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Message from the President

President
Dr. Takahiro Inoue

New Research Strategy of JIRCAS in the 21st Century

The world's total population is expected to approach nine billion by the middle of the 21st century, and it is therefore necessitated that world food supply increase by 150% over its present levels in order to meet the subsequent demand. Since the total area of cultivated land will not substantially increase during the next half-century, it is urgently necessary to increase the yield of agricultural production per surface area and develop crops that can be cultivated in areas having adverse climatic conditions. There is, therefore, a great need to develop crops having outstanding characteristics and establish technologies leading to sustainable crop production. A high percentage of the population in developing regions is malnourished, and since these regions account for 80% of total world population, it is likely that the severity of problems related to nutrition will increase markedly in the future. It is against this backdrop that JIRCAS has formulated its strategy and policies for promoting international research collaboration.

Japan's self-sufficiency in food production is very low (40% in terms of caloric intake and 27% in terms of cereal consumption), and is the lowest among the major developed nations of the world. In the Ministry of Agriculture, Forestry and Fisheries (MAFF's) new basic plan for food, agriculture and rural areas, the target ratio for food self-sufficiency has been assigned to 45% for the year 2010. Based on the current state of agriculture, forestry and fisheries production in Japan and national trends in food consumption, it is necessary to make strident efforts to achieve this goal. Furthermore, the global situation outlined above makes it even more urgently necessary for Japan to contribute substantially towards increasing world food production through research collaboration. International efforts to address food supply and environmental problems are, in other words, inexorably linked to the resolution of Japan's own food supply and environmental issues.

JIRCAS, inaugurated in 1993 after the reorganization of the Tropical Agriculture Research Center which had been established in 1970, underwent a subsequent reorganization into an Independent Administrative Institution (IAI) under the supervision of MAFF on April 1, 2001. The transition to an IAI was achieved in line with the reorganization of government ministries; of two administrative functions formerly overseen by the government, e.g. planning/drafting and implementation, the latter has been delegated to JIRCAS. As a new IAI, JIRCAS operates outside of the framework of limitations imposed by the government and is entrusted with the mission of improving the lives of the Japanese people through the implementation of effective and efficient programs. In exchange for this independence of action, JIRCAS is subjected to strict

JIRCAS Main Building
(Photo: T. Hayashi)

evaluation of its progress towards achieving its stated objectives.

The role of JIRCAS is defined in the following statement: "JIRCAS is responsible within the international community for contributing to the sustainable development of agriculture, forestry and fisheries in harmony with the environment in developing regions and addressing global food and environmental problems through research collaboration with developing countries." Henceforth the activities of JIRCAS will not deviate fundamentally from those undertaken prior to its inception as an IAI. However, due to the significance of global food, environmental and energy problems and their relevance to the food security of Japan itself, emphasis is being placed on the following four countries and regions: China, one of the world's most populous countries, in light of its tremendous influence on global food supply and demand; Southeast Asia, in light of its close historical and economic relations with Japan, mainly in research fields such as paddy field agriculture as well as fisheries production and aquaculture; South America, given its considerable potential as a global food provider; and Africa, which requires collaboration for the production of basic food commodities since a high percentage of its population suffers from malnutrition, particularly in the sub-Saharan region.

International research collaboration to address the problems confronting developing regions is jointly implemented with research organizations from the respective countries. However, when the research capability of these countries is deemed insufficient, collaboration is undertaken with research organizations from developed countries or international and domestic organizations located in Japan.

Note about Annual Report 2001

In keeping with past efforts to highlight JIRCAS activities in particular regions of the world, Annual Report 2001 will feature descriptions of our ongoing programs with research organizations in South America. Due to the continent's outstanding potential as a global food provider, JIRCAS expects that relations with South America, particularly the MERCOSUR countries, will become increasingly important in the 21st century. We hope to place special emphasis on our collaborative efforts by featuring South America in Annual Report 2001. However, while JIRCAS maintains an impressive number of joint projects with various South American research organizations, we also conduct research in partnership with institutions in many other parts of the world. It is our hope that the full extent of JIRCAS's international research programs will be evident in Annual Report 2001.

JIRCAS Biotechnology Building (Photo: T. Hayashi)

President
TAKAHIRO INOUE

HIGHLIGHTS FROM 2001

During Fiscal Year 2001, the Japan International Research Center for Agricultural Sciences (JIRCAS) made a number of strides in its overall efforts to improve world food security. Along with its inauguration ceremony as an independent administrative institution, JIRCAS held a number of evaluation meetings to share and discuss the progress being made in various projects. We are pleased to highlight these activities and achievements in greater detail.

IMPORTANT NEW DEVELOPMENTS

JIRCAS Inauguration Ceremony held to highlight its new mission as an Independent Administrative Institution (IAI)

As a newly-reorganized independent administrative institution (IAI) from April 2001, JIRCAS held an inauguration ceremony at the international convention center "Epochal Tsukuba" on November 27, 2001. Held just prior to the JIRCAS International Symposium which began the following day, this ceremony was attended by over 200 participants including officials and administrators from relevant departments of the Ministry of Agriculture, Forestry and Fisheries (MAFF), other research organizations, university personnel, international symposium attendees, invited researchers, former JIRCAS affiliates, and current JIRCAS staff members, who observed and celebrated JIRCAS's new beginning.

The ceremony opened with greetings from JIRCAS President Dr. Takahiro Inoue, who gave an overview of JIRCAS's new mission and role as an IAI, as well as the motivations and purpose behind its future research projects and policies. Next, congratulatory addresses were delivered in succession by Dr. Mutsuo Iwamoto, Director General of MAFF; Mr. Hisao Azuma, Senior Vice President of the Japan International Cooperation Agency (JICA); Dr. Tran Thuong Tuan, Rector of Cantho University, Vietnam; and Prof. Ali A. Al-Jaloud of the King Abdulaziz City for Science and Technology, Saudi Arabia. After a final address by Mr. Sakue Matsumoto, Chief Counselor of the JIRCAS Advisory Committee, JIRCAS Vice-President Dr. Yoshinori Morooka gave an overview of the institution's new organizational structure, and shared congratulatory messages received by JIRCAS with all participants. Thereafter, the event progressed into a social gathering and the attendees also enjoyed an Indonesian folk dance presentation. The ceremony ended on closing remarks by Dr. Nobuyoshi Maeno, former Director General of JIRCAS. Concurrent with this event, messages of congratulations were received from Mr. Sima Morakul, Director

JIRCAS senior administrators pose for a group photograph at the JIRCAS front entrance. Front row: K. Kiryu, A. Noguchi, T. Inoue, Y. Morooka, K. Kato. Back row: Y. Fukuda, K. Nakajima, K. Tsurumi, T. Hayashi, R. Ikeda, T. Taniguchi. Absent: O. Ito, M. Suzuki. (Photo: T. Hayashi)

General, Land Development Department, Thailand and Dr. Stein Bie, Director General, International Service for National Agricultural Research (ISNAR), the Netherlands. JIRCAS expresses its heartfelt gratitude to all our friends who celebrated our new beginning with us.

Pre-evaluation meeting for the project "Increasing economic options in rainfed agriculture in Indochina through efficient use of water resources"

On March, 18, 2002 in Tsukuba, JIRCAS organized a pre-evaluation meeting for the project entitled "Increasing economic options in rainfed agriculture in Indochina through efficient use of water resources" in order to review the planned research activities down to the sub-theme level. Prior to commencement of the meeting, a brief introduction was given on major research outcomes obtained from a previous project as well as the biophysical and socio-economical situation in relation to water resource management in the region.

Six members of the evaluation committee attended the meeting: from Thailand, Mr. Sakol Ooraikul, Specialist, Office of Agricultural Economics; Dr. Tawachai Na Nagara, Adviser and former Director, Soil Science Division, Department of Agriculture (DOA); and Professor Paiboon Pramopjanee, Walailak University; and from Japan, Prof. Takeshi Horie, University of Kyoto; Prof. Hideo Yano, University of Kyoto; and Prof. Akira Goto, Utsunomiya University. During the meeting, the evaluation system for this international project was firstly explained by Mr. Kazuyuki Tsurumi, Director, Development Research Division, followed by an outline of the project by Dr. Osamu Ito, Director, Crop Production and Environment Division. Next, details of research activities in each sub-theme were explained by the division directors involved. Following these presentations, the six committee members held a closed discussion, after which the chairman, Mr. Sakol Ooraikul, gave a summary of the discussion and each committee member offered additional comments.

The committee members made various suggestions based not only on their research background but also from a general perspective. With regard to possible new research subjects, it was proposed that water-crop-animal-soil nutrition interactions be added, emphasizing a combination of animal husbandry with rice farming as well as upland cropping. It was also recommended that aquaculture be incorporated as a project component in order to utilize farm ponds more efficiently. In regard to readjusting the proposed subject matter, it was suggested that research on land use evaluation include re-evaluation of the extent of usage of rice paddy fields. Finally, regarding project management, more active participation by extension workers and farmer representatives was recommended.

JIRCAS IAI Inauguration Ceremony (Photo: N. Ueno)

Mid-term evaluation meeting for the project "Development of low-input technology for reducing post-harvest losses of staples in Southeast Asia"

JIRCAS held a mid-term evaluation meeting for the project "Development of low-input technology for reducing postharvest losses of staples in Southeast Asia", following the workshop "Status of postharvest losses and related studies in Thailand", in Tsukuba on November 29, 2001. The research project began after the signing of a Memorandum of Understanding (MOU) among three Thai organizations – the Department of Agriculture (DOA), the Institute of Food Research and Product Development of Kasetsart University, and King Mongkut's University of Technology, Thonburi – and JIRCAS on September 18, 2000. Reviewers evaluated the results of research conducted during the one-year period since the signing of the MOU. The project review committee consists of four scientists: Dr. Greg Johnson, Postharvest Program Manager, Australian Centre for International Agricultural Research; Prof. Toshinori Kimura, University of Tsukuba; Dr. Yoshimi Hirose, Professor Emeritus, Kyushu University; and Prof. Tadashi Miyata, Nagoya University.

Participants in the mid-term evaluation meeting for the project "Development of low-input technology for reducing post-harvest losses of staples in Southeast Asia" pose for a group photograph.

After an overview of the project by Dr. Toru Hayashi, Director of JIRCAS's Food Science and Technology Division, Japanese scientists presented current results and future plans. The reviewers and scientists from both Japan and Thailand then discussed the presentations, and afterwards the reviewers gave favorable comments and recommendations. The first suggestions included studying ants as natural enemies of insect pests, and strengthening collaboration and coordination between the Thai and Japanese scientists. It was also recommended that the research plan be slightly altered, omitting the quantitative survey of postharvest losses of rice, since amounts vary greatly depending on facility and locality, such that the collected data would not accurately represent actual losses in Thailand. All the participants agreed with the proposed amendment, and a final suggestion was that as much published data on postharvest losses be collected as possible.

On the following day, November 30, a working group meeting was held during which the Thai and Japanese scientists involved in the project discussed their future work. The evaluation meeting dialogues, the working group meeting and the workshop greatly contributed to the mutual understanding of the background, significance and mission of the project.

Final evaluation meeting for the project "Comprehensive studies on sustainable agricultural systems in Northeast Thailand"

On February 8, 2002, JIRCAS organized a final evaluation meeting for the project entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand" in order to review the major research results after seven years of research activities in the region. The meeting was held in Khon Kaen, Thailand, after two days of workshops during which research outputs were presented and discussed.

Four of the six members of the evaluation committee attended the meeting: from Japan, Dr. Masaki Shibata, Director, Division of Research Planning and Coordination, National Agricultural Research Center for Kyushu Okinawa Region; and from Thailand, Mr. Sakol Ooraikul, Specialist, Office of Agricultural Economics; Prof. Paiboon Prabuddham, Faculty of Agriculture, Kasetsart University; and Prof. Terdsak Subhasaram, Department of Chemistry, Faculty of Science, Mahasarakham University. At the meeting, a brief overview of the project structure and research highlights was given by JIRCAS directors Dr. Osamu Ito and Mr. Kazuyuki Tsurumi, followed by a closed discussion among the committee members. The committee chairman, Mr. Ooraikul, gave a summary of the discussion, to which the comments of each of the other members were added.

The committee expressed a high degree of appreciation for the depth of fundamental scientific achievement in each research field, and called for follow-up research pertaining to the application of developed technologies to the local farm communities. It was thus recommended that the research focus be shifted more to the practical and applied aspects of new technology in the succeeding project entitled "Increasing economic options in rainfed agriculture in Indochina through the efficient use of water resources." (See next page under "New Research Collaboration")

NEW RESEARCH COLLABORATION

New MOUs initiated in Fiscal Year 2001

On April 1, 2001, the Japanese government dictated a new mandate for the Japan International Research Center for Agricultural Sciences (JIRCAS) within the framework of administrative reforms enacted for the structural reorganization of government-affiliated research organizations. This mandate remains fundamentally unchanged from its predecessor, under which JIRCAS was entrusted with the mission of promoting sustainable and environment-friendly development of agriculture, forestry and fisheries in developing regions of the world through the implementation of integrated collaborative research programs.

The priorities set forth by JIRCAS for research strategies in its five-year Mid-Term Plan (see "Research Structure and Evaluation at JIRCAS" and Appendix) include: 1) the development of production and utilization systems for sustainable and environment-friendly agriculture, forestry and fisheries by carrying out research on the development of stress-tolerant crops, and development of technologies for preserving arable land environments, new farming systems for ensuring profitability for producers, and technologies for efficient postharvest management and utilization, and 2) the rehabilitation, maintenance, improvement, and utilization of natural environmental resources with emphasis on tropical forest and coastal ecosystems.

Understanding the importance and urgent necessity of developing sustainable forestry management systems for tropical forests which motivate local inhabitants to participate in reforestation activities, JIRCAS initiated a research project entitled "Development of agroforestry technology for the rehabilitation of tropical forests" with the Forest Research Center (FRC), the Forestry Department of the State Government of Sabah, Malaysia, and the University of the Philippines at Los Banõs (UPLB) in the year 2000. Dr. Yoshinori Morooka, Vice President of JIRCAS, visited Sandakan on December 7, 2001 and held discussions with Mr. Daniel K.S. Khiong, Director of the Forestry Department of the State Government of Sabah and Dr. Sining Unchi, Director General of the FRC, towards concluding a Memorandum of Understanding (MOU) which was signed on December 10. This MOU between JIRCAS and the FRC will be effective for five years, concluding on March 31, 2007, while research collaboration between JIRCAS and the UPLB will continue to be governed by the MOU that has been in effect since 1980. For the current project, three JIRCAS researchers specializing in afforestation, forest soils and mycology have been dispatched to the FRC to carry out their research.

Signing of an MOU between the Forestry Department of the State Government of Sabah and JIRCAS by Mr. Daniel K.S. Khiong and Dr. Yoshinori Morooka.

Since April 1999, JIRCAS has been implementing the second phase of a five-year research project on the development of new technologies and their practice for sustainable farming systems in the Mekong Delta in quadripartite collaboration with the Cuu Long Delta Rice Research Institute (CLRRI), Cantho University, and the Southern Fruit Research Institute (SOFRI) of Vietnam. Three JIRCAS scientists have been dispatched on long-term assignments to these counterpart institutions: a rice agronomist to CLRRI and a soil scientist and an animal husbandry specialist to Cantho University; however, this collaboration was in accordance with the previous MOU which expired at the conclusion of the first phase of the project. Therefore, the MOU with CLRRI was renewed in January 2002 and a new MOU with SOFRI was signed in February 2002. A JIRCAS rice agronomist will conduct work on the development of rice cultivation technology including direct seeding and related methods and research on citrus greening disease in collaboration with SOFRI. An MOU with Cantho University is currently undergoing the final approval process of the Vietnamese government.

JIRCAS, formerly the Tropical Agricultural Research Center (TARC), and the International Rice Research Institute (IRRI), one of the prominent research institutes affiliated with the Consultative Group on International Agricultural Research (CGIAR), have a long history of bilateral research collaboration since 1979. The nature of cooperation changed in 1993 when TARC was reorganized into the

Japan International Research Center for Agricultural Sciences (JIRCAS). In the MOU signed on August 24, 1995, it was stated that IRRI and independent administrative institutions affiliated to the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan shall plan and implement mutually agreed-upon research projects with the cooperation and facilitation of JIRCAS. Upon the expiration of this MOU in August 2000, a new MOU was concluded in March 2002 under which JIRCAS accepted a new role as the representative of Japan's National Agricultural Research Organization (NARO), the National Institute of Agrobiological Sciences (NIAS), and the National Institute for Agro-Environmental Sciences (NIAES).

In order to facilitate research projects in developing regions, JIRCAS requires the cooperation of researchers belonging to other agriculture, forestry and fisheries research institutions affiliated to MAFF. For this purpose, an agreement of cooperation was signed on September 14, 2001 among 8 institutions: NARO, NIAS, NIAES, the National Institute for Rural Engineering (NIRE), the National Food Research Institute (NFRI), the Forestry and Forest Products Research Institute (FFPRI), the Fisheries Research Agency (FRA), and JIRCAS. This cooperation between JIRCAS and other research institutions will continue to be actively promoted.

New project: Increasing economic options in rainfed agriculture in Indochina through efficient use of water resources

Approximately 60% of world food production is derived from rainfed agricultural areas which account for over 80% of total arable land. Productivity of rainfed agriculture is much lower than that of irrigated agriculture and is also marked by more drastic annual variations; therefore, food production that can meet the needs of a growing world population will be heavily dependent on production from irrigated agriculture. Considering the tendency towards stagnation in productivity increases in irrigated agriculture, however, it will not be able to meet the expected demand. The only viable solution is to increase the share of the burden borne by rainfed agriculture through the stabilization and improvement of its productivity. However, it is both logistically and financially difficult to construct efficient irrigation systems having extensive canal networks leading from permanent reservoirs to most rainfed areas. Improving the productivity of rainfed uplands and lowlands is the only realistic option in these areas.

Vegetable cultivation on the levee of a farm pond.

In the rainfed agricultural areas that are prevalent in the central regions of Indochina, crop production has remained at low levels and the gap in living standards between the rural and urban populations has continued to widen. The slow progress in agricultural development despite the introduction of new crop varieties and improved technologies can be attributed primarily to unfavorable environmental conditions, such as unpredictable rainfall patterns and soils with low fertility and inadequate water-retaining capacity.

This project aims to develop differentiated technologies for the collection, storage, and distribution of water, together with crop production technologies with high utilization efficiency. The project's target area is the lowland-upland boundary zone in the central region of Indochina including Northeast Thailand and Laos, where small-scaled mixed farming is predominant. For the purpose of optimizing farm management, tests of combinations of individual technologies will be carried out in the farmers' fields and an integrated farm management plan will be presented. In consideration of the biophysical and socio-economic conditions surrounding each individual farming unit at the project site, it is a major goal of the project to develop farming systems having high profitability and sustainability. The three main research themes are as follows: 1) assessment of regional water availability and identification of factors limiting more efficient utilization of water resources in existing farm systems, 2) development of crop production technologies for more effective water resource utilization, and 3) adaptation and integration of new technologies into farming systems through farmer participatory methods.

ACADEMIC PRIZES AND AWARDS

JIRCAS is pleased to note that many of its staff members have been recipients of academic prizes and awards from scientific societies and other organizations. The following is a brief summary of achievements which we are proud to include in the Highlights of Annual Report 2001.

Dr. Kazunori Igita, Senior Researcher in the Biological Resources Division received the **Ministry of Agriculture, Forestry and Fisheries Minister's Prize** for his work on the development of new soybean seed. In Dr. Igita's work, substantial contributions were made towards the stabilization of soybean production in the Kyushu region of southern Japan and the establishment of techniques for the cultivation of high-potential soybean varieties including "Furuyutaka", "Akirashirome", and "Toyoshirome".

Dr. Kazuko Yamaguchi-Shinozaki, Senior Researcher in the Biological Resources Division received the **Ministry of Education, Culture, Sports, Science, and Technology Minister's Prize** for her work on the identification of abiotic stress tolerance genes in plants. Dr. Yamaguchi-Shinozaki has studied genes encoding stress-inducible transcription factors (DREBs) that in turn regulate significant stress tolerance genes. These DREB genes are expected to have important applications in improving dehydration, salt and freezing tolerance of agriculturally important crops through gene transfer.

Dr. Marcy N. Wilder, Senior Researcher in the Fisheries Division received the **Promising Scientist Award of the Society of Japanese Women Scientists** and the **Achievement Award for Young Scientists of the Japanese Society of Fisheries Scientists** for her work on the physiology and biochemistry of reproductive mechanisms in Crustacea and their applications toward the further development of freshwater prawn culture in Southeast Asia. In Dr. Wilder's research, the full amino acid sequence and primary structure of yolk proteins in economically significant prawn species were determined for the first time, leading to the development of technology for evaluating the reproductive capability of female spawners used in aquaculture operations. In addition, Dr. Wilder's work in collaboration with Vietnam's Cantho University led to the development of freshwater prawn seed production technology adapted to the needs of the Mekong Delta, thus contributing to the further development of prawn-rice combined farming systems in the region.

Dr. Katsumi Suzuki, Senior Researcher at the Okinawa Subtropical Station received the **2001 Research Encouragement Award from the Crop Science Society of Japan** for his work on "Morphological and cytological studies on rice embryogenesis", in recognition of his achievements in crop science made as a young scientist. In Dr. Suzuki's work, important contributions were made toward the development of effective production techniques for somatic embryos, and in addition, the mechanisms of imperfect rice kernel occurrence during the ripening stage were elucidated.

Dr. Takayoshi Terauchi, Senior Researcher at the Okinawa Subtropical Station received the **2002 Research Encouragement Award from the Crop Science Society of Japan** for his work on "Ecological, physiological and molecular biological analyses for high sucrose breeding in sugarcane", in recognition of his achievements in crop science made as a young scientist. In Dr. Terauchi's work, a new physiological hypothesis having applications in sugarcane breeding was established through field analyses. In addition, a novel means of utilization of a gene controlling sucrose accumulation was revealed through molecular analyses. Dr. Terauchi's work is expected to lead to the development of new sugarcane breeding technology.

RESEARCH STRUCTURE AND EVALU

Research Structure at JIRCAS

JIRCAS is located in the Tsukuba Science City, approximately 60 km northeast of Tokyo. Many of the Independent Administrative Institutions (IAIs) affiliated to the Ministry of Agriculture, Forestry and Fisheries (MAFF) are also located in Tsukuba, which itself is home to numerous other national, private and independent research institutions and experimental facilities.

JIRCAS currently has 168 staff members, including research scientists and administrators. Thirty-eight of these staff members are located at the JIRCAS Okinawa Subtropical Station on Ishigaki Island in the southernmost region of Japan. JIRCAS is headed by a President and Vice-President, in addition to an Executive Advisor and Auditor who oversee the utilization of institutional funding and all matters related to budgeting and finance. The Research Planning and Coordination Division oversees seven research divisions which are comprised of the Development Research Division, Biological Resources Division, Crop Production and Environment Division, Animal Production and Grassland Division, Food Science and Technology Division, Forestry Division, and Fisheries Division, as well as the five laboratories of the Okinawa Subtropical Station. The Administration Division is responsible for general administrative affairs. JIRCAS's organizational structure is delineated in Fig. 1.

Research Planning and Coordination Division

The Research Planning and Coordination Division itself does not act as a research division, but rather serves to oversee and support the activities of the seven Research Divisions and the Okinawa Subtropical Station. The Division consists of four sections: the Research Planning Section, Research Coordination Section, International Relations Section, and Publication and Documentation Section. In addition, several International Research Coordinators and a Public Information Officer are assigned to the Division.

In order to promote the implementation of research programs both overseas and in Japan, the first three sections listed above are responsible for the overall planning of JIRCAS research projects, dispatching of researchers on long- or short-term bases, implementation of programs for the invitation of researchers and administrators, and liaison and coordination with international and domestic institutions and agencies. The Publication and Documentation Section is responsible for the collection, classification and provision of bibliographic materials from both overseas and domestic sources, as well as the release of public relations materials. The International Research Coordinators are responsible for overseeing JIRCAS's comprehensive projects, such as those relating to China, South America, and Africa. The Public Information Officer oversees the planning, revision and release of all JIRCAS publications and is responsible for promoting public understanding of the institution's research activities. In addition, the Division is responsible for coordinating the organization of various meetings and workshops including JIRCAS's International Symposia.

Administration Division

The Administration Division consists of three sections: the General Affairs Section, Accounting Section, and Overseas Staff Support Section. The General Affairs Section is responsible for the management of official documents, personnel-related matters and social affairs pertaining to JIRCAS staff. The Accounting Section handles overall accounting, auditing, budgeting, settlements, and wage distribution. The Overseas Staff Support Section is in charge of all matters pertaining to JIRCAS's overseas operations, including general international affairs, overseas expenditures, and overseas shipments of equipment and materials.

Other

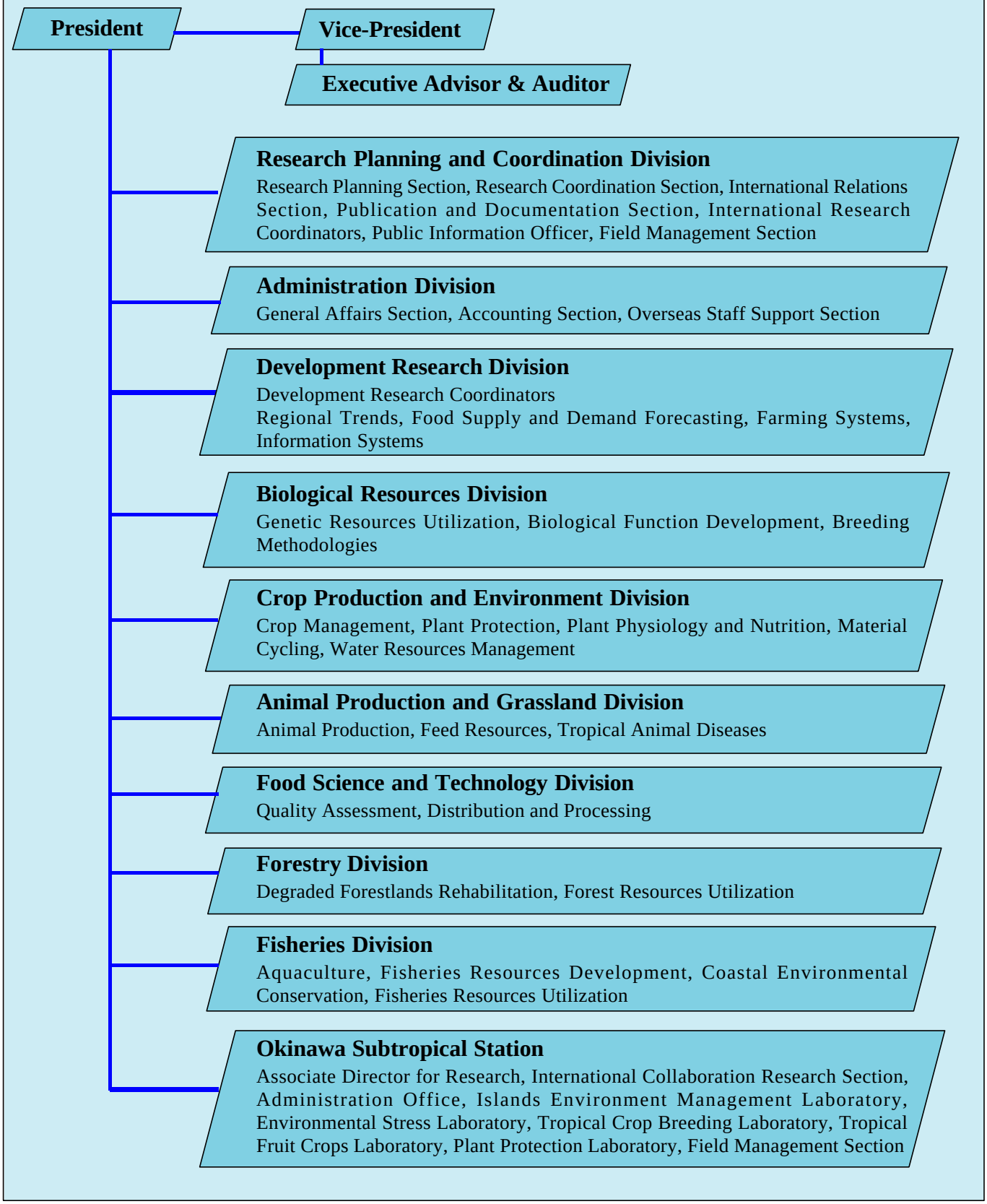
The Okinawa Subtropical Station has an administrative office which is overseen by the aforementioned Administration Division (Fig. 1). Additionally, JIRCAS has two field management sections which oversee JIRCAS's experimental fields; one section is directly under the Okinawa Subtropical Station management, and the other is attached to the Research Planning and Coordination Division.

Domestic institutional support of JIRCAS international collaborative research

JIRCAS's primary mission is to promote sustainable development of agriculture, forestry

ATION AT JIRCAS

Fig. 1. JIRCAS organizational structure



and fisheries compatible with preservation of the environment in developing regions of the world through integrated, collaborative research programs. Towards this objective, JIRCAS endeavors to play an active role in the international research community. Its collaborative projects in developing countries adopt a multi-disciplinary approach including the evaluation of socio-economic conditions in the target countries. In this way, JIRCAS and its counterpart specialists carry out "comprehensive research" in an effort to address the region's most urgent and important agricultural issues. Domestic research at JIRCAS in Japan, the JIRCAS visiting fellowship program, and cooperation with international research institutions all contribute towards and support these overseas research efforts.

To orchestrate a project, JIRCAS first systematically collects and analyzes data from a variety of sources including food supply and agricultural research in developing regions and then proposes international collaborative research strategies and policies tailored to the specific needs of the target country. In this capacity, by devising comprehensive research and policy proposals, JIRCAS essentially functions as a think tank. Next, JIRCAS utilizes existing technologies, policies and research to expand its role into the initiation of research programs to effectively confront such pressing matters as sustainable agricultural development, food security and environmental problems. Currently JIRCAS is conducting 11 comprehensive projects around the world in countries and regions such as Southeast Asia, China, South America, and Africa. Each project is guided and administered by a working group generally composed of the participating scientists, international research coordinators, and JIRCAS directors, who make the necessary adjustments as the project evolves.

JIRCAS maintains a formal staff of over 100 researchers, approximately 40 of whom are on long-term research assignments abroad. In addition, JIRCAS's international collaborative research projects receive substantial support from the Ministry of Agriculture, Forestry and Fisheries' seven other affiliated Independent Administrative Institutions (IAIs) and their 2,700-strong research staff. For example, when a project requires additional human resources, JIRCAS can request the dispatch of researchers from other IAIs on short-term bases typically lasting 1-2 months. JIRCAS researchers who are not on long-term assignments abroad are located in Tsukuba and at the Okinawa Subtropical Station; these staff support international collaborative projects by conducting project-related domestic research that cannot be accomplished in the target countries.

Finally, JIRCAS conducts an "Annual Meeting for the Review and Promotion of Research for International Collaboration" with the participation of representatives from MAFF, other MAFF-affiliated IAIs, universities, non-governmental organizations (NGOs), and the private sector, in order to ensure the efficient implementation of each project. At this meeting, the previous year's activities are evaluated and new strategies and goals are established for the coming year.

JIRCAS as an Independent Administrative Institution

On April 1, 2001, under the Government of Japan's administrative reform facilitating the reorganization of government-affiliated research organizations, the Japan International Research Center for Agricultural Sciences (JIRCAS) became an Independent Administrative Institution (IAI) under the supervision of the Ministry of Agriculture, Forestry and Fisheries (MAFF).

The most distinctive feature of an IAI is its semi-autonomy, with limited prior control from external authorities and an *ex post facto* evaluation system by which it evaluates its own performance. The results of the evaluation are then applied to subsequent activities. Under this new system, MAFF defined JIRCAS's five-year mid-term objectives in April 2001, including the enhancement of research efficiency and the improvement of the quality of research programs and financial performance. Based on these objectives, JIRCAS drafted and implemented a detailed five-year plan (see Mid-Term Plan and in-house evaluation system below and Appendix).

The performance and budgeting management of research activities conducted by JIRCAS will periodically undergo evaluation by the IAI Evaluation Committee established within MAFF, which is composed of experts from the private sector, universities and other research organizations. During each fiscal year, the Committee will investigate and analyze progress towards achieving the mid-term objectives, and the results of this evaluation will be applied, as necessary, to structural modifications of operational and financing systems for subsequent fiscal years.

The comprehensive assessment of

JIRCAS's performance will contribute towards the enhancement of the quality of research programs as well as towards more efficient utilization of financial resources for promoting collaborative research in developing regions. To meet the requirements of this rigorous evaluation, JIRCAS has established an in-house evaluation system, which is described in the following sections.

The Japanese government's basic concepts of science and technology evaluation

Under the 2001 "Science and Technology Basic Plan" which is reflected in the Japanese government's relevant policies, the Japanese community's acceptance of science and technology is extremely important. Research organizations which have become IAIs must clearly identify their research objectives and the implementation of research and development must be enhanced while utilizing funds in an efficient, cost-effective manner. IAIs are also responsible for explaining and communicating their performance both in research and administrative operations to the Japanese people through various information channels that are accessible to the public. To achieve these goals, it is necessary to establish an evaluation system that clearly defines the methodology and orientation of research activities in a manner which will meet public expectations.

Along these lines, in order for JIRCAS to accomplish its objectives, appropriate evaluation of the institution's research and administrative operations are to be conducted from quantitative and qualitative viewpoints based on an objective evaluation system.

JIRCAS Mid-Term Plan and in-house evaluation system

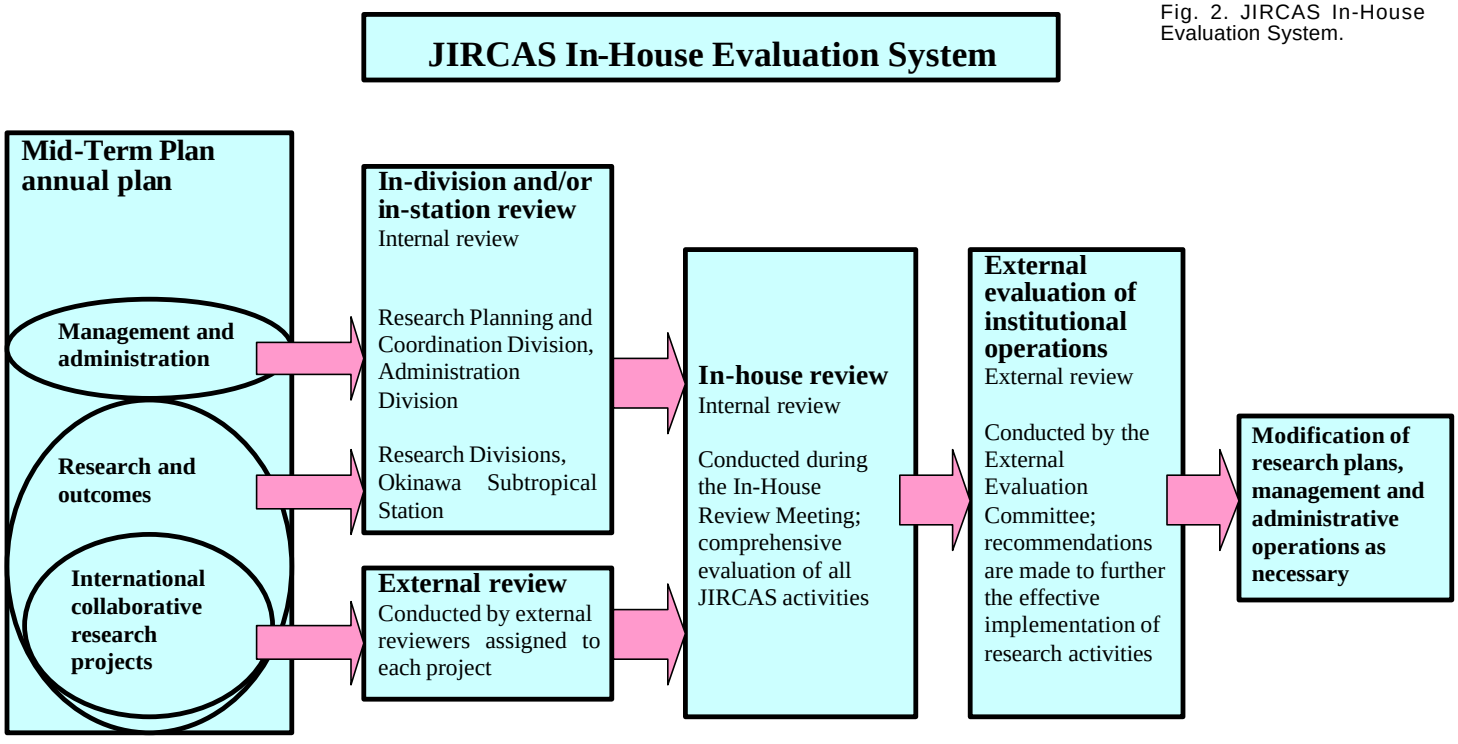
JIRCAS conducts its research activities based on mid-term and annual plans, with the results and efficiency of outcome evaluated by the aforementioned IAI Evaluation Committee. This evaluation system is best characterized as a bilateral process by which feedback is exchanged between JIRCAS and the Committee.

As shown in Fig. 2, under JIRCAS's in-house evaluation system, individual research themes outlined in the Mid-Term Plan and annual plan are firstly evaluated at the division or station level by each director during internal review meetings attended by JIRCAS administrators and directors. These meetings are conducted from mid-December through early January. Concurrently, evaluation of the management and administration of JIRCAS's operations is jointly conducted by the Research Planning and Coordination Division and the Administration Division. The Research Divisions and the Okinawa Subtropical Station evaluate JIRCAS's research and outcomes, and examine the effectiveness of the dissemination of research results.

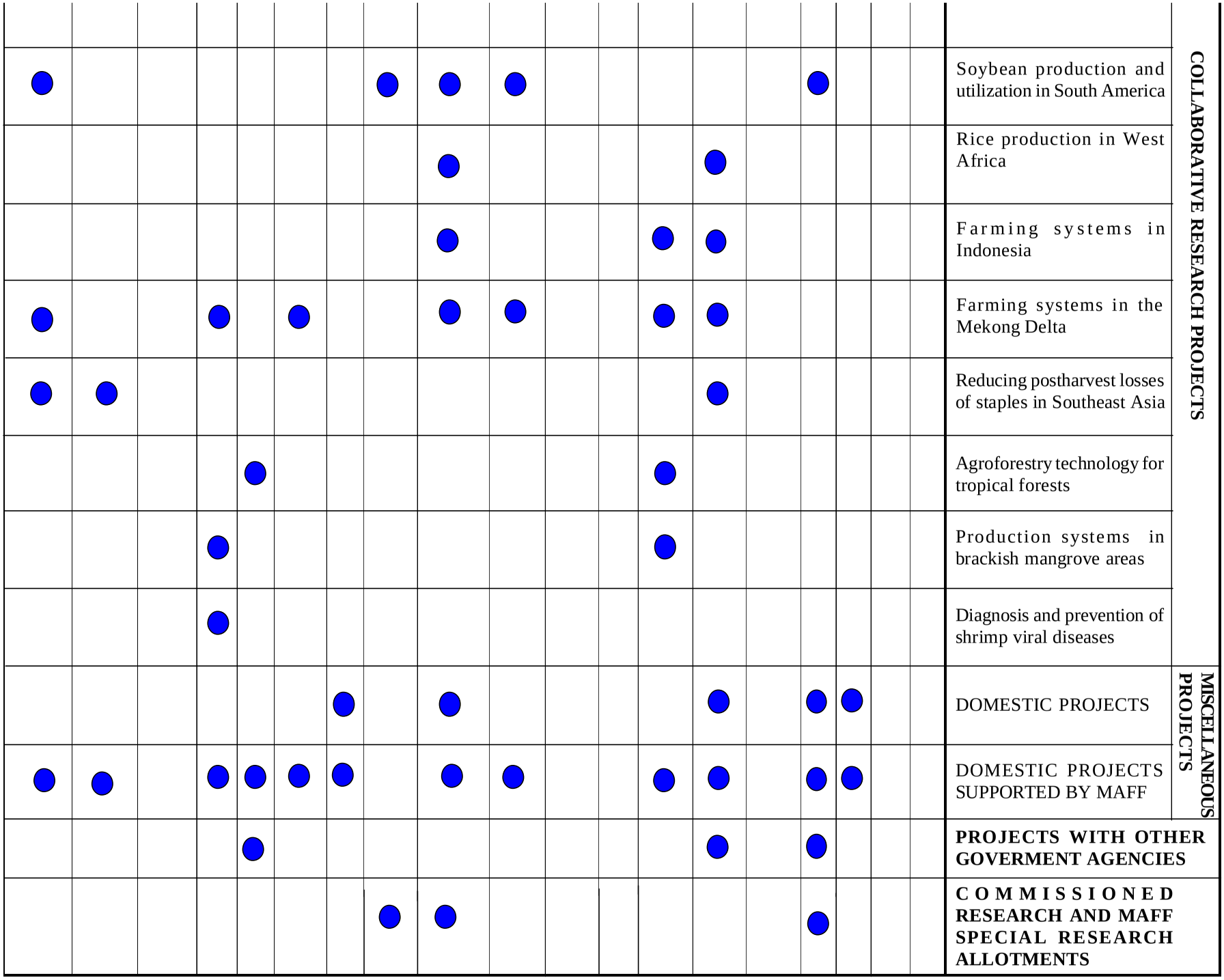
For efficient implementation of the individual research components of the Mid-Term and annual plans, most of the components are organized into international collaborative research projects that focus on specifically

(con't on p. 20)

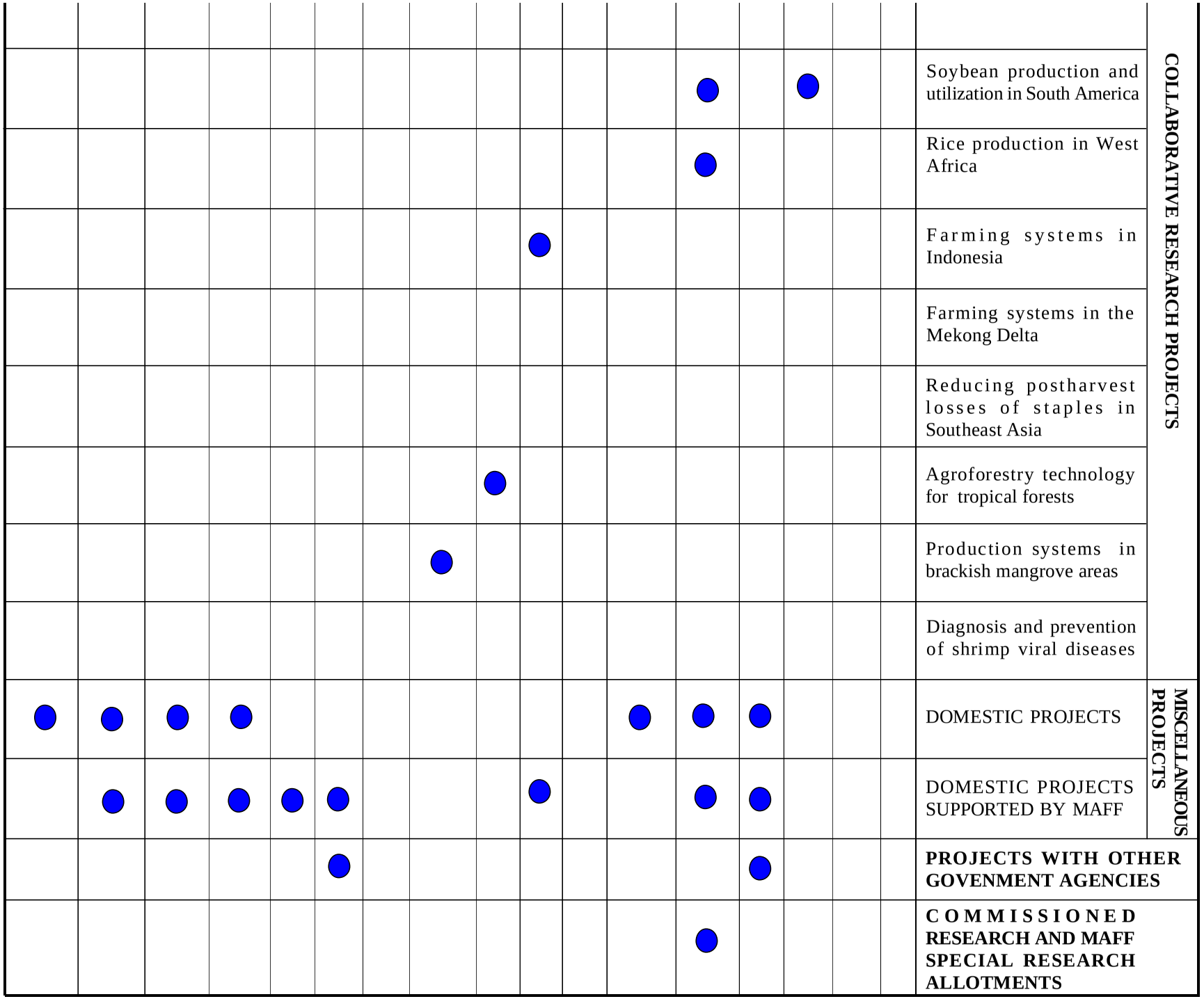
Fig. 2. JIRCAS In-House Evaluation System.



