailand

JIRCAS senior administrators pose for a group photograph at the JIRCAS front entrance. Front row: T. Ono, O. Koyama, K. Iiyama, T. Senboku, S. Matsui, Back row: M. Tada, S. Kitamura, T. Goto, M. Yasunaka, S. Oshio, O. Ito

T. Kumashiro

Y. Mori

T. Imbe

■ In December 2006, MAG of Paraguay presented a Letter of Appreciation to Zenichi Sano at JIRCAS for his research into the cyst nematode in Paraguay.

Ministerio de Agricultura y Ganadería
Viceministerio de Agricultura
Dirección de Investigación Agrícola
INSTITUTO AGRONÓMICO NACIONAL

RECONOCIMIENTO Y GRATITUD

Al Dr. Zen-ichi Sano, experto de JIRCAS

Por su valioso aporte a la investigación en el área de NEMATOLOGIA, durante el período comprendido entre Agosto 2004 a Diciembre 2006.

Letter of Appreciation from MAG, Paraguay

■ In December 2006, a Certificate of Acknowledgement was presented to JIRCAS for its fruitful cooperation with the National Institute of Agricultural Technology through research projects, provision of technical equipment, and exchange of experts from INTA, Argentina.

INTA

The National Institute of Agricultural Technology

Certificate of Acknowledgement

hereby granted to

Japan International Research Center for Agricultural Sciences (JIRCAS)

for its fructiferous cooperation to the National Institute of Agricultural Technology through research projects, technical equipment and exchange of experts.

Buenos Aires (Argentina)
December 28th, 2006

Dr. Roberto Mario Bocchetto
National Director

Agr. Eng. Carlos Alberto Cheppi
President

Certificate of Acknowlegement from INTA, Argentina

International Symposia

Lecture Delivered by Nobel Laureate Dr. Norman E. Borlaug

Issuing a challenge to young scientists and students to undertake international agricultural research

Nobel Laureate Dr. Norman E. Borlaug gave an invitation lecture, entitled “Perspectives of International Agricultural Research and Expectations for the Young Generation,” at Tokyo University of Agriculture on May 29, 2006. About 700 participants, mainly university students, were present.

Dr. Borlaug

In his lecture, Dr. Borlaug stressed the great contribution made by the Green Revolution to global food supply, particularly in conserving marginal land, and on the key importance of applying the results of science and technology, including transgenic technology, to solving persistent problems in world agriculture. He also emphasized the importance of providing wide-ranging support in the area of agricultural development, the foundation for peace-building and economic advancement.

In the panel discussion which followed the lecture, specialists from research institutes, aid agencies, and universities, in addition to the lecturer himself, exchanged their views on current problems facing international agricultural research, including personnel qualification and profiles required for this field, as well as the future role of public research. Dr. Borlaug enthusiastically encouraged the young generation to strive towards the highest targets to achieve personal success.

Events Commemorating the International Year of Deserts and Desertification 2006

The UN General Assembly declared the year 2006 as the International Year of Deserts and Desertification (IYDD), and 10 years have passed since the United Nations Convention to Combat Desertification (UNCCD) came into force. For this reason, several institutions including the UNCCD

Events commemorating the International Year of Desert and Desentification 2006.

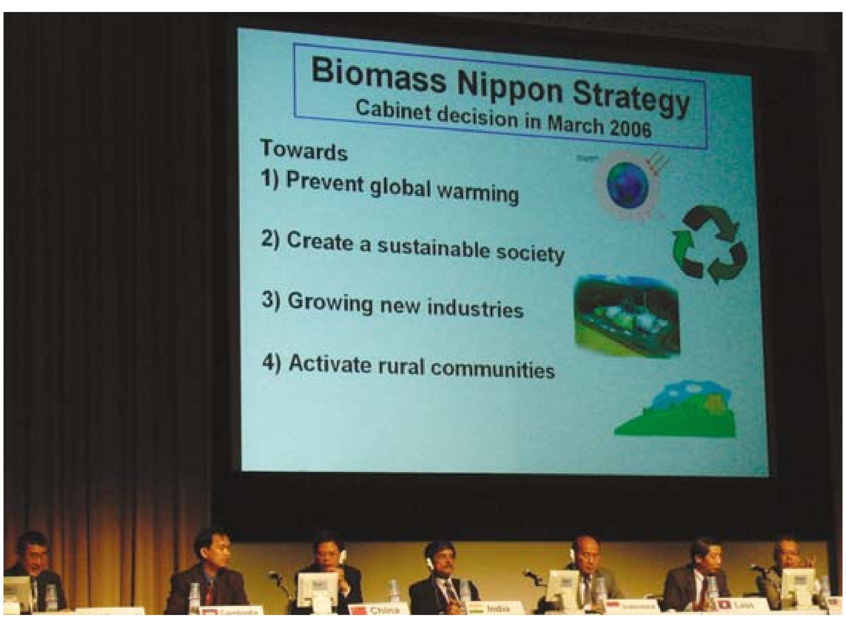
Secretariat, United Nations University (UNU), Tottori University's Arid Land Research Center (ALRC), JICA, and JIRCAS held a series of events commemorating the IYDD.

The first event, an international symposium on "Living with Deserts II - Dry Land Science and Practices on the Ground," was held at UNU in Tokyo on August 25, 2006, with 242 participants.

The second event, entitled "The Role of Citizens in International Contributions," was held in Tottori, Japan, on August 27, 2006.

Finally, for the 3rd in the series of events, JIRCAS held its international seminar, "Outlook of Agricultural Research for Dry Areas," on August 29, 2006 in Tsukuba City, which was attended by 63 participants from research institutes and development agencies. Dr. Mahmoud Solh, Director-General of ICARDA, presented a lecture entitled "Reversing Desertification: New Science, New Approach, New Hope."

Dr. Barry Shapiro, Director of ICRISAT, gave a lecture entitled "From Desert to Oasis: the Role of Science and Research in Combating Desertification in Semi-arid Sub-Saharan Africa." Both speakers stressed the need for proactive research to find good desertification indicators.



Participants in the 3rd Biomass-Asia workshop.

The 3rd Biomass-Asia Workshop

On November 15-17, 2006, JIRCAS held the 3rd Biomass-Asia Workshop at the U Thant International Conference Hall of the United Nations University (UNU), Tokyo, and at the Tsukuba International Congress Center (TICC), Tsukuba City, in cooperation with MEXT, MAFF, METI, and the Biomass-Asia Research Consortium member institutes, such as AIST, NARO, FFPRI, CRIEPI, RITE, and the University of Tokyo. A total of 450 scientists, administrators, and technical experts in both the public and private sectors from 15 countries participated in the symposium and exchanged views and information on the issues addressed by the five keynote speakers, 12 panelists representing different Asian countries, and 15 oral and 31 poster presenters.

In the "Biomass Nippon (Japan) Strategy," the following tasks have become urgently necessary, from both a global and Asian regional perspective:

(1) Dissemination and sharing of technological achievements with regard to the effective use of biomass as a part of the measures needed to prevent global warming.

(2) Contribution to the creation of sustainable, recycling-oriented societies in Asia through the effective use of waste and other measures.

(3) Fostering of competitive, environmentally friendly industries through the use of biomass for alternative energy generation and for conversion into various products.

(4) Revitalization of agriculture, forestry, fisheries, and the communities engaged in them through the effective use of biomass.

In pursuit of these goals and as a definitive step in that direction, JIRCAS and the other collaborating institutions organized the "Biomass-Asia Workshop," bringing together government officials and researchers active in the field of biomass utilization in countries throughout Asia. In the workshop, participants were able to obtain comprehensive information on types and amounts of biomass resources, utilization technologies, on going projects, policies, and institutions. They were also able to exchange views regarding the direction of biomass research and development. As for the research aspect, it was emphasized that breakthroughs are necessary in some areas, such as sustainable biomass production and utilization of cellulosic materials.

NEW RESEARCH COLLABORATIONS

New MOUs initiated in Fiscal Year 2006

JIRCAS signs MOU with the National Agriculture and Forestry Research Institute (NAFRI), Lao PDR

A Memorandum of Understanding between the National Agriculture and Forestry Research Institute (NAFRI) and JIRCAS was signed in November 2006. Under the MOU, the following two collaborative projects were started.

One is a project on "Increasing Economic Options in Rainfed Agriculture in Indochina through Efficient Use of Water Resources." Although various farming types have been established under rainfed conditions, slash-and-burn agriculture and rainfed rice production, which are widely practiced in the Lao PDR, are typical farming types in Southeast Asia where rice cultivation is dominant. Objectives of the collaborative research with NAFRI are to identify socio economic conditions for diversification of farming and to monitor and assess sustainable land resource management and diversification of farming systems in lowland rainfed agricultural areas as well as in mountainous areas.

The other is a project on "Development of Aquaculture Technology Suitable for Southeast Asia." In the Lao PDR there is an abundance of living aquatic resources in the Mekong River and its tributaries, floodplains, swamps and rice fields. Since substantial increases in production from capture fisheries are not believed to be possible, any planned increase in fish production has to come from aquaculture. Fortunately, there is a high potential for developing aquaculture in the Lao PDR, where people have traditionally practiced fish culture using ponds or rice fields. The project aims to develop techniques for integrated rice-fish (-prawn) farming management and the breeding and culture of indigenous species of fish and prawns in collaboration with the Living Aquatic Resources Research Center (LARReC), part of NAFRI. The final goal of the project is the development and dissemination of aquaculture technologies suitable for each ecosystem in rural areas to secure stable protein resources and increase farming incomes.

MOU signed between the Mongolian State University of Agriculture and JIRCAS

A Memorandum of Understanding between JIRCAS and the Mongolian State University of Agriculture (MSUA) was signed on December 1, 2006 by the Presidents of both parties, Dr. Byambaa of MSUA and Dr. Inanaga of JIRCAS. The Work Plan for the collaborative research project, "Development of a Sustainable Agro-pastoral System in Dry Areas of Northeast Asia." was also signed by Dr. Gombojav, the Vice-President of MSUA, and Dr. Oshio, the Director of JIRCAS's Animal Production and Grassland Division.

Taken after signing the MOU. Left to right: Dr. Noguchi, JIRCAS Vice-President; Dr. Inanaga, JIRCAS President; Dr. Byambaa, MSUA President; and Dr. Gombojav, MSUA Vice-President.

MSUA is a leading agricultural university in Mongolia. It has seven departments, 430 staff, and 6,000 students, and is located in Ulaanbaatar, with a branch campus in Darhan and a farm in Bornuur. MSUA will be an important research partner for the improvement of livestock farming in semi-arid areas of northeastern Asia. Together we have started a grazing experiment at Naruto, Bornuur, from May 2007 to identify grazing conditions that will allow the sustainable use of grasslands as well as maintaining the livelihood of livestock producers through an integrated research approach. More than 10 researchers from both parties with different disciplines, such as livestock management, grassland management, remote sensing, and economics, are taking part in the project.

After the signing ceremony, the project members and Mongolian visitors posed before the JIRCAS Tsukuba Headquarters.

Conclusion of MOU with USM

To implement a JIRCAS project entitled "Woody Biomass Conversion into Bio-composites and Functional Materials in the Tropics," JIRCAS and Universiti Sains Malaysia (USM) signed a Memorandum of Understanding on April 26, 2006. The former MOU, concluded on August 1, 1995, when JIRCAS was part of the Ministry of Agriculture, Forestries and Fisheries, has been replaced by the new MOU.

The aim of the project is to develop technologies to convert unused woody biomass resources into usefu1 and value-added materials to assist the establishment and development of a sustainable economy in Asian countries. The project consists of two sub-themes; namely, 1) Production of solid materials by physical processes, and 2) Production of functional materials by means of chemical processes.

New MOUs and JRAs initiated in Fiscal Year 2006

	Category	Institution	Country	Date
1	Memorandum of Understanding	Universiti Sains Malaysia (USM)	Malaysia	Apr. 26, 2006
2	Joint Research Agreement	Asian Vegetable Research and Development Center (AVRDC)	Taiwan	Sept. 14, 2006
3	Joint Research Agreement	Kasetsart University Research and Development Institute (KURDI)	Thailand	Sept. 14, 2006
4	Joint Research Agreement	Bureau of Soil and Water Management (BSWM)	Philippines	Sept. 26, 2006
5	Joint Research Agreement	The Faculty of Mathematics and Natural Science, the University of Jember (FMNS)	Indonesia	Oct. 5, 2006
6	Joint Research Agreement	King Mongkut's University of Technology Thonburi (KMUTT)	Thailand	Oct. 9, 2006
7	Joint Research Agreement	Kasetsart Agricultural and Agro-Industrial Product Improvement Institute, Kasetsart University (KAPI)	Thailand	Oct. 9, 2006
8	Memorandum of Understanding	National Agriculture and Forestry Research Institute (NAFRI)	Lao PDR	Nov. 30, 2006
9	Memorandum of Understanding	Mongolian State University of Agriculture (MSUA)	Mongolia	Dec. 1, 2006
10	Joint Research Agreement	Philippine Rice Research Institute (PhilRice)	Philippines	Dec. 13, 2006
11	Joint Research Agreement	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences (ICS-CAAS)	China	Dec. 15, 2006
12	Joint Research Agreement	The China National Rice Research Institute (CNRRI)	China	Dec. 15, 2006
13	Joint Research Agreement	Cuu Long Delta Rice Research Institute (CLRRI)	Vietnam	Dec. 19, 2006
14	Joint Research Agreement	Prince of Songkla University (PSU)	Thailand	Dec. 26, 2006
15	Joint Research Agreement	Mahasarakham University (MSU)	Thailand	Dec. 27, 2006
16	Joint Research Agreement	Rajamangala University of Technology Isan (RMUTI)	Thailand	Dec. 29, 2006
17	Joint Research Agreement	Maejo University (MJU)	Thailand	Jan. 16, 2007
18	Joint Research Agreement	Cuu Long Delta Rice Research Institute (CLRRI)	Vietnam	Feb. 19, 2007

CGIAR Focal Point Institution

Strong Partnership between JIRCAS and CGIAR

The Consultative Group on International Agricultural Research (CGIAR) nominated JIRCAS as a CGIAR focal point institution in Japan in 2004, because of JIRCAS's long-standing support for international agricultural research and the CGIAR system. JIRCAS sent eight researchers to five CGIAR Centers (ICARDA, ICRISAT, IRRI, CIMMYT, and WARDA) in 2006. We also contributed to CGIAR's activities on several occasions.

In December 2006, former JIRCAS President Dr. Shinobu Inanaga attended the CGIAR Annual General Meeting (AGM 2006) held in Washington DC, USA. During the AGM, Dr. Inanaga exchanged views with CGIAR Chair Ms. Katherine Sierra on strengthening the partnership. JIRCAS managed a partner booth and explained its activities in the exhibit hall. More than 200 AGM participants visited the JIRCAS booth and received the latest information on JIRCAS, including the launch of the "Japan International Award for Young Agricultural Researchers."

The Global Festival Japan was held in Hibiya Park on September 30 and October 1, 2006. The main purpose of this festival was to gain more public understanding and support for international organizations.

JIRCAS received and distributed posters and the latest brochures sent from the CGIAR Secretariat and the Centers, and helped with CGIAR's booth management. Japan-CGIAR fellows (2004-05 and 2005-06) also helped with the exhibition and shared their experiences at the Centers. This festival provided an excellent opportunity for public participants, especially young Japanese scientists and students, to learn more about the CGIAR.

Meeting at the CGIAR Annual General Meeting
(left to right) Dr. Francisco Reifschneider, then CGIAR Director, Ms. Kayo Fujita, Agriculture, Forestry and Fisheries Research Council, Dr. Shinobu Inanaga, then President of JIRCAS, Ms. Katherine Sierra, CGIAR Chair, and Dr. Masayoshi Saito, Chief of Research Planning Section, JIRCAS.

The JIRCAS booth in the exhibit hall of the CGIAR Annual General Meeting.

Japan-CGIAR fellows sharing their experiences with students at the CGIAR booth at Global Festival Japan.

ACADEMIC PRIZES AND AWARDS

Dr. Masayoshi Saito

Dr. Masayoshi Saito, Head of the Research Planning Section, Research Planning and Coordination Division, received the "Journal of the Japanese Society for Food Science and Technology Award" in August 2006.

This award was given for the best paper in the 2005 edition (Vol. 52), entitled "Collection of Japanese Texture Terms." The authors were Fumiyo Hayakawa, Kana Ioku, Sayuri Akuzawa, Masayoshi Saito, Katsuyosi Nishinari, Yoshimasa Yamano, and Kaoru Kohyama.

In the paper, texture-descriptive terms in Japanese were collected and validated, giving a total of 445 terms. The list enables rapid selection of terms for the sensory evaluation of food, as well as providing a basis for an analysis of Japanese sensibilities relating to food textures and changes in diet in Japan.

OVERVIEW OF JIRCAS'S RESEARCH STRUCTURE

1 History

JIRCAS was first established in 1970 as the Tropical Agriculture Research Center (TARC) under the Ministry of Agriculture and Forestry of Japan. TARC was reorganized into the Japan International Research Center for Agricultural Sciences (JIRCAS) in 1993. On April 1, 2001, under the Government of Japan's administrative reforms for facilitating the reorganization of government-affiliated research organizations, JIRCAS became an Incorporated Administrative Agency (IAA) under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF).

2 Mission

Through research and development and dissemination of information related to agriculture, forestry, and fisheries in developing regions, JIRCAS contributes to the improvement of the international presence of our country 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 a part of central government reforms based on the idea that the planning sectors and the implementing sectors should be separated (see http://www.soumu.go.jp/hyouka/dokuritu_n/english.pdf).

Under the IAA system, MAFF defined JIRCAS's second medium-term goals in 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 (FY2006-FY2010) (see "Medium-Term Plan" in the Appendix).

4 Evaluation

The performance and budgeting management of research activities conducted by JIRCAS undergo regular evaluation by the IAA Evaluation Committee established within MAFF. During each fiscal year, the Committee investigates and analyzes progress towards achieving the medium-term goals, and the results of this evaluation are applied as necessary to structural 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 goals.

1) Each project evaluates its own research activity and prepares reports.
2) These were 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, and Directors of each section) in February 2007.
3) Comprehensive evaluation of all JIRCAS activities including administration was implemented at the External Reviewers' Meeting in March 2007.

The external reviewers 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 2006.

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 2006 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 (FY2006-FY2010)

Research Approach	Main Program	Sub-programs (total)
A	A-1	7
	A-2	7
	A-3	3
B	B	2

Second Medium-Term Plan (FY2006-2010)

[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 agro-pastoral 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. 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

6 Collaborative research

JIRCAS needs to cover a wide range of research. The human resources at JIRCAS, however, are limited. This makes collaborative research with other institutes or universities important to achieve JIRCAS's project objectives. When JIRCAS and its collaborators agree on the beginning of collaborative research by exchanging ideas and opinions on research, Memorandum of Understanding (MOU) or Joint Research Agreements (JRAs) will be concluded. We developed the concept of JRAs in 2006. A JRA is a contract for collaborative research with a particular theme and with a set duration. Approximately 80 MOUs or JRAs remain in force at the end of FY 2006.

In 2004, JIRCAS was given a certificate of recognition by CGIAR as a key partner and a CGIAR focal point institution in Japan. JIRCAS is playing an important role in mutual understanding and collaboration between CGIAR and the Japanese government. A JIRCAS senior researcher was dispatched for two years to the CGIAR Washington Office to act as a CGIAR Liaisons Coordinator. JIRCAS has also been intensively implementing collaborative research with several CGIAR research centers.

JIRCAS has been dispatching researchers and research managers to promote research in the developing regions. In FY 2006, JIRCAS staff (103) were dispatched abroad for a total of 10,892 days. We have been also dispatching researchers from other institutes and universities to promote effective implementation of JIRCAS's projects with the cooperation of such organizations.

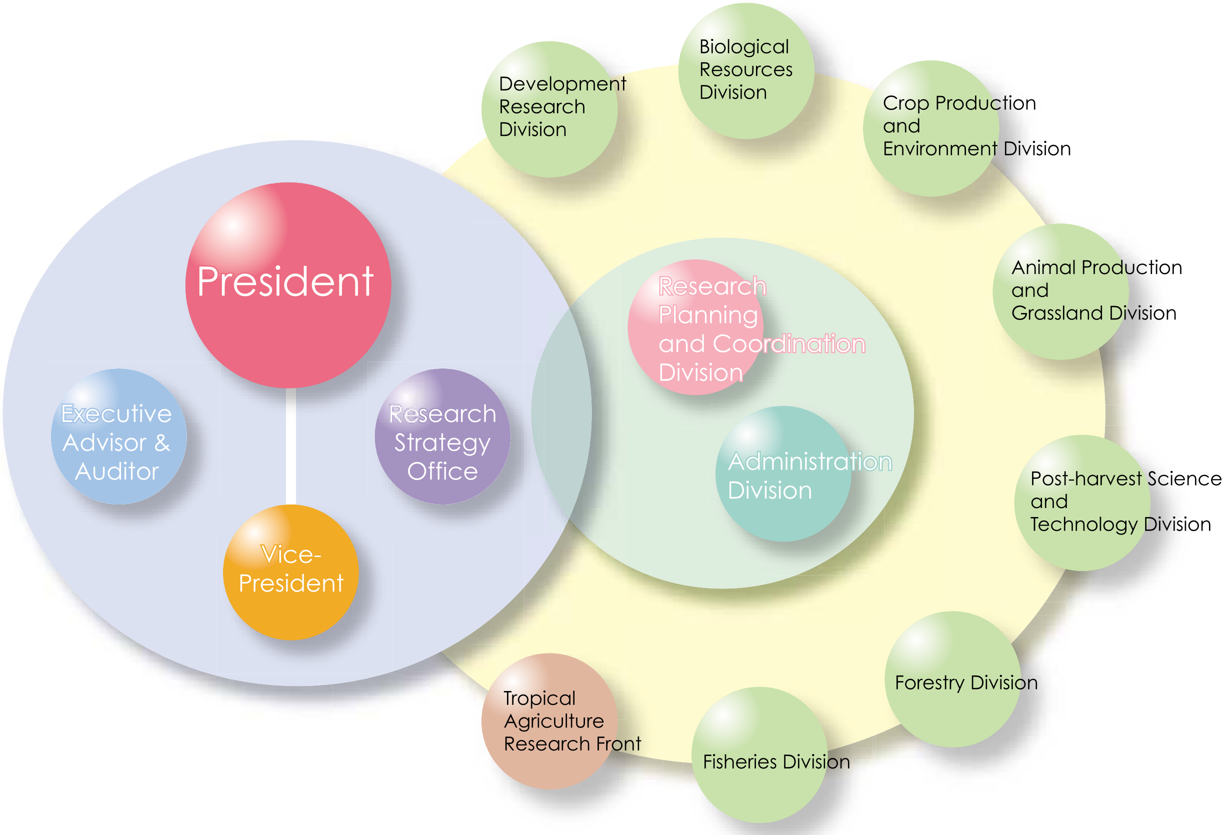
JIRCAS has implemented several invitation programs for overseas researchers and administrators at counterpart organizations. These programs facilitate not only the promotion of international collaborative research but also related exchanges of information and opinions.

7 Organization of JIRCAS

The new organization of JIRCAS in the second medium-term goal period (April 2006-March 2011) is summarized in the figure below.

The directors of each research division and the Tropical Agriculture Research Front have responsibility for the management of individual sub-programs in the Medium-Term Plan.

JIRCAS's Tropical Agriculture Research Front (formerly the Okinawa Subtropical Station) revised its experimental and research duties in the country's southernmost part, taking full advantage of the subtropical weather and the geographical location of the island, and has focused on agricultural, forestry, and fisheries research carried out in overseas regions with highly similar weather and geographic conditions to Okinawa.



Organization of JIRCAS

MAIN PROGRAMS

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

Especially in developing regions, where abiotic stresses such as drought and salinity as well as biotic stresses caused by pests and diseases predominate and comcise the major constrains to agricultural production, it has become an urgent need to develop technologies to enable stable and sustainable production.

This theme has been established with the aim of achieving stable production of various agricultural products encompassing agriculture, forestry, and fisheries. Under this theme, research projects including elucidation of the mechanism of stress tolerance in plants, development of abiotic stress-tolerant crops, and development of technologies to utilize various biological resources in tropical and subtropical regions have been conducted.

Among the many successes under this research theme in 2006, the following items can be listed as highlights.

- Through molecular research on elucidation of plant mechanisms of abiotic stress tolerance, this year new genes which have been confirmed to confer abiotic stress tolerance upon overexpression in plants have been identified and successfully isolated. They include an active form of DREB2 in *Arabidopsis*, an intact form of DREB2 in *Zea mays* (ZmDREB2), AREB (ABA responsive element binding protein) of *Arabidopsis*, and NAC from *Arabidopsis* and rice.
- In a conventional approach to develop abiotic stress-tolerant crops, a reliable and simple screening method for soils suffering problems such as iron toxicity and zinc deficiency has been developed, that will become a powerful tool for screening tolerant germplasm. Using this newly established screening method, QTL mapping has been carried out of genes that confer tolerance to problematic soils.
- In the area of biotic stress tolerance, we are dealing with three major diseases: rice blast, *Fusarium* head blight of wheat, and soybean rust. A simple screening method for resistance to *Fusarium* head blight has been established, featuring inoculation of the fungus to the first leaf. For soybean rust, the screening of a wide range of soybean germplasm has identified novel classes of resistant germplasm.
- Several outstanding results have been generated in the research activities exploring various biological resources for biomass production. Using arming yeast, which is a surface-engineered yeast displaying amylase on its surface, we have developed a method of producing ethanol from cassava pulp. Meanwhile, we have demonstrated that ethanol as well as lactic acid can be easily produced from oil palm trunk.
- In the area of physiological functionalities of foods, we found some types of *douchi*, a Chinese traditional fermented soybean product, to have strong suppressive activity on alpha-glucosidase, which closely correlates with blood sugar level lowering activity. We also found that an edible Thai plant, *Clausena excavata* (Rutaceae), had a remarkably strong inhibitory activity against lipopolysaccharide-induced nitric oxide production in a macrophage-like cell line, and identified a coumarin derivative as the major active constituent.
- Based on the screening of more than 770 accessions belonging to the genus *Vigna*, including cowpeas, for resistance to two species of bean weevils (*Callosobruchus maculatus* and *C. chinensis*), we have found 60 putative resistant lines.
- Seven peptides with vitellogenesis-inhibiting activity were purified from the sinus glands of the white leg shrimp (*Litopenaeus vannamei*). The structure of the most abundant hormone showing strong vitellogenesis-inhibiting activity was determined. This result should have significant implications in the development of shrimp seed production technology.

TOPIC 1

Improving plant drought stress tolerance by utilizing an engineered DREB2A gene that encodes an activated transcription factor

There are concerns that intensification

MAIN PROGRAMS

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

Especially in developing regions, where abiotic stresses such as drought and salinity as well as biotic stresses caused by pests and diseases predominate and comcise the major constrains to agricultural production, it has become an urgent need to develop technologies to enable stable and sustainable production.

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TOPIC 1

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There are concerns that intensification

of global warming will give rise to environmental pollution and abnormal weather. Breeding of stress-tolerant plants is thus an important solution for both agricultural and environmental issues. In this study, we focused on a transcription factor gene, DREB2A, from *Arabidopsis* (*Arabidopsis thaliana* (L.) Heynh), aiming to improve stress tolerance to drought, salinity, and heat in transgenic plants. DREB2A encodes a transcription factor with the potential to regulate multiple genes and functions during the acquisition of tolerance to environmental stress. However, we found that expression of the DREB2A protein is not sufficient to activate the transcription of downstream genes. We therefore attempted to elucidate the mechanism of DREB2A activation and develop techniques for breeding environmental-stress-tolerant plants utilizing an activated form of DREB2A. We also analyzed genes that are regulated by DREB2A.

