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Director General
Dr. Takahiro Inoue

Message from the Director General

A new JIRCAS-structural reorganization

Implications of the new organization

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

The introduction of the new system of Independent Administrative Institutions (IAI) is at the core of the administrative reform. This system has been introduced to enhance the effectiveness, quality, and transparency of technological development by splitting the administration into its implementation functions and its planning and drafting functions. By converting the implementation functions of the national research institutions to the IAI system, each institution has gained its own independent judicial status. Therefore, under the new system, JIRCAS will conduct not only autonomous and flexible programs, but also commit itself to a strict *ex post facto* evaluation and review of its performance, as well as disclosure of various institutional issues.

The new mandate given to JIRCAS by the Japanese Government does not fundamentally change the previous mandate, in which JIRCAS was entrusted with the mission of promoting the development of sustainable agriculture, forestry, and fisheries compatible with environmental preservation in developing regions of the world. Although the demand for food is increasing due to population increases and improvements in dietary habits, agricultural production remains at a low and unstable level in many developing countries. As a result, hunger and poverty remain prominent issues. Moreover, concern for the deterioration of the global environment has generated the need for the development of sustainable systems of agriculture, forestry, and fisheries that are non-destructive to natural ecosystems.

The most distinctive features of the new IAI system are, first, semi-autonomy with limited control from outside institutions, and second, *ex post facto* performance evaluations, the results of which each IAI uses to plan subsequent activities. Under the new system, MAFF presents to JIRCAS mid-term objectives, a list of goals that the "New JIRCAS" is expected to achieve during a five-year period. The mid-term objectives include issues related to the enhancement of the efficiency of research activities, improvement of the quality of research programs, and financial performance. Based on the mid-term objectives, the IAI drafts a mid-term plan to achieve these objectives autonomously.

The IAI Evaluation Committees, established under MAFF and composed of experts not belonging to the public sector, will also periodically review the performance of IAI research activities. Each fiscal year, an IAI Evaluation Committee will investigate and analyze the progress made on the previous year's mid-term objectives. The results of evaluation will be subjected to operational and financial modification the following fiscal year.

Since the research activities need to be fully

JIRCAS Main Building
(Photo: T. Hayashi)

executed, the government will allocate, within budgetary limitations, most or all of the financial resources required to carry out the defined objectives. In addition, JIRCAS will make utmost efforts to gain supplementary financial support from such sources as other governmental offices or the private sector to fulfill the mid-term objectives.

Roles and research strategy

Given that the role of JIRCAS is to promote the advancement of agriculture, forestry, and fisheries in developing regions of the world through integrated collaborative research programs, the "New JIRCAS" has established the following priorities for research strategy. The first is to develop production and utilization systems in sustainable agriculture, forestry and fisheries in harmony with the environment by conducting research on such topics as stress-tolerant crops, technologies for preserving arable land environments, new farming systems for ensuring profitability of producers, and technologies for efficient postharvest management and utilization. The second priority is to rehabilitate, maintain, and improve the utilization of natural resources, with emphasis placed on tropical forest and coastal ecosystems.

In order to complete the mid-term objectives adhering to the above research strategies, the "New JIRCAS" plans to conduct and take full advantage of (1) international collaborative research programs in developing regions, dispatching researchers on long- and short-term bases, (2) collaborative research with researchers from developing regions, (3) domestic research that will further enhance international collaboration, (4) accumulation and analysis of research information for supporting collaborative work, (5) international symposia, workshops and seminars, (6) technical assistance relating to food and environmental issues, and (7) functioning as a think tank for advisory committees of national organizations involved in overseas development.

In conclusion, the reorganization of JIRCAS into an IAI makes it possible for JIRCAS to gain more flexibility in the implementation of its research programs. The reorganization will also transform hiring procedures, enabling JIRCAS to recruit researchers from universities or institutes that do not belong exclusively to the public sector, and the financial aspects of the institution, since funds can now be obtained from both the public and private sectors. At the same time, the strict evaluations by the Evaluation Committee may enhance the quality of the research programs and lead to a more efficient utilization of financial resources, ultimately furthering collaborative activities compatible with the needs of developing regions.

JIRCAS Green House
(Photo: T. Hayashi)

Note about Annual Report 2000

In keeping with recent efforts to highlight JIRCAS activities in particular regions of the world, Annual Report 2000 will feature descriptions of our ongoing programs with Indonesia. JIRCAS expects that relations with Indonesia and its scientific institutions will become increasingly important in the 21st century. We hope to emphasize the significance of our collaborative efforts by choosing Indonesia as the feature in Annual Report 2000. JIRCAS maintains an impressive number of joint projects with Indonesian institutions, fortifying the international bond between the two nations. However, JIRCAS also conducts research with the help of institutions in many other parts of the world. We hope that growing scope of international research at JIRCAS will be equally evident within Annual Report 2000.

President
TAKAHIRO INOUE

HIGHLIGHTS FROM 2000

During Fiscal Year 2000, 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 30th Anniversary, JIRCAS held a number 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

Objectives of JIRCAS following its transition to a semi-autonomous agency

As of April 1, 2001, JIRCAS will convert into a semi-autonomous agency under the supervision of the Ministry of Agriculture, Forestry, and Fisheries within the framework of the administrative reform enacted by the Japanese Government calling for the reorganization of government-affiliated research organizations. An extensive account of this reform will be given in our Annual Report 2001; this year's Annual Report will describe some of the key objectives accompanying the transition.

Under the reformed Research Information Division, the newly created Development Research Division will gather and analyze information from developing regions and coordinate research strategy under the direction of six appointed international research planners. The Division will accumulate data and effectively function as a think tank, and also cooperate with and support other international organizations.

A cohesive promotional system will be established for the development of efficient and effective integrated research projects. Under the supervision of a project leader, long-term dispatched researchers will be more effectively organized for each project while three international research coordinators coordinate and promote the projects.

Another change will be the organization of efficient research structure in individual study fields. Fields of special study essential to international collaborative research will be streamlined to 27 groups of researchers. These groups will serve as distinct units for the promotion of research, with each group having clear research goals. Research groups with relevance to one another will cooperate so that the corresponding research divisions will function as one cohesive system.

This year JIRCAS will place added emphasis on postharvest research, more specifically on

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

agricultural production, distribution, utilization, and consumption. These topics have become crucial areas of study due to the increasing demand for international collaboration to secure food supply for developing nations. To stress the importance of postharvest research, the Crop Production and Postharvest Technology Division will operate separately from the Food Science and Technology Division and will deal with the problems of postharvest losses, quality evaluation, and increasing the value of agricultural commodities.

Another objective for JIRCAS will be to expand the Okinawa Subtropical Station to improve its status as a research base for subtropical agriculture. Five new research laboratories will be added to promote basic and fundamental goal-oriented research in order to satisfy the demand for highly mobile international research. Research themes will center on the subtropical climate, the insular conditions of location, and on subtropical agriculture.

Creation of a stronger system for international information activities will also be among JIRCAS's top priorities. Support systems for research results and submissions of international patent applications will be of great importance. Specialists in each field will be called upon to bolster and aid the support system. In addition, the institution has newly created the position of a "JIRCAS spokesperson" to emphasize the importance of international information activity.

Finally, JIRCAS will reinforce its liaison offices to further support overseas research activities. The offices, located in Thailand, China, and Brazil, to which JIRCAS has dispatched many long-term researchers, will be reinforced with additional human and financial resources in an effort to support overseas research activities more effectively.

JIRCAS celebrates its 30th anniversary

Thirty years have passed since the establishment of JIRCAS's predecessor institution, the Tropical Agricultural Research Center (TARC). To commemorate this occasion, JIRCAS held a 30th anniversary celebration at the Tsukuba Dai-ichi Hotel on October 31, 2000. Over 230 people attended the event, including many former members of TARC/JIRCAS, as well as guests from other institutions in Japan and partner countries.

Mr. Shigeru Motai, Chairman of the Agriculture, Forestry, and Fisheries Research Council, and other distinguished guests from Japan and other countries expressed warm congratulations to JIRCAS on this auspicious event.

After an initial congratulatory message, Dr. Ronald Cantrell, Director General of the International Rice Research Institute (IRRI) and Mr. Shinichi Kobayashi, Director General, Secretariat of the Agriculture, Forestry, and Fisheries Research Council, gave introductory speeches to start the festivities. As part of the celebration, a 30-year TARC/JIRCAS commemorative yearbook was published covering many topics, such as the history of the institution, ongoing and past research projects, future goals of JIRCAS, and a summary of TARC/JIRCAS activity. All participants received a copy of the book, prompting an exchange of stories of well-expended efforts to get TARC off the ground in its first year, and a look back at the successes and hardships of various collaborative activities in which many attendees had participated over the years.

The current staff of JIRCAS took the celebration as an occasion to renew their commitment to even greater achievements as JIRCAS moves into a new era of operation as an independent administrative institution.

The celebration was followed by two days devoted to the 7th JIRCAS International Symposium entitled, "Agricultural technology research for sustainable development in developing regions", held at the Epochal Tsukuba International Conference Hall. More than 300 people, including over 70 participants from overseas, participated in this symposium (see Symposia and Workshops).

Mid-term review for the comprehensive project in China

On May 28, 1997 the research institutes and universities of the Ministry of Agriculture of the People's Republic of China and the Japan International Research Center for Agricultural Sciences (JIRCAS) signed a comprehensive agreement for a collaborative research project entitled "Development of sustainable production and utilization of major food resources in China". This agreement commits institutions from both countries to eight specified research programs spanning seven years. The comprehensive project aims to develop technologies for sustainable production and utilization of major food resources in China. Such resources including rice, soybeans, corn and freshwater fish, will become increasingly important as economic development both strengthens the purchasing power of ordinary Chinese people and enhances their concern for dietary nutrition. This project marks an attempt to develop an effective production and distribution system for food resources in order to cope with the changing supply and demand structures of agricultural products in China.

Starting on February 1, 2001, JIRCAS organized a two-day mid-term review meeting and workshop for the project, inviting officials from the Agriculture, Forestry, and Fisheries Research Council Secretariat of the Ministry of Agirculture, Forestry, and Fisheries (MAFF). Five reviewers headed the project review: Dr. Y. Akama, Project Leader, Bio-oriented Technology Research Advancement Institution (BRAIN), Dr. K. Ito, Director of the Statistics Affairs Coordination Division, Statistics and Information Department, MAFF, Prof. Y. Kaida, The Center for Southeast Asian Studies, Kyoto University, Dr. N. Kitano, Senior Economist, Research Institute for Development and Finance, Japan Bank for International Cooperation, and Dr. K. Takase, Board Member, International Development Center of Japan. JIRCAS planned a project workshop prior to the review meeting in order to facilitate the reviewers' understanding of the significance and the future development of this project in China (see Symposia and Workshops). During the review meeting, Japanese scientists presented major research results from eight research programs and proposed to integrate two closely related programs focusing on socioeconomic studies. After the meeting, favorable comments and recommendations were received from all five reviewers. The recommendations of the reviewers emphasized the integrated contribution of diverse research programs to Chinese food resources under the close cooperation between the Chinese institutions and JIRCAS. In addition to the project review, discussions among scientists from China and Japan during the workshop and review meeting are expected to improve the mutual understanding of the collaborative research project and contribute to its successful implementation in the second half of the comprehensive research project.

Mid-term review for the comprehensive project in the Mekong Delta region of Vietnam

On February 7, 2001, the Japan International Research Center for Agricultural Sciences (JIRCAS) organized a mid-term evaluation meeting for the comprehensive project on "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Mekong II)" in Tsukuba. The evaluation meeting originated in response to the recent instructions of the Ministry of Agriculture, Forestry and Fisheries (MAFF) regarding adherence to a review system for each JIRCAS project. The main purpose of the meeting was to evaluate the current results and examine the future direction of the project.

Prof. Tetsuo Shioya, Tokyo University of Agriculture and Technology, and Dr. Yoshio Akama, Project Leader for the Bio-oriented Technology Research Advancement Institution (BRAIN), attended the meeting as evaluators for

Participants of the mid-term review meeting for the comprehensive project in China pose for a group photograph.

the project. Dr. Bui Ba Bong, Director of the Cuu Long Delta Rice Research Institute in Vietnam, and Dr. Nguyen Thanh Phuong, Vice Director of the Institute for Marine Aquaculture at the College of Agriculture, Cantho University in Vietnam, were also invited as commentators for the meeting.

After Kazuyuki Tsurumi, Director of the Research Information Division at JIRCAS, delivered the opening greetings and Dr. Takasuke Ishitani, Director of the Planning and Coordination Division at JIRCAS, followed with an opening address, Dr. Tetsushi Hidaka, International Research Coordinator and project leader, discussed the outline of the project. Following his presentation, researchers of JIRCAS and related institutes presented results and future research plans for each subject. In Session 1, researchers presented study results on rice cultivation, integrated pest management, upland crops, and drying technologies. Presentations covering fruit production and pig production were presented in Sessions 2 and 3, respectively. In Session 4, researchers gave presentations on aquaculture production including fish and freshwater prawn culture. Session 5 covered the material circulation of by-products and wastes generated under VACR (Vietnamese acronym: V; fruits and vegetables, A; aquaculture, C; livestock, R; rice) farming systems. Lastly, Session 6 covered the results and future plans for the development and evaluation of farming systems as a whole.

Following the conclusion of all presentations, evaluators discussed ways in which the project could overcome some of the difficulties it faced, and participants used these solutions to plan the future framework and direction of the studies.

Final evaluation meeting for the productivity and sustainable utilization of brackish water mangrove ecosystems comprehensive project (Mangrove Estuary I)

JIRCAS held a final evaluation committee meeting for the Mangrove Estuary I project on March 2, 2000, attended by participating project members from various JIRCAS divisions, including the Fisheries Division, Forestry Division, Environmental Resources Division, and Research Information Division, as well as other Japanese institutes such as the Fisheries Agency, the Forestry Agency, and the Agriculture, Forestry and Fisheries Research Council. They were joined by several Malaysian institutes such as the Fisheries Research Institute, the Forest Research Institute, the Department of Fisheries, the Department of Forestry, and the University of Malaya.

Final evaluation meeting for the Mangrove Estuary I project.

The project, implemented from of April 1995 to March 1999, focused on the integration of studies dealing with brackish water mangrove ecosystems, which were conducted on a multidisciplinary basis including fields related to forestry, fisheries, agriculture, and socioeconomics. Although mangrove ecosystems have been studied extensively worldwide, no integrated approach had been previously adopted. The studies and their sub-fields conducted in collaboration between leading scientists from Malaysia and JIRCAS are outlined below.

(1) Differentiation of sampling areas according to type of exploitation of mangrove forest.
(2) Production by mangrove estuary ecosystems. (a) Leaf litter production in mangrove areas. (b) Benthic animal production in mangrove estuaries.
(3) Impact of exploitation of mangrove forests on estuarial aquatic environments.
(4) Food chain studies in mangrove estuaries. (a) Food chain in mangrove forests. (b) Food chain in estuarine waters.
(5) Energy flow and biological diversity in mangrove estuaries.
(6) Evaluation of socioeconomic impact on resources utilized in brackish water mangrove areas.

The evaluation committee meeting was held involving 4 evaluation committee members, 9 and 8 scientists invited from Malaysia and Japan, respectively, and 12 staff members from JIRCAS. The meeting produced 84 evaluation points and several comments, among which the following were prominent themes.

Committee members agreed that in most cases, the natural environment has the ability to repair damage it has incurred. However, in some cases, existing natural processes are not able to accomplish this because of more severe damage brought about by human beings. Because of the rapid growth of the aquaculture industry and the exploitation of mangrove areas in coastal areas in Southeast Asia, a number of environmental problems have arisen, a concern many countries share. Mangrove areas harbor some of the

Earth's most active marine life production sites. The objective of this research project has been to identify appropriate procedures that will lead to sustainable production systems. Thus, the results have been especially important to Southeast Asian countries, which host a large proportion of the world's mangrove forests. In an attempt to preserve the valuable mangrove forests, JIRCAS and foreign research centers have made great efforts to achieve the goals established in the project.

Final evaluation meeting for the project "Development of sustainable systems of grassland management and animal production in Central Asia"

JIRCAS held the final evaluation meeting for the project entitled "Development of sustainable systems of grassland management and animal production in Central Asia" in Tsukuba on March 14, 2001 in order to review the results obtained during the implementation of the project.

The project started in July of 1996 in collaboration with the Kazakh Institute of Agriculture (KIA), Kazakhstan. Agriculture in Kazakhstan, the largest country in Central Asia, has traditionally consisted of pasture and steppe and oasis agriculture in piedmont and desert areas. After the division of the Soviet Union in 1991, the deterioration of the steppes and arable land, environmental problems in the Aral Sea basin, and the erosion of genetic resources have caused serious concern for the nation's agricultural sector. In order to solve these problems, the project focused on the development of grassland conservation and sustainable livestock production, paying special attention to grassland management and fertility and grassland vegetation in steppe soils.

Prof. Takashi Kosaki of Kyoto University, Mr. Toshiaki Nanba, Director General of the National Livestock Breeding Center, and Dr. Muneo Oikawa, Director of the Department of Grassland Management, National Grassland Research Institute, were among those invited as commentators for the meeting.

Final evaluation meeting for the project "Development of sustainable systems of grassland management and animal production in Central Asia". (Photo: T. Taniguchi)

After an opening address from Dr. Takasuke Ishitani, Director of the Planning and Coordination Division, JIRCAS, Dr. Toshiaki Taniguchi, Director of the Animal Production and Grassland Division, JIRCAS, outlined and recapped the project. Then, researchers from JIRCAS and related institutes presented the results and prospects for development of technology for sustainable grassland management and animal production.

Following presentations on each subject, evaluators gave inquiries in regards to the studies and discussed methods of avoiding potential obstacles to future research. Participants also discussed the progress and accomplishments of the project, and recognized the importance of future research in the area and of the invaluable cooperation from KIA.

Mid-term evaluation meeting for the project "Comprehensive soybean research project in South America"

JIRCAS organized a mid-term evaluation meeting that took place on March 22, 2001 in Tsukuba for the comprehensive project entitled "Comprehensive soybean research project in South America" in order to review the results obtained during the implementation of the project as well as other related studies. The project, conducted since 1997, marks a new initiative by the institute to promote multi-disciplinary studies on soybean production and utilization in MERCOSUR countries through collaborative research linking Japanese and South American specialists. 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 socioeconomic factors.

The evaluation meeting originated in response to the Japanese Ministry of Agriculture, Forestry and Fisheries' (MAFF) recent instructions regarding adherence to a review system for each JIRCAS project being conducted in various developing countries. The main purpose of the meeting was to evaluate the results and to examine the future research direction of the project.

Dr. Peter Kerridge, Coordinator, International Center for Tropical Agriculture (CIAT) –Asia, Prof. Kazuo Kawano, Kobe University, and Dr. Shinji Sakai, Director of the Department of Crop

Meeting between Dr. Takahiro Inoue, JIRCAS Director General, and Dr. Peter Kerridge, who visited JIRCAS as a reviewer of the soybean project. (Photo: T. Taniguchi)

Breeding at the Tohoku National Agricultural Experiment Station were invited as commentators for the meeting.

After an opening address from Dr. Takahiro Inoue, Director General of JIRCAS, Dr. Toshiaki Taniguchi, Director of the Animal Production and Grassland Division, JIRCAS, outlined and recapped the project. Next, researchers of JIRCAS and related institutes presented the results and future research plans for the following subjects: genetic improvement of chemical constituents in soybean seeds, creation of DNA markers, breeding methods of insect resistant soybean in South America, identification of soybean genes for resistance to *Phytophthora sojae* using molecular markers, improvement of soil management practices, improvement of controlling methods of diseases and insects in Paraguay, ecology and control of major diseases of soybean in Argentina, morphological and physiological characterization of drought-tolerant soybean cultivars and identification of selection criteria for drought tolerance, analysis of soybean supply and demand, and socioeconomic evaluation of new technologies.

After presentations on each subject, evaluators gave inquiries in regards to the studies and discussed methods of avoiding potential obstacles to future research. Participants also discussed the progress and accomplishments of the project, and recognized the importance of future research.

NEW RESEARCH COLLABORATION

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

The reduction of poverty through the application of advanced science is one of the highest priorities of international agricultural research today. This is especially true in West Africa, where food demand outpaces production. With urbanization leading to increasing rice consumption, food use patterns are changing as well.

West African agriculture is predominantly rainfed. In addition to traditional rainfed upland cereals, nearly all rice production, which takes place primarily in low-lying areas ('bas-fonds'), is also rainfed. However, farmers cannot always rely on 'bas-fonds' production. In dry years, rainfall may be inadequate for rice, and farmers will sometimes plant upland cereals in 'bas-fonds' the following year. If the following year is wet, however, the upland cereals will fail due to water-logging. Farmers thus face weather-induced risk in 'bas-fonds' production, which contributes to their reluctance to invest in agricultural production to obtain higher yields. Moreover, since the use of 'bas-fonds' is part of the farm household's overall land use that includes uplands, farmers must consider risk management of multiple activities, both agricultural and non-agricultural.

To address these problems, in 2000 JIRCAS has begun a new three-year research project in collaboration with the Institut d'Economie Rurale (IER) of Mali, supported by funds from the Fluidity Promoting Research System of the Ministry of Education, Culture, Sports, Science, and Technology of Japan. The objective of the project is to develop information to help farmers make better choices among crops, production practices, and use of 'bas-fonds' and uplands to reduce risk associated with weather variability. The project uses three research strategies: (1) analysis of farmer decision-making behavior and crop performance in response to weather variability, using farmer-participatory methods and information technology, (2) advanced weather analysis, combining analysis of weather patterns in the 600-1200 mm annual rainfall zones and global weather data, and (3) establishment of criteria for more effective production choices, using risk analysis of farmer behavior and weather variability from the first two strategies.

Advanced information technology will help make it possible to gather information on land use and farmer behavior at precise locations in small areas, as well as put the information in a form that can be shared visually and interactively with farmers.

To achieve the project's goals, an interdisciplinary team has been formed consisting of three groups of researchers, with each group focusing on one of the above three project strategies. JIRCAS held an introductory workshop on July 12, 2000 to initiate the project and to establish a common understanding of the potential contributions of the different disciplines. Twenty scientists from seven institutes and organizations representing an array of disciplines participated. The workshop was organized around six topics: West African agriculture, soil and crop conditions, weather analysis and water use, information processing, risk management, and linkages to research in related on-going projects. Following the presentations, all of which were reported in the proceedings, a general discussion at the end of the workshop considered ways to carry out the research envisioned by the project, focusing on the linkages among the three project components of farmer production decision-making criteria, weather modeling, and risk management.

In February 2001, two scientists from JIRCAS, one scientist from the Tohoku National Agricultural Experiment Station, and three scientists from IER conducted surveys with farmers in eleven villages in two regions of Mali: the central OHVN (Opération Haute Vallée du Niger, Upper River Valley of the Niger) region, centered around the capital city of Bamako, and the southeastern cotton producing CMDT (Compagnie Malienne du Développement du Coton, Malian Cotton Development Company) region centered around Koutiala and Sikasso. The villages, selected in consultation with IER, OHVN, and CMDT, covered a broad range of annual rainfall, from 680 mm to over 1200 mm. In each village, researchers held a farmers' meeting, in which farmers drew a village land use map, wrote down soil types using their own soils taxonomic categories, and explained land use. This approach has become possible with the spread of adult literacy in Bamanan over the past decade; this common language of Mali was used together with the official French language, along with visual representation, a participatory research tool, to allow farmers to share information. Visual representation of information in a group setting gave farmers greater ownership of the information than if researchers had gathered and recorded it solely in written form based on oral interviews. In the farmers' meeting, farmers also described both indicators that they have found empirically useful to anticipate the coming rainy season, and their use of meteorological forecsasts provided by radio in Mali. At the end of each farmers meeting, the research team and the farmers visited the principal bas-fonds identified on the map to discuss land use, climatic indicators, and risk on site.

Results emphasized the importance of climatic variability on rice production in bas-fonds. Rice production was not feasible in the two survey villages in the 600 mm rainfall zone. In four villages in the 800 mm rainfall zone, there was great variation in rice production, ranging from complete absence to good production in four out of five years. Even in the 1200 mm annual rainfall zone, rice production was still variable, with succesful production occurring in only half of the years in two of four southern villages. These results highlight the site-specific nature of climatic and soil conditions and their effects on 'bas-fonds' production in the transition zone from the semi-humid to the semi-arid Sahel in West Africa. Farmers also are highly aware of the problem of location-specificity. Current meteorological forecasts are made at the regional level, which are broadcaast to regions with anuual rainfall ranging anywhere from 700 mm to 1200 mm. Farmers in three different villages independently indicated that these forecasts are not precise enough for their specific conditions, and expressed a need for more fine-tuned forecasting at the district or sub-district level.

Farmers had a range of indictors, both secondary (non-climatic) and primary (climatic), that they use in the dry season to anticipate the coming rainy season. In seven of the eleven villages, farmers used secondary indicators based on the flowering or fruiting of specific trees or plants. Four villages also used the appearance

Farmers in Mali explaining land use on a map that they have drawn and written in a village farmers' meeting with the research team.

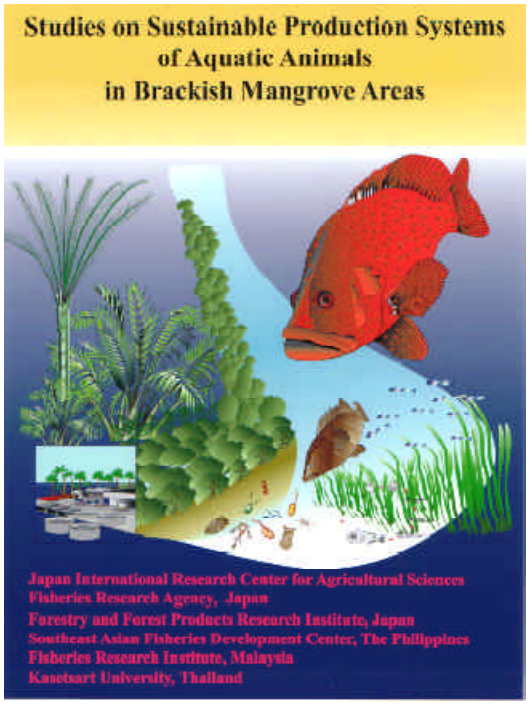
of specific insects or birds as indicators. In two villages in the south, farmers observe a change in wind direction in February, and in one of these villages, farmers found this indicator to be a good predictor of relative yield over the past 20 years.

Based on the above results, the research team selected one village each from the 800 mm and 1200 mm zones of the CMDT region in eastern Mali. At the start of the rainy season and again near the end, the research team will conduct surveys on transects selected to cover the range of soil types and land uses identified by the farmers in their maps in the February 2000 survey. The transects will be mapped using satellite-based geographical positioning (GPS). Farmers on the transects will be grouped accordingly, and representative farmers will be selected from each group for more detailed monitoring of land use and production practice decisions. Weather monitoring will also be carried out concurrently both within and around the selected villages, to obtain information on sub-regional spatial variability of rainfall and other climatic variables. The same types of data will be gathered in 2002, and combined to develop a risk reduction model.

Studies on sustainable production systems of aquatic animals in brackish mangrove areas (Mangrove Estuary II)

In coastal areas of Southeast Asia, the development of cities and agricultural areas has led to the destruction of mangrove ecosystems, compromising their productivity and sustainability. In addition, many areas have adopted large-scale intensive aquacultural systems to promote high-yielding production of crustaceans in the mangrove areas. As a result of this economic activity, a number of serious problems have emerged, including environmental degradation and the destruction of mangrove forest areas due to their conversion into urban and agricultural land and aquaculture ponds. In the case of aquaculture, the spread of drug-resistant bacterial pathogens caused by unrestrained and continuous use of antibiotics in over-stocked culture ponds has become a serious problem affecting the production of marine animals in this area.

To address these problems, researchers have been planning a comprehensive follow-up project entitled "Studies on sustainable production systems of aquatic animals in brackish mangrove areas" or "Mangrove Estuary II". The project team consists of members from a broad range of institutions, including the National Research Institute of Fisheries and Forestry and Forest



Products Research Institute of Japan, the Southeast Asian Fisheries Development Center (SEAFDEC), of the Philippines, the Fisheries Research Institute (FRI) and Malaya University in Malaysia, and the Faculty of Fisheries, Kasetsart University in Thailand.

The five-year project is designed to establish a method of fostering protective and planned management of commercially valuable fish and crustaceans in mangrove estuaries in order to ensure their sustainable use. It is important to encourage low- and minimal-input aquacultural procedures based on synthetic foods and drugs that take advantage of the naturally occurring circulation system of mangrove forests, and also to promote the development of more profitable aquacultural procedures based on the rearing of new indigenous aquatic species of high commercial value.

In addition, after these sustainable production systems in brackish mangrove areas are put into practice, project coordinators will analyze and publicize their economic and environmental advantages to encourage their wider use.

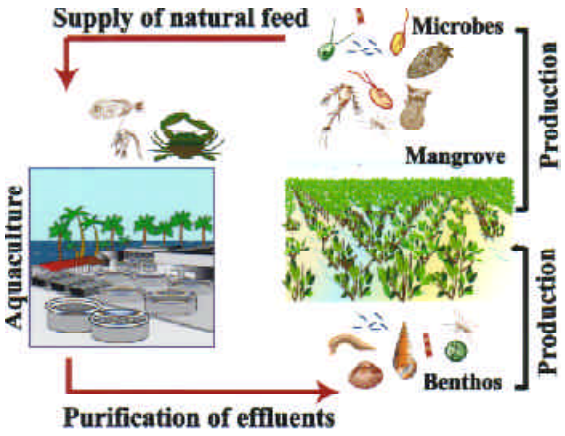
The research will focus on the development of procedures for the protection and management of commercially valuable fish resources to ensure their sustainable use and sustainable aquacultural systems utilizing the productivity of remaining brackish mangrove areas, as described below.

Studies on coupling habitat, biology, and management of commercially important fish species

more focused decisions on mangrove research issues should include work on the entrainment and impingement impacts, with special emphasis on estimating mortality factors, specifically for commercially important species of fish including the grouper (*Epinephelus* sp.) and the snapper (*Lutjanus* sp.). The studies also need to address such issues as spawning population stocks and the spawner-recruitment theories for long-term assessment of the contribution of mangrove forests to coastal fisheries resources. Still other issues involve the application of cross-migration of fish populations to marine sea grass and protected areas as well as biological and physical variability and scale. This information will help determine the role played by the base ecosystem in overall coastal productivity.

Research priority will be based on an understanding of the overall contribution and estimates of individual species recruitment from specific ecosystems to coastal fisheries. This requirement is of great importance due to the need to create a mangrove-friendly aquaculture program designed to have minimal effects on the wild mangrove ecosystem. It will also be important to limit fish production based on the extensive capture of wild fry of economically viable species and to prevent the use of poorly designed or non-species-specific fry harvesting gear. Hence, the proposal will be tailored to consider several aspects of fisheries, taking into account both the mangrove aquatic resource base and aquaculture practices.

Research themes will center on two commercial species of potential use in aquaculture: the snapper (*Lutjanus* sp.) and the grouper (*Epinephelus* sp.), given the potentially excessive utilization of fry from the wild for aquaculture and fishing activities that may lead to depletion of this important resource. Extended capture of fry based on inadequate information about the reproductive patterns of these species may lead to resource destruction and damage the future productivity of the ecosystems as a whole.



Studies on low-input procedures of aquaculture utilizing natural circulating supply systems

In wetlands that exist under mangrove trees, there is an abundant supply of nitrogen, phosphorus, silicates, and other elements. Large populations of phytoplankton and microorganisms depend on these nutrients and in turn act as an abundant microbial food source for shrimp, crabs and other crustaceans, as well as the fish and bivalves that are a source of livelihood for the people living in the area. Also, in brackish mangrove areas, there are a number of natural ecological effects that are advantageous to aquaculture, including the botanical cleaning and filtering of water and the inhibitory effects on the growth of pathogens created by competition with native species of microorganisms. Traditional onshore aquaculture methods based on the natural supply of microbial foods, which require a low frequency of feeding by fisherman, are already in existence in mangrove forests. In an experiment at the Mai Poh Wildlife Center in the northwestern New Territories of Hong Kong, seawater flows back and forth through the mangrove forest into culture ponds. Food microorganisms are carried in and waste products carried out by natural tidal action through the mangrove marshes.

This research project will study the development of low-input aquacultural procedures utilizing live food supplied from highly productive mangrove ecosystems, the composition and growth of live foods, their distribution in various types of mangrove forest, and their potential for use in aquaculture. Research will also cover the breeding of organisms to serve as live food.

With the aim of enabling minimal usage of pharmaceuticals in aquaculture, the project will study water purification by mangroves and the inhibitory effects on the growth of pathogenic microorganisms caused by antagonism among microorganisms and the effects on the improvement of the fish-rearing environment. Researchers will also examine the relationship between mangrove species diversity and production of microorganisms, nano-algae and predators.

Development of aquacultural procedures based on the use of new indigenous fish species of high commercial value

In Southeast Asia, large-scale intensive monoculture, particularly that of black tiger prawn, is being carried out with the short-term aim of generating maximum revenue. This results in frequent and serious problems, such as mass mortality caused by infectious diseases. To remedy this situation, in addition to developing low-input extensive aquacultural procedures as mentioned above, it is necessary to rear a wider spectrum of new profitable fish species to compensate the income loss caused by adopting more extensive culture systems. For these reasons, scientists are developing aquacultural procedures centering on new indigenous species of high commercial value. Researchers are working to improve breeding, larval production, and rearing procedures for new indigenous species with high commercial value.

economic benefits of new sustainable fish production systems in brackish mangrove areas

Income earned from fisheries or shrimp aquaculture in mangrove forests is about double that of conventional agricultural products on dry land. The income from conventional farms occupying the area inland from mangrove forests is 20 percent lower, with higher unemployment rates than in the mangrove forest. Clearly, there are economic advantages to establishing primary industries based on the mangrove ecosystem. However, in shrimp culture, a 'slash-and-burn' attitude still prevails; that is, fishermen prefer intensive shrimp culture leading to over-stocking, infection and mass mortality, rapid abandonment of failed culture ponds, and the construction of new culture ponds. From an economic viewpoint, although local fishermen are able to make short-term gains, this strategy does not lead to consistent income levels. Researchers hope to find a viable aquaculture system that will result in consistent income levels, while at the same time stay attuned to the mangrove ecosystems at a local and global level.

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 2000.

Dr. Osamu Ito

Dr. Osamu Ito, Director of the Environmental Resources Division received the award of the Japanese Society of Soil Science and Plant Nutrition for his work on improvement of crop production in the tropics through elucidation of crop nitrogen requirements. Dr. Ito's research clearly showed the significance of the contribution of biological nitrogen fixation by heterotrophic bacteria and *Azolla* in irrigated rice ecosystems. In additional research conducted in the semi-arid tropics, nitrogen use efficiency was shown to be improved by the adoption of appropriate cropping systems such as intercropping of cereal and leguminous crops and through the enhancement of nitrogen input from biological nitrogen fixation.

Dr. Kazuko Yamaguchi-Shinozaki

Dr. Kazuko Yamaguchi-Shinozaki, Senior Researcher in the Biological Resources Division received the Daily Yomiuri's Techno Forum 21 Gold Medal Award for her work on improving plant tolerance to drought, salt and freezing through genetic transfer. The Daily Yomiuri, one of Japan's major national newspapers, has lauded the development of super-tolerant plants as a significant contribution in the struggle to meet world food security issues in the coming century. In Dr. Kazuko Yamaguchi-Shinozaki's research, a single gene for a stress-inducible transcription factor, DREB1A, that regulates many stress tolerance genes was studied. It was found that overproduction of the DREB1A gene in transgenic plants activated the expression of many stress tolerance to drought, salt, and freezing. This gene can be used to genetically engineer stress-tolerant crops that are of importance in coping with the food crisis and environmental pollution.

JIRCAS AND THE MINISTRY OF AGRICU

MAFF Research Structure

The Japan International Research Center for Agricultural Sciences (JIRCAS) is one of twenty-nine research institutes belonging to the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Government of Japan. In this age, in which we have seen remarkable progress in advanced fields of science and technology including biotechnology, MAFF's research institutes are playing a key role in the development of new technologies to pave the way for further development of the food industry, and promotion of agriculture, forestry and fisheries activities in the twenty-first century. MAFF's institutes work in close collaboration with local governments, universities, and private research organizations and aim to contribute to the overall prosperity of Japan while making significant contributions to the international community.

Nineteen of the twenty-nine institutes including JIRCAS are directly overseen by the Agriculture, Forestry and Fisheries Research Council (AFFRC), which is a special agency attached to MAFF. The main duties of the AFFRC are overall research planning and coordination, liaison and coordination between research and administration, administration and guidance of the institutes, and research assistance to prefectural organizations and the private sector. The AFFRC is headed by a chairman, and its advisory members consist of independent university faculty members and previous MAFF research institute directors and high officials (Table 1). The remaining ten institutes, which include one institute devoted to forestry and nine fisheries research institutes, are also attached to the AFFRC. However, they are overseen by the Forestry Agency and the Fisheries Agency, administrative agencies under the direct supervision of MAFF. The overall structure of research at MAFF is as shown in Fig. 1.

JIRCAS is unique among the twenty-nine research institutes in that it serves as an international research center but is, at the same time, part of the MAFF infrastructure. Thus, it is involved in active exchange and collaboration with the other twenty-eight institutes. JIRCAS is located in the Tsukuba Science City, which is about 50 km northeast of Tokyo (Fig. 2). Many other MAFF institutes are also located in Tsukuba, and the AFFRC secretariat maintains a Tsukuba office, forming the Tsukuba Institutional Complex. Tsukuba itself is home to numerous other research institutes and experimental facilities belonging to other ministries and agencies of the Japanese Government, as well as to the private sector.

Table 1

Chairman	**Shigeru Motai**	**President, The National Association of Racing (NAR)**
Advisory Members	**Kazuo Takahashi**	**Governor, Yamagata Prefecture**
	Akinori Suzuki	**President, Akita Prefectural University**
	Takaharu Hatanaka	**President, Society for Techno-Innovation of Agriculture, Forestry, and Fisheries**
	Hiroshi Harada	**President, Yamagata Agricultural Research and Training Center**
	Satohiko Sasaki	**Dean, College of Bioresource Sciences, Nihon University**
	Takamitsu Sawa	**Professor of Economics, Institute of Economic Research, Kyoto University**

years in cooperation with Cantho University, the Cuu Long Delta Rice Research Institute, and the Southern Fruit Research Institute. The major objective of the project is to foster agricultural practices that are not only economically profitable but also ecologically sustainable as farming systems. Research topics within the project include a development component technology for farming systems in the areas of rice, livestock, fruit, and aquaculture production. Thus far, the project has begun to develop techniques for breeding salt-tolerant varieties and integrating pest management in rice and rice-based farming systems. As for livestock, techniques for feeding management in pig production and pathological diagnosis of porcine diseases have improved. Researchers have developed a model orchard to improve fruit production at an on-farm experimental site. Furthermore, a basic technology for prawn seed production has also been established. Lastly, methods for assessment of nitrogen cycling and evaluation are also in the development stages. Regarding the socioeconomic aspects of the study, researchers classified farming systems and analyzed the cause-effect relationship of the technical and economical problems in farming systems. The project also aims to create and evaluate sustainable farming systems that employ technology for environmental conservation and VACR farming systems and strives to put these technologies into practice through the establishment of model VACR farming and extension systems.

Members of JIRCAS attended a four-day workshop held at Cantho University in Vietnam from November 14 to 17, 2000, and later hosted an evaluation workshop for the project at JIRCAS in Tsukuba on February 7, 2001.

SOUTH AMERICA:

Soybean improvement, production and utilization

The soybean, *Glycine max*, is considered to be one of the principal crops for human sustenance. Soybeans provide a major source of food, oil, and protein-rich livestock feed. Production of this valuable crop has increased rapidly in the past three decades in comparison with that of rice, wheat, corn, and other major grains. Encouraging the continuation of this trend may aid efforts to stabilize the world food supply.

At present, Brazil, Argentina, and Paraguay (MERCOSUR countries) account for approximately one-third of global soybean production, placing them among the leading soybean export countries. However, soybean

No-tillage cultivation of soybean in Paraguay. (Photo: T. Taniguchi)

production in South America has often been carried out under environmentally vulnerable conditions in arid, acid 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.

Comprehensive, multinational research efforts focused on the development of sustainable and more efficient systems of soybean production in South America can be 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 the institute to promote multi-disciplinary 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, Brazil (EMBRAPA), the Ministry of Agriculture and Livestock, Paraguay (MAG), and the National Institute of Agricultural Technology, Argentina (INTA), 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 socioeconomic factors. In order to review the latest results obtained during the project and other related studies, the Soybean Research Center, EMBRAPA (Soja), and JIRCAS held a seminar on soybean research conducted at

Domestic institutional support of JIRCAS international collaborative research

JIRCAS's main role is to promote sustainable development of agriculture, forestry, and fisheries compatible with the preservation of the environment in developing regions of the world through integrated, collaborative research programs. In performing this role, JIRCAS aims to play an active part in the international community. JIRCAS collaborative projects in developing countries take a multi-disciplinary approach by focusing on each country's socioeconomic conditions when evaluating and implementing research programs. JIRCAS and local specialists carry out "comprehensive research" in an effort to address the region's most pressing agricultural problems. Domestic research at JIRCAS facilities in Japan, the JIRCAS visiting fellow program, and strong cooperation with international research institutes all contribute to and support these research efforts abroad.