JIRCAS Mid-Term Plan (April 2001-March 2006) Experiments, research and investigations	INTERNATIONAL			
	Sustainable agricultural technology in Northeast Thailand	Agro-pastoral systems in Brazil	Production and utilization of major food resources in China	
A. Improvement of food supply and demand in the developing regions				
1) World food supply and demand and collaborative research strategy				
(1) Analysis for JIRCAS research strategy building				
(2) World food supply and demand model, particularly in China			●	
2) Characteristics and direction of development related to food supply and the environment				
(1) Major constraints on development in Indonesia, West Africa, Vietnam, and other developing regions				
(2) Trends of development of sustainable farming systems in Indonesia, Vietnam, Thailand, South America, and other regions	●	●		
B. Research for sustainable development				
1) Sustainable production technology for agriculture, forestry and fisheries commodities in harmony with environmental preservation				
(1) Evaluation of nutrient cycling in diversified cultivated ecosystems and soil amelioration	●		●	
(2) Low input production technology for rice and upland crops in Thailand, Vietnam, China, Indonesia, South America, West Africa, and other developing regions	●	●	●	
(3) Major diseases and insect pests of rice, soybean, and other crops in Southeast Asia, South America, and China		●	●	
(4) Local forage resources suitable for agro-pastoral systems	●	●	●	
(5) Physiological characteristics of livestock and of prevalent animal diseases in Thailand, Vietnam, and other developing regions	●			
(6) Supplementary natural regeneration of valuable tree species in tropical forests				
(7) Environment-friendly methods of aquaculture for aquatic organisms				
2) Quality evaluation, distribution and processing of agriculture, forestry and fisheries commodities in developing regions				
(1) Quality parameters including appearance and aroma of food resources in Southeast Asia				
(2) Processing technology and prevention of quality deterioration of aromatic rice and other crops			●	


COLLABORATIVE RESEARCH PROJECTS
Soybean production and utilization in South America
Rice production in West Africa
Farming systems in Indonesia
Farming systems in the Mekong Delta
Reducing postharvest losses of staples in Southeast Asia
Agroforestry technology for tropical forests
Production systems in brackish mangrove areas
Diagnosis and prevention of shrimp viral diseases
MISCELLANEOUS PROJECTS
DOMESTIC PROJECTS
DOMESTIC PROJECTS SUPPORTED BY MAFF
PROJECTS WITH OTHER GOVERMENT AGENCIES
COMMISSIONED RESEARCH AND MAFF SPECIAL RESEARCH ALLOTMENTS

JIRCAS Mid-Term Plan (April 2001-March 2006) Experiments, research and investigations	INTERNATIONAL			
	Sustainable agricultural technology in Northeast Thailand	Agro-pastoral systems in Brazil	Production and utilization of major food resources in China	
(3) Uses for under-utilized wood resources such as oil palm residue				
(4) Uses for under-utilized aquatic resources in China			●	
3) Genetic resources and biological functions in developing regions				
(1) Genetic engineering and mechanisms of resistance to environmental stresses				
(2) Evaluation of resistance to disease and pests of rice, wheat and other crops, and development of breeding materials			●	
(3) Collection, evaluation and preservation of genetic resources of vegetables, fruit trees, and various crops in tropical and subtropical regions				
4) Environmental resources and bio-diversity in developing regions				
(1) Environmental resources related to agricultural production and land use	●	●	●	
(2) Regeneration of tropical forests and introduction of agro-forestry technology				
(3) Aquatic resources in coastal and brackish water mangrove ecosystems in Southeast Asia				
5) Research activities in Okinawa				
(1) Characterization of heat and salinity resistance of snap beans and rice				
(2) Evaluation and utilization of characteristics of sugarcane and root crops				
(3) Regulation of tree form and eating quality of fruits and mass propagation of tropical fruit trees including mango and papaya				
(4) Incidence of major pests and diseases, such as citrus greening disease, in the tropics and subtropics				
(5) Meteorological and soil factors which cause instability in crop production on tropical and subtropical islands	●			
(6) Adjustment of variations in heading traits for the generation advancement of rice, wheat, and other crops				


COLLABORATIVE RESEARCH PROJECTS
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(con't from p. 13)

targeted geographical or topical areas. Prior to in-house review, external reviews are conducted annually for individual international collaborative research projects by Japanese and foreign scientists, and administrators and officers from the public sector who are appointed by the president of JIRCAS. Several reviewers are assigned to each project.

Based on the above three types of evaluation, a comprehensive in-house evaluation of all of JIRCAS's activities takes place during the In-House Review Meeting held in early February, which is attended by all administrators, directors and International Research Coordinators. In March, the outcomes and conclusions of the In-House Review Meeting are presented to the External Evaluation Committee appointed by JIRCAS's president for the evaluation of all aspects of institutional operations. These external reviewers evaluate the overall achievement of objectives defined in JIRCAS's Mid-Term and annual plans and make recommendations for the further effective implementation of JIRCAS's research activities as necessary.

Experiments, research and investigations conducted according to the JIRCAS Mid-Term Plan are shown in Table 1. The tenets of the Mid-Term Plan are detailed in the Appendix.

JIRCAS ANNUAL REPORT EDITORIAL BOARD

JIRCAS's Annual Report is managed by the Research Planning and Coordination Division and an editorial board formed by staff administrators and researchers. In addition to a Chairman, Vice-Chairman, Editors-in-Chief, Editorial Committee, and Advisory Panel, the Board receives the participation of a student intern from Harvard University who serves as a Special Assistant to the Editors-in-Chief. (front row: Kumiko Tsutsui, Tadahiro Hayashi, Akinori Noguchi, Marcy N. Wilder, Jason Fann; back row: Takaharu Hayashi, Vidya Jayasankar, Shuichi Asanuma, Nobuo Ueno, Kumi Yasunobu)

INTERNATIONAL RESEARCH AT JIRCAS

International collaborative projects at JIRCAS encompass all fields of agriculture, forestry and fisheries and are carried out in association with various other institutions, including international research centers, other independent administrative institutions (IAIs), and universities. When the Tropical Agricultural Resource Center (TARC), the predecessor of JIRCAS, was restructured to create the present institution, a series of comprehensive projects were launched that focused on responding to various agricultural problems such as developing sustainable agricultural systems and addressing food supply and environmental issues, all of which confront today's developing countries. Projects combine research in both the natural and social sciences. Within the scope of a given project, JIRCAS dispatches long- and short-term researchers to developing countries and often sponsors research-related conferences and workshops with the partner country. In addition to these comprehensive projects, JIRCAS continues to promote specific, focused, unidisciplinary projects that were originally carried out under TARC.

The following section presents recent developments in JIRCAS's ongoing comprehensive projects. In keeping with Annual Report 2001's focus on South America, this section also highlights important research sites in South America where several collaborative projects are currently being pursued. A complete listing of comprehensive and unidisciplinary projects undertaken by JIRCAS researchers can be found at the end of this section.

COMPREHENSIVE PROJECTS

In 2001, JIRCAS was involved in eleven comprehensive projects in Indonesia, Vietnam, South America including Brazil, Argentina, and Paraguay, the People's Republic of China, West Africa including Côte d'Ivoire and Mali, and Southeast Asia including Malaysia, Thailand, and the Philippines. These projects have been divided into three classifications: "site-specific comprehensive projects", "country-based comprehensive projects", and "multinational comprehensive projects".

Site-specific comprehensive projects first systematically analyze the agricultural, forestry and fisheries issues of a specific region through focused research on the relationships between various factors such as natural resources, environment, technology, and administration. These projects then draw upon multidisciplinary research to address the needs of the region. Projects in Indonesia, Vietnam, Thailand, and Malaysia are examples of site-specific projects. Country-based comprehensive projects identify the most significant food supply and agricultural problems of the partner country and then select several representative research fields and themes in which JIRCAS can best contribute toward the resolution of those problems. In addition, these projects promote comprehensive joint research through collaboration with the government of the partner country. Both the China and Brazil projects fall under this classification. Multinational comprehensive projects incorporate researchers in many fields from a wide region encompassing multiple countries in a cooperative effort to resolve strategically important issues. The projects in South America and West Africa are multinational projects.

Each comprehensive project has a project leader who organizes and oversees collaboration among researchers in participating Research Divisions. During the planning stages of these comprehensive projects, socio-economic studies are conducted to identify research priorities in counterpart countries.

INDONESIA:

Evaluation and improvement of regional farming systems in Indonesia

Agricultural production in Indonesia varies greatly from location to location, depending on the natural, environmental and socio-economic conditions of each locale. For instance, rapid economic growth, industrialization, and urbanization on the island of Java have exacerbated the economic gap between cities and villages, and have fundamentally altered social and economic conditions in rural areas. On the outer islands, however, the generally poor living conditions reflect the slow pace of economic development there. Problems with agricultural production and the developmental delay of appropriate technologies to overcome issues of resource utilization continue to plague these areas. These conditions, combined with shortages in rice production during the past few years, have made the enhancement of food crop production, especially for rice, maize, and soybeans in both lowland and upland areas, a priority for Indonesian agricultural research and development. In order to improve household economics and promote local agribusiness,

unresolved production and distribution issues are still prevalent. It is necessary to evaluate current technologies and to develop those required by farmers for the production of temperate vegetables. Moreover, future methods for technology dissemination and market distribution systems as well as comprehensive methods for the improvement of rural farming systems will be elucidated. These conclusions were reached during discussions held at the Mid-term Review Meeting in March 2000.

Currently, this project is composed of the following five subjects: 1) analysis of physical environmental resources for the evaluation and improvement of vegetable-based farming systems in the highland regions of West Java, 2) historical review of the development of temperate vegetable production and predictions for future development, 3) analysis and evaluation of marketing systems of temperate vegetables in West Java, 4) evaluation of the present cultivation and plant production technologies of temperate vegetables and the development of sustainable technologies, and 5) evaluation and utilization of indigenous upland crops and fruit trees planted in farming systems in highland regions.

In Fiscal Year 2001, the following activities were implemented. Trends in the production of temperate vegetables and related policies were firstly identified; then, by conducting detailed investigations on the concrete working systems of temperate vegetable-cultivating farmers, the current status of land use, trends in agri-management, and prevailing conditions for the introduction of new technologies were evaluated. Based on the farmer participatory approach, land use data and related information were gathered, and methods for promoting cooperation among local research institutes, farmers, and farmers' organizations were investigated through workshops held by researchers and farmers. The existing distribution systems of vegetables focused around production region, the selection of distribution route, and the process of price determination were also examined. Based on land use and climatic data as well as the results of satellite data analyses, guidelines were drawn up to prevent soil erosion in temperate vegetable-cultivating regions. Moreover, technical problems associated with temperate vegetable cultivation were identified and the proper implementation of countermeasures was investigated by collecting related data on differences in land elevation, planting patterns, the effects of insect damage, trends in the seedling process, and methods of preservation of fresh vegetables.

Vegetable field converted from paddy in West Java, Indonesia. (Photo: S. Uchida)

VIETNAM:

Development of new technologies and their practice for sustainable farming systems in the Mekong Delta

The primary crop of Vietnam is rice; in the past decade alone, rice production has expanded to such a degree that the country has become not only self-sufficient in rice, but the world's second largest exporter as well. However, in the Mekong Delta, which is a leading area of rice production, farmers' incomes are being drastically undermined by low rice prices, market uncertainty, poor marketing facilities, and competition with other rice-exporting countries. Furthermore, intensive farming technologies have resulted in many unexpected detrimental effects upon the environment, prompting the Vietnamese government to encourage crop diversification as a means of promoting balanced development. Fortunately, various farming systems, including VACR (a Vietnamese acronym standing for V: fruits and vegetables; A: aquaculture; C: livestock; R: rice) systems, have evolved in response to the natural and socio-economic conditions of each area in the Mekong Delta.

In order to foster agricultural practices that are not only economically profitable but also ecologically sustainable as farming systems, the second phase of a comprehensive project entitled "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Mekong II)" has been conducted since 1999 in cooperation with Cantho University, the Cuu Long Delta Rice Research Institute (CLRRI), and the Southern Fruit Research Institute (SOFRI).

Research topics include the development of component technologies of farming systems for rice, livestock, fruit, and aquaculture production. In recent progress, techniques were developed for breeding salt-tolerant varieties of

Rice-prawn farming trial in Cantho Province. Inset: target species, the giant freshwater prawn, *Macrobrachium rosenbergii*.

rice and implementing an integrated pest management system for rice cultivation. In regard to livestock, improvements were made to feeding management practices in swine production and a method for the pathological diagnosis of porcine diseases was developed. For fruit production, a model orchard was established at JIRCAS's on-farm trial site in Tan Phu Thanh Village, Cantho Province. In aquaculture, basic technology for freshwater prawn seed production was developed and several rice-prawn farming trials were conducted around Cantho and Vinh Long Provinces. Furthermore, methods for assessing nitrogen cycling at various trial sites were set up and are currently being evaluated, adjusted, and improved. In socio-economic studies, farming systems in the Mekong Delta area were classified and analyzed in terms of cause-effect relationships in context of their technical and economical problems. The project also aims to evaluate the present VACR systems, develop technologies in order to enhance their environmental sustainability, put these technologies into practice, and establish model VACR farming and extension systems at JIRCAS's on-farm trial site.

In February 2001 during the previous fiscal year, a mid-term evaluation meeting for Mekong II was held at JIRCAS's Tsukuba premises. The outside reviewers of the project acknowledged that research subjects were well-planned and that activities conducted during the first two years of the project had been smoothly implemented. For the second half of the project, it was firstly recommended that the on-farm trials be further promoted. Secondly, in regard to the research subjects relating to fruit production, it was agreed that the nature of fruit trees in general precluded a longer waiting period for certain results. However, strong collaboration with SOFRI was seen as the most effective way to proceed. Regarding livestock production, it was proposed that, in addition to rice bran and sesame seed, other feed resources based on local materials should be examined to achieve sustainable production. Finally, it was agreed that in regard to farming systems, the current state of distribution systems would be investigated.

In 2001, researchers implemented their activities according to the aforementioned recommendations and proposals. From November 27 to 29, 2001, a midterm workshop was held at CLRRI in Vietnam; participants from Japan included six JIRCAS research staff and four Japanese collaborators from other research organizations. On the final day of the workshop, all participants visited the on-farm trial sites and exchanged views on project performance as well as suggestions for continued success in the future.

SOUTH AMERICA:

Comprehensive studies on soybean improvement, production and utilization in South America

The soybean, *Glycine max*, is considered to be one of the principal crops supporting human sustenance, as soybeans serve as a major source of food, oil, and protein-rich livestock feed. Production of this valuable crop has increased rapidly over the past three decades in comparison with that of rice, wheat, corn, and other major grains. Encouraging the continuation of this trend may contribute substantially towards stabilizing the world food supply.

At present, Brazil, Argentina, and Paraguay (MERCOSUR countries) account for approximately one-third of global soybean production and are among the leading soybean exporting countries. However, no-tillage soybean cultivation in South America, particularly in Paraguay, has often been carried out under environmentally vulnerable conditions in arid, acidic soils characterized by low fertility. In addition, the history of soybean cultivation in these areas is relatively short, giving rise to concerns that continuous cropping, pest and disease outbreaks, and soil erosion may adversely affect future soybean production. Therefore, comprehensive multi-national research efforts focused on the development of more efficient and sustainable systems of soybean production in South America are considered an important means of addressing these concerns.

The JIRCAS research project entitled "Soybean improvement, production and utilization in South America" marks a new

initiative by JIRCAS to promote multidisciplinary studies on soybean production and utilization in MERCOSUR countries through collaborative research linking Japanese and South American specialists. The project involves collaboration with several South American research institutes, including those affiliated with the Brazilian Agricultural Research Corporation (EMBRAPA), Brazil; the Ministry of Agriculture and Livestock (MAG), Paraguay; and the National Institute of Agricultural Technology (INTA), Argentina, as well as the Japan International Cooperation Agency and Centro Tecnologico Agropecuario en Paraguay (JICA-CETAPAR). This comprehensive project complements earlier efforts in the field by focusing research in five areas: genetics and breeding, soil management and pest control, crop management and production, postharvest technology, and socio-economic factors. In order to review the latest results obtained during the project and other related studies conducted at EMBRAPA's Soybean Research Center (EMBRAPA-Soja), at JICA-CETAPAR, at INTA's Marcos Juarez Agricultural Experiment Station, and at JIRCAS, a joint workshop on soybean improvement, production and utilization in South America was held at EMBRAPA-Soja in November 2001.

BRAZIL:
Comprehensive studies on the development of sustainable agro-pastoral systems in the sub-tropical zone of Brazil

The sub-tropical region of Brazil is considered to be one of the origins of modern agriculture in South America. This area, where large-scale continuous cultivation of field crops and extensive cattle grazing have constituted the primary forms of agriculture, is at present vitally important to the food supply and economy of Brazil. Those living in the sub-tropical areas of the country have increased agricultural production by continuously expanding the boundaries of arable land and maintaining a high dependence on the net primary productivity of fertile land with minimum inputs. As a result, the land in most of this area has become environmentally vulnerable, while production efficiency and agricultural technology bases have remained at consistently low levels. Plant growth retardation associated with continuous cropping, the occurrence of diseases, pest outbreaks, and soil erosion threaten the productive capacity of this region and are the main obstacles precluding high levels of sustainability.

Initiated by JIRCAS in 1996, the project entitled "Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil" is one of several research programs based in South America. By emphasizing more effective land utilization through the adoption of crop-pasture rotation systems, this project aims to develop highly productive and sustainable farming systems in the environmentally degraded areas of Brazil's sub-tropical zone. Current research involves collaborative efforts with the National Research Center for Beef Cattle (CNPGC), EMBRAPA, and Japan Immigrant Agricultural Cooperation (JATAK). In cooperation with JIRCAS, these institutes are conducting research based on four themes, including: 1) analysis and evaluation of indigenous and traditional land utilization systems for agriculture, 2) multi-disciplinary studies on the adoption of sustainable crop-pasture rotation systems, 3) socio-economic evaluation of crop-pasture rotation, and 4) research on newly developed agro-pastoral systems.

Experimental field at EMBRAPA-Soja. (Photo: K. Kosaka)

In 2001, JIRCAS dispatched three long-term and seven short-term researchers to the CNPGC. Research subjects currently being studied as part of the project include 1) analysis and evaluation of traditional land utilization systems for agriculture, 2) multi-disciplinary studies for the adoption of sustainable crop-pasture systems, 3) mixed and multiple-cropping agricultural systems employing the soybean as the main crop for field crop diversification, 4) introduction and management of forage crops in mixed, multiple-cropping systems for soil improvement, 5) dynamics of soil fertility and plant nutrition in crop-pasture rotation, 6) socio-economic evaluation of crop-pasture rotation in regard to farming systems, and 7) on-farm participatory research on newly-developed agro-pastoral systems.

Agropastoral systems being utilized on a soybean farm in Paraguay. (Photo: T. Taniguchi)

THAILAND:
Development of sustainable agricultural technology in Northeast Thailand

Northeast Thailand receives annual rainfall ranging from 700 to 1600 mm, and over 90% of this rainfall occurs between the months of May and October (the rainy season), during which time a majority of agricultural activities are carried out. Through deforestation, cultivable areas have expanded rapidly since the 1960s. Rainfed lowland paddy, cassava and kenaf have been the major crops since that time, but lately sugarcane has become the predominant cash crop in this region. Deforestation has led to changes in the hydrological environment and has also caused widespread salinity damage in cassava-growing areas. In addition, problems with sandy soils and salinity are extensive in this region. Because of these conditions, agricultural productivity is in decline. Compounding this, the market prices for agricultural produce are also decreasing, thus further hindering the profitability of agricultural production in Northeast Thailand.

Developing sustainable crop production requires a greater understanding of the hydrology of this region, including the efficient management and utilization of water resources (i.e. minimizing salinization problems), reforestation, minimizing soil erosion, arresting the decline in soil fertility, and crop diversification. In addition, the development of improved production systems which can utilize local resources and create employment opportunities for the local population should be promoted in this region. Milk production is one of the major economic activities in Northeast Thailand, and the rapid economic growth in other parts of the country is expected to create a substantial demand for milk and meat products in the near future. Thus, integrated agricultural development that can functionally link agricultural production, the livestock industry, sericulture, and vegetable and horticultural production should be the goal for improving the overall productivity of this region.

This collaborative project is focused on developing improved technologies for lowland paddy, vegetable and fruit production, while taking regional livestock production into consideration. Crop diversification through the introduction of other field crops into this region is another important project goal. In 2001, the primary focus was to finalize the project, as this was the seventh and final year. In this fiscal year, JIRCAS dispatched 5 long-term and 25 short-term researchers to collaborative organizations in Thailand. The research highlights of the year include: 1) quantitative estimation of endophytic N_2 fixation in sugarcane and pineapple which may lead to the reduction of nitrogen fertilizer application, 2) characterization of *Erianthus spp.*, a wild relative of sugarcane, for its adaptability to extreme hydrological conditions, 3) productivity assessment of rainfed rice cultivation in dry direct seeding without tillage, 4) effects of hard pan destruction by subsoiling to increase water percolation and reduce soil erosion during the wet season, and 5) development of a tractor attachment that can perform simultaneous subsoiling, fertilizer application and planting for purposes of sugarcane cultivation. Prior to conclusion of the project, a workshop was organized at Khon Kaen to present major research findings related to the development of sustainable agricultural systems. Finally, the project was reviewed by an evaluation committee comprised of three scientists from Thailand and one from Japan. Owing to the successful completion of the project, a new project entitled “Increasing economic options in rainfed agriculture in Indochina through efficient use of water resources” began in April 2002 (detailed in “Highlights”).

CHINA:
Development of sustainable production and utilization of major food resources in China

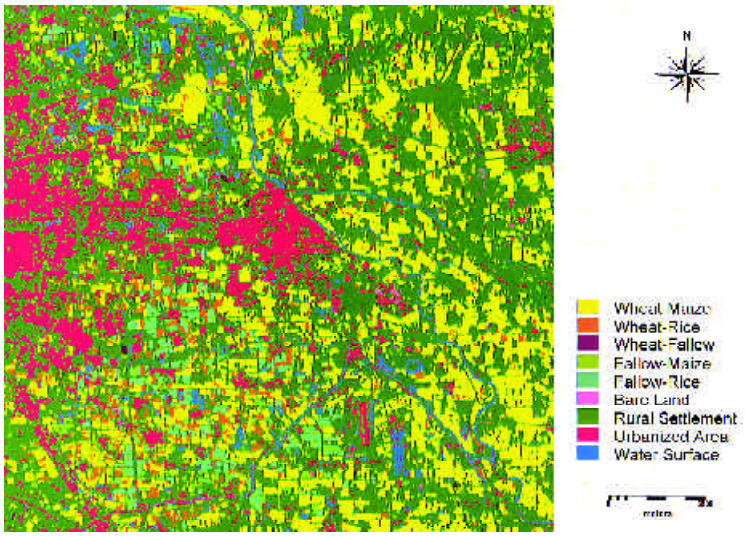
JIRCAS officially inaugurated its first comprehensive research project with the national government of the People’s Republic of China (PRC) on May 28, 1997, with the signing of an agreement by representatives from JIRCAS, the Japanese Agriculture, Forestry and Fisheries Research Council (AFFRC), and the Chinese Ministry of Agriculture (MOA), committing these institutions to a collaborative research program spanning seven years. The

project aims to develop technologies for sustainable production and utilization of major food resources in China. These resources, including rice, soybeans, corn, and freshwater fish, will become increasingly important as economic development both strengthens the purchasing power of ordinary Chinese citizens and enhances their concern for dietary nutrition.

A report by the World Watch Institute entitled, *Who Will Feed China? Wake-up Call for a Small Planet* (Brown 1995), provided the initial impetus behind concerns over the future of China's food supply. In response, many Chinese and foreign researchers have analyzed and made projections regarding food supply problems in China. Although these researchers have focused their studies primarily on the grain sector, their reports reveal conflicting views regarding future scenarios for overall food production and demand. This lack of agreement is most likely due to differences in underlying assumptions, data, and estimation processes. Nevertheless, there exists a sufficient consensus that China's food demand will continue to increase over the next thirty years, and available food supplies will not be able to meet this demand. Consequently, rising demand for imported foodstuffs is likely to occur.

Major factors inhibiting agricultural production increases in China include the limited amount of arable land, the poor quality of existing farmland, the weak response of soils to fertilizer application, and the small-ownership structure of private Chinese farms. Due to rapid economic growth, it is inevitable that increasing amounts of farmland will be used for non-agricultural purposes. New efforts to reclaim land and recent increases in crop indices do not seem to have halted the trend toward declining levels of land cultivation. Moreover, crop yields in China remain significantly lower than in advanced industrialized nations. The major factors affecting future food demand include population expansion, changes in the structure of Chinese society due to rural-urban migration, increases in family income, changes in the price of agricultural products, and the persistence of poor infrastructure. Due to the decline of agricultural resource availability and the natural, structural, financial, and economic constraints on yield potentials, food demand in China will continue to rise and agricultural production will consistently fail to keep pace.

In an effort to curtail these trends, this project aims to develop an effective production and distribution system for food resources in order to cope with the changing supply and demand structures in China. Efforts to achieve this objective will require an evaluation of new technology dissemination and the economic impact this technology has on selected rural areas and individual farmers. In order to improve food supply and meet the demand in selected areas, the project must also generate a supply and demand modeling structure for food resources, develop a system of analysis for corresponding farming areas and agricultural products, and design more effective control systems.



Estimated land use during the 1991-92 cropping season for the Tongxian area of Beijing based on multi-tempo LANDSAT-TM data. (Photo: S. Uchida)

On February 1, 2001, during the previous fiscal year, JIRCAS organized a two-day mid-term review meeting, preceded by a workshop which facilitated the outside reviewers' understanding of the significance and future development of the project in China. During the review meeting, Japanese scientists presented major research findings according to eight research programs and proposed the integration of two programs which are closely related under the heading of socio-economic studies. After the meeting, all five reviewers gave favorable evaluative assessments; their recommendations emphasized the integrated contribution of diverse research programs to Chinese food sources, facilitated under close cooperation between Chinese institutions and JIRCAS. In addition to the project review, the discussions among scientists from China and Japan during the workshop and the subsequent review meeting improved mutual understanding of the collaborative research project and will contribute to its successful implementation during the second phase.

Ten research subjects currently being studied as part of the project include: 1) changes in food policies, rural communities and production structure, regional food balance, marketing, resource use, and environments, 2) remote-sensing and GIS applications for land resource

use, 3) the impact of new technologies on regional and farm economies, 4) evaluation and utilization of rice genetic resources, development of novel breeding materials, and establishment of sustainable high-yielding production methods, 5) development of technologies for insect pest management, 6) evaluation and utilization of soybean genetic resources, 7) studies on materials cycling in the agro-ecosystem, and development of farming systems in paddy fields in context of environmental conservation, 8) development of technologies for the processing, preservation and distribution of foodstuffs, 9) utilization of corn and its residues in animal feed and evaluation of resulting meat products, and 10) development of technologies for the processing, distribution and storage of freshwater fishes.

During Fiscal Year 2001, JIRCAS dispatched 4 long-term and 16 short-term researchers to conduct activities according to the project plan; in addition, six administrators and coordinators visited China for the further discussion of project achievements and research subjects. From China, nine administrators and counterpart researchers were invited to Japan.

WEST AFRICA:
Improving food security in West Africa through increased productivity in rainfed rice systems

The demand for rice in sub-Saharan Africa is growing at a faster rate than that for any other major food staple, with consumption expanding across all socio-economic classes, including the poor. Rapid demographic expansion and urbanization in Africa have shifted food preferences from traditional foodstuffs to more easily prepared rice and bread. These patterns are especially evident in West and Central Africa where the substitution of rice for coarse grains and traditional root and tuber crops has fueled rice demand at an annual growth rate of 6 percent since 1973. Increased rice production in Africa is hampered by a number of constraints such as disease, pest and weed infestation, inadequate water management, infertile soils, lack of suitable rice varieties, and various socio-economic factors. In order to address these problems, JIRCAS initiated a five-year collaborative research project with the West Africa Rice Development Association (WARDA) in April 1998.

The project focuses on two major subjects. The first involves genetic and ecophysiological characterization of indigenous rice varieties and interspecific progenies. Farmers in the region grow two species of rice, Asian rice (*Oryza sativa*) and African rice (*O. glaberrima*), yet they are far from achieving high yields due to the production constraints associated with each species. In order to develop new cultivars for the region which combine the advantages of these two species, WARDA is currently working on the Interspecific Hybridization Project. At the same time, JIRCAS researchers are aiming to develop a simple but reliable method to assess tolerance to drought and soil acidity and to establish a marker-assisted system for selecting desirable interspecific rice progenies. Intensive experiments were carried out at JIRCAS's Tsukuba premises to determine whether xylem exudation rate could be used as a screening criterion for drought tolerance; a positive correlation was discovered. Further trials will be conducted in order to simplify the method and include a greater number of genotypes with a known level of field tolerance to drought. In other work, a complete set of chromosome segment substitution lines with segments of *O. glaberrima* back-crossed into *O. sativa* was evaluated for morpho-physiological traits in Japan and at WARDA. This study is expected to clarify the genetic basis of contribution from both species, leading to further improvement of interspecific hybrids. Asian and African rice germplasm and promising interspecific progenies were evaluated for physiological characteristics related to drought tolerance during the early stages of vegetative growth. Putative indicators for drought tolerance have been identified and will be further ascertained in the coming years.

Rice cultivation in a rainfed lowland area in Ghana. (Photo: T. Sakurai)

The second facet of the project involves the study of socio-economic aspects in relation to effective utilization of rainfed lowlands used in rice cultivation in West Africa. In 1999, a JIRCAS agricultural economist initiated collaborative research under WARDA's Policy Support Program. The objective of this project is to assess how the institutional and economic

environment affects the farmers' capacity to adopt new technology effectively. The target areas for this survey are rainfed lowland regions that are currently under-utilized but which possess significant potential for intensification with improved water control. This year JIRCAS continued its research focus on analyses of how the land tenure system affects the adoption of rice cultivation in areas where biophysical conditions are well-suited for it; nearly 200 villages were covered in this extensive survey. Statistical analyses were conducted to determine how availability of irrigation channels affects rice cultivation in terms of farm size, use of external inputs (fertilizers, herbicides), labor input and profitability of rice cultivation. In addition, factors affecting investment in irrigation channels were investigated. Similar comprehensive research was initiated in Ghana to expand the scope of the study on rice cultivation adoption under specific socio-economic conditions.

SOUTHEAST ASIA:

Development of agroforestry technology for the rehabilitation of tropical forests

With excessive commercial logging and cutting of trees for fuel as well as the increasing exploitation of arable land associated with the high demand for food production, natural forests have been rapidly degraded or decreased. As a result, forests with high biodiversity have been transformed into monoculture plantations of fast-growing lumber trees, rubber trees or oil palms, particularly in developing countries. Human activities, which include unsustainable forest harvesting, repeated short-term shifting cultivation and the incidental setting of forest fires, have had a considerable impact on forest ecosystems, resulting in soil erosion, losses of flora and fauna, flooding, deterioration of forest resources, and soil degradation. This is also resulting in serious economic and environmental problems not only at the local level but also on a global scale. Therefore, the rehabilitation and sustainable management of these forests are urgent issues for the conservation and utilization of forest resources. Forest rehabilitation and enrichment of denuded and degraded lands are the first steps towards achieving sustainable management of the forests.

JIRCAS has been playing a significant role in alleviating forest degradation by focusing its efforts on methods of reforestation and ways to motivate local inhabitants to participate in reforestation activities. Research on methods for the establishment of fast-growing species as shelter wood for promoting the growth of valuable indigenous trees such as *Dipterocarps* species in logged-over tropical forests is being carried out in collaboration with the College of Forestry, University of the Philippines at Los Banos. Studies on the regeneration of *Shorea* species seedlings on logging roads and investigations on the improvement of logging techniques for selective management systems are being carried out in collaboration with the Forest Institute of Malaysia (FRIM).

In the year 2000, JIRCAS proposed a collaborative research project entitled "Development of agroforestry technology for the rehabilitation of tropical forests". This project is being implemented mainly in collaboration with the Forest Research Center (FRC) of the Forestry Department of the State Government of Sabah, Malaysia. The final objective of the project is to establish a technological base for the ongoing development of biodiversity-rich forests, high-value timber production forests, forests that perform critical environmental functions, and fruit tree orchards where soil fertility has been improved or is well-maintained. These studies will contribute towards the mitigation of agriculture-forestry conflicts as well as promoting environmental conservation and sustainable forest resource management.

Over the seven-year (2000-2006) duration of the project, specific objectives will include socio-economic evaluation of agroforestry, the re-establishment of a productive environment for agroforestry, and the development of agroforestry techniques with the utilization of shade trees. Prior to commencement of the collaborative project, an MOU was signed

Experimental site at Kolapis in Sandakan, Sabah State, Malaysia. (Photo: K. Nakashima)

between JIRCAS and the Sabah Forestry Department on December 10, 2001, and three long-term researchers from JIRCAS were dispatched to the FRC.

THAILAND:

Development of low-input technology for reducing postharvest losses of staples in Southeast Asia

Due to increasing world population and the limited amount of arable land available, food security has become a major global concern. While accelerating food production is of vital importance, reducing postharvest losses of agricultural products is an essential task as well. In Southeast Asian countries, postharvest losses have been estimated at approximately 30 percent, caused mainly by improper drying procedures and insect infestation during crop storage under hot and humid climatic conditions.

The world's most widely used fumigant, methyl bromide, is to be phased out by 2015 due to its ozone-depleting potential. An alternative pesticide, phosphine, has generated tolerant insect species and has therefore had only marginal insecticidal value. Many countries have been making efforts to develop alternative methods for disinfesting agricultural products such as grains, fruits and vegetables. The technologies for reducing postharvest losses must not only be environment-friendly but also affordable to small farmers and rural enterprises in Southeast Asia.

The five-year project (2000-2004) is designed to develop disinfestation methods for grains by employing natural insect enemies and botanicals, as well as to develop low-input drying technologies for rice using natural resources and materials such as sunlight, husk, and straw. In cooperation with the Thai Department of Agriculture, Kasetsart University, and King Mongkut's University of Technology, as well as Japanese institutions such as the National Food Research Institute (NFRI) and the National Agriculture Research Organization (NARO), the project is being implemented focusing on 1) analyzing the causes of postharvest deterioration of grains and 2) developing and systemizing low-input and environment-friendly technologies for reducing postharvest losses. These technologies will aid in the establishment of a more cost-effective system for minimizing postharvest losses of grains that are essential to Southeast Asian countries.

In recent research, major stored-product insect pests were identified and many natural enemies were collected from sites throughout Thailand. In particular, in a study on botanicals featuring growth-inhibiting activity against maize weevils, it was observed that *d*-limonene was effective at extremely low atmospheric concentrations. In other work, the physical properties of a Thai brand of rice dryer were studied to determine its drawbacks and to pinpoint areas needing improvement; based upon this information, appropriate structural modifications were proposed. On November 29, 2001, JIRCAS held a mid-term evaluation meeting to review recent research, as well as a workshop to promote understanding of the background and significance of the project. Based on suggestions made by outside reviewers, it was decided that more data pertaining to postharvest losses of rice in Thailand would be collected, and the survey of the seasonal occurrence of insect pests and natural enemies would be continued in the upcoming fiscal year.

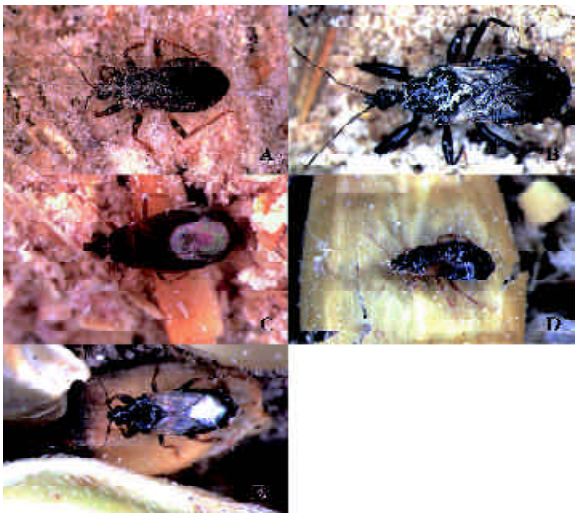


Fig. 1. Predaceous bugs found under stored conditions in Thailand. A: *Pergrinator biannulipes* Mont. et Sign; B: *Amphibolus venator* (Klug); C: *Joppeicus paradoxus* (Thunberg); E: *Xylocoris flavipes* (Reuter); F: *Xylocoris* sp. (Photo: K. Konishi)

SOUTHEAST ASIA:

Studies on sustainable production systems of aquatic animals in brackish mangrove areas

In 2001, JIRCAS launched a five-year comprehensive research project entitled "Studies on sustainable production systems of aquatic animals in brackish mangrove areas". This is an international collaborative research project involving three countries: the Philippines, Malaysia, and Thailand. On the Japan side, the JIRCAS Fisheries Division, the Development Research Division, and the Forestry Division have taken the initiative in implementing the project, with support from the Fisheries Research Agency (FRA) and the Forestry and Forest Products Research Institute.

The importance of brackish water mangrove

areas due to the key ecological functions they play has once again achieved recognition and prominence; for example, their capacity to absorb CO_2 has been evaluated as being quite significant. However, due to the onset of urbanization, industrialization, and human activities such as aquaculture, the brackish water mangrove areas of Southeast Asia have sharply declined to half of their 1960 levels. The current research project is aimed at helping to promote the fisheries industries by shedding light on the multiple functions of brackish water mangrove areas. Moreover, it is believed that this study will play an important role in restoring these areas in Southeast Asia.

A research staff scientist at the Fisheries Division of JIRCAS established the institution's first collaborative research project at the Southeast Asia Fisheries Development Center Aquaculture Department (SEAFDEC/AQD) in Iloilo, the Philippines, and has been working on measures for the prevention and control of diseases that are detrimental to the production of high-value fish. The initial results of this research include the identification of a virus which causes massive mortality rates among the fry of high-value cultured groupers.

Since the beginning of Fiscal Year 2001, another JIRCAS staff scientist has also commenced studies on broodstock culture and production of new high-value species at SEAFDEC/AQD. This research, focusing on the development of feeds, has already revealed that the supplementation of carbohydrates is useful in breeding the blubberlip snapper (*Lutjanus rivulatus*), a predatory fish.

Another staff scientist is engaged in studies on the natural purification of aquaculture effluents in mangrove forests at Kasetsart University in Bangkok, Thailand. Using an artificially-constructed mangrove forest on the university premises, work is being conducted to prove that mangrove forests play highly functional roles as natural purification agents.

At the Fisheries Research Institute in Penang, Malaysia, another JIRCAS staff scientist launched studies linking habitat, biology, and the management of commercially important fish species in mangrove estuaries. The goal is to establish a sustainable control technology for fisheries resources by clarifying the feeding habits of important fish that inhabit mangrove areas and by investigating species abundance and fishing implements used in mangrove areas.

In the field of socio-economics, a staff scientist at the FRA's National Research Institute of Fisheries Science has also begun analyzing the management of fish farms and the economic benefits of new sustainable fish production systems in brackish mangrove areas. This research is being carried out in cooperation with SEAFDEC/AQD in the Philippines.

Aquaculture experiment station in a mangrove area at Igang, the Philippines.

The overarching purpose of this project is to promote fisheries industries in brackish mangrove areas and to improve the incomes of the people whose livelihoods depend on them, while concurrently preserving the natural environment in those areas. It is a challenging program of study, and research to date has already experienced great success.

MALI:
Combining advanced weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems in Mali, West Africa

The goal of this research program is to develop information to help farmers make better selections among crops and production practices, in order to reduce risk associated with climatic variability in rainfed agriculture. Agriculture of both upland cereals and rice in Mali and other Sahelian countries in West Africa is predominantly rainfed, and risk due to variable climatic conditions is a widespread concern.

Climatic variability in the Sahel is marked by several notable characteristics. Latitudinal variability is reflected in isohyets of equal annual rainfall, which are higher in the south along the Gulf of Guinea and decrease as one moves northward towards the Sahara Desert. Interannual variability includes both long-term cycles and changes in total rainfall from year to year. For farmers, intraannual variability is a key form of risk. This includes temporal variability or distribution within the growing season, and spatial variability from one location or field to another. To date, minimal systematic analysis of intraannual distribution and spatial variability has been undertaken, although empirical

Weather monitoring station in a cotton field in Mali.

indications can be seen at the village level, as revealed in the initial reconnaissance survey reported last year.

In its first full year in 2001, the program was carried out in the fields of two villages, one with 800 mm annual rainfall (transition to the semi-arid zone) and the other with 1200 mm (semi-humid zone). Participatory and survey techniques were used to select 30 farmers in each village for monitoring intraannual temporal distribution, spatial variability, and farmer crop production decisions.

First, participatory focus group sessions were held to identify risk factors, using both visual and oral information sharing and assessment techniques. Risk was explained as difficulties (*gelea*) whose likelihood of occurrence is not known in advance. Farmers gave indicators of risk robustness, the household's ability to withstand risk events.

Next, farmer group leaders obtained each farm household's self-assessment of four risk-robustness indicators from the focus groups. A typology was then developed from 2^3 combinations of risk-robustness or vulnerability levels based upon three indicators: food self-sufficiency (the number of surplus or deficit months), cattle herd size (more or less than 10), and outside remittances (whether received or not).

Results of the self-assessment varied greatly between the two villages. In the village with lower annual rainfall, farmers had smaller herds, more food deficits, and almost no remittances; 37% of fully-equipped farmers had food deficits while 63% of sub-equipped farmers had deficits of two to three months. In the village with higher rainfall, only 4% of fully-equipped farmers had food deficits, and there were none with deficits of two months or more.

Small-scale automatic weather monitoring stations were placed in the fields of 15 farmers in each village in order to monitor rainfall as well as air and soil temperatures. These farmers' fields, along with a second sample of another 15 farmers' fields without monitoring stations, were surveyed weekly during the cropping season. One larger automatic station was also placed in a central location in each village, for the purpose of monitoring additional parameters including radiation intensity and wind speed and direction.

In the semi-arid village, the sequence of planting dating from the earliest crop to the latest in 180 surveyed fields was millet -> cotton -> maize / millet intercrop -> rice -> maize / sorghum intercrop -> maize -> groundnut. There was high variability in seeding dates for each crop. For seven of the above eight crops, the standard deviation in initial seeding exceeded ten days. Farmers often planted the same crop on two different dates, one prior to and the other following the first rains; the early seeding is called *semis-à-sec*, or "dry seeding". If successful, the crop is in the field for a longer period of time and can benefit from all the rainfall that year. However, the success of *semis-à-sec* depends on the number of days until the first rain. When *semis-à-sec* fails, due to late rains or poor distribution in the young seedling stage, farmers must reseed and therefore their seed and labor requirements increase, possibly resulting in lower yield if maturity occurs after the seasonal rains have ended.

The project held workshops in July and December 2001, with the second workshop organized around the work of the Malian agroclimatologist Abdouramane Yorote. Mr. Yorote spent one month on analyses of field-level climatic data with team members at JIRCAS in Tsukuba, the National Agricultural Research Center for the Tohoku Region, and the JIRCAS Okinawa Subtropical Station.

In 2002, a second year of data will be obtained from the same farmers in the two villages. This will enable the assessment of interannual variability and interactions between spatial, intraannual, and interannual variability, as well as relationships between toposequence, soil type, and rainfall.

Weather monitoring station at the edge of a rice bas-fonds in Mali.

RESEARCH SITES IN SOUTH AMERICA

As a part of this year's spotlight on JIRCAS initiatives in South America, the following pages detail sites at which JIRCAS researchers are currently undertaking projects in cooperation with governmental and international organizations in Brazil, Argentina and Paraguay.

National Center for Soybean Research, Brazilian Agricultural Research Corporation (CNPSo, EMBRAPA)

EMBRAPA Soybean is one of the 39 units of the Brazilian Agricultural Research Corporation (EMBRAPA) and is located in Londrina, Prana State, Brazil. Its priority is developing technologies, services and products for the soybean agribusiness to assure high standards of living in Brazilian society. It also conducts research on sunflower throughout Brazil and wheat in Parana State. EMBRAPA Soybean is comprised of 15 laboratories, 23 greenhouses and 350 hectares of experimental fields in Londrina, as well as an experimental station in Balsas, Maranhao State. It is staffed by 294 specialized employees of whom 69 are research scientists (38 Ph.D. and 31 M.Sc.) and also maintains various relationships with researchers working in other states in partnership with public and private organizations. In 1960, before EMBRAPA Soybean was founded, soybean production was restricted to the southern states of Brazil including part of Sao Paulo State. Due in large part to technologies developed by EMBRAPA Soybean and its partners, Brazil now ranks second in the world in soybean production, with 13.1 million hectares in 2000. In recent years EMBRAPA Soybean has been attempting to shift its research towards work in biotechnology. At the present time, Brazil is not cultivating transgenic soybeans on a commercial scale, but researchers are laying the groundwork for future studies.

The JIRCAS project began in 1998 with the research topics of breeding ("Genetic improvement of the chemical constituents in soybean seeds") and soil science ("Improvement of soil management practices"). In 1999, research on the subject of crop physiology ("Morphological and physiological characterization of drought-tolerant soybean cultivars and identification of selection criteria for drought tolerance in Brazil") was initiated. All research activities at EMBRAPA take the form of projects; therefore, the subjects of the JIRCAS project are related to the projects

Main gate of EMBRAPA-Soja.

conducted by EMBRAPA Soybean's counterparts. Through this collaboration, the basis for the genetic improvement of protein and chemical components in Brazilian soybean seeds has been established, and the critical level of micronutrients for soybean cultivation in the frontier soils of Brazil has been elucidated. Drought-tolerant and sensitive cultivars have been classified from their yield response to drought during the period of one month after flowering. In the four years since 1998, ten researchers from EMBRAPA Soybean have visited Japan to pursue collaborative research, conducting work at JIRCAS and other institutes within the framework of JIRCAS projects.

Genetic improvement of chemical constituents in soybean seeds

Soybean lipoxygenases and isoflavones have been discovered to be responsible for undesirable flavors and tastes which are partly responsible for the limited direct consumption of soybeans in this region. In particular, isoflavones have become the subject of interest due to their many potential physiological properties. Therefore, the enhancement, reduction or elimination of these compounds could contribute substantially towards the improvement of soybean products. Soybeans are rich in protein, containing an excellent balance of essential amino acids compared to other vegetable proteins and possess many functional properties useful in processing. Most South American soybean cultivars, however, have relatively low protein content because the focus has traditionally been on breeding for oil. The evaluation of genetic resources and breeding of genetic lines for the purpose of improving South American soybean cultivars for human consumption has been conducted by JIRCAS in cooperation with EMBRAPA Soybean. First, since identification of lipoxygenase isozymes is time-consuming, successful attempts were made to simplify detection methods based on

the bleaching activities of these isozymes. Secondly, many South American soybean cultivars grown in Brazil were analyzed for six isoflavone compounds, and remarkable differences in total isoflavone content and in the ratio of daidzin forms/genistin forms were observed. In addition, total isoflavone content in each progeny seed derived from crosses between different content cultivars was analyzed and the possibility of breeding for isoflavone content as a quantitative trait was suggested. Finally, several crosses and early generation advancements from F_1 to F_4 between South American soybean cultivars with relatively high protein content were performed.

Morphological and physiological characterization of drought-tolerant soybean cultivars and identification of selection criteria for drought tolerance

The main goals of this research study were 1) to clarify the characterization of the morphological and physiological traits of roots of drought-tolerant cultivars, 2) to examine gene expression of drought-tolerant and drought-susceptible cultivars, and 3) to identify selection criteria in soybean breeding programs in drought-prone cultivars. The following climatic and cultural conditions were revealed through visits to several soybean-producing areas of Brazil. Rainfall is concentrated during the summer cropping season, and most of it occurs as afternoon showers; high solar radiation in the morning promotes dry matter production. These are both interpreted as favorable conditions for soybean cultivation. However, there was a period with little rainfall between October and December during a particular cropping season, and soybean plants cultivated in Cerrados had shallow roots just 15 cm long, showing evidence of the damage soybean plants incur from drought. According to the results of a pot experiment in a greenhouse, plant growth was inhibited by drought stress, and tolerant cultivars showed greater levels of inhibition than susceptible ones. Water stress inhibited root elongation only in the vegetative stage. Drought tolerance of vegetative growth may not necessarily be consistent with that of reproductive growth; however, a tolerant cultivar, Conquista, seemed to exhibit less reduction of root volume under drought conditions and also showed less or slower decline in maximum root length than did other cultivars after flowering. Photosynthetic light gathering efficiency did not exhibit marked differences among cultivars and stress treatment, suggesting the difficulty of using it as an index of plant damage due to drought stress.