To identify the mechanism of DREB2A activation, we transiently expressed a series of truncated DREB2A proteins in *Arabidopsis* protoplasts and measured their transcriptional activity. As a result, we identified a negative regulation domain (NRD) in the central region of the DREB2A protein that suppresses its transcriptional activity. Thus, to elucidate the function of NRD in plant tissues, we generated transgenic *Arabidopsis* plants expressing wild-type DREB2A or NRD-less DREB2A (DREB2A CA; constitutively active DREB2A) as GFP-fusion proteins under the control of a constitutive promoter. In contrast to GFP-DREB2A CA that accumulated in the nucleus, the wild-type form of GFP-DREB2A showed only a weak accumulation despite mRNA levels of GFP-fusion genes being not significantly different between the plants. This result suggests that deletion of NRD inhibits rapid degradation of DREB2A following translation. Therefore, expression of DREB2A CA may permit stable expression of stress-inducible genes. To test whether DREB2A CA confers stress tolerance on plants, transgenic Arabidopsis plants that express DREB2A CA were produced. These transgenic plants showed higher levels of drought tolerance than wild-type plants (Fig. 1). It was also found that these transgenic plants tolerate heat stress well (Fig. 2). To identify downstream genes that are regulated by DREB2A, the gene expression profile of DREB2A CA transgenic plants was studied by microarray analysis. The results showed that many drought- and heat-inducible genes were up-regulated in the transgenic plants, which can account for their increased tolerance to both drought and heat stress. In addition, we isolated DREB2A knockout mutants and measured the transcript levels of candidates for DREB2A target genes identified by microarray analysis. In DREB2A mutants, a number of these candidate genes showed lower transcript levels when subjected to stress than seen in the wild type. Because DRE sequences, the binding motif for DREB transcription factors, are found within their promoters, these genes are very likely to be direct targets for DREB2A.

In this study, we showed that expression of DREB2A CA confers drought- and heat-stress tolerance on plants. We therefore conclude that DREB2A CA is a promising gene for developing crops that are able to cope with global warming. Because genes that are homologous to DREB2A are already widely distributed in crop species, including monocot plants, we suggest that these DREB2 genes

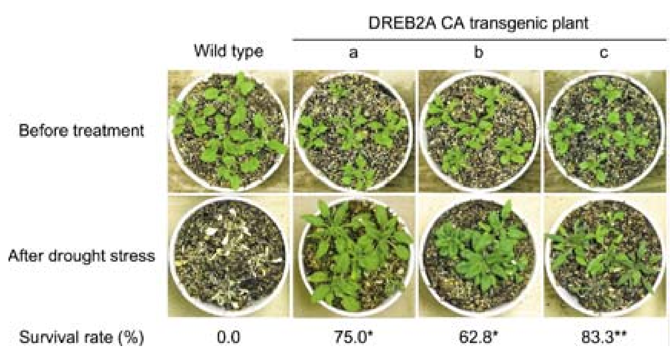

Fig. 1. Drought-stress tolerance of transgenic *Arabidopsis* plants expressing constitutively active DREB2A (DREB2A CA). Wild-type plants could not survive without watering for two weeks. In contrast, three lines of DREB2A CA transgenic plants could survive despite severe desiccation. Plants marked with * and ** had significantly higher survival rates than the wild type (x^2 test, P < 0.05 and P < 0.01, respectively).

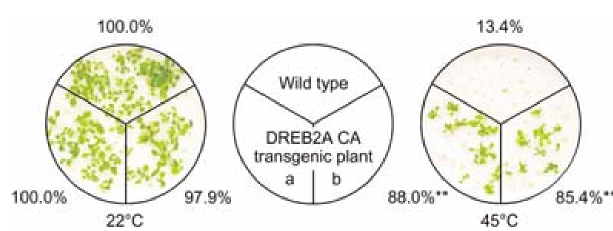

Fig. 2. Heat-stress tolerance of transgenic *Arabidopsis* plants expressing constitutively active DREB2A (DREB2A CA). One-week-old seedlings were treated at 45℃ for 1 h and survival rates were determined after growing them at 22℃ for one additional week. The survival rate of wild-type plants was only 13%. In contrast, two lines of DREB2A CA transgenic plants showed increased survival rates. Plants marked with ** had significantly higher or lower survival rates than the wild type (x^2 test, P < 0.01).

can be used to develop crops that are tolerant to both drought and heat stresses.

(Y. Sakuma, J. Mizoi, and K. Yamaguchi-Shinozaki)

TOPIC2

The maize transcription factor ZmDREB2A in transgenic plants improves tolerance to drought and heat stress

ZmDREB2A is a DREB2A-type transcription factor isolated from maize. ZmDREB2A expression is induced by cold, dehydration, high salinity, and heat stress in maize seedlings. Unlike *Arabidopsis* DREB2A, ZmDREB2A produces two forms of transcript, and quantitative real-time PCR analyses have demonstrated that only the functional transcription form of ZmDREB2A is significantly induced by stresses. Moreover, the ZmDREB2A protein directly exhibits very high transactivation activity in *Arabidopsis* protoplasts without modification, suggesting that ZmDREB2A protein is potentially valuable for improving plant stress tolerance by gene transfer.

We generated transgenic plants overexpressing ZmDREB2A, using the CaMV 35S promoter. The transgenics (35S:ZmDREB2A) showed growth retardation and tolerance to drought stress. Microarray analyses were performed to check the gene expression alteration in these plants. The expression of 44 genes was found to be upregulated more than sevenfold. There were nine genes encoding LEA proteins, which were previously found to play a protective role in plant cells, especially in response to desiccation and salt stresses. Seven of nine LEA genes contain DRE (A/GCCGAC) sequences in their promoters. Four genes were identified as being inducible by dehydration or high salinity stress and one gene was inducible by cold. Notably, four genes that are responsive to heat shock stress were also found to be highly upregulated by ZmDREB2A.

To minimize the negative effect on plant growth, a stress-inducible RD29A promoter was used to control the expression of ZmDREB2A. Almost all the RD29A:ZmDREB2A plants grew as normally as the wild type. Three lines, RD29A:ZmDREB2A-a, RD29A:ZmDREB2A-b, and RD29A:ZmDREB2A-c, were chosen for further analysis. RNA gel blot analysis confirmed that the stress-inducible RD29A promoter could effectively induce ZmDREB2A expression by cold and drought stresses. To verify that the transgenic plants exhibited enhanced drought tolerance, we carried out a drought tolerance test. Three-week-old plants grown on agar plates were transferred to the soil and grown for an additional week. Water was subsequently withheld for a period of 10 days prior to rewatering. As a result, 30% of wild-type plants survived after this treatment, but the survival rate of the RD29A:ZmDREB2A-a, RD29A:ZmDREB2A-b, and RD29A:ZmDREB2A-c plants was 96.3%, 88.8%, and 81.3%, respectively (Fig. 1).

Expression analysis of ZmDREB2A showed that it was strongly and transiently induced by heat stress, and the microarray result indicated that it may upregulate heat shock-inducible gene expressions in plants. To determine whether transgenic plants overexpressing ZmDREB2A had an improved tolerance to heat stress, we investigated the thermotolerance of the 35S:ZmDREB2A plants. Six-day-old plants, after germination on selective agar plates, were transferred to two layers of paper premoistened with

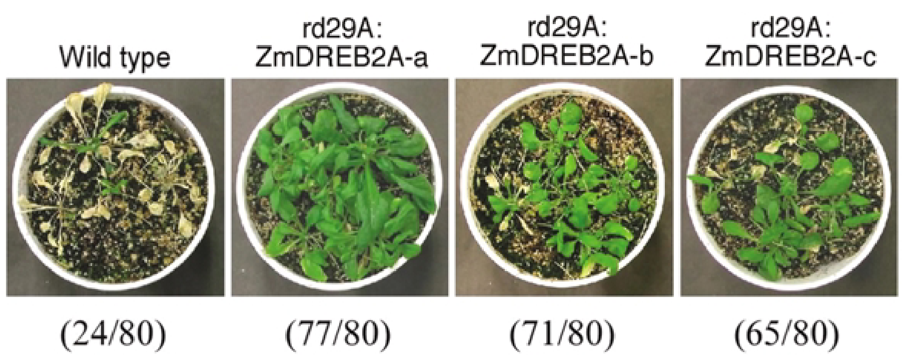

Fig. 1. Enhanced tolerance to drought in the RD29A:ZmDREB2A plants (three independent transgenic plant lines). Watering was withheld from 3-week-old plants for 10 days before the photograph was taken. Number codes = number of surviving plants out of total number.

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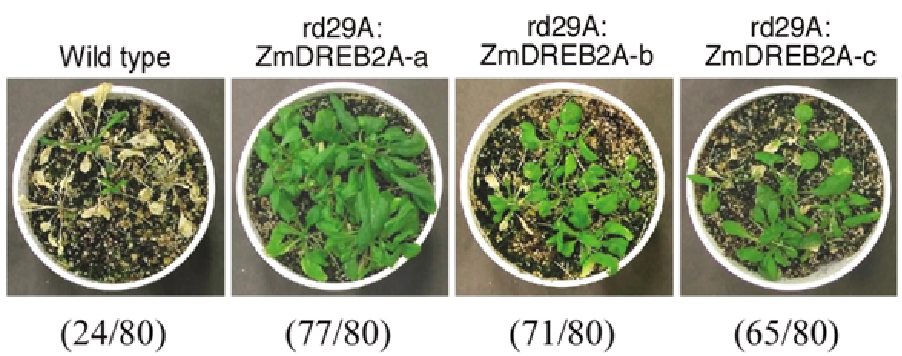

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(F. Qin and K. Yamaguchi-Shinozaki)

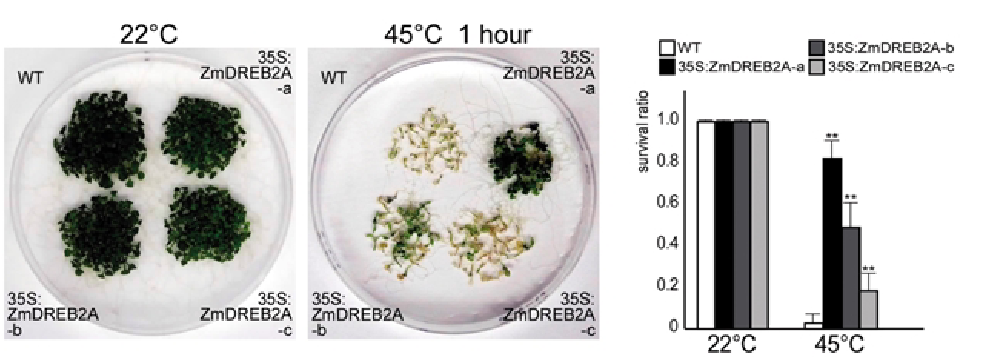


Fig. 2. Thermotolerance test on the 35S:ZmDREB2A transgenic and wild-type plants. Six-day-old plants were transferred onto GM-moistened filter papers in Petri dishes and exposed to 45℃ for 1 hour. Photographs were taken after 2 further weeks of cultivation with liquid GM. Means and SD of survival rate were obtained from three independent experiments (X^2 test, *P < 0.05, **P < 0.001).

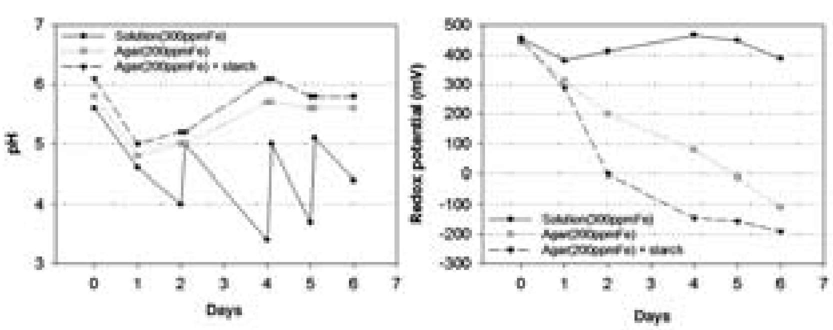
TOPIC3

A screening method using low-concentration agar-based nutrient solutions to study zinc deficiency and iron toxicity in rice

Nutrient solutions are not ideal for studying nutrient-related stresses such as iron (Fe) toxicity or zinc (Zn) deficiency, since rhizosphere changes induced by plants are not maintained in fluids, pH fluctuates rapidly, and nutrients such as Fe and P easily precipitate in solutions, particularly if excess concentrations of one nutrient are supplied to simulate stress (e.g., Fe toxicity). Furthermore, low redox potentials that are a crucial part of the mineral stresses in paddy soils are difficult to induce and maintain in solutions. A modified screening method is therefore needed that overcomes the limitations of nutrient solutions. Our objective was to test the effect of adding agar at low concentrations (0.1%) to nutrient solutions on the response of rice genotypes to Fe toxicity and Zn deficiency.

Plants developed normally in the agar control treatment (Yoshida nutrient solution in 0.1% agar; no additional stress factor added) but total dry weight was lower by about 20% relative to the control in Yoshida solution without agar. The agar system offered several advantages over conventional nutrient solutions when nutrient stresses were induced by adding 200 ppm Fe^{2+} (Fe toxicity) or reducing Zn concentrations to 1 nM (Zn deficiency):

1. Fe precipitates remained suspended in agar and therefore stayed in the root zone. As a result, a lower concentration of Fe^{2+} (200 ppm Fe^{2+} as $FeSO_4$ in agar, compared to 300 ppm in nutrient solution) was sufficient to induce symptoms of Fe toxicity in intolerant genotypes.



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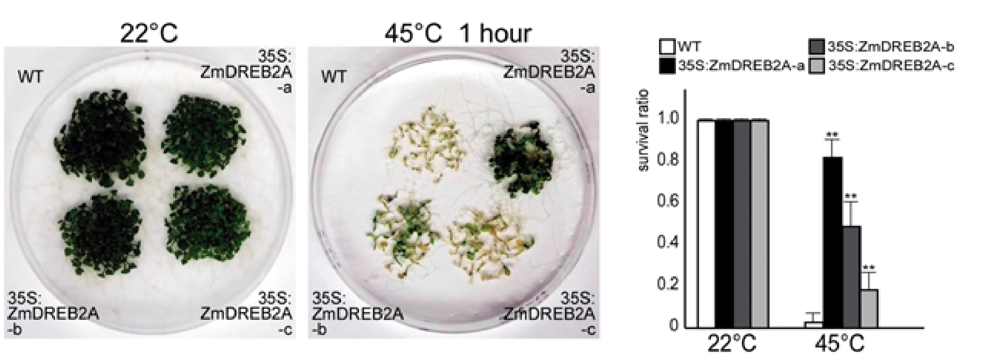

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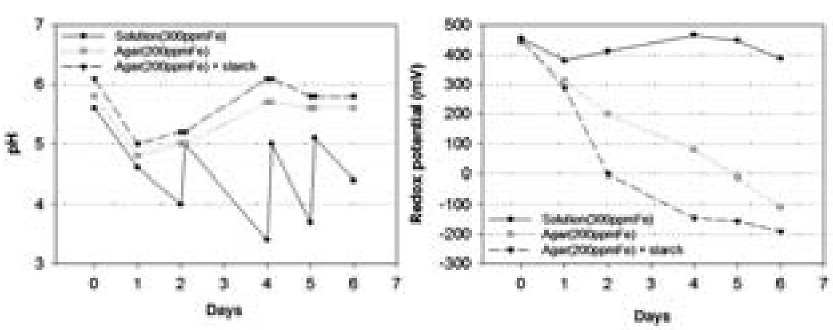

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2. Changes in pH are more gradual in agar and did not reach a toxic low level as they do in solutions (Fig. 1). The pH in the nutrient solution (with 300 ppm Fe^{2+}) fell rapidly and reached levels where the pH needed to be adjusted (see increase at days 2, 4, 5). Not having to adjust pH in agar was beneficial, since the root zone remained undisturbed.
3. Redox potentials decreased rapidly in agar due to low O_2 diffusion and reached negative values (-Eh) after 5-6 days (Fig. 1). Very low redox potentials can be induced by addition of organic substances (starch, organic acids, etc.), presumably because their degradation causes further O_2 depletion.
4. Distinct microenvironments could develop around roots of different genotypes because substances excreted by roots (H^+, O_2, organic acids) do not rapidly move away from the root zone (Fig. 2).
5. Genotypic differences become more pronounced than in nutrient solutions, and tolerance rankings of genotypes are similar in agar and in the field (Fig. 3), whereas they may differ substantially between in the field and conventional nutrient solutions.

Fig. 2. Highly reduced conditions develop in agar, and distinct microenvironments could be observed in the rhizosphere of different genotypes. a) In susceptible genotype IR64 (left), prolonged exposure to excess Fe^{2+} damages roots (note black color) while the tolerant genotype IR 24637 maintains healthy roots (right). b) Genotypes tolerant to Zn deficiency showed a redox potential of -50 mV around their healthy (white) roots while roots of intolerant genotypes were already damaged (black roots) and showed an Eh of -150 mV.

Conclusion: It is possible to use the low-concentration agar nutrient solution technique to screen rice genotypes for tolerance to Zn deficiency and Fe toxicity. This method is now used as a standard tool in our experiments to elucidate the genetic and physiological basis of tolerance to Zn deficiency in rice.

(M. Wissuwa and Y. Wang)

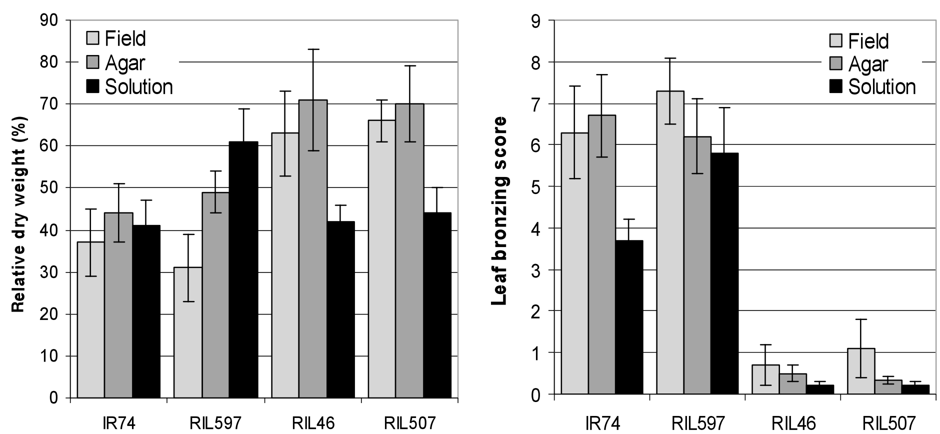

Fig. 3. The agar method shows clear differences between susceptible genotypes (IR74 and RIL597) and tolerant genotypes (RIL 46 and RIL 507) in relative dry weight under Zn deficiency and Zn deficiency-induced leaf bronzing.

TOPIC4

Hosts of *Phakopsora pachyrhizi*, a causal organism of soybean rust, in South America

Soybean is the most important agricultural product in Brazil, Paraguay, and Argentina. Although soybean rust was an endemic disease only in Asia and Australia until the 1980s, its presence was documented in Hawaii in 1994 and then in Paraguay in 2001, its first appearance on the American continent. Since then it has spread to the major soybean production areas in South America. It causes premature defoliation and yield loss.

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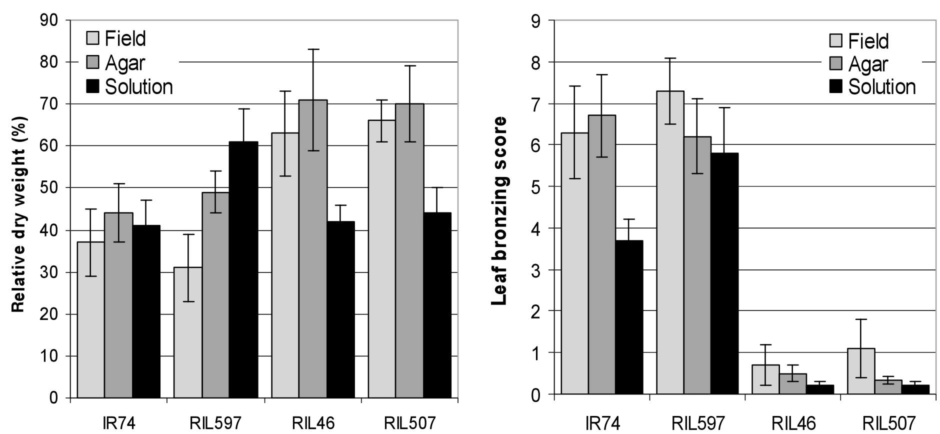

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Soybean is the most important agricultural product in Brazil, Paraguay, and Argentina. Although soybean rust was an endemic disease only in Asia and Australia until the 1980s, its presence was documented in Hawaii in 1994 and then in Paraguay in 2001, its first appearance on the American continent. Since then it has spread to the major soybean production areas in South America. It causes premature defoliation and yield loss.

The disease pathogen, *Phakopsora pachyrhizi*, is an obligate parasite that needs living host tissue to survive. If living hosts are eliminated from fields, the population size of *P. pachyrhizi* diminishes and the onset of soybean rust is considerably delayed. There is little knowledge of the host range of the pathogen in South America because it is an emerging disease. More than one hundred leguminous species are reported to be hosts of *P. pachyrhizi*. Therefore, to be able to eliminate these hosts, it is important to know which plants play a significant role as infection sources in the field.

We examined the host range of *P. pachyrhizi* and compared difference in susceptibility to the pathogen among leguminous plants. Leguminous species were selected from table crops, forage crops, green manure, and weeds around soybean fields in Brazil. Of the 31 species examined, *P. pachyrhizi* produced lesions with uredinia in 19 species (Table 1). The susceptibility varied greatly among hosts. Many lesions, uredinia, and urenidiospores were produced on soybean (*Glycine max*), wild soybean (*Glycine soja*), and kudzu (*Pueraria lobata*). The second most numerous lesions with uredinia were produced on common bean (*Phaseolus vulgaris*), lima bean (*Phaseolus lunatus*), perennial soybean (*Neonotonia wightii*), and least snout-bean (*Rhynchosia minima*). Many lesions were also produced on pigeon pea (*Cajanus cajan*), but defoliation of the infected leaves was too rapid to allow production of urenidiospores. The remaining hosts did not produce many lesions with uredinia.

During June to September, *P. pachyrhizi* was found on volunteer soybean, kudzu, and perennial soybean in southern Brazil and southern Paraguay (Fig. 1), and on soybean irrigated with pivot center systems in the Central West region of Brazil. In particular, soybean and kudzu are likely to play an important role as infection sources of soybean rust to soybean fields.

(M. Kato)

Fig. 1. Volunteer soybeans infected with *Phakopsora pachyrhizi* along the roadside.

Table 1. Production of lesions and urediniospores of *Phakopsora pachyrhizi* on leguminous species.

Species	Utilization in Brazil	Affected leaf area (%) [a)]	Urediniospore production [b)]	Pathogenicity to soybean
Glycine max	food	100	3	+
Glycine soja	-	100	3	not tested
Pueraria lobata	weed	0-70	3	+
Neonotonia wightii	forage/green manure	15-30	3	+
Phaseolus vulgaris	food	5-50	3	+
Rhynchosia minima	weed	10-40	3	+
Phaseolus lunatus	food	10-15	2-3	not tested
Pueraria phaseoloides	green manure	50-60	0-3	+
Calopogonium mucunoides	forage crop/green manure	30-50	2	+
Macroptilium lathyloides	weed	3-8	2	not tested
Vigna angularis	food	0-20	1-2	+
Centrosema sp.	forage	0-40	1-2	not tested
Lablab purpureus	green manure	30-60	1-2	+
Desmodium tortuosum	weed	1-15	0-2	+
Pisum sativum	food/forage	10	1	+
Cajanus cajan	green manure	50-60	1	+
Macroptilium atropurpureum	forage/green manure	30-80	1	not tested
Vigna unguiculata	food	0-10	1	not tested
Crotalaria juncea	green manure	1	1	+

a) Leaf area affected by *P. pachyrhizi* was rated on the leaves with the largest area affected per pot.
b) Percentage of lesions with urediniospores. 0: 0%; 1: less than 10%; 2: from 10% to 50%; 3: more than 50%.

TOPIC5

Development of effective ethanol production technology using cassava pulp

To resolve global warming issues caused by greenhouse gases, biomass-derived fuels (biofuels) are likely to have a future as a replacement for fossil fuel-based energy. Biomass fuels are “carbon neutral,” meaning that they do not add to of the sum total of carbon dioxide in the atmosphere. Ethanol is increasingly being used as a substitute for fossil fuels in the transportation sector. At present, fuel ethanol production chiefly depends on the utilization of sugar cane juice and cornstarch from agricultural crops. However, a dramatic increase in ethanol production using the above crops may not be practical in the near future, since sugarcane and corn production for ethanol will compete for limited agricultural land needed for food and feed production. Therefore, a potential source for low-cost ethanol production and agricultural sustainability is needed to utilize agricultural wastes that are composed of starchy and cellulosic complex materials.

Cassava (*Manihot esculenta* Crantz), which contains high levels of starch, is widely cultivated in tropical areas. In Thailand, cassava starch production is a large and growing industry, with about 10 million tons of fresh cassava tubers used annually. When starch is extracted from cassava tubers in the tapioca starch industry process, grated cassava tubers are separated into starch granules and fibrous residual materials by centrifugation following water extraction. The fibrous residual materials, termed cassava pulp, constitute around 30% of the original tubers as solid waste (Fig. 1). Cassava pulp thus has potential for use as a carbohydrate resource to replace the use of starch in tapioca, sugarcane, corn, and other grains that are currently harvested for ethanol production. In spite of this huge potential, the chief usages of large quantities of cassava pulp have been limited to low-value animal feed and fertilizer. To effectively utilize cassava pulp, we experimented with converting its components to ethanol by employing a sake-brewing yeast strain displaying glucoamylase on its cell surfaces. A *Saccharomyces* cerevisiae Kyokai No. 7 (K7) strain displaying *Rhizopus oryzae* glucoamylase (K7G) was constructed using the C-terminal-half region of α-agglutinin. A sample of cassava pulp was pretreated by hydrothermal reaction (140℃ for 1 h), and then by various kinds of commercially available cellulases to hydrolyze the cellulose in the sample. Strain K7G fermented the pretreated sample very effectively and produced ethanol at high yields: 98 and 92% of the theoretical value at 5 and 10%, respectively, of the substrate (Fig. 2). The ethanol yield and productivity are almost

Fig. 1. Discarded cassava pulp at starch factory in Thailand. Cassava tubers (bottom right corner).

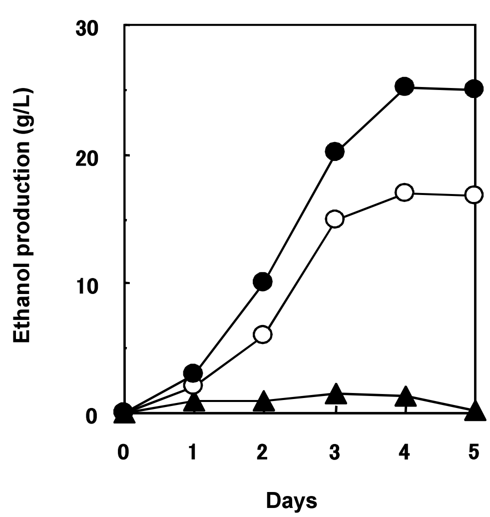

Fig. 2. Fermentation profile of cassava pulp using sake yeast strain K7G displaying glucoamylase. Symbols represent 5% cassava pulp (open circles) and 10% cassava pulp (closed circles). Closed triangles indicate control strain K7.

the same as the results obtained when strain K7 is used to ferment cassava pulp pretreated with cellulase plus amylase, indicating the effectiveness of arming yeasts displaying hydrolytic enzymes in producing ethanol using cassava pulp. We are now constructing a yeast strain codisplaying three types of cellulases and two types of amylases to fully utilize cassava pulp and directly produce ethanol without the addition of any enzymes.