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 targeting the specific needs of a 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 broaden its role into the initiation of research programs to effectively confront such pressing matters as sustainable agricultural development, food security, and environmental problems. At present, JIRCAS is conducting nine comprehensive projects around the world including in regions such as Southeast Asia, China, South America, and Africa. Each project is guided and administered by a working group and a project committee, which make ongoing adjustments as the project evolves. A JIRCAS staff member directs each project and is supported when necessary on short-term bases by researchers from other agriculture, forestry, and fisheries institutes.

JIRCAS maintains over 100 researchers, about 40 of which are on long-term research assignments abroad. Once a topic is decided upon, the details of the research project, such as its parameters, research aim, and length, are presented and the most suitable researchers are selected. When a project requires the long-term assignment of researchers from outside JIRCAS, those scientists participate as JIRCAS staff members for the duration of their assignment. JIRCAS staff members and scientists from other research institutions assist JIRCAS-centered research activities abroad on short-term bases of usually one to two months. Furthermore, about 40 JIRCAS researchers in Tsukuba, Ibaraki Prefecture and Ishigaki Island, Okinawa Prefecture support the international collaborative projects by conducting related domestic research.

In these ways, JIRCAS international collaborative research projects enjoy great support from the Ministry of Agriculture, Forestry and Fisheries' 29 affiliated research organizations and their 2,700 strong research staff. Finally, JIRCAS conducts an Annual Meeting for the Review and Promotion of Research for International Collaboration in order to ensure each project proceeds smoothly. In this meeting, the previous year's activities are evaluated and strategies and goals are set for the coming year's research.

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 and Vice-Chairman, Editors-in-Chief, Advisory Panel, and Editorial Committee, the Board receives the participation of a student intern from Harvard University's Japanese Language Program who serves as a Special Assistant to the Editors-in-Chief (front row: Nobuyo Yamaguchi, Marcy N. Wilder, Akinori Noguchi, Tadahiro Hayashi, Hollin Kretzmann; back row: Takaharu Hayashi, Shuichi Asanuma, Nobuo Ueno, Yukihito Ochiai).

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, national research organizations, and universities. When the Tropical Agricultural Resource Center (TARC), the predecessor of JIRCAS, was restructured to create the present institution, scientists launched a series of comprehensive projects that focused on responding to difficult agricultural problems such as developing sustainable agricultural systems and addressing food supply and environmental problems, 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 sponsor 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 several ongoing comprehensive projects. In keeping with this year's focus on Indonesia, this section highlights important research sites in Indonesia 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 2000, JIRCAS was involved in nine comprehensive projects in Indonesia, Vietnam, South America (Brazil, Argentina, and Paraguay), Thailand, the People's Republic of China, West Africa, and Malaysia. 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 state and then select several representative research fields and themes in which JIRCAS can best contribute toward the resolution of these problems. In addition, these projects promote comprehensive joint research through collaboration with the government of the partner state. Both the China and Brazil projects fall under this classification. Multinational comprehensive projects incorporate researchers in many fields from a wide region covering multiple countries in a cooperative effort to resolve strategically important issues. The projects in South America (soybeans) and West Africa (rice) 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, socioeconomic studies are conducted to identify research priorities in counterpart countries.

INDONESIA:

Evaluation and improvement of regional farming systems

Agricultural production in Indonesia varies greatly from location to location, depending upon the different natural, environmental and socioeconomic conditions in each locale. For instance, rapid economic growth, industrialization, and urbanization on the island of Java has exacerbated the economic gap between cities and villages and 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. 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 the shortage in rice production experienced during the past few years, have made the enhancement of food crop production, especially rice, maize, and soybeans in both lowland and upland areas, a priority for Indonesian agricultural research and development. In order to improve household economies and promote local agribusiness,

researchers are examining vegetable production, in particular that of temperate vegetables.

The comprehensive research project, "Evaluation and improvement of regional farming systems in Indonesia", aims to shed light on problems that Indonesian agriculture faces from a farmers' standpoint by evaluating both the socio-economic and technical aspects of past and current practices of farming systems research and extension (FSR&E). The project began in April 1998 and is scheduled to last for five years. Collaborating Indonesian research institutes working on the project include the Center for Agro-Socio Economic Research and Development (CASERD), the Central Research Institute for Food Crops (CRIFC), the Research Institute for Legume and Tuber Crops (RILET), the Center for Soil and Agroclimate Research (CSAR), and the Lembang Assessment Institute for Agricultural Technology (AIAT-Lembang). The participation of each of these institutes is under the overall coordination of the Agency for Agricultural Research and Development (AARD) of the Ministry of Agriculture of the Republic of Indonesia.

In March 2000, JIRCAS held a midterm review meeting and workshop to present the research results in the first two years. Based on discussions of research results in certain subject areas, project leaders decided that the project should concentrate on temperate vegetable-based farming systems. Accordingly, from fiscal year 2000, the Research Institute for Vegetables (RIV) and its supervisory organization, the Central Research Institute for Horticulture (CRIH), were added to the project as counterpart Indonesian research institutes.

Indonesian institutions and JIRCAS held meetings in July 2000 and March 2001 at Lembang to strengthen linkages and improve collaboration among the scientists of different disciplines. In September 2000, a workshop on evaluation of Indonesia soybean varieties for processing and improvement of fermented foods was held at RILET in Malang, for completion of this research subject.

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

Field survey at a vegetable farm. (Photo: K. Tsurumi)

VIETNAM:

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

After facing a difficult economic situation during 1998 and 1999 that threatened the remarkable strides it had made in the last decade, growth of the gross domestic product (GDP) in Vietnam increased from 3.8 percent in 1998, to 6.1 percent in 2000, and is expected to reach 6.4 percent in 2001, due to a recovery in domestic private sector demand and robust export performance.

The primary crop of the country is rice. In the past decade, rice production has rapidly expanded, aiding the country in becoming not only self-sufficient in rice, but also in becoming the world's second largest exporter. However, an export-oriented rice monoculture system is not the best model for rural development in such places as the Mekong Delta. Low rice prices, uncertain markets, poor marketing facilities, and competition with other rice exporting countries are drastically cutting farmers' incomes. Furthermore, intensive farming technologies have brought about many unexpected detrimental effects on the environment, prompting the Vietnamese government to encourage crop diversification as a means towards balanced development. Fortunately, various farming systems, including VACR (Vietnamese acronym: V; fruits and vegetables, A; aquaculture, C; livestock, R; rice) systems, have evolved in response to natural and socio-economic conditions of each area in the Mekong Delta.

Since its inception in 1999, a comprehensive project, "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta", has been carried out for two

EMBRAPA-Soja in December, 2000. JIRCAS hosted the project's mid-term evaluation meeting in March, 2001.

BRAZIL:
The development of sustainable agro-pastoral systems in sub-tropical zones

The subtropical 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 major form of agriculture, is at present extremely important to the food supply and economy of the country. Those living in subtropical areas of Brazil 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 input. As a result, the land in most of this area has become environmentally vulnerable, while production efficiency and agricultural technologies have remained at the same low levels. Plant growth retardation associated with continuous cropping, the occurrence of diseases, outbreaks of pests, and soil erosion threaten the agricultural production of this region and are the main obstacles precluding high levels of sustainability and productivity.

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 South America-based research programs. By emphasizing more effective land utilization through the adoption of crop-pasture rotation systems, this project aims to develop highly productive, 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 the International Center of Agricultural Technology (JATAK). In cooperation with JIRCAS, these institutes are conducting research on four themes, including analysis and evaluation of indigenous and traditional land utilization systems for agriculture, multidisciplinary studies on the adoption of sustainable crop-pasture rotation systems, socioeconomic evaluation of crop-pasture rotation, and newly developed agro-pastoral systems.

In 2000, JIRCAS dispatched two long-term researchers and six short-term researchers to CNPGC. Research subjects currently being studied as part of the project include 1) analysis and evaluation of traditional land utilization

Nelore cattle gathered by gauchos after grazing on agro-pastoral pastures. (Photo: T. Taniguchi)

systems for agriculture, 2) multidisciplinary studies for the adoption of sustainable crop-pasture rotation systems, 3) mixed and multiple cropping agricultural systems employing soybean as a 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) socioeconomic evaluation of crop-pasture rotation from the standpoint of farming systems, and 7) on-farm participatory research on newly developed agro-pastoral systems.

THAILAND:
Comprehensive studies on sustainable agricultural systems in Northeast Thailand

Among the four regions of Thailand, the northeast region is the largest, covering 170,000 km^2, or about one-third of country's total area. The northeast region's boundaries are defined by the Mekong River to the north and east, the Phetchabun mountain range to the west, and the Dongrak mountain range to the south. The Phupah Mountains, which run northwest to southeast, divide the region into two basins, the Sakon Nakhon and Korat basins. Both basins are characterized by a gently rolling topography with an elevation of approximately 200m.

The soils in Northeast Thailand are mostly sandy and coarse in texture with low inorganic matter content, low water-holding capacity, and low cation exchange capacity. Exchangeable potassium and available phosphorus are very limited. These soil characteristics represent low fertility and poor buffering capacity. The erratic rainfall patterns that vary extremely from year to year add still another constraint to agricultural production in the Northeast.

Due to these environmental limitations, agricultural production in the region remains low. In turn, the region's economic and social infrastructure has been slow to develop, leaving a majority of the area's farmers in the shadow of the modern age. Beginning in the 1960s, the

Aerial view of landscape typical of Northeast Thailand (Photo: K. Matsuo)

amount of cultivated farmland was expanded through extensive deforestation. Rain-fed rice became the major crop, followed by cassava and kenaf. Recently, sugarcane cultivation has also expanded. To meet an increased demand for meat and milk products, the livestock industry has been gradually developed using newly bred, large-size ruminants that possess higher productivity than local breeds. However, because of the depressed international market for agricultural products, the rapid introduction of cash-oriented agricultural production has not led to an increase in farm income. In addition, soils lacking the protection of forest root structures and canopies have been directly exposed to rainfall and thus have been prone to erosion. The depletion of nutrients and organic materials from soils has occurred rapidly, making many believe that the agricultural lands in many parts of Northeast Thailand are less productive than in the past.

In order to further develop agriculture in the region, it is necessary to shift the present agricultural system from one that depends highly on a few cash crops to a more sustainable system in which diverse cropping options are combined with more efficient utilization of local resources. The seven-year project, "Comprehensive studies on sustainable agricultural systems in Northeast Thailand" was initiated in 1995 in order to promote the technological development of rice, field crop, vegetable, livestock, and sericulture industries, and also to advance the conceptual development of a sustainable agricultural system that combines multiple farming with animal husbandry. The project has operated in close collaboration with Thai partners, including Department of Agriculture (DOA), Department of Livestock Development (DLD), Land Development Department (LDD), International Training Center for Agricultural Development (ITCAD), and Khon Kaen University (KKU).

The project has entered its sixth year, a year shy of completing its current phase. To ensure its successful completion, emphasis has been placed to further promote interaction within the project between socioeconomic research themes and technological development for rainfed lowland rice cropping and integration of upland cropping and livestock. To enhance communication among scientists with different research backgrounds, a workshop entitled "Linkages between biological and social science research in the Northeast Thailand comprehensive project" was held on June 16, 2000, at the International Training Center for Agricultural Development (ITCAD) in Khon Kaen. Researchers organized another workshop held on November 21 of the same year in Nakhon Ratchasima to finalize the research outputs related to sericultural components that were incorporated into the project as a part of postharvest technology development. The annual project meeting was also held on November 22 and 23 at ITCAD for a thorough discussion on experimental results obtained during the 1999-2000 period, followed by a research management meeting during which research managers from various counterpart organizations proposed and discussed the research themes for the next phase of the project.

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

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 comprehensive project aims to develop technologies for sustainable production and utilization of major food resources in China. Such 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 little agreement concerning future scenarios for food production and demand. This lack of agreement is most likely due to

differences in underlying assumptions, data, and estimation processes. Nevertheless, there does exist a sufficient consensus that China's food demand will increase continuously over the next three decades, and that available food supplies will not meet this demand. Consequently, rising demand for imported foodstuffs will likely occur. Major factors inhibiting agricultural production increases in China include the area of arable land, the poor quality of farmland, the weak response of soils to fertilizer, and the small-ownership structure of private Chinese farms. Due to rapid economic growth, it is inevitable that more 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 influencing 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 shrinkage of agricultural resources and the natural, structural, financial, and economic constraints on yield potentials, demand for food in China will continue to rise and agricultural production will persistently 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 of agricultural products 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 supplies and meet the demands in selected areas, the project will also have to generate a supply and demand modeling structure for food resources, develop a system analysis of corresponding farming areas and agricultural products, and design more effective control systems.

On February 1, 2001, JIRCAS organized a two-day mid-term review meeting and workshop for the project. A workshop prior to the review meeting was planned in order to facilitate the reviewers to understand the significance and the future development of this project in China (see Symposia and Workshops). During the review meeting, Japanese scientists presented major research results according to eight research programs and proposed to integrate two programs that are closely related each other

Flea market on the grounds of the China Agricultural University in Beijing. (Photo: E. Tatsumi)

under areas of socioeconomic study. After the meeting, all five reviewers gave favorable evaluation comments. The recommendations of the reviewers emphasized the integrated contribution of diverse research programs to Chinese food resources 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 following review meeting will improve the mutual understanding of the collaborative research project and contribute to its successful implementation in the second half of the comprehensive research project.

WEST AFRICA:
Improving food security through increased production in rainfed rice systems

The demand for rice in sub-Saharan Africa is growing faster than that for any other major food staple, with consumption expanding across all socioeconomic 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 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 5.6 percent between 1961 and 1992.

Increased rice production in Africa is hampered by a number of constraints such as disease, pests, weed infestation, inadequate water management, soils with low fertility, lack of suitable rice varieties, and socioeconomic 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 ecopysiological 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

production constraints associated with each species. In order to develop new cultivars for the region that 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 selection system in selecting desirable interspecific rice progenies.

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 those will be further confirmed in the coming years. Microsatellite markers provided by Cornell University have proved to be very useful in detecting polymorphism in interspecific populations and have presented a promising future for use in marker-assisted selection. Both African and Asian rice genotypes showed a large variation in responses to phosphorus application, aluminum toxicity, and excess iron. Therefore, genetic selection is possible for desirable traits in the both species.

The second facet of the project involves studying the socioeconomic aspects in relation to sustainability of lowland 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 effectively adopt new technology. The targeted areas for this survey are lowland regions that currently have no modern irrigation systems, but possess significant potential for improved water control. This year JIRCAS focused on analysis of how the land tenure system affects the adoption of rice cultivation in the areas where biophysical conditions are suited for rice cultivation. Close to 200 villages were covered in this extensive survey. Statistical analysis indicated that market access, population density, and the proportion of immigrants from other regions are positively correlated with adoption of rice cultivation in lowlands. It was further noted that privatization of land ownership also promoted rice cultivation in lowlands. Surprisingly, there was no correlation between land ownership and adoption of intensive rice cultivation techniques. A similar project was initiated in Ghana to expand the scope of the study on rice cultivation adoption under specific socioeconomic conditions.

MALAYSIA:
Development of agroforestry technology for the rehabilitation of tropical forests

With excessive commercial logging and cutting of trees for fuel and the increasing exploitation of arable land necessary for food production, natural forests have been rapidly degraded and decreased. As a result, forests having a high level of biodiversity were transformed into monoculture plantations with fast growing trees, such as rubber trees or oil palms, particularly in developing countries. These commercial activities, which include unsustainable forest harvesting, repeated short-term shifting cultivation, and forest fires, have had a considerable impact on the forest ecosystems and have resulted in losses of flora and fauna, erosion, flooding, deterioration of forest resources, and soil degradation. These practices have also brought about 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 conservation and utilization of forest resources. Forest rehabilitation and enrichment of denuded and degraded lands are the first steps in realizing sustainable management of a forest.

JIRCAS has been playing a significant role

Dipterocarp forest destroyed for development purposes in Malaysia. (Photo: Y. Maruyama)

in alleviating forest degradation by focusing its efforts on methods of reforestation and ways to motivate local inhabitants to participate in reforestation activities. JIRCAS conducts research on methods for the establishment of fast-growing species as shelter wood for the growth of valuable indigenous trees in collaboration with the College of Forestry, part of the University of the Philippines at Los Banos (UPLB). Studies on the regeneration of *Shorea* species seedlings on logging road and on the improvement of logging techniques for selective management systems are carried out in collaboration with the Forest Research Institute of Malaysia (FRIM).

Based on past experiences, JIRCAS proposed a collaborative research project entitled "Development of agroforestry technology for the rehabilitation of tropical forests". This project will be implemented mainly in collaboration with the Forest Research Center, Forestry Department in Sabah, Malaysia, and the UPLB. The ultimate objective of the project is to establish a technological base for the on-going 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 to the mitigation of agriculture-forestry conflicts as well as promoting environmental conservation and sustainable forest resource management.

Over the seven-year duration of the project (2000-2006), specific objectives will include socioeconomic 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 the start of the collaborative project, a half-day workshop was held on September 1, 2000 at JIRCAS in Tsukuba, Japan in order to facilitate mutual understanding of the project through the exchange of valuable information and to discuss future development of the project.

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

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

Rice bags stored inside a mill factory, a hotbed of insect pests. (Photo: K. Takahashi)

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 insects and has had only marginal insecticidal value. Many countries have been making efforts to develop alternative methods for disinfesting agricultural products such as grains and fruits and vegetables. The technologies for reducing postharvest losses need to be not only environment-friendly but also affordable to small farmers and rural enterprises in Southeast Asia.

The five-year project (2000 to 2004) is designed to develop disinfestation methods for grains by employing natural insect enemies and botanicals and utilizing low-input drying technologies using natural energy sources such as sunlight, husk, and straw. With cooperation from the National Agricultural Research Stations affiliated with the Thai Department of Agriculture, Kasetsart University, and King Mongkut's University of Technology, as well as Japanese institutions such as National Food Research Institute (NFRI), National Institute of Agro-environmental Sciences (NIAS) and National Agriculture Research Organization (NARO), the project will focus on (1) analyzing the causes of postharvest deterioration of agricultural crops and (2) developing and systemizing low-input technologies for reducing postharvest losses. These technologies will help establish a more effective and cost-efficient system of minimizing postharvest losses of crops that are essential to Southeast Asian countries.

RESEARCH SITES IN INDONESIA

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

Research collaboration with CASERD

In August 1996, a Memorandum of Understanding (MOU) was signed between the Agency for Agricultural Research and Development (AARD), part of Indonesia's Ministry of Agriculture, and JIRCAS to organize a comprehensive cooperative network.

The Center for Agro-Socioeconomic Research and Development (CASERD), formerly known as the Center for Agro-Socioeconomic Research (CASER) until the beginning of 2001, is one of five research institutes belonging to the AARD. A five-year comprehensive research project entitled "Evaluation and improvement of regional farming systems in Indonesia" started under the JIRCAS-CASER collaborative research agreement in April 1998.

The joint project revolves around two plans of operation, the first being "A study on the farmer-state linkages in upland farm development in Indonesia", which commenced in April 1998, and the second entitled "An evaluation of vegetable-based farming systems and improvement of vegetable and fruit cultivation in highland regions of West Java", which was initiated in April 2000.

The former plan aimed to trace the history of farming systems research (FSR) development in Indonesia and to conduct an in-depth case investigation of the extent of farmers' participation in ongoing FSR activities. The JIRCAS-CASER international workshop on "Learning from the farming systems research experiences in Indonesia" took place in Bogor in March 1999. The proceedings were later published as "JIRCAS Working Paper No.18".

The latter plan has many collaborative research subjects. One subject shared between CASERD and JIRCAS is entitled "Evaluation of vegetable-based farming systems from the viewpoint of rural socioeconomics in highland regions of West Java". The research is separated into two components: (1) the historical review of the development of temperate vegetable production and prediction of future development, and (2) the analysis and evaluation of marketing systems of temperate vegetables in West Java. The Central Research Institute for Horticulture (CRIH) and Research Institute for Vegetables (RIV) also participated in the latter plan, assisting CASERD and JIRCAS through much of the project.

Discussion with farmers at a research site in Indonesia. (Photo: S. Kosugi)

Center for Agro-Socioeconomic Research and Development (CASERD)

CASER, a second echelon of research institutions under the AARD, previously known as the Center for Agro-Economic Research (CAER), was established in 1974. After organizational revisions, CAER officially became CASER in 1990. Four years later, CASER received a mandate to manage 11 units of the Assessment Institute for Agricultural Technology (AIAT), and 6 units of the Local Assessment Institute for Agricultural Technology (LAIAT). Each AIAT and LAIAT unit has subsidiaries known as Research and Assessment Installation of Agricultural Technology (RAIAT). There are 101 units of RAIAT spread throughout the country. In 2001, CASER, changed its name to the Center for Agro-Socioeconomic Research and Development (CASERD).

CASERD's main task is to implement all agro-socioeconomic research activities in Indonesia. It is expected that CASERD will be able to provide information and policy alternatives in regard to the growing various agro-socioeconomic problems at national, regional or international levels.

CASERD manages the Functional Title Group and Technical Services Unit (AIAT/LAIAT) and three research groups: (1) Agricultural Development Policy Analyses, (2)

Resource Management and Agribusiness Systems, and (3) the Institutional and Agricultural Organization.

By 1999, the total number of CASERD employees reached 242, including 23 Ph.D.- and 50 MS-level scientists. Thirteen of the 242 staff members currently hold various strategic government offices and 16 of them are undergoing long-term training.

Research conducted by CASERD (1999-2004) can be grouped into five major programs: research on (1) natural resource management and sustainability of farming systems, (2) agricultural commodity systems, (3) incentives, production, investment, and trade policy, (4) institutional, agricultural, and rural organizations, and (5) agricultural diversification, cross-sector dynamics, and regional development.

Research on natural resource management and sustainability of farming system is further divided into the following research topics: (1) optimization of natural resources use, (2) labor economics, (3) impact of the technology on agro socio-economic aspects, and (4) assessment and development of farming systems.

The sub-themes of research on agricultural commodity system are (1) the dynamics of agricultural commodities demand, (2) the dynamics of agricultural commodities supply, (3) the identification of the advantage agricultural commodities, and (4) food security.

Research on incentive, production, investment and trade policy is divided into three subjects as follows: (1) price policy on agricultural output and input, (2) marketing and trade policy for agricultural commodities, and (3) farm finance policy.

The sub-themes of research on institutional, agricultural, and rural organizations are (1) farm institutions, (2) sociology of agricultural and rural communities, and (3) socioeconomic construction of society.

Research on agricultural diversification, cross-sectoral dynamics, and regional development is divided as follows: (1) agricultural diversification, (2) regional trade, (3) sectoral interrelatedness, (4) regional development policy, and (5) poverty issues.

CASERD has participated in collaborative research with various institutions, including government institutions, private research institutions, universities, and national and international research institutions. From these collaborative efforts, CASERD hopes and expects to improve research on agricultural sector policy.

Research Institute for Vegetables(RIV)

The total area of Indonesia is 1,920,000 km^2, over 5 times the size of Japan. The country is composed of 13,700 islands, spanning 5,100 km along the equator from east to west and 1,900 km from north to south. Despite covering such a large area, the climate and temperature is relatively constant throughout the country, and is atypically mild for its tropical location because of its mountains and oceanic climate. The many volcanoes in the vicinity of big cities provide suitable highlands for temperate vegetable production and function as important bases for supplying various kinds of vegetables to city residents. Altitude and rainfall are very important natural factors for vegetable production, the latter factor revolving around the country's two seasons, dry and rainy.

Sixty percent of the nation's two hundred and twenty million people live in Java Island's large urbanized areas such as Jakarta, Surabaya, and Bandung. Due to this urbanizing population, production and consumption of temperate vegetables have been considerably intensified. Increases in highland vegetable production and continuous cropping are causing many problems such as a decline in production, water pollution, soil erosion, damage to forests, and residual effects of farm chemicals used on vegetables.

The Research Institute for Vegetables (RIV) is located 1,250m above sea level in Lembang, near the capital of West Java, Bandung. The area around RIV is characterized by highland vegetable production and is now one of the biggest production bases for vegetables. Because of the elevation, weather in the area is moderate and less fluctuating. RIV was founded as the Margahayu Experimental Garden in Lembang in 1940. In 1962, the

RIV's main building and a field showing the usage of mulching film.

institution changed to the Horticultural Research Institute, becoming a branch of the Pasar Minggu Horticultural Research Institute. In 1980, the institute was reorganized to form the Lembang Research Institute for Food Crops. Then in 1982, in response to the increased importance and priority of vegetables in Indonesia, it was renamed as the Lembang Horticultural Research Institute. Following reorganization of the Agency for Agricultural Research (AARD), its supervising organization, the institute was specialized and narrowed its focus on vegetables and became the current institution, the Research Institute for Vegetables (RIV), also known as the Balai Penelitian Tanaman Sayuran (BALITSA), in 1995.

There are 201 staff members, including 62 researchers. The facility boasts a 50 hectare experimental garden, containing laboratories for soil, tissue culture, postharvest, and pest and disease together with greenhouses and screened houses. Utilizing these facilities, research activities at RIV cover a wide range of topics on vegetables, from breeding and seed technology to socio-economy. The research programs are often implemented on local farmers' fields. For example, integrated pest management tactics, designed in both highland and lowland vegetables, are disseminated to farmers through IPM field schools.

Breeding is one of the most important activities in RIV, and related research has resulted in some high yielding varieties and promising cultivars of many kinds of vegetables such as potatoes (Cipanas, Cosima, Segunung, Granola Lembang), tomatoes (Berlian, Intan, Ratna, Mutiara), Chinese cabbages (Sangihe, Talaud), amaranths (Giti Merah, Giti Hijau), kangkong (Sutera), yardlong beans (KP1, KP2, Usus Hijau), and clones of the true shallot seed (No. 33, 86, and 88). True potato seed progenies (Atzimba/DT033, Atzimba/R-128.6, HPS-7176) have been developed with cooperation between JIRCAS and local and international research institutes. RIV also is making efforts toward the conservation of genetic resources (germplasm). Another focal point of RIV is seed technologies, through which pathogen-free seed tubers such as potato have been developed. In addition, technologies related to balanced fertilization, fertigation systems, and off-season crop management have been tested for potato cultivation in medium altitudes, and for vegetable cultivation in marginal lands. Integrated pest management is arguably the most important subject in crop management given the high cost of chemical use and the severe environmental problems caused by vegetable cultivation. Thus, special attention has been paid on natural mortality factors, selected pesticides use based on the systematic monitoring and potential interaction among various control tactics, cultural practices, weather, and pests.

In pre-harvest and postharvest technologies, RIV has made significant strides in handling and processing tomatoes and cabbage, packaging vegetables, diffusing light storage facilities for potatoes, and storing shallot to postpone sprouting. Through research activities in production, consumption, and socioeconomics at RIV, vegetable farming databases and vegetable data banks in Java, Bali, Lombok and Sumbawa have been made available.

Research Institute for Legume and Tuber Crops (RILET): A national center for soybean research

Soybean is one of the most important staple foods in Indonesia. Soybean foods such as "tempe", a fermented soybean food, tofu, "kecap", an Indonesian soy sauce, and "tauco", an Indonesian fermented soybean paste, are of great significance to the diet of Indonesians as low-cost sources of proteins and seasonings. In 1998, Indonesia produced about 1.3 million tons of soybeans, but approximately 0.6 million tons of soybeans had to be imported to cover the supply deficiency. Therefore, the Indonesian government has been encouraging domestic soybean production. The Research Institute for Legume and Tuber Crops (RILET), formerly the Malang Research Institute for Food Crops (MARIF), has aided these efforts by conducting research on food legumes, including soybean and tuber crops.

RILET is one of five national research institutes for food crops coordinated by the Central Research Institute for Food Crops (CRIFC) in Bogor, an institute under the direction of the Agency for Agricultural Research and Development (AARD), a division of the Ministry of Agriculture. Located in Malang, about 90 km south of Surabaya in East Java, RILET employs approximately 260 staff members, 93 of which are researchers working

Research Institute for Legume and Tuber Crops (RILET), Indonesia

for the institute. All researchers are affiliated with one of five research groups, based on their respective fields of study as shown in the Table.

To support and conduct research activities, RILET maintains six laboratories for plant breeding, agronomy, soil and plant analysis, phytopathology (mycology, bacteriology, virology, nematology), entomology, and food technology and chemical services. The institute also has cold storage facilities used to maintain legume germplasm collections consisting of more than 1,000 types of soybeans, 400 types of groundnuts, and countless other species. Cassava and sweet potato germplasm are maintained in their natural living state as part of this collection.

Since 1993, JIRCAS has sent to RILET three long-term researchers; a nematologist (1993 – 1995), a soybean breeder (1995 – 1998), and a food scientist (1997 – 2000), to carry out three joint research projects on nematology and soybean cultivation entitled "Studies on the incidence and control of nematodes infesting major upland crops in Indonesia", "Methods of cultivation of soybean in cropping systems with low input (pesticides) in Indonesia", and "Evaluation of Indonesian soybean varieties for the processing and improvement of fermented foods".

A RILET-JIRCAS workshop on soybean research was held on September 28, 2000 to present and review the results obtained through the recent collaborative research and related studies, as well as to discuss future strategy on soybean research in Indonesia. Forty scientists from related Indonesian institutes, the Japan International Cooperative Agency (JICA), and JIRCAS participated in the workshop.

Southeast Asian Regional Research Program

The International Center for Research in Agroforestry (ICRAF), located in Nairobi, Kenya, was established in 1977. ICRAF coordinates research and training programs related to agroforestry systems. In 1992, ICRAF initiated a regional research program in Southeast Asia, establishing its regional headquarters in Bogor, Indonesia, at an altitude of 2,500 meters, 60 km south of Jakarta.

The ICRAF Southeast Asian regional research program develops alternatives to unsustainable slash-and-burn agriculture and examines methods to rehabilitate degraded land. Tropical forests have been greatly damaged by slash-and-burn practices, which shift cultivation and tree crops cultivation (rubber, oil palm, coconut). In Asia, most slash-and-burn activity is a done by tree crop smallholders, large corporate operators, and government-sponsored resettlement projects.

The five research groups of RILET and their disciplines.

Research group	Discipline
Socioeconomics	Socioeconomic evaluation of component technology generated by RILET
Plant breeding and germplasm	Exploration, evaluation, maintenance and utilization of legumes and tuber crops germplasm for breeding
Plant ecophysiology	Physiological and agronomic aspects, cultural practice, agroecosystem and environmental analysis
Entomology and phytopathology	Bio-ecology, epidemiology, biological control of pests and diseases and component technologies of IPM (integrated pest management)
Postharvest technology	Postharvest technology and mechanization for legumes and tuber crops

The Alternatives to Slash-and-Burn (ASB) program, started in 1992, examines the global environmental effects of slash-and-burn and evaluates technological and policy options to alleviate those effects. Nine international research centers and 62 national research institutes, universities and other organizations have adopted the program, thanks in part to the help of the Consultative Group on International Agricultural Research. ICRAF has become the convening center for these institutions participating in the program. ICRAF-Southeast Asia has conducted research for the ASB program in two locations in Indonesia. The first, Jambi, is located in Central Sumatra and has a low population density with a forest margin. The second, North Lampung, is located in South Sumatra and has a high population density, and is characterized by degraded lands.

From 1997 to 2000, JIRCAS and ICRAF coordinated studies on the relationship between tree crop smallholders (the main culprits of slash-and-burn activity) and deforestation. Field investigations were conducted in five villages in Jambi. The first focus of the studies was the impact of road construction and reconstruction on deforestation processes. The aim of this work

Interview with key persons in the study village in Jambi of central Sumatra, Indonesia

was to investigate how road building that facilitates the transportation of rubber also accelerates the development of rubber production activities in the forest by local smallholders. The second focus was on the effects deforestation had on land inequality. The study examines the impact of deforestation on land scarcity, the commercialization of land, and land inequity among local populations. The third and final focus of the studies relates to the changes in land use by local communities in response to deforestation. The objective of this work is to analyze changes in land use, such as intensification of farming systems.

This collaborative research is expected to make positive contributions toward improving the present forestry policies of the Indonesian Government by enabling researchers to more effectively combat poverty and create a sustainable forest management system in Indonesia.

Research Institute for Coastal Fisheries

The total aquaculture production in Southeast Asia increased from 1.12 million metric tons in 1984 to 2.45 million metric tons in 1995. Southeast Asia's contribution to global aquaculture production in 1995 was 8.8 percent by weight and 15.3 percent by value. Indonesia, Thailand, Vietnam, Malaysia, and Myanmar contributed 29.4, 18.9, 9.0, 5.4, and 3.0 percent by weight, respectively. However, in terms of value, Thailand ranked first in 1995 with a share of 29.3 percent, while Indonesia and the Philippines accounted for 28.8 and 19.6 percent, respectively. To a large extent, the relative production of high-value species such as penaeid shrimp accounts for these differences in the countries mentioned. Indonesia and the Philippines contributed over half (53.5 and 51.5 percent, respectively) of fish to total animal protein consumption in 1993. Thus, aquaculture plays a significant role in local food fish production and animal protein consumption in most countries in this sub-region.

Courtyard of the Research Institute for Coastal Fisheries. (Photo: T. Shimoda)

The Research Institute for Coastal Fisheries (RICF) is located in Maros, South Sulawesi (Sulawesi Island), Indonesia. Though it was named the Research Institute for "Coastal" Fisheries, the institute itself is enclosed by rice fields, far from a coastal area, a consequence of its predecessor being a research institute for freshwater fisheries science. Currently, the Research Institute for Freshwater Fisheries has moved to Sukamandi (Java Island). The Research Institute for Coastal Fisheries in Jakarta and the Research Stations for Freshwater Fisheries in Gondol (Bali Island) and in Palembang (Sumatra Island) make up the other institutions under the supervision of the Central Research Institute for Fisheries in Jakarta.

Originally, when collaborative research between JIRCAS and RICF started in 1996, RICF was overseen by the Ministry of Agriculture, but since September 2000, the newly established Ministry of Marine Affairs and Fisheries became the institution's administrator. RICF has also conducted joint research and research visits with the Australian Center for International Agricultural Research (ACIAR).

In the aquaculture of the brackish and seawater regions of Indonesia, the black tiger prawn (*Penaeus monodon*) is the most economically valuable species according to 1998 FAO data, despite the fact that the species is only the third most produced species in terms of volume, behind the milkfish and red seaweed. The productivity decrease in prawn aquaculture, a viable way of acquiring foreign currency, is a serious problem in Indonesia and all of Southeast Asia. Focusing on shrimp aquaculture, dozens of researchers are engaged in fisheries research in the coastal region, which includes the mangrove and coral reef areas. At a large experimental site in Marana near the laboratory, they have conducted research to find solutions to such problems as disease, wastewater treatment, and soil pollution that occur when intensive aquaculture is increased. Moreover, research on the milkfish, a favorite food among local people, is being conducted. Researchers are also examining marine aquaculture using an aquaculture raft in Baruu located within two hours from the laboratory by car. JIRCAS has dispatched a researcher who has worked at this location since 1996, where RICF and JIRCAS continue to carry out collaborative research. The two institutions conducted research concerning fish ecology for the first two-and-a-half years, and a study of the nutrient cycle of the tropical coastal areas for the following two-and-a-half years.

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), 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 a sustainable agro-pastoral system in the subtropical zone of Brazil	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, Shanghai Fisheries University, the Soil and Fertilizer Institute (SFI) and the Soybean Institute of the Jilin Academy of Agricultural Sciences (SIJAAS), People's Republic of China
1997-2006	Comprehensive soybean research project in South America (multinational)	Agricultural Technology Center in Paraguay (CETAPAR), Paraguay; Brazilian Agricultural Research Corporation (EMBRAPA), Brazil; and the National Institute for Agricultural Technology (INTA), 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 Delta Rice Research Institute (CLRRI), Cantho University (CTU), and the Southern Fruit Research Institute, (SOFRI), Vietnam
2000-2004	Development of agroforestry technology for conservation of tropical forest	Sabah Forest Research Center, Malaysia
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

(B) UNIDISCIPLINARY

Time Frame	Project Title	Research Site
1996-2000	Development of technology for sustainable management of grasslands in Central Asia	Kazakh Institute of Agriculture, Republic of Kazakhstan
1996-2000	Development of effective water management in paddy fields in the dry season	International Irrigation Management Institute (IIMI), Sri Lanka
1996-2000	Improvement of logging techniques in hill dipterocarp forests	Forest Research Institute Malaysia (FRIM), Malaysia
1997-2000	The role of local people in the degradation and rehabilitation of tropical forests	International Center for Research in Agroforestry (ICRAF)-Southeast Asia, Indonesia
1997-2000	Improvement of high-yielding wheat varieties through biological procedures	International Maize and Wheat Improvement Center (CIMMYT), Mexico
1997-2000	Studies on technology for sustainable production in closed coastal zones	Kasetsart University, Thailand
1997-2000	The development of methods for the use of under-utilized timber resources in the tropics	School of Industrial Technology, Universiti Sains, Malaysia
1997-2001	Development of diagnosis and prevention technology for shrimp viral diseases	Fisheries Research Institute (FRI), Malaysia
1997-2002	Investigation of the roles of TNFα in the course of trypanosomiasis	International Livestock Research Insitute (ILRI), Kenya
1998-2000	Studies on the feeding management of cattle and poultry in South America	Brazilian Agricultural Research Corporation (EMBRAPA), Brazil
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
1998-2000	Studies on material processing cycles in tropical coastal areas	Research Institute for Coastal Fisheries (RICF), Indonesia

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), 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 a sustainable agro-pastoral system in the subtropical zone of Brazil	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, Shanghai Fisheries University, the Soil and Fertilizer Institute (SFI) and the Soybean Institute of the Jilin Academy of Agricultural Sciences (SIJAAS), People's Republic of China
1997-2006	Comprehensive soybean research project in South America (multinational)	Agricultural Technology Center in Paraguay (CETAPAR), Paraguay; Brazilian Agricultural Research Corporation (EMBRAPA), Brazil; and the National Institute for Agricultural Technology (INTA), 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 Delta Rice Research Institute (CLRRI), Cantho University (CTU), and the Southern Fruit Research Institute, (SOFRI), Vietnam
2000-2004	Development of agroforestry technology for conservation of tropical forest	Sabah Forest Research Center, Malaysia
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

(B) UNIDISCIPLINARY

Time Frame	Project Title	Research Site
1996-2000	Development of technology for sustainable management of grasslands in Central Asia	Kazakh Institute of Agriculture, Republic of Kazakhstan
1996-2000	Development of effective water management in paddy fields in the dry season	International Irrigation Management Institute (IIMI), Sri Lanka
1996-2000	Improvement of logging techniques in hill dipterocarp forests	Forest Research Institute Malaysia (FRIM), Malaysia
1997-2000	The role of local people in the degradation and rehabilitation of tropical forests	International Center for Research in Agroforestry (ICRAF)-Southeast Asia, Indonesia
1997-2000	Improvement of high-yielding wheat varieties through biological procedures	International Maize and Wheat Improvement Center (CIMMYT), Mexico
1997-2000	Studies on technology for sustainable production in closed coastal zones	Kasetsart University, Thailand
1997-2000	The development of methods for the use of under-utilized timber resources in the tropics	School of Industrial Technology, Universiti Sains, Malaysia
1997-2001	Development of diagnosis and prevention technology for shrimp viral diseases	Fisheries Research Institute (FRI), Malaysia
1997-2002	Investigation of the roles of TNFα in the course of trypanosomiasis	International Livestock Research Insitute (ILRI), Kenya
1998-2000	Studies on the feeding management of cattle and poultry in South America	Brazilian Agricultural Research Corporation (EMBRAPA), Brazil
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
1998-2000	Studies on material processing cycles in tropical coastal areas	Research Institute for Coastal Fisheries (RICF), Indonesia

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) 2000.

RESEARCH INFORMATION DIVISION

The Research Information Division fulfills three main responsibilities relating to research operations at JIRCAS. First, the Division collects and analyzes information pertaining to socioeconomic conditions and the state of agricultural sciences in developing countries. Second, it attempts to formulate and coordinate collaborative research projects with public and private organizations in developing countries. In recent years, this role has grown in relative importance as JIRCAS has become increasingly involved in large-scale, comprehensive research projects with countries throughout the world. Finally, the Division has assumed the responsibility of developing and operating a database at JIRCAS.

The Division's research coordinators and senior scientists undertake the above tasks with two distinct perspectives in mind. The first perspective is a strategic one, which focuses on critically important world regions, including China, West Africa, Latin America, and monsoonal, semi-arid and arid areas in Asia. The second perspective concentrates on particular issues, with an emphasis on global problems related to environmental degradation, food insecurity, and unbalanced patterns of rural development. Combining these two perspectives, research coordinators in the Research Information Division conduct studies on agriculture in specific regions and consider the prospects for collaborative studies. They design and coordinate comprehensive projects in which scientists representing different disciplinary backgrounds can work together toward common goals. Since the establishment of JIRCAS, ten major comprehensive projects have been implemented.