Field experiments at EMBRAPA Soybean produced the following results. Two tolerant cultivars did not display yield reduction even under non-irrigated conditions; it was avoided through increases in the seed/stem ratio at harvest. A susceptible cultivar, BR16, had lower relative water content (RWC) in the leaf than other cultivars during the reproductive stage under non-irrigated conditions and under rain shelter. There was a tendency for RWC in the leaf of a tolerant cultivar BR4 to be higher than in other cultivars under water-stressed conditions in pot experiments. Thus far, RWC in the leaf and root longevity in the reproductive stage are considered to be the most useful selection indices for drought-tolerant soybean cultivars.

Sulfur and micronutrients supplying capacity of two Cerrado soils from Northeastern Brazil: Nutritional diagnosis of boron for soybean plants

Soybean cultivation is rapidly expanding to the northeastern areas of Brazil, making it necessary to undertake studies on soil fertility and establish a basis for soil management in the region. This study focused on the supply of sulfur (S), manganese (Mn), zinc (Zn), boron (B) and copper (Cu) in two native savanna (Cerrado) soils. The objectives of this study were: 1) to clarify the effects of S, Mn, Zn, B and Cu on soybean growth in the tested soils, 2) to obtain an indicator for the nutritive conditions of these elements in soybeans, and 3) to categorize critical levels of the tested elements for soybean growth in order to predict an appropriate period and quantity for applying each component.

The experiment revealed that excessive S was the primary growth-limiting factor for soybeans among the tested elements in both soils, and the nutritional diagnosis of S for plants was reported last year. Boron deficiency was the second most significant deterrent to soybean growth in the soils; deficiency began to occur at concentrations below 40 mg/kg in the third leaf at flowering and toxicity above 90 mg/kg. Nevertheless, the B concentration in grains was a more reliable indicator of its nutritive conditions than that in the third leaf due to the clearer correlation to grain yield. The B concentration in grains was classified as follows: deficient in cases below 10 mg/kg, low in cases from 10 to 20 mg/kg, normal from 20 to 27 mg/kg, and toxic above 27 mg/kg. Boron application is necessary before the concentration

decreases to below 20 mg/kg in soybean grains, and it must also be kept below 27 mg/kg. At the present time, soybean cultivation is continuing so that other growth-limiting factors may be determined.

National Center for Beef Cattle Research (CNPGC)

EMBRAPA-CNPGC (National Center for Beef Cattle Research, Brazilian Agricultural Research Corporation) was established in 1977 and is one of the EMBRAPA institutes belonging to the Ministry of Agriculture of Brazil. This institute is located in Campo Grande, Matto Grosso do Sul, Brazil, and employs 220 staff members, of whom 50 are research scientists. The total area of the institute is 4,681 ha, which feeds approximately 3,400 heads of cattle.

EMBRAPA-CNPGC's mandates are the improvement of production and quality of beef and the transfer of knowledge and technology to the public in order to develop sustainable beef production in Brazil. Objectives are stated as follows: 1) contributions towards increasing the production and efficiency of the beef cattle production system, 2) improvement of the quality of beef and its byproducts in accordance with the needs of consumers, 3) development of an integrated system of agriculture and livestock farming, and 4) improvement of the quality of facilities in livestock breeding and the resolution of various problems related to beef production.

To achieve these objectives, the institute is conducting work in pasture management, genetic improvement and management of livestock, animal nutrition and hygiene, and social economics and technology transfer. It is also collaborating with research organizations in Europe, the United States, Canada, Japan, and Australia.

In the subtropical areas of Brazil, agricultural production has been increased through the continuous expansion of arable land and a heavy dependence on the net primary productivity of fertile land with minimum input. As a result, in most areas, land has become vulnerable to even the slightest changes in the external environment; land production efficiency has remained low partly due to the limited introduction of improved agricultural technologies. The decline in plant productivity associated with continuous cropping and the proliferation of diseases and soil degradation are the major constraints on sustainable agriculture in the region. Recently, an agro-pastoral system (a crop-pasture rotation system) has come into consideration as a viable option for the

CNPGC's Main Building.

development of sustainable farming systems with high productivity in environmentally degraded areas in Brazilian subtropical zones. In 1997, JIRCAS began collaboration with EMBRAPA-CNPGC on a research project to develop agro-pastoral systems in these areas. During the first five years of the project, the following results were achieved: 1) the crop-pasture rotation system was considered viable for improving forage production, but its effects depended on plant species and cropping sequence due to differences in soil fertility, 2) the agro-pastoral system was considered beneficial to agricultural exploitation of the Brazilian Cerrados area, as its components complement each other in maintaining a suitable soil carbon balance, and 3) *Brachiaria decumbens* and *B. brizantha* have high N use efficiency and are more suitable for the purposes of improving soil fertility under agro-pastoral systems.

Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil

Nitrogen balance in agro-pastoral systems

Agro-pastoral systems combining soybean and grasses in crop rotation have been proposed for sustaining grassland productivity in the low fertility soils of the Brazilian savanna. Nitrogen flow under an agro-pastoral system developed in 1993 in Purple Red Latosol soil in Campo Grande, Matto Grosso do Sul was studied. Four cropping systems were included: continuous soybean cropping, soybean cropping after four years of grass cultivation, continuous grass cultivation, and grass cultivation after four years of soybean cropping. The rate of N fixation in soybeans was determined by the N difference method and ^{15}N natural abundance method. A non-nodulating isoline, T201, was used as a control in both methods. The rate of N_2 fixation ranged from 23 to 51% of total plant N. The amount of N removed in terms of grain mass was larger than the amount of fixed N in

soybeans, and the amount of N entering the system through rainwater was 6 kgN/ha/yr. Nitrate accumulating in soil from the surface to a depth of 100 cm under soybeans indicated the potential leaching of nitrate. The estimated amount of nitrate leaching from the soybean fields was larger than that from the grasslands; furthermore, a large negative N balance of 134-211 kgN/ha/yr was estimated in the soybean fields whereas the balance in the grasslands was slightly negative.

Introduction and management of forage crops in mixed, multiple-cropping systems for soil improvement

The purpose of this study was to establish grassland management technologies for sustainable agro-pastoral systems in the Brazilian savannas. Characteristics of mineral uptake for several forage crops and pasture productivity in the agro-pastoral systems were examined.

Effects of fertilizer application on the growth of the main forage species were evaluated in several pot experiments and a field experiment. Among the fertilizer components of nitrogen (N), phosphorus (P) and potassium (K), the effect of P on growth was the most significant, and the effects of N and P were apparent only in cases where P was applied. In many cases, the dry matter production of *B. brizantha* was larger than that of *B. decumbens* or *Panicum maximum*, though *P. maximum* showed a higher dry matter yield than the other species at high application levels of N (300 kgN/ha). Moreover, external nitrogen requirements of *P. maximum* were higher than those of *Brachiaria* species. In addition, P acquisition efficiency was compared among the four *Brachiaria* species and the effect of water stress was taken into consideration. Comparing *B. brizantha* and *B. decumbens*, the root weight of *B. decumbens* was lower, but the P acquisition efficiency per unit root weight was higher than that of *B. brizantha*. *B. brizantha* had a larger root system, but the P acquisition efficiency was lower than that of *B. decumbens*. Results of an experiment inoculating arbuscular mycorrhizae suggested that *B. brizantha* was more dependent on the mycorrhizae for P acquisition from the soil than were the other tropical grasses.

CETAPAR's Main Building.

Forage productivity and quality were compared in two *P. maximum* pastures: one which was established after four years of summer soybean (SO) cultivation and the other after four years of rotating summer soybeans and millet for winter grazing (SO/MI). Forage productivity and the contents of nitrogen and crude protein in forage samples were higher in the *P. maximum* pastures established after SO than after SO/MI. In crop rotation of SO/MI, part of the soil nitrogen was reduced by winter grazing by livestock, and the other part was volatilized from the excretion of the grazing animals. Thus, after SO/MI crop rotation, the decline of soil nitrogen restricted the subsequent growth of *P. maximum*. Therefore, summer soybean cultivation with winter fallow is the favored cropping system in terms of soil nitrogen conservation; however, the winter millet of SO/MI is an important forage source for animals during the winter dry season. When the rotation of SO/MI is adopted into agro-pastoral systems, it becomes necessary to combine it with other forms of conservative cropping which compensate for soil nitrogen losses, such as grass-legume mixed pasturing.

Center for Agricultural Technology in Paraguay (CETAPAR)

CETAPAR is the abbreviation for the Centro Tecnologico Agropecuario en Paraguay in Spanish, or the Agriculture and Livestock Technology Center in Paraguay in English. For the purpose of providing support to second-generation “Nikkei” immigrant farmers from Japan with regard to agricultural activities and adapting to new living conditions, the Japan International Cooperation Agency (JICA), CETAPAR’s predecessor, was established in 1962. It began as a farmers’ training center in the Yguazu “Nikkei” colony in Alto Parana Province. Recently, CETAPAR has worked towards the purposes of not only supporting “Nikkei” farmers but also making contributions toward agricultural development in Paraguay. At CETAPAR, 18 staff members and five experts from Japan are currently working in the General Affairs Division and three research divisions: the Crops Division, Livestock Division, and Agriculture Environment Division. The Crops Division is engaged in research for the development of new production technology and for the breeding of soybean, wheat and vegetables. The Livestock Division researches new technologies in cattle production and sustainable agro-pastoral systems, while the Agriculture Environment Division researches soil management for sustainable upland farming

and plant protection for upland crops.

In Paraguay, soybean is considered the most important agricultural product and its production was 3,210,000 tons obtained from 1,340,000 ha in 2001-2002. In recent trends, high yield production is based almost entirely on no-tillage cultivation. Nematode control in the soybean fields of Paraguay, Brazil and Argentina was studied by JIRCAS staff at "CETAPAR/JICA" from 1998 to 2001, as part of the project entitled "Comprehensive studies on soybean improvement, production and utilization in South America".

The main species in soybean fields in Paraguay, Brazil and Argentina are the Javanese root-knot nematode (*Meloidogyne javanica*), coffee root-lesion nematode (*Pratylenchus coffeae*), and reniform nematode (*Rotylenchulus reniformis*), based on a survey of 279 fields. The soybean cyst nematode, *Heterodera glycines* was not detected in Paraguay. *M. javanica* caused more severe damage to soybean yield than *P. coffeae* and *R. reniformis*. The inoculation of 35 larvae per 20 g soil at sowing caused a 35% decrease in yield compared to non-infested soybeans. A pot test revealed that the component of soybean yield most affected by nematodes was the number of pods rather than the main stem length, the number of main stem nodes, seed weight or the number of seeds.

Marcos Juarez Agricultural Experiment Station, National Institute of Agricultural Technology, Argentina (INTA EEA Marcos Juarez)

The National Institute of Agricultural and Farming Technology (INTA) was organized on December 4, 1956. INTA makes itself open to the participation of the private sector, to the extent that the Executive Council is equally comprised of the public sector and representatives from the main associations of producers in the country. The production and private sectors participate in discussing institutional political issues and in the disbursement of the annual budget. Institutional decisions are made at the national, regional and experimental levels. Central INTA consists of 12 institutes and 45 experimental stations. At present count, there are a total of 4,287 staff members, of whom 1,325 are university graduates, 222 have advanced degrees, and 1,114 conduct administrative functions.

INTA EEA Marcos Juarez is located in southeast Cordoba State. In this area, the main agricultural products are soybean, corn, wheat, sunflower, and swine. The institute has 1,400 ha devoted to research, adaptative experiments, and grains and meat production; it also operates several offices, laboratories, a library, greenhouses, a seed classification plant, deposits, and three demonstrative units. It is also supported by 13 rural expansion agencies. The main research subjects are divided into five areas: genetic improvement of soybean and wheat, soils and vegetable protection, animal production, economy, and statistics and data processing, and rural development. There are 166 personnel, of whom 58 are research scientists.

Recently, there has been growing concern over the spread of and damage caused by soil-borne diseases such as stem canker, sudden death syndrome and infection with cyst nematodes, which are all associated with continuous cropping under no-tillage cultivation of soybeans in the MERCOSUR countries. It has therefore become necessary to clarify the ecological characteristics and occurrence of these diseases for the purpose of bringing them under control. Towards this objective, cooperative studies between INTA and JIRCAS on "Ecology and control of major diseases of soybean" have been conducted since 1999. The objectives of current studies include: 1) clarification of the ecological aspects and occurrence of the major diseases in soybean, 2) development of control methods for these diseases, and 3) development of an evaluation method for the breeding of soybean varieties with multiple resistance.

The major results obtained during the past three years are as follows: field surveys in the main soybean cultivation areas in Argentina revealed the predominance of diseases such as sudden death syndrome, brown stem rot and stem canker. Sudden death syndrome was more severe in Santa Fe and Cordoba states. Some correlation was discovered between soybean cultivars and the time of occurrence and severity of diseases. A short-term visiting researcher from Japan isolated the pathogens from infected

INTA EEA Marcos Juarez's Main Building.

tissues of soybean collected from naturally infested fields and developed an identification method for the pathogens. Approximately 20 pathogen strains were obtained from nearly 20 fields, and these strains induced the typical symptoms of sudden death syndrome in soybean seedlings in a subsequent greenhouse test. A simple method called the "corn test" was developed for evaluating the resistance of soybean to SDS in the greenhouse. Another short-term visiting researcher from Japan developed a specific detection method for the pathogen by using PCR and confirmed its application for detecting the pathogen in both artificially inoculated and naturally infested plants.

The research environment, such as the equipment and facilities required to promote cooperative studies between INTA and JIRCAS, was upgraded, especially for the studies pertaining to soybean breeding for resistance to diseases.

From March 2002 to July 2003, two new subjects will be researched in order to develop an evaluation method for breeding cultivars with resistance to multiple diseases. First, the resistance of cultivars will be evaluated using a simple device in the greenhouse and in naturally infested fields. The suitability of this method will be evaluated by comparing the results from experiments under each condition. Secondly, the mechanisms of resistance of soybean cultivars will be elucidated and a method for counting the pathogens in infected plants and infested soils will be developed by short-term visiting researchers from Japan.

Japanese Immigrant Agricultural Cooperation (JATAK-ATC)

JATAK-ATC has been actively involved in the demonstration and dissemination of advanced farming technologies to small landholders among Japanese descendants in Brazil. The center owns 570 ha of upland and 450 ha of wetland experimental fields. In order to increase the profitability of its farms, the center plans to reconstruct farming systems through the introduction of new practices such as pasturing and cattle production into the wetlands.

JIRCAS selected the Agricultural Training Center of the National Federation of JATAK-ATC in the Japanese settlement located in the Guatapara district of Sao Paulo State, which is approximately 300 kilometers northwest of Sao Paulo city, as an on-farm trial site in 1998 in connection with the JIRCAS project entitled "Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil" conducted at EMBRAPA GC in Campo Grande. With the support of Japanese governmental organizations and immigrant farmers' associations, the first Japanese settlers arrived in 1962 and at the present time the area is home to 120 Japanese families. The settlement covers a total area of 7,294 ha, including 4,000 ha of uplands used for crop farming and 1,000 ha of wetlands which are mainly devoted to cattle grazing on native pastures. The major crops produced in the area are corn, sugarcane, soybean, and other vegetables and fruits.

JIRCAS conducted an on-farm pasture establishment experiment using 1.5 ha of wetland at JATAK-ATC from January 1998 (the middle of the rainy season) to May 2001 (the beginning of the dry season). The appropriate seeding times of pasture grasses commonly used in Brazil were tested using *Brachiaria*, *Andropogon*, *Setaria*, and *Paspalum* species. When the seeds of these grasses were sown in the beginning or middle of the rainy season, 37 seedlings did not survive under flooded field conditions at the end of the rainy season. On the other hand, pasture grasses (*B. humidicola* and *P. atratum*) transplanted at the end of the rainy season survived the flooding which occurred during the next season. Proper establishment of *B. humidicola* was observed when seeds were sown at the beginning of the dry season. The results indicate that seeding wetlands with *B. humidicola* at the end of the rainy season establishes good pasture, and it is therefore expected that this technology can be adapted to the area in order to promote effective utilization of wetlands as pasture land for grazing cattle.

Research collaboration with CIMMYT

The International Maize and Wheat Improvement Center (CIMMYT), located at El Batán, Mexico State, Mexico, is one of the centers belonging to the Consultative Group on International Agricultural Research (CGIAR). CIMMYT aims to increase the profitability, productivity and sustainability of maize and wheat farming systems in developing countries through agricultural research and training. JIRCAS began its collaborative project with CIMMYT entitled "Improvement of high-yielding wheat varieties through biological procedures" in 1993, and an efficient breeding system for high-yielding wheats was developed by means of wheat × maize crosses. Currently,

CIMMYT produces approximately 5,000 doubled haploid wheat lines using the project's findings.

Biotic and abiotic stresses on plant production are significant problems in developing countries; wheat diseases are the primary constraint on sustainable wheat production in these areas, and resistant cultivars are very important for economic and environmental reasons. Although the most prevalent diseases may differ depending on the region, the general consensus is that rusts (such as leaf rust, stem rust and stripe rust) are the most destructive diseases that occur in wheat. *Fusarium* head blight (FHB) is also a serious disease in wheat production areas with humid climates due to high rainfall after flowering. Since recent climatic changes have caused a worldwide epidemic of FHB, areas affected by this disease are rapidly increasing. Wheat production in Japan often suffers from serious damage by FHB, especially in the southern and northern regions (Kyushu and Hokkaido, respectively). Therefore, efficient breeding systems for wheat plants resistant to FHB as well as rusts are considered highly essential.

In order to efficiently breed disease-resistant wheat, an appropriate system for selection is prerequisite. Accuracy of evaluation for disease may vary depending on the particular year or environmental conditions, and a considerable amount of labor may be required to evaluate some diseases, such as FHB. Various types of molecular markers may enable the detection of resistance in wheat plants and increase the efficiency for selection, as an alternative method to evaluating them in the field. Once molecular markers for resistance genes are identified, reliable selections unaffected by environmental conditions become possible.

Taking these circumstances into account, in 1998 JIRCAS began the second phase of a new collaborative project entitled "Development of disease-resistant wheat cultivars through biotechnology" with the Applied Biotechnology Center, CIMMYT, targeting leaf rust, stripe rust and FHB resistance. CIMMYT breeders used slow-rusting genes for leaf rust and stripe rust, which are durable and are most active at the adult plant stage. Since many of these genes have minimal effect and are race-nonspecific, it is difficult to identify the genotype for the resistance genes in breeding materials. The inheritance of FHB is more complicated. Since the effects of each gene are miniscule, it is necessary to accumulate several resistance genes for FHB in order to obtain an appropriate and noticeable level of resistance. Moreover, evaluation of FHB in the field is an extremely laborious process which is easily affected by environmental conditions.

On-farm trial site in Guatapara.

Therefore, the tagging of resistance genes for slow-rusting and FHB is of great importance for wheat breeding at CIMMYT. The construction of molecular marker linkage maps for appropriate populations and the successful identification of microsatellite markers closely linked to several slow-rusting genes for leaf rust and stripe rust have been conducted. Analysis of FHB and other slow-rusting genes is now underway, and it is expected that the results will enable wheat breeders to accelerate breeding of resistant wheat cultivars for developing countries.

(The preceding introduction of research sites was prepared by A. Kikuchi, A. Oshibe, C. Noda, E. Fukuda, K. Hitsuda, K. Kosaka, K. Shimizu, T. Nakamura, T. Oya, T. Taniguchi, and Y. Honma.)

INTERNATIONAL COLLABORATIVE PROJECTS

Projects are designated as either comprehensive or unidisciplinary. All projects are handled by the JIRCAS Research Divisions.

(A) COMPREHENSIVE

Time Frame	Project Title	Research Site
1995-2001	Development of sustainable agricultural technology in Northeast Thailand	Department of Agriculture (DOA), Khon Kaen Animal Nutritional Research Center, Department of Livestock Development (DLD), Land Development Department (LDD), Asian Institute of Technology, and Khon Kaen University, Thailand
1996-2002	Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil	National Center for Beef Cattle Research, Brazilian Agricultural Research Corporation (EMBRAPA), Center for Tropical Agriculture Technology (CIAT), and JATAK International Center for Agriculture Technology, Brazil
1997-2003	Development of sustainable production and utilization of major food resources in China	Institute of Agricultural Economics, Institute of Natural Resources and Regional Planning, Research Center for Rural Economy, China Agricultural University, Institute of Soil Science (ISS), China National Rice Research Institute (CNRRI), Shanghai Fisheries University, the Soil and Fertilizer Institute (SFI) and the Soybean Institute and Animal Science Branch of the Jilin Academy of Agricultural Sciences (SIJAAS), People's Republic of China
1997-2006	Comprehensive studies on soybean improvement, production and utilization in South America (multinational)	Ministry of Agriculture and Livestock (MAG), JICA-Agricultural Technology Center in Paraguay (CETAPAR), Paraguay; National Center for Soybean Research and National Center for Beef Cattle Research, Brazilian Agricultural Research Corporation (EMBRAPA), Brazil; and Marcos Juarez Agricultural Experiment Station, the National Institute for Agricultural Technology (INTA EEA Marcos Juarez), Argentina
1998-2002	Evaluation and improvement of regional farming systems in Indonesia	Agency for Agricultural Research and Development (AARD), Indonesia
1998-2002	Improving food security in West Africa through increased productivity in rainfed rice systems	West Africa Rice Development Association (WARDA), Côte d'Ivoire
1999-2003	Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Phase II)	Cuu Long Delta Rice Research Institute (CLRRI), Cantho University, and the Southern Fruit Research Institute (SOFRI), Vietnam
2000-2002	Combining advanced weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems in Mali, West Africa	Institut d'Économie Rurale, Mali
2000-2006	Development of agroforestry technology for the rehabilitation of tropical forests	Sabah Forest Research Center, Malaysia; and the University of the Philippines at Los Banos (UPLB), the Philippines
2000-2006	Development of low-input technology for reducing postharvest losses of staples in Southeast Asia	Kasetsart University, King Mongkut's University of Technology, and the Department of Agriculture (DOA), Thailand
2001-2005	Studies on sustainable production systems of aquatic animals in brackish mangrove areas	The Southeast Asian Fisheries Development Center (SEAFDEC), the Philippines; the Fisheries Research Institute (FRI) and the University of Malaya, Malaysia; Faculty of Fisheries, Kasetsart University, Thailand

(B) UNIDISCIPLINARY

Time Frame	Project Title	Research Site
1997-2001	Development of diagnosis and prevention technology for shrimp viral diseases	Fisheries Research Institute (FRI), Malaysia
1997-2002	Investigation of the roles of the TNFα gene in trypanosomiasis and elucidation of mechanisms of infection and development of trypanosomiasis	International Livestock Research Insitute (ILRI), Kenya
1998-2001	Development of technology for water distribution management for large scale paddy fields in tropical monsoon areas	Muda Agricultural Development Authority (MADA) and Malaysian Agricultural Research and Development Institute (MARDI), Malaysia
1997-2001	Improvement of high yielding wheat varieties through biological procedures	International Maize and Wheat Improvement Center (CIMMYT), Mexico
2001-2003	Studies on the evaluation of environmental impact associated with the construction of logging roads	Forest Research Institute Malaysia (FRIM), Malaysia

JIRCAS RESEARCH DIVISIONS

The following pages offer an introduction to the wide range of activities pursued by the seven Research Divisions and the Okinawa Subtropical Station. Each Division summary features a brief overview describing current research priorities within the Division, followed by more detailed descriptions of selected topics pursued during Fiscal Year (FY) 2001.

DEVELOPMENT RESEARCH DIVISION

The current situation of world food supply and demand has become increasingly unstable due to climatic factors and changes in the policies of major food-producing countries. In addition, due to continuous population increases particularly in developing regions, and worldwide abnormal climatic phenomena linked to El Nino, this trend of instability is bound to become more severe in the long run. Presently, a number of significant efforts to stabilize world food supply and demand have been undertaken by Japanese research organizations, the governments of various developing countries, and international organizations such as the Consultative Group on International Agricultural Research (CGIAR), through activities intended to stabilize and expand food production in developing regions.

In contribution towards the goals stated above, the Development Research Division has been conducting and analyzing macro- and micro-information and data related to the natural and social environment, as well as discussing strategies to efficiently implement international collaborative research to solve problems related to food production and the environment. In the developing regions of Asia, the Middle East, Africa, and South America, the natural conditions (such as climate and soil), social conditions (such as religion and customs) and economic conditions (including income level) are quite varied, and since there are a great number of issues depending on country and region, it is therefore important to clarify the core concerns and means by which to address them.

As for land resources which are indispensable for food production, a series of macro-research and analyses is now in progress, making full use of satellite data and GIS (Geographical Information Systems). In particular, analytical techniques for satellite data to accurately determine the current state of land use in such countries as Thailand and Indonesia are now in development. Methods for applying the results of these analyses towards sustainable land use schemes are also being investigated.

In other work, the development of mid- and long-term econometric models for forecasting future levels of supply and demand on a global scale in major developing regions is now in progress. It is obvious that food production will be greatly affected not only by constraints on resources such as land and water supply, which are steadily growing more severe, but also by changes in policies in each country; therefore, the modeling of the supply and demand situation is a foremost objective which can be accomplished through the collaborative efforts of international organizations such as the OECD and the FAO.

In addition to the macro-analysis described above, studies and analyses are also being implemented on the farmer level. It is of urgent necessity to improve the income levels of farmers in order to combat poverty in rural areas. In this regard, guidelines for measures to improve farm management and farmers' income levels are being researched in Thailand, Vietnam, and Indonesia, among other developing nations. For the purposes of disseminating newly developed and improved technologies to farmers, farming systems research based on farmer-participatory approaches is also being emphasized.

Although a great deal of the research on agriculture, forestry and fisheries in developing regions tended to be limited to a single field in

Group interviews and discussion with farmers in Northeast Thailand. (Photo: M. Ando)

the past, recently the trend has shifted towards research amalgamating several fields, such as production, distribution, and manufacturing and processing. Moreover, in regard to sustainable development, research has begun to favor development which is environment-friendly in the long run, rather than being merely focused on technology for short-term production increases.

Research for the stabilization of food supply and demand in the future will be multi-faceted, although resources available to institutes in Japan and other countries are limited. Therefore, it is the Development Research Division's objective to prepare comprehensive international collaborative research strategies based upon the results of past work, in order to clarify the future direction of research. Towards this end, the Division is undertaking efforts to gauge the current trend of research and activities of international and national research organizations. As an example, an international symposium entitled "Water for sustainable agriculture in developing regions – More crop for every scarce drop" was held in Tsukuba in November 2001 to discuss future technologies for food production and the development of rural areas; the Development Research Division acted as the secretariat overseeing the successful organization of the symposium.

In addition to the activities detailed above, the Division has been editing several types of publications at JIRCAS, such as the "JIRCAS Newsletter", the "Working Report Series", and "JARQ" (Japan Agricultural Research Quarterly) for the purposes of engaging and informing the public.

TOPIC 1

Conformity of agricultural land use and physical stability in Khon Kaen, Northeast Thailand

Agricultural development in Northeast Thailand has rapidly progressed since the 1960s; however, it has occurred under disadvantageous conditions such as infertile soil and erratic rainfall. In order to establish sustainable agriculture in the region, it is necessary to provide technical countermeasures as well as regional planning strategies for land use systems appropriate for the relevant agro-environment. In this study, the land suitability for cultivation of major crops such as rice, sugarcane and cassava was evaluated based on physical factors, and the conformity of suitability with current land use was analyzed using Geographic Information System (GIS) technology and a multi-temporal satellite data set acquired by the LANDSAT-5/Thematic Mapper (TM).

The study site in Khon Kaen Province chosen for this analysis covers the area within 102° 30'E-103° 00'E and 16° 00'N-16° 30'N, which corresponds to an area of 55.6 km by 57.6 km. The established study site is a typical Northeast Thailand rural landscape consisting of rainfed rice paddies and upland fields for sugarcane and cassava and having salt-affected soil. Analysis was carried out in three phases; the first phase was an evaluation of land suitability for the cultivation of rice, sugarcane and cassava by assessing soil properties and water resource availability. The second phase involved land cover/land use classification using the aforementioned satellite data set. In the third and final phase, land suitability as assessed in the first phase was compared to current land use as determined in the second phase; the conformity of the two information sets was then investigated.

Fig. 1 shows the land suitability determined for the cultivation of rice, sugarcane and cassava. Assessment of soil properties followed criteria defined by the Land Development Department in Thailand. Water resource availability was assessed in terms of accessibility to surface water as distinguished by satellite data sets, taking into consideration the size and stability of rivers, lakes, ponds, and other bodies of water. Land suitability was categorized in ranks ranging from 1 to 5, from the most to least suitable. For practical

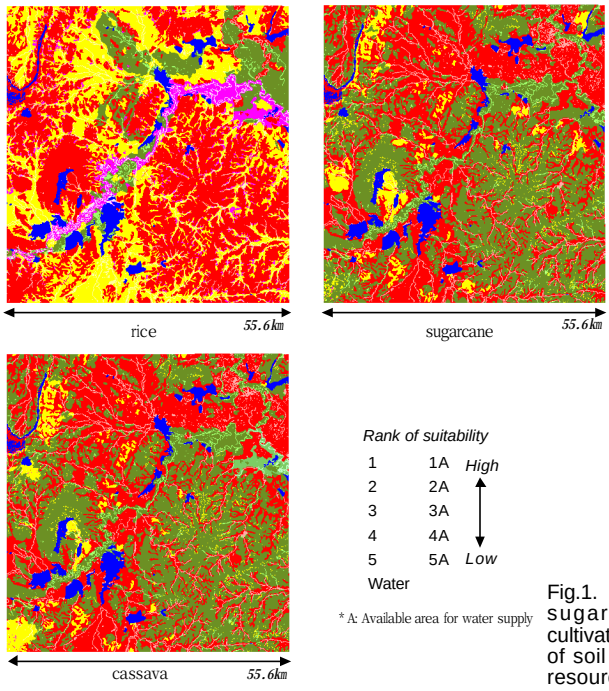


Fig.1. Land suitability for rice, sugarcane and cassava cultivation, evaluated in terms of soil properties and water resource availability.

purposes, Ranks 1 and 2 were regarded as suitable, Rank 3 was moderately suitable, and Ranks 4 and 5 were regarded as unsuitable. The location of suitable areas for sugarcane and cassava overlapped in the hilly southeastern section of the site; suitable land for rice cultivation was found in areas unsuitable for upland crops, such as in the lowland areas near the Chi River.

Fig. 2 shows the land use map produced using the first and second principle components of three LANDSAT5/TM data sets acquired in July 1998, October 1998, and March 1999; they correspond to the middle of the rainy season, the end of the rainy season, and the middle of the dry season. According to these results, more than 60% of the site area was used for agriculture; 120,000 ha or 36% was upland and 90,000 ha or 28% was paddy. Forests, including Eucalyptus plantations, comprised 16% of the area. Upland areas were mainly distributed in the southeastern section of the site; paddy areas were located in the Chi River basin and near some streams, and were collectively distributed in the northeastern and western sections.

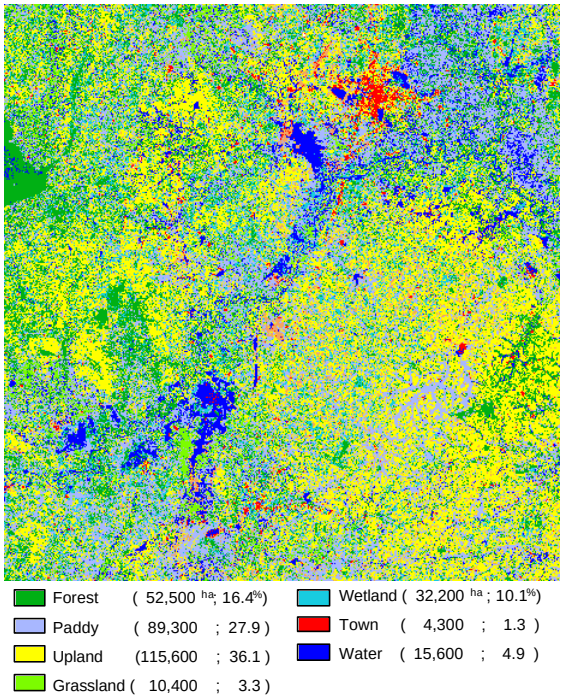


Fig.2. Land cover/land use map produced from PCA1&2 of TM8907, TM9810 and TM9903 data.

The conformity of current land use and land suitability shown in Table 1 was defined as the ratio of the area occupied by each crop to the area of suitable land determined for that particular crop. The results were as follows: 1) suitable areas for sugarcane and cassava covered more than 130,000 ha, and suitable areas for rice were assessed at 30,000 ha; 2) 120,000 ha of upland areas and 90,000 ha of paddy areas were in use at the study site, but the fields located in suitable areas were 50% sugarcane or cassava and 14% rice; and 3) 40% of the suitable area was used for appropriate crops but a large portion of the paddy fields were irrigated; rainfed paddies were found to be very scarce.

In rainfed agricultural regions in Northeast Thailand, it is important to formulate a land use strategy which eliminates the mismatches between current land use and land suitability for crop cultivation. As this study shows, the process by which to delineate suitability and land use through maps and to determine their conformity spatially and quantitatively may help to elucidate problems with current land use, leading to the development of useful strategies for the planning of appropriate regional land use systems.

(Y. Yamamoto)

Table 1. Conformity of land use and suitability

		Rice	Sugarcane	Cassava
Rank 1	A. area (1000 ha)	0.0	0.0	3.2
	B. conformed land use (1000 ha)	0.0	0.0	1.2
	C. comformity (B/A)	*0.00*	*0.00*	*0.39*
	D. share of current use (B/E)	*0.00*	*0.00*	*0.01*
Rank 2	A. area (1000 ha)	29.0	132.3	131.2
	B. conformed land use (1000 ha)	12.1	55.7	55.2
	C. comformity (B/A)	*0.42*	*0.42*	*0.42*
	D. share of current use (B/E)	*0.14*	*0.48*	*0.48*
Rank 3	A. area (1000 ha)	93.2	18.2	16.1
	B. conformed land use (1000 ha)	33.2	6.6	5.9
	C. comformity (B/A)	*0.36*	*0.36*	*0.36*
	D. share of current use (B/E)	*0.37*	*0.06*	*0.05*
Rank 4	A. area (1000 ha)	23.5	0.3	0.3
	B. conformed land use (1000 ha)	6.7	0.1	0.1
	C. comformity (B/A)	*0.29*	*0.25*	*0.25*
	D. share of current use (B/E)	*0.08*	*0.00*	*0.00*
Rank 5	A. area (1000 ha)	138.7	133.5	133.5
	B. conformed land use (1000 ha)	28.6	34.3	34.3
	C. comformity (B/A)	*0.21*	*0.26*	*0.26*
	D. share of current use (B/E)	*0.32*	*0.30*	*0.30*
Others (city, water, swamp, etc.)		35.5	35.5	35.5
Total (1000 ha)		319.8	319.8	319.8
E. Current land use (1000 ha)		89.3	115.6	115.6

BIOLOGICAL RESOURCES DIVISION

Biological resources play a key role in meeting global challenges in the fields of food security and preservation of the environment in developing countries. During various discussions held in international arenas such as the Convention on Biological Diversity (CBD),

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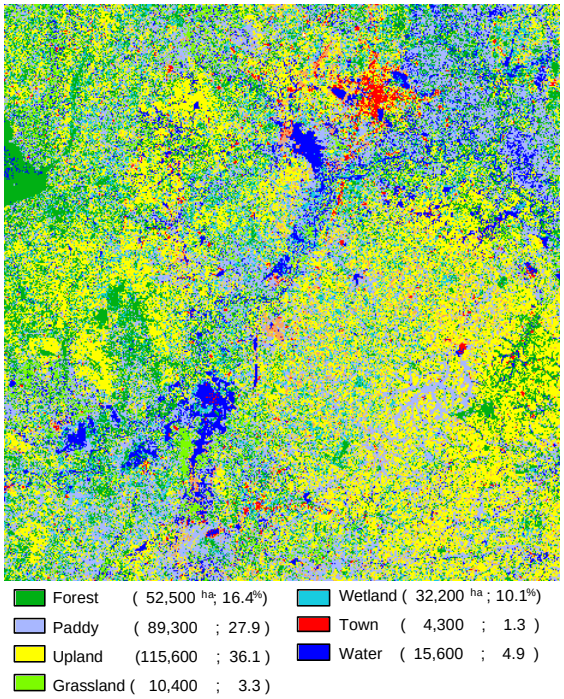

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BIOLOGICAL RESOURCES DIVISION

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the World Food Summit, and the Food and Agricultural Organization's (FAO) Commission on Genetic Resources, the international community confirmed its commitment to the safe conservation, sustainable use and equitable sharing of the benefits of biodiversity. The active use of genetic diversity towards sustainable socio-economic development presents a tremendous challenge for scientists and policymakers.

Over the last decade, there has been remarkable progress in science and the development of technological tools for the improved utilization and understanding of genetic diversity. For example, nearly all economically useful plants are now amenable for transformation, and the molecular bases of biological functions such as stress tolerance are now much more clearly understood. Genomic science is providing sound tools and techniques for the manipulation of genes and their functions for plant improvement. The Division is taking full advantage of such progress to engage the challenges facing developing countries, promoting the active use of genetic diversity for sustainable socio-economic development.

Important work is being conducted in collaboration with CIMMYT in the development of wheat resistance to *Fusarium* head blight and rust disease. The Division has studied the complex mechanisms of resistance to *Fusarium* and has developed methods for reliable screening. More than 600 molecular markers have been mapped using a double haploid population segregating for red and yellow rust resistance, with the QTL mapping of genes involved in resistance as the project goal. The genes on the long-arm of chromosome 5A and the short-arm of chromosome 5B that are responsible for Type I resistance were identified; similarly, a gene responsible for Type II resistance was found on the short-arm of chromosome 3B. These are just two examples of research findings which will be of critical value towards the accumulation of genes having different types of resistance and genetic origins.

As part of JIRCAS's comprehensive project entitled "Comprehensive studies on soybean improvement, production and utilization in South America", Division staff members, in collaboration with INTA EEA Marcos Juarez in Argentina, are working on the delineation of sudden death syndrome (SDS), which is becoming a major threat to sustainable soybean production in the Southern Cone countries. This year, results clearly showed that SDS is caused by *Fusarium solani*. A simple PCR-based method was then developed to identify the pathogenicity of *Fusarium solani* isolates, and intensive studies were carried out to develop a simple and reliable test of diverse germplasm for resistance to *Fusarium solani*.

A vegetable market in Tashkent, Uzbekistan.

Currently, a Division staff member is working with the Asian Vegetable Research and Development Center (AVRDC) on the evaluation and use of traditional vegetable germplasm in South and Southeast Asia. Traditional vegetables are expected to contribute to improving the nutritional status of the low-income population in these regions, and offer income-generating opportunities. More than two hundred accessions of *Amaranthus*, *Basella*, *Corchorus* and *Ipomoea aquatica* were evaluated for their contents of vitamin C, phenol compounds and total anti-oxidants. Significant variation was discovered within and between species, and promising accessions of high nutritional value have been selected.

At present China is importing a large quantity of soybeans to close the gap between domestic production and consumption, despite the fact that it is the country of origin of this important crop. JIRCAS is supporting China's efforts to boost the productivity of soybeans in order to reduce reliance on foreign imports. More than 1,000 accessions of native soybean germplasm have been evaluated for fat and protein content using infrared analysis, and many promising lines have been selected. Previous collaborative efforts in genetic improvement have resulted in the successful release of four soybean varieties given their productivity potential and high protein and fat content.

This year the Division's molecular biology group, working with rice varieties, made important advances toward understanding the molecular mechanisms of plants' defenses against environmental stresses, as well as

developing techniques for their genetic manipulation. Using knowledge of the drought responsive element binding protein (DREB) of *Arabidopsis*, OsDREB1A, 1B, 1C and OsDREB2 genes were isolated as homologues of *Arabidopsis* DREB1A and *Arabidopsis* DREB2A, respectively. It was further discovered that those controlling elements in rice had a very similar structure and function to those found in *Arabidopsis*. This strongly indicates the potential for engineering rice plants possessing abiotic stress tolerance as previously demonstrated by studies on *Arabidopsis* and tobacco plants. CIMMYT has already inserted the DREB gene into wheat and observed improved drought tolerance in transgenic wheat plants. In related research, the Biotechnology Research Group of the University of Tsukuba tested transgenic potato modified by the insertion of the DREB gene for freezing and salinity tolerance, achieving very promising results.

TOPIC 1

Identification of target genes of the DREB1A transcription factor controlling abiotic-stress-responsive gene expression using a full-length cDNA microarray

Crop productivity and yield stability are greatly affected by abiotic stresses such as drought, high salinity, and low temperature. Genetic engineering possesses high potential to improve the stress tolerance of crops through the use of gene transfer technology. Several different approaches have been attempted; the Division's recent approach involved the use of a gene encoding a transcription factor controlling gene expression in response to environmental stresses.

It was reported previously that a *cis*-acting 9-bp element, TACCGACAT (DRE, Dehydration Responsive Element), plays an important role in regulating gene expression in response to drought stress in *Arabidopsis*. DRE is also involved in low-temperature- and high-salinity-responsive gene expression. The transcription factor DREB1A specifically interacts with DRE and induces the expression of stress tolerance genes. Overexpression of DREB1A cDNA in transgenic *Arabidopsis* plants gives rise to strong constitutive expression of DREB1A target stress tolerance genes and increases tolerance to freezing, drought and high salinity.

In past work, six DREB1A target genes were identified: *rd29A, cor78, kin1, kin2, cor15a, rd17, and erd10*. However, it is not well understood how over-expression of DREB1A cDNA in transgenic plants increases stress tolerance to freezing, drought, and high salinity; in order to study the relevant molecular mechanisms, it is necessary to identify and analyze more genes controlled by DREB1A. Therefore, in the recent study, cDNA microarray analysis was employed to identify novel DREB1A target genes.

First, a cDNA microarray using 1,300 full-length *Arabidopsis* cDNAs was prepared. The strategy for identifying DREB1A target genes is shown in Fig. 1. mRNAs prepared from transgenic *Arabidopsis* plants that overexpress DREB1A cDNA under the control of the CaMV 35S promoter (35S:DREB1A transgenic plants) and wild-type control plants were used for the preparation of Cy3-labeled and Cy5-labeled cDNA probes, respectively. These cDNA probes were then mixed and hybridized with the cDNA microarray. Twelve stress-inducible genes were identified as target stress-inducible genes of DREB1A, with six of them found to be novel. On the basis of RNA gel blot and microarray analyses, the six genes were identified as novel drought- and cold-inducible genes that are controlled by DREB1A (Fig. 2). Eleven DREB1A target genes whose genomic sequences have been registered in the GenBank database contained the DRE or DRE-related CCGAC core motif in their promoter regions.

The Division comprehensively analyzed further novel target stress-inducible genes using a 7,000 full-length cDNA microarray. More than 40 genes were identified as target genes of DREB1A and confirmed by RNA gel blot and promoter analyses. These target stress-inducible genes encoded enzymes required for the biosynthesis of osmoprotectants such as proline

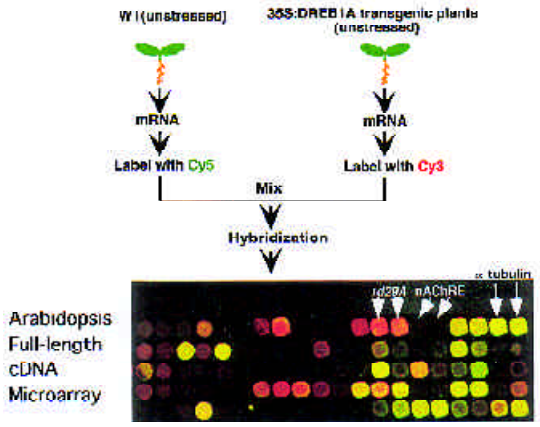

Fig. 1. Strategy for identification of DREB1A target genes. mRNAs from 35S:DREB1A transgenic plants and wild-type (WT) unstressed plants were used for the preparation of Cy3-labeled and Cy5-labeled cDNA probes, respectively. These cDNA probes were mixed and hybridized with the cDNA microarray. In this study, we used the α-tubuline gene as an internal control.

and sugar, membrane proteins, LEA proteins, detoxification enzymes, chaperones, and enzymes involved in phospholipid metabolism, protein kinases and transcription factors. These results indicated that overexpression of the DREB1A proteins in transgenic *Arabidopsis* plants activated more than 40 types of stress tolerance genes and resulted in improved stress tolerance to drought, high salinity and freezing.

(K. Yamaguchi-Shinozaki)

TOPIC2

Simple and rapid method for the detection of lipoxygenase isozymes in soybean seeds

In South American countries, the soybean has been used mainly as a source of edible oil and in livestock feed, while direct food consumption, as is common in Asia, is very limited. Soybeans used for the purposes of food consumption, however, possess great potential for improving the nutrition and health of the local population and for generating income. The limitation on direct consumption in this region is associated with undesirable flavors in soybean food products. Since lipoxygenases have been found to be responsible for grassy-beany flavors, it would therefore be highly desirable to remove these enzymes in locally-adapted soybean cultivars.

Three lipoxygenase isozymes – L-1, L-2, and L-3 – have been reported to exist in soybean seeds. Through the use of mutants lacking lipoxygenase, the genetic approach towards breeding triple mutant soybean lacking all isozymes has been employed, aiming to reduce undesirable flavors. In addition, a lipoxygenase isozyme detection method suitable for routine screening is becoming an increasingly utilized approach. The presence or absence of the three lipoxygenase isozymes can be readily and accurately determined by spectrophotometric methods, based on the different bleaching abilities of L-1, L-2 and L-3 isozymes in contact with methylene blue and ß-carotene. However, this method is time-consuming, as different seed samples are necessary for the analysis of each isozyme. The Division's attempt was based upon this above method and was carried out to develop a simpler and more rapid visual method for the detection of individual lipoxygenase isozymes in soybean seeds derived from progenies of crosses between normal soybeans and triple mutant soybeans lacking all of the isozymes.