(A. Kosugi)

TOPIC6

Development of a measurement method for α-glucosidase suppressant activity (indicator of reduced blood sugar level) and detection of inhibitory activity in Chinese traditional fermented foods

Disaccharides such as sucrose are hydrolyzed by α-glucosidase in the small intestine. The resulting glucose is rapidly absorbed into the blood vessels, causing a rise in blood glucose. Taking an agent to reduce α-glucosidase activity is very useful as a preprandial treatment for diabetics and for people worried about their blood sugar levels. It has been reported that some natural products show this activity. However, it is not easy to detect the inhibitory activity of α-glucosidase, since natural products often have a dark color that interferes with the conventional measurement method that uses synthetic substrates for α-glucosidase. In addition, an IC_{50} value is normally used to describe inhibitory activity, but an IC_{50} value is not effective for expressing intensity when the control value varies between measurements. The test also requires special skills on the part of technicians. This situation prompted us to develop a new measurement process that can be applied to colored samples. *Douchi*, a traditional Chinese soybean-based fermented food that has a reputation for being health-enhancing, shows many local variations. Some types have angiotensin-converting enzyme inhibitory activity, as reported in the 2004 Annual Report. This new method was applied to *douchi* to search for highly active products. Rat small intestine acetone powder was used as an enzyme source of α-glucosidase. This enzyme was placed in a 96-well microplate. Diluted samples were made and added to each well, followed by warming at 37℃ for 40 min with the synthetic substrate 4-nitrophenyl-β-D-glucopyranoside, after which the reaction was stopped by addition of alkali. The absorbance at 405 nm was measured after color development at the same time. A blank without enzyme was measured simultaneously. Mulberry leaf extract was used as the positive contrast. The slope value of the absorbance-dilution straight line was -18.23, indicating that the sample showed strong suppressive activity (Fig. 1A). Coffee was used as the negative sample. The slope value of the line was 0.176, which we interpret as being close to zero (Fig. 1B). The variation index in this assay was 3.39% (n = 4) for intra-assay and 2.68% (n = 3) for inter-assay. Water-extracted samples (extraction concentration 40% (w/v)) of various *douchi* chosen at random in China were measured using this method (Fig. 2). BM (Jiangxi), KKHBS (Hunan), and MK (Sichuan) showed conspicuously higher activity than the other samples. In summary, a simple and sensitive α-glucosidase assay method was developed for colored samples, and *douchi*, a famous Chinese traditional food, was measured using this method. Some *douchi* samples showed strong α-glucosidase-suppressive activity.

(K. Yamaki)

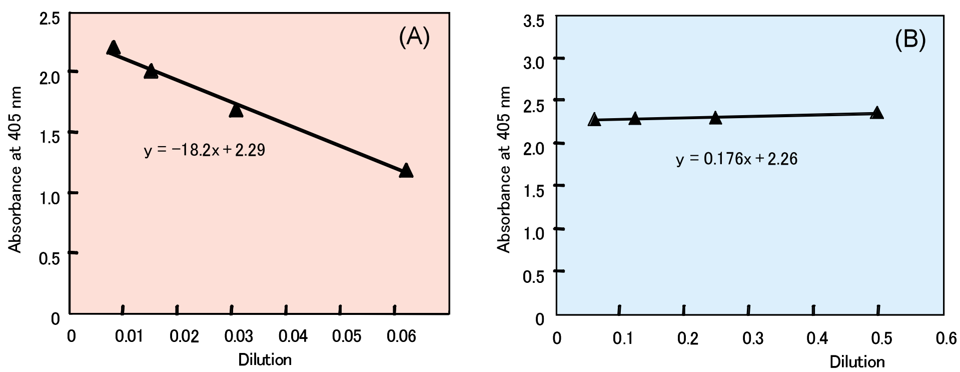

Fig. 1. Absorbance-dilution curves of mulberry leaf extract (A) and coffee (B).

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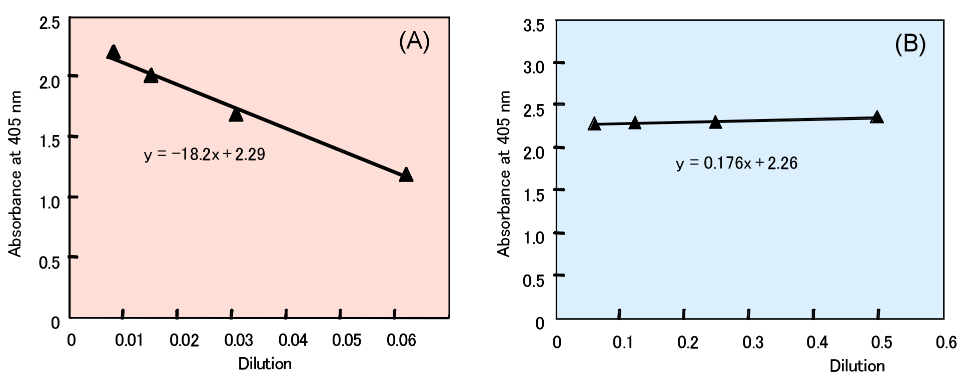

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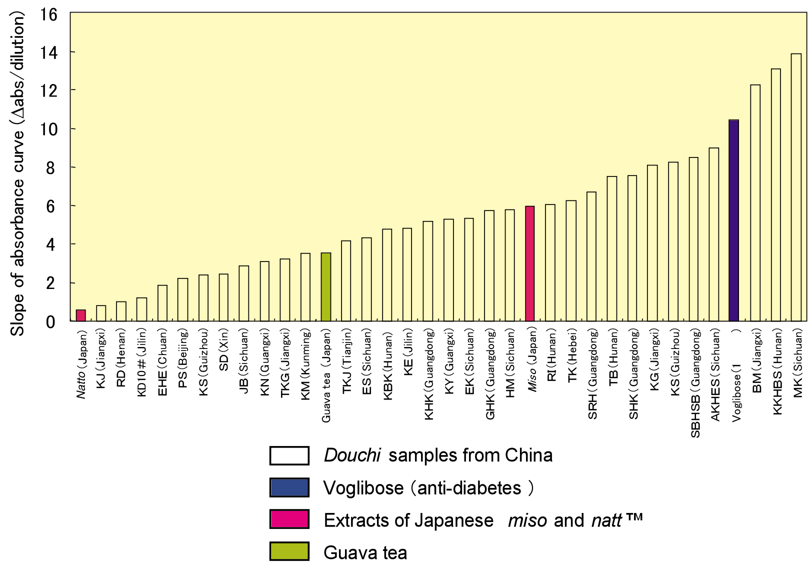


Fig. 2. α-glucosidase-inhibitory activity of various water-extracted samples.
Douchi samples from China are shown as open columns, extracts of Japanese *miso* and *natto* as the red columns, voglibose (anti-diabetes) as the blue column, and guava tea as the green column.

TOPIC7

Seasonal variation in the functional polyphenol contents of fingerroot (*Boesenbergia pandurata* (Roxb.) Schltr.) available in Thai markets

Fingerroot (*Boesenbergia pandurata* (Roxb.) Schltr.) is a member of Zingiberaceae and is sold as a spice in fresh vegetable markets in Thailand. Rhizomes of fingerroot contain high levels of polyphenols, including 2',4',6'-trihydroxychalcon (THC), pinocembrin (PC), cardamonin (CA), and pinostrobin (PS). These compounds have clear health benefits due to their anti-mutagenic or anti-tumor actions. However, the concentrations of the polyphenols varied considerably in the samples we obtained in Thai markets. Although the primary cause of such variation appears to be varietal, we found an additional key factor, that of seasonal differences. Fig. 1 illustrates this. Based on the average of all our samples from the researched markets, THC and CA increase and PC and PS decrease statistically significantly at the beginning of the hot season (February-March), compared to the levels in the early dry season (November-December). Fingerroot is usually planted at the beginning of the rainy season (April-May) and grows during the rainy season (May-October). The samples in the early dry season were thus relatively fresh, and the samples from the beginning of the hot season had been stored for four or five months. We also researched four fingerroot farmers in different places in northeastern Thailand during the same seasons as part of our market research. The fingerroot in their gardens showed the same season-dependent changes in the four above-mentioned polyphenols as the samples from the

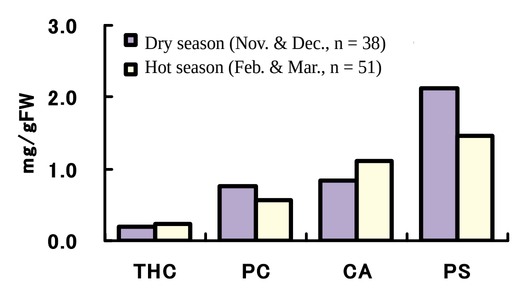


Fig. 1. Seasonal variation in the polyphenol contents of fingerroot available in Thai markets (t-test significant level: *5%, **1%).

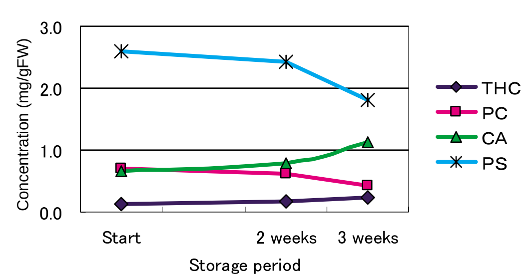
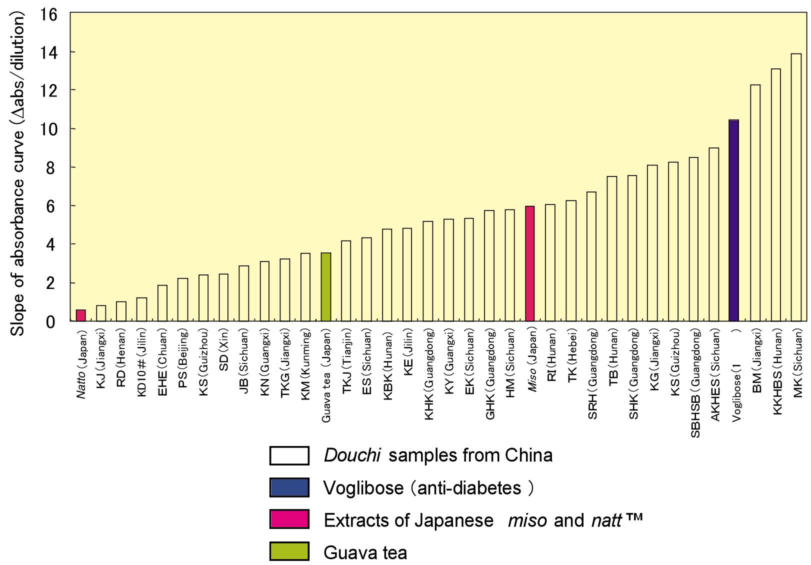


Fig. 2. Polyphenol concentrations in fingerroot during storage (plastic bag, 4℃).



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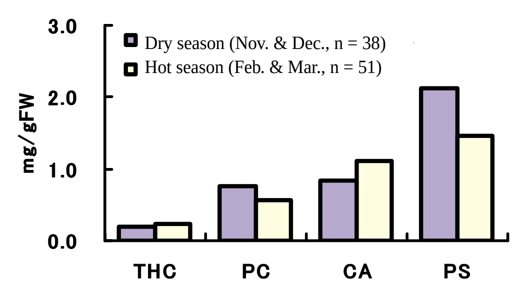

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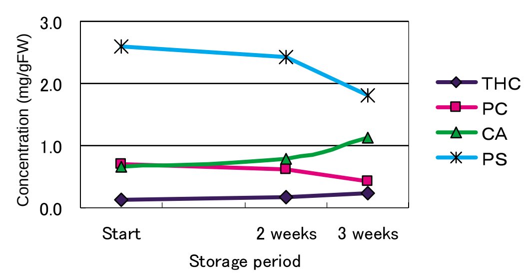

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markets. These facts suggest that the seasonal changes in the polyphenols in the markets occurred during the storage of fingerroot under the ground. To test this, we stored fresh fingerroot from the early dry season for three weeks in plastic bags at 4 ℃, and traced the changes in concentrations of the four polyphenols. Fig. 2 shows the results. During storage, THC and CA increased and PC and PS decreased in the same way as seen in the markets and the garden samples. In conclusion, to be able to utilize the abundant functional polyphenols in fingerroot, fresher products (at the beginning of the dry season) are better for supplying PC and PS; and the products harvested after storage under the ground (hot season or later), or stored for a suitable period after harvesting, have higher levels of THC and CA.

(T. Fushimi)

TOPIC 8

Identification of vitellogenesis-inhibiting hormone (VIH) in the whiteleg shrimp, *Litopenaeus vannamei*

The Fisheries Division is conducting basic physiological research on reproductive mechanisms in the whiteleg shrimp *Litopenaeus vannamei* (Fig. 1), as part of a project in cooperation with the private sector to develop recirculating aquaculture systems and domestic-based seed production for this species. *L. vannamei*, which is native to the western hemisphere, has become an important species in shrimp culture throughout the world, but especially in Southeast Asia. To gain a better understanding of the regulatory mechanisms of vitellogenesis in this species, research was conducted to identify and characterize the biological activity of vitellogenesis-inhibiting hormone (VIH). The presence of hormones harboring molt-inhibiting and hyperglycemic activities in crude sinus gland extracts has been reported in several crustacean species. These substances are thought to harbor VIH activity as well, but this has been a difficult point to clarify.

Vitellogenesis-inhibiting hormone (VIH) in Crustacea belongs to the crustacean hyperglycemic hormone (CHH) family. In this study, to characterize multiple VIH molecules in *L. vannamei*, seven CHH-family peptides, designated as Liv-SGP-A, -B, -C, -D, -E, -F, and -G, were purified by reversed-phase high-performance liquid chromatography (RP-HPLC) and identified by N-terminal amino acid sequencing. Peptides were extracted from a total of 1,300 sinus glands and fractionated by RP-HPLC using acetonitrile containing trifluoroacetic acid (TFA) as a solvent. The dose-response effects of these peptides on vitellogenin mRNA levels were examined using *in vitro* incubation of ovarian fragments of the kuruma prawn, *Marsupenaeus japonicus*. Liv-SGP-D showed no significant inhibitory activities, while the other six peptides significantly reduced vitellogenin mRNA levels, although having differing efficacies, in the order of Liv-SGP-C, -F, -G > -A, -B > -E (Fig. 2). Liv-SGP-G was the most abundant CHH-family peptide in the sinus gland and showed strong vitellogenesis-inhibiting activity. Further structural analysis of this peptide was therefore possible. In order to determine the cysteine residues that characterize CHH-family peptides, native Liv-SGP-G was reduced, carboxymethylated, and subsequently digested with lysyl endopeptidase, resulting in two peptide fragments which were subjected to further analysis. Amino acid sequence analyses of these two peptides identified six residues at positions 7, 23, 26, 39, 43, and 52 as cysteine based on the detection of a peak of phenylthiohydantoin derivative of carboxymethylated cysteine on the HPLC chromatogram. In total, as a result of a detailed structural analysis, its complete primary structure was determined: it consists of 72 amino acid residues and possesses an amidated C-terminus.

In conclusion, six sinus gland peptides

Fig. 1. Cultured *Litopenaeus vannamei* from a production trial with International Mariculture Technology (IMT) Co. (Photo: S. Nohara, IMT)

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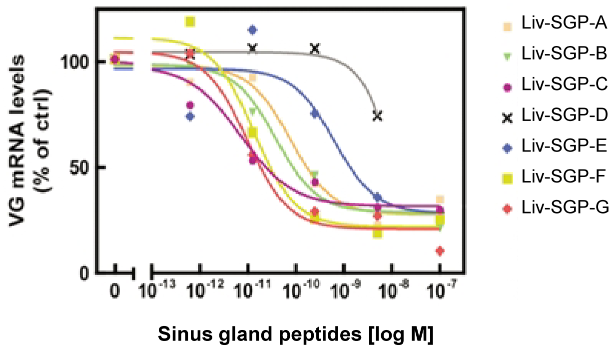

Fig. 2. The dose-response effects of CHH-family peptides from *L. vannamei* on vitellogenin (VG) mRNA levels in incubated ovarian fragments.

having VIH activity were isolated from *L. vannamei*. The dynamics by which these six peptides are involved in the regulation of vitellogenesis in *L. vannamei*, however, remain unclear. To clarify this point, further experiments examining their *in vivo* effects and changes in their circulating levels during vitellogenesis are required. It is hoped that further work along these lines will assist in the development of technology to better control reproduction in captivity of this species.

(M.N. Wilder)

TOPIC9

Development of "Naribushi," a new variety of snap bean (*Phaseolus vulgaris* L.) resistant to high-temperature stress

In Okinawa, temperate vegetables are difficult to cultivate during May to October, when mean monthly air temperature exceeds 25℃. This has prompted JIRCAS to work on developing new vegetable varieties that are resistant to high-temperature stress by evaluating and utilizing crop germplasm accessions collected from tropical areas. Snap bean (*Phaseolus vulgaris* L.) is very prone to high-temperature stress, which causes pollen sterility, leading to flower abscission and a decrease in pod yields. By screening snap bean germplasm accessions based on successful pod setting under hot conditions in the field, JIRCAS successfully developed a heat-tolerant variety, "Haibushi," which was registered as Norin No. 1 in 1995.

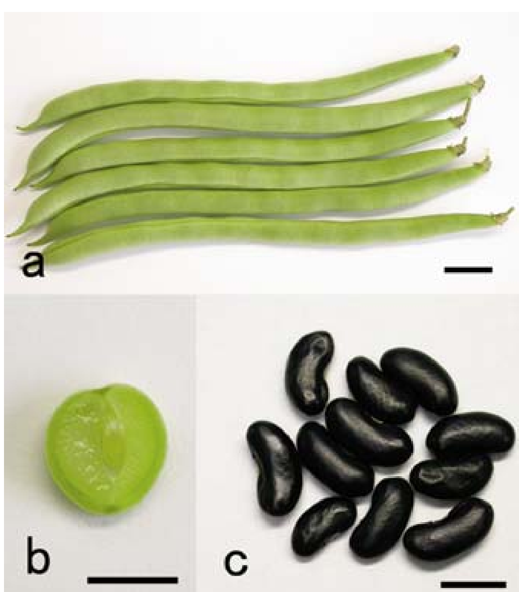

Fig. 1. Pods and seeds of "Naribushi."
a) Pods of "Naribushi" 14 days after flowering
b) Cross-section of the middle of a young pod
c) Mature seeds of "Naribushi"
Note: The bar shows 1 cm.

A new variety, "Naribushi" ("shooting star" in Okinawan), was also developed by selecting germplasm accessions for heat tolerance originally collected from Malaysia in 1985 by the Tropical Agriculture Research Center (now reorganized into JIRCAS). "Naribushi" develops a long, round pod of a light green color (Fig. 1), while "Haibushi" develops a short and flat pod. The Brix value is 4.9 in "Naribushi," the same as that for "Haibushi" and much higher than the 3.9 seen in "Kentucky Wonder" (a standard variety). Thus, the eating quality of "Naribushi" is high.

Pod setting of "Naribushi," "Haibushi," and "Kentucky Wonder" at a mean air temperature of 24ºC was high, at 83.3%, 82.6%, and 85.3%, respectively. Even under high-temperature conditions (a mean air temperature of 28ºC), pod setting of "Naribushi" and "Haibushi" were relatively high at 68.3% and 70.1%, although that of "Kentucky Wonder" declined sharply to 23.3%. "Naribushi" can produce about 1.6 to 1.8 ton of pods per 10 a under high-temperature conditions, indicating that it is suitable for summer cultivation in Okinawa (between May and July, before the typhoons arrive).

We have applied to Japan's MAFF to register this new variety. "Naribushi" is also anticipated to be used in breeding programs to increase the diversity of snap bean varieties in tropical and subtropical

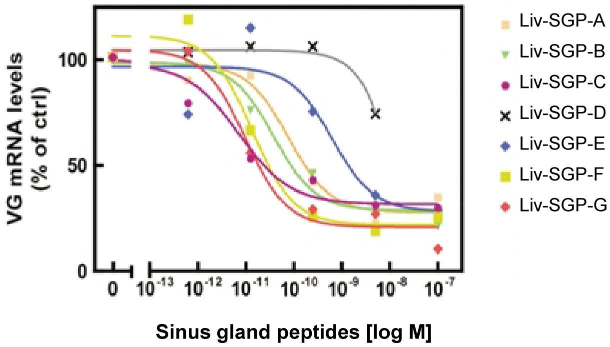

Fig. 2. The dose-response effects of CHH-family peptides from *L. vannamei* on vitellogenin (VG) mRNA levels in incubated ovarian fragments.

having VIH activity were isolated from *L. vannamei*. The dynamics by which these six peptides are involved in the regulation of vitellogenesis in *L. vannamei*, however, remain unclear. To clarify this point, further experiments examining their *in vivo* effects and changes in their circulating levels during vitellogenesis are required. It is hoped that further work along these lines will assist in the development of technology to better control reproduction in captivity of this species.

(M.N. Wilder)

TOPIC9

Development of "Naribushi," a new variety of snap bean (*Phaseolus vulgaris* L.) resistant to high-temperature stress

In Okinawa, temperate vegetables are difficult to cultivate during May to October, when mean monthly air temperature exceeds 25℃. This has prompted JIRCAS to work on developing new vegetable varieties that are resistant to high-temperature stress by evaluating and utilizing crop germplasm accessions collected from tropical areas. Snap bean (*Phaseolus vulgaris* L.) is very prone to high-temperature stress, which causes pollen sterility, leading to flower abscission and a decrease in pod yields. By screening snap bean germplasm accessions based on successful pod setting under hot conditions in the field, JIRCAS successfully developed a heat-tolerant variety, "Haibushi," which was registered as Norin No. 1 in 1995.

A new variety, "Naribushi" ("shooting star" in Okinawan), was also developed by selecting germplasm accessions for heat tolerance originally collected from Malaysia in 1985 by the Tropical Agriculture Research Center (now reorganized into JIRCAS). "Naribushi" develops a long, round pod of a light green color (Fig. 1), while "Haibushi" develops a short and flat pod. The Brix value is 4.9 in "Naribushi," the same as that for "Haibushi" and much higher than the 3.9 seen in "Kentucky Wonder" (a standard variety). Thus, the eating quality of "Naribushi" is high.

Pod setting of "Naribushi," "Haibushi," and "Kentucky Wonder" at a mean air temperature of 24ºC was high, at 83.3%, 82.6%, and 85.3%, respectively. Even under high-temperature conditions (a mean air temperature of 28ºC), pod setting of "Naribushi" and "Haibushi" were relatively high at 68.3% and 70.1%, although that of "Kentucky Wonder" declined sharply to 23.3%. "Naribushi" can produce about 1.6 to 1.8 ton of pods per 10 a under high-temperature conditions, indicating that it is suitable for summer cultivation in Okinawa (between May and July, before the typhoons arrive).

We have applied to Japan's MAFF to register this new variety. "Naribushi" is also anticipated to be used in breeding programs to increase the diversity of snap bean varieties in tropical and subtropical

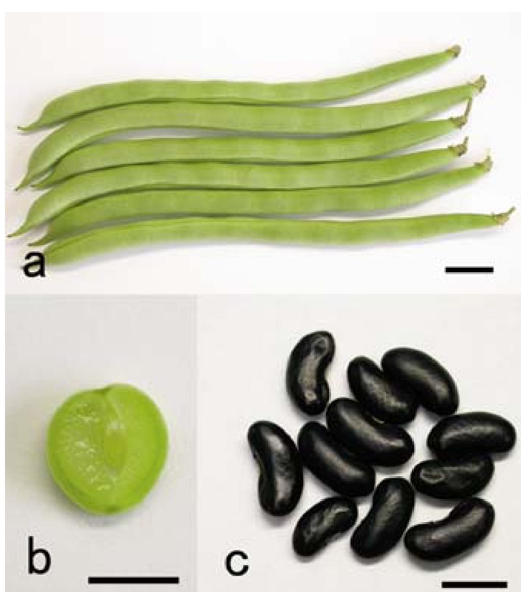

Fig. 1. Pods and seeds of "Naribushi."
a) Pods of "Naribushi" 14 days after flowering
b) Cross-section of the middle of a young pod
c) Mature seeds of "Naribushi"
Note: The bar shows 1 cm.

areas by incorporating heat tolerance into other cultivars with good pod characteristics, high yielding capabilities, etc.

(Y. Egawa, K. Kashiwaba, H. Omae, and M. Shono)

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

Deterioration of resources which support agriculture and forestry has been taking place due to environmental degradation such as worsening water pollution, mainly in developing regions. In response, we are developing systems for production management based on social and economic conditions which enable such systems to be adopted and established in such countries; namely, systems for controlling soil nutrients and water conditions that are suitable for sustainable production in tropical, subtropical, arid, or semiarid regions, and systems for production management that combine agriculture and animal industry in various ways and improve individual production methods.

To enable the effective use of environmental resources and development of systems for sustainable production management by combining agricultural, livestock, and foresting practices, we have launched studies on the optimization of soil, water, and crop management aimed at agricultural, grazing, and forested lands as well as islands.

Major outcomes accomplished in 2006 include:

- A closed chamber divided into measurement and buffer chambers, leading to highly accurate measurement of gas balance in plants and soils through monitoring of fluctuations in gas concentrations in the circulating gas.
- Root exudates from a tropical grass, *Brachiaria humidicola*, have an inhibitory effect on nitrification. We found that the effect was strongly induced by ammonium ions under acidic conditions.
- In the Sahel region of West Africa, a dual-purpose food/feed line of cowpea suitable for growing in the region was selected. By analyzing results from a long-term continuous cropping study, we revealed that accumulation of organic materials and an improvement of productivity can be accomplished by soil fertility management which combines the introduction of crop residues from pearl millet with input of chemical fertilizers, and that a further improvement can be achieved by incorporating cowpea into the crop rotation.
- In Mongolia, although degradation of vegetation all over the nation and a distinctive trend toward desertification have not in fact been observed, there has been a trend toward environmental degradation in city fringes since market-oriented economic reforms were adopted at the beginning of the 1990s. In the intensive dairy farming region near Ulaanbaatar, the capital of Mongolia, we demonstrated that net profit has been boosted by increasing milk production per milking cow as a result of positively feeding concentrated diets under the current status of a high-level stabilization of annual mean milk shipments and expansion of farming.
- We demonstrated that production from mixture-sown pasture of guinea grass and stylo (*Stylothantes capitata* and *S. macrocephala*) was higher than that from single-sown pasture of guinea grass, and that when grazing starts after ripening of stylo seeds, a buried seed bank of stylo is formed under the ground, resulting in a natural succession. In addition, energy demand for basal metabolism in a native-bred steer in northeastern Thailand was revealed.
- Durian fields differing in soil conditions were selected in Thailand and Vietnam. We demonstrated that flower setting can be promoted by limiting the number of main stems by thinning-out training after heading-back pruning of the main trunk on a 5-year-old tree before the fruit set period. Flower setting can also be promoted by improving drainage, even in the monsoon season.

As a whole, the projects have steadily progressed as planned. In particular, concerning the effect of biological nitrification inhibition observed in a tropical grazing grass, excellent results were obtained that have led to further elucidation of its mechanism. On the other hand, some project starts were delayed because of the considerable time needed for preparation of the work plans. Currently, the long-term overseas research fellows deployed have areas by incorporating heat tolerance into other cultivars with good pod characteristics, high yielding capabilities, etc.

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(1) In the project on soil resources, we emphasize prediction of influences using models and evaluation of sustainability in terms of material recycling for input of organic materials.

(2) For the project related to water resources, on-the-spot investigations in Laos and China are being further promoted.

(3) On agriculture and livestock farming in dry lands, we have promoted a study on grazing which will commence in Mongolia, and for tropical livestock farming, we strive for efficient data collection, urging coordination with cooperative organizations.

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TOPIC 1

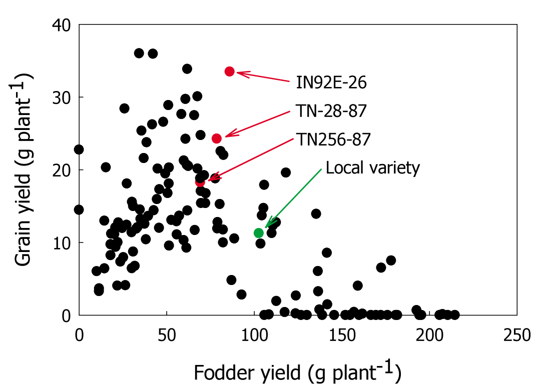
Identification of improved dual-purpose cowpea varieties for the Sahel

Cowpea (*Vigna unguiculata* [L.] Walp.) is one of the most important legumes in West Africa, since it contributes to the traditional crop-livestock system both as grain for human consumption and as residue for animal fodder, particularly in the dry savanna and the Sahel zone. Cowpea can utilize symbiotically fixed nitrogen from the air and take up otherwise insoluble phosphates from the soil, making it also beneficial for companion crops and/or succeeding cereals such as pearl millet and sorghum, the staple food crops in the Sahel. Identification and utilization of genetically improved cowpea varieties with more biomass production (grain and fodder yield), and higher N-fixing and P-uptake abilities, would help not only to achieve sustainable productivity but also to maintain soil fertility in the agricultural ecosystems of the Sahel.