In 1994, JIRCAS launched its first comprehensive research project in Vietnam in order to promote greater efficiency in combined farming systems currently used in the Mekong Delta region. Following the conclusion of Phase I of this project in 1998, JIRCAS initiated Phase II in order to implement on-site trials and farming system evaluations in Fiscal Year (FY) 1999. In 1995, the Division began comprehensive projects focusing on tropical brackish water ecosystems in Malaysia as well as sustainable agricultural technology development projects in Northeast Thailand. The Malaysian project concluded in 1999 and obtained a number of findings in the area of brackish water ecology. During 1996, another comprehensive project began involving sustainable agro-pastoral rotation systems in subtropical Brazil. In FY 1997, the Division initiated two more comprehensive projects, one targeting sustainable production and processing of major food resources in China and the other investigating new technological developments for soybean production and utilization in South American countries. In addition, the Division launched comprehensive projects on rice development in West Africa and farming systems in Indonesia in FY 1998. During 2000, JIRCAS initiated two ongoing comprehensive projects. One is an a agro-forestry project for regeneration of tropical forest in Malaysia, and another is a project for the reduction of post-harvest loss for cereals in Thailand. Moreover, JIRCAS began preparations for the implementation of a sustainable aquaculture project in brackish water area in the Philippines, Malaysia, and Thailand, which is scheduled to begin in FY 2001.

The Research Information Division is also involved in analyzing global issues. In collaboration with the Food and Agriculture Organization (FAO) and other international agencies, the Division has assisted in the development of a sophisticated world food model that can be used to project world food supply and demand and to simulate the effects of proposed

City market in Vientiane, Cambodia. (Photo: T. Hidaka)

policy changes on food resources. Findings derived from ongoing collaborative research projects at JIRCAS are often incorporated into these forecast simulations. Currently, researchers are attempting to expand the model so that the impact of environmental changes and resource constraints can also be analyzed. In addition, researchers within the Division are studying rural development strategies, with particular emphasis on farming systems research, by reviewing recent development strategies and assisting researchers in the natural sciences who are currently involved with integrated rural development projects.

Another important task of the Division is to develop and operate JIRCAS's computer-based databases. Since 1996, the Division has operated a comprehensive statistical database on agriculture, forestry and fisheries, which contains data from many international agencies. The Division also maintains bibliographic and photo (slides) databases on tropical agriculture.

Finally, the Division serves as the secretariat for numerous international seminars and workshops that JIRCAS researchers conduct throughout the year. The largest of these is the JIRCAS International Symposium, which addresses topics of central importance to agricultural research. In FY 2000, the international symposium, "Agricultural Technology Research for Sustainable Development in Developing Regions" was held as a part of TARC-JIRCAS 30th anniversary. JIRCAS formerly operated under the name TARC (Tropical Agriculture Research Center). In all, 328 participants from 32 countries attended the commemorative symposium. (See "Symposia and Workshops" section for additional details).

TOPIC 1

China's accession to the WTO and its impact on domestic agriculture

Prompted by news of China's future induction into the World Trade Organization (WTO), JIRCAS studied and projected its effects on China's agricultural sector. The study investigated that the probable impact under the assumptions that the Chinese government will (1) continue to observe the WTO's "Agreement on Agriculture" and (2) adopt tariff-rate quotas in major crops and tariff reductions of other agricultural products that depend on the U.S.-China WTO Accession Agreement. Subsequently, this analysis concluded that, first, imports of wheat and maize will increase up to the quota level if relative price remains steady and operation of tariff-rate quota is fair. Excess imports over the quota level will occur rarely. Second, while the Chinese government provides large tariff-rate quotas, the rice quota will be used infrequently because domestic prices of Indica and Japonica rice are lower than import prices. Third, a decline in edible oil production as well as soybean cultivation for oil manufacturing is inevitable due to the fact that the domestic price is twice as high as the international price. Finally, the Aggregate Measurement of Support (AMS) of wheat, maize, and soybean was estimated to be approximately 10 percent in 1999. This figure implies that if China joins the WTO as a non-developing country, their prices will decline, while if it joins as a developing country, prices will still not be allowed to increase.

(A. Ikegami)

Table 1. U.S.-China WTO Accession Agreement: Tariff-rate quotas (thousand metric tons, %)

	Tariff-Rate Quota		In-Quota Tariff	Above-Quota Tariff	
	Initial Year	2004		Initial Year	2004
Grain (average)			1% Processed products 10%	76%	65%
Rice (short & medium grain)	1330	2660			
Rice (long grain)	1330	2660			
Wheat	7300	9636			
Maize	4500	7200			
Soybean oil	1718	3261 (2005)	9%	74%	20% (2005)

FAS, USDA, *U.S.-China WTO Accession Agreement* (FAS Online), February 2000.
USIR, *Market Access Commitments of the Government of China on Goods, Services and Agriculture* (Press Release), April 1999.

Table 2. Domestic and foreign price differentials (RMB per metric ton, %).

Item	Area	Domestic Price (RMB)	International Price (RMB)	Price Differential
Japonica Rice	Northeast	2002～2050	3801 2470	-47～-46% -19～-17%
Indica Rice	The Yangtze basin	1580～2120	1868	-15～+13%
Wheat (white)	North China	1196～1420	764	+57～+86%
Wheat (yellow)	Northeast North China	921～1010 1036～1200	656	+40～+52% +58～+83%
Soybean	Northeast North China	1807 2000～2200	1436	+26% +39～+53%
Soybean oil	North China	6980～7200	2930	+138～146%

BIOLOGICAL RESOURCES DIVISION

Biological resources play a key role in meeting global challenges in food security and protection of the environment in developing countries. In discussions in international fora such as the Convention on Biological Diversity (CBD), the World Food Summit, and the Food and Agricultural Organization's (FAO's) 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 policy makers.

Over the last decade, we have witnessed

policy changes on food resources. Findings derived from ongoing collaborative research projects at JIRCAS are often incorporated into these forecast simulations. Currently, researchers are attempting to expand the model so that the impact of environmental changes and resource constraints can also be analyzed. In addition, researchers within the Division are studying rural development strategies, with particular emphasis on farming systems research, by reviewing recent development strategies and assisting researchers in the natural sciences who are currently involved with integrated rural development projects.

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remarkable progress in science and technological tools for better use and understanding of genetic diversity. For example, practically all economically useful plants are now amenable for transformation. The molecular base of biological functions such as stress tolerance is much better understood. Genomic science is providing sound and useful tools for manipulation of genes for plant improvement. The Division is taking full advantage of such progress to contribute to the challenges facing developing countries in the active use of genetic diversity for sustainable socioeconomic development.

Exciting work is proceeding with CIMMYT in the development of resistance of wheat to *Fusarium* head blight and rust diseases. 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 doubled haploid population segregating for red and yellow rust resistance with the objective of QTL mapping of genes involved in resistance. Two chromosomal segments on 7AS and 7DS were found to increase resistance to red rust. In the case of yellow rust, researchers identified several chromosomal locations, including 2D and 7D, conferring resistance according to QTL analysis. The studies have indicated environmental effects are significant as well.

As a part of JIRCAS's comprehensive project entitled, "Comprehensive soybean research project in South America", the Division staff, in collaboration with EMBRAPA-CNPsoja, is working on the genetic improvement of processing quality and pest resistance in soybeans. Isoflavones are a group of plant compounds that have potential antihaemolytic, antioxidative, antifungal, estrogenic and antitumorial actives, and also exhibit undesirable bitter and astringent tastes. Therefore, enhancing, reducing, or eliminating isoflavone compounds could help improve soybean products. Researchers found a wide variety of contents and composition among the more than 300 South American cultivars used in the studies. Genetic studies also indicated that isoflavone content in a seed is determined by the genotype of the embryo rather than the genotype of the maternal parent, and that low isoflavone content is recessive.

JIRCAS has enjoyed long-term collaboration with the Yunnan Academy of Agricultural Sciences (People's Republic of China) in rice genetic resources utilization. The collaboration has resulted in many fruitful outputs in both practical breeding and genetic studies. For instance, rice cultivars produced by this collaborative work now occupy more than 200,000 ha in the Yunnan Province due to their stable yield, blast resistance, cold tolerance and high quality. Many useful genetic resources have also been identified or developed. Unrei 1 to 28 grow with a very high level of cold tolerance. QTL mapping studies have indicated that five chromosomal regions are involved in cold tolerance. A remarkable level of variation was found for amylose content, a key factor in rice quality. Researchers found 22 varieties lacking LOX-3, the major component among lipoxygenase isozymes in rice seeds, after screening 108 varieties of Yunnan rice genetic resources. The lack of lipoxygenase in rice grains is expected to reduce oxidative deterioration during rice storage, resulting in reduced off-flavor and longer shelf-life.

This year the molecular biology group of the Division, working with rice, has made important steps toward understanding the molecular mechanisms of a plant's defense against environmental stresses and their genetic manipulation. Using knowledge of the drought responsive element binding protein (DREB) of *Arabidopsis*, OSREB1A, B, G1 and OsDREB2 were isolated as homologues of DERB1 and DREB2, respectively. It was further found that those controlling elements in rice had a very similar structure and function as those found in *Arabidopsis*. This strongly indicates the potential for engineering rice plants having abiotic stress tolerance as previously demonstrated by studies on *Arabidopsis* and tobacco plants.

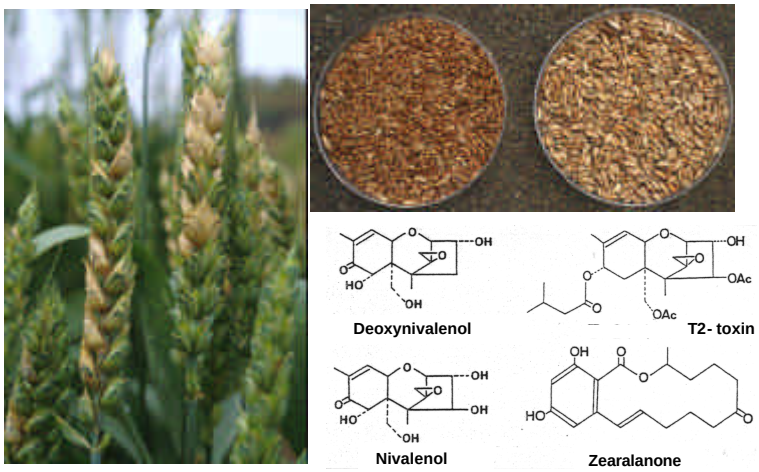


Fig. 1. Symptoms of *Fusarium* head blight caused by *F. graminerum* on wheat apikes (left) and kernels (upper right), and resultant mycotoxins harmful to animals and human health.

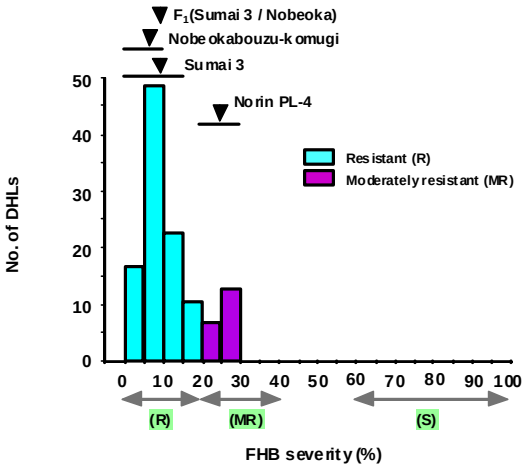


Fig. 2. Frequency distribution of *Fusarium* head blight (FHB) severity and reaction to FHB in 120 doubled haploid lines (DHLs) derived from an F1 cross of Nobeokabouzu-komugi / Sumai 3. Bars ending with arrows show the range of FHB severity and resistance levels of check cultivars at resistant (R), moderately resistant (MR), and susceptible (S) reaction levels.

TOPIC 1

Genetic differences in resistance to *Fusarium* head blight in Japanese and Chinese wheat cultivars Nobeokabouzu-komugi and Sumai 3

Fusarium head blight (FHB, scab), caused by *Fusarium graminearum*, is one of the most destructive diseases of wheat in areas where the weather is warm and humid after the heading of wheat. The disease reduces grain yield and quality due to shriveling. FHB also produces mycotoxins harmful to animals and humans alike, such as deoxynivalenol (DON), nivalenol (NIV), T-2 toxin, zearalenone (ZEA), and their derivatives in the grain (Fig. 1). In order to control this disease, researchers are investigating host resistance. Previous studies indicate that level of resistance to FHB varies not only among wheat cultivars but also among some of their wild relatives. No accession, however, has yet been identified to be completely immune to FHB among the Gramineae. Tests also demonstrated that resistant wheat germplasm could be divided into three gene pools: winter wheat from Eastern Europe, spring wheat from China and Japan, and spring wheat from Brazil and Italy. Repeated screening of the genetic resources led to the identification of several resistant cultivars of spring wheat, such as Shinchunaga, Nobeokabouzu-komugi, and Nyubai from the Japanese gene pool. Sumai 3, Ning 7840 and CItr 11028 were also identified as resistant cultivars to FHB from the Chinese gene pool. Among them, Nobeokabouzu-komugi is highly resistant to FHB. Unfortunately, this cultivar shows unfavorable agronomic characteristics such as late maturity, lodging, and poor quality of flour. However, one Chinese wheat cultivar, Sumai 3, is considered to be the most useful genetic source for resistance to FHB in Japan. It is also used extensively as a parental line elsewhere in the world, resulting in the production of many resistant lines such as the 'Ning' selections in China. Similarly, the resistant line, Saikai 165, was developed from a hybrid between Sumai 3 and a leading Japanese cultivar Asakaze-komugi. The genetic constitutions of sources for resistance to FHB originating from different gene pools, however, have not yet been fully explained. It is essential to study the genetics of the resistance to FHB, including the identification of the genes for resistance to FHB in several gene pools, so that different genes can be combined to improve the overall resistance of wheat. The objectives of the current study are to examine the differences in genetic constitution of resistance to FHB between Nobeokabouzu-komugi and Sumai 3 using doubled haploid lines (DHLs) derived from F1 cross.

From the cross combination of both highly resistant cultivars, researchers discovered transgressive segregants with a reaction of moderate resistance to FHB. Both parents seem to have at least one common gene for resistance because no DHL from a susceptible class was segregated. A Chi-square test indicated that the segregation for the reaction to FHB fitted a three-gene model (7 R : 1 MR) in the population (Fig. 2). The study indicates that Nobeokabouzu-komugi has three dominant genes for resistance, of which two are unique and the third is identical with a gene in Sumai 3. This finding shows promise for pyramiding resistant genes from different genetic backgrounds. Furthermore, many lines having very high levels of resistance stemming from genes from both parents have been selected for possible use as parental lines.

(T. Ban)

Antisense suppression of proline degradation improves environmental stress tolerance in *Arabidopsis*

It has become increasingly important to breed crops tolerant to environmental stress to cope with the world's food crisis and environmental pollution. Plant productivity is greatly influenced by environmental stresses, such as drought, high salinity, and freezing. Genetic engineering can be used as a fast and precise means of achieving improved stress tolerance. Scientists have attempted several different approaches to improve stress tolerance of plants by gene transfer. In our approach to improve stress tolerance, researchers used genes encoding enzymes for proline biosynthesis and degradation.

Proline is a dominant amino acid that accumulates in many plants exposed to environmental stresses such as drought, high salinity, high temperature, freezing, UV radiation, and heavy metals. Under stressed conditions, proline has been thought to have an adaptive role in mediating osmotic adjustment and protecting subcellular structure. In particular, many studies on plants have focused on the roles of proline in defense mechanisms against impairments caused by osmotic stress. Some reports have indicated a positive correlation between the accumulation of proline and stress tolerance in plants. However, other reports have proposed that increased levels of free proline are merely a result of stress. Thus the roles of proline in osmotolerance in plants still remain controversial, and there have been few concrete demonstrations of the function and the mechanism of proline throughout plant growth.

In higher plants, proline is synthesized via the glutamic acid and ornithine pathways. The former is considered to be a major pathway, especially under osmotic stress. In the glutamic acid pathway (Fig. 1), proline is synthesized from glutamic acid via two intermediates, glutamic-g-semialdehyde and D-pyrroline-5-carboxylate (P5C). Two enzymes catalyze this pathway, P5C synthetase in the first step and P5C reductase in the final step. Researchers have isolated genes encoding P5C synthetase and P5C reductase from various plants, and have characterized their expression and the functions of their products.

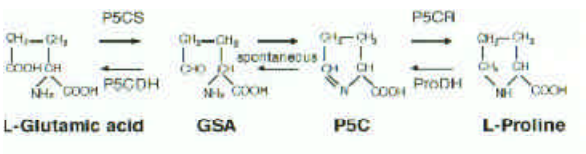


Fig. 1. Metabolic pathway of proline in plants (glutamic acid pathway), glutamic-g-semialdehyde, 1-pyrroline-5-carboxylate (P5C), P5C synthetase, P5C reductase, proline dehydrogenase, P5C dehydrogenase.

Consequently, research has shown that P5C synthetase is the rate-limiting enzyme in proline biosynthesis in higher plants. On the other hand, proline is metabolized to glutamic acid via P5C and glutamic-g-semialdehyde. Two enzymes catalyze this pathway, proline dehydrogenase in the first step and P5C dehydrogenase in the final step.

Arabidopsis accumulates proline in response to osmotic stresses due to drought, high salinity, and chilling. Stress-induced proline accumulation in *Arabidopsis* is caused by the activation of proline biosynthesis, and by the inactivation of proline degradation. The elevated expression of an AtP5C synthetase gene encoding the P5C sythetase protein in *Arabidopsis* precedes the accumulation of proline in response to these stresses. In contrast, expression of the At-proline dehydrogenase gene is repressed during the stress conditions. The manner of gene expression of AtP5C synthetase and At-proline dehydrogenase fits in well with that of proline accumulation, suggesting that metabolic regulation is essential for the control of endogenous proline levels.

To investigate the function of proline biosynthesis and degradation in the accumulation of proline and to further elucidate roles of proline in growth and stress tolerance in plants, JIRCAS researchers generated antisense transgenic *Arabidopsis* plants with an AtP5C synthetase and an At-proline dehydrogenase cDNA, respectively. The AtP5CS antisense transgenic plants showed altered morphology and were susceptible to osmotic stress. Mutated phenotypes in both morphology and osmotolerance were suppressed by the application of exogenous L-proline but not by D-proline, suggesting that proline also functions as a compatible osmolyte with respect to osmotolerance in plants. Further investigation revealed a specific effect of proline deficiency on protein biosynthesis in the AtP5CS antisense transgenics. Studies showed a significant reduction in proline and hydroxyproline contents in hydrolysates of a purified cell wall fraction but not in proline content of hydrolysates of soluble proteins in transgenic leaves. These results show that proline deficiency specifically affects a defect in the biosynthesis of cell wall structural proteins in the transgenic plants. Proline may act as a major constituent of structural proteins of cell walls in osmotolerance as well as morphogenesis of plants.

On the other hand, The At-proline dehydrogenase antisense transgenic plants showed enhanced accumulation of proline, providing evidence for a pivotal role of proline dehydrogenase in proline degradation. These transgenic plants were more tolerant to freezing

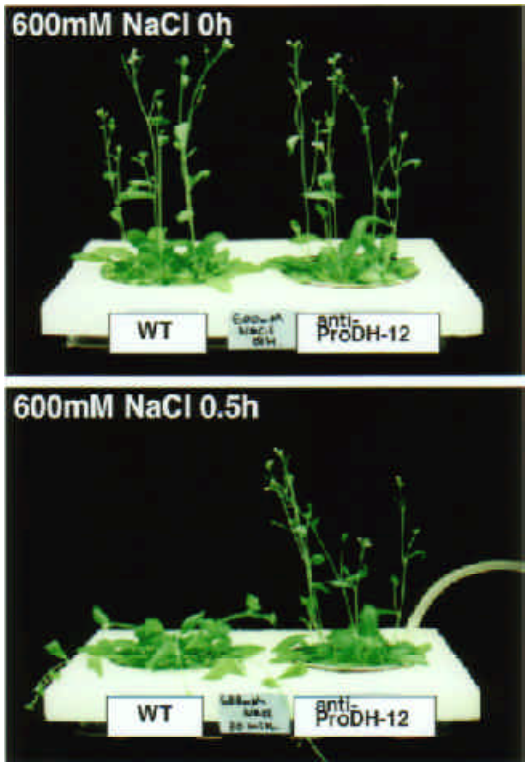


Fig. 2. Salinity tolerance of At-proline dehydogenase antisense transgenic plants and phenotype of plants exposed to salinity stress for 0.5 h. Plants used for analysis were wild-type and anti-At-proline dehydrogenase-12 transgenic plants.

and high salinity, indicating the efficiency of suppressing proline degradation in proline accumulation, and the contribution of proline to stress tolerance in higher plants (Fig. 2). In this study, researchers not only confirmed key roles of two enzymes, P5C synthetase and proline dehydrogenase, for the regulation of proline accumulation, but also showed the positive correlation between proline and osmotolerance in higher plants using transgenic technologies. These results will help us improve crop tolerance to abiotic stresses. The constitutive accumulation of proline due to the inhibition of its degradation may be a promising approach to creating environmental stress tolerant crops.

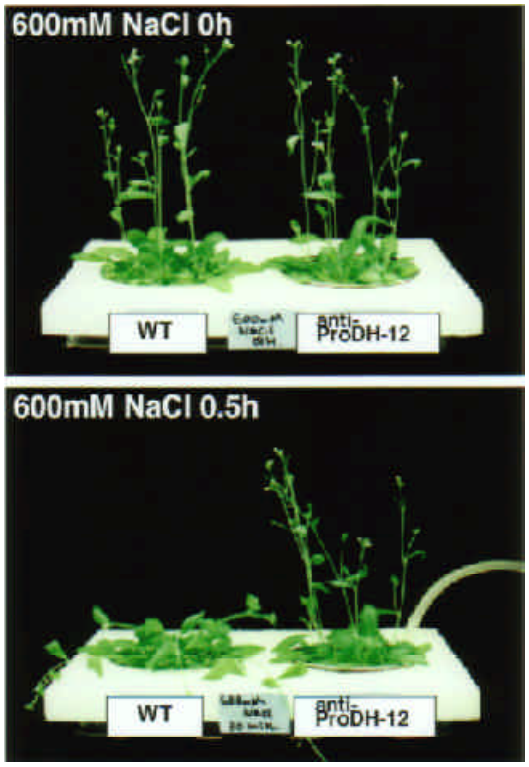
(K. Yamaguchi-Shinozaki)

ENVIRONMENTAL RESOURCES DIVISION

With the world population estimated to reach 6.3 billion by the year 2000 and 10 billion by 2050, the task of feeding this ever-increasing population has become more and more problematic. Given these circumstances, it is necessary to intensify crop cultivation and extend farmlands into marginal areas and also to increase crop productivity per unit area. Trade liberalization in recent years has led to a sharp increase in production of commercial crops in exporting countries, placing a damaging and excessive burden to farmland soils through continuous monoculture, overdoses of farm chemicals, and deforestation. Past experience has shown that these practices accelerate farmland degradation and desertification on a global scale. Should they continue, such drastic changes in land use will cause not only a decline in crop productivity, but also a climatic transformation over extended regions that will bring about unpredictable weather-related impediments to existing agricultural and forest ecosystems.

Patterns of land utilization have been changing due to population expansion since the 1940's and 50's. These changes, along with the rapid increase in fossil fuel consumption, have had a tremendous impact on the atmosphere through intensified carbon, nitrogen, and sulfur gas emissions. If the present level of consumption continues, carbon dioxide (CO_2) concentration will increase by 0.5 percent per year and double by the middle of this century. The 1995 IPCC report suggests that a two-fold increase in CO_2 concentrations could cause an increase in mean global surface temperature by about 2°C by the year 2100. Furthermore, research has shown that the atmospheric concentrations of other greenhouse gases such as methane and nitrous oxide have similarly increased within the past two decades. If the effects of these trace gases are jointly taken into account, global warming is estimated to take place more rapidly than in the case where the effects of CO_2 are considered independently. The negative impact of modern agriculture is also evident in soils that receive excessive amounts of chemical fertilizers, herbicides, and pesticides and not enough organic substances such as crop residues and animal feces that are thought to be effective for fertility maintenance. Although there is little scientific evidence, soils may not be as fertile as they were in the past, meaning more chemicals will be required to produce the same harvest. The excessive nitrogen that goes

Farming family in field with their crops at a village near Kationa, North Côte d'Ivoire. (Photo: S. Tobita)



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Farming family in field with their crops at a village near Kationa, North Côte d'Ivoire. (Photo: S. Tobita)

unutilized by crops disseminates from agricultural lands and pollutes underground and river water. Although farmers still have to produce more foods for the world's increasing population, the environmental impacts of intensified agriculture should be kept to a minimum through balanced management of resources.

To address these problems, the Environmental Resources Division is organizing research to identify and develop technologies that will improve agricultural activities and make them compatible with the environment and more specific ecosystems such as arid lands, wetlands, sloped lands, and degraded lands. Other projects aim at developing technologies for sustainable agriculture by analyzing mechanisms of nutrient cycling within agro-ecosystems, which might in turn lead to a reduction in polluting substances and global environmental conservation.

TOPIC 1

Nitrogen balance in soybean fields and grasslands in the central west region of Brazil

In the central west region of Brazil, grasslands have been developed over large areas that were originally savannas (Cerrados). Despite initial success in soybean production, problems with declining productivity have arisen in recent years because of the reduction in soil fertility. Experts have proposed agro-pastoral systems that combine soybeans and grasses in rotation in order to sustain grassland productivity. One of the primary advantages of these systems is that grasses can benefit from the residual lime and phosphoric fertilizer used for the previous year's crop cultivation. Grasses also benefit from the nitrogen added to the system through N_2 fixation by soybeans. However, another result is that the

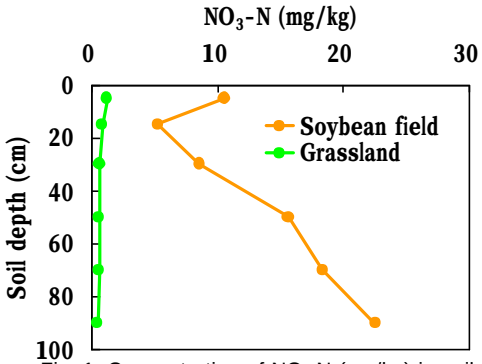


Fig. 1. Concentration of NO_3-N (mg/kg) in soil.

organic matter content of the soil decreases steadily under soybean cultivation. Researchers studied nitrogen flow in the systems, N_2 fixation by soybean, input from rain, nitrogen removal by harvest, and leaching in order to evaluate the agro-pastoral systems in terms of nitrogen economy.

The National Beef Cattle Research Center (CNPGC), part of the National Corporation of Agricultural Research (EMBRAPA) in Campo Grande, MS, Brazil, has conducted a long-term field experiment on soil classified as Purple Red Latosol. In beef cattle-grazed grassland, NPK fertilizer (14 kg N/ha, 70 kg P_2O_5/ha and 70 kg K_2O/ha) was applied and *Brachiaria decumbens* cv. Basilisk was sown in November 1993. In soybean fields, soybeans were sown every November and harvested in April of the next year. PK fertilizer (80 kg P_2O_5/ha and 80 kg K_2O/ha) was applied during the seeding stage of soybean.

Division researchers determined the rate of N_2 fixation of soybeans using a non-nodulating isoline, T201, as a reference. The rate ranged from 23 to 51 percent of the total nitrogen in the plants. Most of the plant nitrogen was harvested with the grains, resulting in a negative nitrogen balance in the soybean fields. It was shown that only a small amount of nitrogen entered the system through rainwater. Nitrate accumulation from the surface to a depth of 100 cm in the soil under soybeans indicated the potential leaching of nitrate. The estimated amount of leaching from the soybean

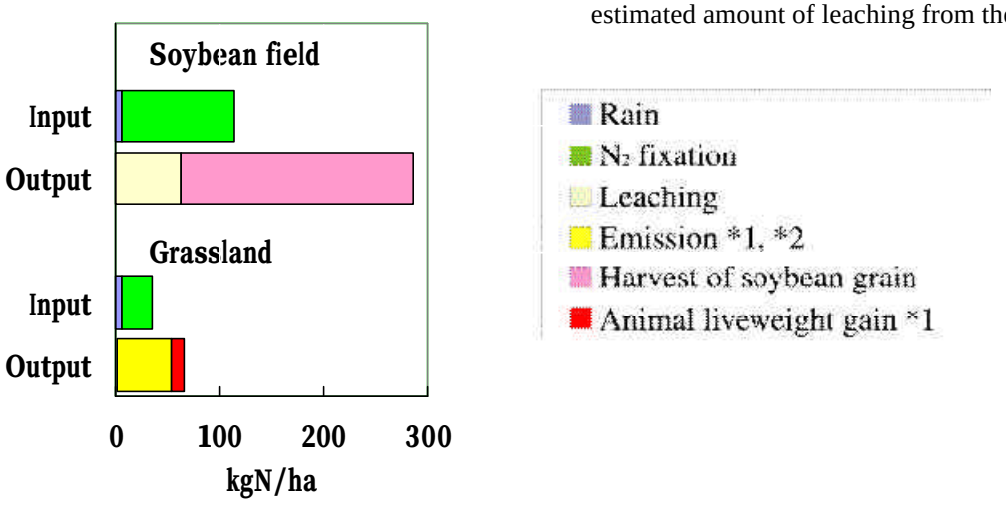


Fig. 2. Nitrogen balance for soybean fields and grasslands. *1) Cadisch et al. (1994); *2) Gaseous losses of ammonia volatilization and denitrification from animal excreta.

field was relatively large compared to that of the grassland; a large negative nitrogen balance was observed in the soybean fields, whereas there was only a small negative nitrogen balance in the grasslands.

Harmful nitrates that accumulated in the subsoil during soybean cultivation can be absorbed by grasses grown thereafter. Thus, agro-pastoral systems that alternate grass and soybean cultivation are considered to be more sustainable. It must be remembered, however, that both soybean fields and grasslands showed a negative nitrogen balance. From this study, researchers were able to speculate that in order to sustain nitrogen fertility in agro-pastoral systems, some application of nitrogen fertilizer may be necessary over time.

(K. Kanda)

TOPIC 2

Nitrogen cycles for agricultural production in Khon Kaen Province in Northeast Thailand

Soils in Northeast Thailand are characterized by their sandy texture and low capacity for supplying nutrients. These inherited attributes typically indicate poor soil fertility and are major limiting factors to crop productivity. One possible way to improve soil fertility is more efficient use of locally available nutrient resources such as crop residues and animal feces. In order to identify the available resources, it is necessary to quantify nutrient cycles related to agricultural activities such as crop and livestock production in the region. Moreover, it is essential to better understand the soils' limiting factors to achieve the most effective utilization of available nutrient resources. This study emphasizes nitrogen as a major nutrient element.

A model has been developed to estimate the nitrogen cycle for agricultural production in Khon Kaen Province by using data from many different areas, including crop yields, animal feed supply, human food supply, production and usage of crop residues, animal and human feces and garbage, and chemical fertilizer application rates. These data were collected from agricultural statistics (1990-92), research reports, field observation, interviews with farmers, and information from Thai researchers.

Nitrogen left as crop residue amounted to 52 kg/ha/yr, of which 12 kg was fed to animals, 29 kg discharged into the air by burning, and 11 kg returned to farmland. Although crop residues are most likely the main nitrogen resource in the area, the rate of recycling back to the farmland should be limited. Animals consumed 23 kg/ha/yr of nitrogen from weeds as feeds separate from crop residues and returned 22 kg/ha/yr of nitrogen to farmland in the form of feces, 80 percent of the total amount of nitrogen returned to farmland. Nitrogen withdrawal resulting from crop harvests (30 kg/ha/yr) was more than the amount of nitrogen restored as animal feces, suggesting that it is not feasible to meet the crop demand for nitrogen through the application of the animal feces alone because of the limited animal husbandry in the area. Chemical fertilizer application was limited to only 18 kg/ha/yr of nitrogen, clearly indicating that even in recent years local farmers have either applied low rates of chemical fertilizer to most crops or applied none at all. Furthermore, nitrogen losses through denitrification, leaching, erosion, and emission far outweigh the nitrogen gains from atmospheric N_2 fixation, irrigation, and rainfall. A rough estimation of the soils' nitrogen balance consequently showed a negative value of 40 kg/ha/yr. Considering that 58 kg/ha/yr of nitrogen is not returned to the farmland, more efficient utilization of organic resources is necessary to reduce the deficit in the soils' nitrogen balance.

(N. Matsumoto)

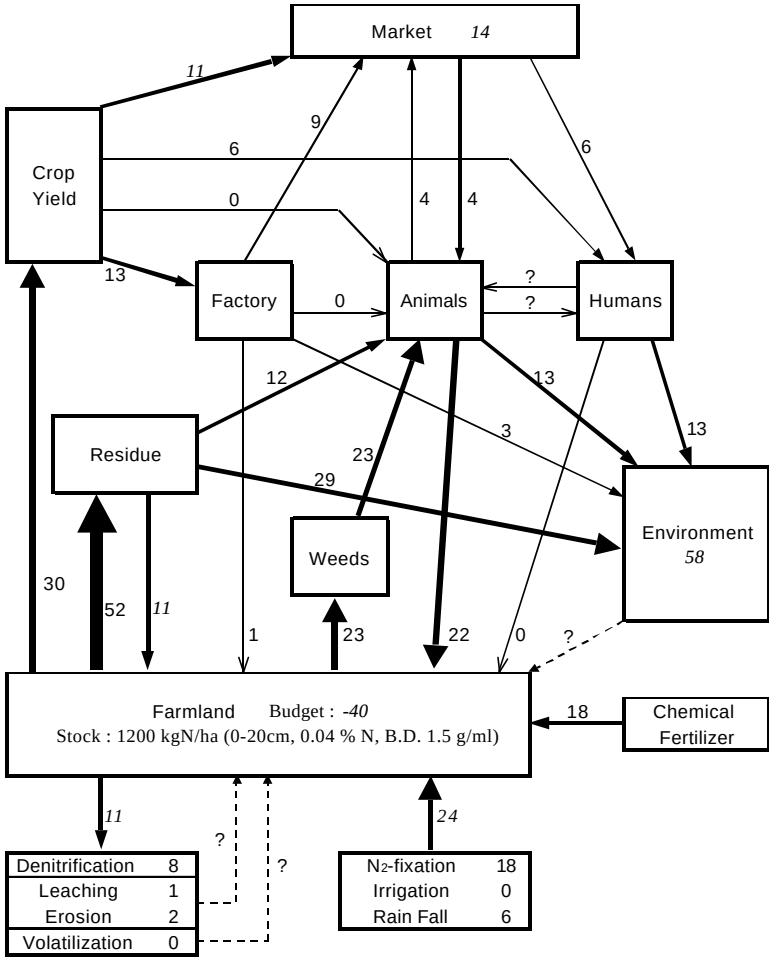


Fig.1. Nitrogen cycles under agricultural practices in Khon Kaen province during 1990-1992 (kgN/ha/yr). (*Italics*: input, output)

CROP PRODUCTION AND POSTHARVEST TECHNOLOGY DIVISION

It is obvious that global food production must increase greatly to meet rapidly growing demands. The need for food will be influenced primarily by population growth. However, demand for food will also depend on the ability of consumers to purchase food, changing dietary patterns, and urbanization.

Although the growth rate has been declining steadily since about 1970, the world's population will increase by approximately 90-100 million people annually for the next several years. Ninety-five percent of the growth will occur in developing regions where food deficits are already severe, and where alternative employment opportunities and economic growth are limited.

In the developing regions, self-reliance seems to take precedence over self-sufficiency. While there are no definite ways to becoming self-reliant, there are various methods that ensure self-sufficiency and still preserve environmental conditions of a particular country.

The Crop Production and Postharvest Technology Division implements research projects on topics ranging from production and storage to the processing and marketing of agricultural products. Its research activities encompass a variety of disciplines including agronomy, plant protection (pest, disease, and weed control), agricultural mechanization, irrigation, drainage, cropping systems, food storage, postharvest technology, farm management, and agricultural economics.

Far too often, the problem of feeding the world's population is conceived in terms of producing a sufficient amount of food. Equally pressing problems related to preservation and distribution, which affect food products between harvest and consumption, are frequently neglected. Postproduction operations in agriculture and horticulture include a wide range of functions necessary for maintaining high quality food, reducing transaction costs, and raising domestic welfare. It is necessary to place emphasis on postharvest studies on agricultural products, such as quality improvement, safety, extension of shelf life, and control of insects and microorganisms in foodstuffs, all of which are important objectives of the Division.

Local market selling vegetables in Bangkok. (Photo: K. Nakahara)

Finally, sustainable production of agricultural commodities can only be ensured by the development of sustainable markets. The Division is working to develop technology that will enhance the value of agricultural products and to increase incentives for farmers to practice sustainable production. Economic studies prove to be essential in such projects, which aim to further the development of target countries.

Food production involves a long chain of production from the initial cultivation to the final food market. Post harvest technology, including selection, preservation, packaging, and processing, has improved agricultural production and has increased farmers' incomes by raising the value of agricultural produce. Agriculture is very sensitive to the natural environment and there are many constraints to the rapid increase of production. Therefore, it is very important to develop techniques to reduce post harvest losses as well as to preserve and improve the quality, freshness, and nutritional value of agricultural produce until the products reach the consumer.

As mentioned above, post harvest technologies encompass too many disciplines given our limited human resources and research budget. Therefore, the Division gives priority to the following technologies, which aid progress toward a stable food supply of and an increase in farmers' incomes in developing regions: drying and keeping of freshness after harvesting, preservation and storage during collection and transportation, safety assessment and selection prior to processing, quality evaluation and processing for adding value and diversification, reduction and effective uses of waste and byproducts during distribution and processing, quality assurance, and preservation of perishables and processed foods during distribution.

While these technologies will be necessary to achieve a stable food supply and to raise farmers' incomes, the infrastructure and government policies relevant to food and agricultural products are still poor in developing regions. Therefore, the use of technologies needs to be selective, and project leaders should recognize the obstacles to immediate implementation to concur with the conditions in developing regions, while keeping in mind that agricultural productivity is improved mainly

through increasing the incentives of farmers.

Among the technologies mentioned above, the following technologies are common issues in developing regions; drying and maintaining freshness after harvesting, preservation and storage during collection and transportation, safety assessment and selection prior to the processing, and improvement and development of processing in accordance with cultural food tradition. The first two fields can be collectively considered as preventive technology for postharvest losses, the main focus being quality evaluation.

The Division will concentrate its research activity on the prevention of post harvest losses, with emphasis on the improvement of drying methods, transportation and storage of the products, quality preservation, and evaluation and food processing. The poor infrastructure and lack of relevant technological progress in developing regions result in the quality deterioration of agricultural produce and in forcing farmers to sell their products at lower prices. The Division will develop low-input preservation technology through identifying the factors that lead to quality deterioration during collection, storage, and distribution. Also, since the price of agricultural products is determined based on freshness, shape, size, color, flavor, texture, nutritional value, safety, damage caused by pests, and functional properties in processing, technology for quality preservation and evaluation will play a very important role in the pricing of agricultural products. However, since most of these technologies have been designed in developed countries, they must be adapted to the specific needs of developing regions by making the technology more simple and inexpensive. Currently, traditional methods of food processing attempt to meet the demands of the domestic market, sometimes depending upon an unstable supply of raw materials and limited level of technology.

The Division will attempt to analyze and improve the various steps involved in the traditional methods of food processing to meet the increasing demand of consumers for diversified and better quality foods, along with developing new methods of food processing through better technology.

TOPIC 1

Varietal resistances to the whitebacked planthopper in Chinese japonica rice

Nation-wide cultivation of high-yielding F1 hybrid rice has significantly contributed to increases in rice production in China starting in the 1980's. However, Chinese hybrid rice has also caused substantial changes in the status of insect pest because of its high vulnerability to insect infestations. Among such pests, the whitebacked planthopper, *Sogatella furcifera*, has strongly emerged as a major pest to hybrid rice, despite being only a secondary insect pest to common inbred rice. *S. furcifera* infests not only hybrid rice, but also japonica rice grown in Middle China due to massive migrations from the hybrid rice cultivation areas in southern China. To combat the upsurge of infestation, farmers have turned increasingly to intensive insecticide use. There is a growing fear that the sustainability of the rice production ecosystem will deteriorate under escalating insecticide treatments. Selecting rice varieties with higher insect resistance is an alternative way of coping with the threat of pest infestation, and is also compatible with biologically and ecologically favorable approaches of pest management.

Drying rice after harvest in the Philippines (Photo: T. Yoshihashi)

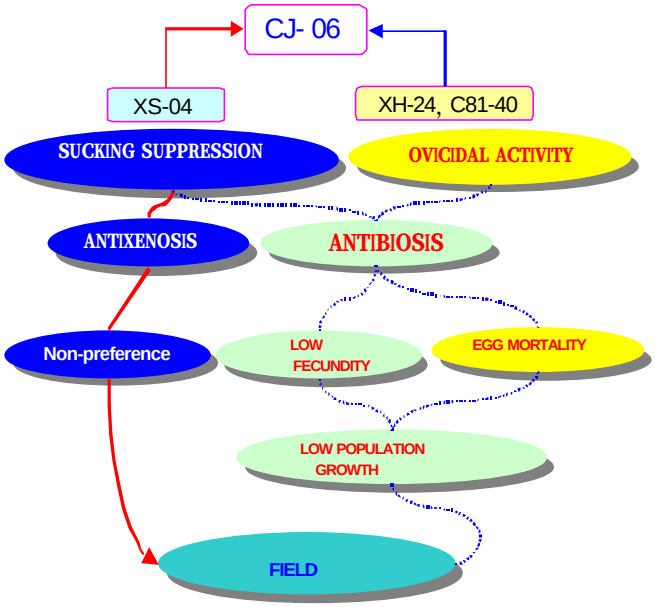
Researchers have found that a Chinese japonica rice, Chenjiang 06 (CJ-06), demonstrated a strong field resistance to *S. furcifera* infestation. Field experiments revealed that the migrant *S. furcifera* did not prefer to settle on CJ-06, and ultimately failed to establish populations on this particular type of rice. Significantly less honeydew excretion by adult females of *S. furcifera* indicated their reluctance to ingest CJ-06 sap, when confined to this variety. Nymphal development was not significantly affected by CJ-06. Adult fecundity and egg hatchability were, however, markedly reduced on CJ-06 when young *S. furcifera* females continuously fed on it. Fecundity on CJ-06 was reduced to about one third of that of susceptible varieties due to suppressed sap ingestion of CJ-06. Additionally, *S. furcifera* eggs suffered from a high mortality rate in watery lesions at oviposition sites of CJ-06. The induction of ovicidal watery lesions and the subsequent

mortality of eggs occurred within 1-2 days after oviposition.