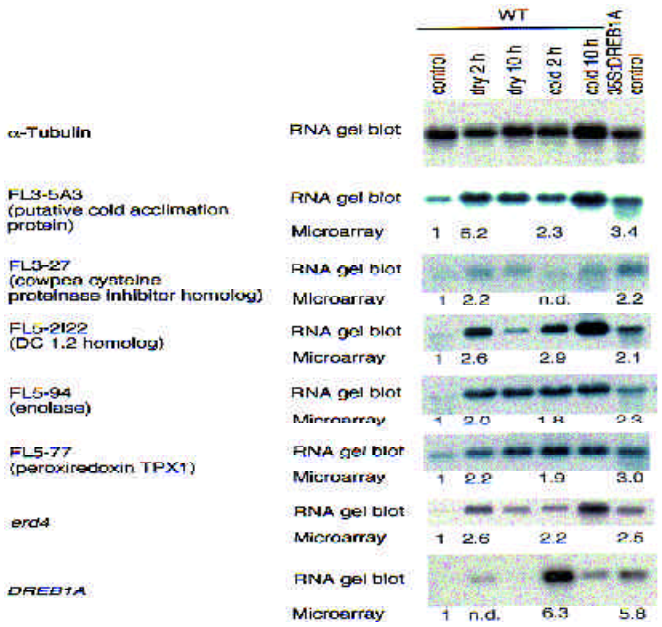

Fig. 2. Comparison of cDNA microarray and RNA gel blot analyses for the identification of new DREB1A target genes controlled by the DREB1A gene.

After several attempts, we succeeded in finding a method by which identification of the lipoxygenase isozymes was possible using only a small amount (about 2.5 mg) of milled soybean seed samples (Table 1). The new method also enabled the identification of two isozymes, L-1 and L-3, by using the same seed sample and adding the reaction reagent for the L-1 isozyme (Fig.1). Within five minutes, it was possible to visually determine the individual lipoxygenase phenotypes as follows: colorless – normal soybean having all isozymes; yellow – single mutant lacking L-3; blue – double mutant lacking L-1 and L-2; green – triple mutant lacking all isozymes (Figs. 1, 2). In crosses between triple mutant soybeans and normal soybeans, the other test which is used to identify the L-2 isozyme may be omitted, since the *Lx1* locus is closely linked to the *Lx2* locus. By using this simplified new method, the genetic variation of these isozymes contained in South American

Table 1. Comparison of original (Suda *et al.* ,1995) and modified methods to identify lipoxygenase isozymes in soybean seeds.

	original	modified
For L-3 test:		
seed material	**2.5mg**	**2.5mg**
crude extracted solution of L-2	**0.5ml**	**10µl**
reaction reagent for L-3	**2.0ml**	**250µl**
(composition) 0.2M sodium phosphate buffer (pH6.6)	**25.0ml**	**12.5ml**
10mM sodium linoleate substrate	**5.0ml**	**5.0ml**
distilled water	**5.0ml**	**17.5ml**
saturated solution of ß-carotene	**5.0ml**	**5.0ml**
For L-1 test:		
seed material	**2.5mg**	**not nec.**
distilled water	**0.5ml**	**not nec.**
reaction reagent for L-1	**2.0ml**	**250µl**
(composition)0.2M sodium borate buffer (pH9.0)	**25.0ml**	**25.0ml**
10mM sodium linoleate substrate	**5.0ml**	**5.0ml**
distilled water	**5.0ml**	**5.0ml**
100mM methylene blue	**5.0ml**	**5.0ml**

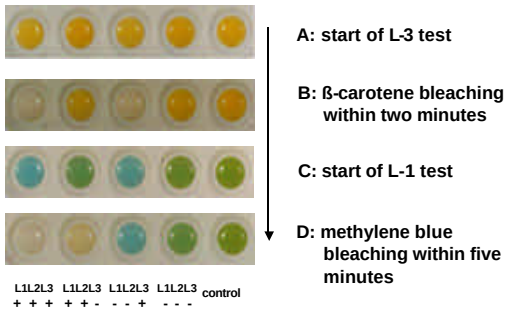

Fig. 1. Visual detection of individual lipoxygenase phenotypes of soybean seeds derived from crosses between triple mutants lacking all isozymes and normal type soybeans.

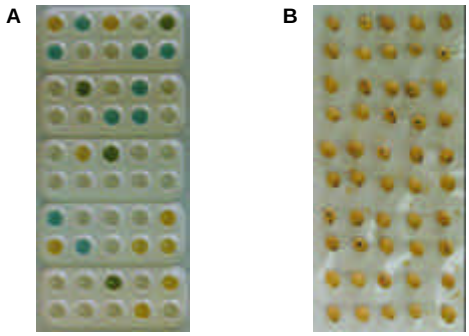

Fig. 2. Analyses of F_2 seeds derived from the cross between a triple mutant lacking all isozymes and normal type soybeans. A: Results of the analyses; B: seeds corresponding to each analysis.

soybean cultivars and genetic lines can be efficiently researched. The studies detailed above were conducted in cooperation with the National Soybean Research Center of Brazil (EMBRAPA Soybean) as part of the JIRCAS research project entitled "Comprehensive studies on soybean improvement, production and utilization in South America".

(A. Kikuchi)

TOPIC 3

Tagging of slow rusting genes for leaf rust, *Lr34* and *Lr46*, using microsatellite markers in wheat

Leaf rust, caused by *Puccinia recondite* Roberge ex Desmaz f. sp. Tritici Eriks. & E. Henn., is the most serious disease that occurs in wheat. The use of resistant cultivars is very important in achieving sustainable wheat production in developing countries for economic as well as environmental reasons. Most of the leaf rust resistance genes identified thus far are race-specific, and since they may be overcome through genetic shifts or new forms of virulence in the pathogen population, durable resistance genes are of great interest to wheat breeders. Slow-rusting genes such as *Lr34* and *Lr46* have been identified to be race-nonspecific and durable.

This type of resistance may best be expressed at the adult plant stage as a quantitative trait. The contribution of each gene is small and easily affected by environmental factors, and therefore it is difficult to identify the resistance genes due to their race-nonspecificity. Tagging these genes with molecular markers increases the efficiency of selecting the resistance genes and facilitates marker-assisted selection for leaf rust.

A doubled haploid (DH) population was produced from cv. Fukuho-komugi × cv. Oligoculm by means of wheat × maize crosses. One hundred and seven DH lines were genotyped for 595 markers, based on the use of molecular markers such as microsatellites, and restriction fragment length polymorphism (RFLP) and random amplified polymorphic DNA (RAPD) methods. Of the 443 markers mapped, 343 markers were used to construct a framework map to perform quantitative trait loci (QTL) analysis for leaf rust resistance in this population. Leaf rust severity was recorded at the adult plant stage in the field for two seasons, 1999-2000 and 2000-2001, at Cd. Obregon, Sonora State, Mexico (Fig. 1).

Two putative QTLs for leaf rust resistance were detected in the chromosome regions of 7DS and 1BL by means of composite interval mapping (CIM, Fig. 2). These QTLs were considered to be due to the effects of the known slow-rusting genes, *Lr34* and *Lr46*. The QTL analysis also indicated that *Lr34* was derived from the Japanese cv. Fukuho-komugi, while *Lr46* was derived from the Israeli cv. Oligoculm. These QTLs accounted for about 40% and 26% of the total variation, respectively.

The microsatellite marker loci, *Xgwm295.1* and *Xwmc44*, were linked to these QTLs on 7DS and 1BL, respectively. When the population was classified according to the genotypes of these markers, the mean differences in leaf rust severity were 40.1% for *Xgwm295.1* and *Xwmc44* was 11.3%. Resistant (F/O) genotype 61.6% more resistant than the susceptible genotype (Table 1), and 19.9% more resistant than the overall population mean. Moreover, genotyping of the DH lines using these molecular markers aided in distinguishing the lines with *Lr34* and *Lr46* from those with only *Lr34*.

Fig. 1. Symptoms of leaf rust-infected leaves. From left to right (two leaves each): Fukuho-komugi (Lr34), Oligoculm (Lr46), resistant and susceptible DH lines.

Table 1. Genotypic effects of flanking loci on leaf rust severity (%)

Locus	Genotype[a]	2000	2001	Mean	
Xgwm295.1	F	12.6	10.9	11.9	
(*Lr34*, 7DS)	O	57.1	46.6	52.1	
	dif.	-44.5	-35.7	-40.1	
Xwmc44	F	47.6	41.4	44.9	
(*Lr46*, 1BL)	O	23.2	16.8	19.5	
	dif.	24.4	24.6	25.5	
Xgwm295.1	F / O	12.6	10.1	11.3	a[b]
/ *Xwmc44*	F / F	11.6	12.5	12.5	a
	O / O	32.8	25.6	30.2	b
	O / F	80.4	66.4	73.0	c
	dif. (FO vs. OF)	-67.8	-56.3	-61.6	

[a] F, O and dif. indicate Fukuho-komugi, Oligoculm and genotypic difference between F and O genotypes. F and O are resistant and susceptible for *Lr34*, and susceptible and resistant for *Lr46*, respectively.
[b] Mean values with different letters are significantly different (P<0.05).

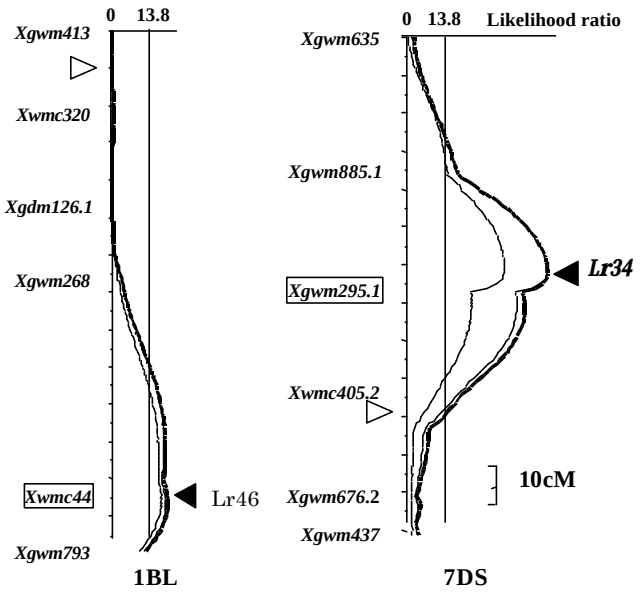

Fig. 2. Likelihood ratio (LR) contour determined by composite interval mapping for QTL detection of leaf rust severity on the long-arm of chromosome 1B and the short-arm of chromosome 7D short arm. Bold contours indicate LR determined by joint analysis of the data for the years 2000 and 2001. LR thresholds, equivalent to LOD=2.5, are 11.5 for a single year and 13.8 for joint analysis. Short arms are toward the top.(▷) indicates centromere.

Lr34 and *Lr46*, classified as slow-rusting genes, are widely used in the International Maize and Wheat Improvement Center (CIMMYT) breeding program. The above results indicate that the molecular marker loci *Xgwm295.1* and *Xwmc44* facilitate the identification of *Lr34* and *Lr46* in breeding materials and contribute to the pyramiding of leaf rust resistant genes.

This study was conducted as part of a collaborative program between the Biological Resources Division, JIRCAS, and the Applied Biotechnology Center, CIMMYT, from January 1998 to January 2002.

(K. Suenaga)

CROP PRODUCTION AND ENVIRONMENT DIVISION

This Division was reorganized from the former Environmental Resources Division after incorporation of research groups specializing in the management of crops, water resources, pests and diseases; in exchange, its GIS/remote sensing group was transferred to the Development Research Division. The new Crop Production and Environment Division carries out research to develop sustainable agricultural technologies and to promote effective utilization of diversified functions of crops, microbes, and natural resources, while at the same time promoting harmony with the natural ecosystem and environmental conservation on a global scale. The Division consists of five research groups: material cycling, crop management, plant physiology and nutrition, water resources management and plant protection. More than half of its researchers are dispatched overseas on a long-term basis to conduct work on various comprehensive projects organized by JIRCAS.

In recent work, quantitative analyses of nitrogen cycles were conducted in Cantho Province in the Mekong Delta, Vietnam. In combination with previous analyses conducted in Lingxian County, Shandong Province, China and Khon Kaen Province, Thailand, three different agro-ecosystems have been characterized in terms of nitrogen flow within the agricultural activities in a given administrative unit. Based on the results of the analyses, efficient procedures for optimization of the nitrogen cycle were proposed; in the case of the China project, it was confirmed that controlled-release nitrogen fertilizer could reduce the impact of nitrogen pollution on the natural environment.

In research on rice cultivation, the validity of newly developed technologies related to direct seeding was proven through demonstration experiments conducted in farmers' fields in two different rice ecosystems: the intensively irrigated ecosystem in the Mekong Delta where optimum rates of seeding and fertilizer were tested, and the rainfed rice ecosystem in Northeast Thailand where mechanization in direct seeding of rice and weed management were tested. In research on upland crops cultivation, a hardpan management system introducing the use of a subsoiler was proposed for the sandy soil areas in Northeast Thailand, and a tractor attachment for simultaneous subsoiling, fertilizing, and planting was

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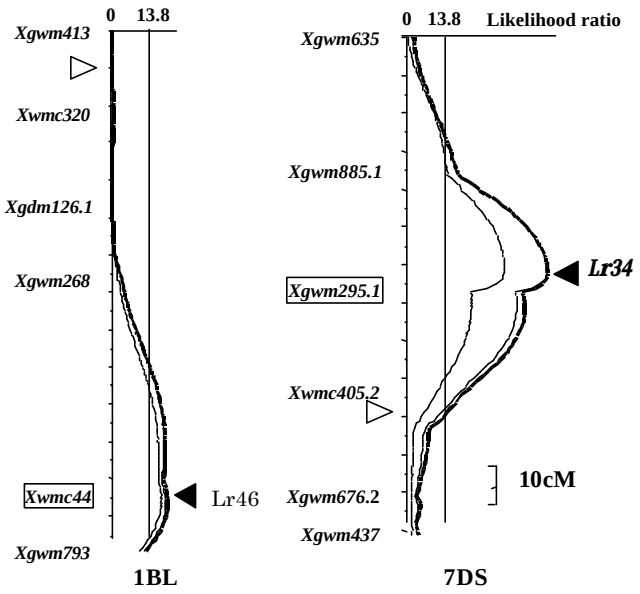

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Water sample collection in Shandong Province, China.

developed. As for crop functions related to the efficient use of nitrogen, nitrification inhibition and organic nitrogen uptake were further researched. In order to reduce water consumption in rice cultivation areas employing large-scale irrigation, the current state of rainfall monitoring, estimation of water requirements and timing of irrigation was clarified and a comprehensive model to address all three of these issues was developed.

In research on crop protection, the utilization of insect resistance in Chinese rice germplasm was conducted as part of the development of sustainable management technologies against the whitebacked planthopper, with the goals of countering the upsurge of the planthopper as well as preventing the excessive application of insecticides that occur due to the widespread adoption of hybrid rice. This year's work was mainly devoted towards the study of resistance mechanisms, the relevant genetics, and the analysis of resistant genes. A special project funded by the Japanese government was conducted at the International Center for Insect Physiology and Ecology (ICIPE) in order to develop management technologies based on the physio-ecological characterization of grasshoppers which occasionally show sudden upsurges in numbers and phase transition and cause widespread damage to crop production. The effects of temperature on the sexual maturation of these grasshoppers was also elucidated. With regard to a nematode that is currently threatening soybean production in South America, the present state of its upsurge was investigated in three countries (Paraguay, Brazil and Argentina) and various protection measures such as the use of tolerant varieties and application of organic phosphorous chemicals was proposed.

TOPIC 1

Alternative tillage system for upland cropping in Northeast Thailand

In recent decades, the development of sugarcane cropping in Northeast Thailand has been accompanied by the utilization of heavy machines rather than draft animals. The operation of heavy machinery for land preparation and product transportation damages the physical condition of the sandy soil, which is extremely vulnerable to mechanical and climatic impacts. In this type of soil, it is not unusual to find hardpan soil having bulk density as high as 1.7 in layers 30-40 cm deep; hardpan soil not only aggravates problems of water run-off and erosion through poor water percolation but, through the limitation of root development, also causes crop growth to be more sensitive to environmental stresses.

In order to find solutions to this problem, the effects of subsoiling treatment were studied in comparison to the conventional tillage system prevalent in sugarcane cropping in Northeast Thailand. With regard to rainy season cropping, the effects of subsoiling on maize yield were not readily apparent during years of abundant precipitation but were quite profound during years of less precipitation. Furthermore, deeper root development of sugarcane was induced and the survival rate of seedlings during the dry season was found to have increased with subsoiling treatment. Soil erosion was also ameliorated through the high levels of water percolation resulting from subsoiling.

Based on the results above, a new working attachment simultaneously incorporating subsoiling, fertilizing and planting functions was developed by modifying a common sugarcane planter (Fig. 1). A chisel with this attachment was useful in breaking up hardpan up to 60 cm in depth and reducing the hardness of the soil from 23 kg·f/cm^2 to less than 10 kg·f/cm^2; this enabled sugarcane to be planted without ridging. It was suggested that this attachment could also

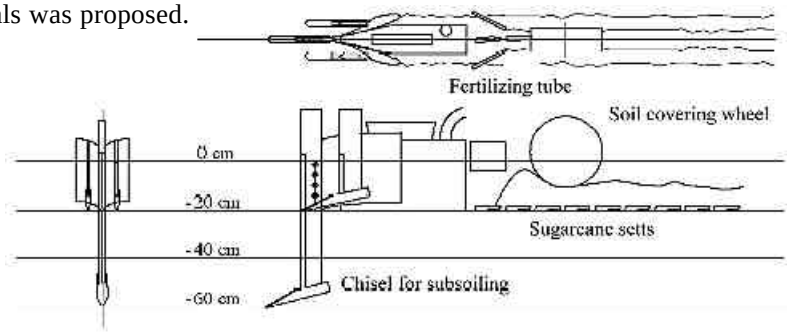

Fig. 1. Structure of the newly-developed working attachment.

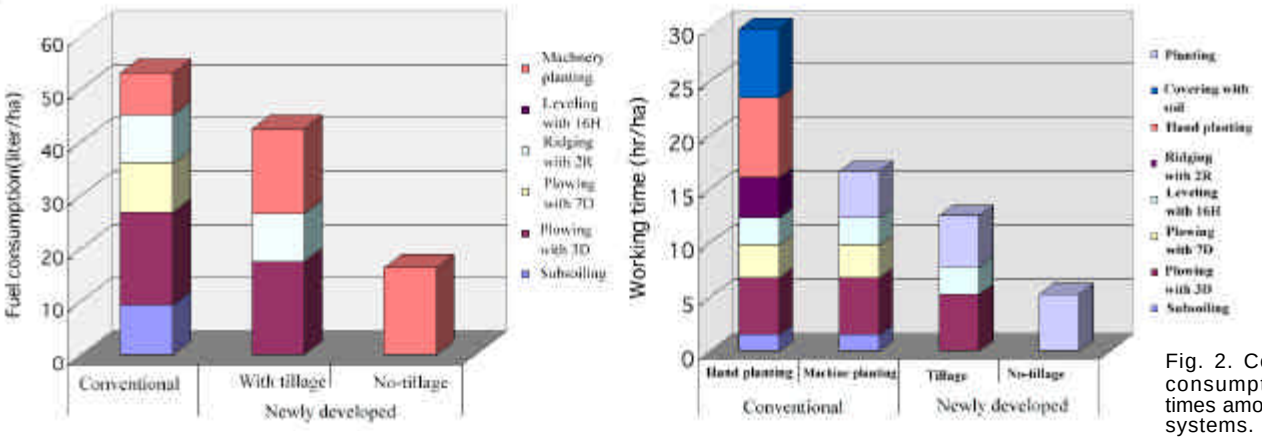

Fig. 2. Comparison of fuel consumption and working times among several planting systems.

Fig. 3. Effects of subsoiling treatment on the growth of sugarcane planted under no-tillage conditions.

work well under no-tillage conditions. Under the conventional system for land preparation and planting, fuel consumption and working time amounted to 50 liters and 15 hours per ha. By using the newly developed attachment, the necessary amount of fuel and time could each be reduced by one-third (Fig. 2). Moreover, the number of required tractor operations could be reduced from five times under the conventional system to just once under the new alternative system, which would also contribute towards reducing the formation of hardpan. The rooting of sugarcane was improved through the use of the new attachment under no-tillage conditions and the growth of sugarcane was superior to that under the conventional planting system (Fig. 3).

In order to make this system practical and applicable to upland cropping in Northeast Thailand, it is necessary to conduct further studies on the management of sugarcane residue and the control of weeds during the fallow period after the end of ratooning.

(K. Matsuo)

TOPIC 2

Eco-physiological characteristics and yielding ability of *Erianthus spp.*

Erianthus spp. is a sugarcane relative that is found throughout the year at various sites ranging from mountainous areas to swamps and riverlands in Thailand. Because of its ability to flourish in such diverse environments, its importance as a genetic resource in sugarcane breeding and as a source of roughage for livestock has achieved widespread recognition. With regard to these functions, the eco-physiological characteristics of *Erianthus* were studied in relation to soil moisture and its yielding abilities were evaluated under the application of animal feces in comparison with napiergrass and maize.

Starting in October 1999, at the beginning of the dry season, root development and the physical conditions of soil were investigated through analysis of soil profiles of neighboring *Erianthus* and napiergrass canopies. Irrespective of plural hardpans and waterlogged conditions, root development of *Erianthus* was observed in layers as deep as 250 cm, while roots of napiergrass were rarely found deeper than 135 cm in soil which was almost completely saturated with water (Fig. 1). The results of soil pF monitoring in the field showed that water loss from soil surface was minimal and considerable amounts of available water existed in the deeper soil layers even in March when there was no vegetation. Meanwhile, the results from pot experiments with adjusted

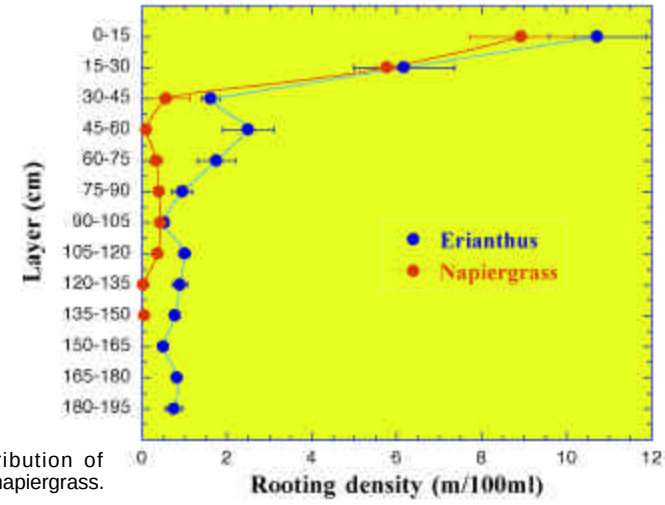

Fig. 1. Root distribution of *Erianthus spp* and napiergrass.

ground water levels suggested that waterlogged conditions were more conducive to biomass production of *Erianthus* than were dry conditions, and well-developed aerenchyma were observed on the roots of plants grown under waterlogged conditions. Therefore, the drought tolerance of *Erianthus* can be attributed to its ability to extend its root system during the rainy season and to draw water from deeper soil layers during the dry season.

The growth and yielding abilities of three forage species including *Erianthus* were evaluated for two years in the field, after several fertilizer treatments. The rooting and growth of *Erianthus* after planting were rather slow and its dry matter yield (DMY) was considerably lower than did napiergrass, although higher than maize in the first year of planting. However, in the second year, *Erianthus* tended to show higher DMY than napiergrass in all plots excluding those which had received the highest rate of dried feces application, and the maximum

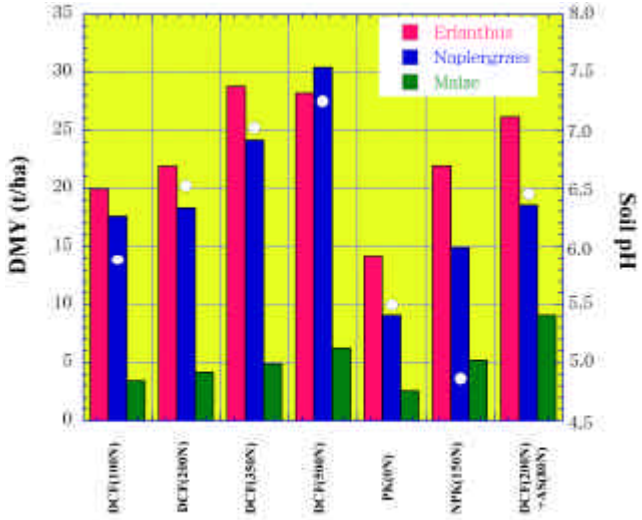

Fig. 2. Dry matter yields of three forages in the second year of planting. (○): soil pH; DCF: dried cattle feces; AS: ammonium sulfate; values in parentheses indicate quantity of material in terms of nitrogen.

DMY of *Erianthus* amounted to 30 t/ha after combining the yields of four harvests. In addition, *Erianthus* showed better yields than did napiergrass under conditions without nitrogen fertilization. There was significant reduction in the DMY of maize and napiergrass associated with the decline of soil pH caused by the annual application of ammonium sulfate, while there was no reduction in the DMY of *Erianthus* (Fig. 2). These results indicate the high yielding ability of *Erianthus*, especially under the acidic and infertile soil conditions common to Northeast Thailand.

The results detailed above suggest the high adaptability of *Erianthus* to the conditions prevalent in Northeast Thailand and its usefulness in sugarcane breeding and biomass production; however, it is necessary to conduct further research focusing on its practical uses as roughage for livestock.

(K. Matsuo)

TOPIC 3

Sustainability of sugarcane production evaluated based on N_2 fixation and organic matter cycle

In Northeast Thailand, infertile sandy soil with limited ability to supply and retain nutrients is distributed over large areas. Crops possessing the ability to fix atmospheric nitrogen endophytically could contribute towards the establishment of sustainable agriculture in these areas, and taking this into consideration, analyses on N_2 fixation in sugarcane and the organic matter cycle of sugarcane production were conducted to evaluate their sustainability.

Possible N input by N_2 fixation in sugarcane planted in the research fields was estimated by the natural ^{15}N abundance ($\delta^{15}N$) method using cassava as a presumed non-N_2-fixing reference plant. Leaf samples were collected at harvesting and $\delta^{15}N$ values were analyzed using an ANCA-SL mass spectrometer. All three varieties of sugarcane planted at the Suphan Buri Field Crops Research Center (Suphan Buri FCRC) and four varieties of sugarcane planted at the Khon Kaen Field Crops Research Center (Khon Kaen FCRC) showed clearly lower $\delta^{15}N$ values than those of cassava. Averages of N input due to N_2 fixation in sugarcane varieties planted at Suphan Buri and the Khon Kaen FCRC were estimated at 22% and 34%, respectively. Averages of N input by N_2 fixation in the seven sugarcane varieties was 29.1% (Fig. 1). Possible N input by N_2 fixation in field-grown sugarcane was also estimated by the natural ^{15}N abundance

($\delta^{15}N$) method using neighboring weeds growing inside sugarcane fields as presumed non-N_2-fixing reference plants. Sugarcane leaves were collected from the northeast regions in September 1997 and January 1998 and from the central regions in December 1997. $\delta^{15}N$ values of leaf samples were analyzed with an ANCA-SL mass spectrometer. Of the total of 54 sugarcane samples from 54 sites, $\delta^{15}N$ values of 19 samples were markedly lower than those of all neighboring plants. Average contribution of N_2 fixation to total plant nitrogen of these 19 sugarcane samples was estimated to be 32% (Table 1).

Table 1. Estimation of N_2 fixation in field-grown sugarcane in Thailand

Regions	No. of samples	No. of positive samples[a]	%Ndfa[b] of positive samples
Northeast	21	7	28
Central	33	11	35
Total	54	19	32

[a]Number of samples with $\delta^{15}N$ values lower than those of all neighboring plants.
[b]Estimated % nitrogen derived from N_2 fixation

The flow of organic matter after harvesting sugarcane was determined in order to evaluate the sustainability of sugarcane production (Fig. 2). Only the stems of sugarcane were removed from the field and most of the other parts including tops, leaves, stubbles and roots remained as residues. Thus, most of the nutrients contained in the residues were returned to the field. In the process of sugar refining at sugar mills, bagasse, filter cake and molasses are discharged as by-products. The main element of the sugar, bagasse and molasses taken out of this organic matter cycle is carbon; on the other hand, filter cake contains large amounts of nutrients. In order to maintain a sustainable cycle of nutrients, the leaves of sugarcane should not be burned during harvesting and filter cake should be properly returned to the field.

Sugarcane has a long history of being grown on plantations and of being an important crop during the colonial era; even now, large-scale farmers engage in its cultivation. It is also a monoculture crop which involves continuous cropping. However, the sustainability of this type of crop has not yet been intensively evaluated. Sugarcane is a C_4 plant and can fix carbon effectively; it tends to leave a great deal of plant residues in the field. N removed from the nutrient cycle is compensated for by N derived from N_2 fixation. Sugarcane in Northeast Thailand has shown vigorous growth even in very infertile sandy soil, and the fact that it has been planted for over 300 years in

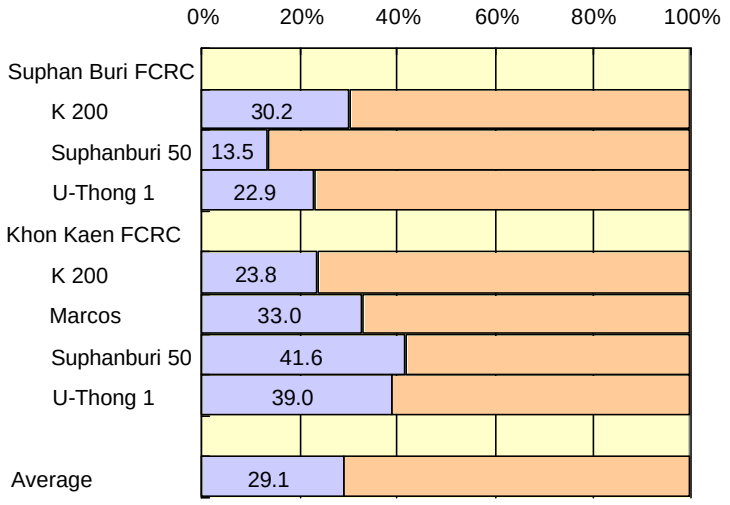

Fig. 1. Estimation of N_2 fixation in different varieties of sugarcane planted in research fields based on the natural ^{15}N abundance method.

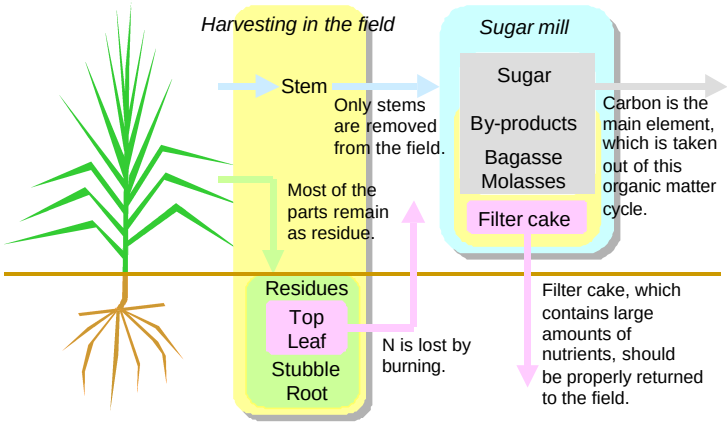

Fig. 2. Organic matter cycle of sugarcane production

infertile soil on the Nansei Islands in Japan without any decreases in production and soil fertility suggest that sugarcane production maintains a sustainable nutrient cycle.

(S. Ando)

TOPIC 4

Technologies for rainfed rice production in Northeast Thailand

The paddy fields of Northeast Thailand account for 55% of paddy area in the country and play a critical role in national food production. However, agricultural production in this large rainfed area has been hindered by dependence on highly irregular rainfall. Consequently, it is difficult for farmers to determine the most advantageous transplanting date and oftentimes transplanted rice suffers from drought when the subsequent rain is insufficient for cultivation. Shortages and rising

costs of labor for transplanting and harvesting are further constraints, resulting from the centralization of the population into urban areas. The low fertility of the sandy soil, frequent drought and salinity have led to decreases in yields which are already quite low as compared to other regions in Thailand.

In response to these issues, a multidisciplinary research project between Thailand and Japan entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand" (1995-2001) was conducted in order to develop sustainable crop production systems.

Introduction of dry direct seeing cultivation of rice

In order to overcome the problems of irregular rainfall and labor shortages in relation to transplanting, intensive technology development was conducted for the establishment of dry direct seeding rice cultivation. On-farm trials of this process were conducted in 1998-2000 in several farmers' fields in the Tung Kula Ronghai area in Roeit Province. Cultural practices such as land preparation, seeding, fertilizer application and harvest were adapted to the local conditions.

The growth and yield of direct seeded rice were comparable to those of rice transplanted under the conventional cultivation planting period, while the former exceeded the latter when the transplanting was delayed due to water shortages. No significant difference in yield was observed between tillage and no-tillage seeding, which indicated the advantage of omitting the procedures of tillage and puddling. No-tillage was superior to tillage when the rainfall after seeding was scarce; this can be attributed to higher soil moisture due to undisturbed soil conditions. Trial manufacture of no-tillage seeders with rotary disk and drill seeders was conducted, paving the way for a large-scale field trial (15 ha) in 2001 exhibiting an equal or higher rice yield compared with vicinal transplanted fields (Fig. 1).

Efficient weed control based on soil moisture regime

Among the component technologies of the direct seeding cultivation system, establishment of effective weed control is most important for the purposes of suppressing proliferation of weeds under irregular precipitation and difficult water control conditions.

Cyperaceae weed species were dominant in rainfed paddy fields. Their emergence began at the onset of rainfall, followed by the emergence of *Graminaea* and broad-leaf weeds with increased rainfall. Emergence patterns of *Cyperaceae* in relation to water were investigated by adjusting soil moisture content. A soil moisture rate greater than 25% was necessary for promoting the emergence of *Cyperaceae* while emergence was found to be inhibited under rates of less than 20%. (Fig. 2). On the other hand, the direct seeded rice variety "KDML105" emerged vigorously under soil moisture rates of 20%. These results strongly suggest that the optimum sowing time would occur when soil moisture approaches 20%, in order to facilitate adequate germination of rice while suppressing the emergence of weeds.

Weed control in no-tillage direct seeding cultivation was established with the application of non-selective herbicide before seeding, followed by foliar treatment with selective herbicide at 3-4 weeks after seeding. Soil and foliar treatment of herbicide at 1-2 weeks after seeding suppressed the weeds in tillage seeding.

Prevention of water leakage in rainfed paddy fields

More than 90% of the paddy fields in Northeast Thailand are of the rainfed type and are not irrigated. Although the accumulation and retainment of water after rainfall or irrigation are important to secure the growth of rice, the sandy soil prevalent in Northeast Thailand is vulnerable to water leakage, which leads to the unstable production of rice. Land reform technologies which can be applied to farmers' fields were investigated in order to enhance the

Fig. 1. Large-scale field trial for no-tillage direct seeding cultivation of rice

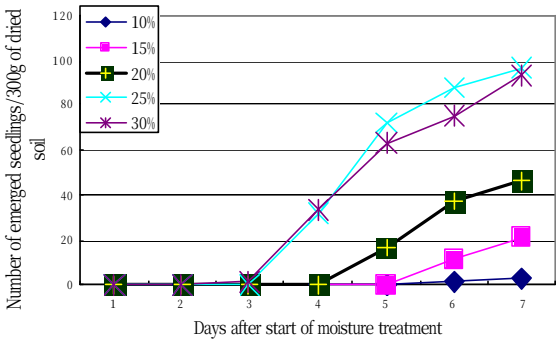

Fig. 2 Emergence of *Cyperaceae* weeds under different soil moisture rates in the soil of rainfed paddy fields.

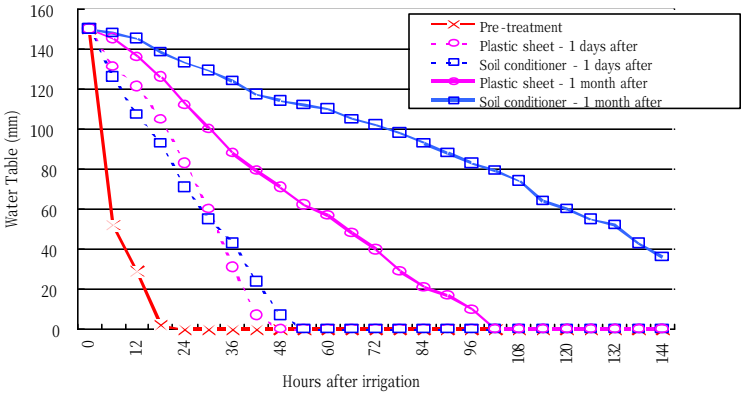

Fig.3. Changes in the depth of standing water after irrigation.

utilization of water resources.

In this research, a paddy field with dikes surrounded by thick plastic sheets was constructed in the lower section of a sloping area. Prior to construction, the height of the dikes from the soil surface was uniformly established; excavation of vertical sections, insertion of plastic sheets, and the filling and shaping of soil were then carried out. A field with dikes solidified by soil conditioner (magnesium compounds) was constructed adjacent to the field with the plastic sheets. The surface soil of the dike was scraped and mixed with soil conditioner, and then the mixture was restored on top of the dike and solidified with a trowel along with the adjustment of soil moisture. Changes in the depth of standing water were measured before and after construction, and the final results showed that whereas the initial standing water would thoroughly leak within half a day prior to the treatment, it remained for a longer period with the implementation of both treatments (Fig. 3). Therefore, both of the above methods are recommended for the purpose of preventing water leakage in rainfed paddy fields.

(N. Kabaki)

TOPIC 5

Evaluation of rainfall station networks in tropical monsoon areas

Large-scale irrigation projects consisting of reservoirs contribute towards stabilizing rainy season rice cropping in Southeast Asia, but the water storage capacity of some reservoirs is not sufficient for double cropping. Therefore, the release of water supply from reservoirs should be reduced to minimum levels in order to increase cropping intensity. Furthermore, when a field plot receives rainfall during the irrigation season, release from the reservoir should be reduced. It is necessary to promote appropriate release reduction by monitoring the average amount of rainfall in irrigation systems; for this purpose, rainfall station networks are necessary. This study aims to propose a method for evaluating rainfall station density.

The study was carried out in the Muda Irrigation Scheme located in the northwestern region of Peninsular Malaysia (Photo 1). It covers an area of 126,000 ha, of which 96,000 ha consists of rice fields.

First, the spatial variability of rainfall was investigated in the target area. Depth Area (DA) analysis deals with the relationship between the rainfall amount and area, which can be described through many empirical equations. In this study, the simplified Horton method was used.

$$P_l = P_0 \exp(-k \cdot l)$$

P_0: Maximum rainfall in one rainfall area
P_l: Rainfall at a point l km apart from a rainfall center
k : Coefficient (km^{-1})
l : Distance (km)

Coefficient k represents characteristics of rainfall spatial variability. Values were obtained using 385 one-day rainfall events in a section of the target area with 10 rainfall stations. The location of the center for each rainfall event was concurrently estimated, and the coefficient of correlation between observed and estimated rainfall for each event was calculated. The average value of the correlation coefficients was 0.78. Although the above equation is very simple, it accurately portrays the spatial variability of rainfall because rainfall caused by convective lifting is predominant in the tropical monsoon area. Application of the equation to rainfall caused by frontal or orographic lifting remains untested at the present time. In general, coefficient k values for 95% of all rainfall events range from 0 to 0.6.

The next step was the simulation of rainfall events with specified coefficient k over an area in which rainfall stations were evenly scattered.

Photo 1. Aerial view of the Muda Irrigation Scheme.

Accuracy of observation for simulated rainfall events under the given station density was calculated, and the relationship between the accuracy of observed rainfall and rainfall station density was obtained for the coefficient *k* of rainfall after appropriate simulations.

Finally, the rainfall station network was evaluated by combining the distribution of the coefficient *k* with the results of simulations. Standard error of rainfall as a function of station density in the Muda Irrigation Scheme is shown in Fig. 1; the evaluation of the rainfall station network implemented in Isohara by the Meteorological Agency of Japan is shown for comparison. The presupposition was that the rainfall station density in the Muda area would be higher due to larger spatial variability of rainfall.

The rainfall station network began with 20 stations and has expanded to 61 stations in the Muda Irrigation Scheme (Photo 2). The effects of this further investment were not apparent, but Fig. 1 shows that the expansion of the network has improved the accuracy of rainfall observations. However, a larger number of rainfall stations are still required in order to improve the system.

Traditional evaluation methods require a large number of rainfall stations. In this study, attempts were made to combine the evaluation of the

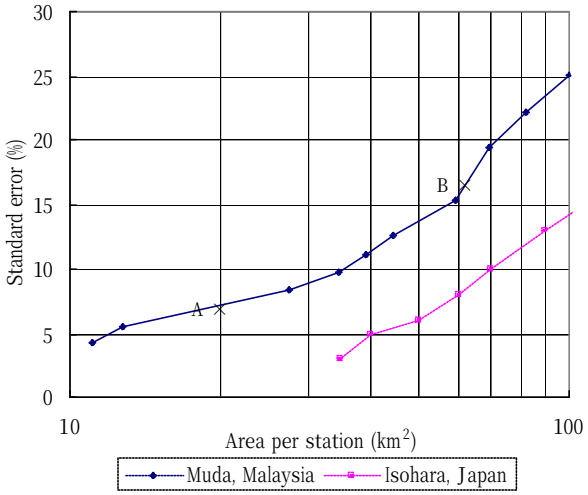

Fig. 1. Standard error c rainfall events as a functio of station density. A: Preser station density; B: Initia station density

Photo 2. Rainfall station equipped with a VHF radio.

station networks with Depth Area analysis in order to reduce the number of rainfall stations needed for evaluation. The proposed evaluation method could be applied to irrigation systems in the flat plains of tropical monsoon areas.

(N. Horikawa)

ANIMAL PRODUCTION AND GRASSLAND DIVISION

In many different capacities, domesticated animals are beneficial to the lives of people in developing countries. Not only do animals produce meat, milk and hides which are essential to daily life and are important sources of income, but they also generate draft power for tillage and transportation and produce wastes that can be used as fertilizer and fuel. Despite these benefits, livestock production throughout the developing world remains at disproportionately low levels due to constraints such as low genetic productivity, poor quality of feeds, disease prevalence, harsh climatic conditions, and management inexperience.

The Animal Production and Grassland Division conducts research aimed at achieving sustainable increases in animal production without generating adverse environmental consequences. In order to achieve this goal, the Division seeks to enhance the productive capacity of natural resources, manage grasslands to secure feed resources, enhance the utilization of agro-industrial by-products, control invasive animal diseases, and improve management practices in developing regions.

During Fiscal Year 2001, two overseas collaborative research projects and one supporting project in Tsukuba progressed towards successful conclusion. The first project involved cooperation between Division researchers and scientists from the Khon Kaen Animal Nutrition Research Center, Thai

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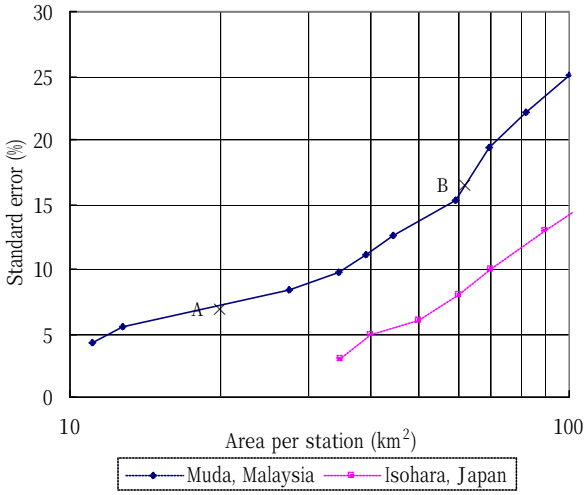

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Department of Livestock Development (DLD) to improve cattle production and feeding with locally available feed resources in Northeast Thailand. The second project was a complementary collaborative research project which began in 1998, analyzing technology for raising small livestock in Brazil. Finally, the domestic research project was conducted in order to isolate and identify endophytic nitrogen-fixing bacteria in plants.

In addition to the aforementioned projects, three long-term international research projects ranging in duration from one to three years are currently underway. Division researchers are working with the National Center for Research on Beef Cattle (CNPGC-EMBRAPA), and the National Center for Soybean Research (CNPSo) in Brazil, and the International Center for Tropical Agriculture (CIAT) in Colombia in order to develop technologies for the sustainable management and utilization of grasslands. A cooperative research project entitled "Improvement of pig feeding management systems in the Mekong Delta" began in 2001 in collaboration with Cantho University, Vietnam. Two joint studies on trypanosomiasis and lactic acid bacteria began in 1998 and 2000, respectively. The former is a study on the mechanisms of infection and development of trypanosomiasis, using mice lacking genes related to trypanotolerance, and draws on assistance from the International Livestock Research Institute (ILRI) in Kenya. The second study involves research on the use of lactic acid bacteria for agricultural products in Thailand with the Department of Agriculture (DOA), the DLD of Thailand, and Kasetsart University.

In addition to long-term projects, the Division conducted the following studies on short-term assignments of one to three months: 1) studies on the characteristics of calcium metabolism of Holstein crossbred cows in Northeast Thailand, 2) studies to evaluate the nutritive value and cattle digestibility of locally available feed resources, and 3) studies on large ruminant management and disease control as well as major constraints on animal husbandry in Northeast Thailand. These were all joint projects with the Khon Kaen Animal Nutrition Research Center and the DLD. Numerous other projects, including: 4) studies on the feeding systems of swine in the Mekong Delta, 5) studies on the incidence of major diseases of swine in the Mekong Delta, and 6) the prevalence of pathogenic *Escherichia coli* in swine feeding environments in the Cantho region of the Mekong Delta. These projects were conducted with Cantho University in Vietnam.

Beef cattle grazing on an alfalfa pasture at the Marcos Juarez Agricultural Experimental Station, National Institute of Agricultural Technology, Argentina. (Photo: T.Taniguchi)

Work conducted in collaboration with the CNPGC included: 7) studies on the estimation of animal productivity in agropastoral systems, 8) studies on the estimation of pasture utilization and management in agropastoral systems, and 9) the contribution of vesicular-arbuscular mycorrhizae to the phosphorous nutrition of pasture crops. In addition, the Chinese Agricultural University in northern China assisted in the following research activities: 10) studies on the improvement of the quality of corn stalk silages through the use of fermentation control additives and 11) the evaluation of the nutrient values of corn stalk silages and agricultural by-products prepared in China. Finally, 12) studies on steroid responses in murine trypanosomiasis with emphasis placed on association with trypanotolerance were jointly conducted with ILRI in Kenya.