A total of 140 cowpea varieties/lines varying in growth habits and phenology, mainly from the IITA (International Institute of Tropical Agriculture) and INRAN (Institute National de la Recherche Agronomique du Niger), were evaluated in an experimental field at the ICRISAT Sahelian Center (N13º14', E2º16'), Niger, during the rainy season in 2004 and 2005.

The yield of cowpea varieties was considerably affected by their phenology in 2004. Late-flowering varieties, which needed more than 60 days to flowering, produced few grains, while intermediate-flowering varieties, which flowered around 45 to 55 days after sowing, had the highest yield (25 g plant^{-1} or more). On the other hand, the late-flowering varieties produced a greater fodder yield (100 to 200 g plant^{-1}). No variety with higher yields of both grains and fodder was found, due to a trade-off relationship between grain and fodder production among the varieties used (Fig. 1). Several varieties, however, had intermediate yields of both grains and fodder. These varieties may be adoptable by local farmers on the project site, since around two-thirds preferred varieties with a balanced harvest of both grains and fodder. Three varieties (TN-28-87, TN256-87, and IN92E-26) were finally selected (Fig. 1) after the evaluation of other characteristics, including grain quality and resistance to major biotic stresses. They mostly flowered earlier and had higher grain production with larger grains but lower fodder production than local varieties (Table 1).

Our survey on farmers' fields on the project site revealed that the planting density of cowpea averaged 2,015 plants ha^{-1}, far lower than the recommended 9,000 plants ha^{-1}. This is thought to be one of the reasons why on-farm yields of cowpea have been much lower than the potential yield and the dissemination of improved cowpea varieties to the farmers has been con-



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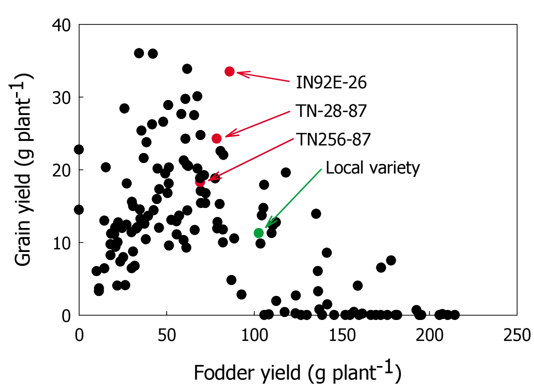

Fig. 1. Relationship between grain and fodder yield of cowpea varieties/lines in an experimental field at the ICRISAT Sahelian Center in 2004.

strained. The most promising variety, IN92E-26, showed higher grain and fodder yields when planted densely, but a local variety did not (data not shown). For the more efficient utilization of the selected varieties, therefore, more attention should be paid to farm practices such as planting density to obtain the best performance.

(R. Matsunaga and S. Tobita)

Table 1. Agronomic characteristics of the selected cowpea varieties/lines in an experimental field at the ICRISAT Sahelian Center in 2004 and 2005.

Year	Variety/line	Days to flowering	Days to maturity	Grain yield (g plant^{-1})	100-grains weight (g)	Fodder yield (g plant^{-1})
2004	TN-28-87	49	74	24.3	17.2	78.7
	TN256-87	49	76	18.8	15.9	69.2
	IN92E-26	52	76	33.5	18.3	86.0
	Local variety 1*	51	77	11.3	15.1	102.7
2005	TN-28-87	60	90	43.1	16.6	25.6
	TN256-87	63	96	30.6	15.9	28.7
	IN92E-26	63	90	31.6	17.3	17.5
	Local variety 1*	69	94	18.0	15.8	25.4
	Local variety 2*	70	95	25.4	13.3	34.5

* Local varieties 1 and 2 originated from farmers' fields in northern Nigeria and western Niger, respectively.

TOPIC2

Sustainable improvement of soil fertility and pearl millet production by returning crop residues, application of chemical fertilizers and rotation with cowpea in the sandy soil of the Sahel, West Africa

The poor fertility of sandy soil in the Sahel, West Africa, is the principal constraint on crop production, and leads to frequent food shortages. Many trials have been carried out, such as manure application to improve crop production, but the experimental periods of only a few years were too short to observe any sustained effect. A long-term experiment on the cultivation of pearl millet, a staple food in West Africa, has been ongoing at ICRISAT Sahelian Center in Niger since 1983 to evaluate the long-term effects of returning pearl millet residue to the soil and chemical fertilizer application (30-30-0 kg N-P_2O_5-K_2O ha^{-1}) on crop production and soil fertility; in addition, rotation with cowpea has been carried out since 1991. The panicles of pearl millet and the aboveground parts of the cowpea are harvested. We analyzed the pearl millet production data and the soil organic carbon data over 23 years.

Total biomass production of pearl millet increased to 1-3 t ha^{-1} as a result of either residue returning or fertilizer application, and increased to 3-6 t ha^{-1} by combining residue returning and fertilizer application, compared with 0.5-2.0 t ha^{-1} with no input of residue plus fertilizer treatment (Fig. 1). Organic carbon in surface soil increased to 1-2 g kg^{-1} as a result of the combined treatment, but did not increase significantly as a result of the single treatments (residue returning or fertilizer application) compared with 1.2-1.8 g kg^{-1} under the no input treatment (Fig. 2).

Pearl millet production under rotation with cowpea was higher, at 0.7-2.4 t ha^{-1}, than under pearl millet monocropping with the single treatments of residue returning or fertilizer application or in the combined treatment, but was not significantly different from the no-input treatment (Fig. 1). Organic carbon in surface soil under rotation with cowpea was 0.6 g kg^{-1} higher than under monocropping with the combined treatment, but it did not differ significantly from the single treatments or the no-input treatment (Fig. 2).

Pearl millet production shows a significant positive relationship with organic carbon in surface soil (r^2 = 0.32, P < 0.01), suggesting that increased soil organic carbon is essential to yield improvement. Returning strained. The most promising variety, IN92E-26, showed higher grain and fodder yields when planted densely, but a local variety did not (data not shown). For the more efficient utilization of the selected varieties, therefore, more attention should be paid to farm practices such as planting density to obtain the best performance.

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The single treatments of residue returning or fertilizer application marginally improved soil organic matter, leading to slightly increased pearl millet production. Combining residue returning and fertilizer application improved soil organic carbon to a much greater degree, resulting in high yields and demonstrating the potential to contribute to solving food shortages in West Africa.

Crop residue returning and rotation with cowpea is acceptable for small farmers who have limited funds, but chemical fertilizer application is conducted by the few rich farmers. Pearl millet residue is used as animal feed, so to promote residue returning, increasing the production of an alternative animal feed supply, e.g., by increasing cowpea production, is needed.

(N. Matsumoto)

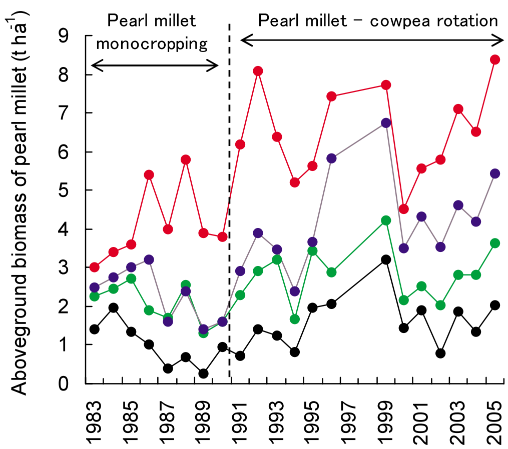

Fig. 1. Aboveground biomass of pearl millet after pearl millet residue returning and chemical fertilizer application. Treatments: no input (●), residue returning (●), fertilizer application (●), combination of residue returning and fertilizer application (●).

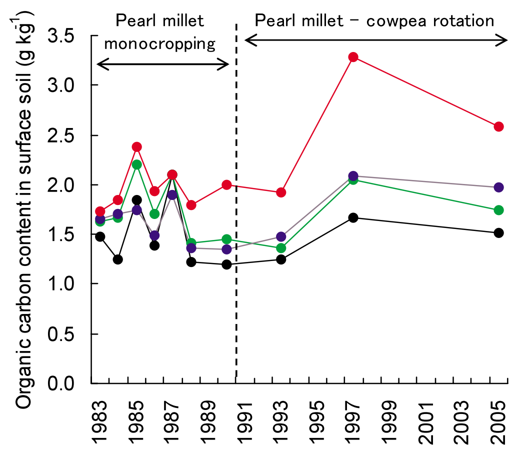

Fig. 2. Organic carbon content in surface soil treated by pearl millet residue returning and application of chemical fertilizer. Legends: See Fig. 1.

TOPIC3

Buffered chamber gas measurement apparatus

High-performance indoor air quality sensors are now obtainable at reasonable prices and can be used for gas measurement in experimental equipment. Fig. 1 depicts the principles of the method. It essentially involves the closed-chamber method. A closed chamber is divided into a chamber and a buffer zone (buffer). The air is circulated between the chamber and the buffer, and the gas concentration is measured in the buffer. Several problems associated with the chamber method can be solved using this method.

We frequently encounter the problem of condensation while measuring transpiration using the closed-chamber method. Increasing the volume capacity of the buffer can solve this problem. This is because with the improved method, the appearance of condensation can be delayed, allowing the measurements to be completed before it occurs. Obviously, the volume of the buffer must be adjusted to suit the measurement conditions. All the air in the chamber is progressively circulated, and thus fans are not required to prevent irregularities in the chamber. A problem associated with the open chamber method is the effects of irregularities in the outside air. To solve this, a vast buffer room is sometimes used. However, this renders the device less portable and is therefore a disadvantage. Sometimes a reference gas canister is used. This technique gives stable results, but the of crop residue was an effective treatment to increase soil organic matter. Chemical fertilizer application increased biomass production, and the underground parts contributed to increased soil organic matter, which led in turn to improved water retention, nutrient levels, and biological activity, together contributing to improved crop yields.

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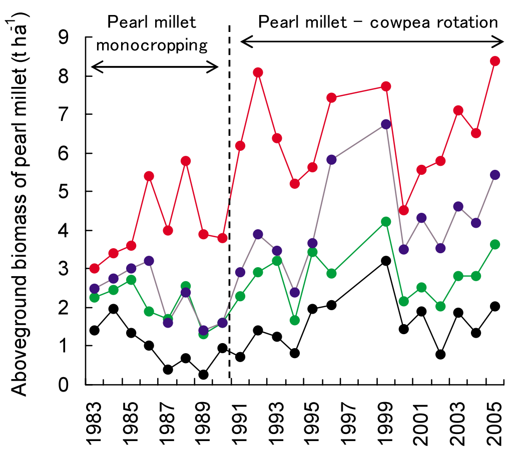

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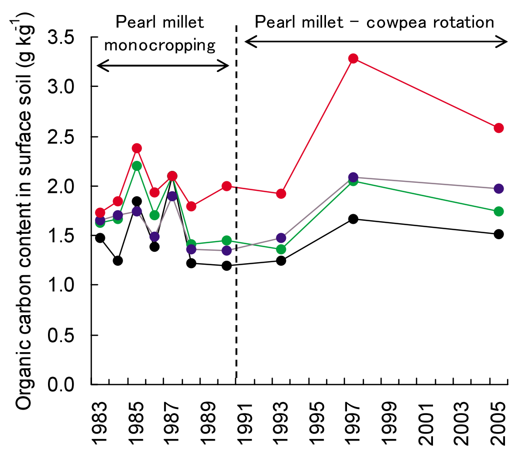

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It is often observed that continuous measurement requires mechanisms by which the lid of the chamber can be repeatedly opened and closed. In the case of our improved method, continuous measurement is easily achieved by ventilating the buffer with a fan.

Calibration of the apparatus is simple to perform. A dish containing water was attached to the load cell and placed in the chamber shown in Fig. 1. The humidity and dew point were measured every minute for 5 min, and the dish was then removed. Measurements were continued for another 2 min. Transpiration and dew point were found to be related (R^2 = 0.997). There was little response lag between the buffer and the chamber and at the same time the irregularities in the chamber were minor. It should be mentioned that the volume of the apparatus can be accurately estimated from the calibration line with water vapor, making it possible to calculate the volume of CO_2 without using a reference gas.

Fig. 2 illustrates an example of the measurement of photosynthesis and transpiration of a tomato plant in the field. The dew point increased by 3.3 ℃, while the CO_2 concentration decreased by 24 ppm.

(M. Oda)

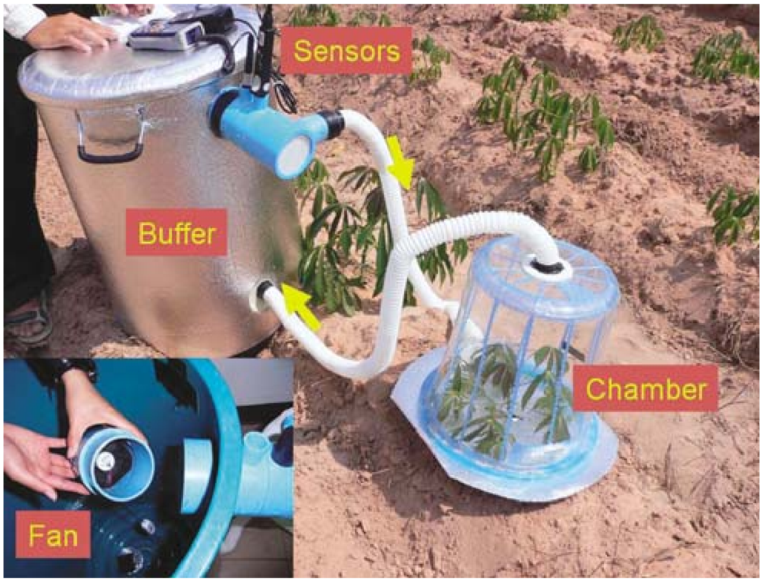

Fig. 1. Principle of the buffered chamber method.
Humidity sensor (Extec Ltd., EA-20), CO_2 sensor (TESTO Ltd., 535), PC fan and battery, 40-L chamber, 130-L buffer (covered by an insulated sheet), connecting pipes.

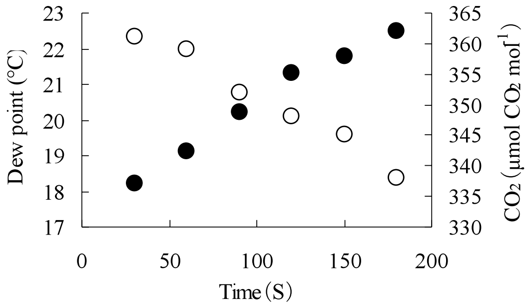

Fig. 2. An example of measurements of photosynthesis and transpiration of a tomato plant in the field.

TOPIC4

Technology development through empowerment of farmers

The farmer-participatory approach is designed to foster voluntary technology development utilizing farmers' existing broad-based knowledge and skills. However, some problems have been identified with the most commonly applied selection model (technology menu basket, etc.). 1) It tends to be constrained by current conditions, since farmers' priorities come first. 2) Increased choice causes an increase in load on the researchers. 3) Because the technological choices available act as preconditions, they cannot be used to develop new technology. 4) The farmer's role is restricted to selection. To overcome these problems, we developed a new technology development technique for the farmer participatory-approach, which we call the invention model.

The farmer can modify the technology voluntarily and unrestrictedly, without being tied down by priorities, so there is considerable potential to modify it. Knowledge that becomes the nucleus of a new technology is set up as a knowledge transfer technology (technology for knowledge transfer). The farmer obtains practical technology through the execution of the knowledge transfer technology, after which modifications that are based on their own knowledge and measurement conditions a are artificial. On the other hand, the use of a closed chamber is limited to suitable objects. The new method increases the range of items that can be measured using a closed chamber.

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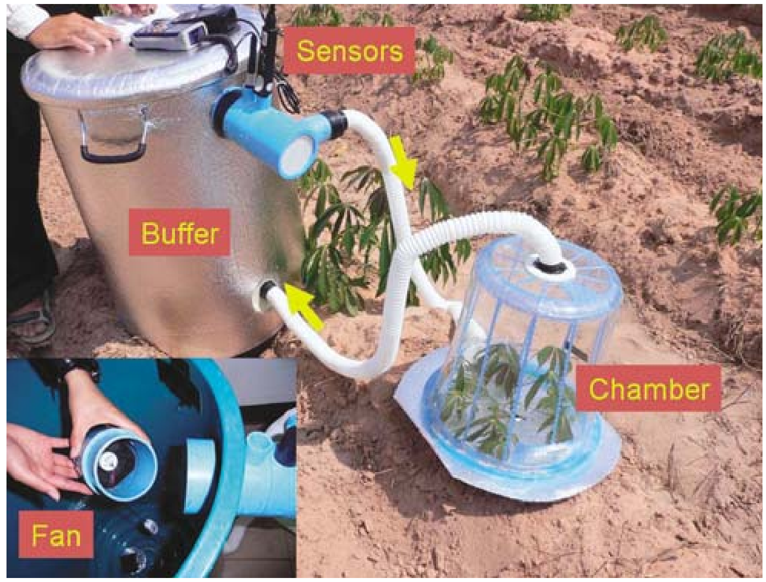

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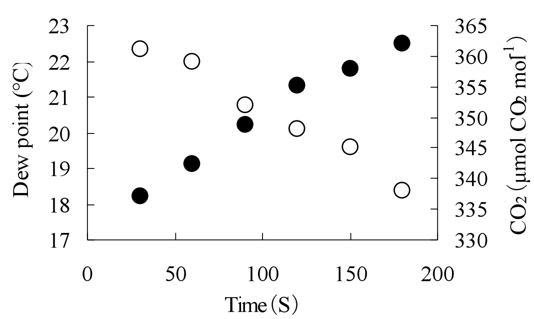

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In the past it was believed that technology for transfer should be complete. However, in this model, the technology is incomplete, so that the farmer can readily modify it on their own initiative.

One example of the implementation of this method (the "mother, baby, and grandchildren" method) is as follows. The researcher executes the knowledge technology as a model in one plot or more (mother). The farmer imitates this and executes the knowledge technology in their own field (baby). An experimental area, where individual knowledge and ideas can be added, is set up at the same time (grandchildren). Each farmer adjusts the baby and grandchildren's numbers according to the resources available and the basic idea (Fig. 2). The knowledge technology should be a new idea that is interesting, simple to modify, easy to execute, and designed methodically enough to be able to measure or observe the results.

In the rainfed agriculture project, 10 farmers participated in developing water-saving vegetable cultivation technology. Two mother technologies were modified to generate 44 technologies. Several of these achieved the local average yield using only 5 mm of irrigated water in total under no-rainfall conditions.

(M. Oda)

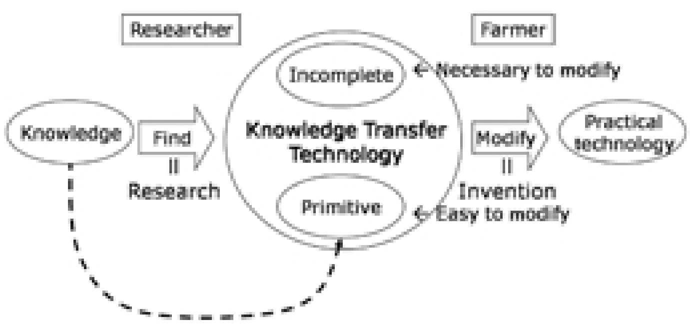

Fig. 1. Participatory technology development using knowledge transfer technology.

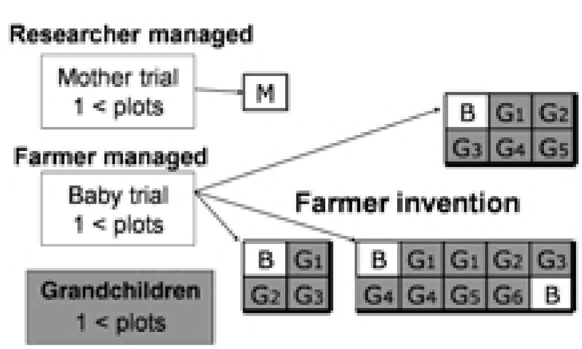

Fig. 2. An example of mother-baby trial layout for Invention model technology development.

TOPIC5

NH_4^+ triggers the synthesis and release of biological nitrification inhibition compounds in the tropical grass *Brachiaria humidicola*

The phenomenon of plants releasing inhibitory compounds from their roots that suppress nitrifying bacterial activity in soil, and thus nitrification, is termed biological nitrification inhibition (BNI). This phenomenon has been demonstrated in *Brachiaria humidicola*, a tropical grass grown extensively in South America. Our earlier studies have indicated that the release of these inhibitors from roots is a highly regulated plant attribute. During this investigation, we have tested a hypothesis that the presence of NH_4^+ in the rhizosphere is necessary for the release of BNI activity from the roots, assuming that BNI activity is released from the roots to specifically protect NH_4^+ from nitrification.

In Experiment 1, plants were grown for 60 days in solution culture (Fig. 1) with NH_4^+ as the nitrogen source. The root exudate was collected from intact plant roots using treatment solutions that included the presence of NO_3^-, NH_4^+, or low pH (such as 1 mM HCl or HNO_3) (Table 1). This was to test the hypothesis that release of BNI activity is stimulated by the presence of NH_4^+ or due to the secondary effect of low pH caused by the uptake of NH_4^+. The results indicated that release of BNI activity was triggered by the synergistic effects of the presence of NH_4^+ and the acidity caused by NH_4^+ uptake; this was evident from the several-fold increase in BNI activity from the roots when root exudate was collected using either NH_4Cl or NH_4NO_3 solutions (where the pH of the root exudate solution became acidic, ranging from 3 to 4 after a 24 h collection period) (Table 1). Acidic pH alone (i.e., treatment solutions of 1 mM HNO_3 or HCl) or the presence of NH_4^+ in the collection solution alone (i.e., without acidic pH followed by NH_4^+ uptake: this was achieved by NH_4HCO_3 solution treatment) did not have a substantial impact on BNI release from roots.

In a follow-up experiment, BNI activity release was monitored in the presence or absence of NH_4^+ in the root exudate collection solution (from NH_4^+ and NO_3^--supplied plants) at 2 h intervals for a 24 h ideas can be added (Fig. 1).

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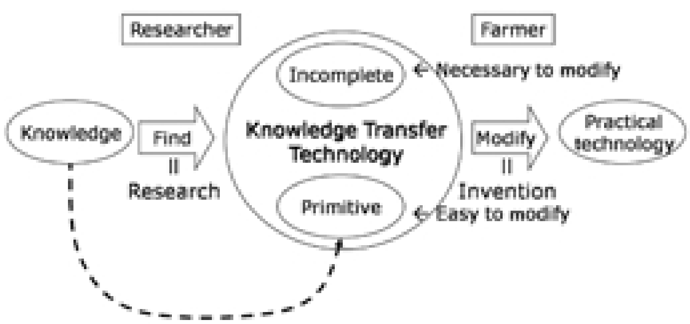
(M. Oda)



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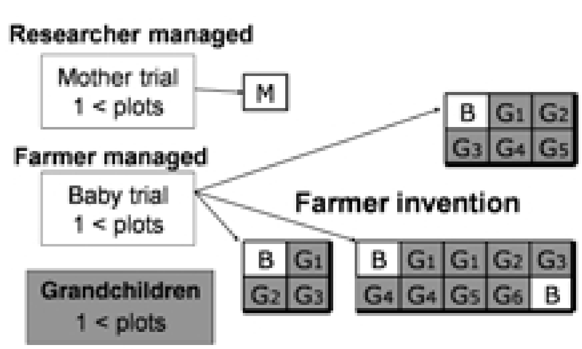

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Our results demonstrate that BNI release from roots in *B. humidicola* is triggered and regulated by the presence of NH_4^+ in the rhizosphere, thus establishing a functional link between BNI release and protection of NH_4^+ from nitrifiers. These results have wide-ranging implications for the genetic exploitation of BNI attributes in pastures and, in particular, the isolation of genes involved in the synthesis and release of BNI activity from *B. humidicola* roots.

(G.V. Subbarao)

Fig. 1. About 60-day-old *B. humidicola* grown in nutrient solutions were used for collecting root exudates using various treatment solutions.

Table 1. Influence of root washing medium on the release of BNI-compounds from roots.

Root washing medium	*pH of the washing medium after 24 h collection period	BNI compoumds released (AT units g^{-1} root dry wt. 24 h^{-1})
Distilled water control	4.2	2.8
Hydrochloric acid (1 mM)	3.2	6.4
Nitric acid (1 mM)	3.8	5.2
Ammonium chloride (1 mM)	3.1	14.6
Ammonium nitrate (1 mM)	3.9	10.6
Potassium nitrate (1 mM)	4.1	2.8
Ammonium bicarbonate (1 mM)	6.5	5.8
LSD (0.05)		***3.6***

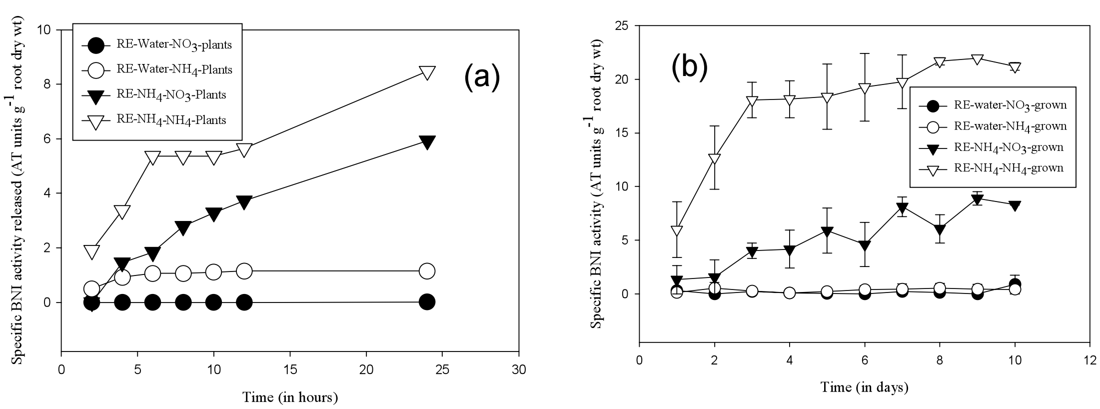

Fig. 2. Release of BNI compounds in the presence and absence of NH_4^+ in the root washing medium during a 24 h collection period [2 h intervals (a)] and a 10-day collection period [24 h intervals (b)].

Schematic representation of various steps involved from growing plants to collecting root exudates

Grow plants for 60 days in nutrient solutions with N supply as $(NH_4)_2SO_4$. → Transfer the plants to N-free nutrient solutions for 7 days. → Keep intact plant roots in distilled water for 1 h. → Collect root exudates from intact plant roots in treatment solutions.

Satellite data analysis of vegetation trends in Mongolia on a national scale

Mongolia is in East Asia, landlocked between Russia and China. It has an extreme continental climate with long, cold winters and short summers, during which most of its annual precipitation is received. Nomadism and animal herding have been central to Mongolian life for thousands of years, and herding is still the country's main economic activity. This is why sustaining the well-being of vegetation, particularly grasslands, is of crucial importance to the nation. Since 1990, when Mongolia began a process of economic reform to phase out the state-controlled economic system in favor of a market economy, the number of domestic animals has been rising, risking serious overgrazing that risks nationwide degradation of vegetation. There are reports claiming that 30-70% of pastureland is already degraded, but opinion differs as to whether there is actually any significant degradation, and if so, how much.

Satellite remote sensing technology has a distinctive advantage over other means of spatial information collection in that it obtains a synoptic view of ground features over large areas. In particular, data collected using multispectral sensors is often processed into a vegetation index for predicting and assessing vegetative characteristics such as percentage ground cover by vegetation, and general plant stress and vigor. One of the most commonly used vegetation indices is the normalized difference vegetation index (NDVI), whose values range between -1 and +1. The higher the NDVI value, the more and healthier the vegetation is expected to be at a given location. Using a time series Global Inventory Modeling and Mapping Studies (GIMMS) NDVI dataset (8 km resolution), we have depicted the spatial distribution of positive and negative vegetation trends over 23 years (1981-2003) on a national scale. The results reveal that only about 12% of the national land area shows statistically significant long-term vegetation trends (3.1% negative; 8.7% positive) (Fig. 1).