From these observations, it was found that field resistance to *S. furcifera in* CJ-06 was expressed by two distinct mechanisms of resistance, namely sucking suppression and ovicidal response. Sucking suppression was the primary source of the antixenosis of CJ-06 against *S. furcifera* immigrants, and functioned as an antibiotic factor in reducing fecundity of inhabitants. Ovicidal function is related to antibiotic resistance induced by a specific interaction between CJ-06 and *S. furcifera*, by which the population growth of *S. furcifera* nearly ceased.

The mode of inheritance of *S. furcifera* resistance in CJ-06 using two populations of F2 plants obtained from reciprocal crosses between CJ-06 and the susceptible TN1 variety was then analyzed. The two resistance traits, sucking suppression and ovicidal activity, were inherited independently. The two F2 populations were segregated into 4 phenotypes, which were expressed by different combinations of sucking suppression and ovicidal activity. The segregation rations fitted statistically to the theoretically predicted ratio of 45:15:3:1, where two dominant and one recessive gene presumably controlled sucking suppression and ovicidal activity, respectively. The F2 plants also showed dominant inheritance of sucking suppressive resistance in CJ-06 in crosses between CJ-06 and the Japanese japonica rice, Koshihikari.

Preliminary genealogical analysis indicated



Mechanism of *S. furcifela* resistance in CJ-06

Field resistance to whitebacked planthopper in Chenjiang 06. Under intensive infestation with the whitebacked planthopper, a susceptible variety of TN1 was completely destroyed with hopperburn, but Chenjiang 06 plants between the TN1 plots suffered little from planthopper damage. (Photo: K. Sogawa)

that dual resistance traits to *S. furcifera* in CJ-06 were derived conjointly from a single parental line, Xiushui 620 (XS-620). The other parental line, C81-40, had only ovicidal activity. Sucking suppression and ovicidal resistance in XS-620 were independently inherited from Xiushui 04 (XS-04) and Xianghu 24 (XH-24), respectively. XS-04 showed sucking suppression resistance, but not ovicidal resistance. Conversely, XH-24 possessed ovicidal resistance, but not sucking suppression resistance.

About a third of the 63 Chinese japonica rice varieties used in the study exhibited as strong ovicidal activity similar to CJ-06 against the *S. furcifera* eggs. Another third of the rice varieties also maintain some, but weaker, ovicidal activity. On the other hand, sucking suppressive resistance to *S. furcifera* was detected only in 6 varieties. Of the six, four varieties were XS-04 and its derivatives. Only CJ-06 and XS-620 had both the sucking suppressive and ovicidal resistance. No Japanese japonica rice has been found to have sucking suppressive resistance to *S. furcifera.* JIRCAS researchers expect that the identification of the genetic origin of the sucking suppressive resistance in XS-04 will provide important clues as to how to improve *S. furcifera* resistance in Japonica rice varieties.

(K. Sogawa)

TOPIC2

Evaluation of Indonesian soybean varieties for processing and improvement of fermented foods

Soybean is one of the most important staple foods in Indonesia. Soybean foods such as “tempe”, a fermented soybean food, tofu, “kecap”, an Indonesian soy sauce, and “tauco”, an Indonesian fermented soybean paste, are of great significance to the diet of Indonesians as low-cost sources of proteins and seasonings. In

Table 1. Characteristics of Indonesian and imported soybeans.

	Indonesian soybeans [1]				Soybeans imported from USA	
	min	max	mean	S.D.	Sample A	Sample B
100-grain weight (g)	6.1	15.9	10.6	2.8	15.8	14.8
Protein content (%)[2)3)]	39.9	44.3	42.0	1.4	36.8	36.0
Lipid content (%)[2)]	16.6	20.0	18.6	1.2	21.7	21.4

[1)] Data obtained with 14 Indonesian varieties [2)] Dry weight percentage [3)] TN x 5.71

1998, Indonesia produced about 1.3 million tons of soybeans, yet approximately 0.6 million tons of soybeans had to be imported to cover the supply deficiency. Although tempe manufacturers prefer imported soybeans to domestic ones due to appearance, the effects that certain soybean characteristics, such as chemical composition, color, size, and cooking properties, have on the quality of traditional soybean foods have yet to be clarified. In order to promote domestic soybean production, it is essential to cultivate soybean varieties suited for food processing. It is thus necessary to clarify the characteristics of domestic soybeans in comparison to imported ones.

In this collaborative research project with the Research Institute for Legume and Tuber Crops (RILET) of Indonesia, the physical, chemical, and processing characteristics of 14 Indonesian soybean varieties were compared with imported soybeans. Tests revealed that Indonesian soybeans contain more proteins and fewer lipids than do imported soybean samples, as shown in Table 1. Except for Argomulyo, Bromo, and Burangrang, all other domestic varieties had lower 100-grain weights than those of imported ones.

Tofu was prepared using either glucono-δ-lactone (GDL) or acetic acid, commonly used in Indonesia as coagulants. The results obtained in this work showed that the protein content of soybean is the most important factor for the hardness and yield of tofu prepared when using either GDL or acetic acid. Further research demonstrated that Indonesian soybeans are superior to imported varieties for preparing tofu using either GDL or acetic acid as a coagulant due to their high protein content and the whitish color of the final product. In making tempe, the 100-grain weight of raw soybeans was found to be most important factor for both yield and sensory evaluation. An Indonesian soybean variety having a 100-grain weight of around 15 grams, about the same as imported soybeans, was found to be best suited for tempe processing.

In Indonesia, traditional soybean-based foods are widely produced by small-scale producers using rather primitive methods. For example, in the kecap fermentation process, cooked soybeans

Photo 1. Tempe dealer in Malang, East Java, Indonesia.

are spread on a bamboo tray and are left for a period to make molded soybeans (kecap koji). Kecap manufacturers do not usually use any inoculum in koji preparation, thereby allowing molds to grow on the surface of the cooked soybeans during fermentation as a result of infection from the environment. Conversely, agricultural products in Indonesia, like peanuts, are frequently contaminated with aflatoxins, a natural carcinogen produced by fungi belonging to *Aspergillus* species, such as *Aspergillus flavus* and *Aspergillus parasiticus.* Since the possibility of aflatoxin contamination cannot be avoided in traditional koji processing, it is necessary to use a pure culture starter for purposes of food safety.

In a collaborative research project between JIRCAS and RILET on the improvement of fermented soybean foods, koji samples were

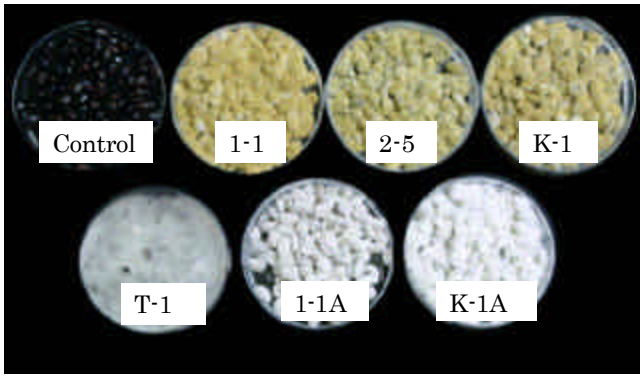


Photo 2. Kecap kojis prepared by using an aflatoxin producer, selected strains, and white-spored mutants.

Strains were cultured on autoclaved soybeans for 3 days 28°C
Control: autoclaved soybeans (black soybeans); 1-1: Koji with isolate from Kecap No.1; 2-5: Koji with *Aspergillus* sp. 2-5, an aflatoxin producer isolated from Kecap No. 2; K-1: Koji with the isolate from Japanese Tane-koji; T-1: Koji with the isolate from Tempe starter; 1-1A: Koji with the white-spored mutant 1-1 *Aspergillus* sp.1-1; K-1A: Koji with the white-spored mutant K-1*Aspergillus* sp. K-1.

collected from kecap and tauco factories on the island of Java. *Aspergillus* was dominant in five out of six koji samples, while one sample contained Mucorales as dominant fungi. *Aspergillus* contributed to the hydrolysis of soybean proteins much more than did Mucoraceous fungus from the tempe starter. Although no aflatoxins were detected in these koji samples, two out of 24 isolates from the kecap and tauco koji samples produced aflatoxins.

In order to develop a pure culture starter for kecap koji, white-spored mutants were isolated by irradiation of ultraviolet rays from the selected *Aspergillus* strains. All white-spored mutants proved to be aflatoxin-negative. The kecap koji prepared by inoculating with the mutant could be distinguished from that inoculated with the original koji mold strain or the aflatoxin producer by the development of its white color spores during koji making (Photo 2). The formol nitrogen contents of the kecap mashes prepared by using white-spored mutants were almost same as those prepared by using original strains. Therefore, it is expected that the white-spored mutant will improve safety when applied as a starter for processing kecap koji.

(S. Nikkuni)

TOPIC 3

Technologies for efficient upland crop cultivation in Northeast Thailand

Most of the upland cropping area in Northeast Thailand has been created through intensive deforestation since the 1960's and is characterized by continuous sloping fields with gradual undulations. Soil erosion has become a serious problem, causing the disappearance of fertile topsoil drained away by rainwater. Unpredictable rainfall in monsoon tropics, which causes frequent drought and flooding, is another constraint to sustainable agriculture.

In response to these issues, a multidisciplinary research project between Thailand and Japan is attempting to develop sustainable crop production systems (1995-2001) entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand". The results obtained thus far are described below.

Alley cropping for soil conservation

In order to realize an environmentally friendly farming system, reforestation, particularly the concept of tree-crop complexes, is strongly recommended to restore year-round vegetation in view of national land planning.

Participating researchers constructed a model field for alley cropping (0.5 ha: 50 x 100 m) with a leguminous tree species, *Leucaena leucocephala*, planted on contour lines in the 5 percent sloping area, in order to prevent erosion and to supply organic materials into upland fields. Studies focused first on the growth of crops (sweet corn, mungbean etc.) at various distances from trees. Shading by tree canopy in the rainy season and depletion of water by tree roots in the dry season were the main obstacles to crop growth when the trees and crops were planted too closely. The width of tree rows was optimal at 20m for crop production, mechanized crop management, and prevention of soil erosion. Pruning the trees and subsequently supplying organic materials was effective in improving soil properties. Regeneration of twigs after pruning followed a similar pattern to the annual rainfall (Fig. 1). The appropriate frequency of pruning was three times per year in order to save the labor under sequential crop cultivation throughout the rainy and dry seasons.

No-tillage cultivation for large-scale farming

Upland cropping in Northeast Thailand is characterized by monoculture plantations that grow such crops as sugarcane or cassava, which are susceptible to fluctuating prices in the world market. Crop diversification and the introduction of new crops accompanied by large-scale cultivation methods will likely increase and stabilize the income of farmers.

In studies, no-tillage cultivation of seed crops (maize, legumes, etc.) showed promise to develop into large-scale production under the variable monsoon climates. No-tillage seeding alleviated farmers from the busy and laborious chore of land preparation at the beginning of each rainy season and prevented soil erosion commonly observed after the tillage of fields. The system also effectively preserved soil moisture during the dry season due to undisturbed soil conditions. Higher soil moisture in no-tillage cultivation contributed to vigorous growth. Growth of crops in no-tillage cultivation was

Fig. 1. Seasonal pattern of regeneration of *Leucaena leucocephala*.

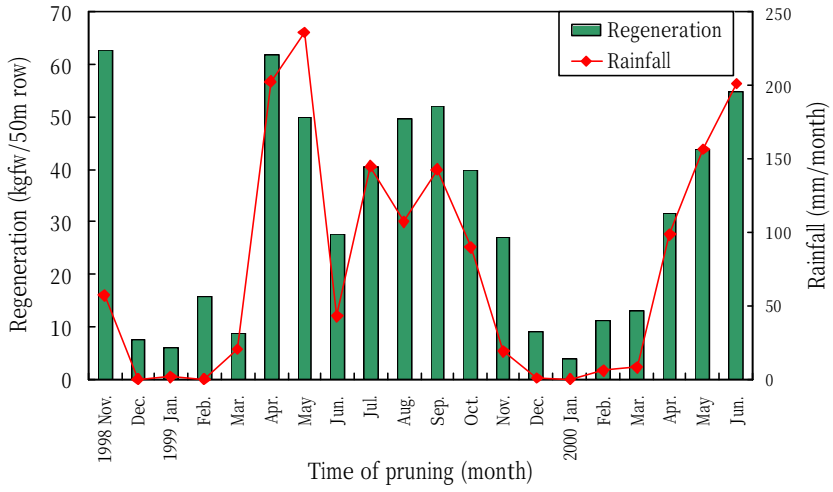


Fig. 2. Seeding with no-tillage seeder

generally superior to that in tillage seeding. During the rainy season, crust formation on the soil surface inhibited growth in tillage seeding, a problem that did not occur in the no-tillage fields.

A no-tillage seeder with a rotary disk and drill seeder was manufactured and tested for applicability, and was found to work sufficiently on sandy soil, performing accurate grooving and seeding (Fig. 2).

Mechanical weeding for labor-saving crop cultivation

Hand weeding is a common yet laborious practice in upland cropping since high temperature and humidity favor the proliferation of weeds. The adoption of labor-saving weed control systems is indispensable not only for raising the productivity of crops but also towards easing the farmers' work.

Mechanical weeding with the use of a small rotary tiller attached to a soil manipulator was effective in controlling a dominant upland weed, *Richardia scabra* L (Fig. 3). Inter-tillage between rows of crops could be conducted at walking speed (1.6 sec/min), making the hard labor of hand weeding unnecessary. Weeds lost their water content after uprooting, eventually leading to withering and extermination. In the field experiment, two to three hours was enough

Fig. 3. Mechanical weeding with soil manipulator

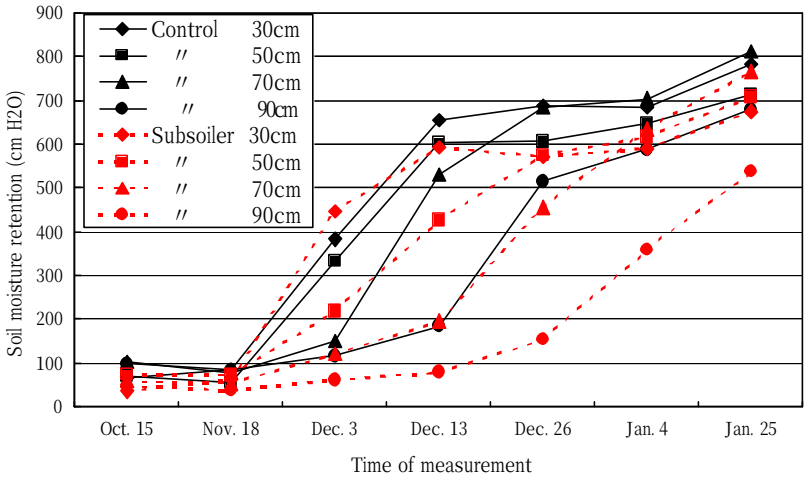


Fig. 4. Changes of soil water retention at different depths of soil layer.

to reach this water deficit, which could be used as a criterion of operation under variable weather conditions.

Research also focused on the impact of mechanical weeding on the growth of crops and weeds. Fast-growing crops such as maize and sorghum were more tolerant to weeds, meaning the frequency of weeding could be reduced compared with relatively slow-growing crops such as rice and mungbean. Mechanical weeding also suppressed weed proliferation for fast-growing crops.

Subsoiling for efficient water utilization

Northeast Thailand is plagued with frequent drought and flooding. One countermeasure to avoid these disasters is to enhance the water holding capacity of soil. While the incorporation of organic materials is known to improve soil texture, development of a direct method to accumulate water is also an important way to retain a sufficient amount of water during the rainy season.

Researchers conducted subsoiling treatment at the beginning of the rainy season by cracking soil layers (50-60cm depth) following the contour lines in sloping fields. The cracks effectively accumulated running rain water, leading to a higher moisture content in the deep layer of soil during the drying process in the dry season (Fig. 4). The soil was also softer after using the subsoiling treatment, reflecting higher soil moisture.

Crop growth was accelerated by the increased availability of water, which was more distinctive during dry season cultivation. Crops exhibited enhanced physiological activity of leaves, depicted by leaf color index and transpiration. In sum, subsoiling in combination with no-tillage cultivation shows the potential to be extremely advantageous to crops.

(N. Kabaki)

TOPIC 4

Optimum seed rates in wet-seeded rice culture in the Mekong Delta of Vietnam

Rice is the staple food in Vietnam, and is grown on approximately 80 percent of the country's arable land. In 1997 alone, Vietnam produced 27.7 million tons of unhulled rice. In the same year, the Mekong Delta area, located in the downstream part of the Mekong river basin, produced 14.8 million tons of rice, about 50 percent of national production, contributing greatly to the 3.68 million tons of exported milled rice. Currently, double and triple cropping in wet-seeded rice culture is the predominant cultivation method, practiced on over 2.5 million hectares. The process involves broadcasting pre-germinated seeds on wet soil after draining out standing water and other such land preparation. The process saves labor fees for transplanting rice seedlings and shortens the rice planting duration to minimize the threat potential of flood damage. However, the average rice yield per hectare under wet-seeded rice culture has stagnated since 1995. Wet-seeded rice culture also uses seed rates as high as 200 to 300 kg/ha, leading some researchers to try to find more efficient methods of rice cultivation. Looking to increase the yield per hectare and to lower seed usage, researchers attempted to identify optimum seed rates.

Scientists conducted most field trials on seed rates at the Cuu Long Delta Rice Research Institute in Omon district in Cantho Province during the dry season in 1998-99 and during the wet season in 1998. The trial fields were divided into three sections. The first plot contained the very early variety "OMCS" and the early variety, "IR64". Different seed rates were used for the subplots (25, 50, 75, 100, and 200 kg/ha in dry season 1998- 99 and 25, 50, 100, 150 and 200 kg/ha in wet season 1998). One field trial conducted during the dry season 1998-99 was based on the application of 100 kg/ha of nitrogen, 40 kg/ha of phosphate, and 40 kg/ha of potassium, respectively. Another field trial during wet season 1998 applied 100 kg/ha of nitrogen, 50 kg/ha of phosphate and 50 kg/ha of potassium, respectively. The weeds in the field trials were controlled by spraying a pre-emergence herbicide and by hand weeding. The seed rates in other experiments are shown in Table 2.

Early growing stage at high seed rates under wet-seeded rice culture in the Mekong Delta.

The number of panicles per square meter significantly decreased as the seed rate decreased from the conventional rate (200 kg/ha) in both dry and wet seasons. In contrast, filled grains per panicle significantly increased as the seed rate decreased in both seasons. This compensatory relationship between the two characteristics is consistent with our understanding of seeded and transplanting rice. The percentage increase seems to indicate that filled grains at lower seed rates have advantages over those grown using conventional seed rate (Table 1). As the weight of 1,000 filled grains are almost the same even at different seed rates, the yields at different seed rates are determined by number of filled grains per square meter.

The ratios of filled gains per square meter at lower seed rates to that at conventional seed rate (200 kg/ha) increased while the seed rate decreased from 200 kg/ha to 100 kg/ha. The highest ratios ranged between seed rates of 50 kg/ha and 100 kg/ha, while the ratio at the lowest seed rate, 25 kg/ha, slightly decreased compared with those at seeds rates of 50 to 100 kg/ha (Fig.1). The same tendency was observed in both dry and wet seasons.

Thus, the highest rice yields were obtained at seed rates from 50 to 100 kg/ha in both dry and wet seasons. The rice yields at both lower seed rates (25 kg/ha) and higher ones (150 to 200 kg/ha) decreased as compared with those at the seed rates of 50 to 100 kg/ha. Optimum seed rates were also confirmed in another on-farm trial on nitrogen application and suitable seed rates at the Song Hau State Farm and Thot Not District during the dry and wet seasons (Tables 1 and 2).

In conclusion, studies have shown that, taking a sufficient number of seedling establishments and lowering vacant spot areas (failed seedling establishment area) into consideration, 80 to 100 kg/ha is the optimal seed rate in wet-seeded rice culture in the Mekong Delta Area. The recommended seed

Seed rate (kg/ha)	No. of panicles (m^{-2})		No. of filled grain per panicle		Filled grain (%)		Grain yield (ton/ha)	
	DS 98-99	WS1998	DS98-99	WS1988	DS98-99	WS1998	DS98-99	WS1998
25	429 e	361 c	46 a	30 a	82 b	62 a	5.48 c	3.02 b
50	475 d	410 b	44 b	29 a	84 a	60 ab	5.69 b	3.33 a
75	507 c	-	44 b	-	85 a	-	6.13 a	-
100	547 b	437 a	38 c	27 a	83 ab	60 ab	5.66 bc	3.29 a
150	-	453 a	-	21 a	-	59 b	-	2.70 c
200	611 a	446 a	31 d	18 b	78 c	55 c	5.09 d	2.25 d

DS: Dry season; WS: Wet season.
Values followed by the same letters are not significant at the level of 5% within treatments.

Table 1. Yields and yield components at different seed rates under wet-seeded rice culture in the Mekong Delta area.

Year	Cropping season	Treatment	Seeding rates (kg/ha) 25	50	75	80	100	150	200	Yield (ton/ha)
1998-99	DS	SRT	110	116	123	-	115	-	100	4.84
1998-99	DS	NAM	-	-	-	-	98	-	100	4.93
1998-99	DS	SHSF	-	-	-	108	-	-	100	5.40
1999-00	DS	TN	-	-	-	-	109	-	100	6.11
1998	WS	SRT	136	149	-	-	144	123	100	1.97
1998	WS	NAM	-	127	-	-	124	-	100	2.65
1998	WS	SHSF	-	111	-	-	106	-	100	2.94
2000	WS	TN	-	-	-	-	106	-	100	3.65

SRT: Seeding rate test; NAM: Nitrogen application test.
SHSF: Test at Song Hau State Farm; TN: Test in Thot Not District, Cantho Province.

Table 2. Percentage of yields at different seed rates as compared with the yield at conventional seed rates (200 kg/ha) under wet-seeded rice culture.

rates not only increase the average yield, but also save 1/3 to 1/2 of seeds needed for traditional methods. The seeds should be applied to fields with smooth, level land and with good irrigation and drainage facilities. Additional productivity can be obtained through farmers who practice good weed control and seedling establishment.

(H. Hiraoka)

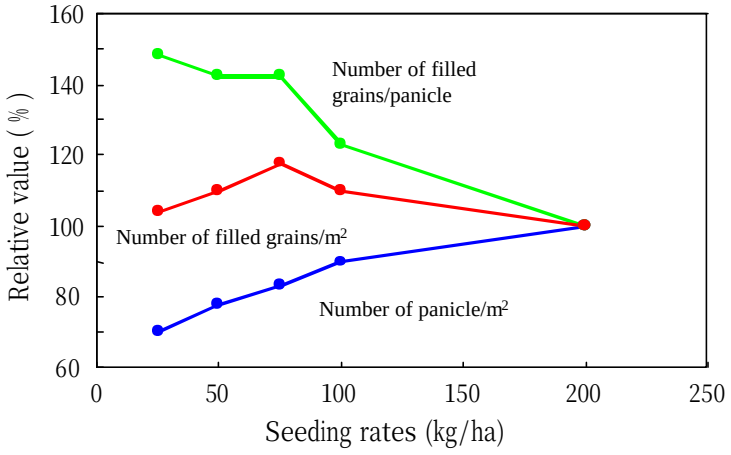


Fig.1. Yield determinants at various seeding rates as compared to that at the rate of 200kg/ha in the dry season of 1998-99.

TOPIC 5

Nutritional diagnosis of sulfur in soybean plants

Soybean cultivation is rapidly expanding to the northeastern areas of Brazil, making it necessary to undertake studies on soil fertility to serve as a basis for soil management. Brazilian acid soils generally lack sulfur (S) needed for modern cropping, but this deficiency has been covered by the use of sulfate fertilizers such as nitrogen sulfate and superphosphate. Recently, farmers have been applying higher guaranteed analysis fertilizers, causing sulfur deficiency to occur more frequently, particularly in newly developed savanna fields (cerrado) that accumulate few sulfur components. The application of sulfate materials easily induces microelement deficiencies due to the acidification of the soil. To address these problems, researchers are working to develop a method to maintain appropriate quantities of elements in soils and plants. This study is part of a collaborative project entitled "Soybean improvement, production and utilization in South America," with the Soybean Research Center of the Brazilian Agricultural Research Corporation (EMBRAPA-Soja).

The study tested two native cerrado soils—a clay soil from Gerais and a sandy clay loam soil from Sambaiba, in Maranhao, Brazil. Project collaborators used greenhouses run by EMBRAPA-Soja to house various soybean plants, and watered the plants using multiple solutions, each lacking a different element; solutions were deficient in sulfur, manganese, zinc, boron, or copper. The experiment revealed that sulfur was the primary growth-limiting factor for soybean among the tested elements in both soils. The lack of sulfur treatment was responsible for leaf yellowing that spread from the top of the plant (Fig. 1) to appear at

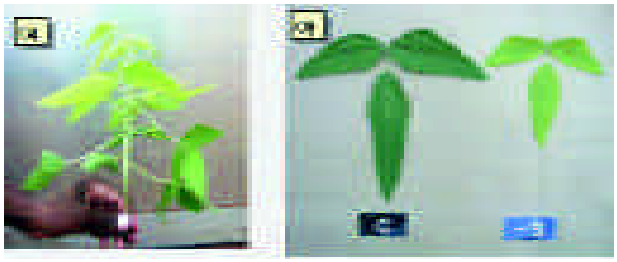


Fig.1. Sulfur deficiency in soybean in soil from Sambaiba, two months after sowing. a) Leaf yellowing started at the top of the plant; b) the third leaf of plants cultivated under S deficiency was smaller and more yellow than that of plants grown under a complete nutrition regimen.

concentrations of 1 g/kg at all positions of plant foliage. Therefore, a third leaf commonly submitted to routine chemical analysis can be used simultaneously as an indicator of the nutritive conditions of the plant. Subsequent experiments used soybean plants grown using different doses of sulfur (Fig. 2). The sulfur concentration in the third leaf at flowering and in the grains at harvest varied almost at a 1:1 ratio (y = 0.94x + 0.13, R2 = 0.65**). The relative grain weight was 20 percent smaller for plants with low sulfur concentrations, and measured less than 2 g/kg in both of the parts. Neither the plant dry weight nor the third leaf color showed a correlation with sulfur concentration close to or above critical values. Sulfur also showed effects on protein composition in grains; electrophoresis analysis showed that sulfur application decreased in ß sub-unit concentrations in ß-conglycinin and increased in glycinin. Sulfur concentration was more than 2.3 g/kg when the composition became equal with the original seeds cultivated under sufficient fertilization. These results classify sulfur concentration in the third leaf and in grains into the following categories: deficient in cases less than 1 g/kg; very low in plants that range from 1.0 g/kg to 2.0 g/kg; low from 2.0 g/kg to 2.3 g/kg; and normal when more than 2.3 g/kg. The sulfur concentration variation within the soil layers was large in a cultivated field, and the depth of the accumulation layer varied depending on the physical characteristics of the soil and on climate. Therefore, it is difficult to formulate a generalized method of soil sampling and to obtain critical soil sulfur concentration for deficiency. To obtain satisfactory production both in terms of grain weight and quality, it is essential to analyze soybean leaves or grains and apply a sulfuric material for the next cropping before sulfur concentrations become lower than 2.3 g/kg.

(K. Hitsuda)

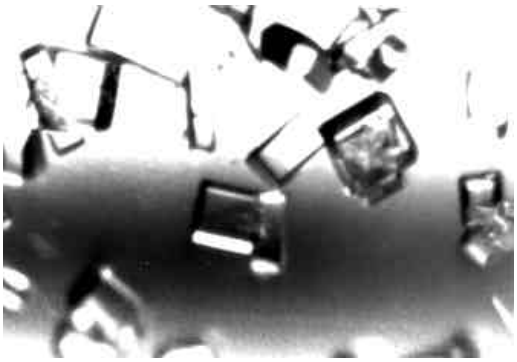
Fig. 2. Soybean growth and obtained grains with sulfur application in the A horizon of Sambaiba soil.

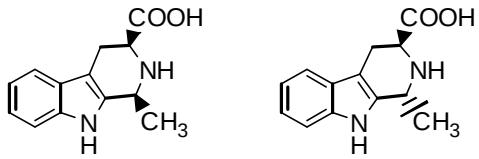
TOPIC 6

Inhibition of the adipocyte differentiation of 3T3-L1 preadipocytes by amino acid derivatives in traditional Asian fermented foods

For centuries, Asian countries have utilized a great variety of fermented foods as important ingredients in various cuisines. Since some components in these fermented foods exhibit certain physiological functions, it has been suggested that fermented foods may help prevent numerous human chronic diseases.

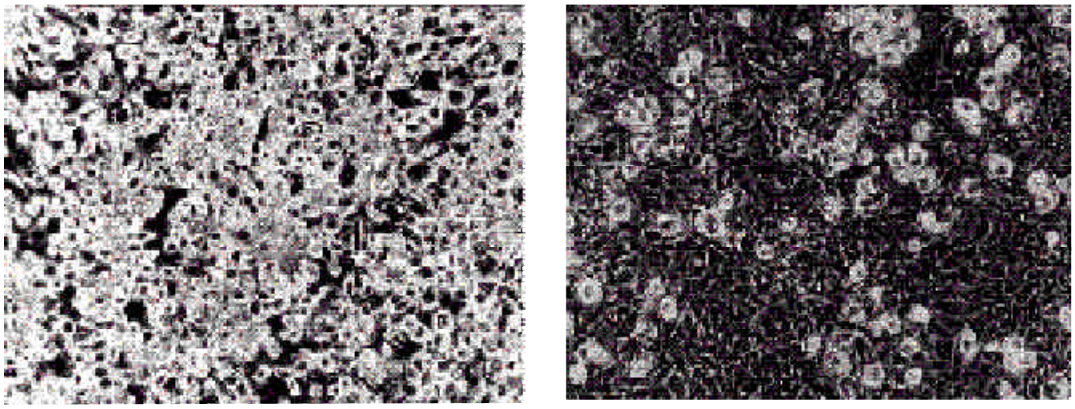
In recent decades, the number of patients suffering from chronic diseases that are mostly caused by obesity, such as heart disease, diabetes, hypertension, hyperlipidemia, and thrombosis, has increased all over the world.





(*1S,3S*)-MTCA (*1R, 3S*)-MTCA

Fig. 1. RS-MTCA crystals (photograph) and MTCA structures. SS-MTCA and RS-MTCA were purified to homogeneity using a Wakogel C-18 column (55 X 300 mm) and a TSKgel ODS-80Ts column (21.5 X 300 mm, Tosoh), and recrystallized. SS-MTCA crystals consisted of yellowish white needles and those of RS-MTCA were colorless prisms. The final yield from 5 kg of fresh miso was 340 mg and 136 mg, respectively. The UV, FAB-MS and ^{1}H-NMR (300 MHz) and ^{13}C-NMR (150 MHz) spectra of SS-MTCA and RS-MTCA were identical to those of the authentic preparations.



A B

Fig. 2. Inhibition of differentiation of 3T3-L1 preadipocytes by RS-MTCA. 3T3-L1 preadipocyte cells were maintained in DMEM/ 10% FCS in 60 mm plastic culture dishes (3003, Falcon, USA). Adipose differentiation was induced by treating the confluent cells with DMEM/ 10% FCS containing 0.1 mM insulin, 1 mM dexamethasone (DEX), 0.5 mM 3-isobutyl-1-methylxanthine (MIX) for two days. Next, cells were replaced by DMEM/ 10% FCS supplemented only with insulin. The medium was replenished every two days. Morphological aspects of adipose differentiation were observed by light microscopy. A: control culture without RS-MTCA treatment; B: RS-MTCA added to the culture media at a concentration of 20 µg/ml through the induction.

The change is most likely correlated with the alteration of diet composition, characterized by the excessive consumption of energy and saturated fat. In response to these trends, these studies focused on food components that modulate fat cell (adipocyte) differentiation.

The current project studies the effects of the components in fermented foods on 3T3-L1 preadipocytes, a useful tool for the *in vitro* study on adipose differentiation. A total of ten types of fermented foods (five from Indonesia, four from Thailand, and one from Japan) were used for the study. Results from a preliminary screening showed definite inhibitory activity in the methanolic extracts of miso (Japanese fermented soybean paste), soy sauce (Japan and Thailand), tau-jaw (fermented soybean in Thailand, semi-liquid style), and su-fu (fermented tofu in Thailand). Active constituents were fractionated from miso by reversed-phase column chromatography, monitoring the inhibitory activity as a guide. Finally, two compounds that exhibited inhibitory activity on adipose differentiation of 3T3-L1 preadipocytes were isolated from miso (Figure 1). They were identified as (-)-(*1S,3S*)-1-methyl-1,2,3,4-tetrahydro-β-carbolin-3-carboxylic acid (SS-MTCA) and (-)-(*1R,3S*)-1-methyl-1,2,3,4-tetrahydro-β-carbolin-3-carboxylic acid (RS-MTCA) by mass and nuclear magnetic resonance spectrometries. The morphological change in 3T3-L1 adipose differentiation in the presence of these compounds was suppressed (Fig. 2). The induction of glycerol-3-phosphate dehydrogenase activity, which is involved in the synthesis of lipids, was suppressed to 44.9± 2.7 percent and 55.9± 3.1 percent by SS-MTCA and RS-MTCA, respectively, at a concentration of 20 µg/ ml. When cells were treated with MTCA in the presence of dexamethasone (DEX) and methylisobutylxanthine (MIX) at the early stages of differential induction, adipose differentiation was suppressed. Conversely, when cells were treated with MTCA only after completing treatment by DEX and MIX, adipose differentiation was not suppressed. Adipose differentiation of 3T3-F442A, a DEX-MIX

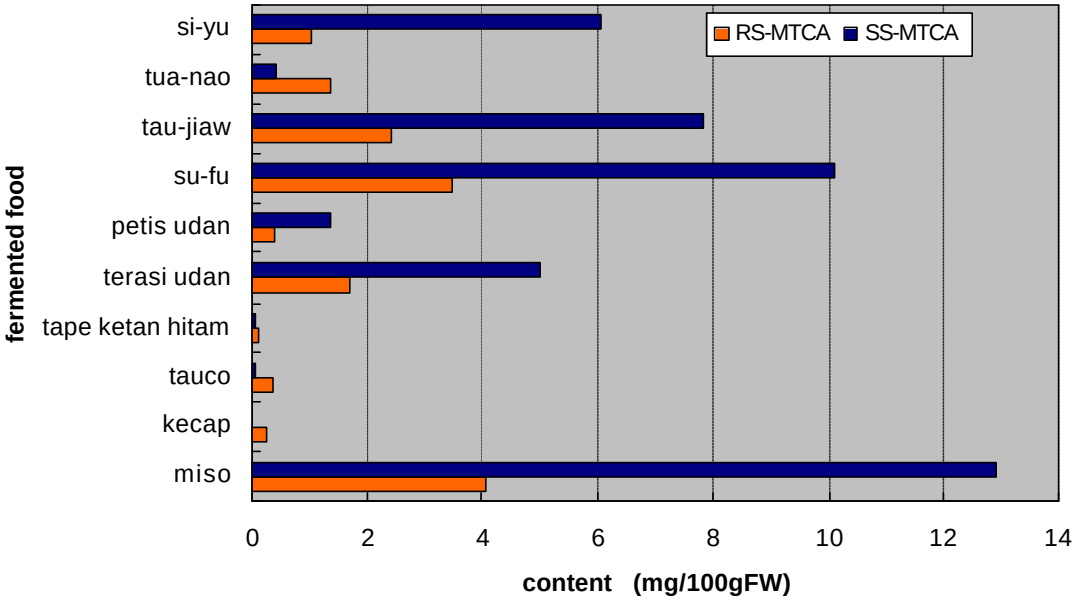


Fig. 3. Content of MTCA's in Asian fermented foods. The content of MTCA in various fermented foods was determined by an HPLC (PX-8020 system equipped with a photodiode array detector, Tosoh) with a TSK gel super-ODS column (4.6x100 mm, Tosoh) maintained at 40°C. The mobile phase system was a linear gradient using 0.5% formic acid and acetonitrile, operating at a flow rate of 1.0 mL/min. Quantification was calculated from the calibration curve of authentic preparations based on the concentrations calculated by their molecular extinction coefficients.

insensitive mutant of the 3T3 cell was not suppressed by MTCA's. These data suggest that MTCA's inhibit early processes induced by DEX and MIX in 3T3-L1 adipose differentiation.

Previous studies have demonstrated that MTCA's occur in soy sauce, wine, beer, wine vinegar, toasted bread, and yogurt. In these foods, MTCA's are spontaneously synthesized by a condensation reaction between tryptophan and aldehydes under acidic pH. Asian fermented foods that exhibited inhibitory activity on the differentiation of 3T3-L1 cells contained higher amounts of MTCA's (Fig. 3). In spite of its wide occurrence in foods, the biological activity of MTCA's is not established. This study demonstrates a potential role of MTCA's in the human body.

(K. Nakahara)

ANIMAL PRODUCTION AND GRASSLAND DIVISION

Domesticated animals are in many ways beneficial to people's lives in developing countries. Animals not only produce meat, milk, and hide, which are essential in daily life and are an important source of income, but also generate draft power for tillage and transportation and produce wastes that can be used as fertilizer and fuel. Despite these benefits, livestock production remains at low levels throughout the developing world due to constraints such as low genetic potential, poor quality 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 reach 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 of the world.

Regular cattle crossed with Dama cattle having resistance for trypanosomiasis on an experimental farm at ILRI. (Photo: T. Taniguchi)

During Fiscal Year (FY) 2000, a research investigation entitled, "Development of technologies for sustainable management of grasslands in Central Asia" moved toward completion. The project was part of a broader collaborative project with the Kazakh Institute of Agriculture (KIA) entitled "Development of sustainable systems of grassland management and animal production". The workshop on pasture and livestock production in Central Asia was held in collaboration with Kazakhstan's National Academy Center for Agriculture Research at JIRCAS in September 2000. JIRCAS also hosted the final evaluation meeting of the project in March 2001. In addition to this project, five long-term international research projects ranging in duration from one to three years are currently underway. Division researchers are working with the Thai Department of Livestock Development (DLD) to improve cattle production and feeding with locally available feed resources in Northeast Thailand. Cooperative research on agro-pastoral systems being carried out with the National Center for Research on Beef Cattle (CNPGC-EMBRAPA), the National Center for Soybean Research (CNPSo) in Brazil, and the International Center for Tropical Agriculture (CIAT) in Colombia focuses on sustainable management and utilization of grasslands. A complementary collaborative research project, started in 1998, analyzes technology related to raising small livestock. Finally, 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 project 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 development of low-cost production technology for feed silage, (2) the evaluation of the potential of local grass resources for year-round supply for forage in Northeast Thailand, and (3) the analysis of nutrient requirements of Holstein milk-cows in

TOPIC 4

Optimum seed rates in wet-seeded rice culture in the Mekong Delta of Vietnam

Rice is the staple food in Vietnam, and is grown on approximately 80 percent of the country's arable land. In 1997 alone, Vietnam produced 27.7 million tons of unhulled rice. In the same year, the Mekong Delta area, located in the downstream part of the Mekong river basin, produced 14.8 million tons of rice, about 50 percent of national production, contributing greatly to the 3.68 million tons of exported milled rice. Currently, double and triple cropping in wet-seeded rice culture is the predominant cultivation method, practiced on over 2.5 million hectares. The process involves broadcasting pre-germinated seeds on wet soil after draining out standing water and other such land preparation. The process saves labor fees for transplanting rice seedlings and shortens the rice planting duration to minimize the threat potential of flood damage. However, the average rice yield per hectare under wet-seeded rice culture has stagnated since 1995. Wet-seeded rice culture also uses seed rates as high as 200 to 300 kg/ha, leading some researchers to try to find more efficient methods of rice cultivation. Looking to increase the yield per hectare and to lower seed usage, researchers attempted to identify optimum seed rates.

Scientists conducted most field trials on seed rates at the Cuu Long Delta Rice Research Institute in Omon district in Cantho Province during the dry season in 1998-99 and during the wet season in 1998. The trial fields were divided into three sections. The first plot contained the very early variety "OMCS" and the early variety, "IR64". Different seed rates were used for the subplots (25, 50, 75, 100, and 200 kg/ha in dry season 1998- 99 and 25, 50, 100, 150 and 200 kg/ha in wet season 1998). One field trial conducted during the dry season 1998-99 was based on the application of 100 kg/ha of nitrogen, 40 kg/ha of phosphate, and 40 kg/ha of potassium, respectively. Another field trial during wet season 1998 applied 100 kg/ha of nitrogen, 50 kg/ha of phosphate and 50 kg/ha of potassium, respectively. The weeds in the field trials were controlled by spraying a pre-emergence herbicide and by hand weeding. The seed rates in other experiments are shown in Table 2.