The Division receives numerous requests from institutions in developing countries to pursue collaborative research, primarily concerning the incorporation of biotechnological applications and the enhancement of overall levels of research. In order to address as many requests as possible, the Division has been promoting basic research on JIRCAS's Tsukuba premises in support of overseas activities. At the present time, two studies on the evaluation and utilization of endophytic bacteria of grasses and socio-economic evaluations of major constraints on domestic animal production in Thailand and Vietnam constitute the primary focus of this domestic research.

TOPIC 1

Significance of indigenous arbuscular mycorrhizal fungi in forage production in the Brazilian savannas

Several tropical grass species, such as the *Brachiaria* species or *Panicum* species, have adapted well to the infertile soils of the Brazilian

savannas and now cover 95% of the pastures in these areas. The existence of arbuscular mycorrhiza (AM) fungi enhances the adaptability of the various higher plants to infertile soils; however, in the Brazilian savannas, there is very little information regarding the significance of indigenous AM fungi in forage production. Since the effects of AM fungi are determined by the type of fungi, grass species and environmental factors, the relationship between the indigenous AM fungi, grass species and soil pH was examined in this study.

Oxisol (clay and dark red Latosol) was collected from 0-20 cm soil depths in a native savanna area of the National Beef Cattle Research Center of the Brazilian Agricultural Research Corporation (EMBRAPA Gado de Corte) in Campo Grande at Mato Grosso do Sul State, Brazil (20° 27'S; 54° 37'W). At the same time, assemblages of indigenous AM fungi were collected from pasture soils at the research site. *Brachiaria decumbens*, *B. brizantha*, *B. humidicola*, and *Panicum maximum* plants were grown in a greenhouse for 70 days with two inoculation treatments (with/without inoculation of the indigenous AM fungi) in combination with three treatments of soil pH at 4.3, 5.1 and 6.4. At the end of the growth period, the shoot and root dry weight, concentration of phosphorous (P) and P accumulation were recorded.

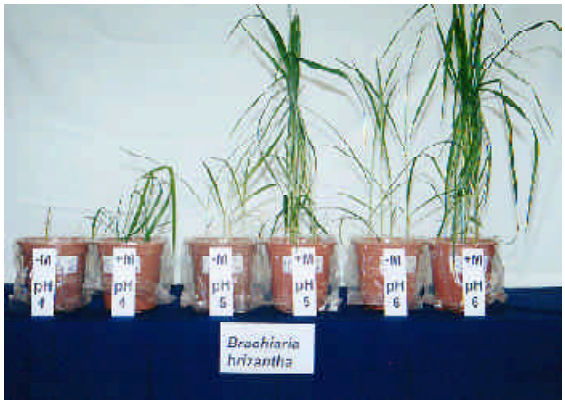


Photo 1. Mycorrhizal (+M) and non-mycorrhizal (-M) *Brachiaria brizantha* at soil pH levels of 4.3, 5.1 and 6.4.

Inoculation of AM fungi increased the shoot and root dry weights in all species (Photo 1). P concentration in the shoots and roots as well as total P accumulation of the examined grass species were improved by AM inoculation (Fig. 1). The mycorrhizal effect on P acquisition was larger in *B. decumbens* and *B. brizantha* than in *P. maximum* and *B. humidicola*. An increase in soil pH had a positive effect on the plant dry weight and P acquisition of the four grass species. Mycorrhizal dependency was calculated for total dry weight and P accumulation according to the following equation: mycorrhizal dependency (%) = (1-(b/a)) x 100, where a and b are dry weight after mycorrhizal and non-mycorrhizal treatments, respectively. All grass species showed the highest AM dependency of dry matter production at the lowest pH levels. At pH levels of 4.3 and 5.4, *P. maximum* was more dependent on AM in dry matter production than the other species. As with dry matter production, AM dependency on P accumulation in all grass species was highest at the lowest soil pH level (4.3). P accumulation dependency decreased as soil pH was increased, and this decline was most pronounced in *P. maximum*.

In this study, it was discovered that the existence of indigenous AM fungi was necessary for the growth of forage grasses in the Oxisol of Brazilian savannas; the mycorrhizal plants absorbed a larger amount of P than did the non-mycorrhizal plants. The mycorrhizal effects on P accumulation were more significant in *B. brizantha* and *B. decumbens* than in *B. humidicola* and *P. maximum*. The AM dependency in dry matter production and P accumulation was higher at the lower soil pH level.

(T. Kanno)

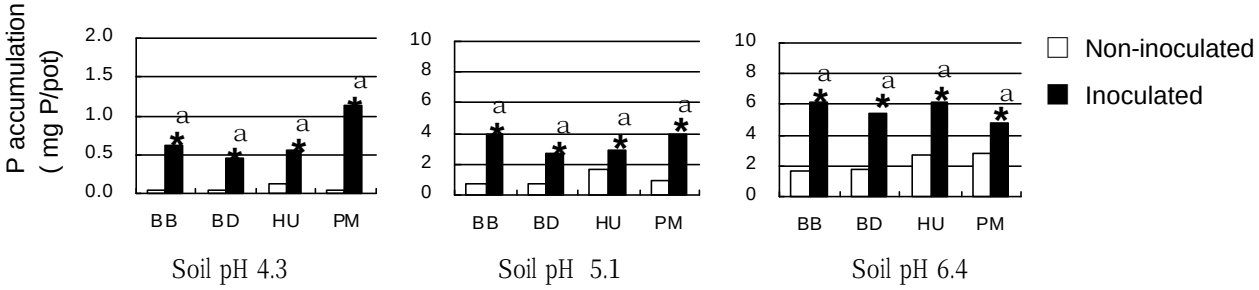


Fig. 1. P accumulation of four grass species affected by arbuscular mycorrhiza inoculation and soil pH.

Abbreviations of grass species are as follows. BB: *B. brizantha;* BD: *B. decumbens;* HU: *B. humidicola;* PM: *P. maximum.* Asterisks on the bars represent significant differences between inoculation treatments. Grass species followed by same letters (a,b,c) were not significantly different according to Tukey's Range Test at the 5% level.

TOPIC 2

On-farm trial for pasture establishment on wetland in the Brazilian savannas

The Brazilian savannas, which cover approximately 200 million hectares in central Brazil, are among the most important areas for livestock production in the world. It is estimated that the savannas contain 12 million hectares of wetlands having abundant water resources which remain under-utilized. Since 1998, JIRCAS has been implementing on-farm trials to improve animal productivity of wetlands in the Brazilian savannas; several field experiments have been conducted to select available grass species for wetland pastures and to pinpoint suitable seeding times for pasture establishment.

The Agricultural Training Center of the National Federation of Japanese Immigrant Agricultural Cooperation (JATAK-ATC) was selected as the experimental site of the on-farm trial. JATAK-ATC is located in the Guatapara District of Sao Paulo State, approximately 300 km northwest of Sao Paulo City. It consists of 570 ha of upland fields and 450 ha of wetlands, and is an important area for the demonstration and diffusion of advanced agricultural technologies to small or medium landholders in the district. In the wetlands, construction of a drainage system occurred between 1994 and 1997 and the drained areas have subsequently been utilized as native pastures (Photo 1).

In January 1998 (the middle of the rainy season), *Brachiaria decumbens* cv. Basilisk, *B. brizantha* cv. Marandu, *B. dictyoneura* (commercial strain), *B. humidicola* cv. Humidicola, *Andropogon gayanus* cv. Baite, and *Setaria anceps* (commercial strain) seeds were sown in wetland field plots. In November 1998 (the beginning of the rainy season), *B. dictyoneura*, *A. gayanus*, and *Paspalum atratum* (cv. BRA-9610) seeds were sown in the same fields. However, in both experiments, there was no particular species which could survive the wetland rainy season. When the grass seeds were sown in the early half of the rainy season, the small seedlings were flooded at the end of the season and could not survive. These results indicate that the suitable seeding period in the wetlands is the beginning of the dry season, when it becomes possible to use a tractor.

In related work, flooding tolerance was compared for *B. decumbens*, *B. brizantha*, *B. humidicola*, *A. gayanus*, *P. atratum*, and *Cyndon dactylon* using adult plants. Plants of each species were transplanted into the wetland plots in July 1999 (the beginning of the dry season)

Photo 1. Grazing cattle on a wetland pasture during the dry season.

Photo 2. Seedling establishment of *Brachiaria humidicola* on a wetland pasture at the beginning of the dry season.

and their survival rates after flooding were observed. In June 2000, it was discovered that only *B. humidicola* and *P. atratum* had survived. In central Brazil, producers can buy *B. humidicola* seeds more easily than those of *P. atratum*, and therefore it was concluded that *B. humidicola* was the most suitable forage species for the wetlands of JATAK-ATC.

(T. Kanno)

TOPIC 3

Energy requirements for maintenance of Holstein crossbred dry cows in Northeast Thailand

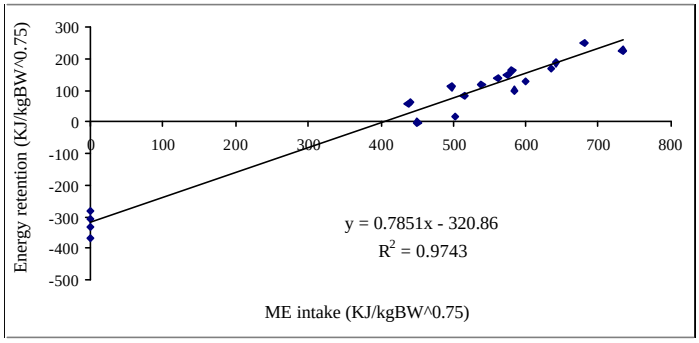
Dairy farming in Northeast Thailand has been growing as an important agricultural sector, but it still faces numerous difficulties in the area of feeding management. Feeding strategies for dairy cattle are clearly dictated in feeding standards for cattle in temperate countries, but they cannot be applied directly to the industry in Thailand because the specific breed of cattle, available feed and surrounding environment in the region are quite different from conditions elsewhere. The nutritional physiology of dairy cattle raised in Northeast Thailand has not yet been well-documented, and so the present study aims to examine the effect of protein levels on energy and nitrogen balances in dairy dry cows.

Photo 1. Cows installed with harnesses for the attachment of feces bags and urine tubes used to separately collect feces and urine during the collection period.

Metabolism trials were conducted with four Holstein crossbred dry cows in order to examine the requirements for maintenance in dairy cows; each cow was fed Ruzi grass hay mixed with different quantities of soybean meal. Crude protein contents in the four dietary treatments were 3.3, 6.4, 9.7, and 13.1%. The dietary treatments consisted of a nine-day preliminary period and a five-day collection period. After the last dietary treatment, the cows were fasted for four days. Feces and urine were collected from each animal during the collection period, and only urine was collected over the last two days of the fasting period (Photo 1). Oxygen consumption and the production of carbon dioxide and methane were measured with the ventilated flow-through method during the last four days of the feeding period and during the last two days of the fasting period.

The metabolizable energy (ME) requirements for maintenance were calculated through a regression analysis of energy retention against ME intake on the basis of metabolic body size. The regression equation was estimated as Y=0.7851X-320.86, and the obtained ME requirement for maintenance was 409 KJ/BWkg$^{0.75}$ (Fig. 1). This value was the highest compared to animals examined in previous studies, followed by Brahman cattle (377 KJ/BWkg$^{0.75}$), swamp buffalo (334 KJ/BWkg$^{0.75}$), and Thai native cattle (245 KJ/BWkg$^{0.75}$). It was 17% lower than the value in Holstein cattle (487 KJ/BWkg$^{0.75}$) as suggested in the feeding standards (Agriculture, Forestry and Fisheries Research Council Secretariat, 1999). Further studies are required to conclude values of ME requirements for the maintenance of Holstein crossbred cattle in Thailand; however, at present it is clear that heat and methane production of the Holstein crossbred cattle in the present studies were higher than those in animals from previous studies.

Fig. 1. Relationship between ME intake and energy retention in dairy dry cows.



The digestibility of neutral detergent fiber, acid detergent fiber and total digestible nutrients (TDN) of Ruzi grass hay could be improved by the supplementation of soybean meal supplement up to a crude protein content of 10%. Beyond this level, the supplement exhibited no noticeable effects. The TDN of Ruzi grass hay was estimated from 51.3% to 56.3%. The results of these studies can be used for the feeding management of dry dairy cattle and will serve as valuable basic information for the establishment of appropriate feeding standards in Thailand.

(M. Odai)

FOOD SCIENCE AND TECHNOLOGY DIVISION

Global food production must increase substantially in order to meet the demands of a rapidly growing population, and food security is one of the major problems facing the human race today. In developing countries, postharvest losses of grains have been estimated at 20-30%, caused mainly by insect infestation, microbial infection, and improper handling. Because agriculture is influenced by environmental conditions and global arable land is limited, there are numerous constraints on the rapid increase of food production. Therefore, products, once harvested, should be consumed with minimal loss during handling, transportation, and storage. Developing techniques to reduce postharvest losses of agricultural products and maintain their quality will contribute significantly towards global food security.

Agriculture is still the largest sector of rural economies, engaging a majority of the rural population. However, the mean income among urban populations is significantly higher than that among rural populations, and most of the extremely poor are from rural areas. In light of this, efforts must be made to provide rural populations with the necessary tools by which to increase their income, so that they may

Photo 1. Cows installed with harnesses for the attachment of feces bags and urine tubes used to separately collect feces and urine during the collection period.

Metabolism trials were conducted with four Holstein crossbred dry cows in order to examine the requirements for maintenance in dairy cows; each cow was fed Ruzi grass hay mixed with different quantities of soybean meal. Crude protein contents in the four dietary treatments were 3.3, 6.4, 9.7, and 13.1%. The dietary treatments consisted of a nine-day preliminary period and a five-day collection period. After the last dietary treatment, the cows were fasted for four days. Feces and urine were collected from each animal during the collection period, and only urine was collected over the last two days of the fasting period (Photo 1). Oxygen consumption and the production of carbon dioxide and methane were measured with the ventilated flow-through method during the last four days of the feeding period and during the last two days of the fasting period.

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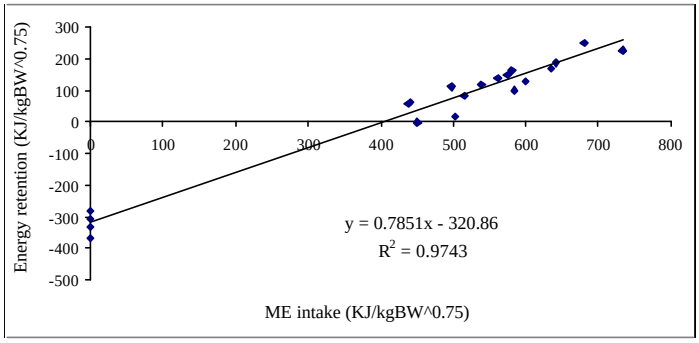

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continue to cultivate their lands and raise livestock. Values of many agricultural commodities are declining, along with farmers' percentage stake in the final consumer price; this indicates the urgent necessity of adding value to various commodities. Consumers are concerned about the quality and safety of food products, and changes in urban lifestyles have resulted in increased consumer demand for a more diversified diet and for convenient, processed foods. Therefore, it is becoming increasingly important for rural farmers and entrepreneurs to produce and market products that meet the demands of urban customers. Studies to ensure the high quality and safety of agricultural commodities and to enhance their value will contribute a great deal towards the improvement of rural income.

Potential postharvest technologies should be environment-friendly in order to facilitate environmental sustainability. Technologies less dependent upon chemicals are preferable in regard to food safety and the environment, and so the development of alternative methods to chemical treatment is highly necessary. For example, the world's most widely used fumigant, methyl bromide, is to be phased out by the year 2015 due to its ozone-depleting potential, and scientists worldwide have been attempting to establish alternative methods for disinfesting agricultural products such as grain, fruits, and vegetables.

The Food Science and Technology Division, a new division which was established on April 1, 2001, is to be engaged in research activities in the field of postharvest technology, with the goal of contributing towards food security, poverty alleviation and sustainable development on a global scale. Postharvest operations in agriculture and horticulture include a wide range of functions necessary for maintaining high quality in food products, reducing transaction costs, and raising domestic welfare. Therefore, postharvest research covers a wide range of fields in the production-consumption chain: crop grading, drying and packaging as well as secondary processing, storage, marketing and distribution. It is necessary to emphasize postharvest studies on agricultural products, such as quality improvement, safety, extension of shelf life, and control of insects and microorganisms in foodstuffs. These are all primary objectives of the Division.

The Division is conducting a research project entitled "Development of low-input technology for reducing postharvest losses of staples in Southeast Asia" in collaboration with Thai scientists to develop low-input drying technology using natural resources and materials such as sunlight, husk and straw and to develop insect pest-controlling technology for rice employing natural enemies and bioactive botanicals. Physical properties such as equilibrium moisture content and drying constants of Thai rice in commercial rice dryers were ascertained for analyzing and predicting the drying process. Based upon these results, a simple and low-cost system for drying rice has been proposed. Various natural enemies of insect pests have been collected and identified, and the insecticidal effectiveness of *d*-limonene from indigenous plants has been clarified. The bioactivity of indigenous plants in Southeast Asia such as Thai ginger and Thai aromatic rice were also investigated in order to establish value-adding utilization of these commodities.

Chinese soybean products. (Photo: E.Tatsumi)

The Division is involved in another research project entitled "Development of sustainable production and utilization of major food resources in China", in which research on the improvement of traditional Chinese foods such as soybean-curd (tofu) and rice noodle (mifun). As a result of this study, the Division proposed two-stage heating of soymilk for preparing soy-curd having good physical characteristics, utilization of electrolyzed water for sanitation of soybeans to be used for tofu production, and the use of Indica variety rice having an amylose content of 20% or higher for the production of high-quality rice noodle.

In a study under the research project entitled "Development of new processing technology for quality improvement of indigenous soybean foods in developing regions", white-spored mutants induced from koji molds were applied in the production of Kecap, an Indonesian soy sauce, to prevent aflatoxin contamination. The Division's Indonesian counterparts have successfully mass-produced koji using one of the white-spored mutants and will use it to produce Kecap on a pilot-plant scale in 2002.

TOPIC 1

Microorganism control in packed tofu manufacture using electrolyzed water

As a traditional food, tofu is an important part of Asian diets and has now achieved popularity worldwide due to its nutritional value, as it is high in protein containing essential amino acids and isoflavone. However, since the relatively high water activity (A_w, the amount of water that is available for bacterial growth), nutrient content, and pH values of tofu products are conducive to microorganism growth, they decay easily and have a very limited shelf life. To control microorganisms in tofu manufacture, electrolyzed water (EW) was applied to the soybean soaking phase of packed tofu processing.

The available chlorine in EW, which is a mixture of hypochlorous ions, hypochlorous acid and chlorine, acts as a sterilizer. Although chlorine is highly effective in killing microorganisms in simple aqueous systems, its activity is decreased by the presence of organic materials in foods. Hypochlorous acid around available chlorine acts primarily as a bactericide. Hypochlorous ions, on the other hand, have about 20 times less anti-microbial activity than hypochlorous acid. The Division focused on the distribution pattern of available chlorine in response to pH levels. Under weak acidic conditions around pH 6.5, concentrations of chlorine and hypochlorous ions become minimal, making EW more stable and active as a bactericide.

Acidic EW (pH 2.1; oxidation reduction potential, 1185 mv; available chlorine, 100 ppm) and alkaline EW (pH 11.7; oxidation reduction potential, -120mv) were prepared by electrolysis of 0.075% sodium chloride solution. Mixed EW (pH 6.5; oxidation reduction potential, 891 mv; available chlorine, 50 ppm) was prepared by mixing acidic and alkaline EW to adjust pH levels to 6.5. Sterilization effects during soybean soaking and the quality of soymilk and tofu produced from soybeans soaked in three types of EW were analyzed. Acidic EW and mixed EW were very effective in killing all microorganisms in soybeans and kept the soaking water aseptic (Fig. 1).

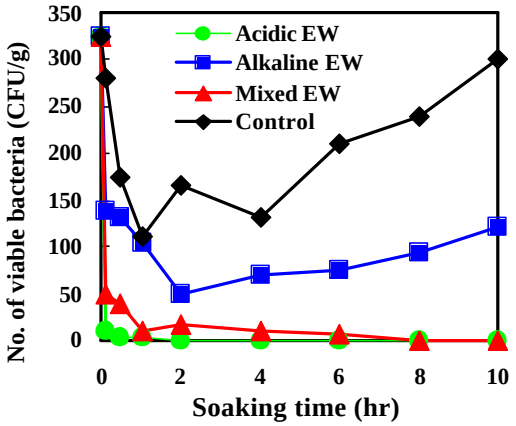

Fig. 1. Changes over time of viable bacteria counts in soybeans after soaking in EW.

To estimate the effects of EW soaking, soymilk and tofu were prepared from soaked soybeans. Although soymilk yields and solid content in soymilk showed no significant differences among the four types of soaking water, tofu consistencies produced from acidic EW and alkaline EW soaking were lower than the values obtained from mixed EW and sterilized water (Table 1). We conclude that mixed EW is the most effective disinfectant among the three types of electrolyzed water due to weak acidic pH values, stability, and the lack of damage to soymilk and tofu.

(E. Tatsumi and M. Saito)

Table 1. Effects of soaking soybeans in four types of solutions on soybean, soymilk and tofu quality

	Alkaline EW	Acidic EW	Mixed EW	Sterilized water
Solids content in wastewater (%)	0.51	0.47	0.37	0.32
Soymilk (ml)*	232.9	230.6	229.1	227.4
Solids content in soymilk (%)	10.85	11.04	10.6	10.64
Tofu gel strength (kPa)	15.14	15.9	17.68	17.78

TOPIC 2

Processing of high-quality rice noodles in China

Rice noodles are a traditional food, widely consumed in southern China and Southeast Asia. Various types of rice noodles have been produced during the long history of food processing; in China, most manufacturing has traditionally been carried out by small shops or producers (Photo 1). As purchasing power has increased along with the rapid development of the Chinese economy, the daily lives of the Chinese people have become dramatically reoriented towards westernization and diversification. Consumer demand has been shifting away from food quantity towards quality, safety and functionality, and therefore the modernization

of food processing has become highly necessary. Unfortunately, very little scientific and technological knowledge regarding traditional foods has been accumulated in China, as almost all of these foods have been produced according to the experience and perception of workers in the respective shops. To industrialize the rice noodle industry, it is necessary to gather basic knowledge about the production process. Towards this objective, a study on the effects of rice varieties, soaking time and milling methods was conducted by the Food Science and Technology Division.

Generally, Indica rice varieties are used in rice noodle processing. Rice noodle structure depends on the gelatinization and retrogradation properties of starch, and noodle quality is believed to be highly dependent upon amylose content. To determine the influence of rice varieties, the correlation between amylose content and rice noodle quality was analyzed for two Japonica varieties, five Indica varieties and three hybrid Indica varieties. The rice noodles made from the high amylose (greater than 20%) Indica varieties achieved high scores in sensory evaluation (Fig. 1).

Grinding of rice granules is the first step in rice noodle processing, affecting rice flour in terms of particle size distribution, degree of gelatinization and damaged starch content. The effects of dry and wet milling of rice granules were determined, with results showing that the damaged starch content of rice flour after dry milling was greater than that after wet milling. Other results showed that 1) rice granules reached plateaus in water absorbency after soaking for two hours, 2) cooking loss of rice noodles was remarkably decreased through soaking treatment (Fig. 2), and 3) rice noodles made from wet milled flour had higher values in gel strength (Fig. 3).

(E. Tatsumi)

Photo 1. Rice noodle processing in China.

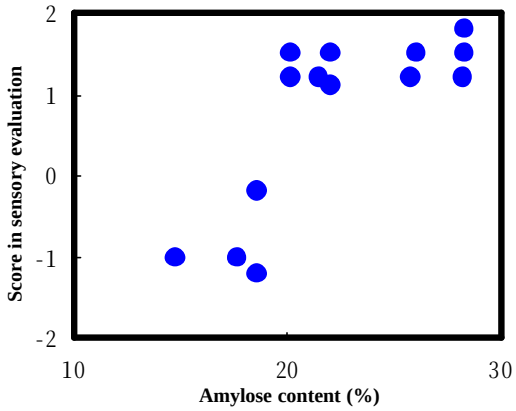

Fig. 1. Correlation between amylose content of rice materials and rice noodle quality.

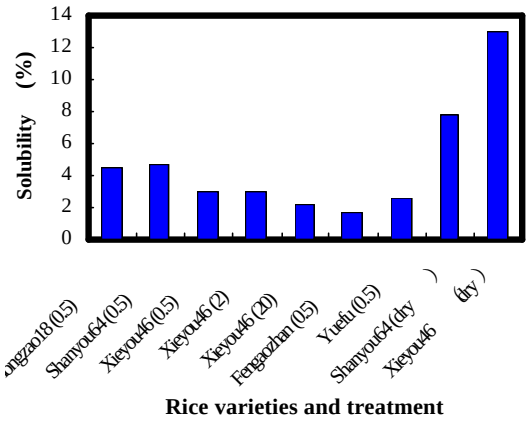

Fig. 2. Cooking loss of rice noodles under different soaking times.

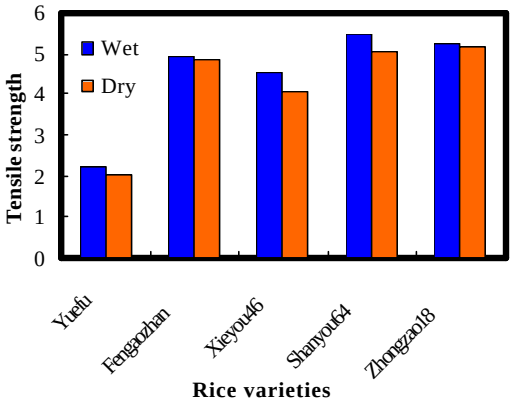

Fig. 3. Effects of milling methods on rice noodle gel strength.

FORESTRY DIVISION

Increasing demand for food is compelling farmers to exploit larger amounts of arable land, leading to the massive decline of natural forest cover, particularly in developing regions of the world. Forest degradation has generated serious economic and environmental problems not only at the local level but also on a global scale. Providing methods based on scientific data for the rehabilitation and sustainable management of forest areas therefore remains an urgent necessity. Improving forest production systems and postharvest technologies in local

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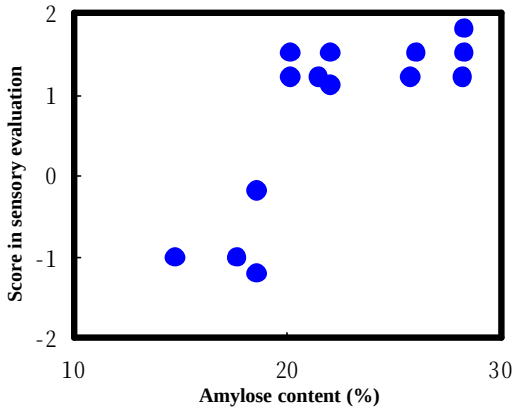

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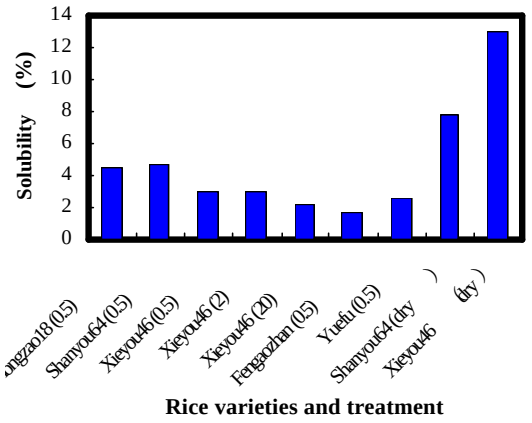

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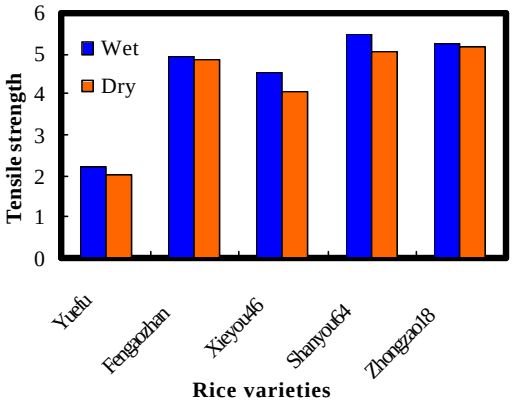

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Tropical rain forest in the Sepilok Forest Reserve in Sabah State, Malaysia. (Photo: K. Nakashima)

communities should be considered an essential means of arresting forest decline.

The Forestry Division conducts a wide range of research activities for the establishment of sustainable management systems for the forests of Southeast Asia. Projects undertaken by the Division can generally be classified into two categories: 1) regeneration or rehabilitation technologies on degraded secondary forests or grasslands and 2) processing technologies for the effective use of forest products. Through these projects, researchers are involved in various disciplines, including silviculture, forest ecology, plant physiology, soil science, mycology, forest mechanization, socio-economics, and wood technology.

Enrichment and rehabilitation of degraded forests are the initial steps toward the establishment of sustainable management of forest reserves. Working towards these objectives, the Forestry Division has focused its research on developing relevant technologies in silviculture and site evaluation, while also taking natural environmental conditions into consideration. Concurrently, the Division also manages studies on species behavior, systems for natural forest regeneration, enrichment planting methods, and reduced impact logging and harvesting systems. These studies are designed to support the sustainable production of forest products, which will help to stabilize levels of exploitation in both natural and plantation forests.

The Forestry Division has initiated a comprehensive project entitled “Development of agroforestry technology for the rehabilitation of tropical forests”, which aims to establish a technological base for the rearing of biodiversity-rich forests and high-value timber production forests as well as for the enhancement of forest environment functions. These studies are expected to contribute towards policy decisions and promotion of social forestry projects aiming to optimize land utilization and productivity. In due course, these policies and projects will help to improve the standard of living in the local communities and to diversify economic activities for both agricultural and forestry enterprises. Growing forests rich in biological diversity will also contribute towards the development of the local environment and the conservation of valuable forest resources in the region. The Division also believes that this project will enable the dispensation of technical advice to policymakers and local communities, farmers, and agricultural and forestry enterprises, for purposes of promoting agroforestry practices.

This project has involved collaboration with the University of the Philippines at Los Banos since 2000, and a 12 ha experimental site for the establishment of cover forests on degraded grasslands was built and planted with 12 native tree species and 6 fruit species. In December 2001, JIRCAS and the Forest Department (FD) of the State Government of Sabah, Malaysia signed an MOU to conduct the project in Sabah State. According to the project schedule, three JIRCAS specialists in forest ecology, soil sciences and mycology were dispatched as long-term researchers to the Forest Research Center (FRC) in Sandakan, Sabah State. Four specialists were also dispatched to the FRC on a short-term basis in March 2002, for the purposes of supporting the long-term researchers and for discussion and review of research plans with FRC researchers and FD officers.

TOPIC 1

Preparation of cellulose pulp from oil palm empty fruit bunches

As a source of palm oil, oil palm is one of the most important tree species in Southeast Asian countries such as Malaysia. However, fibrous wood-like residues that remain after oil production have not been effectively utilized thus far despite their potential value as abundant and renewable natural resources. These are called empty fruit bunches (EFB, Photo 1), and have only been used as energy sources at individual palm oil mills; in such cases, they were simply burnt as fuel. Alternative forms of utilization of EFB include pulp production for papermaking and the production of cellulose pulp, or dissolving pulp (DP). DP is used for the production of cellulose derivatives or

regenerated cellulose, which serve as indispensable fine chemicals in various industries such as fiber, film, food and pharmaceutical production. In this study, the preparation of DP from EFB using environment-friendly chemical technologies and methods was conducted.

The pulping process employed in this study used soda–anthraquinone (active alkali 24%/ anthraquinone as 0.1% of total material), which does not include a sulfur element that causes water pollution under cooking temperatures of 170°C. EFB fibers were first hydrolyzed with 1.5% sulfuric acid at 120°C for 90 minutes (pre-hydrolysis), followed by soda-anthraquinone pulping. Ozone bleaching was then carried out on the pulp at a rate of 0.4-1.5% to total pulp at room temperature. Ozone is a powerful and less pollutant reagent in pulp bleaching, and has the potential to replace bleaching processes using chlorine-containing reagents. One of the pulps was treated with alkali extraction (NaOH 2.5% on pulp, 60°C, 60 minutes) after ozone bleaching. Chemical properties of the pulps are shown in Table 1; a pulp prepared without pre-hydrolysis (Pulp C) and a commercial softwood pulp are shown for reference. Contents of α-cellulose (an indicator of cellulose purity) approached 90% and above for the pre-hydrolyzed pulps (A and B), which is an acceptable level for DP in comparison with commercial DP. Moreover, these results clearly show that acid pre-hydrolysis is effective in increasing cellulose purity when comparing Pulps A and B with C. Ash and pentosan contents of the pulps, which are indicators of cellulose impurity, were also comparable to those of commercial DP. In particular, pentosans are induced from hemicelluloses of raw materials, making it necessary to carry out the pre-hydrolysis phase of DP preparation in this procedure. The amounts of ozone reacted were 0.4, 0.6 and 1.5% to total pulp for Pulps A, B and C, respectively. Comparing A and B, the α-cellulose content of A was 6% higher than that of B, although the amount of reacted ozone was lower. This is indicative of the effectiveness of alkali extraction after ozone treatment for increasing cellulose purity. Despite the limited amount of information on the use of ozone, the results of this study showed the effectiveness of ozone bleaching for DP production. Above all, it is concluded that EFB has significant potential as a raw material to be utilized for dissolving pulp in an environment-friendly manner.

(R. Tanaka)

Table 1. Chemical properties of EFB pulps.

	Preparation condition	a-Cellulose content (%)	Ash content (%)	Pentosan content (%)
A	Pre-hydrolysis → pulping → ozone → alkali extraction	95.1	0.09	1.8
B	Pre-hydrolysis → pulping → ozone	88.6	0.06	1.8
C	Pulping → ozone	77.9	0.12	24.2
	Commercial softwood DP	92.3	0.14	2.5

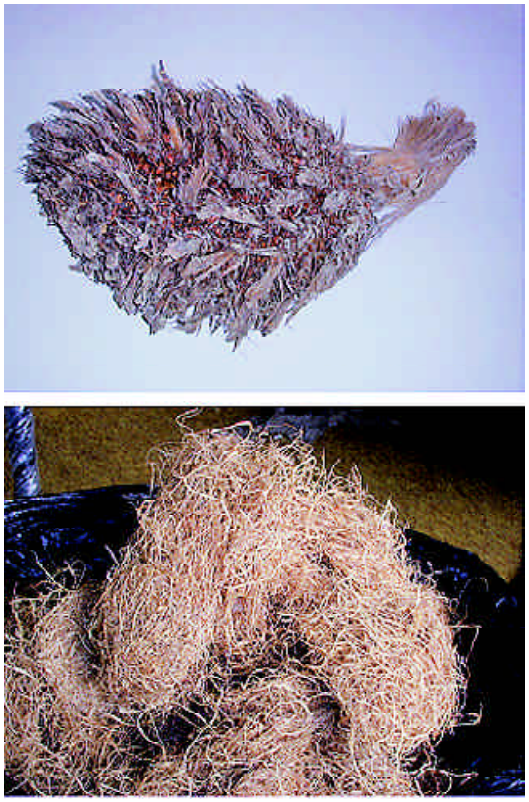

Photo 1. An empty fruit bunch (EFB, top) and its fibrous form (bottom).

FISHERIES DIVISION

The world's hydrospheric regions, despite their tremendous volumetric capacity, have a lower capacity for food resources production than do land-based regions. It is generally believed that the ocean's capacity to provide food resources will approach its limit in the near future. On the one hand, in 1999 the total catch of the world's fisheries reached 137 million tons; on the other, in 2010 the world's population is expected to reach 7.03 billion people. Accordingly, 100 to 120 million tons of fisheries-based foods will be needed. Assuming that approximately 30% of total catch is

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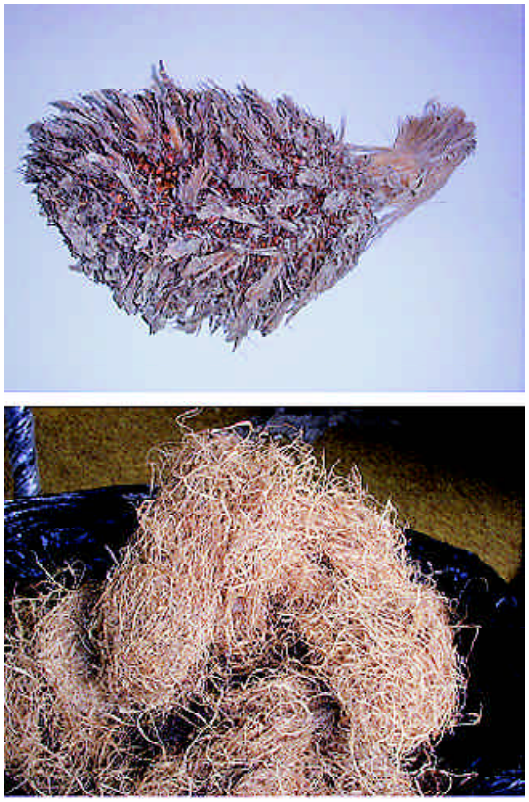

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FISHERIES DIVISION

The world's hydrospheric regions, despite their tremendous volumetric capacity, have a lower capacity for food resources production than do land-based regions. It is generally believed that the ocean's capacity to provide food resources will approach its limit in the near future. On the one hand, in 1999 the total catch of the world's fisheries reached 137 million tons; on the other, in 2010 the world's population is expected to reach 7.03 billion people. Accordingly, 100 to 120 million tons of fisheries-based foods will be needed. Assuming that approximately 30% of total catch is

unsuitable for human consumption, it is expected that there will be a shortfall of 10 to 40 million tons in regard to fisheries products. Japan and other Asian countries including China, India, Indonesia, Thailand, Korea, Malaysia, and the Philippines consume a particularly large portion of fisheries products, and various forms of fish-eating culture have developed in monsoon regions around Asia where the staple food is rice. Considering the significant increase in personal income levels in Asia in recent years, it is estimated that 69 million tons of fisheries products will be needed in the region by the year 2010. In other words, more than half of the world's fisheries foods will be consumed in Asian countries.

In consideration of the above projections, the JIRCAS Fisheries Division is engaged in three international collaborative research projects in Southeast Asia. The first project is "Studies on sustainable production systems of aquatic animals in brackish mangrove areas", conducted in cooperation with research organizations in the Philippines, Malaysia, and Thailand. This study aims to restore fisheries resources and develop technology for environment-friendly aquaculture using naturally available sources of feed and the environmental protection capabilities of brackish water mangrove forests. The second project is entitled "Elucidation of reproductive mechanisms in freshwater prawns, and research aiming to improve prawn-rice farming systems in the Mekong Delta". This study is being conducted as part of JIRCAS's comprehensive collaborative project entitled "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta" with Vietnam, and is aimed at the establishment of freshwater prawn aquaculture systems combined with rice growing. The third project is "Development of utilization technology of freshwater fisheries resources". This research is being conducted as part of JIRCAS's comprehensive project entitled "Development for sustainable production and utilization of major food resources in China", aimed at the development of techniques to manufacture frozen fish meat paste and fishmeal made from freshwater fish.

Frozen fisheries products, the consumption of which has expanded rapidly in China in recent years.

TOPIC 1

Characteristics of Chinese domestic freshwater fish: Post-mortem changes in the muscle quality of silver carp and grass carp

In the year 2000, 42.8 million tons of total fisheries production was recorded in China. This quantity accounts for approximately 30% of all fisheries production in the world, and it should also be further noted that the production of freshwater fish through aquaculture accounts for approximately 35% of total production in China. China has a long history of more than four thousand years of aquaculture; however, freshwater aquaculture production of this magnitude is only a recent phenomenon. Nearly all of the freshwater fish produced through aquaculture is sold live or killed at market (Photo 1), but freshwater fish meat is rarely distributed in the uncooked state due to the lack of a proper distribution network. This is inefficient from a resources utilization point of view. Recently refrigerators have come into widespread use in China, suggesting the possibility of distributing raw freshwater fish in the near future provided that research is conducted on the freshness of fish meat during the distribution, transportation and processing phases.

In a collaborative research project between the Shanghai Fisheries University and JIRCAS

Photo 1. Local market selling live freshwater fish in Shanghai.

entitled “Development of utilization technology of freshwater fisheries resources”, a study on the post-mortem changes of fish muscle quality during storage was conducted in order to obtain information about the characteristics of Chinese domestic freshwater fish. The experiments focused on the silver carp (*Hypophthalmichthys molitrix*) and grass carp (*Ctenopharyngodon idellus*) because they are the most popular Chinese domestic freshwater fish and the primary species of freshwater aquaculture in China. The fish were kept at temperatures of 5, 10, and 20°C, after death by sacrifice. Changes in muscle quality during storage were then monitored by sensory evaluation of the skin surface, gills and eyes, as well as the smell and hardness of the muscles. Fig. 1 shows deterioration in fish muscle quality as a function of time. If the score was higher than 8, the fish was considered palatable to Chinese consumers. When the fish were kept at 20°C, scores on the sensory test decreased immediately after death, and within half a day, the scores fell below 8 in both species. On the other hand, when the storage temperature was 5°C, the period that the fish was considered palatable extended to about three days.

This study also measured the concentration of ATP and its related compounds in the muscles in order to calculate the K-value, which is widely accepted as a freshness index for fish meat. Degradation of ATP into inosine and hypothanthine in fish muscles was monitored. As shown in Fig. 2, the K-value increased rapidly when both silver carp and grass carp were kept at 20°C. On the other hand, storage at low temperatures such as 5 and 10°C delayed the increase of the K-value. However, there were significant differences between the two species of fish; K-values in grass carp rose faster than in silver carp, and the K-value of silver carp remained at low levels throughout five days of storage at 5°C. This finding may indicate that silver carp meat itself is stable, although rapid deterioration was evaluated through the sensory test. Poor marks on the sensory test of fish quality is usually indicative of the growth of microorganisms; if the presence of these microorganisms is well-controlled, the shelf life of fish meat may be extended. It is necessary to conduct further investigation on the extension of freshwater fish shelf life after distribution.

(M. Yokoyama)

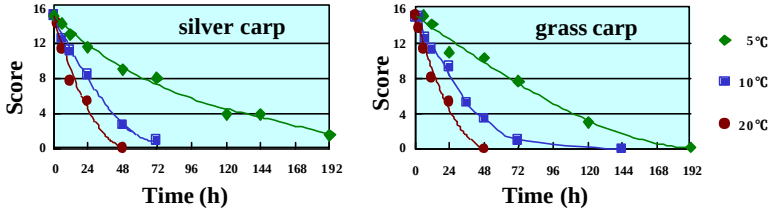

Fig. 1. Changes in sensory evaluation scores of silver carp (left) and grass carp (right) during storage under different temperatures.

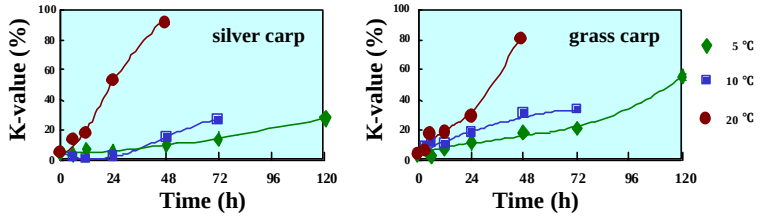

Fig. 2. Changes in K-values of silver carp (left) and grass carp (right) muscle during storage under different temperatures.

TOPIC 2

Diagnosis and prevention of viral diseases occurring in cultured shrimp

In recent years, prawn culture has developed rapidly as an industry in Southeast Asian nations such as Thailand, Malaysia and Indonesia due to the establishment of new culture technologies. In the early 1990s, total worldwide prawn production was approximately 700,000 metric tons, and nearly all of this took place in Asia, particularly Southeast Asia. However, the production of cultured prawns has decreased markedly as a result of serious viral disease outbreaks since that time; Yellow Head Virus (YHV) and White Spot Syndrome Virus (WSSV) are representative of these viral pathogens. At present, WSSV is the most serious problem facing the prawn industry in Southeast Asia, and the increasing severity of widespread viral infection is the most significant threat to stable aquacultural production. Therefore, in order to ensure stable production of cultured products, it is essential that preventive countermeasures against viral diseases be adopted. The JIRCAS international collaborative project entitled “Development of diagnosis and prevention technology for shrimp viral diseases” began in 1996 and is scheduled to conclude in 2002. The aim of this project is the development of serological diagnosis, disinfection and other control methods for the prevention of prawn viral diseases.

Serological diagnosis using monoclonal antibodies is one of the most rapid and accurate methods, in addition to being simple and low

cost. The use of monoclonal antibodies results in a higher sensitivity to the virus than the use of polyclonal antibodies, due to the fact that monoclonal antibodies react very specifically against a particular component of the virus. The production of monoclonal antibodies involves four steps. The first step involves the preparation of virus antigen for injection into mice. Wild virus is injected into healthy prawns, and hemolymph containing a large amount of virus is collected from the infected prawns. Next, the virus is concentrated and purified through high-speed centrifugation and ultracentrifugation. In the second step, mice are immunized. The virus antigen prepared as above is injected intraperitoneally into the mice, and then several more booster injections are performed as a booster after three weeks. In the third step, cell fusion is conducted. After final immunization, the spleens of immunized mice are removed and the spleen cells are fused with myeloma cells, because spleen cells cannot survive over long periods of time while hybridomas (fused spleen and myeloma cells) can grow and produce antibodies. In the final step, screening and culture are performed. The cells which produced the specific antibodies against WSSV are selected from many hybridomas through a screening process. After screening, they are cultured and their product antibodies are used as monoclonal antibodies. A few strains producing virus-specific antibodies are obtained from more than 100 strains of hybridomas, which are selected through antibody production tests. These monoclonal antibodies are thereafter used in the diagnosis of WSSV.

Viral inactivation was tested using chemicals such as formalin and halogenous disinfectants, including sodium hypochlorite and Isodine® (povidone-iodine was an effective ingredient). The concentrations of formalin were 0, 0.1, 0.25, 0.5, and 1% (V/V), while 0, 0.5, 1.0, 2.5 and 5.0 ppm of chloride as sodium hypochlorite, and 0, 1.25, 2.5, 5.0 ppm of povidone-iodine as Isodine were used in the inactivation test. These chemicals were mixed with equal volumes of the virus and were then allowed to react at 25 °C for 10 minutes. After the reaction, the resultant products were injected intramuscularly into 10 healthy prawns at dosage levels of 0.1 ml/prawn. Mortality was monitored for two weeks after injection. The experiments showed that mortality did not occur at concentrations above 0.25% for formalin, 0.5 ppm for chloride, and 1.25 ppm for povidone-iodone. These data indicated that halogenous disinfectants induced an effective inactivation even at lower concentrations. It was suggested that these disinfectants would be extremely useful for the inactivation of WSSV.