However, a closer look over the 10 year-time periods before and after the political changes in 1990 indicates that negative trends have come to predominate during 1991-99 (4.6% negative; 1.7% positive), whereas it was the other way round during 1981-89 (1.6% negative; 12.2% positive). Contrary to common belief, no extensive vegetation degradation has been observed nationwide but localized degradation was in fact evident (Fig. 2). Our ground survey of hot spots and further assessments using higher resolution satellite data reveals that degradation is commonly observed around big cities (Ulaanbaatar and Darhan) and in

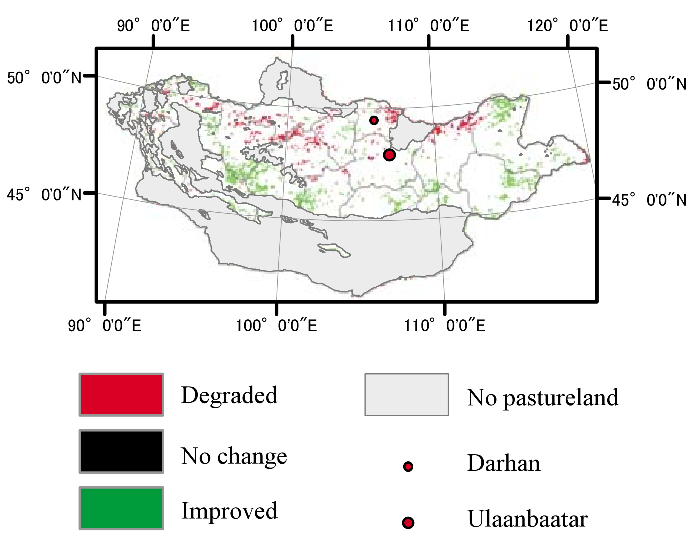

Fig. 1. Spatial distribution of long-term vegetation trends (1981-2003).

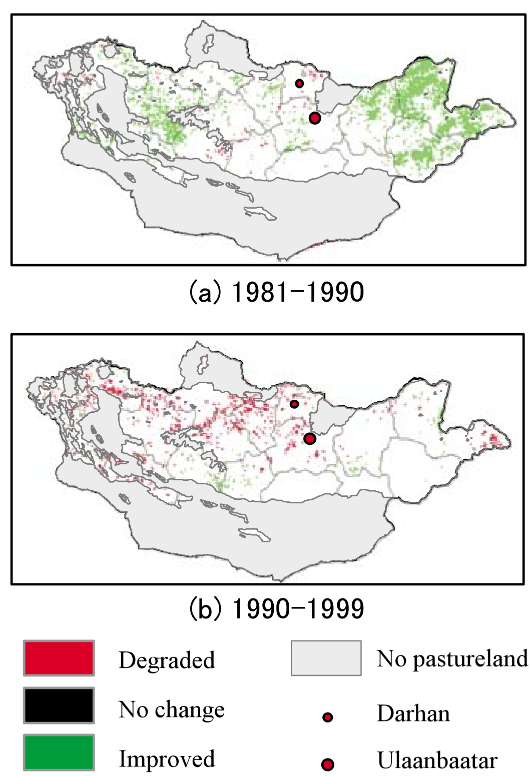

Fig. 2. Spatial distribution of vegetation trends over the 10-year time periods before and after the political changes in 1990.

abandoned croplands once heavily exploited under Soviet rule. It is also important to take into consideration the effect of ongoing global climatic change, but our findings shed light on specific areas that require immediate attention. Urgent technological development is required to prevent and mitigate further degradation in these problem areas.

(A. Hirano)

TOPIC 7

Metabolizable energy requirement for maintenance of native beef cattle in northeast Thailand

In Thailand, the nutrient requirements of cattle are based on information gathered from countries located in temperate zones. Since the breed of cattle, climatic conditions, and available feed resources in Thailand differ from those in temperate zones, the nutrient requirements of cattle in Thailand may not be the same as those recommended. However, the energy balance in cattle has been measured to a limited extent. To be able to study energy metabolism in cattle, we have developed a respiration trial system with a ventilated hood at Khon Kaen Animal Nutrition Research and Development Center, Khon Kaen, Thailand.

Metabolizable energy (ME) requirement for maintenance was estimated by regression analysis from the results of 16 energy balance trials using four mature Thai native steers. Their average body weight (BW) was 185 (from 175 to 210) kg and age in months was 36. Steers were fed at 1.5% of BW on a dry matter (DM) basis twice a day. Crude protein content in the experimental diet was 7.1 to 7.8% on a DM basis.

Energy balance was negative along with nutrient contents in the feed when the feeding level was set at 1.5% of BW on a DM basis (Table 1). Average ambient temperature was 28.3 (minimum 15.2, maximum 40.0) degrees Celsius and humidity was 54.6% (minimum 10.0, maximum 95.0%) during the experiments.

The ME requirement for maintenance was estimated as 476.6 kJ/kgBW$^{0.75}$ from all the data for ME intake and balance by Thai native steers (Fig. 1). This value is the same as for Japanese black steers as listed in the Japanese feeding standard (470.3 kJ/kgBW$^{0.75}$). Furthermore, it is nearly half the value of several kinds of beef cattle in Europe and the United States (401.7 to 543.9 kJ/kgBW$^{0.75}$) as listed in the National Research Council feeding standard.

The ME requirement for maintenance in Thai native steers is useful information for calculating the daily amount of feed and should be utilized as basic data for feeding standards in the Indochinese peninsula. To be able to promote more efficient use of local feed resources, it is necessary to be aware of not only the animals' requirements but also of the nutrient content of their feed. Furthermore, since there are many kinds of native cattle in each area and they may have different characteristics, we will continue to collect more data on requirements using indigenous cattle in many areas in Thailand.

(T. Nishida)

Table 1. Feed formulation and results of energy balance trial with Thai native steers.

	Feed 1	Feed 2	Feed 3	Feed 4	Fasting
Ingredients (% of DM)					
Pangola grass hay	99	40	30	20	
Cassava chips	-	58	54.8	21.1	
Brewery waste	-	-	15	-	
Cassava pulp	-	-	-	57	
Urea	1	2	0.2	1.9	
Energy balance (kJ/BWkg$^{0.75}$)					
Gross energy intake	792	774	860	740	
Feces excretion	405	238	285	206	
Urine excretion	18	14	11	12	
Methane production	71	94	86	66	
Metabolizable energy intake	298	428	478	455	
Heat production	500	477	491	449	451
Energy balance	-203	-49	-13	6	-451

Data from 4 steers; average body weight was 185 kg.

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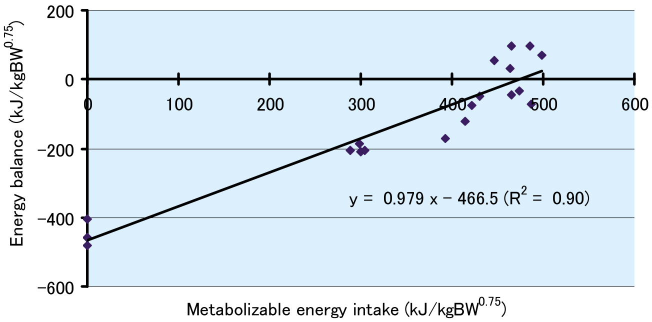


Fig. 1. Relationship between metabolizable energy intake and energy balance in Thai native steers.

TOPIC8

Management method for regeneration of stylo in guinea grass-stylo mixed pasture

Since the productivity of guinea grass (*Panicum maximum*) is high, its cultivation has expanded in the tropical savannas of South America. However, if no fertilizer is applied after establishment of guinea grass pasture, pasture productivity falls sharply every year, making it important to use legumes as an alternative nitrogen source. However, the maintenance of legumes in pasture is difficult in tropical savanna, since they are grazed selectively. Selection of legumes that show persistence under grazing pressure and the establishment of utilization with guinea grass is thus needed. This study aimed to maintain stylo (*Stylothantes capitata* and *S. macrocephala*) in mixed sown pasture of guinea grass and stylo by promoting its regeneration. This study was conducted in collaboration with JATAK in Brazil.

Guinea grass pasture (seeding rate 6 kg/ha) and guinea grass-stylo mixed sown pasture (seeding rate 3 kg/ha and 4 kg/ha, respectively) were established early in December 2004. Each pasture was then mowed and divided into two treatments: grazed before and after seed maturity of the stylo. Over one year, the dry matter yield in the mixed sown pasture was 30.6 tons/ha/yr, 50% more than in the guinea grass pasture.

In the mixed sown pasture grazed after seed maturity, the buried seed density of the stylo in the soil, sampled in mid-November just before the rainy season, reached about 80 seeds/m^2 at a depth of 5 cm (Table 1). This density is equivalent to one half of the seeding rate. However, no buried seed bank was formed in the mixed sown pasture grazed before seed maturity. In the mixed sown pasture grazed after seed maturity, stylo seeds were present at a high density in cattle dung, and seed dispersal was performed efficiently by cattle defecation. However, the seed was not contained in cattle dung in the guinea grass pasture or the mixed sown pasture grazed before seed maturity.

In addition, numerous stylo seedlings (25.4/m^2) appeared at the beginning of the rainy season (Fig. 1). Seedling density had decreased to 3.7/m^2 about one year later. However, about 70% of the seedlings grew to over 15 cm in height, enabling regeneration.

Stylo is able to regenerate in mixed sown pasture if it is grazed after seed maturity. Seed dispersal is conducted via cattle dung, forming a buried seed bank, allowing the pasture to maintain high productivity.

(K. Shimoda)

Table 1. Density of buried seeds and seedlings of stylo (*Stylosanthes capitata* + *S. macrocephala*).

	Treatment			
	Guinea grass Before*	Pasture After*	Mixd sown Before*	Pasture After*
Density of buried seeds (N/(m^2 × 5cm))	0	0	0	80.0
SD	0	0	0	470.0
Density of seedlings (N/m^2)	0	0	0	25.4
SD	0	0	0	107.6

Before*: Setting up the grazing before the seed maturation
After*: Setting up the grazing after the seed maturation
Measuring date: Density of buried seeds (November 2005)
Density of seedlings (December 2005)

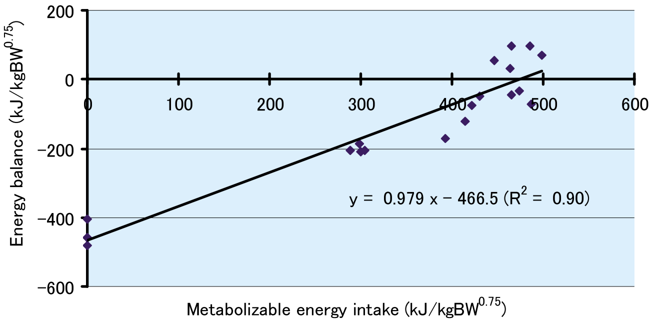


Fig. 1. Relationship between metabolizable energy intake and energy balance in Thai native steers.

TOPIC8

Management method for regeneration of stylo in guinea grass-stylo mixed pasture

Since the productivity of guinea grass (*Panicum maximum*) is high, its cultivation has expanded in the tropical savannas of South America. However, if no fertilizer is applied after establishment of guinea grass pasture, pasture productivity falls sharply every year, making it important to use legumes as an alternative nitrogen source. However, the maintenance of legumes in pasture is difficult in tropical savanna, since they are grazed selectively. Selection of legumes that show persistence under grazing pressure and the establishment of utilization with guinea grass is thus needed. This study aimed to maintain stylo (*Stylothantes capitata* and *S. macrocephala*) in mixed sown pasture of guinea grass and stylo by promoting its regeneration. This study was conducted in collaboration with JATAK in Brazil.

Guinea grass pasture (seeding rate 6 kg/ha) and guinea grass-stylo mixed sown pasture (seeding rate 3 kg/ha and 4 kg/ha, respectively) were established early in December 2004. Each pasture was then mowed and divided into two treatments: grazed before and after seed maturity of the stylo. Over one year, the dry matter yield in the mixed sown pasture was 30.6 tons/ha/yr, 50% more than in the guinea grass pasture.

In the mixed sown pasture grazed after seed maturity, the buried seed density of the stylo in the soil, sampled in mid-November just before the rainy season, reached about 80 seeds/m^2 at a depth of 5 cm (Table 1). This density is equivalent to one half of the seeding rate. However, no buried seed bank was formed in the mixed sown pasture grazed before seed maturity. In the mixed sown pasture grazed after seed maturity, stylo seeds were present at a high density in cattle dung, and seed dispersal was performed efficiently by cattle defecation. However, the seed was not contained in cattle dung in the guinea grass pasture or the mixed sown pasture grazed before seed maturity.

In addition, numerous stylo seedlings (25.4/m^2) appeared at the beginning of the rainy season (Fig. 1). Seedling density had decreased to 3.7/m^2 about one year later. However, about 70% of the seedlings grew to over 15 cm in height, enabling regeneration.

Stylo is able to regenerate in mixed sown pasture if it is grazed after seed maturity. Seed dispersal is conducted via cattle dung, forming a buried seed bank, allowing the pasture to maintain high productivity.

(K. Shimoda)

Table 1. Density of buried seeds and seedlings of stylo (*Stylosanthes capitata* + *S. macrocephala*).

	Treatment			
	Guinea grass Before*	Pasture After*	Mixd sown Before*	Pasture After*
Density of buried seeds (N/(m^2 × 5cm))	0	0	0	80.0
SD	0	0	0	470.0
Density of seedlings (N/m^2)	0	0	0	25.4
SD	0	0	0	107.6

Before*: Setting up the grazing before the seed maturation
After*: Setting up the grazing after the seed maturation
Measuring date: Density of buried seeds (November 2005)
Density of seedlings (December 2005)

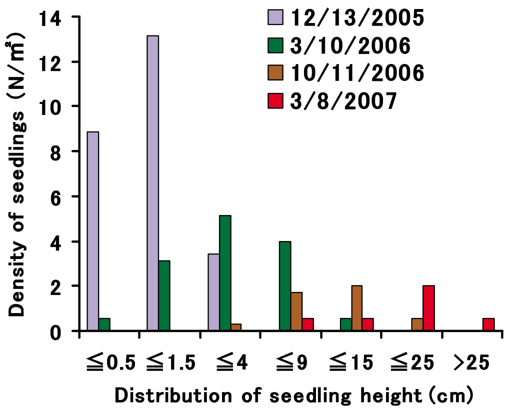


Fig. 1. Change in distribution of seedling heights of stylo.

TOPIC9

Soil and water management techniques through no-tillage farming after leguminous cover cropping

In low-input agriculture in tropical and subtropical regions, soil erosion is a significant cause of loss of soil fertility. In rainfed agriculture, water runoff is another serious problem: it accelerates damage to crops due to low water percolation into the soil in drought-prone areas. No-tillage farming has a long history as a soil erosion control measure; however, no-tillage farming is rare in low-input agriculture due to the need to apply herbicides. A combination of cover cropping together with no-tillage is expected to overcome the weeding problem without the need for herbicide application. At the same time, a leguminous cover crop can be used as a green manure to improve soil fertility. We conducted experiments in no-tillage farming after leguminous cover cropping to elucidate its comprehensive effects on soil erosion, water runoff, weed growth, and crop productivity. Mucuna bean (*Mucuna pruriens*) and sorghum were used in 2004 as test crops, and maize and hairy vetch (*Vicia villosa*) in 2005.

Tilling after mucuna bean cropping decreased soil erosion by about 35% compared with tilling after natural fallow (conventional practice), while no tilling after mucuna bean cropping decreased the soil erosion rate by 4% to 5% of that seen with conventional farming practices. Thus, tilling after mucuna cover cropping is the most effective way to control soil erosion (Fig. 1). The combination of a cover crop with no tillage was also able to decrease water runoff. The increased percolating water, corresponding to reduced water runoff, appears to be effective in reducing water stress experienced by crops in drought-prone areas.

No tilling after mucuna bean or hairy vetch cropping significantly reduced weed biomass due to the presence of plant residue mulch (Fig. 2). Cover cropping thus allows subsequent sorghum or maize no-tillage farming without herbicide application.

With or without tillage, the cereal crop yields after cover cropping and fertilizer application at half the normal rate or even at zero rate were equal to or greater than those obtained by conventional farming with the full rate of application of fertilizer. These results indicate that leguminous cover copping can be very effective as green manure to increase crop productivity.

Thus, our overall conclusion is that no-tillage farming after cover cropping is an effective system for limiting soil erosion and water runoff, reducing weed growth, and ultimately increasing crop productivity.

(F. Nagumo, R.N. Issaka, R.R. Zougmoré, and A. Hoshikawa)

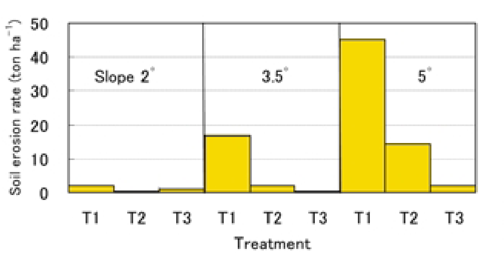


Fig. 1. Effects of different treatments and field slopes on soil erosion during the cropping period. The treatments are a combination of tillage, pre-cropping (fallow or mucuna bean cropping), and fertilizer level. T1: Natural fallow + Tillage + Full fertilizer (100 kgN ha^{-1}), T2: Cover crop + Tillage + Half fertilizer, T3: Cover crop + No tillage + Half fertilizer.

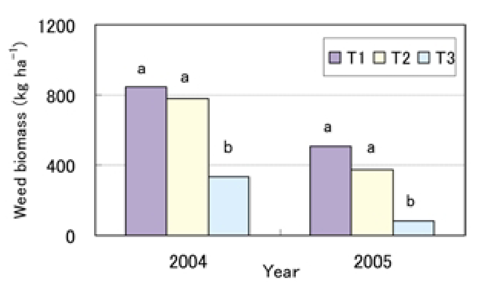
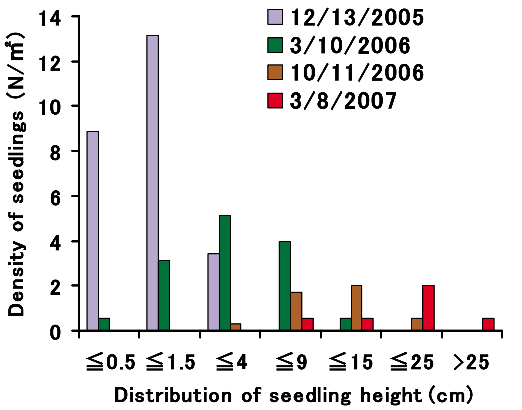


Fig. 2. Effects of different treatments on weed biomass.
The treatments are the same as those in Fig. 1. Test crop combinations are sorghum after mucuna bean in 2004 and maize after hairy vetch in 2005. Different letters indicate a statistically significant difference ($p < 0.05$).



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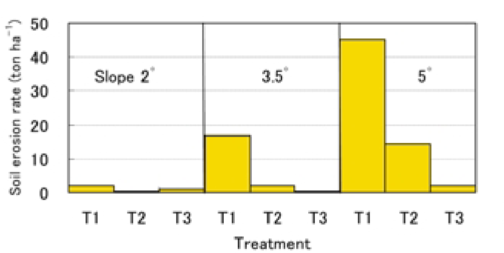

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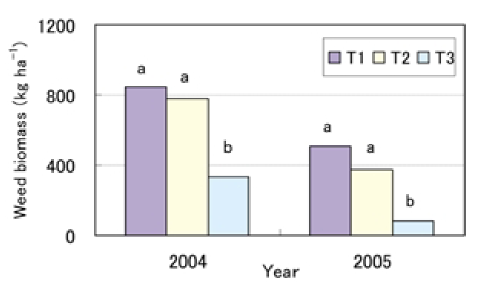

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The treatments are the same as those in Fig. 1. Test crop combinations are sorghum after mucuna bean in 2004 and maize after hairy vetch in 2005. Different letters indicate a statistically significant difference ($p < 0.05$).

TOPIC 10

"Ishigaki Sango," a new variety of heat-tolerant dwarf papaya

In Japan, papayas are produced from southern Kyushu to Okinawa, in the southernmost regions of Japan, and are consumed as a fruit and/or vegetable. 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 and low temperatures, fruit abscission occurs due to male sterility. These two characteristics constrain papaya production in Japan's growing areas in both summer, when temperatures are high, and winter, due to frequent typhoons. We therefore embarked on a program to breed a new heat-tolerant dwarf tree papaya for sub-tropical regions, with fruit quality equal to or better than the "Sunrise" family fruit.

The new papaya variety was found from a chance seedling of "Wonder Bright" in 1997. We planted it and other crossed seedlings in 1998 and selected it in 2000. This variety exhibits high fruit quality, is early bearing, and gives the highest yield of all the seedlings we raised. In 2007, the new variety was named "Ishigaki Sango" and registered with Japan's Ministry of Agriculture, Forestry and Fisheries.

"Ishigaki Sango" has a dwarf tree form and is heat-tolerant. It is ever-bearing, producing parthenocarpic fruit with a high sugar content and good flavor and taste. Plants are exclusively female.

The average fruit weight is 840 g and the average sugar content is 13.8 Brix%. The skin color is vivid orange (Japanese standard horticultural plant color charts: No. 1605), the flesh is bright reddish orange (No. 1005), and the flavor and taste are good (Table 1, Fig. 1 and 2).

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

	"Ishigaki Sango"	"Sunrise"	"Wonder Flare"
Sexing	Female	Hermaphrodite	Female
First flowering node	15	25	16
Internode length (mm)	12	35	11
Average fruit weight (g)	840	540	620
Skin color	Vivid orange	Vivid orange	Vivid reddish yellow
Flesh color	Bright reddish orange	Bright yellowish red	Vivid reddish yellow
Texture	4	5	4
Sugar content (Brix%)	13.8	14.2	13.1
Flavor	5	5	2
Heat tolerance	5	1	5

(JIRCAS-TARF, 2001 ～ 2005)

Texture: 1 (rough) ~ 5 (fine), Flavor: 1 (least) ~ 5 (most), Heat-tolerance: 1 (weak) ~ 5 (strong).

Fig. 1. Fruit of "Ishigaki Sango."
A: fruit side, B: stem end, C: fruit apex.
D: longitudinal cross section, E: transverse cross section.

Fig. 2.   Fruiting of “Ishigaki Sango” potted tree.

The tree form is dwarf because the first bearing node is the 15th, and average internode length is 12 mm, considerably shorter than in the “Sunrise” family. The average period from planting to first flowering is only 90 days. “Ishigaki Sango” is able to produce fruit throughout the year and down to 15 ℃, since it is parthenocarpic and thus not affected by male sterility at high and low temperatures.

(H. Fukamachi and H. Kato)

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*TOPIC*11

Suitable night temperature conditions for reducing the acidity content in winter-harvested passion fruit

Passion fruit (*Passiflora* spp.) are native to southern Brazil and were introduced to Japan in the 1890s. They have been cultivated commercially since the 1940s. Passion fruit can be harvested twice in a year, in summer and winter. Winter-harvested fruit display a much higher acidity than those harvested in summer; i.e., 5.3% in winter but only 2.2% in summer. High acidity in the fruit causes a reduction in their commercial value. It is important to reduce the acidity as much as possible before harvest. In the current experiment, the combined effect of a fixed day temperature of 30ºC and various night temperatures was analyzed using a growth chamber to identify suitable temperature conditions for sufficient reduction in acidity.

Experiments were performed in 2004, 2005, and 2006 using 2-year-old “Summer Queen” (*P. edulis* x *P. edulis* f. *flavicarpa*) passion fruit plants grown in a greenhouse at the Japan International Research Center for Agricultural Sciences (JIRCAS) on Ishigaki Island, Okinawa Prefecture. The plants were transplanted to 20-liter pots in July 2004. On November 15, 2005, supplemental lighting from 18:00 to 23:00 was started to promote floral induction. On January 3, 2006, when half of the experimental plants had started flowering, four plants were brought into each growth chamber and kept under temperature regimes of 30/30ºC (day/night), 30/25ºC, and 30/20ºC. The duration of the day temperature was 12 hours with artificial lighting. The other trees were left in the greenhouse with natural ventilation. Fruits were bagged to prevent them dropping to the ground, and harvested when they were mature and had dropped into their bag.

Fruit maturation was significantly enhanced at higher temperatures (Table 1). The fruit weight and juice percentage decreased with increasing temperature (Table 1). Peel color development was poor at high night temperatures (Table 1). The Brix value was not affected by night temperatures (Table 2). Titratable acidity (TA) was the lowest and the sugar/acid ratio was the highest under the 30/25ºC regime (Table 2).

The present study reveals that a temperature regime of 30/25ºC is the most effective in reducing the acidity of the winter crop of passion fruit. To be able to harvest low-acidity fruits in winter, it is recommended to keep the night temperature at around 25ºC by heating.

(Y. Yonemoto, N. Kozai and T. Ogata)

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(Y. Yonemoto, N. Kozai and T. Ogata)

Table 1. Effect of temperature regime on duration of fruit maturation period and fruit qualities of passion fruit harvested in winter.

Treatment[1)]	Duration of fruit maturation period (days)	Fruit weight (g)	Juice percentage (v/w)	Skin color[2)]		
				L* value	a* value	b* value
30/30ºC	53.5 d	66.5 c	30.6 b	54.6 a	6.8 b	31.5 a
30/25ºC	63.8 c	72.4 bc	31.1 b	40.1 b	17.1 a	17.8 b
30/20ºC	73.0 b	77.6 b	35.4 a	35.5 c	16.7 a	11.5 c
24/17ºC	86.8 a	93.5 a	35.2 a	32.4 d	9.7 b	8.3 d

Different letters indicate significant difference by Duncan's multiple range test at $p < 0.05$.

Table 2. Effect of temperature regimes on fruit qualities of passion fruit harvested in winter.

Treatment[1)]	Brix (º)	TA (%)[2)]	Sugar/acidity ratio
30/30ºC	18.1 b	3.32 b	5.5 b
30/25ºC	18.5 ab	2.81 c	6.7 a
30/20ºC	18.5 ab	3.22 b	5.8 b
24/17ºC	18.6 a	3.99 a	4.7 c

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1) Refer to Table 1.
2) Titratable acidity.

TOPIC12

An index for maturity and harvesting time of white sapote

White sapote (*Casimiroa edulis* Llave & Lex.) is an evergreen subtropical fruit tree belonging to Rutaceae, native to the highlands of Mexico and Central America. Its fruit has a sweet taste and low acidity, suitable for consumption as fresh fruit. The flavor can be preserved for long periods under refrigerated conditions. Furthermore, it is thought to be a promising new fruit crop for commercial cultivation due to its high yield (Fig. 4 top) and easy maintenance. However, there are few commercial white sapote orchards due to the short shelf-life of the fruit after ripening and the difficulty in determining the optimum harvesting time by visual observation because the fruit skin color does not change much at maturity. Harvesting immature fruit leads to low sugar content and consumer dissatisfaction. There is a slight bitterness in the fruit of most white sapote cultivars, and this may also lead to consumer discontent. It is therefore important to clarify what is a suitable harvesting time and establish a practical index to determine harvesting time for white sapote to increase its popularity.

Experiments were performed in 2003 and 2004 using the same five 7-year-old white sapote trees of cv. "Cuccio" grown under conventional commercial conditions in a field in Okinawa, Japan. The fruits showed a sigmoid growth pattern for fruit width and length (Fig. 1). The growth rate decreased 185 days after pollination (DAP). The TSS content (Brix) of the fruit pulp increased rapidly from 120 DAP, reaching 18~20º Brix at 220 DAP (Figs. 1 and 2). The percentage of dry matter (DM) in the

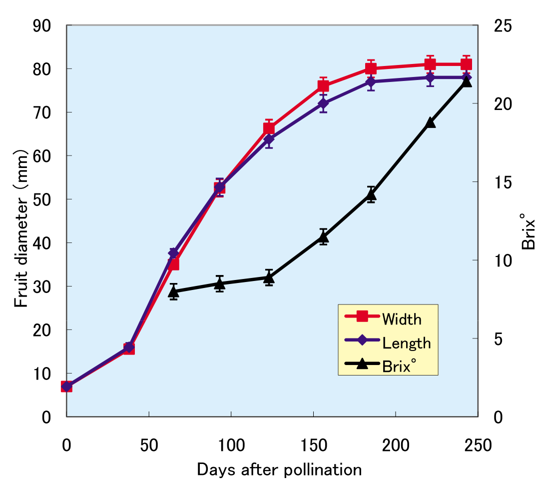

Fig. 1. Changes in fruit diameter (width and length) and total soluble solids (TSS) content during fruit development in white sapote cv. "Cuccio" (2003).