Early growing stage at high seed rates under wet-seeded rice culture in the Mekong Delta.

The number of panicles per square meter significantly decreased as the seed rate decreased from the conventional rate (200 kg/ha) in both dry and wet seasons. In contrast, filled grains per panicle significantly increased as the seed rate decreased in both seasons. This compensatory relationship between the two characteristics is consistent with our understanding of seeded and transplanting rice. The percentage increase seems to indicate that filled grains at lower seed rates have advantages over those grown using conventional seed rate (Table 1). As the weight of 1,000 filled grains are almost the same even at different seed rates, the yields at different seed rates are determined by number of filled grains per square meter.

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In conclusion, studies have shown that, taking a sufficient number of seedling establishments and lowering vacant spot areas (failed seedling establishment area) into consideration, 80 to 100 kg/ha is the optimal seed rate in wet-seeded rice culture in the Mekong Delta Area. The recommended seed

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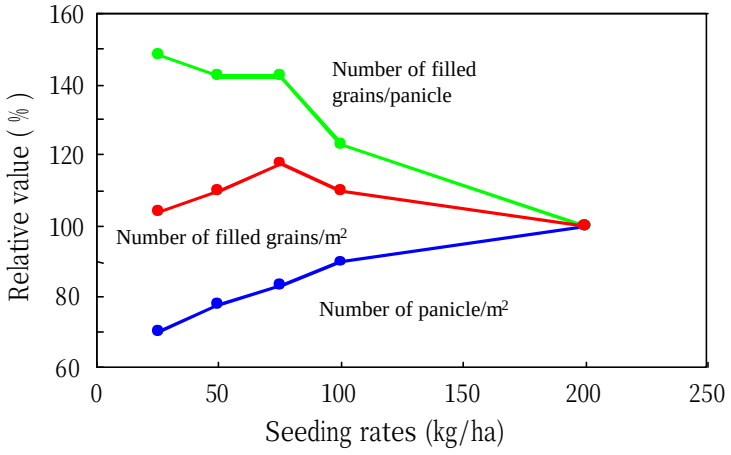

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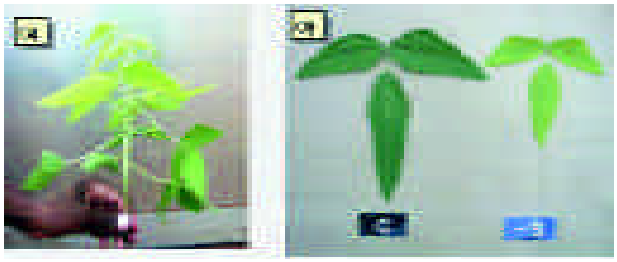

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(K. Hitsuda)

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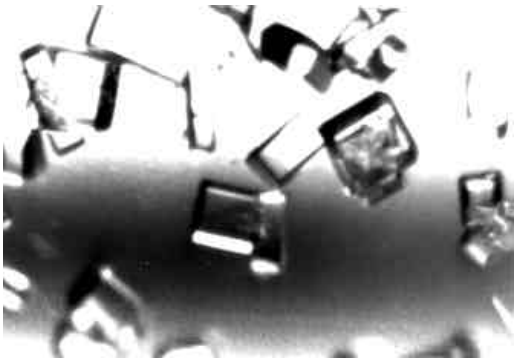
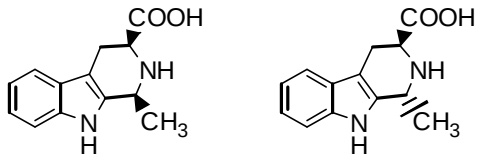
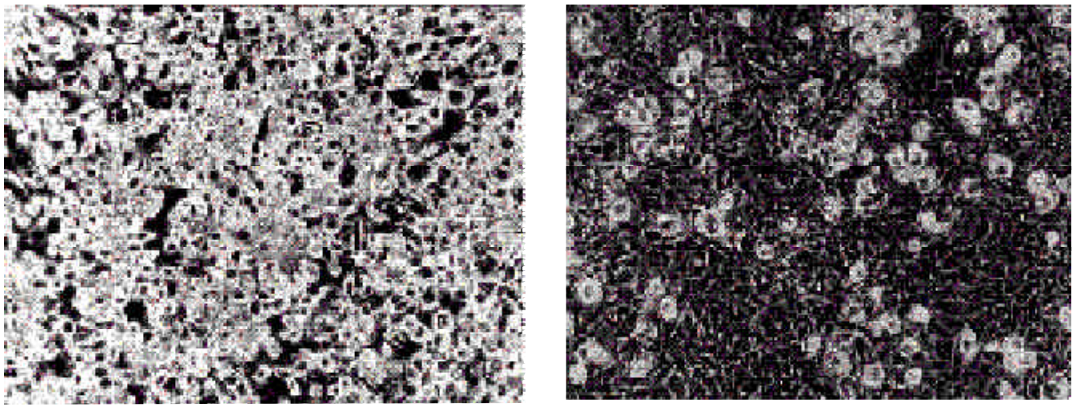




(*1S,3S*)-MTCA (*1R, 3S*)-MTCA

Fig. 1. RS-MTCA crystals (photograph) and MTCA structures. SS-MTCA and RS-MTCA were purified to homogeneity using a Wakogel C-18 column (55 X 300 mm) and a TSKgel ODS-80Ts column (21.5 X 300 mm, Tosoh), and recrystallized. SS-MTCA crystals consisted of yellowish white needles and those of RS-MTCA were colorless prisms. The final yield from 5 kg of fresh miso was 340 mg and 136 mg, respectively. The UV, FAB-MS and ^{1}H-NMR (300 MHz) and ^{13}C-NMR (150 MHz) spectra of SS-MTCA and RS-MTCA were identical to those of the authentic preparations.



A B

Fig. 2. Inhibition of differentiation of 3T3-L1 preadipocytes by RS-MTCA. 3T3-L1 preadipocyte cells were maintained in DMEM/ 10% FCS in 60 mm plastic culture dishes (3003, Falcon, USA). Adipose differentiation was induced by treating the confluent cells with DMEM/ 10% FCS containing 0.1 mM insulin, 1 mM dexamethasone (DEX), 0.5 mM 3-isobutyl-1-methylxanthine (MIX) for two days. Next, cells were replaced by DMEM/ 10% FCS supplemented only with insulin. The medium was replenished every two days. Morphological aspects of adipose differentiation were observed by light microscopy. A: control culture without RS-MTCA treatment; B: RS-MTCA added to the culture media at a concentration of 20 µg/ml through the induction.

The change is most likely correlated with the alteration of diet composition, characterized by the excessive consumption of energy and saturated fat. In response to these trends, these studies focused on food components that modulate fat cell (adipocyte) differentiation.

The current project studies the effects of the components in fermented foods on 3T3-L1 preadipocytes, a useful tool for the *in vitro* study on adipose differentiation. A total of ten types of fermented foods (five from Indonesia, four from Thailand, and one from Japan) were used for the study. Results from a preliminary screening showed definite inhibitory activity in the methanolic extracts of miso (Japanese fermented soybean paste), soy sauce (Japan and Thailand), tau-jaw (fermented soybean in Thailand, semi-liquid style), and su-fu (fermented tofu in Thailand). Active constituents were fractionated from miso by reversed-phase column chromatography, monitoring the inhibitory activity as a guide. Finally, two compounds that exhibited inhibitory activity on adipose differentiation of 3T3-L1 preadipocytes were isolated from miso (Figure 1). They were identified as (-)-(*1S,3S*)-1-methyl-1,2,3,4-tetrahydro-β-carbolin-3-carboxylic acid (SS-MTCA) and (-)-(*1R,3S*)-1-methyl-1,2,3,4-tetrahydro-β-carbolin-3-carboxylic acid (RS-MTCA) by mass and nuclear magnetic resonance spectrometries. The morphological change in 3T3-L1 adipose differentiation in the presence of these compounds was suppressed (Fig. 2). The induction of glycerol-3-phosphate dehydrogenase activity, which is involved in the synthesis of lipids, was suppressed to 44.9± 2.7 percent and 55.9± 3.1 percent by SS-MTCA and RS-MTCA, respectively, at a concentration of 20 µg/ ml. When cells were treated with MTCA in the presence of dexamethasone (DEX) and methylisobutylxanthine (MIX) at the early stages of differential induction, adipose differentiation was suppressed. Conversely, when cells were treated with MTCA only after completing treatment by DEX and MIX, adipose differentiation was not suppressed. Adipose differentiation of 3T3-F442A, a DEX-MIX

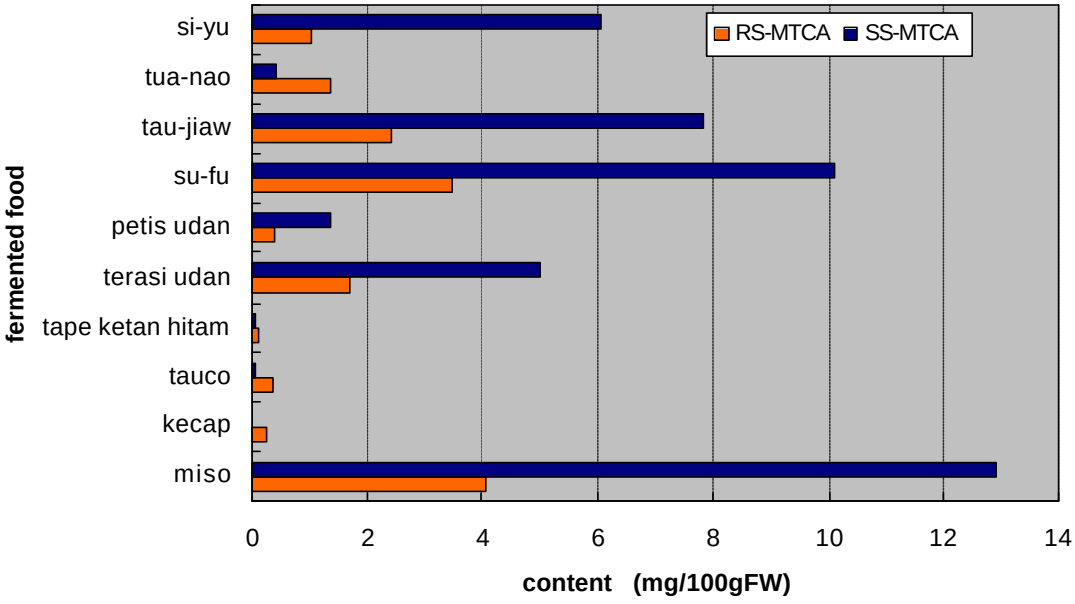


Fig. 3. Content of MTCA's in Asian fermented foods. The content of MTCA in various fermented foods was determined by an HPLC (PX-8020 system equipped with a photodiode array detector, Tosoh) with a TSK gel super-ODS column (4.6x100 mm, Tosoh) maintained at 40°C. The mobile phase system was a linear gradient using 0.5% formic acid and acetonitrile, operating at a flow rate of 1.0 mL/min. Quantification was calculated from the calibration curve of authentic preparations based on the concentrations calculated by their molecular extinction coefficients.

insensitive mutant of the 3T3 cell was not suppressed by MTCA's. These data suggest that MTCA's inhibit early processes induced by DEX and MIX in 3T3-L1 adipose differentiation.

Previous studies have demonstrated that MTCA's occur in soy sauce, wine, beer, wine vinegar, toasted bread, and yogurt. In these foods, MTCA's are spontaneously synthesized by a condensation reaction between tryptophan and aldehydes under acidic pH. Asian fermented foods that exhibited inhibitory activity on the differentiation of 3T3-L1 cells contained higher amounts of MTCA's (Fig. 3). In spite of its wide occurrence in foods, the biological activity of MTCA's is not established. This study demonstrates a potential role of MTCA's in the human body.

(K. Nakahara)

ANIMAL PRODUCTION AND GRASSLAND DIVISION

Domesticated animals are in many ways beneficial to people's lives in developing countries. Animals not only produce meat, milk, and hide, which are essential in daily life and are an important source of income, but also generate draft power for tillage and transportation and produce wastes that can be used as fertilizer and fuel. Despite these benefits, livestock production remains at low levels throughout the developing world due to constraints such as low genetic potential, poor quality 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 reach 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 of the world.

Regular cattle crossed with Dama cattle having resistance for trypanosomiasis on an experimental farm at ILRI. (Photo: T. Taniguchi)

During Fiscal Year (FY) 2000, a research investigation entitled, "Development of technologies for sustainable management of grasslands in Central Asia" moved toward completion. The project was part of a broader collaborative project with the Kazakh Institute of Agriculture (KIA) entitled "Development of sustainable systems of grassland management and animal production". The workshop on pasture and livestock production in Central Asia was held in collaboration with Kazakhstan's National Academy Center for Agriculture Research at JIRCAS in September 2000. JIRCAS also hosted the final evaluation meeting of the project in March 2001. In addition to this project, five long-term international research projects ranging in duration from one to three years are currently underway. Division researchers are working with the Thai Department of Livestock Development (DLD) to improve cattle production and feeding with locally available feed resources in Northeast Thailand. Cooperative research on agro-pastoral systems being carried out with the National Center for Research on Beef Cattle (CNPGC-EMBRAPA), the National Center for Soybean Research (CNPSo) in Brazil, and the International Center for Tropical Agriculture (CIAT) in Colombia focuses on sustainable management and utilization of grasslands. A complementary collaborative research project, started in 1998, analyzes technology related to raising small livestock. Finally, 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 project 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 development of low-cost production technology for feed silage, (2) the evaluation of the potential of local grass resources for year-round supply for forage in Northeast Thailand, and (3) the analysis of nutrient requirements of Holstein milk-cows in

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Northeast Thailand were joint projects with the Khon Kaen Animal Nutrition Research Center and DLD. Other projects, including (4) studies on the nutritional status of swine in the Mekong Delta, (5) pathological diagnosis of major swine diseases in the Mekong Delta, (6) chemical studies on water pollutants associated with swine production in the Mekong Delta, and (7) identification of bacteria isolated from the water pollutants associated with swine production were conducted with Cantho University in Vietnam. Still other projects, such as (8) studies on the estimation of the potential productivity of main forage crops and pastures in agro-pastoral systems in Brazil and (9) the evaluation of vesicular-arbuscular (VA) mycorrhizae in tropical forage grasses were aided by the CNPGC. In addition, the Chinese Agricultural University in northern China assisted (10) studies on the feed composition analysis of corn stalk silage in China and (11) evaluation of the feed value of corn stalk silage and agricultural by-products. Finally, (12) studies on glucose metabolism and hepatic function in murine trypanosomiasis and (13) the effects of tumor necrosis factor alpha (TNFα) on trypanosomes cultured *in vitro* in relation to trypanotolerance were jointly investigated 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 enhancement of overall levels of research. In order to address such needs, the Division has been promoting basic research at JIRCAS's Tsukuba premises in support of overseas activities. At present, a study on the evaluation and utilization of endophytic bacteria of grass constitutes the focus of domestic research.

TOPIC 1

Forage productivity and quality of *Panicum maximum* in two agro-pastoral systems in the Brazilian Savannas

Since the 1970's, *Brachiaria* spp. of African origin, such as *B. decumbens* and *B. brizantha*, have been rapidly introduced into the Brazilian savannas. However, extensive pasture utilization without basic fertilizer application has caused pasture degradation in over 50 percent of the grass pastures in which *Brachiaria* was introduced. Recently, the use of agro-pastoral systems (sustainable crop-pasture rotation systems) has been discussed as an option for pasture renovation in the savanna regions. The most important advance in agro-pastoral systems relating to forage production is the use of residual fertilizer applied to the preceding year's crops. It is expected that such usage will make possible high quality forage species even on the highly infertile savanna soils. *Panicum maximum* is a promising forage species of high productivity and nutritive value. Thus, in this study, researchers visited the Brazilian savannas to examine the availability and capacity of *P. maximum* in agro-pastoral systems.

Photo: Grazing experiment on *Panicum maximum* pastures established after 4-year cultivation of soybean (SO-PM; front) and 4-year rotation of summer soybean with winter millet (back: SO/MI-PM). Leaf color of SO/MI-PM is more yellow than that of SO-PM, due to nitrogen deficit.

The National Beef Cattle Research Center of the Brazilian Agricultural Research Corporation in Campo Grande, Brazil, conducted a grazing experiment where *P. maximum* pastures were established after two different cropping sequences: one anterior cropping sequence with four years of soybean cultivation in summer (SO-PM), and the other involving four years of rotating summer soybeans with winter millet for grazing (SO/MI-PM). The average soybean yield of the anterior four years was 2,559 kg/ha. On the *P. maximum* pastures, herbage samples were harvested at six-week intervals during a period of 253 days, after which dry matter productivity was evaluated. Table 1 shows the average value of total biomass (plant top combined with existing litter) during the experimental period. The average biomass in SO-PM was significantly higher than that in SO/MI-PM. Total dry matter production of SO-PM was much higher than in SO/MI-PM. During the investigation period, leaf samples were taken at two different times to evaluate nutritive values. Significant differences were observed in the contents of crude protein and nitrogen. These data indicated that forage productivity and quality of SO-PM are much higher than

	Average biomass	Dry matter production	Crude protein	In vitro digestibility	Nitrogen
	(DMt/ha)	(DM t/ha/253 days)	(%)	(%)	(%)
After soybean cultivation	12.7	16.6	12.7	56.0	1.92
After soybean+millet cultivation	9.0	10.3	8.6	51.8	1.31

Table 1. Average biomass, dry matter production, and nutritive values of *Panicum maximum* pastures established after a four-year cultivation of soybean and four-year rotation of summer soybean with winter millet.

those of SO/MI-PM. Results of soil analysis indicated that, in the rotation of SO/MI-PM, a part of the soil nitrogen was immobilized into the plant residue of millet, while the other part of the nitrogen was lost due to livestock grazing on millet during the winter. Thus, *P. maximum* could not utilize soil nitrogen after SO/MI-PM rotation.

In terms of farming practice, crop rotation of summer soybean and winter millet appears to be more effective than restricting harvests to summer soybean cultivation; the winter millets are of crucial importance because they supply sufficient forages to grazing animals during the dry seasons. Studies show that if *P. maximum* is planted after the cropping sequence of summer soybean and winter millet, a minimum amount of nitrogen fertilizer should be applied to maintain the productivity of *P. maximum* pastures. In sum, the utilization of *P. maximum*-legume mixture is one viable option for establishing sustainable agro-pastoral systems in the Brazilian savannas.

(T. Kanno)

TOPIC 2

The roles of tumor necrosis factor α in genetic resistance of mice to *Trypanosoma congolense* infection

Trypanosoma congolense is a protozoan parasite that causes disease and mortality in domestic livestock in large areas of sub-Saharan Africa. Despite numerous efforts to control the spread of the parasite, African trypanosomiasis still has a substantial negative impact on livestock productivity. Genetic mapping of murine trypanosomiasis resistance genes suggests that tumor necrosis factor α (TNFα) is one of the primary factors of trypanosomiasis resistance. A research group at the National Institute of Animal Health (NIAH) has generated TNFα-gene-deficient mice, which they infected with *Trypanosoma congolense* IL 1180. Scientists then studied pathological and physiological responses of these mice to understand the roles of TNFα in murine trypanosomiasis.

TNFα-deficient mice were highly susceptible to *T. congolense* infection, with a mean survival time of 35 days in this study (Fig.1). In contrast, the mean survival time of wild-type mice was 67 days. Therefore, TNFα has an essential role in prolonging the mice's survival during *T. congolense* infection. In accordance to the shorter survival time, TNFα-deficient mice showed higher parasitaemia levels than wild-type mice (Fig. 2). These results confirm that TNFα plays an important role in controlling parasitaemia levels during experimental *T. congolense* infection in mice.

TNFα-deficient mice did not show any germinal center structures in the lymph organs. However, titers of *T. congolense*-specific, as well as non-specific immunoglobulin (Ig) M and IgG in sera of TNFα-deficient mice were similar to those in wild-type mice. Therefore, TNFα-deficient mice were able to mount a humoral immune response to the same extent and of the same quality as wild-type mice.

TNFα is an important mediator for the induction of acute phase proteins. To determine whether the increased susceptibility to *T. congolense* infection of TNFα-deficient mice is due to a reduced acute phase response, studies quantified three acute phase proteins. Ceruloplasmin,α1-acid glycoprotein, and serum amyloid P rapidly increased 11 days after infection, when the first peak of parasitaemia was observed. The levels of these proteins decreased at day 14, then moderately increased again after 21 days after infection. Overall profiles of these acute phase proteins were generally similar in TNFα-deficient and wild-type mice, indicating that the acute phase response can be elicited in the absence of TNFα. Moreover, the increased susceptibility of TNFα-deficient mice to *T. congolense* infection, by comparison with wild-type mice, could not be attributed to a failure of production of these acute phase proteins.

Research confirms that TNFα plays an important role in mice infected with *T. congolense*, possibly by controlling parasitaemia levels. However, how TNFα controls parasitaemia in infected animals remains

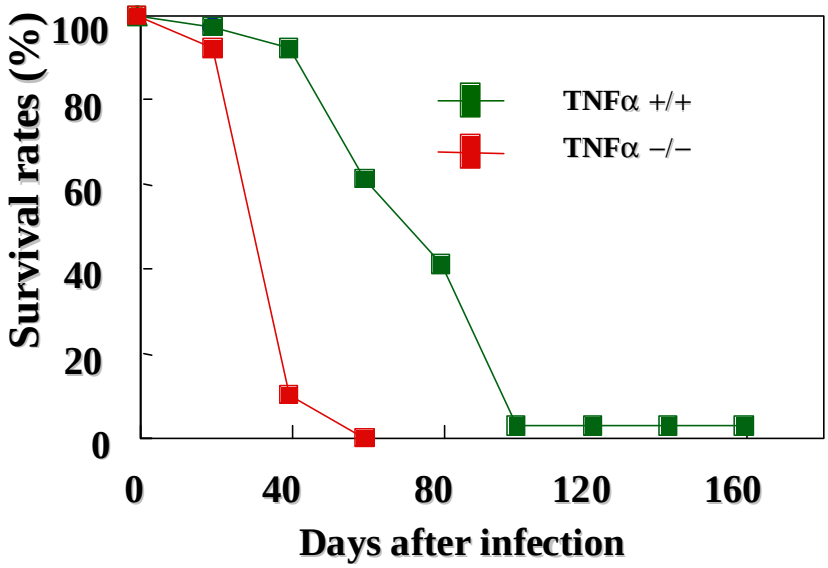

Fig.1. Survival rates of different mouse strains with (■) and without (■) the presence of the TNFα gene after infection with *T. congolense*.

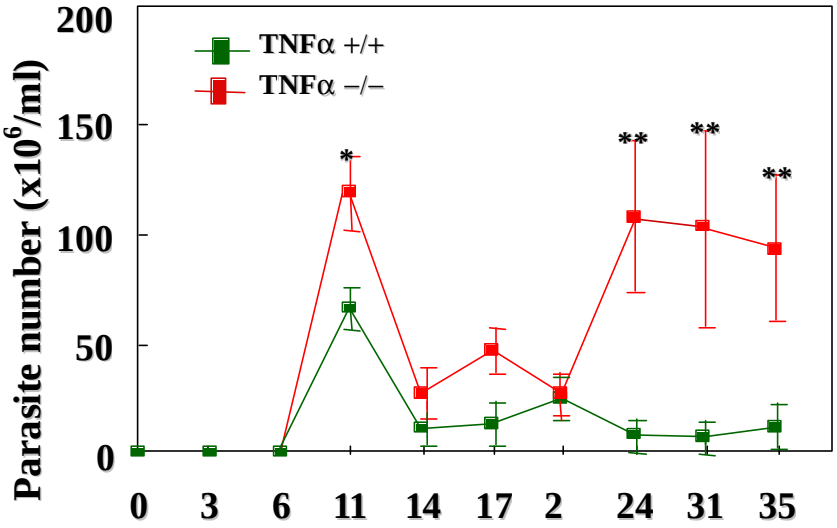

Fig. 2. Changes in mean parasite numbers in the peripheral blood in wild-type (■) and TNFα-deficient (■) mice after infection with *T. congolense*. Significantly different at P<0.05(*) and P<0.001(**) between the two mouse strains.

unknown. Further studies will be necessary to determine whether TNFα controls *T. congolense* parasitaemia directly or indirectly, and in either case, whether or not such control is a factor in the variation in resistance/susceptibility between mouse strains.

(H. Kitani)

FORESTRY DIVISION

Increasing demand for food compels farmers to make use of larger amounts of arable land. As a result, vast areas of natural forests in the tropics have disappeared. Large-scale commercial logging has also been detrimental to forest preservation. Forest degradation has generated serious economic and environmental problems, not only at the local level but also on a global scale. Providing methods for rehabilitation and sustainable management of forest areas thus remains an urgent issue. Improving forest production systems and postharvest technologies in local communities is an essential means of preventing forest destruction.

The Forestry Division conducts a wide range of research in developing countries, addressing issues from production to end-use. The Division generally undertakes projects that fall under one of two categories: silvicultural and forest management technologies or processing technologies for forest products. In these projects, researchers utilize their expertise in various disciplines, including silviculture, forest ecology and plant eco-physiology, soil science and forest conservation, mycology, forest mechanization, socioeconomics, and wood technology.

Enrichment and rehabilitation of degraded forests are the initial steps toward the development of sustainable management of forest reserves. In an effort to make these initial goals attainable, the Forestry Division has concentrated its research on relevant technologies in silviculture, site evaluation, and conservation, while also taking into consideration natural environmental conditions. At the same time, the Division has been managing studies on species behavior, systems for natural forest regeneration, enrichment planting methods, and harvesting systems. These studies are designed to support sustainable production of forest products, which constitute a principal trading commodity in thirty-three developing countries around the world. If achieved, sustainable production will help to stabilize levels of land abuse, both in natural forests and on plantations.

Monoculture plantations with primary growing trees, *Acacia mangium*, in Kinarut, Sabah, Malaysia. (Photo: K. Nakashima)

Finally, the Forestry Division has focused its research on problems with shifting cultivation, which remains a major cause of forest degradation in developing countries. Such problems require the development of forest production and planning systems that stimulate local economies. In those countries where forest biological resources face complete annihilation, development of technology for conservation and rehabilitation are urgent issues. To minimize forest degradation, the Division recently initiated studies on development of technologies available for agro-forestry systems in order to restore and enhance biological diversity in tropical forests.

TOPIC 1

Development of low impact harvesting methods for tropical natural forests

Although scientists have studied and improved management systems for tropical natural forests, sustainability of the forest management is yet to be attained. One of the causes of this problem is the lack of proper harvesting techniques. Currently, the only option for selective cutting in the forests is the ground-based harvesting method, bulldozer logging, in which bulldozers penetrate forest areas and seek tagged trees for extraction. The pathways left by bulldozers damage surface vegetation and produce severe site disturbance. In addition, because the work is normally done at the bulldozer operator's discretion, large portions of the harvested area tend to remain heavily disturbed after harvesting. Thus, many operations also damage the remaining trees that are meant to grow as dominant trees in the following years. In one study, 25 out of 40 trees left after harvest per hectare were damaged through breakage of treetops or branches, peeling bark, and root trampling, and other injuries.

According to our observations, more than 50 percent of the bulldozer logging area was disturbed by such operations. Soil disturbance levels were categorized as "mineral soil exposed with heavy compaction", "mineral soil exposed with light compaction", "mineral soil partially exposed", or "mineral soil not exposed". According to the study, the areas classified as "mineral soil exposed with heavy compaction",

Table 1. Comparison of disturbed area between bulldozer logging and cable logging.

	Category	Ratio (%)
Bulldozer	Logging trail	5.4
	Skid trail	4.8
	Dragged area	7.2
	Total	17.4
Cable System	Dragged in corridor	0.7
	Lateral hauling	0.9
	Total	1.6

and "mineral soil exposed with light compaction", were likely to remain uncovered with vegetation for an extended period when in areas with steep gradient. The factors that contributed to such disturbances were construction of landings, steep gradient roads, or heavy traffic on skid trails.

The cable logging system provides a favorable alternative, reducing the area of disturbance because there is no need to use heavy machinery or construct skid trails. However, in selective cutting, heavy weight logs are scattered throughout tropical natural forests, creating difficulties for conventional cable logging systems. In order to develop a cable logging system suitable for these circumstances, researchers have developed a combination system ('cable yarding system') of standing skyline and running skyline using a small wire rope 20-mm in diameter for the heavy timbers. To maintain adequate safety, researchers installed the skyline very loosely, with maximum sag value 0.1, and added a special function that controls the skyline tension and sag according to log weight.

Using this combination system, we have conducted several trials in a 30-hectare research plot in Compartment 51, located in the Jengai Forest Reserve, Terengganu, Peninsular Malaysia (Photo 1). Our experiment showed that logs weighing up to five tons could be carried safely when using a 0.08 sag value and 230 meter span setting. Table 1 shows the ratio of disturbed area by the bulldozer and cable logging operation. The disturbance in the cable system only occurred in steep slopes where logs slip more frequently. The study showed that the ratio of disturbed area is much less under cable logging than under bulldozer logging.

Currently, researchers continue to make improvements to the system, seeking techniques that will lead to more efficient and less damaging harvests. We hope that this cable yarding system will be of practical use in the near future and contribute to the sustainable management of tropical forests.

(S. Sasaki)

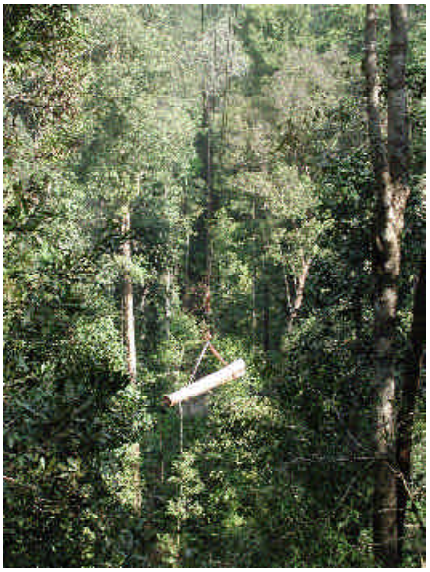

Photo 1. Harvesting operation using the cable logging system.

FISHERIES DIVISION

Biotic factors in the marine environment can be characterized in terms of interactions among organisms. Four distinct levels of organization occur in the biotic sector of the environment: (1) individuals, (2) populations, (3) communities, and (4) ecosystems. Ecosystems interrelate on a global scale, forming the Earth's biosphere. The Fisheries Division conducts research concerning these four levels of biotic marine environments. The Division conducts five major international research projects in Asian countries, including projects to improve the management of fisheries resources and the coastal environment in Malaysia and Indonesia, aquaculture in Thailand and Vietnam, and fisheries product processing in China. In addition to these studies, the Division also takes part in a research project targeting prawn viral diseases in Southeast Asian countries including the Philippines and Malaysia.

During Fiscal Year (FY) 2000, the Division carried out research on fisheries resource management in Malaysia with cooperation from the Fisheries Research Institute (FRI). The project involved the integration of studies in fisheries and forestry. JIRCAS has successively dispatched senior researchers to Penang, Malaysia, to provide long-term oversight for the ongoing research, and several short-term scientists specializing in fish larval ecology. In March 2001, JIRCAS held a project meeting to extend the research to an international

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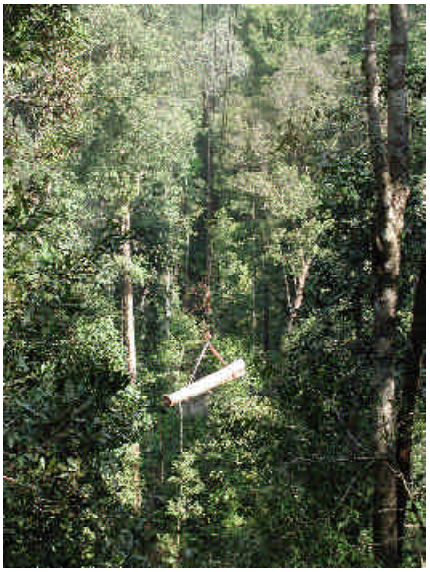

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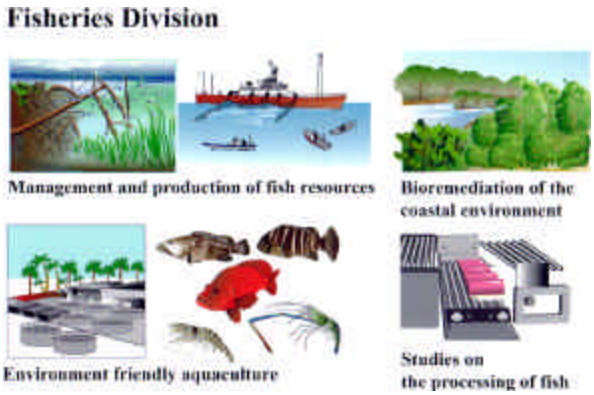
FISHERIES DIVISION

Biotic factors in the marine environment can be characterized in terms of interactions among organisms. Four distinct levels of organization occur in the biotic sector of the environment: (1) individuals, (2) populations, (3) communities, and (4) ecosystems. Ecosystems interrelate on a global scale, forming the Earth's biosphere. The Fisheries Division conducts research concerning these four levels of biotic marine environments. The Division conducts five major international research projects in Asian countries, including projects to improve the management of fisheries resources and the coastal environment in Malaysia and Indonesia, aquaculture in Thailand and Vietnam, and fisheries product processing in China. In addition to these studies, the Division also takes part in a research project targeting prawn viral diseases in Southeast Asian countries including the Philippines and Malaysia.

During Fiscal Year (FY) 2000, the Division carried out research on fisheries resource management in Malaysia with cooperation from the Fisheries Research Institute (FRI). The project involved the integration of studies in fisheries and forestry. JIRCAS has successively dispatched senior researchers to Penang, Malaysia, to provide long-term oversight for the ongoing research, and several short-term scientists specializing in fish larval ecology. In March 2001, JIRCAS held a project meeting to extend the research to an international



multidisciplinary project, inviting colleagues from the Philippines, Malaysia and Thailand. Attendees agreed to continue with studies to establish methods of encouraging low- and minimal-input synthetic foods and drug-based aquacultural procedures that take advantage of the naturally occurring circulation systems in mangrove forests. They also agreed to further pursue the development of aquacultural procedures based on the rearing of new indigenous aquatic species of high commercial value. After such sustainable production systems in brackish mangrove areas are put into practice, studies will be needed to analyze and publicize their economic and environmental advantages to promote their wider use.

At the same time, the Division remains involved in several other ongoing projects. These include collaborative studies with the Research Institute for Coastal Fisheries (RICF), under the jurisdiction of the Central Research Institute for Fisheries (CRIFI), on the environmental management of the coastal waters of Indonesia; a research team is currently conducting ecological and chemical analyses in Maros, South Sulawesi, Indonesia. The project aims to deepen understanding of plankton ecology and its environmental interaction to improve marine resource management methods. One researcher has been dispatched to Maros as a long-term resident scientist.

The Division's collaborative work on the development of sustainable aquaculture technology in Southeast Asia also continued at Kasetsart University in Bangkok, Thailand. In addition, the Division has been participating in a comprehensive project entitled "Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Phase II)" in conjunction with the College of Agriculture at Cantho University in Vietnam. This project involves multidisciplinary studies of integrated farming systems to address problems in rice production, animal husbandry, freshwater aquaculture, and socioeconomics. JIRCAS has dispatched one researcher specializing in crustacean endocrinology and one Fisheries Agency scientist specializing in fish nutrition on a short-term basis to oversee the aspects of the project relating to fisheries management.

In fisheries products processing, the Division has continued collaborative research on postharvest technology and the processing of freshwater fish in China with the Faculty of Food Science and Technology at Shanghai Fisheries University. JIRCAS again dispatched one senior researcher to Shanghai, and has sent two short-term scientists specializing in postharvest technology to lend support to the project. Finally, under numerous JIRCAS invitation programs, several scientists from the Philippines, Malaysia, Thailand, and Indonesia have been invited to Tsukuba to undertake cooperative studies on aquatic animal ecology. These scientists are expected to become core scientists in JIRCAS's counterpart institutions and to contribute to the continued development of collaborative studies.

TOPIC 1

Study of treatment systems for wastewater of prawn aquaculture ponds using the natural purification ability of mangrove areas

In the Southeast Asian countries including Indonesia, people rely on prawn aquaculture to acquire foreign currency. Coastal areas, including large areas of mangrove forests, have been destroyed in order to develop more of this commercially valuable aquaculture. Consequently, wastewater containing large quantities of nutrient material is discharged from aquaculture ponds, causing environmental deterioration in coastal waters.

The studies outlined below were initiated in order to analyze the effectiveness of improving the quality of wastewater using mangrove areas and the mangrove ecological system prior to the discharge of wastewater into the environment (investigation site shown in Fig. 1). Wastewater from a prawn culture pond was introduced into a mangrove reforestation area. The mangrove stands consisted of saplings aged 0 to 2 years, planted in a pond at intervals of 40 cm. Water that had passed through the mangrove pond was recirculated into the prawn culture pond via an oyster pond and a seaweed pond. Thirty percent of the water in the prawn pond was exchanged

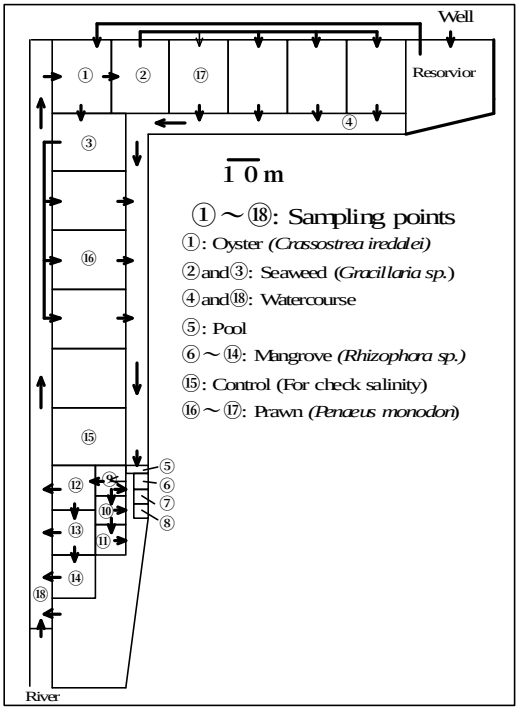


Fig. 1. Investigation site in Maranak, South Sulawesi, Indonesia.

once every three days. Water evaporation and seepage into the soil were compensated by adding river or well water, depending on the degree of salinity. Researchers conducted investigation every 15 days, measuring water temperature, salinity, dissolved oxygen, pH, turbidity, and the concentrations of nutrients (ammonia, nitrate, nitrite, phosphate and silicate) and chlorophyll-*a*.

Water temperature ranged from 25 to 30°C. Salinity exceeded 40 psu in the dry season and fell below 30 psu in the rainy season. From the beginning of the experiment, ammonia (NH_3) (Fig. 2) and nitrate (NO_3) concentrations remained high and increased in the oyster and seaweed ponds. Phosphate (PO_4) concentration was initially high because the concentration in the supplied river water was also high. Subsequently, the level of concentration first decreased, and then slightly increased in all the ponds. Silicate (SiO_2) concentration increased in the oyster pond, as well as in the seaweed and mangrove ponds due to the composition of the well water supplied. In the prawn pond, on the other hand, after initially increasing, levels decreased due to an increase in the population of diatoms, which have a silicious skeleton. chlorophyll *a* concentrations increased gradually in the prawn pond, and exceeded 160 mg/l at the end of the experiment (Fig. 2).

In this experiment, the pond in which wastewater was most effectively disposed was the oyster pond. Since oysters feed on phytoplankton

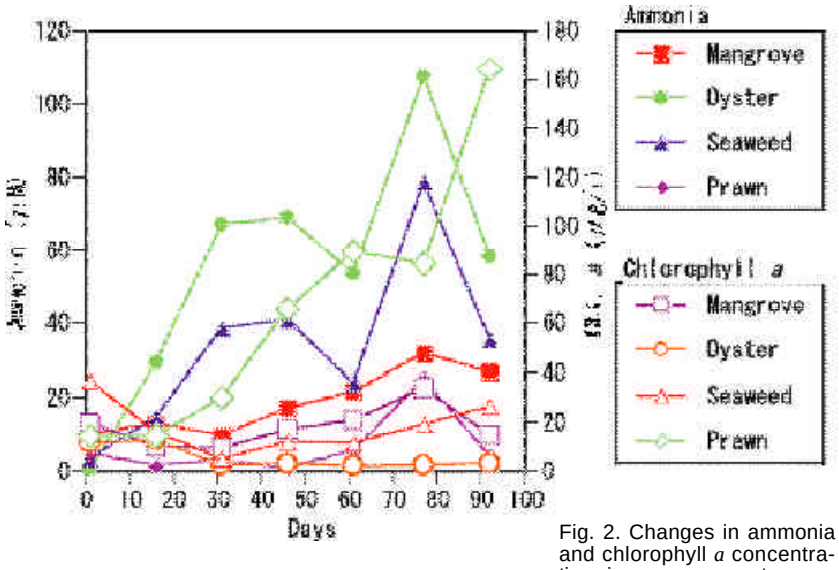


Fig. 2. Changes in ammonia and chlorophyll *a* concentrations in mangrove, oyster, seaweed, and shrimp culture ponds.

while excreting ammonia, the phytoplankton concentration was very low after 30 days while the ammonia concentration remained high. Therefore, the amount of phytoplankton, which is organic in nature, markedly decreased. The ammonia and phosphate concentrations in the seaweed pond adjacent to the oyster pond were lower than those in the oyster pond, indicating that the seaweed consumed nutrients. The ammonia concentration in the mangrove pond was always higher than that in the prawn pond and continued to gradually increase. Studies showed that the amount of nutrients generated from feed and excreta were greater than those consumed by the mangrove stands, presumably because the area of the mangrove pond was smaller than the aquaculture pond. Subsequent studies will attempt to obtain an afforestation area that corresponds to the area of the aquaculture pond by analyzing the material balance in the mangrove stands and the amount of nutrients taken up per unit area of the mangrove stands.