Aquaculture pond for prawn farming in Malaysia.

Mass mortality of prawns due to viral disease in Malaysia.

From the studies detailed above, these diagnosis and disinfection techniques for WSSV should enable the prevention of pathogen intrusion into aquaculture farms and contribute towards establishing sustainable aquaculture in Southeast Asia.

(N.Oseko)

OKINAWA SUBTROPICAL STATION

The Okinawa Subtropical Station was restructured in line with the overall reorganization of JIRCAS in April 2001. The Administrative Section and the Field Management Section remained unaffected by the restructuring process while, with the exception of the chief of the International Collaborative Research Section, other staff members were assigned to the following five newly-established laboratories: the Islands Environment Management Laboratory, Environmental Stress Laboratory, Tropical Crop Breeding Laboratory, Tropical Fruit Crops Laboratory, and Plant Protection Laboratory. As in past years, the International Collaborative

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Research Section accepted ten postdoctoral research fellows this year under the auspices of the JIRCAS Visiting Research Fellowship Program at Okinawa; these researchers were assigned to laboratories in accordance with the requests of each laboratory. This new system is expected to promote closer cooperation between the laboratory staff and the research fellows and create a more conducive atmosphere for pursuing their research objectives.

The Islands Environment Management Laboratory became the leading laboratory at the Station and is expected to represent the Station in all research activities. One of the major objectives of the Station is to develop technologies for sustainable agricultural production on small islands in developing regions; it is located on Ishigaki Island, which is well-suited for conducting research in this area due to its subtropical climate. The Environmental Stress Laboratory is attempting to clarify mechanisms of heat tolerance in vegetable crops and identify useful genetic resources that can be utilized for breeding purposes. The Tropical Crop Breeding Laboratory is conducting research to develop useful breeding materials for sugarcane and tuber crops through the use of biotechnology, and is at the same time promoting the rapid generation advancement of breeding materials such as rice and wheat by utilizing the specific conditions of the subtropical environment. The Tropical Fruit Crops Laboratory is developing technology for the evaluation of specific characteristics, such as the regulation of tree form and the eating quality of fruits, of fruit trees cultivated in greenhouses which protect the trees from strong winds, disease and insect damage; work is also in progress to develop new technologies for the mass production of seedlings. The Plant Protection Laboratory is aiming to develop technologies to control major insect pests, such as those associated with citrus greening disease, by means of integrated pest control methods.

A research fellow working together with a JIRCAS staff member at the Okinawa Subtropical Station.

TOPIC 1

The function of tomato mitochondrial small heat shock protein under heat stress conditions

Heat stress is one of the most significant constraints on crop production. Plants respond to heat stress by changing their metabolic pathways so as to acclimatize to high temperatures. Under heat stress, synthesis of most proteins is repressed and some proteins, which are called heat shock proteins (HSPs), begin to be synthesized. In plant species adapted to temperate environments, 20 to 40 different HSPs, which are divided into several classes, are induced under heat stress. Some low molecular weight (15-30 kDa) HSPs, so-called small heat shock proteins (sHSPs), are also expressed in plants. Accumulation of sHSP in mitochondria (MT-sHSP) under heat stress has recently been reported in a number of plant species but little is known about the cellular functions of MT-sHSP in the heat tolerance of plants.

The Station's goal in this study was to clone mitochondrial sHSP cDNA from tomato (*Lycopersicon esculentum* Mill.) leaves, evaluate the transcription of the mitochondria-sHSP gene at various temperatures, and assay the molecular chaperone activity of mitochondria-sHSPs *in vitro*.

The cloning and sequencing of a full-length cDNA (LeHSP23.8: accession number AB017134) encoding the precursor of the MT-sHSP in tomato was successfully conducted. The deduced protein precursor, with a calculated molecular weight of 23.8 kDa, was presupposed to target mitochondria. A single copy of LeHSP23.8 was found in tomato genomic DNA through southern-blot analysis, and northern-blot analysis revealed the heat-inducible character of LeHSP23.8 mRNA. The threshold temperature was approximately 36°C, and it was accumulated abundantly at 40°C in tomato leaves (Fig. 1). Among the MT-, ER-, Class I- and Class II-sHSP genes, MT-sHSP mRNA responded most quickly at 40°C in tomato flowers (Fig. 2).

The molecular chaperone function of LeHSP23.8 was demonstrated *in vitro*. Citrate synthase (CS) was used as a target enzyme for

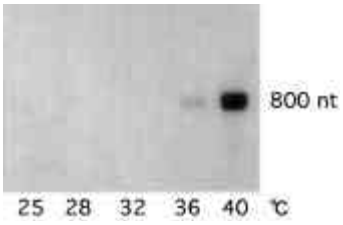


Fig. 1. Northern-blot analysis of temperature-dependent LeHSP23.8 mRNA accumulation in tomato leaves. Tomato plants were grown in greenhouse conditions at 25°C and treated at 28°C, 32°C, 36°C or 40 °C for two hours.

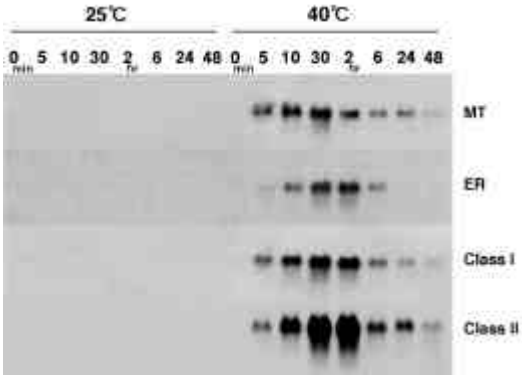


Fig. 2. Northern-blot analysis of a heat-induction time course for sHSP genes in tomato flowers. Tomato plants grown under greenhouse conditions were transferred to a growth chamber on the day of flowering, and then incubated at 25°C or 40°C. The flowers were collected 0 minutes to 48 hours after the incubation. Panels indicated by MT, ER, Class I and Class II show the expression of genes for MT-, ER-, Class I- and Class II-sHSP, respectively.

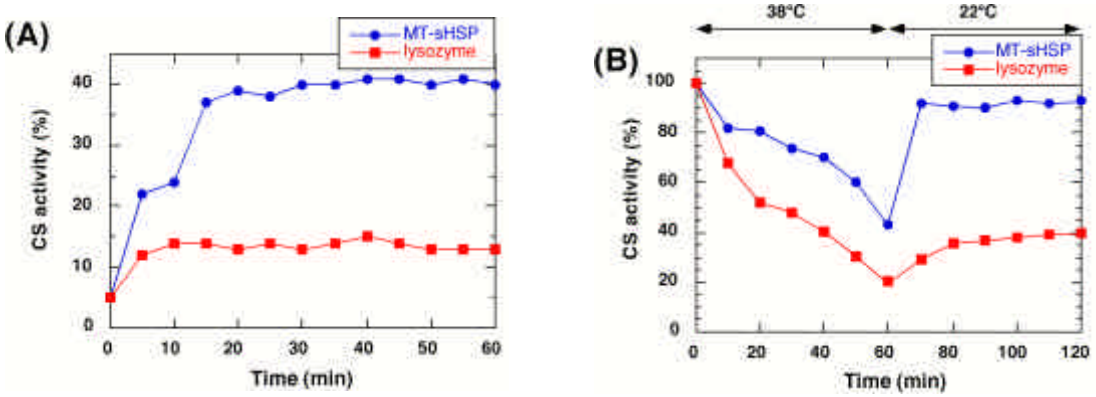


Fig. 3. (A) Effects of LeHSP23.8 protein on the renaturation of chemically denatured citrate synthase (CS). CS (15 μM) was denatured in 6 M guanidine hydrochloride for 120 minutes and then diluted 100-fold into a solution supplemented with 150 nM lysozyme (■) or with 1.8 μM recombinant LeHSP23.8 (●). (B) Effects of recombinant LeHSP23.8 on the thermal inactivation of CS. CS (150 nM) was incubated in the presence of 150 nM lysozyme (■) or 1.8 μM recombinant LeHSP23.8 (●) at 38°C for 60 minutes and then at 22°C.

the assay of the molecular chaperone activity of LeHSP23.8 according to a standard experimental procedure. When the recombinant LeHSP23.8 was mixed with CS denatured by guanidine hydrochloride, the activity of CS was gradually recovered. After one hour of incubation, 40% of the native CS activity was recovered. This value was two-fold that of the control experiment in which LeHSP23.8 was replaced by lysozyme (Fig. 3A). In another experiment, recombinant LeHSP23.8 protected CS from thermal inactivation and also promoted the renaturation of thermally inactivated CS. The loss of CS activity was relatively slow when CS was incubated with recombinant LeHSP23.8 at 38°C. After one hour of incubation at 38°C, the remaining activity of CS was 39%, which was two-fold that of the control experiment with lysozyme. Furthermore, when the incubation temperature was shifted to 22°C, rapid renaturation of thermal-denatured CS was observed within 10 minutes, and 90% of CS activity was recovered (Fig. 3B).

Further studies on transgenic tobacco flowers will lead to a better understanding of the role of MT-sHSP in the heat tolerance of plants.

(M. Shono)

TOPIC 2

A breeding index for improving the early growth of sugarcane

Sugarcane (*Saccharum* sp.) yield remains low compared to its photosynthetic ability. The slow growth of sugarcane at the early stages, taking three to sixth months until canopy close, is one of the primary reasons for this low productivity. A high percentage of sunlight is lost to the soil at this stage. In order to increase sunlight absorption, the rapid expansion of leaf area in sugarcane is considered highly necessary. The delayed expansion of leaf area is attributed to the slow growth of individual plants as well as low density planting in sugarcane crops. Analysis of sugarcane growth

at the early stage should be conducted with regard to plant growth as well as crop growth.

For the purpose of identifying the main reason for the slow growth of young sugarcane plants, the growth of sorghum (*Sorghum bicolor*) was compared to sugarcane during the early growth stages. The dry weight of the sorghum was five times greater than that of the sugarcane 48 days after emergence (Fig. 1), and it was concluded that a higher increasing rate of leaf area enabled rapid growth in the sorghum.

Leaf area increases due to several factors: photosynthetic ability, the partitioning of dry matter to leaf, and leaf expansion efficiency. The net assimilation rate (NAR) implies the same photosynthetic ability in both species. The higher dry matter percentage of leaves suggests that dry matter partitioning to leaves is higher in sugarcane. Specific leaf area (SLA) is approximately double in sorghum. As relative growth rate correlates to SLA (Fig. 2), the smaller SLA is one of the main reasons for the slow growth of sugarcane at the early stage.

Genetic diversity of SLA is observed as an aspect of sugarcane genetic resources (Fig. 3).

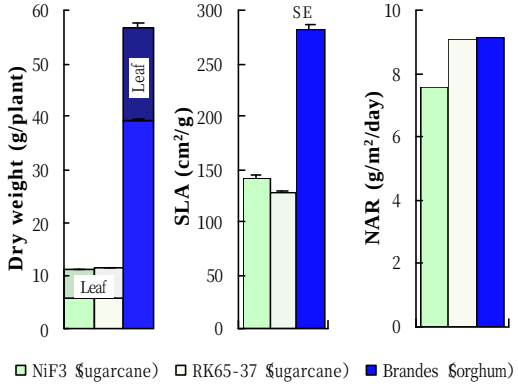


Fig. 1. Comparison of dry weight, specific leaf area (SLA) and net assimilation rate (NAR) between sugarcane and sorghum 48 days after emergence.

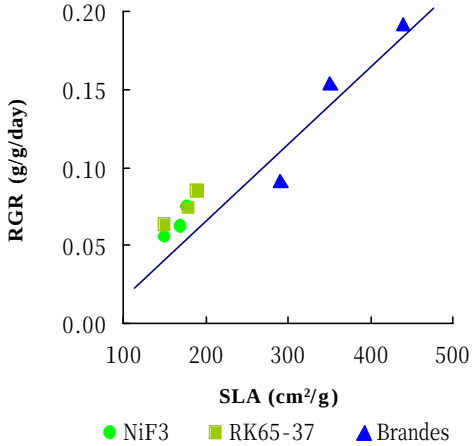


Fig. 2. Relationship between SLA and relative growth rate (RGR).

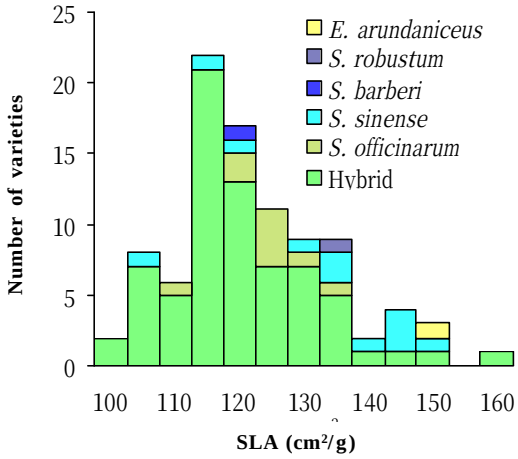


Fig. 3. SLA variation among sugarcane genetic resources.

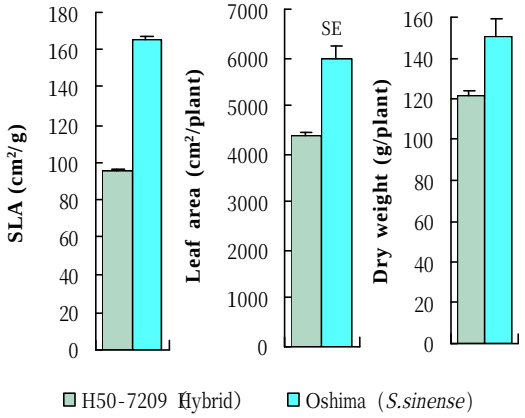


Fig. 4. Comparison of dry weight, leaf area and SLA among sugarcane varieties 84 days after emergence.

Some native clones including *S. sinense* are considered suitable for the breeding of varieties having greater SLA values. Even when compared to one of the rapid-growing commercial varieties, a native variety “Oshima” with greater SLA shows more rapid leaf area expansion and growth (Fig. 4). Therefore, SLA can be employed as an index for improving the early growth of sugarcane.

(T. Terauchi)

TOPIC 3

The relationship between the distribution of citrus psylla, the vector insect of citrus greening disease, and jasmine orange distribution

Asian citrus greening disease, or “huang long bing”, is the most significant obstacle to sustainable citrus production in tropical and subtropical Asian countries. The pathogen of this disease is a phloem-limited bacterium-like organism “*Candidatus* Liberibacter asiaticus”.

Diagnosis of this disease is very difficult for the following reasons: 1) one of the symptoms is very similar to that of zinc deficiency, 2) the pathogen has never been successfully cultured, and 3) infection by the pathogen is restricted to sieve tubes within the phloem tissue. However, it has become possible to detect the pathogen by amplifying 16S rDNA by PCR. The first detection of this disease in Japan was in 1988 on Iriomote Island, Okinawa. Subsequently, the disease spread throughout Okinawa prefecture with the exception of the Daito Islands.

The disease is transmitted by grafting or vector insects; therefore, controlling vector insects is an important step towards controlling the disease itself. The vector insect in this case is the Asian citrus psylla, *Diaphorina citri* (Fig. 1), which is distributed throughout tropical and subtropical Asia and has also been recorded on major islands among the southwest islands of Japan (Amami-Oshima, Okinawa-jima, Miyako-jima, Ishigaki-jima, and Iriomote-jima). *D. citri*

Fig. 1. Infection of adult *Diaphorina citri* on *Murraya paniculata.*

Fig. 2. *Murraya paniculata* "orange jasmine" planted as a hedge around a house.

has also invaded parts of Brazil and the United States. The host plants of *D. citri* are restricted to species belonging to the family Rutaceae. Among these species, *Murraya paniculata*, or "orange jasmine" (Fig. 2), and cultivated *Citrus* spp., especially *C. aurantifolia* "lime", are the most favored host plants.

A survey on the distribution of cultivated *Citrus* spp., *M. paniculata*, *D. citri*, and its parasitic natural enemies was conducted on the following islands within the southwest islands of Japan (Fig. 3): Yaku-shima, Tokara-Nakano-shima, Tokara-Takara-jima, Amami-Oshima, Tokuno-shima, Okinoerabu-jima, Okinawa-jima, Kita-Daito-jima, Minami-Daito-jima, Kume-jima, Miyako-jima, Ishigaki-jima, Kohama-jima, Kuro-shima, Hateruma-jima, and Yonaguni-jima. *Citrus* spp. were found on all the islands investigated; however, *M. paniculata* and *D. citri* were found only on the islands located

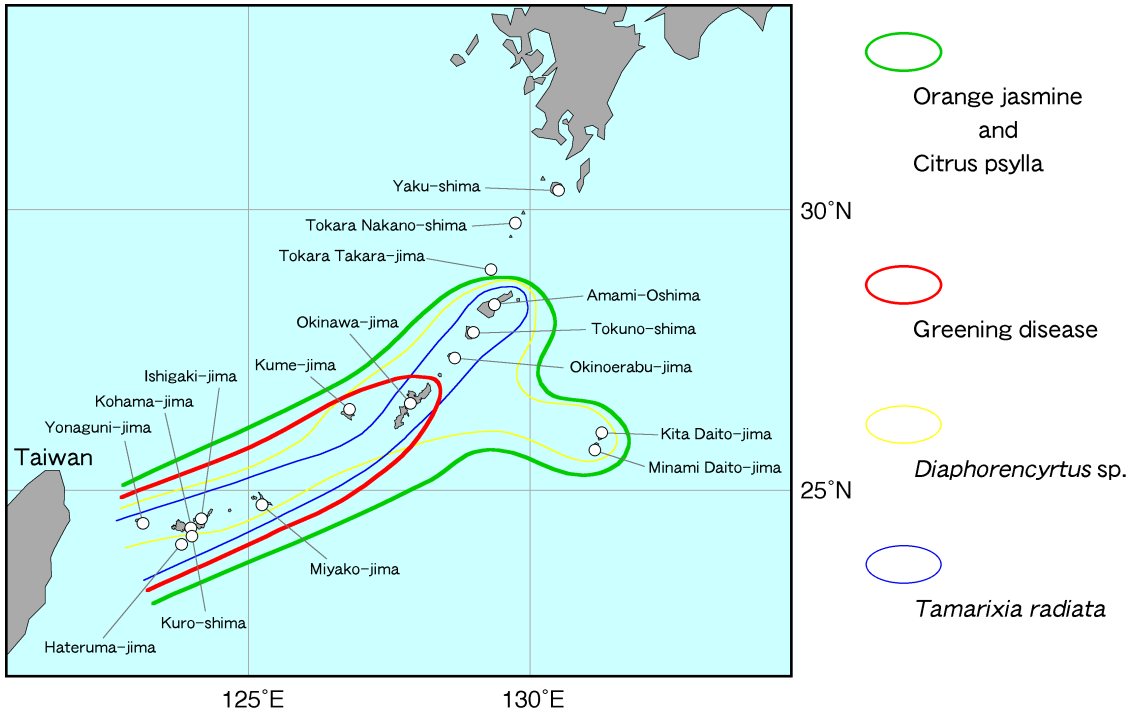


Fig. 3. Distribution of *Murraya paniculata* "orange jasmine", *Diaphorina citri* "citrus psylla", citrus greening disease "huang long bing", and two wasps parasitizing *D. citri* (*Diaphorencyrtus* sp. and *Tamarixia radiata*) on Okinawa.

south of Amami-Oshima. On the islands where the distribution of *D. citri* was confirmed, at least one of the two species of parasitic natural enemies (an encyrtid wasp *Diaphorencyrtus* sp. and an eulophid wasp *Tamarixia radiata*) was found. Distribution of parasitic natural enemies represents the continuous occurrence of the host in the area. Therefore, it is concluded that *D. citri* maintains a continuous presence on the islands south of Amami-Oshima.

In conclusion, the most intensive efforts to prevent invasion by Asian citrus greening disease should be implemented in areas where *D. citri* is distributed, even if the disease has not yet been detected at the present time.

(K. Kohno)

TOPIC 4

Ecological characteristics of *Antilochus coqueberti*, a special natural predator of cotton stainers

Cotton is the world's most important natural fiber material. One of the major obstacles hindering cotton production is insect pest infestation; in particular, cotton stainers (*Dysdercus* spp.; Heteroptera: Pyrrhocoridae) are difficult to control by insecticide application in cotton fields because they are highly mobile and have many alternative host plants. A pyrrhocoid bug *Antilochus coqueberti* (Heteroptera: Pyrrhocoridae) was presupposed to prey upon cotton stainers, but there had been no precise study on its ecological characteristics. In this study, the food preferences and ecological characteristics of *A. coqueberti* were investigated in order to elucidate its validity as a biological control agent against cotton stainers.

A. coqueberti adults and nymphs prey upon two species of cotton stainers (*D. cingulatus* and *D. decussates*) in the fields of Ishigaki-jima Island. Laboratory experiments showed that *A. coqueberti* also preys upon all the pyrrhocorids (*D. poecilus*, *D. philippinus*, *D. mesiostigma*, *D. solenis* and *Armatillus* sp.) and alydids (*Riptortus clavatus* and *Daclera levana*). However, lygaeids (*Oncopeltus nigriceps*, *Spilostethus hospess*, *Graptostethus servus* and *Thunbergia sanguinaria*), largids (*Physopelta cincticollis* and *P. gutta*), coreids (*Dasynus coccocinctus*), and rhoparids (*Leptocoris augur* and *L. rufomarginatus*) are not preyed upon by *A. coqueberti*, although all of these species bear considerable visual resemblance to cotton stainers.

Fig. 1. *Antilochus coqueberti* in copulation preying on *Dysdercus cingulatus*.

Developmental periods from oviposition to adult emergence of *A. coqueberti* fed with *D. cingulatus* under 14L-10D day length at 20°C, 22.5°C, 25°C, 27.5°C, and 30°C were 87.1±1.4 days (mean ±SE), 62.3±0.4 days, 49.3±0.5 days, 41.9±0.5 days, and 35.5±0.7 days, respectively. Based on these values, developmental zero and the effective cumulative temperature from oviposition to adult emergence were estimated to be 12.8°C and 606.1 day-degrees, respectively.

Female *A. coqueberti* laid eggs 10 to 183 days after emergence under 25°C and 14L-10D day length. The preovipositional period was 10.7±0.7 days (mean ±SE). The number of ovipositions was 10.9±5.9 and the egg batch size was 55.2±15.5. Longevity was 97.2±56.9 days and the total number of eggs laid was 601.7±294.5. These values clearly reflect the high reproductive potential of this species.

Female *A. coqueberti* did not exhibit reproductive diapause even if they were reared under short day lengths (10L-14D). The nymphal developmental period and preovipositional period were shorter when compared to those under long day lengths (14L-10D).

The results detailed above how that, as a special natural predator, *A. coqueberti* is a promising biological control agent against cotton stainers, and its utilization should be highly recommended when this species is artificially reared.

(K. Kohno)

TOPIC 5

Differences among rice cultivars in CH_4 emission and populations of rhizospheric methanotrophic bacteria at the rice ripening stage

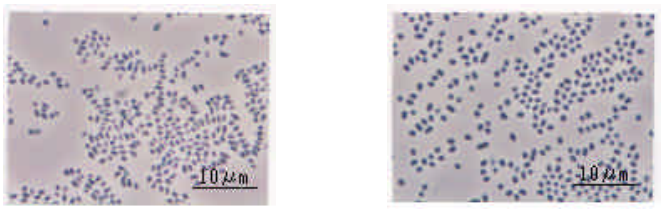
Methane is one of the most significant greenhouse gases related to global warming, and

its concentration in the atmosphere is increasing at a rate of approximately 1% per year. In lowland rice cultivation, rice plants grow under flooded conditions and CH_4 is emitted from the fields. Controlling CH_4 emissions from paddy fields is expected to contribute to the mitigation of global warming. Methanotrophic bacteria are aerobic respiratory bacteria that can utilize CH_4 as their sole carbon and energy source for growth, making them important regulators of atmospheric CH_4 fluxes. In this project, the populations of methanotrophic bacteria in rice rhizosphere and soil in a subtropical paddy field were enumerated. Because CH_4 emissions in field and pot experiments increased from the rice heading to the rice ripening stages, the differences among three rice cultivars (Chiyonishiki, Japonica rice; IR72, Indica rice; and IR65598, tropical Japonica rice) in terms of CH_4 emission, CH_4 oxidative activity in roots, and rhizospheric methanotrophic population at the ripening stage were investigated.

Methanotrophic bacteria in the genus *Methylosinus* (Fig. 1) were isolated from rice rhizospheres in a subtropical paddy field on Ishigaki Island in Okinawa Prefecture. (light clay soil; alluvial origin). Fig. 2 shows fluctuations in population levels of methanotrophic bacteria in rice rhizospheres and soil with and without rice straw application at 4 and 10 t/ha. At the rice heading to ripening stages, the methanotrophic populations in rice rhizospheres increased to about 10^5/g dry matter, whereas the populations in soil concurrently declined to $3x10^3$/g dry soil. Table 1 shows that CH_4 emission rate for IR65598 was significantly lower than in the other two cultivars at the ripening stage, while its CH_4 oxidative activity in roots was the highest among the three cultivars. Furthermore, the methanotrophic population in roots in IR65598 was significantly higher than in the other two cultivars at the ripening stage.

From this study, it was concluded that methanotrophic bacteria *Methylosinus* spp. inhabited rice rhizospheres in the subtropical fields used in the trial, and it was also found that CH_4 emission rates and methanotrophic populations in roots differed significantly among rice cultivars at the rice ripening stage.

(K. Adachi and K. Nakamura)



a b

Fig. 1. Photomicrographs of methanotrophic bacteria *Methylosinus* spp. isolated from rice rhizospheres in a subtropical paddy field. a: strain R16; b: strain R18. The bar indicates 10 μm.

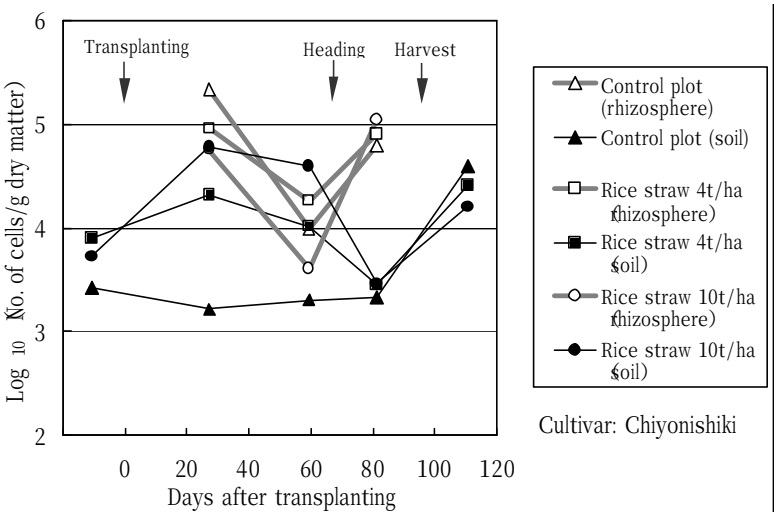


Fig. 2. Fluctuations in population levels of methanotrophic bacteria in rice rhizospheres and soil with and without rice straw application at 4 and 10 t/ha in a subtropical paddy field.

Table 1. CH_4 emission rate, CH_4 oxidative activity and methanotrophic population levels in roots, and root dry weight of three rice cultivars at the rice ripening stage (pot experiment, 1 plant/pot).

Cultivar	CH_4 emission rate (mg pot^{-1} h^{-1})	CH_4 oxidative activity (CH_4 oxidized μg g^{-1} root d^{-1})	Methanotrophic population level in roots (No. g^{-1} dry roots)	Root dry weight (g $plant^{-1}$)
Chiyonishiki	1.78±0.52 a	13.9±2.5 a	4.2×10^6 b	2.23±0.43 b
IR72	2.25±0.46 a	11.1±3.4 b	4.5×10^6 b	3.63±0.54 a
IR65598	0.66±0.25 b	16.0±3.7 a	6.5×10^7 a	3.06±0.84 ab

Values are means of 3 replicates ± SD (standard deviation). Data in columns indicated by the same letters are not significantly different.

MISCELLANEOUS PROJECTS OUTLINE

In addition to international collaborative projects, JIRCAS conducts a variety of miscellaneous projects including domestic projects in cooperation with other MAFF-affiliated independent administrative institutions, commissioned research, primarily in cooperation with universities, cross-ministry projects currently involving the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Environment, and special allotment projects.

DOMESTIC PROJECTS

In close cooperation with related research in organizations, JIRCAS conducts domestic research at its main premises in Tsukuba and at its Okinawa Subtropical Station in an effort to support its international collaborative projects.

JIRCAS further enhances its comprehensive projects through its Tsukuba and Okinawa research fellowship programs in which foreign researchers from JIRCAS counterpart organizations are invited to carry out studies which support ongoing collaborative projects abroad. In addition, these programs also promote positive relationships between JIRCAS and foreign institutions and facilitate future exchanges of individual research staff. JIRCAS domestic research has produced a variety of significant results, especially in the areas of drought-resistant crop development and world food supply and demand analysis. By focusing on fields where it can bring its strengths in research management and coordination to bear, JIRCAS is able to effectively utilize its limited budget and personnel in resolving critical agricultural and food supply problems in developing countries. Current domestic research focuses on: 1) world food supply analysis; 2) development of sustainable agriculture; 3) technology development for the utilization of animal resources; 4) crop tolerance to low temperatures, drought, and blight; 5) circulation of nitrogen in soil; 6) the utilization of remote sensing technology for evaluating environmental resources; 7) technology for the preservation and utilization of environmental resources; 8) evaluation of foodstuff quality in developing countries; and 9) cultivation and practical application of fisheries resources.

In Fiscal Year 2001, JIRCAS supported nearly 20 special in-house projects in order to further promote basic studies related to the above-mentioned research themes and supplement international collaborative research projects. These topics were selected within JIRCAS on a competitive basis. Other domestic projects are listed below.

JIRCAS International Research Career Network
(Research Planning and Coordination Division, 2001-2005)

Molecular analysis of stress response and tolerance to low temperature in plants
(Biological Resources Division, 1998-2007)

Development of screening methods for resistance to *Fusarium* head blight and integration of resistance genes using molecular markers in wheat
(Biological Resources Division, 1999-2001)

Monitoring of expression patterns of rice genes under drought, high-salt and cold stress conditions using cDNA microarrays
(Biological Resources Division, 1999-2003)

Improvement of abiotic environmental stress tolerance in transgenic model crops
(Biological Resources Division, 1999-2005)

Development of DNA markers for screening tolerance to *Fusarium* toxins in wheat
(Biological Resources Division, 2000-2001)

Supporting capacity building in developing countries and biotechnology applications
(Biological Resources Division, 2001-2005)

Exploration, isolation and identification of endophytic nitrogen-fixing bacteria
(Animal Production and Grassland Division and Crop Production and Environment Division, 1999-2001)

Development of a world forest products model for analysis of the effects of tariff liberalization
(Forestry Division and Development Research Division, 2000-2002)

Effective application of nitrogen in sugarcane production
(Okinawa Subtropical Station, 1998-2002)

Studies on the control of citrus psylla, the vector insect of citrus greening disease
(Okinawa Subtropical Station, 1999-2001)

Rapid generation advance breeding in order to shorten the wheat breeding cycle
(Okinawa Subtropical Station, 1999-2001)

Development of technology for the enhancement of nutraceuticals in fruit
(Okinawa Subtropical Station, 2000-2004)

Primary characterization of rice genetic resources
(Okinawa Subtropical Station, 2000-2005)

Development of trench cultivation to protect vegetables and fruit trees against heat, drought and typhoons
(Okinawa Subtropical Station, 2001-2003)

Rapid generation advance breeding of rice with adaptability to direct seeding and combined tolerance
(Okinawa Subtropical Station, 2001-2004)

Development of technology for advancing generation time in fruit trees: Study on differentiation-promoting effects of subtropical environment on fruit tree flower buds
(Okinawa Subtropical Station, 2001-2004)

Evaluation and utilization of sugarcane genetic resources
(Okinawa Subtropical Station, 2001-2005)

COMMISSIONED RESEARCH

Development of evaluation methods of environmental security and applications to Asian regions
(Development Research Division in cooperation with Kyoto University and the Association of International Research Initiatives for Environmental Studies, 1999-2001)

Application of inter-specific hybrids for stable rice production in West Africa: Evaluation of potential properties of African rice (*Oryza glaberrima*) using chromosome substitution lines
(Biological Resources Division in cooperation with Kyushu University, 2001-2003)

Function of water channel proteins and morphological formation of roots under water stress conditions
(Biological Resources Division in cooperation with Okayama University, 2001)

Creation of DNA markers closely linked to resistance genes against disease and pests in soybeans
(Animal Production and Grassland Division in cooperation with Chiba University under the project entitled "Comprehensive studies on soybean improvement, production and utilization in South America", 2000-2002)

RESEARCH PROJECTS WITH OTHER GOVERNMENT MINISTRIES

In cooperation with the Ministry of Education, Culture, Sports, Science and Technology

Combining advanced climatological weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems in West Africa
(Development Research Division, 2000-2002)

Use of biotechnology in developing regions in order to stabilize agricultural production and fisheries resources
(Biological Resources Division and Fisheries Division, 2001-2005)

In cooperation with the Ministry of Environment

Development of an evaluation method of environmental security and its application in Asian regions
(Development Research Division, 1999-2001)

Development of a logging system having low impact on forest ecosystems
(Forestry Division, 1999-2001)

In cooperation with the Bio-oriented Technology Research Advancement Institution (BRAIN)

Development of transgenic crops tolerant to environmental stresses
(Biological Resources Division, 2000-2004)

Study on regulation of gene expression and signal transduction pathways regulated by a plant hormone ABA (abscisic acid) and its application to biotechnology
(Biological Resources Division, 2001-2005)

Physiological and genetic studies of heat-tolerance of crops and development of tolerant crops
(Okinawa Subtropical Station, 1998-2002)

MAFF SPECIAL RESEARCH ALLOTMENTS

Physio-genetic studies on yield determination and ecological adaptability for sustainable agriculture
(JIRCAS in cooperation with the International Rice Research Institute (IRRI), 1999-2003)

Physiological and ecological studies for the development of IPM for economically important pests in Africa
(JIRCAS in cooperation with the International Centre of Insect Physiology and Ecology (ICIPE), 2000-2004)

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 strengthening international research ties among scientists and administrators in other countries. Current programs are described in greater detail below.

1) Administrative Invitation

Under the Administrative Invitation program, JIRCAS invites administrators from counterpart organizations to the Tsukuba premises to engage in discussions and to review ongoing research in order to ensure that collaborative projects run smoothly. In addition, the program exposes administrators to current activities at JIRCAS and other MAFF-affiliated Independent Administrative Institutions (IAIs). 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 cooperation. Fifty-six individual visits to JIRCAS were made during FY 2001 under the Administrative Invitation program, including eight invitations to the International Symposium. Invited administrators and their home institutions are listed below.

FY2001		
Barry Ira Shapiro	Program Director International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Mali	July 10-13, 2001
Nguyen Minh Chau	Director General Southern Fruit Research Institute (SOFRI) Ministry of Agriculture and Rural Development Vietnam	July 10-21, 2001
Aliou Diagne	Impact Assessment Economist Rice Policy and Development Program West Africa Rice Development Association (WARDA) Côte d'Ivoire	July 11-16, 2001
Frederic Lançon	Acting Program Leader Rice Policy and Development Program West Africa Rice Development Association (WARDA) Côte d'Ivoire	July 11-13, 2001
Victor Manyong	Agricultural Economist International Institute for Tropical Agriculture (IITA) Congo	July 11-16, 2001
Mo Fang	Professor China Agricultural University People's Republic of China	July 26-Aug. 6, 2001
Somchart Soponronnarit	Professor King Mongkut's University of Technology Thonburi Thailand	Aug. 26-31, 2001

Dr. Duong Van Chin	Head Multiple Cropping Department Cuu Long Delta Rice Research Institute (CLRRI) Vietnam	Sept. 12-21, 2001
Peter C. Kerridge	Program Coordinator CIAT-Asia International Tropical Agriculture Center Laos	Nov. 10-18, 2001
Alfredo Lattanzi	Director INTA EEA Marcos Juarez Argentina	Nov. 11-16, 2001
Luis Alberto Salines	Researcher INTA EEA Marcos Juarez Argentina	Nov. 11-16, 2001
Silvia D. de Vallone	Researcher INTA EEA Marcos Juarez Argentina	Nov. 11-16, 2001
Adrian Palacios Morinigo	Chief Agronomy Section Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Carlos Alberto Chavez Pereita	Chief Soybean Breeding Section Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Fabio Centrion Molas	Researcher Japan International Cooperation Agency (JICA) Center for Agricultural Technology in Paraguay (CETAPAR) Paraguay	Nov. 12-15, 2001
Itamar Pereira de Oliveira	Researcher National Center for Rice and Bean Research Brazilian Agricultural Research Corporation (EMBRAPA)	Nov. 12-15, 2001
Javier Szostak	Brazil Researcher Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Kei Shimizu	Researcher INTA EEA Marcos Juarez Argentina	Nov. 12-15, 2001

Ken Hoshiba	Researcher Japan International Cooperation Agency (JICA) Center for Agricultural Technology in Paraguay (CETAPAR) Paraguay	Nov. 12-15, 2001
Manuel Claudio Motta Macedo	Researcher National Soybean Research Center Brazilian Agricultural Research Corporation (EMBRAPA) Brazil	Nov. 12-15, 2001
Masakazu Toyoda	JICA Expert Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Mirzawan P. D. Nurtjahjo	Chairman Sugarcane Breeding Group Indonesian Sugar Research Institute Indonesia	Nov. 12-22, 2001
Takao Shiozaki	JICA Expert Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Takehiko Tsuchiya	JICA Expert Regional Center for Agricultural Research (MAG-CRIA) Paraguay	Nov. 12-15, 2001
Yoshihiko Sugai	Reseacher National Soybean Research Center (CNPSo) EMBRAPA-Soja Brazil	Nov. 12-15, 2001
Yoshirou Seki	Researcher Japan International Cooperation Agency (JICA) Center for Agricultural Technology in Paraguay (CETAPAR) Paraguay	Nov. 12-15, 2001
Joao Alberto Bordignon	Director Nutrimental S.A. Ind.e Com. de Alimentos Brazil	Nov. 13-14, 2001
Greg Johnson	Research Program Manager Australian Centre for International Agricultural Research (ACIAR) Australia	Nov. 25-Dec. 1, 2001
Somchart Soponronnarit	Professor King Mongkut's University of Technology Thonburi Thailand	Nov. 25-Dec. 1, 2001

Warunee Varanyanond	Director Institute of Food Research and Product Development Kasetsart University Thailand	Nov. 25-Dec. 6, 2001
Auranuj Kongkanjana	Director Division of Entomology and Zoology Department of Agriculture (DOA) Thailand	Nov. 26- Dec. 7, 2001
Chaiyasit Aneksamphant	Deputy Director General Land Development Department (LDD) Ministry of Agriculture and Cooperatives Thailand	Nov. 26- Dec. 6, 2001
Aziz Azin Asandhi	Researcher Coordinator Research Institute for Vegetables Indonesia	Dec. 6-13, 2001
Abu Talib Bin Ahmad	Head Resource Section Fisheries Research Institute Malaysia	Jan. 17-26, 2002
Chong Ving Ching	Associate Professor University of Malaya Malaysia	Jan. 17-26, 2002
Dato' Hashim Bin Ahmad	Director General Department of Fisheries Ministry of Agriculture Malaysia	Jan. 17-26, 2002
Veloo Palanisamy	Head Fish Health Research Section Fisheries Research Institute Malaysia	Jan. 17-26, 2002
Arnil Cabading Emata	Section Head Breeding Section Aquaculture Department Southeast Asian Fisheries Development Center (SEAFDEC) The Philippines	Jan. 21-30, 2002
Aurelio Alfonso delos Reyes, Jr.	Scientist, Farming Systems and Ecology Section Aquaculture Department Southeast Asian Fisheries Development Center (SEAFDEC) The Philippines	Jan. 21-30, 2002
Chittima Aryuthaka	Associate Professor Kasetsart University Thailand	Jan. 21-30, 2002
Prathak Tabthipwon	Vice Dean Kasetsart University Thailand	Jan. 21-30, 2002

Huang Shuolin	Vice-President Shanghai Fisheries University People's Republic of China	Jan. 24-31, 2002
Abou Berthe	Chef du Programme Systemes de Production/Gestion de Resources Naturelles, Institut d'Économie Rurale (IER), Centre Regional de Récherche Agricole (CRRA) de Sotuba Mali	Feb. 27- Mar. 16, 2001
Ann Braun Wheatley	Facilitator Centro Internacional de Agricultura Tropical (CIAT) New Zealand	Feb. 27- Mar. 10, 2002
Peter Malcolm Horne	Agronomist and Team Leader Forages and Livestock Systems Project, Laos Centro Internacional de Agricultura Tropical (CIAT) Laos	Feb. 27-Mar. 10, 2002
Paiboon Pramojanee	Lecturer Institute of Industrial and Resource Technology Walailak University Thailand	Mar. 17-20, 2002
Sakon Ooraikul	Specialist Office of Agricultural Economics Ministry of Agriculture and Cooperatives Thailand	Mar. 17-20, 2002
Tawachai Na Nagara	Advisor Soil Science Division Department of Agriculture (DOA) Ministry of Agriculture and Cooperatives Thailand	Mar. 17-20, 2002

International Symposium invitees, FY 2001

David Molden	Research Leader International Water Management Institute (IWMI) Sri Lanka	Nov. 26-30, 2001
Rodomiro Ortiz	Director Crop Improvement Division International Institute of Tropical Agriculture (IITA) Nigeria	Nov. 26-30, 2001
Rony Wallach	Department of Soil and Water Sciences The Hebrew University Israel	Nov. 26-30, 2001
Peter Thorburn	Senior Research Scientist Commonwealth Scientific and Industrial Research Organisation (CSIRO) Sustainable Ecosystems Australia	Nov. 26-30, 2001

Ali A. Al-Jaloud	Professor Natural Resources and Environment Research Institute, King Abdulaziz City for Science and Technology (KASCT) Saudi Arabia	Nov. 26-30, 2001
Paivit Watanavitawas	Director International Training Center for Agricultural Development (ICTDA), Department of Agriculture (DOA) Thailand	Nov. 26-Dec. 12, 2001
Pichai Wichaidit	Director Land Development Department (LDD) Ministry of Agriculture and Cooperatives Thailand	Nov. 26-30, 2001
Tran Thuong Tuan	Rector Cantho University Vietnam	Nov. 26-30, 2001

2) Counterpart Researcher Invitation

The Counterpart Researcher Invitation Program provides invitations for periods of up to six months to researchers engaged in collaborative work with members of the JIRCAS research staff. Counterparts conduct in-depth research at JIRCAS, at other MAFF-affiliated Independent Administrative Institutions (IAIs), 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. Twenty-eight researchers were invited under the Counterpart Researcher Invitation program during FY 2001. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

FY 2001		
At Japan International Research Center for Agricultural Sciences, May 22-Nov. 21, 2001		
Chu Haiyan	Institute of Soil Science Chinese Academy of Sciences People's Republic of China	A study on microbial processes of nitrogen cycling in upland soils
At Japan International Research Center for Agricultural Sciences, June 2-Sept. 1, 2001		
Lidia Margarita Pedrozo Fleitas	Department of Plant Pathology Instituto Agronomico Nacional Paraguay	Suppressive effects of antagonistic plants and Pateuria penetrans on root-knot nematodes
At Japan International Research Center for Agricultural Sciences, June 4-Aug. 7, 2001		
Yu Xiufang	Institution of Animal Nutrition Jilin Academy of Agricultural Sciences People's Republic of China	Improvement of nutritional values and preparation of corn stover silage
At Japan International Research Center for Agricultural Sciences, July 3-Sept. 28, 2001		
Joko Sulistyo	Research and Development Center for Biology Indonesian Institute of Science Indonesia	Development of a pure culture starter for Kecap using a white-spored mutant of koji mold

At Japan International Research Center for Agricultural Sciences and National Institute of Agricultural Sciences, Aug. 1-Oct. 19, 2001		
Duong Minh	Cantho University Vietnam	Development of new detection method for *Fusarium* (fruit trees) using molecular techniques
At Japan International Research Center for Agricultural Sciences and National Institute of Crop Science, Aug. 20-Sept. 29, 2001		
Norman Neumaier	National Soybean Research Center (CNPSo) EMBRAPA Soybean Brazil	Effect of drought stress on green stem syndrome (GS) in soybean through translocation of photosynthate to grain
At Japan International Research Center for Agricultural Sciences and Integrated Research for Agriculture, Aug. 26-Sept. 21, 2001		
Somkiet Prachayawarakorn	King Mongkut's University of Technology Thonburi Thailand	Development of paddy drying techniques with low input energy and material in Thailand
At Japan International Research Center for Agricultural Sciences, Aug. 28-Nov. 16, 2001		
Tran Thi Thanh Hien	Aquaculture and Fisheries Science Institute Cantho University Vietnam	Improvement of freshwater prawn seed production technology and elucidation of necessary nutritional factors
At Japan International Research Center for Agricultural Sciences, Sept. 1-30, 2001		
Qu Boaoxiang	Institute of Natural Resources and Regional Planning Chinese Academy of Agricultural Sciences People's Republic of China	Study on main factors affecting food consumption patterns and trend in major regions
At Japan International Research Center for Agricultural Sciences and National Agricultural Research Center, Sept. 3-Oct. 6, 2001		
José Tadashi Yorinori	National Center for Beef Cattle Research Brazilian Agricultural Research Corporation (EMBRAPA) Brazil	Comparative study on epidemiology and search for genetic resistance and crop management for control of soybean diseases in Japan and Brazil
At Japan International Research Center for Agricultural Sciences and National Institute of Crop Science, Sept. 18-Nov. 13, 2001		
Ketsuda Dejbhimon	Agricultural Development Research Center Khon Kaen University Thailand	A study on inhibitory effects of leguminous crop on the growth of succeeding maize
At Japan International Research Center for Agricultural Sciences and National Institute of Livestock and Grassland Science, Sept.18-Nov. 16, 2001		
Rumphrai Narmsrilee	Khon Kaen Animal Nutrition Research Center (KANRC) Thailand	Mineral composition of agricultural by-products and its availability
At Japan International Research Center for Agricultural Sciences and National Institute of Crop Science, Sept. 25-Dec. 14, 2001		
Sofyan Ritung	Center for Soil and Agroclimate Research and Development (CSARD) Indonesia	Analysis of land degradation parameters in the sloping area using remote sensing and GIS

At Japan International Research Center for Agricultural Sciences and National Food Research Institute, Sept. 26-Dec. 21, 2001		
Porntip Visarathanonth	Division of Entomology and Zoology Department of Agriculture (DOA) Thailand	Ecology and mass production of natural enemies of stored-product insect pests
At Japan International Research Center for Agricultural Sciences, Sept. 26-Dec. 14, 2001		
Yang Peng	Institute of Natural Resources and Regional Planning Chinese Academy of Agricultural Sciences People's Republic of China	Analysis of land use changes in suburban areas using remote sensing
At Japan International Research Center for Agricultural Sciences and the National Agricultural Research Center for Western Region, Oct. 2-Dec. 26, 2001		
Yang Guangyu	Soybean Institute of China Jilin Academy of Agricultural Sciences People's Republic of China	Development of technology improving soybean processing aptitude using soybean mutation
At Japan International Research Center for Agricultural Sciences, Oct. 8-Dec. 20, 2001		
Rattana Sanoh	Soil Science Division Department of Agriculture (DOA) Thailand	Transformation of soil carbon in the processes of organic matter decomposition in upland soil in Thailand
At Japan International Research Center for Agricultural Sciences, Oct. 8-Dec. 20, 2001		
Praphai Itsara	Soil Science Division Department of Agriculture (DOA) Thailand	Genetic ecology for endophytic nitrogen-fixing bacteria isolated from sugarcane and pineapple
At Japan International Research Center for Agricultural Sciences and National Institute of Livestock and Grassland Science, Oct. 8-Nov. 20, 2001		
Taweesak Chuenpreecha	Khon Kaen Animal Nutrition Research Center (KANRC) Thailand	Studies on the utilization and preservation of small round bale silage of the forage
At Japan International Research Center for Agricultural Sciences, Oct. 24-Dec. 27, 2001		
Marie-Noel Ndjionjop	West Africa Rice Development Association (WARDA) Côte d'Ivoire	Development of marker assisted selection system for rice breeding in Africa
At Japan International Research Center for Agricultural Sciences, Nov. 5-Dec. 21, 2001		
Gassinee Trkoontivakorn	Institute of Food Research and Product Development Kasetsart University Thailand	Prevention of stored insect pests using natural products
At Japan International Research Center for Agricultural Sciences, Nov. 5-Dec. 12, 2001		
Somsak Sukchan	Land Development Department (LDD) Thailand	Analysis and evaluation of physical factors for sustainable agricultural systems
At Japan International Research Center for Agricultural Sciences, Nov. 7-Dec. 20, 2001		
Abdoulaye Yorote	Institut d'Économie Rurale (IER), Centre Regional de Récherche Agricole (CRRA) de Sotuba Mali	Farmer reasons for crop and production practice choices in reponse to climatic variability

At Japan International Research Center for Agricultural Sciences, Nov. 19-Dec. 19, 2001		
Kitiya Kitkuandee	Rice Research Institute Department of Agriculture (DOA) Thailand	Identification of causes of quality changes during rice storage
At Japan International Research Center for Agricultural Sciences, Nov. 19-Dec. 21, 2001		
Wu Wen	Research Center for Rural Economy Ministry of Agriculture People's Republic of China	Development of a mathematical method to reflect changes in national agriculture and rural structure
At Japan International Research Center for Agricultural Sciences, Nov. 19, 2001-Feb. 6, 2002		
Yinghong Qu	Shanghai Fisheries University People's Republic of China	Fish meat binding technology
At Japan International Research Center for Agricultural Sciences, Jan. 16-March 28, 2002		
Zeng Da Li	China National Rice Research Institute (CNRRI) People's Republic of China	QTL analysis and mapping of sheath blight resistance in rice
At Japan International Research Center for Agricultural Sciences and National Institute of Vegetables and Tea Science, Jan. 28-Feb. 29, 2002		
Etti Purwati	Research Institute for Vegetables (RSV) Indonesia	Inoculation method for disease resistance in tomato and eggplant seedlings

3) JIRCAS Visiting Research Fellowship Program at Okinawa

The Okinawa Visiting Research Fellowship Program was initiated in FY 1992, prior to the reorganization of the Tropical Agricultural Research Center (TARC) into JIRCAS. The program invites post-doctoral scientists to conduct research for a period of one year at the Okinawa Subtropical Station. Researchers must focus on important topics relating to tropical agriculture in developing countries within one of several broad categories: development of techniques for environmental control utilizing plants and microorganisms specific to the tropics and subtropics, studies on heat-tolerance mechanisms in tropical and subtropical crops, identification and evaluation of salt-tolerant crops, or evaluation and development of long-term conservation techniques of genetic resources of vegetatively propagated crops in the tropics and subtropics. Ten fellows are chosen each year, beginning their terms on October 1 and ending on September 30 of the following year. Recent invitees and their research activities are summarized below.