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30/25ºC	63.8 c	72.4 bc	31.1 b	40.1 b	17.1 a	17.8 b
30/20ºC	73.0 b	77.6 b	35.4 a	35.5 c	16.7 a	11.5 c
24/17ºC	86.8 a	93.5 a	35.2 a	32.4 d	9.7 b	8.3 d

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Table 2. Effect of temperature regimes on fruit qualities of passion fruit harvested in winter.

Treatment[1)]	Brix (º)	TA (%)[2)]	Sugar/acidity ratio
30/30ºC	18.1 b	3.32 b	5.5 b
30/25ºC	18.5 ab	2.81 c	6.7 a
30/20ºC	18.5 ab	3.22 b	5.8 b
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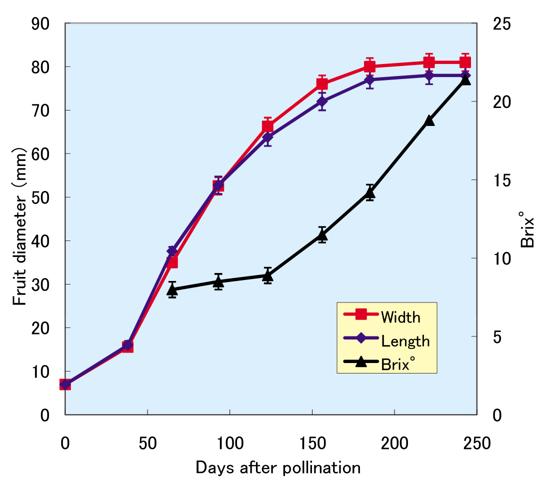


Fig. 1. Changes in fruit diameter (width and length) and total soluble solids (TSS) content during fruit development in white sapote cv. "Cuccio" (2003).

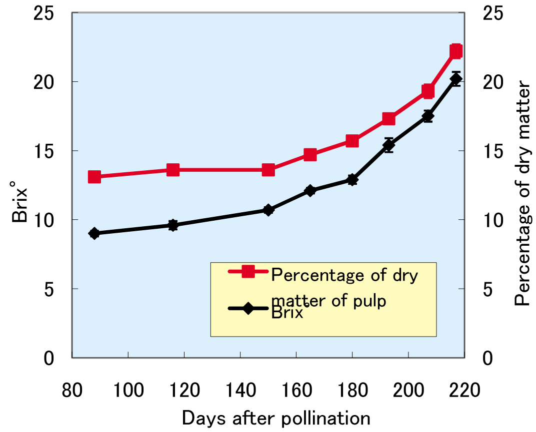


Fig. 2. Changes in dry matter percentage and total soluble solid (TSS) content during fruit development in white sapote cv. 'Cuccio' (2004).

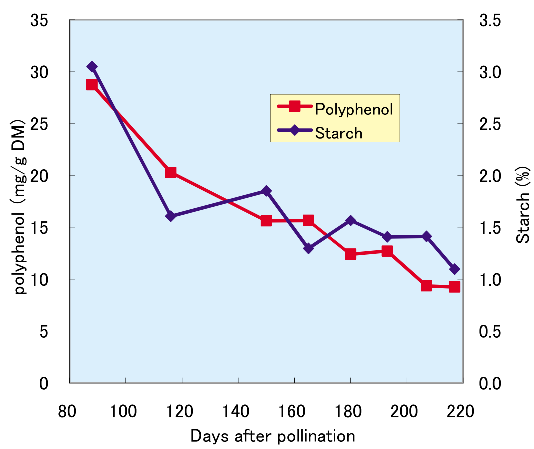


Fig. 3. Changes in polyphenol and starch contents during fruit development in white sapote cv. "Cuccio" (2004).

Fig. 4. Fruit set on branch (above).
Fruit after ripening (below).

fruit pulp increased with increased Brix during the fruit's development (Fig. 2). There is a strong correlation between TSS content and percentage DM in pulp; therefore, %DM $\geq$ 18.0% could be used as an index for fruit maturity. The rapid increase in Brix in the late period of fruit development is thought to be due to increased translocation of substances from the leaves rather than decomposition of starch, since the starch content in the fruit at this period is low (Fig. 3) at less than 1.5%, and little sugar is produced from the starch during the ripening period (Fig. 3). Thus it is necessary to harvest the fruit after the sugar content becomes high enough for fresh fruit consumption. The bitter polyphenol (equivalent to catechin) content in the fruit pulp is about 3% of DM at 88 DAP, falling to below 1% at 207 DAP, then remaining constant. This suggests that cv. "Cuccio" should be harvested 207 DAP to minimize the bitterness. Even though the fruit skin color changes little on the tree, it turns to yellowish when the fruit softens after ripening (Fig. 4 bottom).

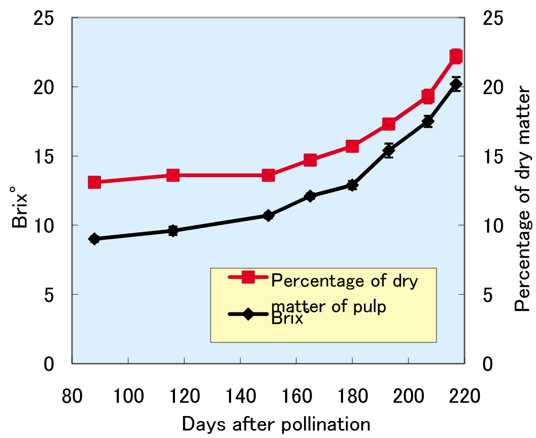
These results indicate that DAP, TSS, and % DM are potentially good indicators of fruit maturity in cv. "Cuccio."

(Y. Yonemoto)

TOPIC13

The effectiveness of the medicinal plant *noni* as a cash crop in agroforestry

Agroforestry systems are anticipated to contribute to sustainable forest management and the improvement of local economies. We have focused on agroforestry systems as a technology for forest rehabilitation from degraded secondary forests and derelict plantations of fast-growing tree species in Sabah, Malaysia. Our previous findings



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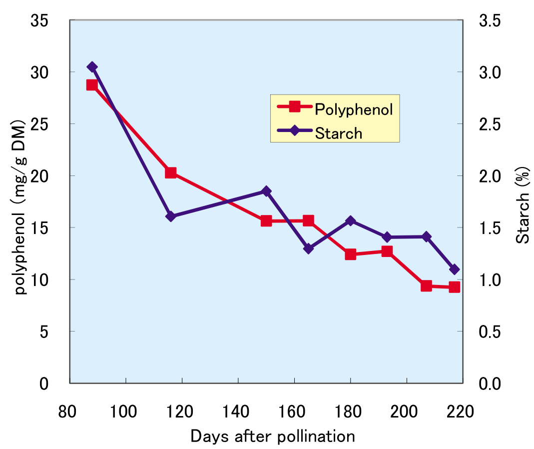

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TOPIC13

The effectiveness of the medicinal plant *noni* as a cash crop in agroforestry

Agroforestry systems are anticipated to contribute to sustainable forest management and the improvement of local economies. We have focused on agroforestry systems as a technology for forest rehabilitation from degraded secondary forests and derelict plantations of fast-growing tree species in Sabah, Malaysia. Our previous findings suggested that *Acacia mangium* is usable as a nurse tree to provide suitable conditions (e.g., the correct amount of shade) for seedling establishment of indigenous tree species such as dipterocarps. Choice of suitable cash crops which can be cultivated under *Acacia mangium* trees is essential to permit forest rehabilitation to be integrated with the cultivation of cash crops.

Demand for medicinal and herbal products has recently increased worldwide due to health fads. *Noni* (*Morinda citrifolia*, Rubiaceae) is one of the most popular medicinal plants. It has been used for treatment of various ailments such as hypertension, diabetes, and poor digestion. We monitored the growth performance and fruit yield of *noni* to examine its potential as an agroforestry cash crop under *Acacia mangium* trees.

A field census was conducted at an agroforestry experimental plot (1.6 ha) in an 18-year-old (as of 2006) *Acacia mangium* plantation at the Kolapis-A Research Station, Lungmanis Forest Reserve, Sabah. The plot slopes from east to west. It consists of subplots with different thinning treatments (unthinned, 33% thinned, and 66% thinned). In 2003, *noni* seedlings were planted in each subplot together with seedlings of indigenous species including dipterocarps, fast-growing species, and cash crops such as fruit trees. Ripe *noni* fruit were harvested and weighed every month. Soil moisture content was measured using an ADR sensor (Delta-T Devices, Ltd.). Water permeability was measured using falling head permeability tests (DIK-4012, Daiki Rika Kogyo Co., Ltd.).

Noni fruit were harvestable from 1 year after planting. The highest fruit yield was found on the upper slope with 66% thinning (Fig. 1). Soil moisture content was constantly higher on the lower slope than on the upper slope all year round (Fig. 2). Higher water permeability was detected on the upper slope than on the lower slope (1.6×10^{-2} to 2.7×10^{-3} cm s^{-1} on the upper slope versus 2.0×10^{-3} to 2.6×10^{-5} cm s^{-1} on the lower slope).

These results suggest that high light conditions and good drainage are preferable to obtain high fruit yields of *noni* under *Acacia mangium* plantations. Thus, *noni* has potential as a useful cash crop under *Acacia mangium* plantations, provided light conditions and soil drainage are managed.

(K. Miyamoto, T. Yamada T. Ota, K. Kamo, and J. Lapongan)

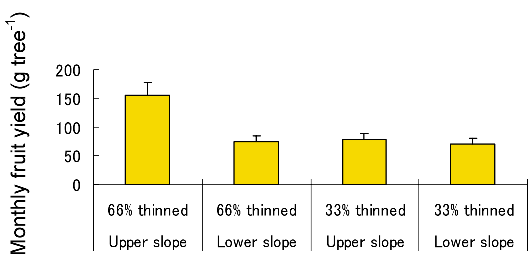

Fig. 1. Comparison of monthly fruit yield of *noni* between upper and lower slope at different thinning rates (from August 2005 to January 2006).

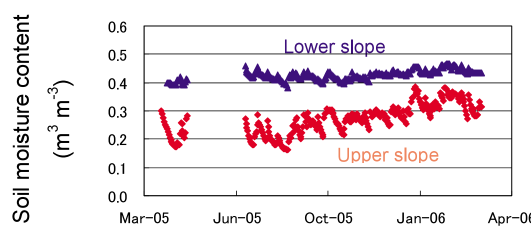

Fig. 2. Variation in soil moisture content at 10 cm soil depth.

TOPIC14

Primary factors to improve management of dairy farms in suburbs of the Mongolian capital

In Mongolia, which is located in arid and semi-arid zones, nomadism is a traditional way of life but is at the mercy of weather conditions. The animal husbandry industry, which is chiefly nomadic, continues to serve as a pillar of the economy. After the transition to a market economy in 1990, nomadic herders rapidly increased their livestock numbers. The country suffered record snow-cold disasters (*Dzud*) during the three successive winter-spring periods of 1999-2002 for the first time in a half-century, which were fatal to about one-third of the total livestock as of the end of 1999. After this experience, nomads began to discuss giving up nomadism, which is susceptible to the influence of climate suggested that *Acacia mangium* is usable as a nurse tree to provide suitable conditions (e.g., the correct amount of shade) for seedling establishment of indigenous tree species such as dipterocarps. Choice of suitable cash crops which can be cultivated under *Acacia mangium* trees is essential to permit forest rehabilitation to be integrated with the cultivation of cash crops.

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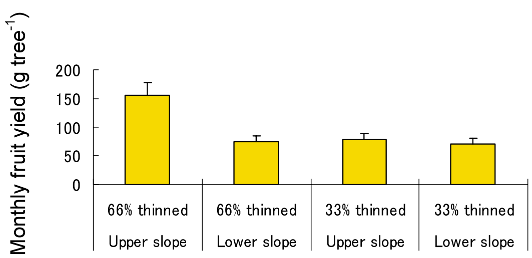

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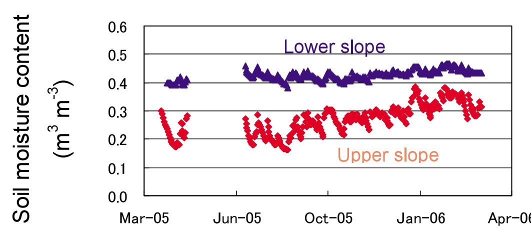

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Table 1. Deciding factors of milk shipment per milking cow.

Explanatory variables	Estimates	t-values
Constant	0.757*	1.734
Labor per milking cow	0.104	0.928
Concentrate feed per milking cow	0.421***	3.597
Dummy: Dairy farms with shifts in location of grazing land	0.458	1.473
Dummy: Dairy farms started before 1999	0.452	1.415
Dummy: Dairy farms with > 15 milking cows	1.110***	3.309
Adjusted R^2	0.617	

Values marked *** and * are statistically significant at 1% and 10%, respectively.

Table 2. Deciding factors of net profit rate to milk sales.

Explanatory variables	Estimates	t-values
Constant	-11.635*	-2.010
Concentrate feed per milking cow	0.978	1.627
Annual average of milk shipping price	3.267*	1.902
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change, in favor of residing permanently in city suburban zones, and starting intensive animal husbandry, especially dairy farming. The Mongolian government is also adopting a policy of promoting more intensive settled and semi-settled types of animal husbandry.

It must be verified whether settled and semi-settled types of animal husbandry, accompanied by the production and purchase of feed, are economically sustainable in arid and semi-arid zones like Mongolia, where many previous studies have concluded that nomadism is the optimal means of animal husbandry.

To investigate this, a dairy farm survey that targeted dairy households in the Ulaanbaatar suburbs was implemented in 2004 with the cooperation of the Mongolian State University of Agriculture to investigate dairy management.

Analyses of the economic viability of dairy farming were carried out using data from 30 surveyed dairy farms. The average net profit rate of these farms was approximately 25%, showing them to be sufficiently profitable and apparently economically viable at present.

To identify the primary factors influencing milk shipment per milking cow and net profit rate to milk sales, regression analyses were carried out using explanatory variables such as labor, animal feed, and milk prices. These analyses revealed that a higher amount of concentrate feed per milking cow and larger numbers of milking cows were the most important factors in increasing milk shipment per milking cow. On the other hand, higher milk prices and larger numbers of milking cows were the most important factors in increasing net profit rate to milk sales.

(H. Komiyama)

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

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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 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 quasi-real-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.

■ **Stable food supply systems for mitigating the fluctuations in production and markets in China**: We established early warning systems on climate disasters, incorporating mesh data on temperature and precipitation, in Heilongjiang Province, and developed a technology to ensure 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 construction of 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 based on various scenarios in natural environments and social conditions (Fig. 1).

■ **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

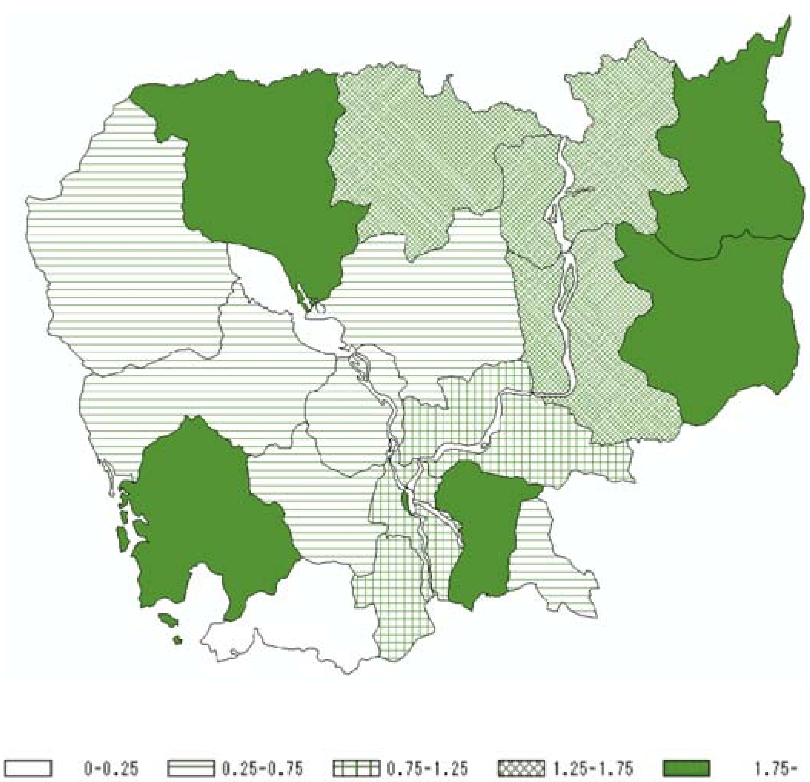

Fig. 1. Areas in which rice planted areas respond sensitively to water cycle fluctuation; the ratios in the legend are the growth rates of the rice planted area assuming a 20% increase in water cycle fluctuation.

Photo 1. *Diaphorina citri* larvae on a bud of an HLB-infected citrus seedling. (Photo: Yasuo Ohto)

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.

B Collection, analyses 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 as well as technology development trends in agriculture, forestry, and fisheries were collected and examined by attending meetings organized by international organizations. To formulate future plans for collaborative research in African regions, a strategic survey on the key technologies for innovation in African agriculture was implemented.

The needs and outcomes of our international agricultural research were disseminated to the public by organizing open meetings, including a series of symposia commemorating the Year of Deserts and Desertification and a lecture by the Nobel laureate Norman Borlaug.

Regarding the socioeconomic analyses of technology development and rural development, two new projects, a study on the determining factors of the adoption of new water management technologies in Southeast Asia, as well as a study on the impacts of regional and economic integration on agricultural structure and farm income, were initiated, and extensive preliminary surveys were conducted.

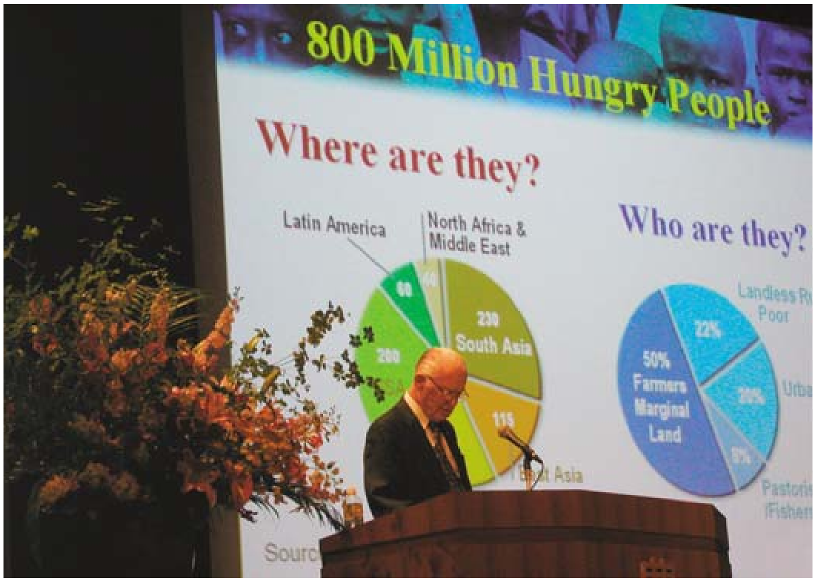

Fig. 1. Nobel laureate Dr. Borlaug giving his lecture.

TOPIC 1

The role of foreign direct investment and the food processing industry in realizing high value-added agriculture in developing countries

In Asia, vertical coordination between food processing enterprises and farms such as contract farming is spreading in response to the expansion of the vegetable, fruit, and livestock sectors due to continuous economic development and increased public awareness of food safety issues. In contract farming schemes, foreign firms tend to instruct farmers in good farming practices, and this momentum is accelerated by the arrival of foreign supermarkets in big cities.

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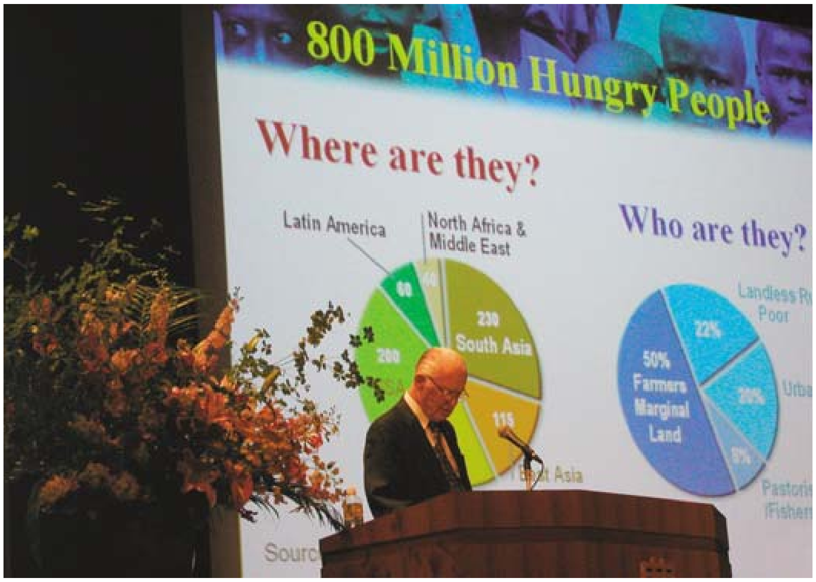

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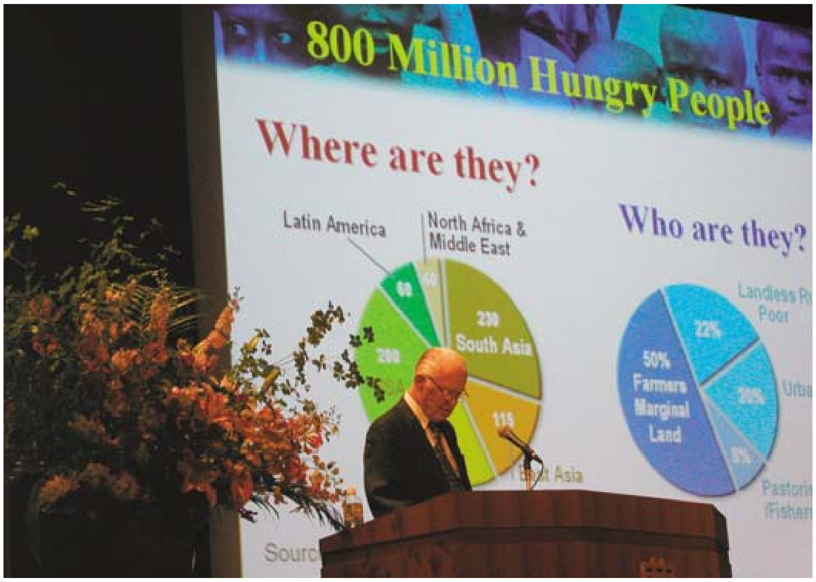

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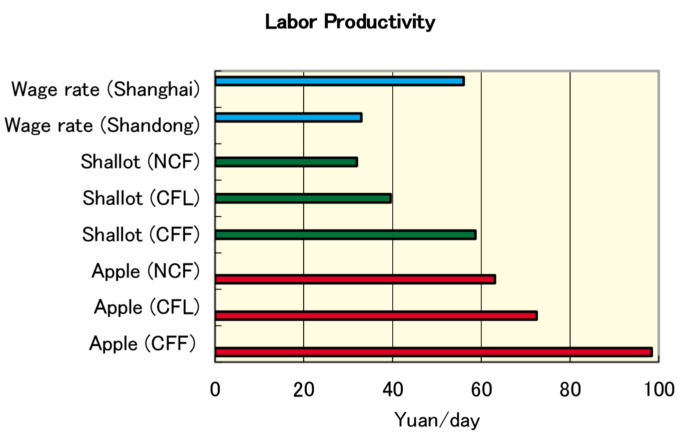
has a positive influence on farmers, in 2004 we conducted a cross-country statistical analysis to test the value addition linkage from the food processing industry to the agricultural sector, and a field survey on farm incomes which compared the relative productivity between contract farmers and non-contract farmers in Shandong Province, China. In the survey, contract farmers were classified into two types: those who had contracts with firms with predominantly foreign capital holdings and those who had contracts with firms whose capital was held mainly by local firms, for the commodities of shallots, apples, and chickens.

The results of a regression analysis of the factors affecting differences in agricultural value addition per agricultural worker across countries showed the value addition in the food processing industry per agricultural worker to be significant as well as other variables, such as the share of fruits and vegetables in farmland, farmland area per agricultural worker, and the irrigation ratio. This implies that the development of the food processing industry and the shift in agricultural production toward fruits and vegetables contributes to increased farm incomes.

In addition to this statistical analysis, our field survey in China gave evidence that a) contract farmers are provided with advanced technology as well as discounted chemicals and fertilizers, b) contract farmers, especially those who have contracts with firms with predominantly foreign capital holdings, show higher labor and land productivity (Fig. 1), c) the labor productivity of farmers who are producing apples is higher than the wage rate in Shandong Province and Shanghai City (Fig. 1), and d) the average farm size is less than one ha for each farm type, and participation in contract farming did not correlate with farm size or the academic record of the farm head. It thus appears that there is no entry barrier to contract farming for small farmers.

This study's results suggest that inviting foreign enterprises to the food processing sector and promoting vertical firm-farm coordination effectively enhance farm income in rural areas of developing countries.

(M. Tada)



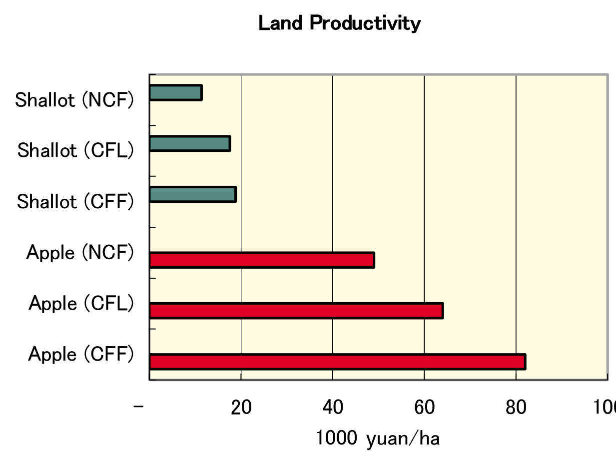


Fig. 1. Comparison of labor and land productivity by type of farm.

Note
Farm types:
CFF: Contract farmers who have contracts with firms with predominantly foreign capital holdings;
CFL: Contract farmers who have contracts with firms with predominantly local capital holdings;
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TOPIC2

Analyzing priorities for agricultural R&D in Asian developing countries

To support policy planners in deciding how to allocate resources for R&D activities in an appropriate manner, a questionnaire survey was conducted in eight Asian countries (Bangladesh, India, Indonesia, Lao People's Democratic Republic, Myanmar, Sri Lanka, Thailand, and Vietnam) in 2005. The survey was designed to reveal has a positive influence on farmers, in 2004 we conducted a cross-country statistical analysis to test the value addition linkage from the food processing industry to the agricultural sector, and a field survey on farm incomes which compared the relative productivity between contract farmers and non-contract farmers in Shandong Province, China. In the survey, contract farmers were classified into two types: those who had contracts with firms with predominantly foreign capital holdings and those who had contracts with firms whose capital was held mainly by local firms, for the commodities of shallots, apples, and chickens.