(T. Shimoda)

TOPIC2

Polyculture of black tiger prawns and green mussels in Thailand

Although it is possible to achieve high rates of production, intensive prawn culture results in the discharge of organic wastes into the environment. In the collaborative study "Development of sustainable aquaculture technology in Southeast Asia" between Kasetsart University and JIRCAS, scientists in Thailand ran studies on polyculture, combining the culture of the black tiger prawn *Penaeus monodon* and green mussel *Perna viridis* in both concrete tanks and earthen ponds. The goal was to reduce the amount of organic wastes, using

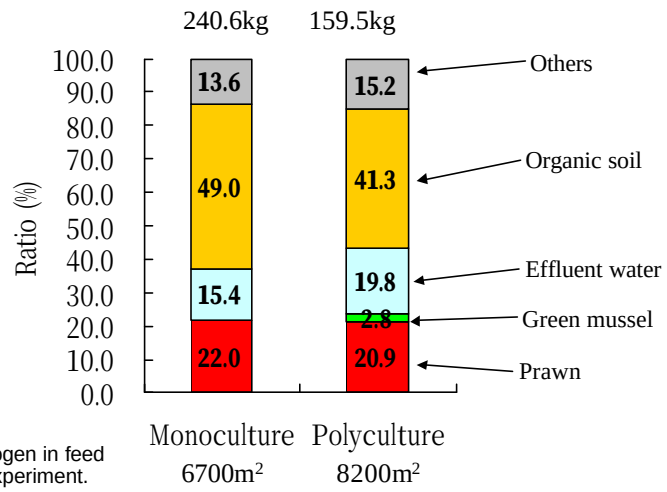


Fig. 1. Fate of nitrogen in feed in earthen pond experiment.

the green mussel as a biofilter to absorb organic matter from the phytoplankton. In concrete tanks having an area of 17 – 23 m^2, black tiger prawns were reared together with green mussels (polyculture) and in isolation (monoculture) at various stocking densities of prawn for 145 days. The survival rates of prawn at densities of 20, 30, 50 ind./m^2 were 68, 65, 59 percent under polyculture and 75, 70, 62 percent under monoculture. The survival rates of green mussels were 43, 24 and 0.3 percent, respectively. The average weight of prawns at a density of 20 ind./m^2 was 19g in polyculture and 12g in monoculture, while the conversion ratio of nitrogen in the prawn's feed was 21 percent under polyculture and 16 percent under monoculture. Ratios for discharge were 56 and 71 percent, respectively. Assimilation by green mussel was estimated at 0.5 percent of the total fed nitrogen. JIRCAS and Kasetsart University also conducted rearing experiments in earthen ponds of 6,700 m^2 using polyculture and 8,200 m^2 using monoculture, at a stocking density of 20 ind./m^2 for 118 days (Photo 1). The production of prawns under polyculture and monoculture were 1.5 and 2.05 tons/ha, respectively. Lower production in the polyculture pond was due to the low concentration of dissolved oxygen (3 mg/l) during the night; bamboo poles used for green mussels prevented water flow and subsequently decreased the level of dissolved oxygen. However, the average thickness of the organic sediment was 6.7 cm under polyculture and 17.1 cm under monoculture. Fig. 1 shows the result of nitrogen in feed as percentages in both culture ponds. The conversion ratio of nitrogen in feed to prawn under monoculture was slightly higher than under polyculture, and the nitrogen content of organic soil under monoculture was much higher, while nitrogen contents of effluent water that included higher concentrations of phytoplankton under polyculture exceeded that under monoculture. In sum, these experiments showed that polyculture combining giant tiger prawn and green mussel led to a reduction of the amount of organic wastes compared with prawn monoculture, presumably due to the biofilter role played by the green mussel.

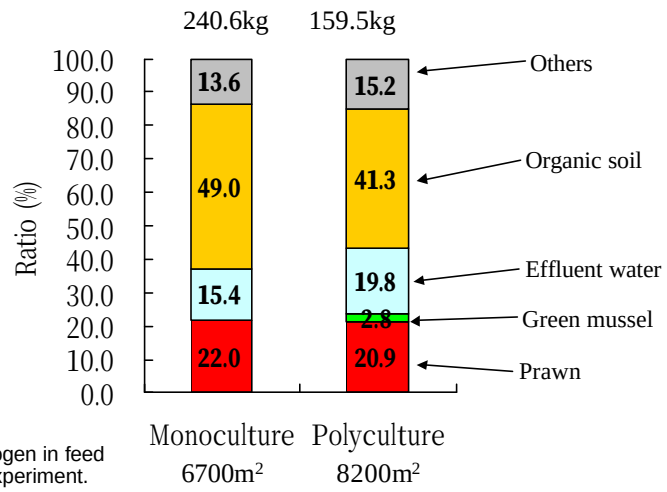
(J. Higano)

Photo 1. Monoculture pond for black tiger prawn (left) and bamboo poles for green mussel in a polyculture pond (right).

OKINAWA SUBTROPICAL STATION

The Okinawa Subtropical Station is located on Ishigaki Island, nearly 2,000 km southwest of Tokyo. The island is only 230 km^2 in area, and its climate is humid subtropical with an average temperature of 24°C and an annual precipitation of 2,100 mm. The organization of the Station consists of the Administration Section, the International Collaborative Research Section, the Field Management Section, and five laboratories: the Crop Introduction and Cultivation Laboratory, Crop Breeding and Rapid Generation Advance Laboratory, Tropical Fruit Tree Laboratory, Plant Protection Laboratory, and Soil Fertility Laboratory. The staff consists of 24 researchers and 14 people in the Administration and Field Management Sections. In addition, the Station invited 10 post-doctoral scientists from Bangladesh, China, Ghana, India, Indonesia, Pakistan, and Vietnam to conduct advanced research under the auspices of the "JIRCAS Visiting Research Fellow Program at Okinawa". The scientists worked closely with one another to develop technology on optimum utilization of bio-resources and the promotion of sustainable agricultural production in the tropics and subtropics.

During Fiscal Year 2000, the Station conducted studies on a wide range of subjects, including (1) reduction in the incidence of tip-burn and internal rot in Chinese cabbage by reducing nitrogen application using subsurface drip fertigation (a technology combining fertilization and irrigation), (2) complete



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Group photo of Okinawa Subtropical Station Staff.

nucleotide sequence and genetic organization of the papaya leaf distortion mosaic virus RNA, (3) molecular cloning of Na^+-ATPase cDNA from a marine alga, *Heterosigma akashiwo*, (4) simple crossing method of snap bean based on physiological pollen sterility due to high temperature treatment, (5) occurrence of male sterile cytoplasm in "Kurodane Kinugasa" snap bean, and (6) detection of sucrose phosphate synthase loci in sugarcane.

Like the main organization of JIRCAS, the Okinawa Subtropical Station will be structurally reorganized in the next fiscal year, starting in April 2001. The International Collaborative Research Section will strengthen its ties with new research groups, such as the Island Environment Management Laboratory, Environmental Stresses Laboratory, Crop Breeding Laboratory, Tropical Fruit Crops Laboratory, and Plant Protection Laboratory. Along with the structural changes, the Station's projects will be shifted to be much more oriented toward sustainable agricultural production in small tropical and subtropical islands in order to contribute to the agricultural development of these islands.

TOPIC 1

Reduction in the incidence of tipburn and internal rot in Chinese cabbage by reducing nitrogen application using subsurface drip fertigation

Chinese cabbage (*Brassica campestris* ssp. *pekinensis*) has been one of the most important vegetable crops in eastern Asia for many centuries. However, the sensitivity of traditional cultivars to high temperature limits its potential as an alternative crop in tropical and subtropical areas. Tipburn and internal rot (Photo 1) are very serious problems often encountered when Chinese cabbage is grown at high temperatures. They are most likely caused by calcium (Ca) deficiency attributable to a variety of environmental, physiological, and nutritional factors. To minimize the occurrence of tipburn and internal rot, efficient management of soil, water, and fertilizer is strongly needed. Recently, fertigation, a technology combining fertilization and irrigation, particularly subsurface drip fertigation, has shown considerable potential in addressing some of the pressing concerns related to soil, water, and nutrient management. Thus, researchers studied the potential of subsurface drip fertigation in reducing the incidence of tipburn and internal rot in Chinese cabbage and compared the results to conventional fertilization.

Two field trials were conducted on yellow soil at the Okinawa Subtropical Station over two cropping seasons. One trial, conducted in the fall (from November to January), used cool season cultivars obtained from mainland Japan, while the other, taking place in the spring (from March to May), used high temperature tolerant varieties from the Asian Vegetable Research and Development Center in Taiwan. Subsurface drip irrigation tubing was installed 20 cm below the soil surface in both the fertigation and conventional fertilization plots. In the fertigation plot, scientists applied nutrient solution through a subsurface drip irrigation system (Photo 2) once a week for eight consecutive weeks. The nitrogen (N) rate was equivalent to 5 gN/m^2, far lower than the conventional rate of 25 gN/m^2 from compound fertilizer containing crotonylidene diurea applied before planting and given similar subsurface drip irrigation. A

Photo1. Tipburn and internal rot in Chinese cabbage.

net row cover protected plants in both plots.

Studies showed that Chinese cabbage could grow under warm subtropical conditions. The soil moisture content was well within the adequate range favorable for normal growth and development. Conventionally fertilized and fertigated plots produced comparable yields. However, the incidence of tipburn and internal rot in both autumn and spring-grown Chinese cabbage was significantly higher under conventional fertilization. Disease incidence was more frequent in spring than in autumn trials.

High temperature is one of the environmental factors that contributes to the vulnerability of Chinese cabbage to physiological disorders. Mean maximum air temperatures in autumn (22.5 °C) and spring (25.4 °C) were high enough to induce or exacerbate the incidence of tipburn and internal rot. On the other hand, these high percentages of disease incidence were reduced by 47 and 97 percent in autumn and spring, respectively, when nutrients were applied by fertigation, and had no deleterious effect on yield.

In both autumn and spring trials, plant tissue analysis showed that total nitrogen (TN) in the inner leaves was higher in the conventionally fertilized plants than in fertigated plants. The level of TN in the inner leaves was highly correlated with the incidence of tipburn and internal rot. Though calcium content was 6 to 7 times higher in the outer than in the inner leaves, no significant variation was noted in the latter as a result of fertilization treatments. The exceedingly low Ca concentration in the inner leaves may have been induced by the increased supply of N, presumably by a dilution effect. As nitrate reduction increased, the demand for Ca simultaneously increased in response to the need for the formation and expansion of cell walls. Such a high demand for Ca may have caused membrane disintegration when tissue content of Ca fell below a critical level. However, absolute values of Ca alone were not sufficient to evaluate the critical level required for cell wall stabilization and membrane integrity. Summarily, the ratio between Ca and N was found to have a more profound effect on the incidence of tipburn and internal rot. Maintaining a high Ca/TN ratio in the inner leaves effectively reduced the disease incidence in Chinese cabbage. Conversely, lower ratios decreased the plants' resistance to injury. Increasing the Ca/TN ratio by increasing Ca supply to the roots may prove beneficial. However, it may not be feasible as most Ca transport in plants occurs mainly in the xylem by mass flow, and reduced transpiration could restrict its transport to the developing leaves. Thus, it would appear that reducing N rate to the minimum is a more practical approach in obtaining an optimum Ca/TN ratio necessary for good yield and reduced physiological injury in Chinese cabbage.

The significant and consistent reduction in the incidence of tipburn and internal rot by fertigation can be attributed to the reduced N rate and regulated nutrient application. Fertigation made it possible to apply fertilizer in small quantities, allowing soil solution nutrient concentrations to remain relatively low while still meeting crop nutrient needs. Subsurface drip fertigation has tremendous potential for improving not only the yield and quality of Chinese cabbage but also in promoting soil environmental protection through its ability to improve nutrient efficiency and minimize nutrient losses below the root zone.

(K. Sugahara, T. Masuda and L.G. Hernandez)

Photo 2. Subsurface drip fertigation.

TOPIC 2

Complete nucleotide sequence and genetic organization of Papaya leaf distortion mosaic virus RNA

Papaya (*Carica papaya* L.) is one of the most important fruit trees in tropical and subtropical areas. Papaya leaf distortion mosaic virus (PLDMV) and *papaya ringspot virus* P type (PRSV-P) were reported as the causal viruses of papaya disease in Japan. Both of these belong to the genus *Potyvirus*, and between them, PLDMV is the more destructive factor to papaya production in Japan (Fig. 1).

Fig.1. Diseased papaya fruit due to PLDMV infection.

The complete nucleotide sequence of the RNA genome of PLDMV was determined using six overlapping cDNA clones and primer extension. The genomic RNA is 10,154 nucleotides in length, excluding the poly(A) tract, and contains one large open reading frame (ORF) that starts at nucleotide positions 135 to 137 and ends at positions 9940 to 9942, encoding a polyprotein of 3269 amino acids. The 5´ untranslated region (UTR) of PLDMV proceeding the ORF was 134 basic pairs and contained a box-a (example: ACAAAACTT) and a box-b (example: TCAATACA) sequence which were highly conserved sequences compared to other reported potyviruses.

Cleavage sites were predicted by analogy with other potyviruses. The genetic organization of PLDMV RNA is proposed to be P1, the first proteinase; Hc-Pro, helper component proteinase; P3, the third protein; 6K1 and 6K2, 6kDa protein 1 and 2; CI, cytoplasmic inclusion protein; NIa, nuclear inclusion protein "a" including the VPg (NIa-Vpg) and NIa proteinase (NIa-Pro); NIb, nuclear inclusion protein "b"; and CP, coat protein (Fig. 2). The genetic organization of PLDMV is similar to that of the other potyviruses. The P1 protein processed from the N terminus of the polyprotein consists of 480 amino acids. It is larger than those of the other potyviruses except that of PRSV-P, which consists of 548 amino acid residues. The P1 protein of potyviruses is the most variable and may be considered important for the identification of individual potyviruses. It may prove useful to distinguish between PLDMV and PRSV-P by RT-PCR. The sequence will be used for transformation into papaya in order to develop a PLDMV-resistant papaya.

(T. Maoka)

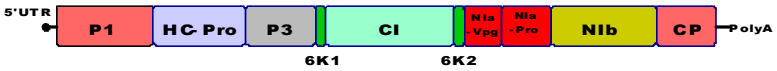


Fig. 2. Genomic map for PLDMV.

TOPIC 3

Molecular cloning of the sodium pump in plant cells, Na^+-ATPase cDNA from marine algae, *Heterosigma akashiwo*

More than 40 percent of the world's irrigated land is affected by salinity, making it a major abiotic concern in plant agriculture. Its growing impact is due to the accumulative effects over decades or centuries of using water containing dissolved salts on the soil of arid regions. Reclamation, drainage and water control can minimize the extent and spread of saline soils; however, the resulting engineering and management costs are extremely high. Breeding of salt tolerant crops through genetic engineering is considered to be one alternative solution to the problem of high cost.

Recently, several genes have been proved to be crucial for salt tolerance in plants. Na^+-transporter, which can prevent the accumulation of sodium ions into the cytoplasm, is a current subject of genetic engineering. Unlike animal cells, which have an Na^+-pump (Na^+/K^+-ATPase), higher plant cells do not have an Na^+-pump and instead have an Na^+/H^+-antiporter. However, a marine algae *Heterosigma akashiwo*, possesses Na^+-ATPase activity on its plasma membrane (Fig. 1).

Station researchers cloned a novel Na^+-ATPase cDNA from *H. akashiwo* as a target gene for the transformation. The full-length Na^+-ATPase cDNA was 4467-bp long and coded for a 1330-amino acid protein with a molecular weight of 146,306 Da. Na^+-ATPase showed homology with animal Na^+/K^+-ATPase α-subunits (Fig. 2) at a level of 40 percent identity.

Fig. 1. Na^+-transporter model on the plasma membrane of *Heterosigma akashiwo*.

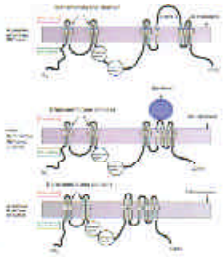


Fig. 2. Comparison of secondary structure among P-type ATPases.

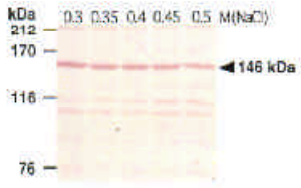


Fig. 3. Immunoblotting analysis of algae Na^+-ATPase. *Heterosigma akashiwo* cells were cultured for 5 days at 20°C under 16 hours of light and 8 hours of darkness in ASP-7 medium, which contained various concentrations of NaCl ranging from 0.3 M to 0.5 M.

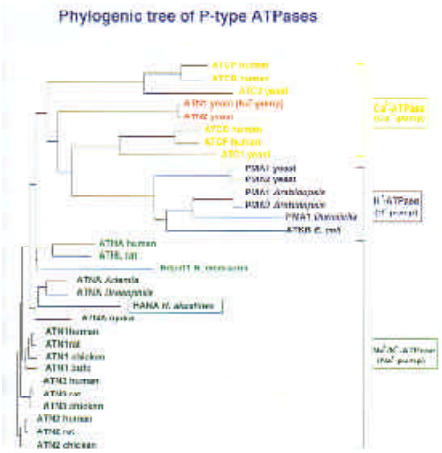


Fig. 4. Phylogenetic tree for P-type ATPases, constructed using the neighbor-joining method (GrowTree Phylogram Wisconsin GCG DNA sequence analysis software). Sequences of ATPases were obtained through the GenBank, EMBL, and SWISS-PROT databases.

A hydrophilic sequence of 285 amino acid residues that showed no homology with any sequence listed in databases existed in the M7-M8 junction of Na^+-ATPase. Northern blotting analysis revealed a transcript of 4.8 kb (data not shown) and immunoblotting analysis detected an approximately 146,000 Da polypeptide at almost the same abundance in all batches of cells cultured for one week at various concentrations of NaCl ranging from 0.3 to 0.5 M (Fig. 3). A phylogenetic tree of a P-type ATPase family is shown in Fig. 4. The tree comprises three major clusters, mainly correlating with cation specificity, which are Ca^{2+}-ATPases, H^+-ATPases, and Na^+/K^+-ATPases. Na^+-ATPase is included in the cluster of Na^+/K^+-ATPases, being especially close to Na^+/K^+-ATPases in invertebrates such as brine shrimp (*Artemia*), fruit flies (*Drosophila*) or hydra. However, yeast Na^+-ATPases are classified into the cluster of Ca^{2+}-ATPases. This is the first report on the primary structure of a putative Na^+ transporting ATPase from plant cells.

(M. Shono)

TOPIC 4

Simple crossing method of snap bean based on physiological pollen sterility due to high temperature treatment

The snap bean (*Phaseolus vulgaris* L.) is highly sensitive to heat stress. High temperatures easily cause pollen sterility, resulting in flower abscission and a decrease in pod yields. By screening about 350 accessions of snap bean germplasm for heat tolerance (evaluated based on high pod setting under hot conditions), the Okinawa Subtropical Station successfully developed a heat-tolerant snap bean variety, 'Haibushi'.

To increase the diversity of snap bean varieties cultivated in tropical and subtropical areas, the Station is now attempting to incorporate high yielding capabilities into other cultivars through crossbreeding methods, while maintaining tolerance to high temperatures exhibited by 'Haibushi'. However, crossing the snap bean by conventional bud pollination methods is difficult since the keel petal, which envelopes the pistil and stamen, curls into a spiral (Fig. 1). This structure makes the process of castration difficult, during which the pistil is easily injured. We successfully applied physiological pollen sterility caused by high temperature treatments to the crossing of snap beans without the need for castration.

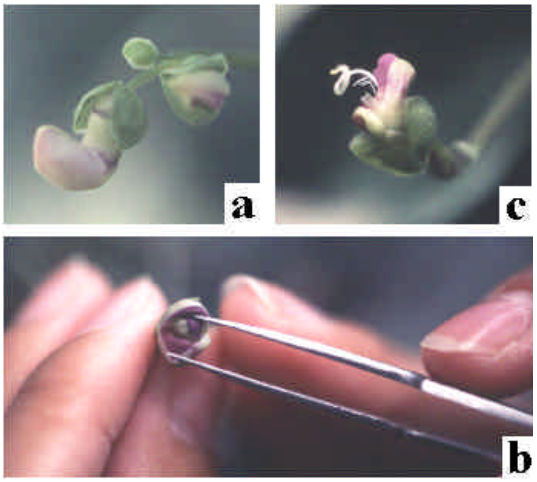


Fig. 1. Bud pollination method. (a) Flower buds 1 to 2 days before flowering. (b) Standard petal is opened for castration. (c) Pistil is ready for being cross-pollinated.

The study then focused on exposing the 'Light Green' snap bean to high temperatures at the flowering stage after cultivation under favorable growth conditions, using a growth chamber heated to 35°C for 72 hours. Thereafter, the plants were returned to favorable conditions. During the period of 8 to 17 days after exposure to high temperatures, pod setting caused by self-pollination was examined. As shown in Fig. 2, flowers that opened 8 to 12 days after the heat treatment did not undergo spontaneous pod setting. Pod setting began 13 days after the treatment, reaching 75 percent after 15 days.

The study also examined pod setting of the heat-treated 'Light Green' snap bean cross-

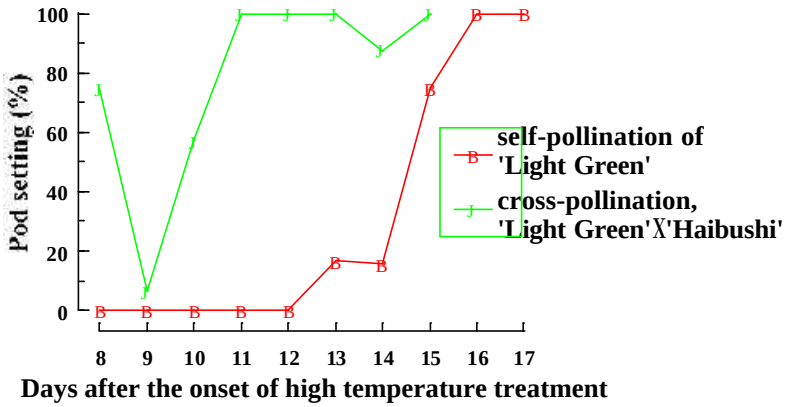


Fig. 2. Pod setting of 'Light Green' snap beans by self-pollination and by cross-pollination with fertile 'Haibushi' pollen after high temperature treatment (35°C for 72 hours).

pollinated with 'Haibushi' pollen. Crossing was accomplished on the day of flowering without castration. The stigma can be easily extended from the open mouth of keel petal by pressing down the wing petals with one's fingers. The stigma was then pollinated with fertile pollen of 'Haibushi'. Subsequently, pod setting was nearly 100 percent 11 to 15 days after the treatment (Fig. 2). However, pod setting was relatively low (6.3 percent) 9 days after the onset of the high temperature treatment. It is probable that female reproductive organs were also seriously damaged at that time by heat treatment, although the ovule was obviously less affected by heat stress than was the pollen (Fig. 2).

The color of the hypocotyl of the 'Light Green' snap bean is green, while those of 'Haibushi' and F_1 hybrids between these two types are reddish purple. Based on the coloration of the hypocotyl, hybridity of seeds obtained by crossing 'Light Green' with 'Haibushi' were examined. The plants obtained from crossing 8 to 12 days after heat treatment had reddish purple hypocotyl and were judged to be hybrids, although some self-pollinated seeds of 'Light Green' also occurred when crossed 13 to 15 days after the heat treatment (Table 1).

The study demonstrated that the crossing methods proposed here do not require skillful castration techniques and makes possible a more facile production of F_1 hybrids for practical and experimental usages.

(Y. Egawa)

Table 1. Hybridity of seeds obtained from crossing*, 'Light Green' treated by high temperature × 'Haibushi'.

Days after heat-treatment	No. of seeds examined	No. of seeds germinated	Hybridity**	
			Yes	No
10	24	16	16	0
11	30	21	21	0
12	16	9	9	0
13	22	19	15	4
14	30	26	19	7
15	18	10	4	6

* Pollinated without castration on the day of flowering
** Confirmed based on hypocotyl coloration

TOPIC 5

Occurrence of male sterile cytoplasm in 'Kurodane Kinugasa' snap bean

During the course of crossing experiments for incorporating high yielding ability under high temperatures exhibited by 'Haibushi' into other cultivars, the 'Kurodane Kinugasa' snap bean was found to produce semi-sterile hybrids when crossed as a seed parent with 'Haibushi'. The pollen stainability of the hybrid plants determined by aceto-carmine staining was 36.8 percent. Since the reciprocal cross, 'Haibushi' × 'Kurodane Kinugasa' exhibited a high pollen stainability (83.8 percent), the occurrence of male sterility in this cross combination is thought to be cytoplasmic in character.

B_1F_1 progeny derived from ('Kurodane Kinugasa' × 'Haibushi') × 'Kurodane Kinugasa' segregated into semi-sterile (12.8 to 26.5 percent pollen stainability) and fertile (87.0 to 95.4 percent pollen stainability) plants in a 1:1 ratio. 'Kurodane Kinugasa' is considered to have a single major restoring gene whose action is gametophytic.

Pod setting of the F_1 plants ('Kurodane Kinugasa' × 'Haibushi') by self-pollination was 0.8 percent. However, pod setting was very high (90 percent) when the F_1 was pollinated with 'Haibushi' pollen on the day of flowering as illustrated in Fig. 1. Backcrossing to the F_1 progeny with 'Haibushi' pollen by conventional bud pollination produced pods successfully, with 30 percent pod setting. Cytoplasmic male

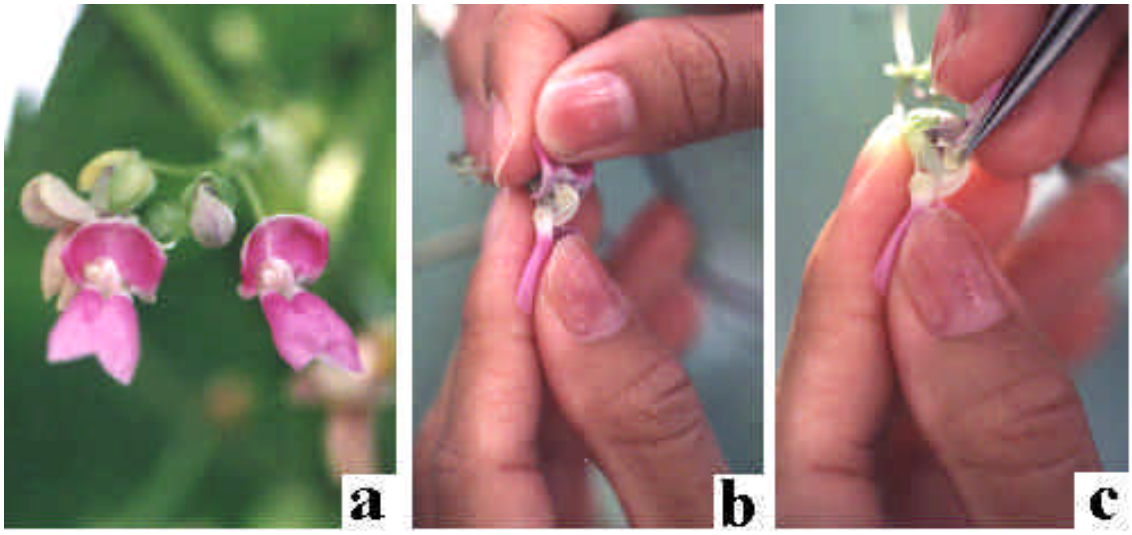


Fig. 1. Cross-pollination using cytoplasmic male sterility. (a) Flowers that opened on the day of flowering. (b) Stigma easily protrudes from the open mouth of the keel petal. (c) Stigma was subsequently pollinated.

sterility is thus very useful for producing hybrids efficiently and successfully.

According to the observations, F_1 hybrids between 'Haibushi' and other varieties exhibited high yields even at high temperatures. Thus, this study has produced a cytoplasmic male sterile line of 'Haibushi' through recurrent backcrossing. To establish F_1 varieties of snap bean that exhibit high yielding ability during summer cultivation using male-sterile 'Haibushi' as one parent, snap bean lines having a sporophytic restorer gene against this cytoplasmic male sterility are now being explored.

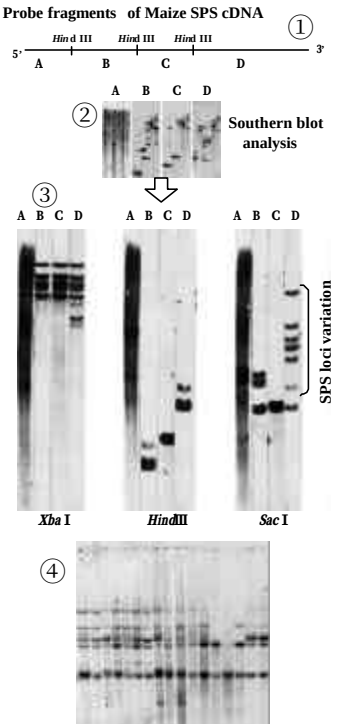
(Y. Egawa)

TOPIC 6

Detection of sucrose-phosphate synthase loci in sugarcane

Sucrose-phosphate synthase (SPS) is considered to be an important enzyme involved in sucrose accumulation in sugarcane stems, as well as in sucrose transportation in the photosynthesis of higher plants. Breeding sugarcane with higher sucrose content requires the development of methods for the identification of SPS loci.

The SPS cDNA cloned from maize was divided into four fragments and used these as probes in Southern blotting analysis. Sugarcane genomic DNA was analyzed following subjection to one of three restriction enzyme digestions. Bands that were detected correspond to the SPS gene; the same band patterns were observed in detection patterns using the four probes produced by using *Xba I* enzyme. A single band, produced by using *Sac I* or *Hind III* enzyme and using a probe obtained from the middle section of a maize SPS cDNA



Principle of detecting SPS loci variation. (1) Probe fragments of maize SPS cDNA. (2) Results of Southern blot analysis on sugarcane and maize genomic DNA using four probes and three restriction enzymes. (3) Rearrangement of the Southern blot results in sugarcane according to restriction enzyme. Results obtained using a D probe and SacI enzyme shows SPS loci variation. (4) Results of Southern blot analysis on sugarcane genetic resources which include hybrid canes, *S. sinense* and *S. spontaneum*.

fragment was detected. Two recognition sites in each enzyme commonly exist in sugarcane SPS gene. Observations showed the existence of plural bands using Sac I enzyme and a probe that was made from the 3′ end part of a maize SPS cDNA fragment. Southern blot analysis using *Sac I* enzyme and the probe of the 3′ end side fragment showed variation relating to SPS loci in sugarcane, as no *Sac I* recognition site

was found from the 3′-end side of cloned SPS gene of sugarcane, with the exception of two common recognition sites. These studies demonstrated the existence of polymorphic band patterns in sugarcane genetic resources, which will enable the screening of SPS loci among genetic resources. One band that exists in all varieties did not indicate any locus, leaving open the possibility of the existence of a variation of an SPS gene that is undetectable through these methods.

(T. Terauchi)

MISCELLANEOUS PROJECTS OUTLINE

In addition to international collaborative projects, JIRCAS conducts a variety of miscellaneous projects including domestic projects in cooperation with other MAFF institutes, commissioned research, principally in cooperation with universities, cross-ministry and cross-agency projects currently involving the Science and Technology Agency and the Environment Agency, and special allotment projects.

DOMESTIC PROJECTS

In close cooperation with other related Japanese research institutes, 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.

A comprehensive evaluation of the effects of international trade fluctuation on resources and the environment
(Research Information Division, 1996 - 2000)

Analysis and settlement of macro indicators (MI) for water resource changes affected by changes in agricultural production and industrial structure
(Research Information Division, 1996 - 2000)

Development of tools for agricultural information analysis using Geographic Information Systems (GIS)
(Research Information Division, 1997 - 2002)

Development of remote sensing methods to evaluate major food crops in Asia
(Research Information Division, 1998 - 2001)

Effects of cold stress on the phenological development of plants and the analysis of mechanisms for acquiring tolerance to cold stress
(Biological Resources Division, 1998 - 2007)

Development of wheat lines highly resistant to *Fusarium* head blight by utilizing rice DNA markers
(Biological Resources Division, 1998 - 2000)

Genetic analysis of pathogenic microorganisms and the development of its application techniques
(Biological Resources Division, 1995 - 2000)

Rice genome analysis and related projects
(Biological Resources Division and Okinawa Subtropical Station, 1998 - 2008)

Search for possible natural enemies of the golden apple snail and evaluation of their efficacy
(Crop Production and Postharvest Technology Division, 1997 - 2000)

Establishment of highly profitable agricultural technologies in subtropical regions through the introduction of vegetables and flowers
(Okinawa Subtropical Station, 1998 - 2002)

Primary characterization of rice genetic resources
(Okinawa Subtropical Station, 1993 - 2000)

Development of the experimental rice, Nipponbare
(Okinawa Subtropical Station, 1998 - 2000)

Rapid generation advance breeding of rice with adaptability to direct seeding and combined tolerance
(Okinawa Subtropical Station, 1995 - 2000)

COMISSIONED RESEARCH

Climatic changes in cool, dry areas and accompanying environmental changes for cattle raising
(Environmental Resources Division in cooperation with Tsukuba University, 1998-2000)

RESEARCH PROJECTS WITH OTHER GOVERNMENT AGENCIES AND MINISTRIES

In cooperation with the Science and Technology Agency

Development of molecular markers for rapid screening of resistance to biotic and abiotic stresses under rigorous environmental conditions in major crops
(Biological Resources Division, 2000)

Elucidation of yolk protein structure and site of synthesis during reproduction in selected prawn species
(Fisheries Division, 2000)

Elucidation of quality changes on staples and its effects on processing properties in developing region
(Crop Production and Postharvest Technology Division, 2000)

Study of natural infection mechanisms of tropical plant diseases by monoclonal antibodies
(Okinawa Subtropical Station, 2000)

In cooperation with the Environment Agency

Evaluation, improvement and preservation of soil productivity for the establishment of sustainable agricultural systems in Sub-Saharan West Africa
(Research Information Division, 1999 - 2000)

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

Development of a logging system having low disturbance to forest ecosystems
(Forestry Division, 1999 - 2000)

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

Molecular analysis of drought and salt stress tolerant mechanisms and its application to breeding
(Biological Resources Division, 1996 - 2000)

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 related MAFF research organizations. 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. Forty-eight individual visits to JIRCAS were made during FY 2000 under the Administrative Invitation program, including fourteen invitations to the International Symposium. Invited administrators and their home institutions are listed below.

FY2000		
Han Lujia	Professor China Agricultural University China	July 26-Aug. 6, 2000
John A. Otto	Director Crop Research Institute Ghana	Sep. 10-16, 2000
Malachy O. Akoroda	Professor University of Ibadan Nigeria	Sep. 10-16, 2000
Lynda D. Wickham	Senior Lecturer The University of West Indies Trinidad and Tobago	Sep. 10-16, 2000
Mathew George	Senior Scientist Central Tuber Crop Research Institute India	Sep. 10-16, 2000
Manuel C.M. Macedo	Project Leader National Beef Cattle Research Center (EMBRAPA) Brazil	Sep. 20-29, 2000
Azimhan A. Satybaldin	President Kazakh Agricultural Research Academy Center Kazakhstan	Sep. 25-Oct. 3, 2000
Kasym A. Asanov	Director Kazakh Scientific Research Institute of Feed and Pasture Kazakhstan	Sep. 25-Oct. 3, 2000

Amirbekova J. Abdigapparovna	Lecturer Kazakh National State University Kazakhstan	Sep. 25-Oct. 3, 2000
Mercedes C. Carrao-Panizzi	Researcher National Center for Soybean Research (EMBRAPA) Brazil	Oct. 12-28, 2000
Alfred R. Lattanzi	Director INTA EEA Marcos Juarez Argentina	Oct. 14-27, 2000
Sun Huan	Vice Director Jilin Academy of Agricultural Sciences People's Republic of China	Oct. 14-21, 2000
Caio Vidor	Director General National Center for Soybean Research (EMBRAPA) Brazil	Oct. 14-24, 2000
Tawachai N. Nagara	Director Soil Sciences Division Department of Agriculture (DOA) Thailand	Oct. 26-Nov. 3, 2000
Panya Ekmahachai	Director Khon Kaen Field Crops Research Center Department of Agriculture (DOA) Thailand	Oct. 26-Nov. 3, 2000
Pichai Wichaidit	Director Soil Survey and Classification Division Land Development Department (LDD) Thailand	Oct. 26-Nov. 3, 2000
Henk Breman	Director International Fertilizer Development Center (IFDC)-Africa Togo	Dec. 5-9, 2000
Zhou Ying Qi	President Shanghai Fisheries University People's Republic of China	Jan. 30-Feb. 9, 2001
Zhu Xigang	Director Research Center for Chinese Agricultural Economy People's Republic of China	Jan. 30-Feb. 9, 2001
Tang Huajun	Director Research Center for Agricultural Natural Resources People's Republic of China	Jan. 30-Feb. 9, 2001
Li Shuyun	Director Industrial Bureau People's Republic of China	Jan. 30-Feb. 9, 2001

Wang Weiqin	Vice Director International Department Chinese Agricultural Ministry People's Republic of China	Jan. 30-Feb. 9, 2001
Zhu Jianguo	Researcher Institute of Nanking Soil Sciences People's Republic of China	Jan. 30-Feb. 9, 2001
Zhao Linping	Vice Researcher Institute of Soils and Fertilizers People's Republic of China	Jan. 30-Feb. 9, 2001
Huang Hongxiang	Vice Director Institute of Soils and Fertilizers People's Republic of China	Jan. 30-Feb. 9, 2001
Cai Zucong	Researcher Institute of Nanking Soil Sciences People's Republic of China	Jan. 30-Feb. 9, 2001
Feng Wei	Director Jilin Academy of Agricultural Sciences People's Republic of China	Jan. 30-Feb. 9, 2001
Liu Kai	Director Jilin Research Institute of Soybean People's Republic of China	Jan. 30-Feb. 9, 2001
Li Lite	Vice Director China Agricultural University People's Republic of China	Jan. 30-Feb. 9, 2001
Zhang Zhitao	Vice Director China National Rice Research Institute People's Republic of China	Jan. 30-Feb. 9, 2001
Bui Ba Bong	Director General Cuu Long Delta Rice Research Institute Vietnam	Feb. 5-9, 2001
Nguyen Thanh Phuong	Vice Director Research Institute for Marine Aquaculture College of Agriculture Cantho University Vietnam	Feb. 5-9, 2001
Yuthasak Chiamchaisri	Scientist Information Service Center Thailand	Feb. 18-24, 2001
Weli Zhang	Scientist Institute of Soil and Fertilizer People's Republic of China	Feb. 18-24, 2001
Suhaimi Napis	Assistant Professor Putra Malaysia University Malaysia	Feb. 18-24, 2001

Pisuth Paiboonrat	Scientist Information Service Center Thailand	Feb. 18-24, 2001
Guoying Pan	Assistant Professor Jiaozuo Institute of Technology People's Republic of China	Feb. 18-24, 2001
Prathak Tabthipwon	Vice Director Kasetsart University Thailand	Mar. 4 -16, 2001
Md. Akhir Arshad	Senior Research Officer Fisheries Research Institute (FRI) Malaysia	Mar. 4 -16, 2001
Erlinda C. Lacierd	Senior Scientist Southeast Asian Fisheries Development Center (SEAFDEC) Philippines	Mar. 4-16, 2001
Clarissa L. Marte	Division Head Southeast Asian Fisheries Development Center (SEAFDEC) Philippines	Mar. 4-16, 2001
Su Xiuxia	Deputy Director General Jilin Academy of Agricultural Sciences People's Republic of China	Mar. 5-17, 2001
Kiran K. Sharma	Senior Researcher International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India	Mar. 10-17, 2001
Jonathan H. Crouch	Chief International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India	Mar. 10-17, 2001
Swapan Datta	Chief International Rice Research Institute (IRRI) Philippines	Mar. 5-15, 2001
Karabi Datta	Researcher International Rice Research Institute (IRRI) Philippines	Mar. 5-15, 2001
Chittima Aryuthaka	Associate Professor Kasetsart University Thailand	Mar. 4-18, 2001
Peter C. Kerridge	Coordinator CIAT Regional Office Laos	Mar. 16-26, 2001

International Symposium invitees, FY 2000		
Willam D. Dar	Director General International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India	Oct. 30-Nov. 4, 2000
Pedro A. Sanchez	Director General International Center for Research in Agroforestry (ICRAF) Kenya	Oct. 30-Nov. 4, 2000
Stein W. Bie	Director General International Service for National Agricultural Research (ISNAR) Netherlands	Oct. 30-Nov. 4, 2000
Ronald P. Cantrell	Director General International Rice Research Institute (IRRI) Philippines	Oct. 30-Nov. 4, 2000
Greg Johnson	Program Co-ordinator Australian Center for International Agricultural Research (ACIAR) Australia	Oct. 30-Nov. 4, 2000
Eric T. Craswell	Director General International Board for Soil Research and Management Thailand	Oct. 30-Nov. 4, 2000
S.A. Prathapar	Director International Water Management Institute (IWMI) Pakistan	Oct. 30-Nov. 4, 2000
Meryl J. Williams	Director General International Center for Living Aquatic Resources Management (ICLARM) Malaysia	Oct. 30-Nov. 4, 2000
Harold J . McArthur	Director International Relation Section University of Hawaii USA	Oct. 30-Nov. 4, 2000
David W. Norman	Professor University of Hawaii USA	Oct. 30-Nov. 4, 2000
Achmad M. Fagi	Secretary Agency for Agricultural Research and Development Indonesia	Oct. 30-Nov. 4, 2000

Edi Abdurachman	Head Agency for Agricultural Research and Development Indonesia	Oct. 30-Nov. 4, 2000
Bangbang Suprihatno	Director Research Institute of Vegetables Indonesia	Oct. 30-Nov. 4, 2000
S.D.G. Jayawardena	Director General Department of Agriculture Ministry of Agriculture and Lands Sri Lanka	Oct. 30-Nov. 4, 2000

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 research institutes, 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-seven researchers were invited under the Counterpart Researcher Invitation program during FY 2000. Invited researchers, their affiliated research organizations, and their research activities are summarized below.