More information on the Okinawa Visiting Research Fellowship Program can be obtained by contacting the International Relations Section, Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, Japan. (Tel.:+81-298-38-6335; Fax:+81-298-38-6337; e-mail:irs@jircas.affrc.go.jp).

Okinawa Fellows in 2001 pose for group photograph.

from October 2000 to September 2001

Khalilur Rhaman	University of Dhaka Bangladesh	Subsurface drip irrigation of some vegetable crops
Le Van Hoa	Cantho University Vietnam	Physiological and biochemical studies on aluminum-resistant pineapple

Abudul Awal Howlader	Bangladesh Agricultural Research Institute Bangladesh	Molecular mechanism of biosynthesis and metabolism of metabolites related to heat tolerance of crops
Jalal Ud Din	Land Resources Research Institute Pakistan	Physiological, biochemical and molecular basis of heat tolerance in transgenic tomato (MT-sHSP) at the reproductive growth stage
Vijay Kumar Yadav	Rajasthan Agricultural University India	Cloning of salinity gene(s) in *E. coli* and their characterization
Arifin N. Sugiharto	Brawijaya University Indonesia	Cloning of useful genes and transformation in sugarcane
Liu Xiaochuan	China National Rice Research Institute (CNRRI) People's Republic of China	Comparison of salt-tolerance QTLs in different RI populations of rice (*Oryza sativa* L.)
Lawrence M. Aboagye	Plant Genetic Resources Center Ghana	Characterization and evaluation of factors for early growth in sugarcane
Liu Yunxia	Institute of Biological Control People's Republic of China	Development of a regeneration system of sweet potato for utilizing anthocyanin transcriptional activator genes
Jiang Ling	Huazhong Agricultural Institute People's Republic of China	Development of genetic transformation techniques in papaya plants

from October 2001 to September 2002

Nur Ahmed Khondaker	Bangladesh Agricultural Research Council Bangladesh	Maximizing water use efficiency by micro-irrigation at different irrigation depths and with different amounts of water
Wan Abdullah Wan Yusoff	Malaysia Agricultural Research and Development Institute Malaysia	Evaluation of soil erosion and nutrient flux in Ishigaki Island
Tarlan Mamedov	Azerbaijan Academy of Sciences Azerbaijan	Characterization of heat tolerance in transgenic tobacco (ER-sHSP)
Sabaruddin Zakaria	Syiah Kuala University Indonesia	Pollen tube growth and accumulation of reserve substances under high temperature stress in snap bean
Mohamed Koronfel	Cairo University Egypt	Genetic engineering of salt tolerance in rice plants
Arifin Noor Sugiharto	Brawijaya University Indonesia	Development of transformation methods and suitable tissue culture procedures for generating a high survival rate among sugarcane regenerants
Yunxia Liu	Chinese Academy of Agricultural Sciences People's Republic of China	Differential screening of anthocyanin transcriptional activator genes of sweet potato
Muchdar Soedarjo	Research Institute for Legume and Tuber Crops Indonesia	Cloning of anthocyanin transcriptional activator genes from cDNA library of sweet potato

Jiang Ling	Huazhong Agriculture University People's Republic of China	Development of genetic transformation technique in papaya plant
Bui Thi Ngan	Cotton Research Center Vietnam	Evaluation and utilization of a natural predator, *Antilochus coqueberti*, against the cotton stainer

4) JIRCAS Visiting Research Fellowship Program at Tsukuba

A program similar to the Okinawa Visiting Research Fellowship Program has been implemented on the 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. Until September, 2001, eight researchers has been invited annually under the program. Four researchers engaged in two-year projects (long-term) at JIRCAS and four researchers conducted short five-month projects (short-term) at the National Institute of Agrobiological Sciences (NIAS). For the period, October 2001 to September 2002, however, some changes were initiated in the long-term invitation program. The two-year term was shortened to a one-year term and the number of invitees was increased to five. Starting from October 2002, a total of 10 researchers will be invited under the one-year term program and four researchers under the short-term program. Recent invitees and their research activities are listed below.

More information on the Tsukuba Visiting Research Fellowship Program can be obtained by contacting the International Relations Section, Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, Japan. (Tel.: +81-298-38-6335; Fax: +81-298-38-6337; e-mail: irs@jircas.affrc.go.jp).

Host scientist and Tsukuba Fellow engaged in experiment on endophytic organisms in the Animal Production and Grassland Division.

Long-term at JIRCAS from October 1999 to September 2001

Malik A. Rabbani	National Agricultural Research Center Pakistan	Identification and molecular characterization of osmotic stress-inducible genes in rice (*Oryza sativa* L.)
Yin Changbin	Natural Resources and Regional Planning (NRRP), CAAS People's Republic of China	Projection of the regional food situation in an underdeveloped area in China - A case study of Guinhou Province
Najeeb S. Alzoreky	Sana'a University Yemen	Biological activities of indigenous edible plants of some Asian countries
Jose R. Bordignon	National Soybean Research Center (CNPSo) EMBRAPA Soybean Brazil	Changes in quality factors during lactic acid fermentation of soymilk

Long-term at JIRCAS from October 2000 to September 2002

Donghe Xu	Tianjin Agricultural Academy of Sciences People's Republic of China	Mapping of resistance genes to *Fusarium* head blight (FBH) in wheat
Nguyen Van Dong	Agricultural Genetics Institute Vietnam	Molecular analysis of regulation gene expression under abiotic stress conditions in rice

Nguyen Thi Thu Huong	Institute of Chemical Technology Vietnam	Quality analysis and evaluation of food resources for better use
Subbarao V. Guntur	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India	Physiological studies on nitrification inhibition and nitrogen absorption in *Brachiaria humidicola*

Long-term at JIRCAS from October 2001 to September 2002

Ketut Wikantika	Bandung Institute of Technology Indonesia	Diversification of vegetable type mapping in mountainous areas using remote sensing and GIS data
Lam-Son Phan Tran	Nara Institute of Science and Technology, Japan (from Vietnam)	Functional analysis of drought-inducible genes for transcription factors containing an NAC DNA binding domain
Pan, Xin	Chinese Academy of Sciences People's Republic of China	Physiological mechanisms of nutrient acquisition by crops from low-fertility tropical soils
Rowena H. Oane	International Rice Research Institute (IRRI) The Philippines	Studies on the ecology and physiology of endophytic microorganisms (nitrogen-fixing bacteria and chitinase-producing bacteria) in plants
Molay Kumar Roy	Ehime University, Japan (from Bangladesh)	Studies on the mechanism of apoptotic cell death induced by some dietary components in human cancer cell lines

Short-term at NIAR from October 2001 to March 2002

Muhamad Ayub Khan	National Agricultural Research Center Pakistan	Analysis of the relationship between bruchid resistance and mungbean seed protein
Zong Xuxiao	Institute of Crop Germplasm Resources People's Republic of China	Analysis of genetic diversity in the *Vigna angularis* complex and related species in East Asia
Nguyen Van Hau	National Institute of Animal Husbandry Vietnam	Study on methods for evaluation and characterization of Vietnamese pig genetic resources using DNA markers
Edna Y. Ardales	University of the Philippines at Los Banos The Philippines	Characterization of the *aur Bs2* gene homolog in *Xanthomonas oryzae* pv. *oryzae*

5) Other fellowships for visiting scientists

The Government of Japan sponsors a post-doctoral fellowship program for both Japanese and foreign scientists through the Japan Society for the Promotion of Science (JSPS). This fellowship program, which was formerly administered by the Science and Technology Agency (STA), was transferred to the Japan Society for the Promotion of Science (JSPS) on April 1, 2001 (FY 2001). The program places post-doctoral and sabbatical fellows in national research institutes throughout Japan according to research theme and prior arrangement with a host scientist for a term of generally one month to three years. Fellowships can be undertaken in any of the ministries and many fellows are currently working at various independent administrative institutions affiliated to the Ministry of Agriculture, Forestry and Fisheries (MAFF). In 2001, the following visiting scientists resided at JIRCAS: Dr. Vidya Jayasankar (India), Fisheries Division; Dr. Safiah Jasmani (Malaysia), Fisheries Division; Dr. Hua Xu (People's Republic of China), Crop Production and Environment Division; Dr. Dennis S. Simpson (United Kingdom), Biological Resources Division; and Dr. Najeeb S. Alzoreky (India), Food Science and Technology Division.

In addition, eight Japanese fellows, Dr. T. Furihata, Biological Resources Division; Dr. H. Abe, Biological Resources Division; Dr. Y. Ito, Biological Resources Division; Dr. Y. Keike, Biological Resources Division; Dr. Y. Fujita, Biological Resources Division; Dr. T. Watanabe, Crop Production and Environment Division; Dr. K. Suzuki, Development Research Division; and Dr. C. Oguchi, Crop Production and Environment Division, also conducted research at JIRCAS.

SYMPOSIA AND WORKSHOPS

1) INTERNATIONAL SYMPOSIA

Between 1967 and 1993, the Tropical Agriculture Research Center (TARC), JIRCAS's predecessor, sponsored annual international symposia in order to promote scientific exchange while accurately gauging and responding to agriculture, forestry and fisheries needs of the world's developing regions. Since its transition from TARC, JIRCAS has continued this practice. At present, each year's JIRCAS International Symposium is organized around themes of central importance to international agricultural research.

Appropriately, the 8th JIRCAS International Symposium, held in November 2001, focused on "Water for Sustainable Agriculture in Developing Regions", and the program appears below.

8th JIRCAS International Symposium
WATER FOR SUSTAINABLE AGRICULTURE IN DEVELOPING REGIONS – *More crop for every scarce drop*
Held November 27-28, 2001, at the Tsukuba International Congress Center, "Epochal Tsukuba", in conjunction with the National Agricultural Research Center, the National Institute of Crop Science, the National Institute of Agrobiological Sciences, the National Institute for Agro-Environmental Sciences, the National Institute for Rural Engineering, and the Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries, Japan.

Opening address and welcoming remarks
- Inaugural address by Dr. Takahiro Inoue, President, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Welcoming remarks by Mr. Katsuyuki Nagayama, Research Councilor, Agriculture, Forestry and Fisheries Research Council Secretariat (AFFRC), Japan

Keynote addresses
- "Global water resources assessment and future projections" by Prof. Katsumi Mushiake, Institute of Industrial Science, University of Tokyo, Japan
- "Meeting the water needs for food and environmental security" by Dr. David Molden, International Water Management Institute (IWMI), Pakistan
- "Evolution and future directions of water use in agriculture" by Prof. Yoshihiro Kaida, Center for Southeast Asian Studies, Kyoto University, Japan

Session 1: Increasing drought resistance and water stress tolerance through ecological and genetic approaches
Chaired by Dr. Masa Iwanaga, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Reducing water stress through ecological approaches and crop characteristics. Prof. Shinobu Inanaga, Tottori University, Japan
- Development of drought-resistant and water-stress tolerant crops through traditional breeding. Dr. Rodomiro Ortiz, International Institute of Tropical Agriculture (IITA), Nigeria
- Development of drought-resistant and water stress-tolerant crops through biotechnology. Dr. Kazuko Yamaguchi-Shinozaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 2: Agronomic approaches for improved crop water use
Chaired by Dr. Osamu Ito, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Soil water availability and water use efficiency. Prof. Rony Wallach, The Hebrew University of Jerusalem, Israel
- Technologies for improved soil water use. Prof. Shuichi Hasegawa, Graduate School of Agriculture, Hokkaido University, Japan

- New water-saving production technologies: Advances in trickle irrigation. Dr. Peter J. Thorburn, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Sustainable Ecosystems, Australia

Session 3: Transforming agricultural production in water-stressed areas of developing regions
Chaired by Mr. Kazuyuki Tsurumi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Improving water availability and use in rainfed systems. Dr. Osamu Ito, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Improving effective water availability and use in rainfed cropping systems: Perspectives across Asia and Africa. Dr. John S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Optimal water management: Case study of the tank cascade system in Sri Lanka. Dr. Yoshiyuki Shinogi, National Institute for Rural Engineering (NIRE), Japan
- Utilization of water for rainfed agricultural areas in Northeast Thailand. Dr. Chayasit Aneksamphant, Land Development Department (LDD), Thailand
- Water management and crop production in semi-arid and arid environments: Successes from technical cooperation projects. Mr. Ryuzo Nishimaki, Japan International Cooperation Agency (JICA), Japan
- Crop production and management in semi-arid and arid environments. Prof. Ali A. Al-Jaloud, King Abdulaziz City for Science and Technology, Saudi Arabia
- Empowerment of farmers for sustainable farming in semi-arid and arid environments: Technical cooperation to enhance farmers' activities. Mr. Yoshiaki Kano, Tsukuba International Center, Japan International Cooperation Agency (JICA), Japan

Session 4: General discussion
Chaired by Dr. Yoshinori Morooka and Dr. John S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Summary of major themes and issues from each session
- JIRCAS's contributions and future directions
- Needs and contributions of partners
- Developing collaborative partnerships with public institutions, international research institutions, non-governmental organizations, and stakeholders

Closing remarks by Dr. David Molden, Research Leader, International Water Management Institute (IWMI), Pakistan

2) SPECIAL PROGRAMS

INTERNATIONAL WORKSHOP: "ECONOMIC ANALYSES OF AGRICULTURAL TECHNOLOGIES AND RURAL INSTITUTIONS IN WEST AFRICA: ACHIEVEMENTS, CHALLENGES AND APPLICATION TO RICE FARMING RESEARCH"

The international workshop entitled "Economic Analyses of Agricultural Technologies and Rural Institutions in West Africa", emphasizing rice farming research in the region, was held at JIRCAS's Tsukuba premises on July 12-13, 2001.

In 1998, JIRCAS initiated a collaborative research project with the West Africa Rice Development Association (WARDA). Rapid demographic expansion and urbanization in Africa have shifted food preferences from traditional foodstuffs to rice and bread, and the demand for rice in sub-Saharan Africa is growing faster than that for any other major food staple; these patterns are especially evident in West Africa. In collaboration with WARDA, JIRCAS is conducting an economic study which focuses mainly on rice farming in lowland regions of Côte d'Ivoire and Ghana. Factors such as land tenure management through local organizations, market access and access to capital through informal financial systems have been recognized as playing important roles in farmers' capacity to adopt and utilize improved technologies, including such developments as land improvement through investment in water control mechanisms, utilization of improved rice varieties, chemical inputs, and related cultural

practices. Furthermore, it has been observed that the systems by which individuals gain access to land and capital may be discriminatory toward an individual's social origin and gender. Therefore, the objective of this project is to assess how the institutional and economic environment affects farmers' capacity to effectively adopt new technology.

The significant value of economic analysis is clearly recognized in the field of agricultural research in developing countries. Its potential value is expected to be even greater for assessing the impact of technology systems as well as policies and institutions on the welfare of agricultural households and the regional economy. Session I of the workshop reviewed socio-economic research activities at institutes belonging to the Consultative Group on International Agricultural Research (CGIAR) and JIRCAS in West Africa; the role of economic analyses in the field of agricultural research were discussed. Session II focused on the rice farming-related research of the JIRCAS-WARDA project and details of the schemes and methodology of economic analysis were discussed. The workshop, attended by 53 participants, provided an excellent opportunity to discuss the role of economic studies in addressing problems related to agriculture and rural livelihood in West Africa. It was suggested that effective interaction between economic and technological studies based on a multi-disciplinary approach was essential for facilitating agricultural research and development in the region.

Opening address by Dr. Takahiro Inoue, President, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 1: The roles of economic analyses in the field of agricultural research in West Africa
Chaired by Dr. Yoshinori Morooka and Mr. Kazuyuki Tsurumi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Economic research on rice farming in West Africa at WARDA. F. Lançon, West Africa Rice Development Association (WARDA), Côte d'Ivoire
- The socio-economic determinants of in-situ conservation of biodiversity and the impact of modern varieties on rice biodiversity. A. Diagne, West Africa Rice Development Association (WARDA), Côte d'Ivoire
- Economic research at IITA for the improvement of agriculture in the sub-humid and humid zones of West Africa. V. Manyong, International Institute for Tropical Agriculture (IITA), Nigeria
- Improving rice production in mixed rainfed/irrigated production systems: livelihood strategies and bio-economic modeling. B. Shapiro, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Nigeria
- Economic research relating to JIRCAS's West Africa Rice Project. T. Sakurai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 2: Economic analyses: methodology and applications
Chaired by Prof. Keijiro Otsuka, Foundation for Advanced Studies on International Development, Japan

- Farm household surveys and micro-development economics. T. Kurosaki, Hitotsubashi University, Japan
- The effects of land tenure systems in lowlands on the adoption of water control technologies for rice production. T. Sakurai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- "Why is lowland rice cultivation not expanding in Ghana?" T. Tachibana, Hokkaido University, Japan

General discussion
Chaired by Dr. Masa Iwanaga, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, with three commentators: Prof. Y. Takamura, Kyoto University, Japan; Prof. H. Inaizumi, Tokyo University of Agriculture, Japan; and Dr. J.S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Closing address by Dr. Yoshinori Morooka, Vice-President, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

REGIONAL WORKSHOP: "VARIETAL RESISTANCE-BASED SUSTAINABLE INSECT PEST MANAGEMENT IN RICE"

JIRCAS and the Department of Agriculture, People's Republic of China launched the project entitled "Development of sustainable production and utilization of major food resources in China" on May 28, 1997 under a comprehensive agreement signed between the two parties. One of the primary research goals in this collaborative project is the development of environment-friendly technologies for sustainable crop pest management. The five-year research collaboration began at the China National Rice Research Institute (CNRRI) on August 20, 1997, upon the conclusion of a Memorandum of Understanding (MOU) between JIRCAS and CNRRI. This collaboration aims to develop "Varietal resistance-based sustainable integrated pest management in rice", focusing on the prevalence of the whitebacked planthopper (WBPH) in high-yielding paddy fields in China. The JIRCAS-CNRRI joint research group has thus far discovered an unusually high prevalence of WBPH in Chinese hybrid rice and has clarified new mechanisms of WBPH resistance in Chinese *japonica* rice. In order to further promote this ongoing collaboration, the project duration was extended to 2003 during the review meeting for the JIRCAS-China projects held in February 2001 at JIRCAS's Tsukuba premises.

Workshop on "Varietal Resistance-based Sustainable Insect Pest Management in Rice" held at the conference room of the China National Rice Research Institute (CNRRI). (Photo: G. Liu)

After the midterm review meeting, the JIRCAS-CNRRI Cooperative Unit organized a regional workshop entitled "Varietal resistance-based sustainable insect pest management in rice" to review and promote the ongoing project, as well as to strengthen the cooperation network of participating rice entomologists in China and neighboring countries. The workshop was held on October 29-30, 2001 at CNRRI, and 14 Chinese, 2 Vietnamese and 3 Japanese participants were invited to give presentations.

Opening address and welcoming remarks by Prof. Zhitao Zhang, Deputy Director, China National Rice Research Institute (CNRRI), People's Republic of China, and Dr. Osamu Ito, Director, Crop Production and Environment Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Introductory session

Chaired by Prof. Zhitao Zhang, China National Rice Research Institute (CNRRI), People's Republic of China

- Recent advances, salient problems and prospects of sustainable planthopper management based on varietal resistance. G. Liu, CNRRI & JIRCAS Cooperative Unit, China National Rice Research Institute (CNRRI), People's Republic of China
- JIRCAS-CNRRI cooperative research project on varietal resistance-based insect pest management for rice planthoppers: Review and prospects. K. Sogawa, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 1: Special characteristics of rice planthoppers

Chaired by Prof. Zhitao Zhang, China National Rice Research Institute (CNRRI), People's Republic of China

- Studies on monitoring of biotypes of the brown planthopper, *Nilaparvata lugens*, and its fluctuations in Zhejiang Province. X. Yu, Zhejiang Academy of Agricultural Sciences, People's Republic of China
- Genetic basis and environmental determination of wing dimorphism in the whitebacked planthopper. M. Matsumura, National Agricultural Research Center for Kyushu-Okinawa Region, Japan
- Changes in juvenile hormone titer and its relation to wing dimorphism and mating behavior of the brown planthopper, *Nilaparvata lugens*. H. Dai, X. Wu, S. Wu, Nanjing Agricultural University, People's Republic of China

- Electronic monitoring of feeding and oviposition behavior of the planthopper, and its application in plant resistance studies. M. Hattori, National Institute of Agro-Biological Sciences, Japan
- Effect of Bt rice on the population dynamics of rice planthoppers. G. Ye, Zhejiang University, People's Republic of China
- Mechanism for genetic and ecological homeostasis of the population of the yellow stem borer, *Scirpophara incertulus*, and a novel management strategy for population control. J. Hang, H. Guo, Jiangsu Academy of Agricultural Sciences, People's Republic of China

Session 2: Rice varieties and planthopper interactions

Chaired by Dr. Xiaoping Yu, Zhejiang Academy of Agricultural Sciences, People's Republic of China

- Resistance of different rice cultivars to the whitebacked planthopper, *Sogatella furcifera*, and its relationships to nutrient contents in rice plants. F. Liu, Yangzhou University, People's Republic of China
- Changes in virulence of the whitebacked planthopper, *Sogatella furcifera,* to rice varieties carrying the resistance genes *Wbph 2* and *Wbph 5*. J. Shen, G. Liu, K. Sogawa, CNRRI & JIRCAS Cooperative Unit, China National Rice Research Institute (CNRRI), People's Republic of China
- Quantitative genetic basis for the virulence shift of the brown planthopper, *Nilaparvata lugens*. Q. Fu, China National Rice Research Institute (CNRRI), People's Republic of China
- Studies on the tolerance and compensation of rice varieties to the brown planthopper infestation. J. Chen, Zhejiang Academy of Agricultural Sciences, People's Republic of China
- Intra- and inter-specific effects of *Sogatella furcifera* and *Nilaparvata lugens* on their population performance. W. Zao, J. Cheng, Y. Lou, Z. Zhu, Zhejiang University, People's Republic of China
- Role of volatile compounds in rice plant resistance to the brown planthopper. Y. Luo, Zhejiang University, People's Republic of China

Session 3: Hybrid rice and insect pest problems

Chaired by Prof. Huaguo Dai, Nanjing Agricultural University, People's Republic of China

- Changes in insect pest occurrence in relation to the shifting of rice varieties in the Red River Delta. H.P. Thinh, National Institute of Plant Protection, Vietnam
- Effects of changes in rice cultivars and cropping systems on the population dynamics of planthoppers and hybrid rice in Hubei. S. Shi, Hubei Station of Plant Protection, People's Republic of China
- Recent outbreak of the whitebacked planthopper and its management in the Red River Delta. D.V. Thanh, National Institute of Plant Protection, Vietnam
- Occurrence and management of major insect pests in hybrid rice in Sichuan Province. S. He, Sichuan Academy of Agricultural Sciences, People's Republic of China
- Occurrence and management of rice planthoppers in hybrid rice in Xiushan County, Chongqing. X. Xie, Xiushan Station of Plant Protection, People's Republic of China
- Population dynamics and causes of major insect pests in two line hybrid rice of Hunan. Z. Huang, Hunan Academy of Agricultural Sciences, People's Republic of China

General discussion

Chaired by Dr. Kazushige Sogawa, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Closing address by Dr. Guangjie Liu, CNRRI & JIRCAS Cooperative Unit, China National Rice Research Institute (CNRRI), People's Republic of China

WORKSHOP ON "MODELING WEATHER VARIABILITY AND REDUCING CROP PRODUCTION RISK IN MALI/WEST AFRICA"

In Fiscal Year 2000, JIRCAS launched a research project entitled "Combining advanced climatological weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems" in collaboration with research institutes in Mali. The outline of research results to date are detailed below. Rainfall isohyets have moved southward in Mali,

increasing crop production risk. In order to emphasize risk management research, reconnaissance surveys were conducted in nine villages, followed by focus group assessments and household surveys in two villages. The village of Niessoumana in the semi-arid 800 mm rainfall zone and the village of Diou in the southern semi-humid 1200 mm zone were selected based on ten criteria. The following extension typology based on animal traction was used for the focus groups: fully-equipped (A), sub-equipped (B), and non-equipped/manual (C/D). A second typology was generated from farmer group leaders' classification of farmers as more risk robust (A1, B1) or more risk vulnerable (A2, B2). A third typology was based on each farm household's self-assessment of risk robustness indicators from the focus groups: food self-sufficiency, cattle herd size and exterior remittances. The majority of farmers were sub-equipped (Diou, 75%; Niessoumana, 67%). Farmer groups leaders classified more sub-equipped farmers as less risk robust (B2) (Diou, 70%; Niessoumana, 68%). Self-assessment revealed greater risk robustness in the semi-humid zone than in the semi-arid zone. Only 4% of the A farmers and 0% of the B farmers had food deficits in Diou, while 37% of the A and 63% of the B farmers had food deficits of two to three months in Niessoumana.

In order to confirm these research results and to facilitate research activities, project workshops were held twice at JIRCAS's Tsukuba premises, in July and December 2001. Participants included not only those scientists directly involved with the projects in Japan and Mali, but also those generally concerned with rural development in West African countries.

July 2001 Workshop

Opening remarks by Mr. Kazuyuki Tsurumi, Director, Development Research Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Project overview and workshop objectives by Dr. John S. Caldwell, Development Research Coordinator, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- February and March surveys: site selection, land use, farm household selection and typology. J.S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Indigenous farmer weather indicators, weather monitoring, and rainfall modeling. H. Kanno, National Agricultural Research Center for the Tohoku Region, Japan
- Land use and risk management, Mali research plan and comparisons with neighboring West African countries. T. Sakurai, Development Research Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Upcoming research objectives and plans. J.S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

December 2001 Workshop

Opening remarks by Mr. Kazuyuki Tsurumi, Director, Development Research Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Workshop objectives by Dr. John S. Caldwell, Development Research Coordinator, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- Analysis of the Malian climate using upper air weather data. H. Kanno, National Agricultural Research Center for the Tohoku Region, Morioka, Iwate, Japan
- Division of the rainy season into period based on hourly rainfall patterns. K. Sasaki, National Agricultural Research Center for the Tohoku Region, Morioka, Iwate, Japan
- Spatial differences in rainfall timing and efficiency for agricultural production. A. Yorote, Institut d'Économie Rurale (IER), Sotuba, Bamako, Mali
- Effects of soil and toposequence factors on effective rainfall. K. Ozawa, Okinawa Subtropical Station, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

EMBRAPA SOYBEAN/JICA-CETAPAR/INTA-EEA/JIRCAS JOINT WORKSHOP ON SOYBEAN IMPROVEMENT, PRODUCTION AND UTILIZATION IN SOUTH AMERICA

The research project entitled "Comprehensive studies on soybean improvement, production and utilization in South America" has been in progress since 1997. This research project is focused on five primary subjects: genetics and breeding, soil management and pest control, crop management and production, postharvest technology, and socio-economic factors. The studies are being carried out by JIRCAS in collaboration with the National Soybean Research Center (EMBRAPA Soybean), the Agricultural Technology Center of Paraguay (JICA-CETAPAR), and the Marcos Juárez Agricultural Experiment Station (INTA-EEA). The main purpose of this workshop, held on November 13-14, 2001 at EMBRAPA Soybean's premises in Brazil, was to review the results obtained thus during the implementation of the project as well as other studies. The future strategy and orientation of the project were also discussed.

Opening address by Dr. Caio Vidor, Head, National Soybean Research Center (EMBRAPA Soybean), Brazil

Project introduction by Dr. Toshiaki Taniguchi,Director, Animal Production and Grassland Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 1: Soil and crop management

Chaired by Dr. Noriharu Ae, National Institute for Agro-Environmental Sciences (NIAES), Japan and Dr. Norman Neumaier, National Soybean Research Center (EMBRAPA Soybean), Brazil

- Sulfur and micronutrient supplying capacity of two Cerrado soils from Northeastern Brazil. K. Hitsuda, Japan International Research Center for Agricultural Sciences (JIRCAS)/National Soybean Research Center (EMBRAPA Soybean), Brazil
- Plant residues management for acid subsoil neutralization and calcium transport. M. Miyazawa, Agricultural Research Institute of Paraná (IAPAR), Brazil
- Soil management using intercropping system with soybean and pasture. I.P. de Oliveira, National Rice and Beans Research Center (EMBRAPA Rice and Beans), Brazil
- Development of high yielding super-nodulating soybean. J. Arihara, National Institute of Crop Science (NICS), Japan
- Agronomic, physiological and molecular characteristics of drought-tolerant Brazilian soybean cultivars. T. Oya, Japan International Research Center for Agricultural Sciences (JIRCAS)/ National Soybean Research Center (EMBRAPA Soybean), Brazil

Session 2: Pest control

Chaired by Dr. José Tadashi Yorinori, National Soybean Research Center (EMBRAPA Soybean), Brazil

- Current situation of soybean diseases in Argentina. S.D. de Vallone, Marcos Juárez Agricultural Experiment Station (INTA-EEA), Argentina

Participants in the workshop "Soybean improvement, production and utilization in South America" pose for group photograph. (Photo: T. Taniguchi)

- Evaluation method for resistance of soybean to sudden death syndrome. Y. Homma, Japan International Research Center for Agricultural Sciences (JIRCAS)/Marcos Juárez Agricultural Experiment Station (INTA-EEA), Argentina
- Survey of plant parasitic nematodes on soybean and pasture crops in Argentina, Brazil and Paraguay and its control (related control measures). F.C. Molas, Agricultural Technology Center of Paraguay (JICA-CETAPAR), Paraguay
- Current research for controlling soybean cyst nematode in Brazil. J.F.V. Silva, National Soybean Research Center (EMBRAPA Soybean), Brazil

Session 3: Breeding and postharvest technology
Chaired by Dr. Leones Alves de Almeida, National Soybean Research Center (EMBRAPA Soybean), Brazil and Dr. Mercedes C. Carrão Panizzi, National Soybean Research Center (EMBRAPA Soybean), Brazil

- Genetic improvement of soybean in Argentina. L.A. Salines, Marcos Juárez Agricultural Experiment Station (INTA-EEA), Argentina
- Genetic improvement of resistance to soybean cyst nematode in Brazil. C.A.A. Arias, National Soybean Research Center (EMBRAPA Soybean), Brazil
- Improvement of seed quality of soybean by genetic engineering. M. Ishimoto, National Agricultural Research Center for Western Region (NARCW), Japan
- Genetic improvement of chemical constituents of soybeans for human consumption in Brazil. A. Kikuchi, Japan International Research Center for Agricultural Sciences (JIRCAS)/National Soybean Research Center (EMBRAPA Soybean), Brazil
- Current and future demand for soybean food uses in Brazil. J.A. Bordignon, Nutrimental S.A. Indústria e Comércio de Alimentos, Brazil

WORKSHOP ON THE "STATUS OF POSTHARVEST LOSSES AND RELATED STUDIES IN THAILAND"

Prior to the mid-term evaluation meeting for the research project entitled "Development of low-input technology for reducing postharvest losses of staples in Southeast Asia", JIRCAS held a half-day workshop on the "Status of postharvest losses and related studies in Thailand" in Tsukuba on November 29, 2001. Project reviewers, Japan scientists and Thai counterparts participated in the workshop, which facilitated mutual understanding of the background and significance of the project.

Opening address by Dr. Takahiro Inoue, President, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- Control of pests in Thailand: Production technology and management of orchid cut flowers for exportation in Thailand. A. Kongkanjana, Department of Agriculture (DOA), Thailand
- Control of stored product insect pests in Thailand. P. Visarathanonth, Department of Agriculture (DOA), Thailand
- Prevention of stored product insect pests using natural products in Thailand. G. Trakoontivakorn, Institute of Food Research and Product Development, Kasetsart University, Thailand
- Quality evaluation of Thai rice. W. Varanyanond, Institute of Food Research and Product Development, Kasetsart University, Thailand
- Recent research and development work on paddy drying in Thailand. S. Soponronnarit, King Mongkut's University of Technology Thonburi, Thailand

WORKSHOP ON THE MANGROVE ESTUARY PHASE II PROJECT

On January 23-24, 2002, JIRCAS held a workshop and evaluation meeting for the international comprehensive project entitled "Studies on sustainable production systems of aquatic animals in brackish mangrove areas (Mangrove Estuary II)" in Tsukuba. The objectives of this project are to develop technologies for the protection and management of commercially valuable fish resources to ensure their sustainable production in brackish mangrove areas, to investigate the economic and environmental benefits resulting from the introduction of the new technologies, and to determine the conditions by which to disseminate them in brackish mangrove areas.

The main purpose of the workshop was to examine the future orientation of the project and to strengthen mutual cooperation between researchers through discussions concerning the overall research plan and first-year results.

At the workshop, Dr. Takahiro Inoue, President of JIRCAS, delivered the opening address, and the eight topics listed below were presented and discussed by participants including three evaluation committee members and eleven scientists invited from Thailand, Malaysia, the Philippines, and Japan, as well as 17 JIRCAS staff members.

-topics-

- Biological production of mangrove brackish waters in Southeast Asia. M. Maeda, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Fishing gear and methods in brackish mangrove areas of Peninsular Malaysia. Y. Ogawa, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Recruitment dynamics of fish larvae, with special reference to mangrove areas. C.V. Ching, University of Malaya, Malaysia
- Review on the present state of information on groupers (*Epinephelus* spp.) and snapper (*Lutjanus* spp.) resources in mangrove estuaries in Malaysia. A. Ahmad, Fisheries Research Institute, Malaysia
- Elucidation of the natural purification ability of mangrove forests and ecosystems. T. Shimoda, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Meiobenthic communities in a reforestation mangrove forest in Samut Songkhram Province, Thailand. C. Aryuthaka, Kasetsart University, Thailand
- The influence of broodstock nutrition on the reproductive performance and egg larval biochemical composition of mangrove red snapper, *Lutjanus argentimaculatus*, for its sustainable aquaculture production. A.C. Emata, Southeast Asian Fisheries Development Center (SEAFDEC), The Philippines
- Development of environment-friendly aquaculture technologies and practices. A.A. Reyes, Jr., Southeast Asian Fisheries Development Center (SEAFDEC), The Philippines

MID-TERM WORKSHOP ON THE DEVELOPMENT OF NEW TECHNOLOGIES AND THEIR PRACTICE FOR SUSTAINABLE FARMING SYSTEMS IN THE MEKONG DELTA (MEKONG II)

JIRCAS has conducted the Mekong Delta Project (Mekong II) since 1999, focusing on the establishment of technology to reuse and recycle by-products and wastes generated under VACR systems. VACR is a Vietnamese acronym standing for fruits and vegetables, aquaculture, livestock, and rice-farming systems. Collaborative relationships have been strengthened with Cantho University, the Cuu Long Delta Rice Research Institute (CLRRI), and the Southern Fruit Research Institute (SOFRI).

On November 27-29, 2001, CLRRI hosted a three-day workshop for the mid-term evaluation of the project. More than 100 participants joined the workshop, including members of Vietnamese local authorities (agricultural extension departments and representatives from Tan Phu Thanh Village, the project's on-farm trial site), faculty members

from Cantho University and researchers from CLRRI, and six Japanese participants.

After greetings from Dr. Bui Chi Buu, Director of CLRRI, an opening speech was delivered by Dr. Vo-tong Xuan, Director of the Mekong Delta Farming Systems Research and Development Institute. Fifty-five papers were presented in six workshop sessions. In Session H, "Discussion of future activities", participants exchanged views and opinions following reports by the chairpersons of each section and reached the conclusion that project resources should be concentrated on efficient rice management, prevention of pig disease, development of freshwater prawn culture integrated with rice cultivation, and fruit production, emphasizing the economic implications of each result. Concluding remarks were delivered by Dr. Kunihiko Kato, Executive Advisor of JIRCAS. On the last day of the workshop, all participants visited four on-farm trial sites in Tan Phu Thanh Village.

Session A: Technology development of rice production

Chaired by Dr. Pham Sy Tan, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

- Genotypic variability of salt tolerance in rice. N.T. Lang, T.H. Khai, D.G. Tien, B.T.D. Khuyeu, N.V. Tao, and B.C. Buu, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Optimum seed rate and row spacing in different crop management practices. T.Q. Khuong, T.N. Huan, and P.S. Tan, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Optimum nitrogen rate for high-yielding rice based on growth diagnosis during the wet season. T.T.N. Huan and P.S. Tan, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Effect of irrigation and drainage practices on rice yield under irrigated culture. P.S. Tan and T.Q. Khuong, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Lowland rice weeds in Vietnam. D.V. Chin, T.T.N. Son, and L.C. Kiet, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; K. Itoh, Japan National Institute for Agro-Environmental Sciences, Japan; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Effects of partial protection of four leave-stage rice on pest insect-natural enemy complexes and rice yield. L.M. Chau, T.T.M. Quyen, and P.G. Nam, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; T. Ngoc, the Sub-Plant Protection Department of Cantho Province, Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Analysis of rice pest constraint survey data in an intensive cultivation area in Tan Phu Thanh Village, Cantho Province. H.D. Din, N.D. Cuong, N.D. Tai, and P.V. Du, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Effects of organic biofertilizer on rice-soybean cropping systems. T. T. N. Son, V.V. Thu, L.H. Man, and D.V. Chin, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam
- Development of small dryers suitable for small farmers in remote areas. L.V. Banh and H.B. Quoc, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; K. Kobayashi, National Agricultural Research Center, Japan; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- On-farm trials of seeding and fertilizer application methods on directly-seeded rice. D. Dinh, P.S. Tan, T.V. Hien, D.V. Chin, L.M. Chau, and P.V. Du, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session B: Fruit production

Chaired by Dr. Pham Van Kim, Cantho University, Vietnam

- The second-year progress report on fruit tree production based on integrated pest management in the Mekong Delta. D. Minh, L.T. Sen, P.V. Kim, L.V. Dung, L.T. Liem, Cantho University, Vietnam; T.N. The, Crop Protection Station, Chau Thanh District, Cantho Province, Vietnam; and H. Hiraoka and H. Kobayashi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Screening citrus germplasm for salinity and flood tolerance. N.N. Chau and L.T.T. Hong, Southern Fruit Research Institute (SOFRI), Vietnam
- Effects of different cultural practices on water logging damage on fruit trees. V.T. Truyen, L.T.T. Hong, N.T.N. Truc, and N.T. Nhan, Southern Fruit Research Institute (SOFRI), Vietnam
- Effects of various parameters on PCR results in citrus. H.L. Bin and L.T.T. Hong, Southern Fruit Research Institute (SOFRI), Vietnam
- Insect pest management (IPM) in mango using the green ant as a key element in Tan Phu Thanh Village, Cantho Province. H.T. Du and P.T. Hao, Southern Fruit Research Institute (SOFRI), Vietnam
- IPM in citrus with an emphasis on Huanglongbin management in Tan Phu Thanh Village. T. Duc and P.T. Hao, Southern Fruit Research Institute (SOFRI), Vietnam
- Present status of citrus Huanglongbin disease in Tan Phu Thanh Village. N.T.N. Truc and L.T.T. Hong, Southern Fruit Research Institute (SOFRI), Vietnam
- Preliminary study on fruit cultivating practices – relationship to water logging damage in the Mekong Delta. V.T. Nguyen, Southern Fruit Research Institute (SOFRI), Vietnam
- Views on diversity of fruit crops distributed in the Mekong Delta and their characteristics affecting prices. H. Nesumi, National Institute of Fruit Tree Sciences, Japan

Session C: Livestock production

Chaired by Dr. Vo Van Son, Department of Animal Science, Vietnam and Dr. Tran Thi Phan, Veterinary Medicine Department, Cantho University, Vietnam

- Evaluation of diets containing water spinach for growing pigs. L.H. Manh, N.N.X. Dung and L.T. Men, Cantho University; R. Takada, Japanese Institute of Livestock and Grassland Sciences (NILGS), Japan; and S. Yamasaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Evaluation of water spinach and coconut meal diets for fattening pigs in Tan Phu Thanh Village. L.T. Men, V.V. Son, L.H. Manh, N.T. K. Khang, and T.P. Hao, Cantho University, Vietnam; and R. Takada, National Institute of Livestck and Grassland Sciences (NILGS), Japan
- Effects of coconut oil on performance and backfat thickness of Yorkshire fattening pigs. V.V. Son, L.H. Manh, L.T. Men, and B.P.T. Hang, Cantho University, Vietnam
- Isolation and comparison of *Salmonella* serotypes in domestic animals and water in Tan Phu Thanh Village. T.T. Phan, L.T.L. Khai, and C.B. Loc, Cantho University, Vietnam; H. Hayashidani, Tokyo University of Agriculture and Technology, Japan; M. Akiba and H. Itoh, National Institute of Animal Health (NIAH), Japan; and T. Watanabe and T. Taniguchi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Prevention and treatment of piglet diarrhea caused by bay enterobacteriacea in Tan Phu Thanh Village. L.T.L. Khai, N.D. Bao, T.T. Phan, and C.B. Loc, Cantho University (CTU), Vietnam
- Efficacy of Nevugon and Vimectin against swine fluke worms in Tan Phu Thanh Village. N.H. Hung, C.B. Loc, and D.T. Gia, Cantho University, Vietnam
- Prevalence of *Leptospira* in pigs in Tan Phu Thanh Village. H.T.V. Thu and T.C. Hieu, Cantho University, Vietnam

Session D: Aquaculture production

Chaired by Dr. Marcy N. Wilder, Japan International Research Center for Agricultural Studies (JIRCAS), Japan

- Characterization and pathogenicity studies on *Vibrio* bacteria isolated from freshwater prawn hatcheries. T.T.T. Hoa, Cantho University, Vietnam
- Culture of freshwater prawns in rice fields using hatchery-reared postlarvae in Tam Binh District, Vinh Long Province. T.N. Hai, T.T.T. Hien, D.H. Tam, V.T. Toan, N.T. Phuong, Cantho University, Vietnam; and M.N. Wilder, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- The effects of dietary rice bran levels on the growth and maturation of giant freshwater prawn. B.T.B. Hang, D.T. Yen, T.T.T. Hien, and V.T. Toan, Cantho University, Vietnam
- The effects of feeding diets containing various lipid sources on the performance of freshwater prawn broodstock. T.T.T. Hien, T.N. Hai, N.T. Phuong, B.T.B. Hang, and D.T. Yen, Cantho University, Vietnam

- Osmoregulation in the giant freshwater prawn. D.T.T. Huong, Cantho University, Vietnam; and M.N. Wilder, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Characterization and pathogenicity studies on *Vibrio* bacteria isolated from freshwater prawn hatcheries. D.T.H. Oanh, T.T.T. Hoa, and N.T. Phuong, Cantho University, Vietnam
- Rice freshwater prawn integrated culture in Tan Phu Thanh Village, Chau Thanh District, Cantho Province. N.T. Phuong, V.N. Son, V.T. Toan, T.T.T. Hien, and P.M. Duc, Cantho University, Vietnam
- Effects of dietary protein levels on the growth and survival rate of snakehead fish fingerlings. N.V. Trieu, D.N. Long, and L.M. Lan, Cantho University, Vietnam
- Seed production technology of snakeskin gouramy: Reproductive biology and induced spawning. L.N. Xuan, Q.T. Hung, D.N. Long, L.S. Trang, and N.V. Trieu, Cantho University, Vietnam
- On-farm trial on fish stocking density in plastic tanks under pig-fish integrated farming systems. L.M. Lan and D.N. Long, Cantho University, Vietnam; T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan; and D.T.H. Oanh, N.V. Lanh, and L.T.N. Thanh, Cantho University, Vietnam

Session E: Development of technology for environmental conservation

Chaired by Dr. Ngo Ngoc Hung, Senior Lecturer of the Soil Department, Cantho University

- Development of plastic biogas digester technology in integrated farming systems. V. Lam, Cantho University, Vietnam
- Improvement of soil fertility by rice straw manure. L.H. Man and V.T. Khang, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- On-farm trial of rice straw manure application in Tan Phu Thanh Village. N.N. De and N.T. Liem, Cantho University, Vietnam; L.H. Man, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; and T. Watanabe and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Nitrogen flow estimation in Cantho Province. T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Clarification of nitrogen flow in fishponds under the pig-fish integrated farming systems. T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan; D.N. Long, Cantho University, Vietnam; and L.M. Lan, D.T.H. Oanh, N.V. Lanhand, and L.T.N. Thanh, Cantho University, Vietnam

Session F: Farming Systems

Chaired by Dr. Vo-tong Xuan, Visiting Professor, Center for Southeast Asian Studies, Kyoto University, Japan

- Delineation and characterization of physical conditions of on-farm trial sites in alluvial soil areas. V.Q. Minh and L.Q. Tri, Cantho University, Vietnam; and R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Land evaluation and land use planning of on-farm trial sites in alluvial soil areas. L.Q. Tri and V.Q. Minh, Cantho University, Vietnam; and R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Changes in household economy at on-farm trial sites. L.C. Dung, Cantho University, Vietnam
- Agricultural resource management of on-farm trial site households – Case study in Tan Phu Thanh Village, Chau Thanh District, Cantho Province. N.Q. Tuyen, V.V. Tuan, and L.C. Dung, Cantho University, Vietnam; and R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Interim evaluation of on-farm trial technology based on farmers' concepts. R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan; and N.Q. Tuyen, L.C. Dung, V.V. Tuan, and V.V. Ha, Cantho University, Vietnam
- Technology adoption at the on-farm trial site. L.C. Dung and N.Q. Tuyen, Cantho University, Vietnam; R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan; and V.V. Tuan, V.V. Ha, L.T. Giang, and P.C. Huu, Cantho University, Vietnam.
- Farming systems and farm economy at on-farm trial sites – Omon District, Cantho Province. N.X. Lai, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam; R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan; and L.Q. Long and

N.D. Loc, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

- Problem identification in rice culture using the TN-Method: Step 1 – Omon District, Cantho Province. R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of sustainable farming systems in acid sulphate soil areas: Farm management. N.T. Binh, Cantho University, Vietnam
- Specifications of the rice market in the Mekong Delta. N.P. Son, N.V. Thach, N.T.C. Chi, T.P. Hung, and N.D. Loc, Cantho University; and R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Specifications of the fruit market in the Mekong Delta. N.P. Son, N.V. Thach, N.T.C. Chi, and T.P. Hung, Cantho University, Vietnam
- Specifications of the fish market in the Mekong Delta. N.P. Son, Cantho University, Vietnam

Session H: Discussion of future activities

Chaired by Dr. Bui Chi Buu, Deputy Director, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam and Dr. Tetsushi Hidaka, Development Research Coordinator, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

WORKSHOP ON IMPROVING AGRICULTURAL PRODUCTIVITY THROUGH LOCAL RESOURCE UTILIZATION AND TECHNOLOGY DEVELOPMENT IN NORTHEAST THAILAND

Since 1995, the governments of the Kingdom of Thailand and Japan have conducted a collaborative research project entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand". This project consists of two sub-phases, a "fundamental research" sub-phase and a "constructive research" sub-phase. In the first sub-phase, carried out from 1995 to 1998, "fundamental research" was conducted in six areas: environmental resources, biological resources, crop production, livestock production, postharvest technologies, and socio-economic conditions in rural areas. In the second sub-phase, "constructive research" was carried out from 1999 to 2002 to integrate crop and livestock production and to evaluate the potential applicability of technologies developed in the project's first sub-phase. The ultimate research goal of the project is to propose sustainable agricultural systems which are applicable to local conditions. Prior to completion of the project, a workshop was held in Khon Kaen, Thailand, from February 6-7, 2002 to present major research highlights. Emphasis was placed on the integration of each research component into the final output, which is the comprehensive plan for developing sustainable agricultural systems in the region. The workshop was jointly held with collaborative research organizations such as the Thai Department of Agriculture (DOA), Land Development Department (LDD), Department of Livestock Development (DLD), Khon Kaen University, and the International Training Center for Agricultural Development (ITCAD), and received 66 participants from Thailand as well as 21 from Japan.