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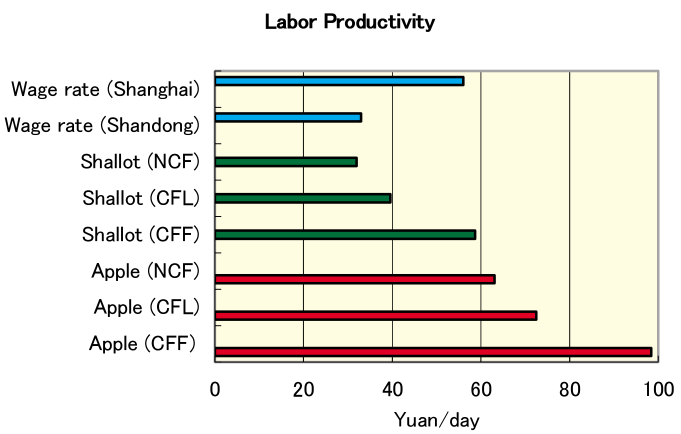

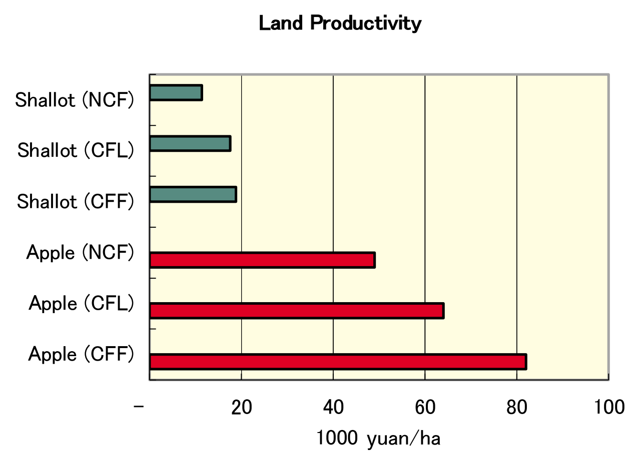

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Table 1 shows the I-index of all the surveyed R&D topics, which reveals the priority of each R&D topic, calculated using the answers of all the 259 respondents from the eight countries. While the development of labor-intensive (= material-saving) technologies such as "Economical soil improvement," "Pest-tolerant varieties," and "Effective input use" received a higher I-index, "labor-saving technology" received a lower I-index.

Out of six R&D topics which received an I-index of 80 or more, "Pest-tolerant varieties" was the only topic recognized as effective for all three outcomes, namely "Poverty alleviation," "Socio economic development," and "Environmental issues." "Economical soil improvement" and "Soil conservation" were recognized as quite effective in "Environmental issues" while "Poverty alleviation" and "Socioeconomic development" scored relatively lower. "Food/feed processing technology," "Stress-tolerant varieties" and "Effective input use" were recognized as effective in improving rural welfare both on a short- and long-term basis with fewer expected environmental issues.

Fig. 1 shows that while 60% of researchers anticipate the development of "Stress-tolerant varieties" to have a positive impact on environmental problems, only 39% of extension staff and 15% of farmers felt the same. It is necessary for researchers to put more effort into practical application of the technology to win trust in technology development on the part of farmers and extension staff. The difference between researchers and farmers regarding "Effective input use" can also be attributed to the respondents' expectations of how technology can contribute to solving environmental problems. Researchers focus on overuse of input, while farmers without access to adequate input supplies gave this a lower priority. While researchers gave more

Table 1. Importance index (I-index)* and expected effects** of 15 R&D topics (Respondents*** = 259).

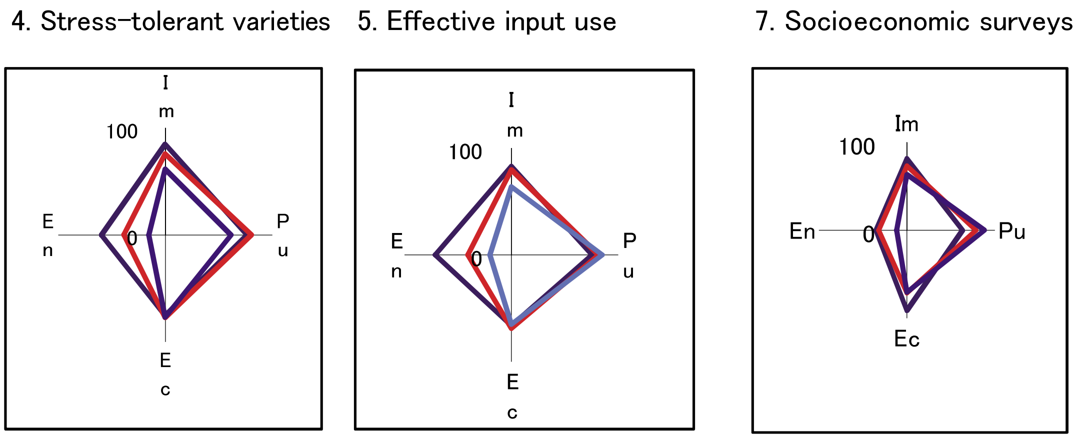
R&D topics****	I-Index	Poverty alleviation	Socioeconomic development	Environmental issues
1. Economical soil improvement	**88**	B	C	**A**
2. Pest-tolerant varieties	**88**	**A**	**A**	**A**
3. Food/feed processing technology	**82**	B	**A**	D
4. Stress-tolerant varieties	**81**	B	B	D
5. Effective input use	**80**	B	B	C
6. Soil conservation	**80**	C	C	**A**
7. Socioeconomic surveys	78	B	**A**	D
8. Cheaper machinery	78	B	**A**	D
9. Economical pest control technology	78	C	B	**A**
10. Decreasing contamination	75	D	B	**A**
11. Water management technology	74	C	B	B
12. Non-food/feed processing technology	70	C	B	B
13. Intercropping technology	69	**A**	B	D
14. Consumer preference surveys	67	D	**A**	D
15. Labor saving technology	63	C	**A**	D

* I-index = (Number of respondents answering that the R&D topic is "extremely important" * 100 + Number of respondents answering "important" * 50 ＋ Number of respondents answering "somehow important" * 25 + Number of respondents answering "not important" * 0)/(Number of total respondents except those answering "unknown").

** A: Quite effective (100-80% of respondents chose the option), B: Effective (65-79%), C: Somewhat effective (50-64%), D: Not very effective (0-49%).

*** Profession of respondents: Research 107, extension 36, education 29, farming 27, policy planning 27, research management 18, others15.

**** Bold means I-index is 80 or more.



— Researchers
— Extension staff
— Farmers
Im: I-index
Pu: Poverty alleviation (percent of respondents choosing this option)
Ec: Socioeconomic development (percent of respondents choosing this option)
En: Environmental issues (percent of respondents choosing this option)

Fig. 1. I-index and expected effects on R&D topics by respondents' occupation.

priority than farmers to “Socioeconomic surveys,” farmers had higher hopes of a positive impact on poverty alleviation from this subject than researchers. It has been shown that researchers are less confident that the conclusions of a socioeconomic study can contribute to poverty alleviation, although they admit the importance of socioeconomic studies in general. More attention should be paid to promoting socioeconomic studies that can result in actual beneficial impacts on the welfare of the rural poor, as well as producing scientific findings.

(T. Sugino)

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 concerning agriculture, forestry, and fisheries administration, while at the same time strengthening international research ties among scientists and administrators in other countries. Current programs are described in greater 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 review ongoing research 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). Finally, 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-two individual visits to JIRCAS were made during FY 2006 under the Administrative Invitation Program. Invited administrators and their home institutions are listed below.

Administrative Invitations, FY 2006		
Norman Neumaier	EMBRAPA-Saja, National Center for Soybean Research, Brazil	July 2-10, 2006
Carlos Alfredo Senigagliesi	Institutional Relations, Instituto Nacional de Tecnologia Agropecuaria (INTA), Argentina	July 2-10, 2006
Peter Kerridge	Former CIAT-Asia Project leader, Australia	July 2-10, 2006
Patcharee Tungtrakul	Institute of Food Research and Product Development (IFRPD), Kasetsart University, Thailand	July 23-31, 2006
Warunee Varanyanond	Institute of Food Research and Product Development (IFRPD), Kasetsart University, Thailand	July 27-31, 2006
Pannee Panyawattanaporn	Office of International Affairs, National Research Council of Thailand, Thailand	Aug. 20-25, 2006
Warapan Wicharn	Office of International Affairs, National Research Council of Thailand, Thailand	Aug. 20-25, 2006
Choosri Keedumorngkool	Office of International Affairs, National Research Council of Thailand, Thailand	Aug. 21-25, 2006
Mahmoud El-Solh	International Center for Agricultural Research in the Dry Areas (ICARDA), Lebanon	Aug. 22-30, 2006
Barry Ira Shapiro	International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), India	Aug. 24-30, 2006
Marl W. Rosegrant	International Food Policy Research Institute (IFPRI), Environment and Production Technology Division (EPTD), USA	Oct. 21-27, 2006
Pilanee Vaithanomsat	Kasetsart Agriculture and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Thailand	Nov. 14-23, 2006

Warunee Thanapase	Kasetsart Agriculture and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Thailand	Nov. 15-22, 2006
Xu Xiaoqing	Department for Rural Economic Development Research Center of the State Council, P.R. China	Nov. 19-26, 2006
Ismail bin Awang Kechik	Fisheries Research Institute, Malaysia	Nov. 26-Dec. 2, 2006
Badarch Byambaa	Mongolian State University of Agriculture, Mongolia	Nov. 27-Dec. 1, 2006
Altangerel Gombojav	Mongolian State University of Agriculture, Mongolia	Nov. 27-Dec. 1, 2006
Mai Van Tri	Southeast Fruit Research Center, Vietnam	Jan. 14-18, 2007
Siriporn Volakuldumrongchai	Chanthaburi Horticultural Research Center, Vietnam	Jan. 14-20, 2007
Khanphet Roger	Living Aquatic Resources Research Center, Lao PDR	Feb. 26-Mar. 6, 2007
Bandith Tansiri	Land Development Department, Thailand	Mar. 5-10, 2007
Chumpol Lilittham	Office of Soil Survey and Land Use Planning, Land Development Department, Thailand	Mar. 5-10, 2007

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 in foreign countries and to facilitate exchanges between individual research staff. Seventeen researchers were invited under the Counterpart Researcher Invitation Program during FY 2006. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

Counterpart Researcher Invitations, FY 2006

Gassinee Trakoontivakorn	Institute of Food Research and Product Development, Kasetsart University, Thailand	Study on food functionalities of indigenous vegetables using mouse presdipocytes	Apr. 6-May 20, 2006
Plernchai Tangkanakul	Institute of Food Research and Product Development, Kasetsart University, Thailand	Study on food functionalities of indigenous vegetables using human cancer cells	Apr. 6-May 20, 2006
Chaturong Laorpansakul	Land Development Department (LDD) Soil Survey and Land Use Planning, Thailand	Mapping of soil, topography, and land use for efficient use of water resources in a study area	June 4-July 1, 2006
Chen Yongfu	College of Economics and Management, China Agricultural University, P.R. China	Elucidation of supply and demand trend of rice in the north region	July 20, 2006-Jan. 19, 2007
Qian Guixia	Department of Economics, College of Economics and Management, Inner Mongolia University, P.R. China	Development of a farm planning model for reducing the risks of production fluctuation	Aug. 7, 2006-Feb. 2, 2007

Krailert Taweekul	Department of Agricultural Extension, Faculty of Agriculture, Khon Kaen University, Thailand	Expansion of technology development through farmer exchange	Sept. 20-Oct. 20, 2006
He Yingbin	Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, P.R. China	Analysis of changes of cropped area on regional scale using satellite data	Sept. 25-Dec. 15, 2006
Chakrit Tachaapaikoon	Enzyme Technology Laboratory, Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi (Bangkuntien), Thailand	Efficient degradation of crop residues using microbial enzymes	Oct. 2-Dec. 1, 2006
Dusut Aue-umneoy	King Mongkut's Institute of Technology Ladkrabang (Rayong Campus), Thailand	Study on sustainable production systems of tropical resources	Oct. 22-Nov. 1, 2006
Do Thi Thanh Huong	College of Aquaculture and Fisheries, Cantho University, Vietnam	Relationship between osmoregulation and reproduction in the Pacific white shrimp, *Litopenaeus vannamei*	Nov. 1-27, 2006
Ryon Slow	Aquatic Ecology Section, Fisheries Research Institute, Malaysia	Site survey of semienclosed coastal ecosystem and analytical trainings on the physiology of bivalves against marine chemical agents	Nov. 12-Dec. 2, 2006
Guo Jianjun	Department for Rural Economic Development Research Center of the State Council, P.R. China	Elucidation of supply and demand trend of rice in the north region	Nov. 19-Dec.19, 2006
Xu Yinlong	Institute of Agro-Environment and Sustainable Development, Chinese Academy of Agriculture Sciences, P.R. China	Development of methods to evaluate agro-meteorological disasters using mesh climate/metorological data	Dec. 10-16, 2006
Martin Broadley	University of Nottingham, UK	Genetics, transcriptomics, and metabolomics of plant nutrition	Jan. 23-30, 2007
Sun Weilin	Technology Economics and Scientific Development Research Department, Institute of Agricultural Economics and Development Chinese Academy of Agricultural Sciences, P.R. China	Evaluation of functions of agricultural social service system for stabilization of farm and rural management	Jan. 29-Feb. 27, 2007
Mohammad Daud Stanikzai	Soil Department, Agriculture Research Institute, Ministry of Agriculture, Animal Husbandry and Food, Afghanistan	Analysis of agriculture in Afghanistan and the proposal of R&D strategies for the development	Feb. 3-Mar. 25, 2007
Chalao Pitaksinsuk	Animal Nutrition Division, Department of Livestock Development, Thailand	Establishment of rapid estimation method of the nutritive value in feed by enzyme and near infrared spectrophotometer	Feb. 19-Mar. 16, 2007

Project Site Invitation Program

In FY 2006, JIRCAS launched this invitation program to invite researchers from developing countries to project sites, such as collaborative project sites in developing countries where JIRCAS researchers are engaged in collaborative activities on various research themes and in other countries where workshops or planning meetings are held. Under this program, 27 researchers were invited to JIRCAS project sites and have implemented their programs listed below.

Project Site Invitations, FY 2006			
Sar Chetra	Department of Animal Health and Production, Ministry of Agriculture and Fisheries, Cambodia	Planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	June 8-10, 2006
Chhum Phith Loan	Royal University of Agriculture, Faculty of Animal Science and Veterinary Medicine, Cambodia	Planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	June 8-11, 2006
Viengsakoun Napasirth	Department of Livestock and Fisheries, Faculty of agriculture, National University of Laos, Lao PDR	Planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	June 8-11, 2006
Thongphanh Kousonsavath	Faculty of Agriculture, National University of Laos, Lao PDR	Planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	June 8-11, 2006
Rasti Saraswati	Soil Biology Div., Indonesian Soil Research Institute, Indonesia	Good soil care in the tropics	June 13-17, 2006
Nani Sumarni	Soil Division, Indonesian Vegetable Research Institute, Indonesia	Good soil care in the tropics	June 13-17, 2006
Luu Hong Man	Cuu Long Rice Research Institute, Vietnam	Good soil care in the tropics	June 14-17, 2006
Le Cam Loan	Plant Pathology Department, Cuu Long Delta Rice Research Institute, Vietnam	Development of differential system in Vietnam	Aug. 28-31, 2006
Pham Van Du	Plant Pathology Department, Cuu Long Delta Rice Research Institute, Vietnam	Development of differential system in Vietnam	Aug. 28-31, 2006
Cailin Lei	Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, P.R. China	Differential system of blast resistance for stable rice production environment	Aug. 28-31, 2006
Suwarno	Indonesian Institute for Rice Research (IIRR), Indonesia	Differential system of blast resistance for stable rice production environment	Aug. 28-31, 2006
Santoso, Msi	Fitopathology Division, Indonesian Institute for Rice Research (BALITPA), Indonesia	Differential system of blast resistance for stable rice production environment	Aug. 28-31, 2006
Sobrizal	National Nuclear Energy Agency, Center for Application of Isotope and Radiation Technology, Indonesia	Differential system of blast resistance for stable rice production environment	Aug. 28-31, 2006
Loida M. Perez	Plant Breeding and Biotech Division, Philippine Rice Research Institute, Phillipines	Differential system of blast resistance for stable rice production environment	Aug. 28- 31, 2006
Fe A. Dela Pena	Crop Protection Division, Philippine Rice Research Institute, Phillipines	Differential system of blast resistance for stable rice production environment	Aug. 28-31, 2006
Antonio Juan Gerardo Ivancovich	Instituto Nacional de Tecnologia AgroPecuaria (INTA) - Estacion Experimental Agropecuaria (EEA) Pergamino, Argentina	Workshop on soybean rust (at Embrapa-Soja)	Sept. 17-22, 2006

Ing. Agr. Angela Narma Farmento	Instituto Nacional de Tecnologia AgroPecuaria (INTA) - Estacion Experimental Agropecuaria (EEA) Pergamino, Argentina	Workshop on soybean rust (at Embrapa-Soja)	Sept. 17-22, 2006
WilfridoMorel Paiva	Centro Regional de Investigacion Agricola (CRIA), MAG, Paraguay	Workshop on soybean rust (at Embrapa-Soja)	Sept. 18-21, 2006
Manuel Santiago Paniagua	Centro Regional de Investigacion Agricola (CRIA), Paraguay	Workshop on soybean rust (at Embrapa-Soja)	Sept. 18-21, 2006
Adrian Dario De Lucia	Instituto Nacional de Tecnologia AgroPecuaria (INTA) - Estacion Experimental Agropecuaria (EEA) Cerro Azul, Section Soja, Argentina	Workshop on soybean rust (at Embrapa-Soja)	Sept. 18-21, 2006
Leonardo Daniel Ploper	Estacion Experimental Agroindustrial “Obispo Colombres” (EEAOC), Argentina	Workshop on soybean rust (at Embrapa-Soja)	Sept. 18-22, 2006
Chhum Phith Loan	Royal University of Agriculture, Faculty of Animal Science and Veterinary Medicine, Cambodia	Results and planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	Dec. 18-19, 2006
Viengsakoun Napasirth	Department of Livestock and Fisheries, Faculty of Agriculture, National University of Laos, Lao PDR	Results and planning meeting of research project for establishment of feeding standard of beef cattle and feedstuff database in Indochina	Dec. 18-19, 2006
Kimsan Sophorn	Royal University of Agriculture, Faculty of Animal Science and Veterinary Medicine, Cambodia	Acquisition of neutral and acid detergent fiber analysis and gas production technique by mixed culture with rumen juice from cattle	Jan. 7-20, 2007
Wilfrido Morel Paiva	Centro Regional de Investigacion Agricola (CRIA), MAG, Paraguay	Meeting of soybean rust project (at Embrapa-Soja)	Jan. 16-20, 2007
Antonio Juan Gerardo Ivancovich	Instituto Nacional de Tecnologia AgroPecuaria (INTA) - Estacion Experimental Agropecuaria (EEA) Pergamino, Argentina	Meeting of soybean rust project (at Embrapa-Soja)	Jan. 16-20, 2007
Ray-yu Yang	Nutrition University, AVRDC - The World Vegetable Center, Taiwan	Workshop on functionality of indigenous vegetables	Mar. 12-16, 2007

FELLOWSHIP PROGRAMS AT JIRCAS

JIRCAS Visiting Research Fellowship Program at Tsukuba

A program similar to the Okinawa Visiting Research Fellowship Program has been implemented at JIRCAS’s Tsukuba premises since October 1995. The Tsukuba Visiting Research Fellowship Program aims to promote collaborative research to address various problems confronting countries in developing regions. Under this program, nine researchers were invited to conduct research at JIRCAS HQ in Tsukuba for a period of one year from May 2006 to April 2007. The invitees and their research activities in FY 2006 are listed below.

JIRCAS Visiting Research Fellowships at Tsukuba (May 2006 to April 2007)		
Pan Xianzhang	Department of Soil Geography, Institute of Soil Science, Chinese Academy of Sciences, P.R. China	Development of methods of classification and monitoring of land use using satellite data
Wang Yunxia	College of Agriculture, Yangzhou University, P.R. China	Factors associated with rice zinc deficiency tolerance
Wang Zhiguo	Center for Agricultural Resources Research, Institute of Genetics and Development Biology, Chinese Academy of Sciences, P.R. China	Development of DNA markers associated with tolerance to environmental stresses in soybean
Hairmansis Aris	Indonesian Institute for Rice Research (BALITPA), Indonesia	Genetic study and molecular breeding for blast resistance in rice (*Oryza sativa* L.)
Qin Feng	Laboratory of Plant Molecular Biology, Department of Biological Sciences and Biotechnology, Tsinghua University, P.R. China	*Arabidopsis* DREB2A interacting proteins 1 and 2 function as RING E3 ubiquitin ligase and negatively regulate plant stress-responsive gene expression
Hossain Zakir	Department of Crop Botany, Faculty of Agronomy, Bangladesh Agricultural University, Bangradesh	Characterization of biological nitrification inhibition in Sorghum bicolor L
Ho Giang Thi Thu	Department of Entomology, Faculty of Agronomy, Hanoi Agricultural University, Vietnam	Biological control of invasive insect pests on coconut trees
Pason Pattra	Biochemical Technology, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bang Khun Tian), 10150, Bangkok, Thailand	Efficient degradation of crop residues using microbial enzymes
Tran Uyen Thi	Bureau of Accreditation, Directorate for Standards and Quality, Ministry of Science and Technology, Vietnam	Studies on water soluble polysaccharide and 1-pyrroline dehydrogenase in rice

JIRCAS Visiting Research Fellowship Program at Okinawa

The Okinawa Visiting Research Fellowship Program was initiated in FY 1992. The program invites scientists who hold at least a Master's Degree to conduct research for a period of one year at the Tropical Agriculture Research Front (formerly the Okinawa Subtropical Station). In FY 2006, four researchers focused on important topics relating to tropical agriculture in developing countries. The invitees and their research activities in FY 2006 are listed below.

JIRCAS Visiting Research Fellowships at Okinawa (May 2006 to April 2007)		
Houngnandan Pascal	University of Abomey-Calavi, Faculty of Agricultural Sciences Crop Production Sciences, Benin	Effect of rock phosphate (RP) and triple superphosphate (CP) on cowpea and maize's growth and on P availability
Zulfiquar Ali Abu Hena	Soil Water & Environment Department, Dhaka University, Bangladesh	Effects of irrigation time and watered plastic bottle on vegetable production
Orwintinee Chusri	Chanthaburi Horticultural Research Center, Thailand	Effect of Paclobutrazol on flowering of “Irwin” mango (*Mangifera indica* L.)
Subbarayan Silvakumar	Tamil Nadu Agricultural University, Directorate of Research, India	Cloning of proline transporter gene from cowpea (*Vigna unguiculate* L.)

JIRCAS Visiting Research Fellowship Program at Project Sites

This Visiting Research Fellowship Program has been implemented at project sites of JIRCAS researchers since May 2006. It aims to promote collaborative research to address various problems confronting countries in developing regions. Researchers in developing countries gather at project sites where JIRCAS researchers are engaged in collaborative activities with national and international research organizations. In FY 2006, four researchers stayed in Brazil, Niger, Thailand and the Philippines. The invitees and their research activities in FY 2006 are listed below.

For more information on the JIRCAS Visiting Research Fellowship Program, please visit JIRCAS’s website (http://www.jircas.affrc.go.jp/english/research/jircasfellow/index.html).

JIRCAS Visiting Research Fellowships at Project Sites (May 2006 to April 2007)		
Stolf Renata	Department of Technology, Paulist State University, Brazil	Gene expression analysis of stress-inducible orthologous genes in soybean
Abdoulaye Tahirou	Department of Rural Economy and Sociology and Technology Transfer, Institute National de la Recherche Agronomique du Niger (INRAN), Niger	Improvement of sandy soil fertility in the semi-arid tropics through better management of organic matters
Nitipot Peerapot	Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand	Establishment of standard beef cattle feeding system as well as feed resource data base
Rodriguez Ma. Victoria	University of the Philippines Population Institute (UPPI) College of Social Sciences and Philosophy, Phillipines	Social capital and technology adoption: a social network analysis of farmer members of irrigation service cooperatives (ISCs), Tarlac, Philippines, 2006

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 postdoctoral and sabbatical fellows in national research institutes throughout Japan according to research theme and prior arrangement with host scientists. Fellowships can be undertaken at any of the ministries, and many fellows are currently working at various IAAs affiliated with MAFF. The visiting scientists who resided at JIRCAS in 2006 are listed below.

JSPS Postdoctoral Fellowships for Foreign Researchers (Novermber 2004 to October 2008)			
Hoi Xuan Pham	Researcher, National Key Laboratory for Plant Cell Technology, National Institute of Agricultural Genetics, Vietnam, Vietnam	Functional analysis of genes that encode transcription factors involved in abiotic stress tolerance	November 30, 2004-November 29, 2006
Humnath Bhandari	Visiting Research Fellow, Social Sciences Division, IRRI, Phillipines	Impact of social capital on water management in different rice ecosystems in Southeast Asia	October 3, 2005-October 2, 2007
Subramaniam Gopalakrishnan	India	Biochemical, physiological and molecular characterization of nitrification inhibitor from root exudates of *Brachiaria humidicola*	November 30, 2005-November 29, 2007
Ashiq Rabbani Malik	Senior Scientific Officer, National Agricultural Research Center, Pakistan	Promoter analysis of abiotec stress-inducible genes in rice	April 14, 2006-June 12, 2006
Asad Jan	Assistant Professor, Institute of Biotechnology and Genetic Engineering, NWFP Agricultural University, Pakistan	Analysis of plant growth regulation under abiotic stress conditions	November 1, 2006-October 31, 2008

WORKSHOPS

Workshop: Differential System for Blast Resistance for Stable Rice Production Environment

Rice blast is one of the most destructive diseases worldwide, and *Magnaporthe oryzae,* the organism that causes it, is considered a model organism for understanding the molecular basis of fungal diseases in plants.

Through a long-term collaboration between Japan and the International Rice Research Institute (IRRI), sets of differential varieties, each a valuable research asset, have been developed. Differential varieties consisting of monogenic lines as well as near-isogenic lines carrying a single gene, together with a set of blast isolates, have the potential to constitute a powerful tool for understanding host-pathogen interactions.

A workshop, “Differential System for Blast Resistance for Stable Rice Production Environment” organized by JIRCAS and IRRI was held at IRRI, Los Banos, Laguna, Philippines, on August 29, 2006. Around 40 participants from 14 countries participated.

The objectives of this workshop were 1) to assess the current rice production situation in relation to damage caused by rice blast disease in different countries, 2) to discuss the current differential system for blast resistance in rice, 3) to identify the research needs of each country in relation to breeding for blast resistance, and 4) to discuss important issues in collaborative research on blast.

Prior to this workshop, JIRCAS carried out a survey on the current rice production situation in relation to the disease, the needs of each country, and damage caused by blast disease in several Asian and South American countries as well as international organizations such as CIAT (the International Center for Tropical Agriculture) and CIRAD (the French Agricultural Research Centre for International Development). At the workshop, the gathered information was shared and further updated among participating countries.

In this workshop, JIRCAS, together with IRRI, proposed the establishment of a collaborative research network, the “Blast Research Network for Stable Rice Production,” that would feature the effective utilization of a rice blast differential system. This network is open to all countries with an interest in rice blast research.

Research activities in this network using the differential system would greatly contribute to identifying the prevailing races of blast pathogens in each region, isolating effective resistance genes, and building a breeding strategy to tackle this disease, thus ensuring a sustainable rice cultivation system.

Program

August 29, 2006

Opening Remarks and Welcome Address

Dr. Ren Wang, Deputy Director General for Research, IRRI, Dr. Takashi Kumashiro, Director, Biological Resources Division, JIRCAS

Keynote Address

Durability of resistance to rice blast disease; Dr. Shinzo Koizumi, Team Leader, Lowland Crop Rotation Research Team, National Agricultural Center for the Tohoku Region

Marker–assisted rice breeding of isogenic lines for blast

Resistance with genetic background of elite japonica varieties; Dr. Ikuo Ando, Team Leader, Marker–Assisted Rice Breeding Research, Team, National Institute of Crop Science

First Session: Differential system for blast resistance in rice

Differential varieties bred at IRRI and virulence analysis of blast

isolates from the Philippines; Dr. Nobuya Kobayashi, IRRI

Diversity of blast resistance in rice; Dr. Yoshimichi Fukuta, JIRCAS

System for designation of blast races; Dr. N. Hayashi, National Institute of Agrobiological Sciences

Rice blast atlas; Dr. Y. H. Lee, Seoul National University

New molecular markers for rice blast fungus; Dr. D. Tharreau, CIRAD

Second Session: Country reports for blast research: "Pathogen variation of *M. oryzae* and varietal resistance to blast"

Country report – Japan; Dr. N. Hayashi

Current research on rice blast resistance and breeding in China; Dr. Cailin Lei, Dr. Jian–Li Wu

Blast research in the Mekong River Delta of Vietnam; Dr. Pham Van Du, Dr. Le Cam Loan

Occurrence of rice blast fungus *Pyricularia grisea* in the Philippines; Dr. Fe dela Pena, Ms. Loida Perez

Rice blast disease in Indonesia; Dr. Sobrizal, Mr. Sontoso, Dr. Swarno

Pathogen variation of *M. grisea* and varietal resistance to blast; Dr. Poonsak Mekeatannakarn

Pathogenic variation in *M. grisea* and breeding for blast resistance in India; Dr. Mukund Variar

Study on differential system and gene resistance to rice blast in Korea; Dr. Y.C. Cho, Dr. S.S. Han

Using rice differentials with known blast resistance genes for pathogen characterization and improvement of rice cultivars in Latin America; Dr. Fernando Correa

Rice blast situation, research in progress, needs, and priorities: Summary of results from a blast survey in 13 countries.; Dr. Casiana M. Vera Cruz

General Discussion

Closing Remarks

Dr. David J. Mackill

South American Workshop on Soybean Rust

Soybean rust has been spreading rapidly throughout the soybean-producing countries in South America since the first outbreak in Paraguay and Brazil in 2001, and is now the most serious disease in these countries. It is therefore important to exchange and co-own information on epidemic status in the area and to utilize such information to efficiently develop control measures against the disease.