FY 2000

At Japan International Research Center for Agricultural Sciences, Kyushu National Agricultural Experiment Station and National Institute of Animal Industry, May 31- July 25, 2000

Yan Quaojuan	China Agricultural University, Food College People's Republic of China	Improvement of silage making and estimation of nutritional values of silage

At Japan International Research Center for Agricultural Sciences, National Agriculture Research Center and National Institute of Animal Industry, May 9 - July 29, 2000

Witthaya Sumamal	Khon Kaen Animal Nutrition Research Center Thailand	Study on energy requirements of dairy heifer

At Japan International Research Center for Agricultural Sciences, Tohoku National Agricultural Experiment Station and University of Tokyo, Aug. 18 - Sept. 25, 2000

Alexandre Lima Nepomuceno	National Soybean Research Center EMBRAPA Brazil	Genetic engineering as a tool in the development of drought tolerant transgenic soybean plants

At Japan International Research Center for Agricultural Sciences and Kyushu National Agricultural Experiment Station, July 3-Aug. 30, 2000

Alvaro Manuel Rodrigues Almedia	National Soybean Research Center EMBRAPA Brazil	Molecular analysis of soybean mosaic virus (SMV) isolates from Brazilian strains

At Japan International Research Center for Agricultural Sciences, National Agriculture Research Center, National Institute of Agrobiological Resources and Tohoku University, July 17-Aug. 16, 2000

Mariangela Hungria da Cunha	National Soybean Research Center EMBRAPA Brazil	Biological nitrogen fixation with soybeans

At Japan International Research Center for Agricultural Sciences and Akita Prefectural Agricultural Experiment Station, July 18-Dec. 14, 2000

Liu Gang	Chinese Academy of Sciences People's Republic of China	Measurements of ammonia volatilization from paddy soils

At Japan International Research Center for Agricultural sciences, Akita Prefectural Agricultural Experiment Station and Tohoku National Agricultural Experiment Station, July 20-Oct. 17, 2000		
Zou Changming	Chinese Academy of Agricultural Sciences People's Republic of China	Measurement of ammonia volatilization from fertilized soils
At Japan International Research Center for Agricultural Sciences, National Food Research Institute and University of Kyoto, June 26-Sep.22, 2000		
Zhao Zhaohui	China Agricultural University, Food College People's Republic of China	Developing of sterilizing technologies using electrolyzed water
At Japan International Research Center for Agricultural Sciences and Tohoku National Agricultural Experimaent Station, July 24-Oct.21, 2000		
Trinh Quang Khuong	Cuu Long Delta Rice Research Institute Vietnam	Eco-physiological study of lodging tolerance in rice varieties grown by direct sowing cultivation
At Japan International Research Center for Agricultural Sciences, Aug. 30-Oct.20, 2000		
Muhammad Iskandar shaq	Lambang Assessment Institute for Agricultural Technology Indonesia	Evaluation, characterization and classification of indigenous vegetable germplasm in Indonesia
At Japan International Research Center for Agricultural Sciences and National Grassland Research Institute, Sep. 11-Nov. 3, 2000		
Sompong Meunchang	Soil Science Division, Department of Agriculture (DOA) Thailand	Development of an inoculation-method of endophytic nitrogen-fixing bacteria to sugarcane and pineapple under the project entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand"
At Japan International Research Center for Agricultural Sciences and Chugoku National Agricultural Experiment Station, Oct. 3, 2000-Jan. 30, 2001		
Wang Yang	Soybean Institute of the Jilin Academy of Agricultural Sciences People's Republic of China	Soybean breeding and analysis of soybean components
At Japan International Research Center for Agricultural Sciences and Fruit Tree Research Station, Sep.11-Dec. 8, 2000		
Le Thi Thu Hong	Southern Fruit Research Institute Vietnam	Technical methodology for research on citrus virus and greening diseases
At Japan International Research Center for Agricultural Sciences and University of Gifu, Sep. 26-Dec. 22, 2000		
Wahyu Wahdini Marta	Center for Soil and Agroclimate Research Indonesia	Spatial analysis of farming systems using GIS
At Japan International Research Center for Agricultural Sciences and University of Gifu, Sep. 4-Dec. 1, 2000		
Chen Zhongxin	Chinese Academy of Sciences People's Republic of China	Analysis of environmental changes of winter wheat production using multi-temporal remote sensing data and GIS
At Japan International Research Center for Agricultural Sciences and Industral Technical Center of Kumamoto Prefecture, Oct. 12-Nov. 22, 2000		
Joko Susilo Utomo	Research Institute for Legume and Tuber Crops Indonesia	Improvement of kecap fermentation process using starter culture
At Japan International Research Center for Agricultural Sciences, National Research Institute of Fisheries Science and National Research Institute of Aquaculture, Nov. 27, 2000 - Feb. 23, 2001		
Cheng Yu-Tong	Shanghai Fisheries University People's Republic of China	Degradation mechanisms of freshwater fish surimi gel

At Japan International Research Center for Agricultural Sciences, National Institute of Sericultural and Entomological Sciences, Hokuriku National Agricultural Experiment Station and Kyushu National Agricultural Experiment Station , Jan.16-Mar. 27, 2001		
Shen Junhai	China National Rice Research Institute People's Republic of China	Analysis of biotypic variation in *S. furcifera*
At Japan International Research Center for Agricultural Sciences, Oct.1-Nov. 22, 2000		
Iswar Singh	Indian Institute of Sugarcane Research India	Physiology and molecular effects of brassinosteroids on thermotolerance of tomato
At Japan International Research Center for Agricultural Sciences and National Research Institute of Agricultural Economics, Jan. 31-Mar. 2, 2001		
Liu Ziren	Research Center for Rural Economy People's Republic of China	Major factors affecting the transformation of rural communities and production structures in the course of recent economic development in China
At Japan International Research Center for Agricultural Sciences and National Research Institute of Fisheries Sciences, Mar. 1 -29, 2001		
Emma Suryati Hala	Research Institute for Coastal Fisheries Indonesia	Material budget in mangrove re-afforestation regions
At Japan International Research Center for Agricultural Sciences and Kyushu National Agricultural Experiment Station, Jan. 8-Feb. 8, 2001		
Praphan Prasertsak	Suphan Buri Field Crops Research Center Thailand	Analysis of nutrient movements in soil and plant for development of efficient methods of fertilizer application to sugarcane
At Japan International Research Center for Agricultural Sciences, Jan. 9-Feb. 1, 2001		
Somsak Sukchan	Land Development Department Thailand	Analysis and evaluation of physical factors for sustainable agricultural systems
At Japan International Research Center for Agricultural Sciences and National Institute of Agro-Environmental Sciences, Jan. 9 -Feb.22, 2001		
Chairo Wongwiwatchai	Khon Kaen Field Crops Research Center Thailand	Status of inorganic and organic nitrogen in organic matter amended soils
At Japan International Research Center for Agricultural Sciences, Jan. 9- Mar. 24, 2001		
Eduardo Alejandro Guillin	National Agricultural Experiment Station, Marcos Juarez Argentina	Studies on ecology and control of major diseases of soybean
At Japan International Research Center for Agricultural Sciences, Jan. 22 -Mar. 30, 2001		
Erni Susanti	Center for Soil and Agroclimate Research Indonesia	Spatial analysis of rainfall distribution in West Java
At Japan International Research Center for Agricultural Sciences, Jan. 30-Feb. 24, 2001		
Ronnie S. Natawidjaja	Padjadjaran University Indonesia	Study on international research collaboration applying APAN

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 2000 pose for group photograph.

from October 1999 to September 2000

Development of techniques for environmental control by using plants and microorganisms specific to the tropics and subtropics		
Md. Khalilur Rahman	University of Dhaka Bangladesh	Subsurface drip irrigation for certain vegetable crops
Lauro Gumasing Hernandez	Bureau of Soils and Water Management Philippines	Effects of subsurface “drip fertigation” on Chinese cabbage tipburn
Studies on the mechanism of heat-tolerance of tropical and subtropical crops		
Sayed Fathey El-Sayed	Cairo University Egypt	Genetic studies on heat tolerance in snap bean (*Phaseolus vulgaris*) plants
Identification and evaluation of salt-tolerant crops		
Nguyen Thi Lang	Cuulong Delta Rice Research Institute (CLRRI) Vietnam	QTL mapping and evaluation of salt tolerance genes in rice
Evaluation and development of long-term conservation techniques of genetic resources of vegetatively propagated crops in the tropics and subtropics		
Werapon Ponragdee	Khon Kaen Field Crops Research Center Thailand	Intergenetic crossing in sugarcane for greater environmental tolerance
Lin Tong-Xiang	Fujian Agricultural University People’s Republic of China	Analysis of DNA markers in *Dimocarpus* longan and development of a test kit
Liu Xiaochuan	China National Rice Research Institute People’s Republic of China	Tagging heterosis trait with molecular markers in rice

Ishwar Singh	Indian Institute of Sugarcane Research India	Mechanisms of heat tolerance in crop plants under sub-tropics
Maribel Regla Quintana Sanz	Institute of Pastures and Forages Research Cuba	Molecular characterization in sugarcane germoplasm
Fan Shuguo	South China Institute of Botany, Academia Sinica People's Republic of China	Obtainment, identification and evaluation of salt tolerant rice *in vitro*

from October 2000 to September 2001

Development of techniques for environmental control by using plants and microorganisms specific to the tropics and subtropics		
Md. Khalilur Rahman	University of Dhaka Bangladesh	Response of subsurface drip-irrigated row crops
Le Van Hoa	Cantho University Vietnam	Physiological and biochemical studies on aluminium-resistant plants
Studies on the mechanism of heat-tolerance of tropical and subtropical crops		
Abdul Awal Howlader	Bangladesh Agricultural Research Institute Bangladesh	Molecular mechanism in biosynthesis and metabolism of metabolites
Identification and evaluation of salt-tolerant crops		
Vijay Kumar Yadav	Rajasthan Agricultural University India	Cloning of salinity genes in *E. coli* and its characterization
Evaluation and development of long-term conservation techniques of genetic resources of vegetatively propagated crops in the tropics and subtropics		
Ling Jiang	Huazhong Agricultural University People's Republic of China	Establishment of genetic transformation technique in papaya plants
Jalal Ud Din	Land Resources Research Institute Pakistan	Physiological, biochemical and molecular basis of heat tolerance in transgenic tomato at the reproductive growth stages
Liu Xiaochuan	China National Rice Research Institute People's Republic of China	Tagging heterosis trait with molecular markers in rice
Liu Yunxia	Institute of Biological Control People's Republic of China	Establishment of a regeneration system of sweet potato for utilizing anthocyanin transcriptional activator genes
Lawrence Misa Aboagye	Plant Genetic Resources Center Ghana	Characterization and evaluation of factors for early growth in sugarcane
Arfin Noor Sugiharuto	University of Brawijaya Indonesia	Cloning of useful genes and transformation in sugarcane

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. The program allows for the invitation of eight researchers per year. Four researchers engage in two-year projects at JIRCAS and four researchers conduct short five-month projects at the National Institute for Agrobiological Resources (NIAR). 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).

Tsukuba Fellows in 2000 pose for group photograph with JIRCAS host researchers.

Long-term at JIRCAS from October 1998 to September 2000

Methods for optimum utilization of biological resources

Joseph Gogo Dubouzet	University of the Philippines at Los Banos (UPLB), Philippines	Molecular analysis of drought stress responses in rice
Vipaporn Na Thalang	Kasetsart University Thailand	Chemical and biological evaluation of Thai vegetables
Do Thi Thanh Huong	Cantho University Vietnam	Physiological studies on reproduction and osmoregulation in the giant freshwater prawn, *Macrobrachium rosenbergii*

Analysis and evaluation of the impact of climatic and anthropogenic factors on environmental resources

Guo Jianjun	Research Center for Rural Economy (RCRE) People's Republic of China	Economic analysis of food consumption of Chinese farm households

Long-term at JIRCAS from October 1999 to September 2001

Methods for optimum utilization of biological resources

Malik A. Rabbani	National Agricultural Research Centre Pakistan	Analysis of plant responses to environmental stresses and gene expression
Najeeb S. Alzoreky	Sana'a University Yemen	Analysis and evaluation of biological activity of indigenous edible plants
Thanawan Boonpunt	Kasetsart University Thailand	Studies on changes in the physicochemical properties of rice grain during postharvest processing

Systems analysis of food problems and rural development

Yin Changbin	Natural Resources and Regional Planning (INRRP), CAAS People's Republic of China	Studies on regional food production, marketing and consumption in China

Long-term at JIRCAS from October 2000 to September 2002		
Methods for optimum utilization of biological resources		
Xu Donghe	Tianjin Agricultural Academy of Sciences People's Republic of China	Mapping of resistance genes to *Fusarium* head blight (FHB) in wheat
Nguyen Van Dong	Agricultural Genetics Institute Vietnam	Analysis of stress-inducible genes for transcription factors in higher plants
Methods for efficient use of food resources		
Nguyen Thi Thu Huong	Institute of Chemical Technology Vietnam	Elucidation of quality change factors in stored rice
Analysis and evaluation of the impact of climatic and anthropogenic factors on environmental resources		
Subbarao V. Guntur	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) India	Physiological study on nitrification inhibition and nitrogen absorption by *Brachiaria humidicola*
Short-term at NIAR from October 2000 to March 2001		
Wong Boonsuebsakul	Department of Agriculture Thailand	Pathological, serological and molecular biological charaterization of Thai strains of *Ralstonia solanacearum*
Hong Chongjian	China Agricultural University People's Republic of China	The induction of high quality mutants and analysis for mutation mechanisms in sweetpotato
Shahid Masood	National Agricultural Research Center Pakistan	Molecular evaluation of the rice cytoplasmic genome
Tan Zhenbo	Beijing Academy of Agricultural and Forestry Sciences People's Republic of China	Isolation of cDNAs clones encoding proteins that regulate freezing of cold hardy plant tissues

5) Other fellowships for visiting scientists

The Government of Japan sponsors a post-doctoral fellowship program for both Japanese and foreign scientists through the Science and Technology Agency (STA). 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 the various institutes within the Ministry of Agriculture, Forestry and Fisheries (MAFF). In 2000, the following visiting scientists resided at JIRCAS: Dr. Wei-Jun Yang (People's Republic of China), Fisheries Division; Dr.Vidya Jayasarkar (India), Fisheries Division; Dr. Safiah Jasmani (Malaysia), Fisheries Division; Dr. Yan Xiaoyuan (People's Republic of China), Environmental Resources Division; Dr. Hua Xu (People's Republic of China), Enviromental Resources Division; Dr. Dennis S. Simpson (United Kingdom), Biological Resources Division; Dr. Mohammad M. Parvez (Bangladesh), Biological Resources Division; Dr. Zhang Bing (People's Republic of China), Research Information Division.

In addition, three Japanese fellows, Dr. T. Furihata, Biological Resources Division; Dr. T. Kitamado, Fisheries Division; and Dr. H. Abe, Biological Resources Division, Dr. Ito, Biological Division; Dr.Y. Keibe, Biological Division; Dr. T. Watanabe, Enviromental 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 the 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.

The year 2000 marked JIRCAS's 30th anniversary. For JIRCAS, it was an opportunity to reassess the progress of agricultural development in developing countries and to reexamine the future role of agricultural research.

Appropriately, the 7th JIRCAS International Symposium, held in November 2000, focused on "Agricultural Technology Research for Sustainable Development in Developing Regions". The program from the 7th JIRCAS International Symposium appears below.

TARC-JIRCAS 30th Anniversary and the 7th JIRCAS International Symposium
AGRICULTURAL TECHNOLOGY RESEARCH FOR SUSTAINABLE DEVELOPMENT IN DEVELOPING REGIONS

Held November 1-2, 2000, at the Tsukuba International Congress Center, "Epochal Tsukuba", in conjunction with the National Agriculture Research Center (NARC), the National Institute of Agrobiological Resources (NIAR), the National Institute of Agro-Environmental Sciences (NIAES), and the National Research Institute of Agricultural Economics (NRIAE), Japan.

Opening address and welcoming remarks

- Inaugural address by Dr. Nobuyoshi Maeno, Director General, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Welcoming remarks by Dr. Mutsuo Iwamoto, Research Councilor, Agriculture, Forestry, and Fisheries Research Council Secretariat (AFFRC), Japan

Keynote addresses

- "An assessment of technology development from the Green Revolution to today" by Dr. William D. Dar, Director General, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India
- "Key characteristics of agricultural sustainability" by Dr. Pedro A. Sanchez, Director General, International Center for Research in Agroforestry (ICRAF), Kenya
- "Evolution and new directions using information systems for enhanced farmer partnership in NARS agricultural research" by Dr. Stein W. Bie, Director General, International Service for National Agricultural Research (ISNAR), Netherlands

Session 1: Technology development for increased production: accomplishments, needs, and potential
Chaired by Dr. Masa Iwanaga, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Developing new crop varieties for stress and low-input conditions. Prof. Kazuyoshi Takeda, Okayama University, Japan
- Contribution of molecular biology to breeding and issues associated with its application in developing countries. Dr. Ronald P. Cantrell, Director General, International Rice Research Institute (IRRI), the Philippines
- Distribution and processing systems for stable supply of products from agriculture, forestry, and fisheries. Dr. Greg Johnson, Program Manager, Postharvest Technology, Australian Centre for International Agricultural Research (ACIAR), Australia

Session 2: Concepts, needs, and approaches for agro-ecological sustainability
Chaired by Dr. Osamu Ito, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Sustainable land management for crop production. Dr. Eric T. Craswell, Director General,

International Board for Soil Research and Management (IBSRAM), Thailand
- Sustainable water management for crop production. Dr. S. A. Prathapar, Director, International Water Management Institute (IWMI), Pakistan
- Sustainable aquaculture production and fisheries management. Dr. Meryl J. Williams, Director General, International Center for Living Aquatic Resources Management (ICLARM), Malaysia

Session 3: Evolution of farmer-researcher extension private sector partnerships for technology development and dissemination

Chaired by Prof. Keiji Ohga, the University of Tokyo, Japan

- Evolution of concepts and approaches of systems-oriented, farmer participatory agricultural research. Dr. John S. Caldwell, International Research Coordinator, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Contributions of farmer knowledge to agricultural technology development. Prof. Harold J. McArthur, University of Hawaii
- Institutionalization of technology development. Prof. David W. Norman, Kansas State University, USA

Chaired by Dr. Yoshinori Morooka, National Agriculture Research Center (NARC), Japan

- Developing sustainable agricultural systems: case study examples, determinants, future approaches, and roles of different partners, as viewed from the Cooperation Agency. Mr. Nobuyuki Samejima, Managing Director, Japan International Cooperative Agency (JICA), Japan
- Developing sustainable agricultural systems: determinants, future approaches, and roles of different partners, as determined by the soybean breeding program for human nutrition, at the National Soybean Research Center (EMBRAPA). Dr. Mercedes Concordia Carrao-Panizzi, National Soybean Center (EMBRAPA), Brazil
- Developing sustainable agricultural systems: determinants, future approaches, and role of different partners. Dr. Achmad M. Fagi, Secretary of the Agency for Agricultural Research and Development (AARD), Indonesia

Session 4: Discussion and synthesis of key issues for agricultural technology research for sustainable development

Chaired by Dr. Masa Iwanaga and Dr. Osamu Ito, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Presentation of key issues from Sessions 1, 2, and 3 for agricultural technology research for sustainable development
- Future directions for JIRCAS's collaboration with partners
- Discussion and synthesis

Closing remarks by Dr. Ronald P. Cantrell, Director General, International Rice Research Institute (IRRI), the Philippines

2) SPECIAL PROGRAMS

WORKSHOP ON LINKAGES BETWEEN BIOLOGICAL AND SOCIAL SCIENCE RESEARCH IN THE NORTHEAST THAILAND COMPREHENSIVE PROJECT

Since 1995, the governments of Thailand and Japan have carried out a collaborative research project entitled "Comprehensive studies on sustainable agricultural systems in Northeast Thailand". The project consists of two sub-phases, a "fundamental research" sub-phase and a "constructive research" sub-phase. In the first sub-phase, which ran from 1995 to 1998, reserachers focused on six areas: environmental resources, biological resources, crop production, livestock production, postharvest technologies, and actual conditions of rural areas. In the second sub-phase, the ongoing constructive research, scheduled to last from 1999 to 2001, focuses on developing methods of integrating crop and livestock production, and evaluates the potential applicability of technologies developed in the project's first subphase. The ultimate goal of the project is the further development of sustainable agricultural systems. One recommendation for the project coming from a mid-term evaluation in September 1999 was that social science research be strengthened as a means of focusing the project's work on issues more relevant for the effective diffusion of new farming systems.

In response to this recommendation, JIRCAS held a joint workshop with Thai institutions such as the International Training Center for Agricultural Development (ITCAD), Department of Agriculture (DOA), and the Ministry of Agriculture and Cooperatives (MOAC), focusing on two ways of creating closer linkage between social and technological research within the project: (1) to exchange research results and ideas on socioeconomic aspects of technological development in Northeast Thailand and (2) to discuss progress in research on the development of rainfed lowland rice farming systems. Forty-three scientists from Thailand and 12 from Japan were among those who attended the workshop, held on June 16 at the International Training Center for Agricultural Development (ITCAD) in Khon Kaen, Thailand. The schedule of the workshop is outlined below.

Morning session: Building on research for development of systems-compatible user technologies by applying social sciences

- Opening remarks by Mr. Paiwit Watanavitawas, Director, International Training Center for Agricultural Development (ITCAD), Thailand
- Message from the DOA by Dr. Ananta Dalodom, Director General, Department of Agriculture (DOA), Thailand
- Welcome address by Dr. Waewchark Kongpolprom, Director of the Office for Development of Agricultural Research, Ministry of Agriculture and Cooperatives (MOAC), Thailand
- Explanation of workshop objectives by Dr. Osamu Ito, Director, Environmental Resources Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- Socioeconomic perspectives on project goals, activities, and accomplishments to date. K. Tsurumi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Farming system types in Northeast Thailand: importance, geographical distribution, and technological needs. S. Ooraikul, Representative of the Office of Agricultural Economics, Thailand
- Internal conditions for technology acceptance: farmer needs, ease of use, economic viability, systems compatibility, and sustainability. J.S. Caldwell, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- External conditions for technology acceptance: regional markets, village social structure, farmer organizations, extension, and other support agencies. M. Ando, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Social science research focused on agriculture and agricultural technology development at Khon Kaen University: accomplishments, current efforts, and possibilities for collaboration. N. Suphanchaimat, P. Prapertchob, W. Pak-Uthai, and C. Wongsamarn, Faculty of Agriculture, Khon Kaen University, Thailand

Afternoon session: Rice-based cropping systems in rainfed lowland ecosystems

- Strategy and scope of research on rainfed lowland ecosystems. O. Ito, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- No-tillage direct seeding method for crop establishment. U. Arromratana, Soil Science Division, Department of Agriculture (DOA), Thailand
- Cultural practices for dry direct seeding of rice. T. Wungkahart, International Training Center for Agricultural Development (ITCAD), Thailand
- Genotype requirements for rice varieties during drought and low fertility. S. Khonthasuvon, Khon Kaen Rice Experiment Station, Thailand
- Weed control in rainfed paddy fields. H. Morita, National Agriculture Research Center (NARC), Japan
- Water management in rainfed lowland areas. C. Ogura, Japan International Research Center for Agricultural Sciences (JIRCAS), and S. Fujimori, National Research Institute of Agricultural Engineering (NRIAE), Japan
- Water-saving cultivation techniques for upland crops and vegetables. S. Thipayarugs, Khon Kaen Field Crop Research Center, Thailand
- Technologies for efficient and labor-saving cropping systems. N. Kabaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

RILET-JIRCAS WORKSHOP ON SOYBEAN RESEARCH

JIRCAS and the Research Institute for Legume and Tuber Crops (RILET), part of the Indonesian Ministry of Agriculture's Agency for Agricultural Research and Development, held a joint workshop in Malang, Indonesia on September 28, 2000, entitled "RILET-JIRCAS workshop on soybean research".

Soybean foods such as tempe (a fermented soybean food), tofu, kecap (an Indonesian soy sauce), and tauco (an Indonesian fermented soybean paste), are of great significance to the diet of the Indonesian people, as low-cost sources of proteins and seasonings. These foods are also an integral part of Indonesian culture. The country's per capita average of direct consumption of soybeans along with the total demand for soybeans, has increased every year, rising from 4 kg per person in the early eighties to 9 kg in 1994. Indonesia produced 1.5 million tons of soybeans in 1996, but about 0.8 million tons of soybeans had to be imported to cover the deficiency. Since 1993, JIRCAS has dispatched three researchers on a long-term basis to RILET a nematologist (1993-1995), a soybean breeder (1995-1998) and a food scientist (1997-2000), to participate in collaborative research projets on soybeans and to promote Indonesian domestic soybean production.The main purpose of the joint workshop was to present and review the collaborative research works on soybean between JIRCAS and RILET as well as those of related studies, and to discuss the future strategies of soybean research in Indonesia.

Forty scientists from the Japan International Cooperative Agency (JICA) Soybean Seed Project, JIRCAS, and related Indonesian institutes participated in the workshop. Supported by the experienced staff of RILET, the workshop stimulated productive and in-depth discussions. The proceedings of the workshop will be published in 2001.

- Welcome Address by Dr. N. Saleh, Director, Research Institute for Legume and Tuber Crops (RILET), Indonesia, and Dr. A. Noguchi, Director, Crop Production and Postharvest Technology Division, Japan International Research Center for Agricultural Sciences, (JIRCAS), Japan
- Opening Remarks by Dr. D.S. Damardjati, Director, Central Research Institute for Food Crops (CRIFC), Indonesia

Keynote lecture

- Recent research and industrial achievements on soybean foods in Japan. Dr. A. Noguchi, Director, Crop Production and Postharvest Technology Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Production and postharvest technology for soybeans

- Improved soybean production technology in Indonesia. T. Adisarwanto, Research Institute for Legume and Tuber Crops (RILET), Indonesia.
- Soybean food utilization in Indonesia. J.S. Utomo, Research Institute for Legume and Tuber Crops (RILET), Indonesia, and S. Nikkuni, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Uniformity and improvement of soybean seeds in Indonesia. T. Sanbuichi and N. Sekiya, Soybean Seed Project, Japan International Cooperation Agency (JICA), Japan; Jamaluddin, Central

Representatives of JIRCAS, the Research Institute for Legume and Tuber Crops (RILET), Central Research Institute for Food Crops (CRIFC), and the Soybean Seed Project, Japan International Cooperation Agency (JICA) attending the RILET-JIRCAS workshop on soybean research pose for a group photograph.

Foundation Seed Farm for Field Crops, Indonesia; Susanto, Seed Control and Certification Service, Indonesia; D.M. Arsyad and M. Adie, Research Institute for Legume and Tuber Crops (RILET), Indonesia

JIRCAS-RILET Collaborative Research Works on Soybean

- Breeding soybean for insect resistance. Suharsono, M. Adie, and Tridjaka, Research Institute for Legume and Tuber Crops (RILET), Indonesia; K. Igita, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Evaluation of Indonesian soybean varieties for the processing and improvement of fermented foods, Part I: Evaluation of Indonesian soybean varieties for food processing. S.S. Antarlina, J.S. Utomo, E. Ginting, Reserach Institute for Legume and Tuber Crops (RILET), Indonesia, and S. Nikkuni, Japan International Reserach Center for Agricultural Sciences (JIRCAS), Japan
- Evaluation of Indonesian soybean varieties for the processing and improvement of fermented foods, Part II: Improvement of kecap koji making process using a white-spored mutant of koji mold. S. Nikkuni, Japan International Research Institute for Agricultural Sciences (JIRCAS); T. Goto, National Food Research Institute (NFRI), Japan; S.S. Antarlina, E. Ginting, and J.S. Utomo, Research Institute for Legume and Tuber Crops (RILET), Indonesia

AARD/JIRCAS Research Collaboration in Indonesia

- AARD/JIRCAS Research Collaboration in Indonesia - Past, Present and Future. S. Asanuma, Japan International Reserach Center for Agricultural Sciences (JIRCAS), Japan

Conclusions

- Closing address by Dr. Suwandi, Head, Planning Division, Central Research Institute for Food Crops (CRIFC), Indonesia.

WORKSHOP FOR THE PROJECT "DEVELOPMENT OF AGRO-FORESTRY TECHNOLOGY FOR CONSERVATION OF TROPICAL FORESTS

Inter-cropping of the weed between fast growing trees in South Kalimantan, Indonesia. (Photo: K. Nakashima)

The process of reforestation using fast-growing trees such as oil palms has been expanding in tropical countries. These types of monoculture forests are a serious threat to the conservation of biological diversity as well as to the sustainable use of forest resources in the tropics. The main purpose of the project is to develop technology for the cultivation of agricultural crops and valuable tree species under or between fast-growing trees inhabiting the same land in order to restore biological diversity.

Prior to the start of the project, JIRCAS held a half-day workshop entitled "Development of agroforestry technology for conservation of tropical forest" on September 1, 2000 in Tsukuba, Japan, in order to facilitate a mutual understanding of the project through an exchange of information and to discuss the future development of the project. The workshop was attended by representatives of the project's main collaborator, the Forest Research Center, a division of the Forestry Department in Sabah, Malaysia.

Specific objectives of the project include the re-creation of productive environments for agro-forestry, development of agro-forestry techniques with utilization of shade trees, and socio-economic evaluation of agro-forestry. It is indispensable to construct close relations between forestry and agricultural research in order for the project to succeed.

Workshop schedule

- Inaugural address by Dr. T. Ishitani, Director, Research Information and Coordination Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- General outline of the project by Dr. T. Suzuki, Director, Forestry Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- Diversification of tropical forest ecosystems and evaluation methods for agriculture and forest production systems. S. Kobayashi, Principal Research Coordinator, Forestry and Forest Products Research Institute (FFPRI), Japan

- Analysis of conditions of crop production and indexes for economic evaluation of agro-forestry. S. Tsuru, Director of Silviculture, Kyushu Research Center, Forestry and Forest Products Research Institute (FFPRI), Japan
- Thinning techniques in monoculture forests and silviculture techniques for growing cover forests. H. Kushima, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Evaluation of environment conditions for growing crops and trees in agroforestry. M.N. Inagaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of techniques for cultivation and planting of useful tree seedlings in tropical forests. Y. Ochiai, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of techniques for growing fruit trees under shade trees. H. Fukamachi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of techniques for growing non-arboreal crops under shade trees. Y. Araki, National Research Institute of Vegetables, Ornamental Plants and Tea (NIVOT), Japan
- Development of techniques for recycling of forest resources in the tropical forest. A. Yokota, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

General discussion

- Closing address by Dr. T. Ishitani, Director, Research Planning and Coordination Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

WORKSHOP ON *ORYZA GLABERRIMA* GENETIC RESOURCES: EVALUATION AND USE

Increased rice production in West Africa is hampered by a number of constraints including diseases, pests, weed infestation, environmental stresses, and lack of suitable varieties. To help address these problems, JIRCAS initiated a five-year research project in conjunction with the West Africa Rice Development Association (WARDA) in April 1998. This project involves genetic and ecophysiological characterization, and the use of *Oryza glaberrima* germplasm by crossing it with *O. sativa* to combine the advantages of the two species with a special focus on drought resistance. To further advance the project, JIRCAS organized with its collaborators in Japan a workshop entitled "*Oryza glaberrima* genetic resources: its evaluation and use", held at Tsukuba on September 8, 2000. The workshop, attended by 57 participants, was successful in stimulating active discussions assessing the current status of research on the use of *Oryza glaberrima*. Discussions led to an exchange in opinions concerning various strategic research approaches to improving drought resistance of rice in West Africa.

Introductory session

- Opening address by Dr. Nobuyoshi Maeno, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- JIRCAS Collaborative Research Project on Rice in West Africa. Dr. Hiroko Takagi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

***Session 1. Genetics and physiological background of* Oryza glaberrima**

Chaired by Dr. Masa Iwanaga, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- *Oryza glaberrima:* its significance for genetic resources. H. Morishima, Professor Emeritus, National Institute of Genetics, Japan
- Growth characteristics of *Oryza glaberrima* in reference to annuality. Y. Takasaki, Chiba University, Japan
- Genetic analysis of *Oryza glaberrima* Steud. traits in *O. sativa* L. : development and utilization of introgression lines. A. Yoshimura and K. Doi, Kyushu University, Japan

Session 2. Evaluation and use of* Oryza glaberrima *germplasm: collaborative research projects at the West Africa Rice Development Association (WARDA)

Chaired by Dr. Hiroko Takagi, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Interspecific hybridization project of WARDA. S. Tobita, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Grain quality characteristics of *Oryza glaberrima* Steud. and interspecific progenies with the goal of breeding high protein rice. H. Watanabe, Japan International Cooperation Agency (JICA), Japan
- Submergence tolerance and deep-water avoidance in *Oryza glaberrima* Steud. and interspecific progenies. K. Futakuchi, West Africa Rice Development Association (WARDA), Côte d'Ivoire

Session 3. Physiological study and evaluation of drought resistance of rice

Chaired by Dr. Osamu Ito, Driector, Environmental Resources Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Ecophysiology of drought resistance in crop plants with emphasis on rice. Prof. T. Hirasawa, Tokyo University of Agriculture and Technology, Japan
- Stabilization of rice production under water stress in the tropics. M. Kondo, National Agriculture Research Center (NARC), Japan
- Study on drought resistance in *Oryza glaberrima* Steud. Y. Yamagishi and T. Fujimura, University of Tsukuba, Japan
- Comparative studies on physiological responses among Asian and African rice varieties and their interspecific hybrid lines to drought stress at the early growth stage. S. Tobita, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, and Dr. T. Okawa, Tokyo University of Agriculture and Technology, Japan

General discussion

Chaired by Dr. Osamu Ito, Driector, Environmental Resources Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

WORKSHOP ON PASTURE AND LIVESTOCK PRODUCTION IN THE CENTRAL ASIA

The Japan International Research Center for Agricultural Sciences (JIRCAS) hosted a workshop on "Pasture and Livestock Production in the Central Asia" on September 27, 2000, which outlined an ongoing collaborative study entitled "Development of sustainable systems of grassland management and animal production in Central Asia" between the Kazakh Institute of Agriculture and JIRCAS initiated in 1996. This research project focuses on the development of grassland conservation and sustainable livestock production in Central Asia, with special emphasis placed on management, fertility, and vegetation of grassland in steppe soil. The main purpose of this workshop was to review updated results obtained during the implementation of the project as well as other related studies, and to discuss future strategy after completion of the project. Approximately thirty scientists from Kazakhstan and Japan participated in the workshop, which generated many fruitful results. All participants recognized the importance of grassland management and sustainable production of livestock in the Central Asia. JIRCAS will publish a proceedings of the workshop.

Participants attending the workshop on Pasture and Livestock production in Central Asia pose for group photograph. (photo: T. Taniguchi)

Workshop schedule

- Opening address by Dr. Nobuyoshi Maeno, Director General, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Current conditions and problems of development agriculture of Kazakhstan and Central Asian countries. Dr. Azimkhan A. Satybaldin, President of the CAC Regional Forum, National Academy Center for Agricultural Research (NACAR), Kazakhstan

-topics-

- Agricultural characteristics and research development in Central Asia. M. Oka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Relations between Japan and the Republic of Kazakhstan. A.A. Jalyn, Kazakh National State University, Kazakhstan
- Pastures in Kazakhstan, past and present. K.A. Asanov, Director, Kazakh Research Institute of Feed and Pastures, National Academy Center for Agricultural Research (NACAR), Kazakhstan
- Ecosystem distribution and issues on conservation in Kazakhstan: natural environment of livestock production. Y. Morimoto, Professor, University of Osaka Prefecture, Japan
- Legumes available for soil fertilization and animal feeding, and establishment of esparcet (*Onobrychis*) in the Kazakh steppe. K. Sato, Kyushu National Agricultural Experiment Station, Japan
- Land use, animal husbandry, and grassland farming in Almaty, Republic of Kazakhstan. M. Nashiki, National Grassland Research Institute, Kazakhstan
- *General discussion*

Closing remarks

- Closing address by Dr. Takasuke Ishitani, Director, Research Planning and Coordination Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

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

The comprehensive project entitled ‘‘Development of new technologies and their practice for sustainable farming systems in the Mekong Delta (Mekong II)” has been implemented since 1999, after achieving a high degree of success in the first phase of the project, entitled “Evaluation and improvement of farming systems combining agriculture, animal husbandry, and fisheries in the Mekong Delta”. The Mekong II project focuses on the establishment of commodities through the material circulation of by-products and wastes generated in VACR farming systems. VACR is a Vietnamese acronym standing for fruits and vegetables, aquaculture, livestock and rice. JIRCAS has conducted studies in collaboration with Cantho University (CTU) and the Cuu Long Delta Rice Research Institute (CLRRI) since 1999, and with the Southern Fruit Research Institute (SOFRI) since 2000.

From November 14, 2000, CTU hosted a four-day annual workshop for the comprehensive project on ‘Mekong II’ at the Mekong Delta Farming Systems Research and Development Institute (MDFSRDI) in Cantho, Vietnam. The main purpose of the workshop was to review the results and to examine the future research direction of the project.

There were more than 80 participants from Vietnamese organizations, including local authorities such as agricultural extension departments and Tan Phu Thanh village representatives (the research site for the on-farm trial of the project), as well as faculty from CTU and CLRRI, in addition to the 12 Japanese participants.

After greetings from Dr. Le Quang Minh, Vice Rector of CTU, and opening addresses by Dr. Vo-Tong Xuan, Director of the MDFSRDI, and by Dr. Osamu Ito, Director of the Environmental Resources Division of JIRCAS, 52 reports were presented in 9 sessions during the first three days. Session A introduced an outline of the project’s on-farm trial site. Researchers presented technical reports on rice cultivation in Session B. Session C covered integrated pest management in rice cultivation. Sessions D and E concerned topics on upland crops such as soybean with rice culture and on drying technologies, respectively. After discussion on fruit production in Session F, results on pig production were presented in Session G. In Session H, 12 reports were presented on aquaculture production including fish and freshwater prawn. After Session I, which covered the development and evaluation of farming systems, the future direction and development for closer collaboration for the studies were discussed comprehensively in Session J. On the last day, November 17, all participants visited Tan Phu Thanh village on a field trip. The workshop’s success arose from the strong commitment of the experienced staff of the MDFSRDI and CTU. JIRCAS later published the workshop proceedings.

Participants exchanged views on the progress

of the project and confirmed the importance of such studies. During the workshop, participants concluded that the development of sustainable farming systems that combine rice cultivation, fruit production, animal husbandry, and aquaculture is essential, and organizations involved in the project committed themselves to devising new strategies for the further development of techniques towards the improvement of farming systems in the Mekong Delta.

The next annual workshop for the project will be held at CLRRI in late November 2001.