Participants in the workshop on "Agricultural productivity in Northeast Thailand" pose for a group photograph.

Introductory session

Chaired by Mr. Kazuyuki Tsurumi, Director, Development Research Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Opening address by Dr. Yoshinori Morooka, Vice-President, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Greeting address by Mr. Suthep Limthongkul, Deputy Directory General, Department of Agriculture (DOA), Thailand
- Outline of the JIRCAS project by Dr. Osamu Ito, Director, Crop Production and Environment Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 1: Evaluation of environmental and biological resources in Northeast Thailand

-Animal and feed resources-

Chaired by Mr. Supachai Udchachon, Director, Pak Chong Animal Nutrition Research Center (PCANRC), Department of Livestock Development (DLD), Thailand

- Energy and nitrogen metabolism in lactating cows fed with Cavalcade, rice straw and corn silage as roughage. M. Odai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Nutritive values of Ruzi grass and Verano stylo as tropical forages. R. Narmsilee, Khon Kaen Animal Nutrition Research Center (KKANRC) Department of Livestock Development (DLD), Thailand
- Nutritive values of Purple guinea grass and Thapra stylo as tropical forages. W. Sumamal, Khon Kaen Animal Nutrition Research Center (KKANRC), Department of Livestock Development (DLD), Thailand

-Nutrient utilization-

Chaired by Dr. Sukwat Chanthrapanik, Director, Soil Science Divison, Division of Agriculture (DOA), Thailand

- Nitrogen cycles and nutrient balance in agro-ecosystems in Northeast Thailand. N. Matsumoto, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Utilization of organic resources in cassava farming in Northeast Thailand. K. Paisancharoen, Soil Science Division, Department of Agriculture (DOA), Thailand

Session 2: Development of agricultural production technologies and socio-economic evaluation

-Soil conservative upland cropping systems-

Chaired by Mr. Panya Ekmahachai, Director, Khon Kaen Field Crops Research Center (KKFCRC), Department of Agriculture (DOA), Thailand

- Prevalent practices and contract works in sugarcane cropping of Northeast Thailand. C. Wongwiwatchai, Khon Kaen Field Crops Research Center (KKFCRC), Department of Agriculture (DOA), Thailand
- Development of an alternative tillage system for soil conservation and for increasing productivity. K. Matsuo, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Present conditions and improvement of upland farm management – Focusing on sugarcane production. M. Ando, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-Water efficient lowland cropping-

Chaired by Mr. Prasop Virakornphanich, Director, International Training Center for Agricultural Development (ITCAD), Department of Agriculture (DOA), Thailand

- Development of sustainable crop production technologies. N. Kabaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of no-tillage direct seeding cultivation of rice. U. Arromratana, Soil and Science Division, Department of Agriculture (DOA), Thailand
- Crop management in direct seeding of rice by T. Wungkahart, International Training Center for Agricultural Development (ITCAD), Department of Agriculture (DOA), Thailand

-Development of silage for cattle feed-

Chaired by Mr. Somchit Indramanee, Director, Khon Kaen Animal Nutrition Research Center (KKANRC), Department of Livestock Development (DLD), Thailand

- Performances of fattening Holstein bulls fed with bagasse silages. M. Odai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Utilization and preservation of small round wrapping silage on tropical forages. T. Chuenpreecha, Khon Kaen Animal Nutrition Research Center (KKANRC), Department of Livestock Development (DLD), Thailand

Session 3: Evaluation of integrated farming systems

-Crop/animal integrated farming systems-

Chaired by Mr. Pichai Wichaidit, Director, Soil Survey and Classification Division, Land Development Department (LDD), Thailand

- Yielding performance of three forages under cattle feces application. K. Matsuo, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Nitrogen excretion in feces and urine of Holstein dairy cattle. M. Odai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Nutrient cycle in crop/animal integrated farming systems. N. Matsumoto, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Feed management and significance of storage roughage for the dry season in dairy farming. M. Ando, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session 4: General discussion and synthesis of major project achievements

Chaired by Mr. Kazuyuki Tsurumi, Director, Development Research Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Closing remarks by Dr. Prasop Virakornphanich, Acting Director, International Training Center for Agricultural Development (ITCAD), Thailand

3) INTERNATIONAL RESEARCH WORKSHOPS

Attended jointly by JIRCAS researchers and foreign invitees, these workshops aim to facilitate discussion regarding the numerous collaborative research projects that JIRCAS is currently undertaking with counterpart institutions throughout the world.

July 12-13, 2001	Workshop on the West Africa Project: Economic analysis of agricultural technologies and rural institutions in West Africa: Achievement, challenges, and application to rice farming research. Tsukuba, Japan *Attended by representatives of JIRCAS, Japan; West Africa Rice Development Association (WARDA), Côte d'Ivoire*
July 18, 2001	Project workshop on combining advanced climatological weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems in West Africa. Tsukuba, Japan *Attended by representatives of JIRCAS, National Agricultural Research Center for Tohoku Region, Japan*
October 18-19, 2001	Workshop on the China Project: Beijing 2001 Sino-Japan Symposium on Remote Sensing and GIS for Agricultural Applications. Beijing, China *Attended by representatives of JIRCAS, Japan; Institute of Natural Resources and Regional Planning, Research Center for Rural Economy, China Agricultural University, People's Republic of China*
October 29-30, 2001	Workshop on the China Project: Varietal resistance-based sustainable insect pest management in rice. Hangzhou, China *Attended by representatives of JIRCAS, Japan; China National Rice Research Institute (CNRRI), People's Republic of China*

November 27-28, 2001	Workshop on the Mekong Delta (Phase II) Project : 2001 Annual Workshop of JIRCAS Mekong Delta Project: Development of new technologies and their practice for sustainable farming systems in the Mekong Delta. Cantho, Vietnam *Attended by representatives of JIRCAS, Japan; Cuu Long Delta Rice Research Institute (CLRRI), Cantho University, and the Southern Fruit Research Institute, (SOFRI), Vietnam*
November 29, 2001	Workshop on the Postharvest Loss Project: Status and studies on postharvest loss in Thailand. Tsukuba, Japan *Attended by representatives of JIRCAS, Japan; Kasetsart University, King Mongkut's University of Technology Thonburi, and the Department of Agriculture (DOA), Thailand*
December 13-14, 2001	Workshop on the Soybeans in South America Project: Soybean improvement, production and utilization in South America. Brazil *Attended by representatives of JIRCAS, Japan; Ministry of Agriculture and Livestock (MAG), JICA-Agricultural Technology Center in Paraguay (CETAPAR), Paraguay; National Center for Soybean Research and National Center for Beef Cattle Research, Brazilian Agricultural Research Corporation (EMBRAPA), Brazil; and Marcos Juarez Agricultural Experiment Station, the National Institute for Agricultural Technology (INTA), Argentina*
December 17, 2001	Project workshop on combining advanced climatological weather modeling and farmer knowledge for risk reduction in cereal-based cropping systems in West Africa. Tsukuba, Japan *Attended by representatives of JIRCAS, National Agricultural Research Center for Tohoku Region, Japan; Institut d'Économic Rurale (IER), Mali*
January 23, 2002	Workshop on the Brackish Mangrove Areas Project: Studies on sustainable production systems of aquatic animals in brackish mangrove areas. Tsukuba, Japan *Attended by representatives of JIRCAS, Japan; The Southeast Asian Fisheries Development Center (SEAFDEC), The Philippines; Fisheries Research Institute (FRI) and Malaysia University, Malaysia; Faculty of Fisheries, Kasetsart University, Thailand*
February 6-7, 2002	Workshop on the Northeast Thailand Project: I. Evaluation of environmental and biological resources in the Northeast Thailand. II. Development of agricultural production technologies and socio-economical evaluation. III. Evaluation of integrated farming systems. Khon Kaen, Thailand *Attended by representatives of JIRCAS, Japan; Department of Agriculture (DOA), Khon Kaen Animal Nutritional Research Center, Department of Livestock Development (DLD), Land Development Department (LDD), Asian Institute of Technology, and Khon Kaen University, Thailand*
March 5-7, 2002	Workshop on the China Project: 5th Planning workshop on evaluation and development of methods for sustainable agriculture and environmental conservation. Beijing, China *Attended by representatives of JIRCAS, Japan; Soil and Fertilizer Institute (CAAS), Institute of Soil Science (CAS), People's Republic of China*

4) INTERNATIONAL RESEARCH SEMINARS

International research seminars are held throughout the year, either on JIRCAS premises or overseas. During these seminars, foreign guests give presentations on topics of importance related to international agricultural research. The following fifteen seminars were held in FY 2001.

May 18, 2001	Recent situation and future course of IRRI partnership. *W.G. Padolina*
July 3, 2001	Managing water resources to ensure food and environmental security. *F. Rijsberman*
July 11, 2001	Fruit production in Vietnam. *N. M. Chau*
July 26, 2001	Development of feed technology from corn stalks and leaves in China. *M. Fang*
July 27, 2001	Wheat breeding and related research activities in CIMMYT. S. Rajaram
August 17, 2001	Agriculture and the developing world - challenges for today and tomorrow. *F. J. B. Reifschneider*
September 25, 2001	Development of pure culture starter for kecap using a white-spored mutant of koji mold. *J. Sulistyo*
November 19, 2001	Sugarcane genetic resources in Indonesia. *M.P. D. Nurtjahjo*
December 11, 2001	Environment-conservation technology in vegetable production in Indonesia. *A. A. Asandhi*
December 18, 2001	Soil nitrogen form in upland soil mixed with organic matter in Northeast Thailand. *R. Sanoh*
January 25, 2002	Determination of grain quality QTLs in durum (*Triticum turgidum* L. var. Durum). *I. Elouafi*
January 25, 2002	Present state and prospects of fishery policy and management in China. *H. Shuolin*
January 28, 2002	World agroforestry: The way ahead. *D. Garrity*
February 5, 2002	The effect of food additives on binding properties and organoleptic characteristics of silver carp mince. *Y. Qu*
March 19, 2002	Recent research activity of ILRI and its research strategy in Asia. *C. Sere*

5) JIRCAS RETURN SEMINARS

At JIRCAS, researchers returning from overseas dispatches or research projects give an oral presentation accompanied by a written summary of activities that is distributed to JIRCAS staff. These sessions are termed “JIRCAS Return Seminars” and are held during the interim or upon the completion of research projects or dispatch assignments. Such seminars are ordinarily held twice per month, and each year approximately thirty scientists give presentations.

PUBLISHING AT JIRCAS

OFFICIAL JIRCAS PUBLICATIONS

In English

1) JIRCAS Journal for Scientific Papers	No. 10
2) JARQ (Japan Agricultural Research Quarterly)	Vol. 35-No. 2, No. 3, No. 4 Vol. 36-No. 1
3) Annual Report	No. 7 (2000)
4) JIRCAS Newsletter	No. 27, No. 28, No. 29, No. 30
5) JIRCAS International Symposium Series	No. 9 Agricultural Technology Research for Sustainable Development in Developing regions
6) JIRCAS Working Report Series	No. 23 Genetic Engineering of Crop Plants for Abiotic Stress

In Japanese

1) JIRCAS News	No. 26, No. 27, No. 28, No. 29
2)JIRCAS Working Report Series	No. 21 Trend in Farm Household Economy under the Tanzania Kilimanjaro Agricultural Development Project No. 22 *Oryza glaberrima* genetic resources: Evaluation and use
3) JIRCAS International Agriculture Series	No.11 An Illustrated Guide to Tropical Fruits
4) JIRCAS Research Highlights	No. 8

LIBRARY HOLDINGS

April 1, 2001 – March 31, 2002

	Books			Periodicals (titles)			Materials (Proceedings, maps and other)		
Language	Purchase	Gift	Total	Purchase	Gift	Total	Purchase	Gift	Total
Japanese	289 (33)	10 (0)	299 (33)	42 (28)	493 (36)	535 (64)	17	246	263
Foreign	79 (10)	3 (0)	82 (10)	97 (28)	227 (22)	324 (50)	9	184	193
Total	368 (43)	13 (0)	381 (43)	139 (56)	720 (58)	859 (114)	26	430	456

( ) Indicates separate holdings of the Okinawa Subtropical Station

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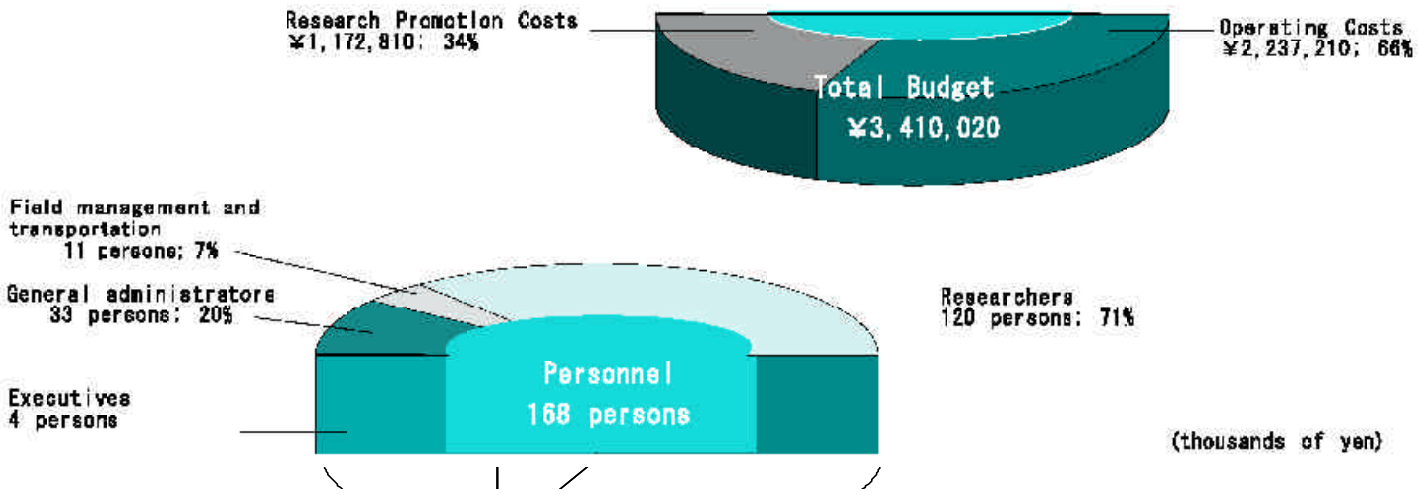
FINANCIAL OVERVIEW

Fiscal Year 2001

	thousands of yen
TOTAL BUDGET	**3,410,020**
OPERATING COSTS	**2,237,210**
Personnel (168)	1,734,988
President (1), Vice-President (1), Executive Advisor & Auditor (2)	
General administrators (33)	
Field management and transportation (11)	
Researchers (120)	
*Number of persons shown in ( )	
Administrative Costs	502,222
RESEARCH PROMOTION COSTS	**1,172,810**
Research Development	257,645
Overseas Dispatches	301,696
Research Exchange/Invitation	11,473
Research Information Collection	86,549
International Collaborative Projects	326,653
Comprehensive	(312,236)
Unidisciplinary	(14,417)
Fellowship Programs	188,794

Budget FY 2001 (Graph)



TENETS OF THE JIRCAS MID-TERM PLAN (April 2001-March 2006)

On April 1, 2001, the Japan International Research Center for Agricultural Sciences (JIRCAS) was inaugurated as an Independent Administrative Institution (IAI) and commenced implementation of research programs and administrative operations according to a five-year Mid-Term Plan approved by the Ministry of Agriculture, Forestry and Fisheries (MAFF). The tenets of this Mid-Term Plan, divided into research and administrative operations, are detailed in the following outline.

RESEARCH

I. Enhancement of the quality of experiments, research and investigations

A. Analysis of the orientation of agriculture, forestry and fisheries activities in developing regions, examination of research status in Japan and overseas, and elucidation of trends in technology development

1) Analysis of trends in world food supply and demand, and development of mid-term strategies to promote international collaborative research

1. Analysis of research orientation in major developing countries
   An information network necessary for the accumulation of research information will be developed; the background, future objectives, and orientation of research themes pursued by developing countries and relevant international research organizations will be examined and mid-term research strategies will be proposed.
2. Improvement of models for world food supply and demand through analysis of trends, particularly in China
   In order to define medium- and long-term trends in world food and supply and demand, JIRCAS's world food supply model will be modified based on analyses of relevant policies and economic conditions, particularly in China.

2) Analysis of regional characteristics and orientation of development relating to food production and environmental conditions in developing regions

1. Analysis of major constraints on agriculture, forestry and fisheries development as well as trends in technological and economic development in Indonesia, West Africa, Vietnam, and other regions
   The characteristics of each region will be analyzed in terms of background, social customs, and differences in technological levels in order to implement research collaboration in an effective manner.
2. Analysis of trends in the development of sustainable farming systems in Indonesia, Vietnam, Thailand, South America, and other regions
   Examination of the status of farming systems in these developing regions and analysis of constraints on their effective adoption will be conducted.

B. Research and development for sustainable agriculture, forestry and fisheries in developing regions

1) Improvement and development of sustainable and environment-friendly production technology

1. Improvement of technology for soil amelioration and nutrient cycling evaluation in diversified ecosystems
   Nutrient cycling will be studied in target areas and techniques will be developed for the management of cultivated ecosystems and soil.
2. Development of low-input production technology for rice and upland crops in Thailand, Vietnam, and other countries
   More efficient methods of soil management and cultivation, as well as technology to improve water management and achieve higher yields and quality, will be developed.
3. Analysis of the prevalence of major diseases and insect pests in rice and soybean in Southeast Asia, South America, and other developing regions
   The incidence of major disease pathogens and insect pests will be determined in order to develop suitable countermeasures.
4. Analysis of characteristics of under-utilized local forage resources, such as gramineous pasture grasses, maize stems and leaves under agro-pastoral systems
   The physiological and ecological characteristics and nutritive value of forage resources will be determined and potential utilization methods will be examined.
5. Analysis of physiological characteristics of cattle, pigs and other livestock, as well as the prevalence

of major livestock diseases in Thailand, Vietnam, and other countries
Physiological characteristics such as nutrient metabolism will be analyzed and the prevalence of dieases such as trypanosomiasis will be evaluated.

6. Development of technology for supplementary natural regeneration of valuable tree species in tropical forests having tree species of low quality
Silvicultural and logging technology for the sustainable management of forests in Southeast Asia will be developed, and the restoration of forests in degraded grassland areas through the utilization of useful low-quality trees will be promoted.

7. Development of environment-friendly aquaculture technology
Analyses of maturation and spawning stages, feeding behavior, selection and culture of biological feeds, and identification and utilization of various artificial feeds for major aquaculture species will be conducted. Aquaculture technology characterized by low feed and drug inputs will be developed.

2) Improvement and development of technology for quality evaluation, distribution, and processing of agriculture, forestry and fisheries commodities in developing regions

1. Analysis of quality parameters for food resources in Southeast Asia
Methods of evaluation utilizing low-cost instrumentation and materials will be developed for determining basic characteristics of food resources prior to harvest, and during postharvest processing and distribution. Factors affecting quality changes will be identified.

2. Development of methods for the prevention of quality deterioration and methods for the improvement of processing technology
Technology for low-input drying and storage of food commodities will be developed in order to reduce postharvest losses. Local processing technology will be improved in order to develop more value-added products.

3. Development of technology for the use of under-utilized wood resources
Technology for the processing of wood materials into wood products will be developed through analyses of the characteristics of materials such as oil palm residue.

4. Development of technology for the use of under-utilized aquatic resources and the production of surimi (fish paste) in China
Technology for environment-friendly utilization of aquatic products will be developed while considering the state of food production, distribution and consumption in China.

3) Development of technology for the analysis and utilization of genetic resources and biological functions in developing regions

1. Development of technology for the analysis and transformation of mechanisms of resistance to environmental stresses
Resistance mechanisms in model plant species will be analyzed at the molecular level in order to develop genetically-modified crops having resistance to drought, salinity and other stresses.

2. Development of breeding materials and technology to evaluate the resistance of rice and wheat to disease and insect pests
The characteristics of crops such as rice, wheat and soybean related to diseases and insect pest resistance will be elucidated for the purposes of developing useful breeding materials.

3. Collection, evaluation and preservation of genetic resources of vegetables and fruit trees in tropical and subtropical regions
JIRCAS will serve as a sub-bank to the central gene bank of the National Institute of Agrobiological Science (NIAS), a fellow MAFF-affiliated IAI.

4) Evaluation of environmental resources and bio-diversity

1. Evaluation of characteristics of environmental resources related to agricultural production and analysis of the mechanisms of changes in land use
Technology for the analysis and effective utilization of environmental resources will be developed, and the relationship between changes in land use and these resources will be elucidated.

2. Analysis of necessary conditions for introducing agroforestry technology in Malaysia and other developing countries
The establishment of productive and environment-friendly agroforestry systems will be promoted, with emphasis on bio-diversity and sustainability of tropical forest regeneration.

3. Analysis of changes in major aquatic resources in coastal and brackish water mangrove ecosystems in Southeast Asia
The changes in major fish and aquatic resources associated with the development of coastal areas,

including environmentally valuable brackish water mangrove areas, will be analyzed.

5) Research activities in Okinawa

1. Evaluation and utilization of heat and salinity resistance in snap beans and rice
   Through the evaluation of characteristics related to high-temperature stress tolerance in vegetable species such as the snap bean, useful breeding materials will be collected and studied.
2. Development of technology for the evaluation and utilization of useful traits in sugarcane and root crops
   Characteristics related to useful traits of vegetatively propagated crops from tropical and subtropical regions will be evaluated, and breeding materials having outstanding characteristics will be developed through genetic engineering.
3. Development of basic technology for the evaluation and mass propagation of tropical fruit trees
   The production of substances required for regulation of tree form, fruit set and flowering will be studied. Basic technology will be developed for quality evaluation and for mass propagation.
4. Analysis of ecological characteristics and the incidence of major insect pests and diseases in tropical and subtropical areas
   The eco-physiological characteristics of major diseases, insect pests and natural enemies occurring in tropical and subtropical crops will be elucidated.
5. Analysis of factors leading to the instability of crop production on tropical and subtropical islands, and the development of technology for crop cultivation using low water and fertilizer inputs
   The effect of environmental factors such as weather and soils on crops and their subsequent response will be elucidated.
6. Development of methods for controlling variations in heading traits through generation advancement of rice and other crops
   Technology will be developed for effectively fixing variations in heading traits through generation advancement.

II. Contribution to society through research activities

A. Analyses and consultations

Upon the requests of administrative authorities, corporations, and universities, JIRCAS will conduct various analyses and experiments, extending its expertise to other organizations.

B. Training courses and programs

1) JIRCAS will organize training courses and lectures for administrative authorities and various research organizations and offer its collaboration in programs sponsored by the government or the private sector.
2) JIRCAS will make significant efforts to receive trainees from other IAIs, universities, national public organizations, and the private sector in order to further develop human resources, upgrade existing technology, and promote information and technology transfer. JIRCAS will also conduct invitation programs for overseas counterpart scientists.
3) JIRCAS will be entrusted by the Japanese government to develop and provide human resources for activities related to research in the fields of international agriculture, forestry and fisheries.
4) JIRCAS will establish consultations with various organizations in order to conduct information exchange on technical problems.

C. Collaboration with administrative authorities, international organizations, academic societies, and other organizations

JIRCAS will dispatch delegates to participate in committee meetings and conferences sponsored by administrative authorities, international organizations and academic societies. Upon request from administrative authorities, JIRCAS will also supply relevant technological information both in Japan and overseas.

III. Publication and dissemination of research results

A. Promotion and utilization of research results

Manuals and databases will be prepared for use by administrative authorities, research organizations and primary producers in developing regions. Efforts will also be made to promote the dissemination and application of research results through the MAFF research network and through international collaborative efforts.

B. Publication and dissemination of research results

1) JIRCAS researchers will be encouraged to present research results at meetings organized by academic societies and at symposia held in Japan and overseas. During the period covered in the Mid-Term Plan, a goal has been established to publish over 540 reports in scientific journals and organizational bulletins.
2) Research results will be made available on the Internet and published at expositions and other appropriate venues. Important achievements will also be reported through suitable mass media.

C. Acquisition and utilization of intellectual property rights

1) Active acquisition of intellectual property rights will be encouraged; a goal has been established to submit over 20 patent applications to the Japan Patent Office during the period covered in the Mid-Term Plan. JIRCAS will also encourage the submission of patent applications in countries other than Japan.
2) Plant varieties developed through breeding research will be registered based on the Seed and Stock Law. JIRCAS will also encourage applications by foreign organizations to utilize registered varieties overseas.
3) Information concerning intellectual property rights will be disseminated through the Internet, and requests for their utilization will be actively considered.

ADMINISTRATION

I. Evaluation and review of research activities

A. Internal review will be conducted under the guidance of experts from outside organizations, as well as JIRCAS directors and administrators.

B. Review of research themes will be conducted in order to evaluate research strategies, planning and progress. These results will be evaluated under the guidance of outside experts and JIRCAS directors and administrators, and will be made public.

II. Efficient utilization of resources allocated for research activities

A. Resources for research activities will be allocated in context of the objectives of the Mid-Term Plan.

III. Promotion of liaison and collaboration

A. Liaison and collaboration with other IAIs

Liaison and collaboration with other MAFF-affiliated IAIs will be actively pursued, including common research objectives, joint research and personnel exchange.

B. Liaison and collaboration with research organizations in developing regions

1. Research administrators from counterpart organizations will be invited to Japan through the Administrative Invitation program for exchanging information and opinions concerning policy-making and project design.
2. Researchers from counterpart organizations in developing regions will be invited to Japan to conduct collaborative research.

C. Liaison and collaboration with organizations from the private sector, universities, and the government

1. Collaborative research or researcher exchange with national public organizations, universities, the private sector, overseas organizations, international organizations, and the Japan International Cooperation Agency (JICA) will be actively promoted.
2. Research collaboration conducted with public organizations utilizing governmental support will be promoted.

The status of mutual relations and collaboration will be evaluated annually. The promotion of research activities at JIRCAS will be examined with the participation of representatives from related IAIs and administrative authorities as well as from municipal, district and prefectural organizations.

ADVISORS AND PRINCIPAL STAFF

Advisors

Hisao Azuma	Vice-President, Japan International Cooperation Agency (JICA)
Hiroshi Kakurai	Economic Analyst, formerly Commentator, Nippon Hoso Kyokai (NHK)
Sakue Matsumoto	President, Japan Food and Agriculture Organization (FAO) Association

JIRCAS External Evaluation Committee

Haruo Inagaki	Councilor, Japan Food and Agriculture Organization (FAO) Association
Keiji Ohga	Professor, Graduate School of Agricultural and Life Sciences, the University of Tokyo
Naoto Owa	Professor, Department of Applied Biological Chemistry, Faculty of Agriculture, Niigata University
Shuichi Kitada	Professor, Department of Aquatic Biosciences, Faculty of Fisheries, Tokyo University of Fisheries
Katumi Musiake	Professor, Institute of Industrial Science, the University of Tokyo
Seiichi Murayama	Professor, Department of Bioproduction, Faculty of Agriculture, University of the Ryukyus
Keiko Morishima	Professor, Department of Agriculture, Faculty of Agriculture, Tokyo University of Agriculture
Hitoshi Yonekura	Professor, Graduate School of Agricultural Science, Tohoku University
Hiroyuki Watanabe	Professor, Graduate School of Agriculture, Kyoto University

External Reviewers for International Collaborative Projects

Development of sustainable agricultural technology in Northeast Thailand

Paiboon Prabuddham	Assistant Professer, Department of Soil Science, Faculty of Agriculture, Kasetsart University
Waewchark Kongpolprom	Director, Central Land Consolidation Office, Ministry of Agriculture and Cooperatives
Terdsak Subhasara	Lecturer, Faculty of Science, Mahasarakham University
Sakol Ooraikul	Specialist, Agricultural Economic Production and Marketing, Office of Agricultural Economics, Ministry of Agriculture and Cooperatives
Yoshitaka Sumi	Deputy Director, Planning and Evaluation Department, Japan International Cooperation Agency (JICA)
Masaki Shibata	Director, Department of Research Planning and Coordination, National Agricultural Research Center for Kyushu Okinawa Region, National Agricultural Research Organization (NARO)

Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil

Peter Kerridge	CIAT Asia Program, Lao PDR Office, Centro Internacional de Agricultura Tropica (CIAT)
Kazuo Kawano	Professor, University Farm, Faculty of Agriculture, Kobe University
Muneo Oikawa	Director, Department of Grassland Ecology, National Institute of Livestock and Grassland Science, National Agricultural Research Organization
Makie Kokubun	Professor, Graduate School of Agricultural Science, Tohoku University

Development of sustainable production and utilization of major food resources in China

Yoshihiro Kaida	Professor, the Center for Southeast Asian Studies, Kyoto University
Kunio Takase	Advisor, International Development Center of Japan
Naohiro Kitano	Section Chief, Division 1, Development Assistance Department, Japan Bank for International Cooperation
Ryoichi Ikeda	Director, Department of Rice Research, National Institute of Crop Science, National Agricultural Research Organization (NARO)

Comprehensive studies on soybean improvement, production and utilization in South America (multinational)

Peter Kerridge	CIAT Asia Program, Lao PDR Office, Centro Internacional de Agricultura Tropica (CIAT)

Kazuo Kawano	Professor, University Farm, Faculty of Agriculture, Kobe University
Shinji Sakai	Director, Department of Integrated Research for Agriculture for the Kanto and Tokai Region, National Agricultural Research Center, National Agricultural Research Organization (NARO)
Makie Kokubun	Professor, Graduate School of Agricultural Science, Tohoku University

Evaluation and improvement of regional farming systems in Indonesia

Ken Menz	Australian Center for International Agricultural Research (ACIAR)
Koji Tanaka	Professor, the Center for Southeast Asian Studies, Kyoto University
Ryozo Hanya	Director, Agricultural Technology Cooperation Division, Agricultural Technology Cooperation Department, Japan International Cooperation Agency (JICA)
Setsuya Harada	Director, Department of Research Planning and Coordination, Headquarters of the National Agricultural Research Organization (NARO)
Haruo Inagaki	Councilor, Japan Food and Agriculture Organization (FAO) Association

Improving food security in West Africa through increased productivity in rainfed rice systems

Ryuichi Ishii	Professor, College of Bioresource Sciences, Nihon University
Ryoichi Ikeda	Director, Department of Rice Research, National Institute of Crop Science, National Agricultural Research Organization (NARO)
Keijiro Ohtsuka	Professor, National Graduate Institute for Policy Studies, Japan
Masataka Minagawa	Head of Finance and Administration, Tokyo Office, Sasakawa Africa Association
Shigenari Koga	Director, Planning Division, Agricultural Development Cooperation Department, Japan International Cooperation Agency (JICA)

Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Phase II)

Vo-tong Xuan	Director, Mekong Delta Farming Systems Research and Development Institute, Cantho University; Rector, An Giang University
Tetsuo Shioya	Professor, University Farm, Faculty of Agriculture, Tokyo University of Agriculture and Technology
Yoshiaki Kano	Director,Tsukuba International Center, Japan International Cooperation Agency (JICA)
Michiko Takagaki	Lecturer, Faculty of Horticulture, Chiba University

Development of agroforestry technology for the rehabilitation of tropical forests

Minoru Kumazaki	President, Gifu Academy of Forest Science and Culture, Gifu Prefecture
Hideki Miyakawa	Director, Forestry and Natural Environment Cooperation Department, Japan International Cooperation Agency (JICA)
Mitsuyoshi Yatagai	Professor, Graduate School of Agricultural and Life Sciences, the University of Tokyo
Yoshiya Tadaki	Director, Ecological Research Center, PREC Institute Inc.
Fujio Kobayashi	Vice-Chairman, the Japan Forestry Association

Development of low-input technology for reducing postharvest losses of staples in Southeast Asia

Greg Johnson	Australian Center for International Agricultural Research (ACIAR)
Toshinori Kimura	Professor, Institute of Agricultural and Forest Engineering, the University of Tsukuba
Yoshimi Hirose	Professor Emeritus, Kyushu University
Tadashi Miyata	Professor, Department of Biological Resources and Environmental Sciences, School of Agricultural Sciences, Nagoya University

Studies on sustainable production systems of aquatic animals in brackish mangrove areas

Fumitake Seki	Professor Emeritus, the University of Tsukuba
Makoto Terazaki	Professor, Ocean Resarch Institute, the University of Tokyo
Akio Inoue	Professor Emeritus, Kagoshima University
Prathak Tabthipwon	Vice Dean, Faculty of Fisheries, Kasetsart University

Development of diagnosis and prevention technology for shrimp viral diseases

Akio Inoue	Professor Emeritus, Kagoshima University
Masanori Azeta	Executive Advisory Engineer, Marino Forum 21, Japan
Kiyoshi Inoue	Director, Pathology Division, National Research Institute of Aquaculture, Fisheries Research Agency

JIRCAS STAFF FY 2001

President

Takahiro Inoue

Vice-President

Yoshinori Morooka

Executive Advisor & Auditor

Kunihiko Kato
Akimi Fujimoto

Research Planning and Coordination Division

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Shuichi Asanuma, Section Head
Kumi Yasunobu, Senior Researcher
(Yukihito Ochiai*, Senior Researcher)
Tomohide Sugino, Senior Researcher
Marcy N. Wilder, Senior Researcher in Fisheries Division, Joint Appointment

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Shoichi Kawasugi, Senior Researcher
Kazuo Ise, Senior Researcher

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Chiyoichi Noda*, Plant Virology

Public Information Officer
Tadahiro Hayashi, Information Engineering

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Hiromi Miura, Librarian

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Takashi Komatsu, Field Operator

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Michito Kimura, Accounting Officer
Yoshihiko Sumomozawa, Auditing Head
Koji Ito, Supplies/Equipment Manager
Ryo Okamoto, Supplies/Equipment Officer
Kuniaki Katsuyama, Facilities Manager

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Nobuharu Fukui, Overseer Stationed Overseas
Hideko Shimada, Overseas Operations Manager
Hiroshi Tanaka, Overseas Expenditures Manager
Juzo Nishino, Overseas Shipments Manager
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Hiroko Takagi-Watanabe, Plant Breeding
Masaharu Yajima, Plant Physiology

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Akihide Ikegami, Agricultural Economics
Sho Kosugi, Agricultural Economics
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Takeshi Sakurai, Agricultural Economics
Satoshi Uchida, Geographic Information Systems
Ryuichi Yamada, Agricultural Economics
Yasuharu Yamada, Geographic Information Systems
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Norihiro Yamashita, Agricultural Economics

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Kazuo Nakashima, Plant Molecular Biology
Takanori Sato, Vegetable Breeding
Kazuhiro Suenaga, Wheat Breeding
Hiroshi Tsunematsu, Rice Breeding
Takeshi Urao, Plant Molecular Biology
Kazuko Yamaguchi-Shinozaki, Plant Molecular Biology
Naoki Yamanaka, Plant Breeding

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Hiroshi Fujimoto, Plant Physiology
Tamao Hatta, Mineralogy and Geology
Naoki Horikawa, Water Management
Yasukazu Hosen, Soil Physics and Chemistry
Takayuki Ishikawa, Plant Physiology
Nobuyuki Kabaki, Agronomy
Hiromi Kobayashi, Agronomy
Kazuyuki Matsuo, Agronomy
Naruo Matsumoto, Environmental Conservation
Takuji Nakamura, Soil and Plant Nutrition
Chikara Ogura, Agricultural Land Improvement
Kensuke Okada, Plant Physiology
Kazushige Sogawa, Insect Ecology
Satoshi Tobita, Plant Nutrition and Physiology
Takeshi Watanabe, Soil Chemistry
Mitate Yamada, Agronomy

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Eiki Fukuda, Pasture Management
Akemi Kamakawa, Livestock Development
Tsutomu Kanno*, Pasture Ecology
Kiyomi Kosaka, Animal Nutrition
Yoshio Nakamura, Veterinary Parasitology
Masaharu Odai, Animal Nutrition
Sadahiro Ohmomo, Applied Microbiology
Seishi Yamasaki, Animal Nutrition

Food Science and Technology Division

Toru Hayashi, Director

Research Staff
Tsutomu Fushimi, Food Analysis
Kazuhiko Nakahara, Food Chemistry
Sayuki Nikkuni, Fermentation
Masayoshi Saito, Food Science
Eizo Tatsumi, Food Science
Tadashi Yoshihashi, Food Evaluation

Forestry Division

Kiyoshi Nakashima, Director

Research Staff
Masahiro Inagaki, Forest Soil Science
Koichi Kamo, Silviculture
Motoe Miyamoto, Social Forestry
Shoji Noguchi, Forest Hydrology
Yukihito Ochiai, Silviculture
Kazunori Takahashi, Silviculture
Ryohei Tanaka, Cellulose Chemistry
Akihiko Yokota, Mycology

Fisheries Division

Yutaka Fukuda, Director
(Masachika Maeda*, Director)

Research Staff
Yukio Maeno, Fish Pathology
Hiroshi Ogata, Fish Nutrition
Yasuki Ogawa, Crustacean Zoology
Norihisa Oseko*, Fish Pathology
Toru Shimoda, Coastal Ecology
Marcy N. Wilder, Crustacean Biochemistry
Masahito Yokoyama, Fish Biochemistry

Okinawa Subtropical Station

Masaaki Suzuki, Director
Kiyoshi Ozawa, Associate Director for Research

General Affairs Section
Kenichi Hasse, Section Chief

Satoshi Kawamitsu, Section Manager
Toshiaki Shoni, Section Officer
Takao Ohga, Accounting Manager
Yoshiyuki Hoshinoya, Accounting Officer
(Makoto Nishiyama*, Accounting Officer)
Hitoshi Sekiguchi, Accounting Officer

International Collaborative Research Section
(Chiyoichi Noda*, Section Chief)

Islands Environment Management Laboratory
Kenji Banzai, Environmental Conservation, Head
Taizo Masuda, Soil Science
Ken Nakamura, Soil Science

Enviromental Stress Laboratory
Yoshinobu Egawa, Plant Genetic Resources, Head
Mariko Shono, Plant Physiology
Katsumi Suzuki, Plant Morphology

Tropical Crop Breeding Laboratory
Makoto Matsuoka, Plant Breeding, Head
Koshun Ishiki, Plant Breeding and Genetic Resources
Yasuaki Tamura, Rice Breeding
Masahiko Tanio, Wheat Breeding
Takayoshi Terauchi, Agronomy

Tropical Fruit Crops Laboratory
Kazunori Ogawa, Plant Chemistry, Head
Hiroshi Fukamachi, Pomology
Hidenori Kato, Plant Physiology

Plant Protection Laboratory
Masatoshi Ohnuki, Plant Virology, Head
Katsuyuki Kohno, Entomology
Tadafumi Nakata, Entomology
Kunimasa Kawabe, Plant Virology

Field Manegement Section
Yoshimitsu Katsuda, Crop Breeding, Head
Masakazu Hirata, Machine Operator
Hirokazu Ikema, Machine Operator
Masayoshi Kuwada*, Machine Operator
Yuho Maetsu, Machine Operator
Atsushi Ogasawara, Machine Operator
Yasuteru Shikina, Machine Operator
Masato Shimajiri, Machine Operator
Koji Yamato, Machine Operator
Masaki Yoshida, Machine Operator

Researchers on Loan to Other Institutions

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)-CGPRT CENTER
Shigeki Yokoyama, Agricultural Economics

Food and Agriculture Organization (FAO)
Kunio Tsubota, Agricultural Economics

International Centre of Insect Physiology and Ecology (ICIPE)
Satoshi Nakamura, Insect Ecology

International Rice Research Institute (IRRI)
Yoshimichi Fukuta, Rice Breeding
Takuhito Nozoe, Soil Chemistry
Seiji Yanagihara, Plant Breeding

Japan International Cooperation Agency (JICA)
Takasuke Ishitani, Postharvest Technology
Akinori Oshibe*, Animal Feeding
Masahito Sato, Rural Development

Part-Time informal employees
Nearly 90 persons are working at JIRCAS as non-permanent staff. They serve as editorial advisors for many of JIRCAS's publications, perform much of the institute's secretarial work, function as laboratory technicians, and maintain the buildings and laboratories. Their services to JIRCAS are highly valued.

* Indicates transfer within JIRCAS, relocation, retired, or deceased during the Fiscal Year covered by this Annual Report.

( ) Indicates previous position holder

THE JAPANESE FISCAL YEAR AND MISCELLANEOUS DATA

The Japanese Fiscal Year

About Annual Report 2001

The Japanese fiscal year is defined as a period of fiscal activity occurring from April 1 through March 31 of the following year. Thus, Fiscal Year (FY) 2001 covers the period from April 1, 2001 through March 31, 2002. Annual Report 2001 is intended to summarize the full extent of JIRCAS activities that occurred during this time period. The following Annual Report will detail events and activities from April 1, 2002, through March 31, 2003 (FY 2002).

Buildings and campus data

Land	(units: m^2)
Tsukuba premises	109,538
Okinawa Subtropical Station	294,912
Total	404,450

Buildings	(units: m^2)
Tsukuba premises	10,749
Okinawa Subtropical Station	8,696
Total	19,445