The workshop was held on September 19-20, 2006, at Embrapa Soja, Londrina, Parana, Brazil. The workshop was co-sponsored by JIRCAS, EMBRAPA, and Anti-Ferrugem Consórcio. Approximately 50 scientists and research managers from JIRCAS and the three major soybean-producing countries—Brazil, Argentina, and Paraguay—gathered to report the status of soybean rust epidemics and research activities in each country, and to discuss future strategies against the disease. A representative from the Embassy of Japan also attended the workshop. JIRCAS scientists reported the results of the ongoing JIRCAS research project (Soybean Rust Project).

During the workshop's Internal Discussion Section, an outline of the entire Soybean Rust Project during 2006 to 2010 was presented. A research plan for the sub-theme "Investigation of geographical and temporal variation of the pathogenicity of soybean rust" was proposed, and its appropriateness was discussed among the participants concerned from Embrapa Soja, Brazil, CRIA, Paraguay, INTA Pergamino, Argentina, and JIRCAS.

Participants asked that this kind of workshop/meeting be held on a regular basis to be able to exchange useful information. A full version of each presentation in the workshop will be published in the JIRCAS-EMBRAPA Joint Working Report in FY 2007.

Workshop on Development of Agroforestry Technology for the Rehabilitation of Tropical Forests 2006

Agroforestry could be one approach to rehabilitating degraded lands and conserving environments in cooperation with local communities in the tropics. However, technologies available for such use of agroforestry targeting the rehabilitation of tropical forests are presently limited. To develop technologies for agroforestry practices, a collaborative research project entitled "Development of agroforestry technology for the rehabilitation of tropical forests" between the Sabah Forestry Department (SFD) and the Japan International Research Center for Agricultural Sciences (JIRCAS) has been in operation in Sabah from 2000 to 2006. This workshop was planned on the

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Participants asked that this kind of workshop/meeting be held on a regular basis to be able to exchange useful information. A full version of each presentation in the workshop will be published in the JIRCAS-EMBRAPA Joint Working Report in FY 2007.

Workshop on Development of Agroforestry Technology for the Rehabilitation of Tropical Forests 2006

Agroforestry could be one approach to rehabilitating degraded lands and conserving environments in cooperation with local communities in the tropics. However, technologies available for such use of agroforestry targeting the rehabilitation of tropical forests are presently limited. To develop technologies for agroforestry practices, a collaborative research project entitled "Development of agroforestry technology for the rehabilitation of tropical forests" between the Sabah Forestry Department (SFD) and the Japan International Research Center for Agricultural Sciences (JIRCAS) has been in operation in Sabah from 2000 to 2006. This workshop was planned on the occasion of project termination and was successfully held with 99 participants from various organizations on November 28-29, 2006, at Sandakan, Sabah. The aims of the workshop were to present the research achievements over the whole period of the project and to discuss how to utilize the results to promote agroforestry in Sabah. Fourteen papers were presented on the utilization of nurse trees, planting and growing techniques for useful cash crops such as medicinal plants, evaluation of land suitability and the socioeconomic aspects of agroforestry.

The participants in the workshop pose for a group (photo: Public information office of the Sabah Forestry Department).

International Workshop for Prevention of Citrus Greening Disease in Severely Infested Areas

Citrus greening disease, one of the most destructive diseases in the citrus industry, is spreading in tropical and subtropical regions worldwide. The formation of an international research network is imperative for the promotion of collaborative research and practical action to stop the spread of this disease and to regain productivity in severely infested areas. The Ministry of Agriculture, Forestry and Fisheries (MAFF) and JIRCAS held an international workshop, "Prevention of Citrus Greening Disease in Severely Infested Areas," on December 6 to 7, 2006, at the Tropical Agriculture Research Front of JIRCAS in Ishigaki, Okinawa, as part of the MAFF program entitled "Multilateral Research Network for Food and Agricultural Safety."

A total of 32 people including eight invited speakers attended from Australia, Brazil, France, Indonesia, Taiwan, the USA, Vietnam, and Japan. Fourteen topics on recent progress in research into the epidemiology and practical management techniques of citrus greening disease were presented and discussed. Through this activity, we hope to promote a multilateral research network to ultimately overcome this disease.

Program:
Opening Address
・Dr. Yamamoto (MAFF)
Address
・Dr. Senboku (Director of JIRCAS-TARF)
Session 1: Current status of research to prevent the expansion of affected areas in newly infested countries
・"Concepts in Huanglongbing Epidemiology" Dr. Gottwald (USDA-ARS, USA)
・"Huanglongbing in Brazil" Dr. Lopes (Fundecitrus, Brazil)
・"Greening: A New Threat to Citrus Production in Japan and Two Strategies for Control" Dr. Iwanami (National Institute of Fruit Tree Science, Japan)
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Session 2: Current measures and research strategies for the control of citrus greening disease in severely affected areas

"The Current Measures and Perspective of Controlling Citrus Greening (HLB) in Taiwan" Dr. Su (National Taiwan University, Taiwan)

"Research Chain on Huanglongbing in Indonesia" Dr. Subandiyah (Gadjah Mada University, Indonesia)

"Citrus Diseases in the Mekong River Delta: Present Status and Solutions" Dr. Hoa (Southern Fruit Research Institute, Vietnam)

"Contribution of CIRAD to Huanglongbing Disease Management: Experiences and Perspectives" Dr. Gatineau (CIRAD, France)

"Aspects and Insights of Australia-Asia Collaborative Research on Huanglongbing" Dr. Beattie (University of Western Sydney, Australia)

Session3: Basic studies for clarifying the epidemiology of citrus greening disease

"Shotgun Cloning of *Candidatus Liberibacter asiaticus* DNA Fragments from Partially Purified Bacterial Fraction" Dr. Miyata (National Institute of Fruit Tree Science, Japan)

"Color Response of the Asian Citrus Psyllid, *Diaphorina citr*i Kuwayama (Homoptera: Psyllidae)" Mr. Kawamura (Okinawa Prefectural Plant Protection Center, Japan)

"Distribution and Cold-hardiness of the Asian Citrus Psyllid, *Diaphorina citri* Kuwayama in Japan" Dr. Ashihara (National Institute of Fruit Tree Science, Japan)

"Effective Marking Method of Citrus Psyllids Using Fluorescent Powder" Mr. Nakata (JIRCAS-TARF, Japan)

"Research of Replanting Guava" Dr. Beattie (University of Western Sydney, Australia)

General Discussion

Closing Address

JIRCAS Workshop: "Functional Properties and Utilization of Local Vegetables"

An international workshop entitled "Functional properties and utilization of local vegetables" was held in Bangkok, Thailand, on March 14, 2007. It was organized as the final evaluation meeting of the project "Physiological functionalities of indigenous vegetables in Southeast Asia (FY 2004-2006)," which had terminated before extending it to the current project, "Value-addition to traditional agricultural products in Asia (FY 2006-2010)" under the new Mid-Term Plan. The aim of the workshop was to present the achievements of the last three years of research activities to the public, and at the same time to pass on to the industrial sector new scientific knowledge concerning the physiological functionality of local vegetables. Educational lectures by guest speakers were also incorporated into the program to promote a better understanding of functionality and to show useful laboratory techniques to participants from academic organizations.

Program:

Opening Address

Outline and Scope of the Project

Presentations

- Role of indigenous vegetables in local agriculture (AVRDC - the World Vegetable Center)
- Anticancer promotion effective compounds isolated from tropical plants (Kagawa University, Japan)
- Nutritional and antioxidant properties of *Moringa* and sweet potato leaves from germplasm, to plant, to food, to health (AVRDC)
- Horticultural parameters controlling functionality (AVRDC)
- Indigenous vegetables and oxidative DNA damage (Institute of Food Research and Product Development (IFRPD), Kasetsart University)
- Phenolic compounds isolated from Thai local vegetables reducing oxidative stress (JIRCAS)
- Instrumental chemical analysis of food components (National Food Research Institute, Japan)

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"The Current Measures and Perspective of Controlling Citrus Greening (HLB) in Taiwan" Dr. Su (National Taiwan University, Taiwan)

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- Instrumental chemical analysis of food components (National Food Research Institute, Japan)

- Lowering effects of some indigenous vegetables in Thailand on oxidative stress biomarkers in rats (National Institute of Vegetable and Tea Science, Japan)
- Food products used indigenous vegetables (IFRPD)

General Discussion

Closing Remarks

JIRCAS RETURN SEMINARS

At JIRCAS, each researcher returning from an overseas dispatch or research project gives an oral presentation, accompanied by a written summary of his or her activities that is distributed to JIRCAS staff. These sessions are termed "JIRCAS Return Seminars" and are held during, or upon the completion of, research projects and overseas dispatch assignments. These seminars are ordinarily held twice a month, and each year approximately 30 scientists give presentations.

PUBLISHING AT JIRCAS

OFFICIAL JIRCAS PUBLICATIONS

In English

1) JARQ (Japan Agricultural Research Quarterly)	Vol. 40-No. 2, No. 3, No. 4 Vol. 41-No. 1	
2) Annual Report	No. 12 (2005)	
3) JIRCAS Newsletter	No. 46, No. 47, No. 48, No. 49	
4) JIRCAS Working Report Series	No. 50	Proceedings of the Workshop on Japan-China Collaborative Research Project Development of Early-Warning Systems for Mitigating the Risk Caused by Climate Disasters through Technological Enhancement of Resource Monitoring and Crop-Model Simulation
	No. 51	Comprehensive Studies on the Development of Sustainable Soybean Production Technology in South America
	No. 52	Possibility of Foreign Direct Investment and Vertical Coordination toward High Value Agriculture in Asia
	No. 53	A Differential System for Blast Resistance for Stable Rice Production Environment
	No. 54	Comparative Analysis of Aquaculture Management in Brackish Mangrove Areas in Three Southeast Asian Countries

In Japanese

1) JIRCAS News	No. 46, No. 47, No. 48, No. 49	
2) JIRCAS International Agriculture Series	No. 15	Whitebacked planthopper in Chinese japonica rice
4) JIRCAS Research Highlights	No. 13	

RESEARCH ACTIVITY 2006-2007

Journal articles, book chapters, and monographs

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(J) Denotes articles written in Japanese; (C) Denotes articles written in Chinese; bold lettering indicates staff member at JIRCAS during FY2006.

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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, 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 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 return high-quality achievements to the international community. Major research at JIRCAS is 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.

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 to carry out comprehensive research in agriculture, forestry, and fisheries.

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

As for operations implemented by operational grants for administration, 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 input of research resources and obtained results are analyzed from the viewpoint of ensuring contributions 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 feed the results of in-house evaluation back 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 officials 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's 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 helping them to 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 by 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 exchange 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 the 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 the 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 agriculture, forestry, and fisheries research organizations in the developing regions during the second medium-term goal period to conduct collaborative research or improve the ability 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 agriculture, forestry, and fisheries research organizations in the developing regions.

(2) Course 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 investigations into 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 to 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 3rd 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 (a new rice for Africa), a wide range of rice germplasms will be evaluated for such tolerances to select tolerant types, and then from them, DNA markers linked to the tolerance will be acquired. The selected tolerant germplasm 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, 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 germplasm 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 residue and the waste of oil palm trees mass grown in East Asia, and 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 antimutagenicity 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 matter and fertilizer in the agropastoral areas in the Sahel region of West Africa, where production of organic matter is low, and clarify the dynamics of key elements such as nitrogen in the soil-plant ecosystem. In Southeast Asia, which has a high production of organic matter, we will also clarify soil nutrient dynamics, physical properties, and changes in the biota of soil in response to the input of organic material. 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 utilization 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.

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 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 combined management of agriculture 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) 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 agriculture, 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 make clear 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.

2. Promotion of the release and dissemination of research results

(1) Securing interactive communication with the public

1) We will wherever possible open seminars and workshops on international collaborative research projects, disclose research results collected and analyzed through information media, publish the results of research evaluations, engage in interactive communication with the public regarding collaboration on international research projects implemented by JIRCAS, and ensure the public understanding and transparency of JIRCAS's 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 concerned with research projects on site.
3) 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 during the period covered by the 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 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 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, and 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 international organizations and academic associations. It will also provide domestic and overseas technical information on request.

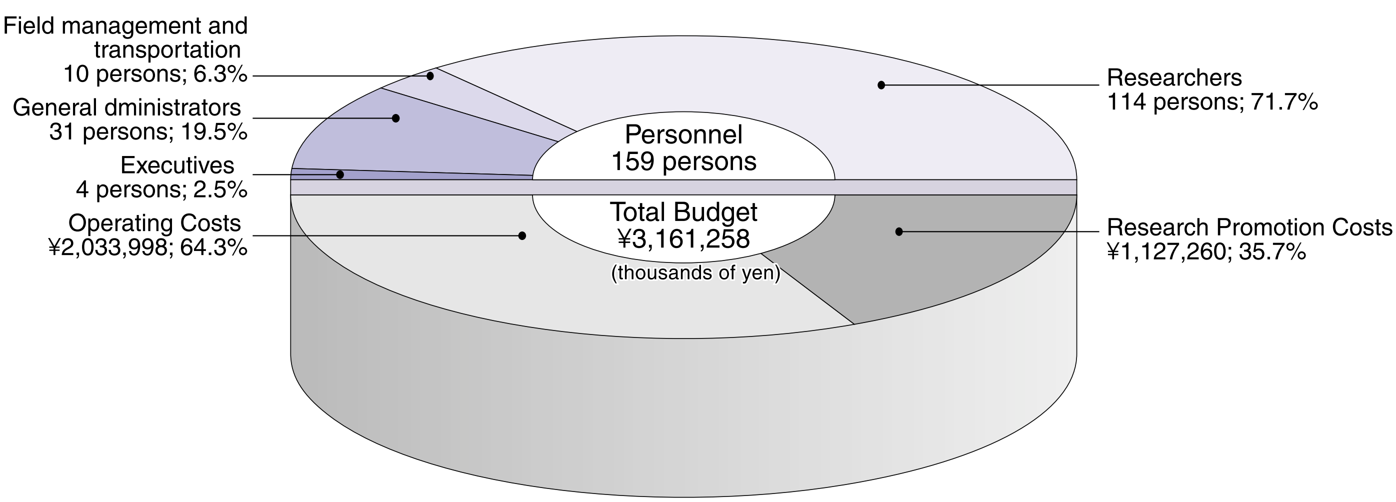
FINANCIAL OVERVIEW

Fiscal Year 2006

(*thousands of yen*)

TOTAL BUDGET	**3,161,258**
OPERATING COSTS	**2,033,998**
Personnel (159)	1,622,770
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (31) Field management and transportation (10) Researchers (114) *Number of persons shown in ( )	
Administrative Costs	411,228
RESEARCH PROMOTION COSTS	**1,127,260**
Research and development	430,653
Overseas dispatches	203,859
Research exchanges/invitations	14,159
Collection of research information	103,371
International collaborative projects	321,513
Fellowship programs	53,705

Budget FY 2006 (Graph)



MEMBERS OF JIRCAS EXTERNAL EVALUATION COMMITTEE AND PRINCIPAL STAFF

Members of the JIRCAS External Evaluation Committee

Haruo INAGAKI	Chair of the Committee Former Counselor, Japan Food and Agriculture Organization Association
Haruyuki MOCHIDA	Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba
Fumio TAKASHIMA	Former President, Tokyo University of Marine Science and Technology
Kunio TSUBOTA	Deputy Director/Professor, Asia Center, Kyushu University

External Reviewers for the JIRCAS Program Review Meetings

[Agro-environment]

Kenji HATA	Program Coordinator, Department of Hydraulic Engineering, National Institute for Rural Engineering, National Agriculture and Food Research Organization
Toshiaki IMAGAWA	Principal Research Coordinator, National Institute for Agro-Environmental Sciences
Shigeru KAMEYA	Section Chief, Soil and Environment Section, Okinawa Prefectural Agricultural Research Center
Masanori SAITO	Principal Research Coordinator, National Institute for Agro-Environmental Sciences

[Crop Production]

Hiroaki INOUE	Professor, Graduate School of Bioresource Sciences, Nihon University
Nozomu MINAGAWA	Research Manager, National Agriculture Research Center for Kyushu Okinawa Region, National Agriculture and Food Research Organization

[Agro-biological Resources]

Ikuo ANDO	Head, Biotechnology Laboratory, Department of Rice Research, National Institute of Crop Sciences, National Agriculture and Food Research Organization
Tatsuhito FUJIMURA	Professor, Graduate School of Life and Environmental Sciences, University of Tsukuba
Kyuya HARADA	Professor, Faculty of Horticulture, Chiba University
Hitoshi NAKAGAWA	Director, Institute of Radiation Breeding, National Institute of Agrobiological Sciences

[Animal Production & Grassland]

Toshiaki IMAGAWA	Principal Research Coordinator, National Institute for Agro-Environmental Sciences
Hitoshi NAKAGAWA	Director, Institute of Radiation Breeding, National Institute of Agrobiological Sciences

Fuminori TERADA	Director, Livestock Research Support Center, National Institute of Livestock and Grassland Science, National Agriculture and Food Research Organization

[Fisheries]

Yukimasa ISHIDA	Director, Project Management Division, Tohoku National Fisheries Research Institute, Fisheries Research Agency
Takashi MINAMI	Professor, Graduate School of Agricultural Sciences, Tohoku University
Toshio TAKEUCHI	Professor, Graduate School of Marine Science and Technology, Tokyo University of Marine Science and Technology

[Development Research]

Kazuhiko KOBAYASHI	Professor, Graduate School of Agriculture and Life Sciences, the University of Tokyo
Takashi KUROSAKI	Professor, Institute of Economics, Hitotsubashi University
Hitoshi YONEKURA	Professor, Graduate School of Agricultural Sciences, Tohoku University

[Post-harvest Science & Technology]

Yoshiaki KITAMURA	Senior Research Coordinator, National Food Research Institute, National Agriculture and Food Research Organization
Tojiro TSUSHIDA	Director, Food Function Division, National Food Research Institute, National Agriculture and Food Research Organization

[Biomass Utilization]

Mitsutoshi NAKAJIMA	Director, Food Engineering Division, National Food Research Institute, National Agriculture and Food Research Organization
Koichi YAMAMOTO	Principal Research Coordinator, Forestry & Forestry Products Research Institute

[Forestry]

Naoto MATSUMURA	Professor, Graduate School, Faculty of Bioresources, Mie University
Akira SATO	Principal Research Coordinator, Forestry & Forestry Products Research Institute

JIRCAS STAFF in FY 2006

President

Shinobu Inanaga
[Kenji Iiyama from April 1, 2007]

Vice-President

Akinori Noguchi
[Toshihiro Senboku from April 1, 2007]

Executive Advisor & Auditor

Shigeo Matsui
Akimi Fujimoto
[Hitoshi Yonekura from April 1, 2007]

Research Strategy Office

Osamu Koyama, Director

Research Planning and Coordination Division

Masami Yasunaka, Director
Toshihiro Uetani, Senior Researcher

Research Planning and Evaluation Office
Takeshi Kano, Head

Research Planning Section
Masayoshi Saito, Head
Kazuhiro Suenaga, Senior Researcher

Research Evaluation Section
Hiroko Takagi, Head

Field Management Section
Haruo Tamura, Chief Field Operator
Takashi Komatsu, Field Operator

Research Support Office
Research Support Section
Kazutoshi Tateyama, Head
Hatsui Yashiro, Assistant Head
Tsuneyoshi Sasaki, Overseas Travel Subsection Head
Gaku Takeda, Overseas Operations Subsection Head

Research Coordination Section
Takahito Noda, Head

Public Relations Office
Kunimasa Matsumoto, Head
Mie Kasuga, Senior Researcher

International Relations Section
Naoya Fujimoto, Head
Akihiko Yokota, Senior Researcher

Publications and Documentation Section
Fumio Yoshida, Head
Hiromi Miura, Network Subsection Head
Noriko Yatabe, Managing Subsection Head (Librarian)

Regional Research Coordinators
Satoru Miyata, Representative of Southeast Asia Office (Thailand)
Hiroshi Kudo, Representative of South America Office (Brazil)

Administration Division

Tokuzo Ono, Director

General Affairs Section
Hideo Miyauchi, Head
Ryoichi Saito, General Affairs Assistant Head
Kaoru Watanabe, Personnel Management Assistant Head
Yoshihiko Sumomozawa, General Affairs Subsection Head
Yukio Konuma, Social Affairs Chief
Koichi Fuse, Welfare Subsection Head
Yoshinori Kawasaki, Personnel Subsection Head
Keisuke Takada, Personnel Officer

Accounting Section
Moriji Uchino, Head
Hiroshi Miyamoto, Accounting and Examination Assistant Head
Nobuhiko Nakamura, Procurement and Asset Managing Assistant Head
Katsunori Kanno, Financial Subsection Head
Shinji Ishizaka, Accounting Subsection Head
Toshiki Kikuchi, Overseas Expenditures Subsection Head
Takao Oga, Audit Subsection Head
Toshiaki Sato, Procurement Subsection Head
Takashi Kitami, Procurement Officer
Junichi Irino, Supplies/Equipment Subsection Head
Kuniaki Katsuyama, Facilities Subsection Head

Administration Section (Tropical Agriculture Research Front, Ishigaki)
Hiroshi Nakamura, Head
Hisato Ohshima, General Affairs Subsection Head
Yasuhiro Onozaki, Accounting Subsection Head
Osamu Oikawa, Accounting Officer

Development Research Division

Minoru Tada, Director

Project Leaders
Hsiaoping Chien, Agricultural Economics
Jun Furuya, Agricultural Economics
Satoshi Uchida, Geographic Information Systems
Kumi Yasunobu, Agricultural Economics

Senior Researchers
Akira Hirano, Geographic Information Systems
Hiroshi Komiyama, Development Economics
Kazuo Nakamoto, Agricultural Economics
Shunji Oniki, Agricultural Economics
Masato Shirai, Agricultural Economics
Tomohide Sugino, Development Economics
Ryuichi Yamada, Agricultural Economics

Biological Resources Division

Takashi Kumashiro, Director

Project Leaders
Tomohiro Ban, Wheat Breeding
Yoshimichi Fukuta, Rice Breeding

Senior Researchers
Yasunari Fujita, Plant Molecular Biology
Masanori Inagaki, Wheat Breeding
Kazuo Ise, Rice Breeding
Masayasu Kato, Plant Pathology
Nobuya Kobayashi, Physiology and Breeding
Ryoichi Matsunaga, Legume Breeding
Kazuo Nakashima, Plant Molecular Biology
Motoki Takahashi, Legume Physiology
Xu Tonghe, Plant Molecular Genetics
Hiroshi Tsunematsu, Rice Breeding
Seiji Yanagihara, Rice Breeding (Tropical Agriculture Research Front, Ishigaki)

Researchers
Takuma Ishizaki, Plant Molecular Biology (Tropical Agriculture Research Front, Ishigaki)

Yusuke Ito, Plant Molecular Biology
Kyonoshin Maruyama, Plant Molecular Biology
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
Satoshi Tobita, Plant Physiology and Nutrition

Senior Researchers
Hiromasa Hamada, Groundwater Hydrology
Tamao Hatta, Mineralogy and Geology
Yasukazu Hosen, Environmental Soil Science
Takayuki Ishikawa, Plant Physiology
Naruo Matsumoto, Environmental Conservation
Masato Oda, Crop Management
Guntur V. Subbarao, Crop Physiology and Nutrition
Takeshi Watanabe, Soil Chemistry
Junichi Sakagami, Crop Improvement
Zen-ichi Sano, Nematology
Matthias Wissuwa, Physiology and Genetics

Researchers
Keiichi Hayashi, Soil Management
Sachiko Senô, Crop Science
Kenji Suzuki, Environmental Hydrology

Animal Production and Grassland Division

Shuichi Oshio, Director

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

Senior Researchers
Yasuo Ando, Plant Microbiology
Katsuhisa Shimoda, Pasture Management
Takehiro Nishida, Animal Nutrition
Seishi Yamasaki, Animal Nutrition

Food Science and Technology Division

Yutaka Mori, Director

Project Leader
Kazuhiko Nakahara, Food Chemistry

Senior Researchers
Tsutomu Fushimi, Food Analysis
Akihiko Kosugi, Molecular Microbiology
Yoshinori Murata, Applied Microbiology
Hiro Nakamura, Cereal Chemistry and Plant Breeding
Eizo Tatsumi, Food Science
Koji Yamaki, Food Functionality
Tadashi Yoshihashi, Food Evaluation

Forestry Division

Shozo Nakamura, Director

Senior Researchers
Fumio Kawamura, Forest Chemistry
Atsushi Sakai, Silviculture
Tsutomu Yagihashi, Silviculture
Tsuyoshi Yamada, Forest Soil Science
Yasuhiro Yokota, Social Forestry

Researcher
Kazuki Miyamoto, Silviculture

Fisheries Division

Shoji Kitamura, Director

Project Leader
Marcy N. Wilder, Crustacean Biochemistry

Senior Researchers
Yoshimi Fujioka, Coastal Ecology
Kaoru Hamano, Aquatic Animal Physiology
Yukio Hanamura, Marine Biology
Shinsuke Morioka, Fish Biology
Kazuyuki Teshima, Fish Biology

Researchers
Sayaka Ito, Freshwater Ecology
Toshihiro Yamamoto, Fish Ecology

Tropical Agriculture Research Front

Toshihiro Senboku, Director
Yoshinobu Egawa, Research Coordinator
Yoshimitsu Katsuda, Public Relations Officer

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

Senior Researchers
Fujio Nagumo, Soil Science
Ken Nakamura, Soil Science

Researcher
Yoshiko Iizumi, Water Management

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

Senior Researcher
Hide Ohmae, Plant Physiology

Researcher
Kouichi Kashiwaba, Plant Breeding

Sugarcane Improvement Project Team
Project Leader
Koshun Ishiki, Plant Breeding and Genetic Resources

Senior Researcher
Mitsunori Sato, Sugarcane Breeding

Crop Production and Protection Group
Tropical Fruits Production Project Team
Group Head, Project Leader
Yoshimi Yonemoto, Pomology

Senior Researchers
Hidenori Kato, Molecular Biology
Tatsushi Ogata, Pomology

Citrus Greening Disease Management Project Team
Project Leader
Yasuo Ohtoh, Plant Pathology

Senior Researchers
Katsuya Ichinose, Entomology
Tadafumi Nakata, Entomology
Kunimasa Kawabe, Plant Virology

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

Researchers on Loan to Other Organizations

Africa Rice Center (WARDA)
Ryoichi Ikeda, Rice Breeding

THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

The Japanese Fiscal Year and the Annual Report 2006

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) 2006 covers the period from April 1, 2006 through March 31, 2007. The Annual Report 2006 summarizes the full extent of JIRCAS activities that occurred during this period. The subsequent Annual Report will detail events and programs from April 1, 2007, through March 31, 2008 (FY 2007).

Buildings and campus data

Land (m^2)

Headquarters (Tsukuba)	109,538
Tropical Agriculture Research Front (Okinawa)	294,912
Total	404,450

Buildings (m^2)

Headquarters (Tsukuba)	10,749
Tropical Agriculture Research Front (Okinawa)	9,523
Total	20,272

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