Opening session

Chaired by Prof. Dr. Vo-Tong Xuan, Director, Mekong Delta Farming Systems Research and Development Institute (MDFSRDI), Vietnam

- Introduction of guests by Dr. Hiroyuki Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Greetings address by Prof. Dr. Le Quang Minh, Vice Rector, Cantho University (CTU), Vietnam
- Opening speeches by Prof. Dr. Vo-Tong Xuan, Project Coordinator, and Dr. Osamu Ito, Director, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session A: General information on farming systems at Tan Phu Thanh Village, Chau Thanh, Cantho Province

Chaired by Prof. Dr. Vo-Tong Xuan, Director, Mekong Delta Farming Systems Research and Development Institute (MDFSRDI), Vietnam

- Classification of land mapping units based on soils and hydrological characteristics of Tan Phu Thanh Village, Chau Thanh District, Cantho Province. V.Q. Minh, L.Q. Tri, Cantho University (CTU), Vietnam, and R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- The classification of farming systems in Tan Phu Thanh village. R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, N.Q. Tuyen, L.C. Dung, and V.V. Tuan, Cantho University (CTU), Vietnam
- The agricultural production of Tan Phu Thanh village in recent years. N.Q. Tuyen, L.C. Dung, V.V. Tuan, N.D. Can, L.T. Giang, P.C. Huu, and V.V. Ha, Cantho University (CTU), Vietnam, R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Farm households' status in Tan Phu Thanh Village—results from benchmark survey in 2000. L.C. Dung, N.Q. Tuyen, N.D. Can, V.V. Ha, P.C. Huu, V.V. Tuan, L.T. Giang, T.T.N. Hiep, Cantho University, (CTU), Vietnam, R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, D.C. Muoi, Agricultural Extension Center (AED of Cantho), Vietnam, N.T. Hung, Agricultural Extension Center (AED of Chau Thanh), Vietnam, and N.V. Thanh, Agricultural Extension Office (AED of Tan Phu Thanh), Vietnam

Session B: Technology development for higher and stable production in direct seeding culture

Chaired by Prof. Bui Ba Bong, Director General, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

- Studies on genotypic variability in rice (*Oryza sativa* L.) in responses to salt stress. N.T. Lang, N.V. Tao, T.T. Luy, B.C. Buu, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Establishment of optimum seeding rate for row seeders. P.S. Tan, T.Q. Khuong, T.T.N. Huan, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Optimum fertilizer—nitrogen rates for high yielding rice based on growth diagnosis in wet-seeded rice culture. T.T.N. Huan, P.S. Tan, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Establishment of water control methods. P.S. Tan, T.Q. Tuyen, N.T. Hoai, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session C: Development of technology for integrated pest management in rice and rice based farming systems

Chaired by Prof. Dr. Bui Chi Buu, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

- Collection and identification of lowland rice weeds. D.V. Chin, T.T.N. Son, C.V. Hach, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, K. Ito, National Institute of Agro-Environmental Science (JAEI), Japan, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Study on sole and supplemental hand weeding for weed control in rice. D.V. Chin, T.T.N. Son, C.V. Hach, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, K. Ito (JAEI), and H. Hiraoka Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Comparison of effectiveness between the complete protection and partial protection from the four leaves stage (20-21 days after sowing) of rice plants based on the effects of insect pests, natural enemy complexes, and rice yield. L.M. Chau, L.T. Phuong, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Survey on pest constraints of the three rice crops in Tan Phu Thanh village in the Mekong Delta of Vietnam. P.V. Du, H.D. Dinh, N.V. Tai, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session D: Development of varieties and suitable technologies for uplands crops in rotation with rice

Chaired by Prof. Dr. Bui Chi Buu, Cuu Long Delta Rice Research Institute, (CLRRI), Vietnam

- Soybean breeding in the Mekong Delta—current situation and research directions. D. Le-Viet, H.T. Tung, N.P. Dang, V.C. Thanh, T.T. Ngon, P.T.T. Thuy, T.T. Tuan Cantho University (CTU), Vietnam, H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Effect of organic and bio-fertilizer on soybean and rice under rice-based cropping systems. T.T.N. Son, V.V. Thu, D.V. Chin, Cuu Long Delta Rice Research Institute, (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session E: Development of grain drying technology

Chaired by Prof. Dr. Bui Chi Buu, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

- Development of small dryers suitable for small farms and farms in remote areas. L.V. Banh, P.V. Ngan, and H.B. Quoc, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, Y. Kanetani and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session F: Fruits production

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

- First year progress report on fruit tree production based on integrated pest management (IPM) in Tan Phu Thanh village of the Mekong Delta of Vietnam. D. Minh, P.V. Kim, L.T. Sen, N.V. Huynh, L.V. Dung, L.T. Phong, and L.T. Liem, Cantho University (CTU), Vietnam, H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, T.N. The, Crop Protection Station (PPD of Chau Thanh), L.H. Man, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

Session G: Pig production

Chaired by Prof. Dr. Chau Ba Loc, Cantho University, Vietnam

- Study on helminthes in swine at Tan Phu Thanh village. N.H. Hung, Cantho University (CTU), Vietnam, and H.Q. Tram, Department of Science, Technology, and Environment (DSTE of Cantho Province),Vietnam
- Digestion of coconut oil meal diets for finishing pigs. L.H. Manh, V.V. Son, L.V. Hung, N.N.X. Dung, Cantho University (CTU), Vietnam, and R. Takada (NIAI)
- Isolation and antibacterial sensitivity of *Escherichia* coli isolated from piglets' diarrhea. C.B. Loc, L.T.L. Khai, and T.T. Phan, Cantho University, Vietnam
- Cross-sectional serology on porcine parvovirus, Japanese B encephalitis virus, and *Brucella suis* specific antibodies in pigs in Tan Phu Thanh village. H.T.V. Thu, C.B. Loc, L.T. Thu, Cantho University (CTU), Vietnam
- Bacteriological indicators of fecal contamination of water in Tan Phu Thanh village. T.T. Phan, LyT.L. Khai, C.B. Loc, Cantho University (CTU), Vietnam

Session H: Aquaculture production

Chaired by Dr. Nguyen Thanh Phuong, Vice Director, Research Institute for Marine Aquaculture, College of Agriculture, Cantho University, Vietnam

- Progress report of the experiments on seed production and culture of freshwater prawn (*Macrobrachium rosenbergii*). N.T. Phuong, T.N. Hai, T.T.T. Hien, D.T. Yen, B.T.B. Hang, N.L.H. Yen, D.H. Tam, Cantho University (CTU), Vietnam
- Reproductive mechanisms in the giant freshwater prawn, *Macrobrachium rosenbergii*: identification of yolk protein structure and site of synthesis. M.N. Wilder, W-J. Yang, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, D.T.T. Huong, Cantho University (CTU), Vietnam
- Observation on the growth, maturation and survival rate of freshwater prawn (*Macrobrachium rosenbergii*). T.N. Hai, V.T. Toan and T.T.T. Hien, Cantho University (CTU), Vietnam
- The effects of dietary lipid sources and lecithin on growth and survival rate of freshwater prawn (*Macrobrachium rosenbergii*) larvae, T.T.T. Hien, T.N.Hai, N.T.Phuong, Cantho University (CTU), Vietnam, H.Y. Ogata, National Research Institute of Agriculture (NRIA), Japan, M.N. Wilder Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- The effects of vitamin C on the larvae of freshwater prawn (*Macrobrachium rosenbergii*) T.T.T. Hien, T.N. Hai, N.T. Phuong, Cantho University (CTU), Vietnam, H.Y. Ogata, National Research Institute of Agriculture (NRIA), Japan, M.N. Wilder, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- The effects of larval sources and stocking density on the growth and survival rate of freshwater prawn (*Macrobrachium rosenbergii*) larvae reared under the modified green water system and re-circulating systems. N.T. Phuong, T.N. Hai and N.C. Cuong, Cantho University (CTU), Vietnam
- The effects of probiotics on culture conditions of freshwater prawn (*Macrobrachium rosenbergii*) larvae. D.T.H. Oanh, T.T.T. Hoa and N.T. Phuong, Cantho University (CTU), Vietnam
- The evaluation of certain plants as dietary protein sources for fingerlings of tilapia (*Oreochromis niloticus*) and silver barb (*Puntius gonionotus*). D.T. Yen, T.T.T. Hien, N.T. Phuong, Cantho University (CTU), Vietnam
- Preliminary results on using hormones for artificial propagation of climbing perch (*Anabas testudineus*). N.V. Trieu and D.N. Long, Cantho University (CTU), Vietnam
- Using hormones for artificial propagation of snakehead (*Channa striatus* Bloch) in the Mekong Delta. N.V. Trieu, D.N. Long and L.S. Trang, Cantho University (CTU), Vietnam
- Improvement of pond preparation technology and zones affected by acid sulfate soil. D.N. Long, L.M. Lan, D.T.H. Oanh, V.N. Son, N.T.K. Lien, Cantho University (CTU), Vietnam
- Optimization of stocking density and stocking population in freshwater fish farming systems. D.N. Long, L.M. Lan, P.V. Manh, N.V. Lanh, L.T.N. Thanh, Cantho University (CTU), Vietnam

Session I: Development and evaluation of sustainable farming systems

Chaired by Dr. Ngo Ngoc Hung, Cantho University, Vietnam

- Improvement of soil fertility by rice straw manure. L.H. Man, 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 on summer-autunm rice crop in Tan Phu Thanh. N.N. De, N.T. Liem, Cantho University (CTU), Vietnam, L.H. Man, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam, and H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Comparison of growth and yield between the row seeding and fertilizer application methods recommended by CLRRI and JIRCAS and conventional wet seeded methods by farm households at Tan Phu Thanh village and Omon District. H. Hiraoka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, T.Q. Khuong, T.T.N. Huan and H.D. Dinh, Cuu Long Delta Rice Research Institute (CLRRI), Vietnam
- Nitrogen flow estimation in rural area in the Mekong Delta. T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Water quality and natural foods in ponds under pig-fish integrated systems. D.N. Long, L.M. Lan, D. Thi, H. Oanh, V.N. Son, N.T.K. Lien, Cantho University (CTU), Vietnam, T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Development of a low-cost plastic bio-gas digester in integrated farming systems: case studies in Tan Phu Thanh village, Chau Thanh and Hoa An, Phung Hiep (Cantho). V. Lam, Cantho University (CTU), Vietnam and T. Watanabe, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Development of new methods of technology selection in integrated research projects. R. Yamada Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, N.Q. Tuyen, L.C. Dung, Cantho University (CTU), Vietnam, T. Monma, Tokyo University of Agriculture, Japan
- Existing farm economic situation of on-farm trial households in Tan Phu Thanh village. N.Q. Tuyen, L.C. Dung, T.T.N. Hiep, V.V. Tuan, V.V. Ha, Cantho University (CTU), Vietnam, R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Analysis of problem relationships in farming systems by the demated method. R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, N.Q. Tuyen, L.C. Dung, V.V. Tuan, Cantho University (CTU), Vietnam, T. Monma, Tokyo University of Agriculture, Japan

Chaired by Prof. Dr. Vo-Tong Xuan, Director, Mekong Delta Farming Systems Research and Development Institute (MDFSRDI),Vietnam

- An analysis of vegetable marketing channels in Cantho Province. N.P. Son, N.C. Phy, T.V. Binh, T.M. Hai, N.M. Chau, L.N.M. Trang, N. Thi C. Chi, N.D. Loc, N.V. Thach, T.P. Hung, Cantho University (CTU), Vietnam, T. Shimoyama (TNAES), R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Present status of farmers organizations in Tan Phu Thanh village. L.C. Dung, N.Q. Tuyen, N.D. Can, V.V. Ha, V.V. Tuan, L.T. Giang, Cantho University (CTU), Vietnam, R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, N.T. Hung, Agricultural Extension Center (AED of Chau Thanh), Vietnam, and N.V. Thanh, Agricultural Extension Center (AED of Tan Phu Thanh village), Vietnam
- Sustainable farming systems research on acid sulphate soil: farmers' plan. N.T. Binh, H.V. Nghiem, D.V. Ni, Cantho University (CTU), Vietnam, R. Yamada, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Session J: Discussion for activities in the future

Chaired by Prof. Dr. Vo-Tong Xuan, Director, Mekong Delta Farming Systems Research and Development Institute (MDFSRDI),Vietnam, and Dr. Tetsushi Hidaka, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

- Discussion on future research
- Closing remarks by Prof. Dr. Vo-Tong Xuan, Director, Mekong Delta Farming Systems Research and Development Institute MDFSRDI), and Dr. Osamu Ito, Director, Japan International Research Center for Agricultural Aciences (JIRCAS), Japan

WORKSHOP ON POLYVOLTINE SERICULTURE AND POST HARVEST TECHNOLOGIES

The goal of the collaborative research project entitled, "Comprehensive studies on sustainable agricultural systems in Northeast Thailand" is to promote the technological development of rice, field crops, vegetables, livestock, and sericulture industries, as well as to develop a sustainable agricultural system combining multiple types of farming and animal husbandry. The agricultural development of Northeast Thailand in recent years is characterized by the intensification of upland farming through introduction of cassava and sugarcane as main cash crops. However, intensive upland farming has not yet brought sufficient income to the farmers—family income is only 40 percent of the national average. Furthermore, the soils used for continuous upland crops have been showing signs of declining fertility.

In order to further develop agriculture in the region, it is necessary to shift the agricultural system from one that depends highly on a select few cash crops to a more sustainable system in which diverse cropping options are combined with more efficient utilization of local resources. Thus, a sericultural focus has been incorporated into the project in close collaboration with the Nakhon Ratchasima Sericultural Research Center. JIRCAS organized a workshop to discuss the research outputs with scientists from several sericultural centers in Thailand. The workshop was held on November 21, 2000 in Nakhon Ratchasima. More than 90 percent of all sericulture scientists in Thailand were among the 61 participants attending the workshop.

Workhop schedule

- Opening remarks by Dr. Osamu Ito, Director, Environmental Resources Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

-topics-

- Silkworm disease and their control. M. Kaewwiset, Udornthani Sericultural Research Center, Department of Agriculture (DOA), Thailand
- Improvement of multivoltine-bivoltine hybrid silkworm "Udornthanee". K. Saennamvong, Udornthani Sericultural Research Center, Department of Agriculture (DOA), Thailand
- Ubonratchathani 90-35, a bipolyvoltine silkworm hybrid. S.Tengrattanaprasert, Ubonratchathani Sericultural Experiment Station, Department of Agriculture (DOA), Thailand
- Sakhonnakorn Thai hybrid silkworm, the multivoltine × bivoltine silkworm. P. Nopphasenee, Sakhonnakorn Sericultural Experiment Station, Department of Agriculture (DOA), Thailand
- Thai silkworm varieties. S. Boonman, Sisaket Sericultural Research Center, Department of Agriculture (DOA), Thailand
- A test on the efficiency of the cottage basin UB2 reeling machine. S. Tengrattanaprasert, Ubonratchathani Sericultural Experiment Station, Department of Agriculture (DOA), Thailand
- Improvement of the traditional reeling machine "Denchai 1". C. Pannengpet, Phare Sericultural Research Center, Department of Agriculture (DOA), Thailand
- Texture and durability of silk fabrics obtained from "Dokbua" cocoons. K. Tsubouchi, T. Akane, National Institute of Sericultural and Entomological Science (NISES), Japan, A. Chauboonmee, Sisaket Sericultural Research Center, Department of Agriculture (DOA), Thailand, and V. Raksang, Nakonratchasima Sericultural Research Center, Department of Agriculture (DOA), Thailand
- Strength of silk fabric woven from polyvoltine and bivoltine silk yarn. V. Raksang, Nakonratchasima Sericultural Research Center, Department of Agriculture (DOA), Thailand, and K. Tsubouchi, National Institute of Sericultural and Entomological Science (NISES), Japan
- New materials from mulberry. W. Kaeruang and S. Wongchareonwanakit, Udornthani Sericultural Research Center, Department of Agriculture (DOA), Thailand
- Development of sustainable cropping systems in Northeast Thailand. N. Kabaki, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Non-kill reeling. V. Raksang, Nakonratchasima Sericultural Research Center, Department of Agriculture (DOA), Thailand

PROJECT WORKSHOP "DEVELOPMENT OF SUSTAINABLE PRODUCTION AND UTILIZATION OF MAJOR FOOD RESOURCES IN CHINA

Prior to the mid-term review meeting of the collaborative research project in China, JIRCAS held a one-day workshop in order to facilitate a mutual understanding of the significance and future development of the collaborative project in China on February 1, 2001 in Tsukuba, Japan. Thirteen research administrators and scientists from the participating Chinese institutions attended the workshop, along with external reviewers, officials from the Agriculture, Forestry, and Fisheries Research Council, and affiliated Japanese scientists, bringing the total number of workshop participants to 53.

The workshop began with two introductory addresses on the recent development of Chinese agriculture and research. The topics of the workshop included (1) constraints and approaches to Chinese agriculture, (2) sustainable agriculture and environmental conservation, (3) development of rice production and prevention to pest damage, (4) soybean and corn research, (5) processing and utilization of agricultural products, and (6) utilization of freshwater fisheries resources. The group discussed ten presentations from Chinese institutions with the aim of deciding the future direction of the collaborative research project. Interests in the general discussion centered on agricultural investment toward infrastructure and the development of market systems for improving product quality.

Workshop schedule

- Opening address by Dr. Takasuke Ishitani, Director, Research Planning and Coordination Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan
- Inaugural addresses by Dr. Takahiro Inoue, Director General, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, Wang Weiqin, Deputy Division, Director, Department of International Cooperation, Ministry of Agriculture (MOA), People's Republic of China, T. Tsuchiya, Director, International Research Division, Research Council, Ministry of Agriculture, Forestry, and Fisheries (MAFF), and Li Shuyun, Senior Project Officer, International Cooperation Department, CAAS, People's Republic of China
- Outline of the collaborative research project by Dr. Akinori Noguchi, Director, Crop Production and Postharvest Technology Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

Significance and future development of the collaborative research project

Session 1: Constraints and approaches to Chinese agriculture

- Current status of Chinese agriculture and policy direction. L. Zhiren, Senior Research Fellow, Research Center for Rural Economy, Ministry of Agriculture (MOA), People's Republic of China
- Current status of Chinese agricultural resources and supply of major products. T. Huajun, Institute of National Resources and Regional Planning, CAAS, People's Republic of China
- New developmental stages in Chinese agriculture: increasing farmers' incomes. Z. Xigang, Director, Institute of Agricultural Economics, CAAS, People's Republic of China

Session 2: Sustainable agriculture and environmental conservation

- Utilization of chemical fertilizer and development of environmentally sound agricultural technologies. H. Hongxiang, Vice Director, Institute of Soils and Fertilizers, CAAS, People's Republic of China
- Evaluation of effects of agricultural pollution to water quality in Taihu Lake. C. Zucong and Z. Jianguo, Researcher, Institute of Nanjing Soil Sciences, CAS, People's Republic of China

Session 3: Rice production and prevention of pest damage in China:

- Rice production and pest control. Z. Zhitao, Vice Director, China National Rice Research Institute, People's Republic of China

Session 4: Soybean and corn research in China

- Research at the Jilin Academy of Agricultural Sciences (JAAS). F. Wei, President, Jilin Academy of Agricultural Sciences (JAAS), People's Republic of China
- Evaluation and utilization of soybean genetic resources in northeast China. L. Kai, Director, Jilin Research Institute of Soybean, Jilin Academy of Agricultural Sciences (JAAS), People's Republic of China

Session 5: Outline of processing and utilization of agricultural products in China

- Agricultural products in China. L. Lite, Vice President, China Agriculture University, People's Republic of China

Closing session: China-Japan collaborative research on freshwater fishieries resources

- Collaborative research on freshwater fisheries resources. Z. Yingqi, President, Shanghai Fisheries University, People's Republic of China
- Closing address by Dr. Takasuke Ishitani, Director, Research Planning and Coordination Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Japan

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.

June 16, 2000 — Workshop on the Northeast Thailand comprehensive project: Linkage between biological and social science research. *Khon Kaen, Thailand*
Attended by representatives of JIRCAS, Japan; Department of Agriculture (DOA), the Ministry of Agriculture and Cooperatives (MOAC), and the International Training Center for Agricultural Development (ITCAD), Thailand

July 18, 2000 — Workshop on the West Africa project: Weather prediction for risk reduction in cereal-based cropping systems.
Attended by representatives of JIRCAS, Tohoku National Agricultural Experiment Station (TNAES), Hokuriku National Agricultural Experiment Station (HNAES), and the National Agricultural Research Center (NARC), Japan

September 1, 2000 — Project workshop on the establishment of reconstructive agro-forestry techniques for tropical forests.
Attended by representatives of JIRCAS, National Research Institutes of Vegetables, Ornamental Plants and Tea (NIVOT), Forestry and Forest Products Research Institute (FFPRI), Japan

September 8, 2000 — Project workshop on the importance of *Glaberrima* and its potential uses.
Attended by representatives of JIRCAS, National Institute of Genetics, National Agricultural Research Center (NARC), Chiba University, Tokyo Uninersity of Agriculture and Technology, Kyushu University, Japan; West Africa Rice Development Association (WARDA), Côte D`Ivoire

September 27, 2000 — Project workshop on grassland and domestic animals management in Central Asia.
Attended by representatives of JIRCAS, National Grassland Research Institute (NGRI), Kyushu National Agricultural Experiment Station (KNAES), University of Osaka Prefecture, Japan, National Academy Center for Agricultural Research (NACAR), National State University, Kazakhstan

September 28, 2000 — RILET-JIRCAS workshop on soybean research.
Attended by representatives of JIRCAS, Japan International Coorperation Agency (JICA), Japan; Research Institute for Legume and Tuber Crops (RILET), Central Research Institute for Food Crops (CRIF), Indonesia

November 14-17, 2000 — Workshop for the Mekong Delta project: Development and introduction of new technologies regarding sustainable farming systems. *Cantho, Vietnam.*
Attended by representatives of JIRCAS, Japan; Mekong Delta Farming Systems Research and Development Institute (MDFSRDI), Cantho University (CTU), Agricultural Extension Center (AED), Cuu Long Delta Rice Research Institute (CLRRI), Vietnam

November 21, 2000 — Project workshop on polyvoltine sericulture and postharvest technologies. *Nakon, Thailand.*
Attended by representatives of JIRCAS, National Institute of Sericultural and Entomological Science (NISES), Japan; Department of Agriculture (DOA), Thailand

February 1, 2000 — Project workshop on development of sustainable production and utilization of major food resources in China. 2000

Attended by representatives of JIRCAS, Research Council, Ministry of Agriculture, Forestry, and Fisheries (MAFF), Japan; Ministry of Agriculture (MOA), International Cooperation Department, CAAS, Institute of National Resources and Regional Planning, CAAS, People's Republic of China

February 19-20, 2000 — APAN-AG workshop: Knowledge sharing for agricultural research
Attended by representatives of JIRCAS, National Agricultural Research Center (NARC), National Institute for Environmental Studies (NIES), and Agriculture, Forestry, and Fisheries Research Information Center (AFFRIC), Japan, and the NARs institutes of China, Thailand, Malaysia, and Indonesia.

March 5, 2000 — Project workshop on the use of brackish water areas.
Attended by representatives of JIRCAS, Research Council, Ministry of Agriculture, Forestry, and Fisheries (MAFF), Fisheries Agency, Forestry Agency, Japan; Fisheries Research Institute, Forestry Research Institute, Malaysia

4) INTERNATIONAL RESEARCH SEMINARS

International research seminars are held throughout the year, either on JIRCAS premises or overseas. During these seminars, foreign guests, Japanese specialists, and JIRCAS staff give presentations on topics of importance related to international agricultural research. The following thirteen seminars were held in FY 2000.

April 17, 2000 — "Science with a human face" and an update on current ICRISAT projects. *W.D. Dar*

May 11, 2000 — On the future of the CGIAR. *E. Javier*

June 1, 2000 — Update on current SEAFDEC projects. *S. Sugiura*

June 22, 2000 — Research collaboration through the IRRI-Japan Shuttle Project. *T.W. Mew*

July 14, 2000 — The role of IRRI in the 21st Century. *R.P. Cantrell*

July 17, 2000 — Research Activities of CIAT. *J. Voss*

July 28, 2000 — Quality, quantity, and price changes of Chinese industry feed in the 1990's. *R. Kan*

August 28, 2000 — Soybean virus diseases in Brazil. *A.M.R. Almeida*

September 22, 2000 — Sustainable soil fertility and grassland management in Brazil's 'cerrados'. *M.C.M. Macedo*

October 17, 2000 — Soybean research conducted by IITA. *K. Dashiell*

October 23, 2000 — Report on current soybean research conducted in Brazil and Argentina. *C. Vidor and A.R. de Lattanzi*, Current condition of edible soybean varieties in Brazil. *M.C.C. Panizzi*

October 30, 2000 — The role of Indonesia's international collaborative research projects on agriculture. *A.M. Fagi and E. Abdurachman*
Obstacles to raising vegetables in the plateaus on the island of Java: Current activities of RIV. *B. Suprihatno*

December 11, 2000 — International seminar on soybean research preoject collaboration between JIRCAS and EMBRAPA in Brazil.

5) ANNUAL MEETING FOR REVIEW AND PROMOTION OF RESEARCH

JIRCAS conducts its Annual Meeting for the Review and Promotion of Research for International Collaboration in February, toward the end of the fiscal year. The purpose of the meeting is to review and evaluate the year's activities in detail in preparation for the subsequent fiscal year. All operations of JIRCAS are outlined, and research achievements deemed of particular importance are highlighted (see Research Overview: Research Division topics for more detail). Those in attendance include JIRCAS directors and invited representatives from the Agriculture, Forestry, and Fisheries Research Council (AFFRC), the Forestry Agency, the Fisheries Agency, and various research institutes affiliated with the Ministry of Agriculture, Forestry, and Fisheries. In fiscal year 2000, the meeting's primary focus was the new independent structure of the administration to be initiated on April 1, 2001. The structural reorganization will no doubt bring about changes in the way research is planned, coordinated, and executed. Thus, the meeting was meant to be a forum where ideas about the new methods of research could be exchanged.

6) 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.

7) REVIEW AND PROMOTION OF INTERNATIONAL RESEARCH COLLABORATION - COMMITTEE MEETINGS

A series of committee meetings are held throughout the year in order to review and promote international collaborative research. These committee members, who are responsible for all executive decisions pertaining to JIRCAS's activities, are headed by the Director of the Research Planning and Coordination Division and consists of all directors of the Research Divisions and International Research Coordinators. Arrangements concerning dispatches of JIRCAS researchers on overseas assignments, project support by other domestic institutions are evaluated and authorized; the committee members are also responsible for the evaluation of ongoing projects and final decisions concerning the implementation of new research projects.

PUBLISHING AT JIRCAS

OFFICIAL JIRCAS PUBLICATIONS

In English	
1) JIRCAS Journal for Scientific Papers	No. 8
2) JARQ (Japan Agricultural Research Quarterly)	Vol. 34-No. 2, No. 3, No. 4 Vol. 35-No. 1
3)Annual Report	No. 6(1999)
4)JIRCAS Newsletter	No. 23, No. 24, No. 25, No. 26
5) JIRCAS Working Report Series	No. 18 Learning from the Farming Systems Research Experiences in Indonesia No.19 JIRCAS/EMBRABA Gado de Corte International Joint Workshop on Agropastral Systems in South America No. 20 Development of Technology for Utilization and Processing of Freshwater Fisheries Resources

In Japanese	
1) JIRCAS News	No. 21, No. 22, No. 23, No. 24, No. 25
2) JIRCAS International Agriculture Series	No. 9 No. 10

LIBRARY HOLDINGS

April 1,2000 – March 31, 2001

	Books			Periodicals (titles)			Materials (Proceedings, maps and other)		
Language	Purchase	Gift	Total	Purchase	Gift	Total	Purchase	Gift	Total
Japanese	182 (11)	125 (9)	307 (20)	42 (28)	424 (24)	126 (52)	22	461	483
foreign	66 (11)	75 (4)	141 (15)	94 (26)	204 (9)	283 (35)	10	232	242
Total	248 (22)	200 (13)	448 (35)	136 (54)	628 (33)	409 (87)	32	693	725

( ) Indicates separate holdings of the Okinawa Subtropical Station

JIRCAS PUBLICATIONS AND CONTENTS

JIRCAS Journal for Scientific Papers No.8 March 2000

JIRCAS Working Report Series No.18
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Agropastoral systems: Activities developed by the Cerrados Agricultural Reserch Center (EMBRAPA Cerrados)
Lourival Vilela, Miguel A. Ayarza, and Jeanne C.C. de Miranda

Preliminary results of agropastoral systems in the cerrados of Mato Grosso do Sul-Brazil
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Ecoomic evaluation of agropastoral systems: Some alternatives for Central Brazil
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Development of grassland management technology for sustainable agropastoral systems in the sub-tropical zone in Brazil
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Can phosphorus fertilizer application enrich soil in an agropastoral system?
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JIRCAS Working Report Series No.20
Development of Technology for Utilization and Processing of Freshwater Fisheries Resources

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5. Changes of ATP and its related compounds in freshwater fish muscle during ice storage
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6. Properties of lipid and lipid hydrolase in muscle of Chinese freshwater fish
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9. Discussion on development of the freshwater fish processing industry
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11. Study on thermal denaturation of carp (*Cyprinus carpo*) muscle
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14. Characteristics of surimi and kamaboko made from Japanese common carp
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18. Processing technology of frozen surimi from silver carp (*Hypophthalmichthys molitrix*)
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JIRCAS Working Report Series No. 10

Development of farming systems in the Mekong Delta

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4. Planning and implementation
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Ikegami, A. (2001). Situation and outlook of Chinese agricultural trade. International Cooperation of Agriculture and Forestry, 23 (9-10): 2-10.

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Li, L., Jiang, Z., Han, D., Cheng, M. and **Tatsumi, E.** (2001). A study on improving quality of instant fresh bifen. New Cereal Processing Technology, China: 250-255. (C)

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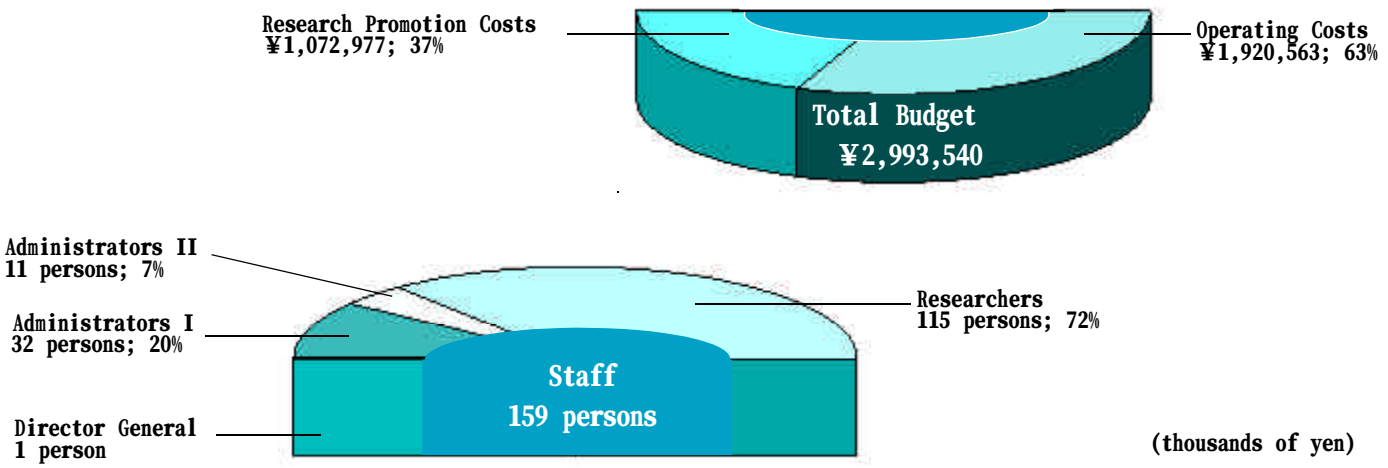
FINANCIAL OVERVIEW Fiscal Year 2000

thousands of yen

TOTAL BUDGET	**2,993,540**
OPERATING COSTS	**1,920,563**
Personnel (159)*	1,414,825
Director General (1)	
Administrators I (32)**	
Administrators II (11)***	
Researchers (115)*	
*Number of persons shown in ( )	
**General administration	
***Field management and transportation	
Administrative Costs	505,738
RESEARCH PROMOTION COSTS	**1,072,977**
Research Development	41,381
Overseas Dispatches	278,762
Research Exchange/Invitation	44,339
Research Information Collection	16,104
International Collaborative Projects	460,763
Comprehensive	(425,633)
Unidisciplinary	(35,130)
Fellowship Programs	231,628

Budget FY 2000 (Graph)



ADVISORS AND PRINCIPAL STAFF

JIRCAS Advisory Committee FY 2000

The JIRCAS Advisory Committee members generally convene one time each year for a round table discussion regarding policy formation, research direction, and project design at JIRCAS. The Committee consists of scientists and administrators representing various fields of international development. We actively seek their advice and opinions throughout the year and greatly value their participation in the affairs of JIRCAS. The Committee was formed at the request of the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Agriculture, Forestry, and Fisheries Research Council (AFFRC).

Advisors

Dr. Hisao Azuma	Vice-President, Japan International Cooperation Agency
Dr. Ronald P. Cantrell	Director General, International Rice Research Institute
Mr. Tadao Chino	President, Asian Development Bank
Dr. Keiji Kainuma	Board Member, Bio-oriented Technology Research Advancement Institute
Mr. Sakue Matsumoto	Chairman, Organization of Food Marketing Structure Improvement
Dr. Keiji Ohga	Professor, University of Tokyo
Dr. Kazuo Shima	President, Japan Fisheries Resource Conservation Association
Dr. Kunio Takase	Board Member, International Development Center of Japan
Dr. Hiroyuki Watanabe	Professor, Kyoto University

JIRCAS STAFF FY 2000

Director General

Takahiro Inoue
(Nobuyoshi Maeno*)

Research Planning and Coordination Division

Takasuke Ishitani, Director

Research Planning Section
Shuichi Asanuma, Section Head
(Masanori Inagaki*, Section Head)
Yukihito Ochiai, Senior Researcher
Tomohide Sugino, Senior Researcher
Marcy N. Wilder, Senior Researcher in Fisheries Division, Joint Appointment

Research Coordination Section
Osamu Koyama, Section Head
(Masahito Sato*, Section Head)
Shoichi Kawasugi, Senior Researcher
Kazuo Ise, Senior Researcher

International Relations Section
Takahito Noda, Section Head
(Sho Kosugi*, Section Head)
Hiromasa Hamada, Senior Researcher

International Research Coordinator
Ryoichi Ikeda, Agronomy

Research Information Officer
Tadahiro Hayashi, Information Engineering

Publication and Documentation Section
Nobuo Ueno, Chief Librarian
Kiriko Hashimoto, Librarian

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(Kenji Murakami*, Director)

General Affairs Section
Norio Kikuchi, Section Chief
Harumi Yakushiji, Assistant Section Chief
Gaku Takeda, Section Manager
(Masayuki Matsumoto*, Section Manager)
Naomi Yamamoto, Section Officer
Yasuhiro Onozaki, Personnel Head
Toshiki Kikuchi, Personnel Officer
Masayuki Matsumoto, Social Affairs Head
(Yoshihiro Saito*, Social Affairs Head)

Accounting Section
Hisashi Kamimura, Section Chief
Hideo Azechi, Assistant Section Chief
Isao Takahashi, Financial Manager
Nobuo Shinotsuka, Financial Officer
Tsutomu Wada, Accounting Manager
Michito Kimura, Accounting Officer
Yoshihiko Sumomozawa, Auditing Head
Koji Ito, Supplies/Equipment Manager
Ryo Okamoto, Supplies/Equipment Officer
Mitsumasa Sato, Transportation
Kuniaki Katsuyama, Facilities Manager

Overseas Staff Support Section
Kazuyoshi Kita, Section Chief
Teruki Kurihara, Overseer Stationed Overseas
Nobuharu Fukui, Overseas Affairs Overseer
Hideko Shimada, Overseas Operations Manager
Hiroshi Tanaka, Overseas Expenditures Manager
Yoshio Tanaka, Overseas Shipments Manager

Research Information Division

Kazuyuki Tsurumi, Director

International Research Coordinators
Shuichi Asanuma*, Soil Microbiology
John S. Caldwell, Horticulture and Farming Systems
Tetsushi Hidaka, Fruit Breeding
Osamu Koyama*, Agricultural Economics
Hiroko Takagi-Watanabe, Plant Breeding
Kensuke Okada, Crop Physiology
Masaharu Yajima, Plant Physiology

Research Staff
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Jun Furuya, Agricultural Economics
Chien Hsiaoping, Agricultural Economics
Akihide Ikegami, Agricultural Economics
Sho Kosugi, Agricultural Economics
Takeshi Sakurai, Agricultural Economics
Yasuharu Yamada, Geographic Information Systems
Shigeki Yokoyama, Agricultural Land Improvement

Associated Researchers
Kiyoko Hitsuda, Soil Fertility and Plant Nutrition
Tetsuo Oya, Agronomy

Biological Resources Division

Masaru Iwanaga, Director

Research Staff
Taizan Adachi, Soybean Breeding
Tomohiro Ban, Wheat Breeding
Yoshihisa Honma, Agricultural Engineering
Kazunori Igita, Soybean Breeding
Masanori Inagaki, Wheat Breeding
Kazuo Ise*, Rice Breeding
Mie Kasuga, Biochemistry
Akio Kikuchi, Soybean Breeding
Yasufumi Kunihiro, Rice Breeding
Masaaki Nakano, Plant Pathology
Kazuo Nakashima, Plant Molecular Biology
Takuji Nakamura, Soil and Plant Nutrition
Mitsunori Oka, Agronomy
Takanori Sato, Rice Breeding
Kazuhiro Suenaga, Wheat Breeding
Hiroshi Tsunematsu, Rice Breeding
Takeshi Urao, Plant Molecular Biology
Kazuko Yamaguchi-Shinozaki, Plant Molecular Biology

Environmental Resources Division

Osamu Ito, Director

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Tamao Hatta, Geology
Yasukazu Hosen, Soil Physics and Chemistry
Takayuki Ishikawa, Plant Physiology
Kenichi Kanda, Soil Fertility
Naruo Matsumoto, Environmental Conservation
Chikara Ogura, Agricultural Land Improvement
Satoshi Tobita, Plant Nutrition and Physiology
Satoshi Uchida, GIS and Remote Sensing
Takeshi Watanabe, Soil Chemistry
Kazuyuki Yagi, Bio-geochemistry
Yukiyo Yamamoto, GIS and Remote Sensing

Crop Production and Postharvest Technology Division

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Naoki Horikawa, Water Management
Nobuyuki Kabaki, Agronomy
Kazuyuki Matsuo, Agronomy
Kazuhiko Nakahara, Food Chemistry
Sayuki Nikkuni, Fermentation
Takahito Noda*, Plant Pathology
Masayoshi Saito, Food Science
Kei Shimizu*, Nematology
Kazushige Sogawa, Insect Ecology
Eizo Tatsumi, Food Science
Tomio Usugi*, Plant Virology
Mitate Yamada, Agronomy
Ryuichi Yamada, Agricultural Economics
Emiko Yamamoto*, Nematology
Tadashi Yoshihashi, Food Evaluation

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

Animal Production and Grassland Division

Toshiaki Taniguchi, Director

Research Staff
Yasuo Ando, Plant Microbiology
Tsutomu Kanno, Pasture Ecology
Kiyomi Kosaka, Animal Nutrition
Yoshio Nakamura, Veterinary Parasitology
Masaharu Odai, Animal Feeding
Sadahiro Ohmomo, Applied Microbiology
Seishi Yamasaki, Pig Feeding

Forestry Division

Terunobu Suzuki, Director

Research Staff
Masahiro Inagaki, Forest Soil Science
Koichi Kamo, Silviculture
Hiromichi Kushima*, Silviculture
Motoe Miyamoto, Social Forestry
Shozo Sasaki, Forest Engineering
Kazunori Takahashi, Silviculture
Ryohei Tanaka, Cellulose Chemistry
Akihiko Yokota, Mycology

Fisheries Division

Masachika Maeda, Director

Research Staff
Junya Higano, Coastal Ecology
Katsuhiro Kiso*, Fisheries Resources
Yukio Maeno, Fish Pathology
Norihisa Oseko, Fish Pathology
Toru Shimoda, Coastal Ecology
Marcy N. Wilder, Crustacean Endocrinology
Masahito Yokoyama, Fish Biochemistry

Okinawa Subtropical Station

Masaaki Suzuki, Director
Kiyoshi Ozawa, Associate Director for Research

General Affairs Section
Kenichi Hatsuse, Section Chief
(Katsuhide Masumoto*, Section Chief)

Satoshi Kawamitsu, Section Manager
(Hideki Yoneyama*, Section Manager)
Toshiaki Shoni, Section Officer
Yuho Maetsu, Transportation
Hiroyuki Nakazato, Accounting Manager
Makoto Nishiyama, Accounting Officer
Hitoshi Sekiguchi, Accounting Officer

International Collaborative Research Section
Chiyoichi Noda, Plant Virology, Head
(Takahito Noda*, Plant Pathology, Head)
Koshun Ishiki, Plant Breeding and Genetic Resources
Ken Nakamura, Soil Science
Mariko Shono, Plant Morphology
Takayoshi Terauchi, Agronomy
Seiji Yanagihara*, Plant Breeding

Crop Introduction and Cultivation Laboratory
Yoshinobu Egawa, Plant Genetic Resources, Head
Katsumi Suzuki, Plant Morphology
Hiroyuki Takeda, Plant Physiology

Crop Breeding Laboratory
Makoto Matsuoka, Plant Breeding, Head
Osamu Ideta, Rice Breeding
Masahiko Tanio, Wheat Breeding

Tropical Fruit Tree Laboratory
Kazunori Ogawa, Plant Chemistry, Head
Hiroshi Fukamachi, Pomology
Sadao Komori, Fruit Tree Breeding

Crop Protection Laboratory
Chiyoichi Noda*, Plant Virology, Head
Katsuyuki Kohno, Entomology
Tadafumi Nakata, Entomology
Kunimasa Kawabe, Plant Virology

Soil Fertility Laboratory
Kenji Banzai, Environmental Conservation, Head
Taizo Masuda, Soil Science

Field Management Section
Yoshimitsu Katsuda, Crop Breeding, Head
Masakazu Hirata, Machine Operator
Hirokazu Ikema, Machine Operator
Masayoshi Kuwada, Machine Operator
Yuho Maetsu, Machine Operator
Junichi Sawase, Machine Operator
Masato Shimajiri, Machine Operator
Koji Yamato, Machine Operator
Akio Yoshida, Machine Operator

Researchers on Loan to Other Institutions

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

International Center 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)
Eitaro Imaizumi*, Animal Nutrition
Akinori Oshibe, Animal Feeding
Tomio Usugi, Plant Virology
Masahito Sato, Rural Development
Shigeki Yokoyama, Agricultural Land Improvement

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,or retirement 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 2000

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) 2000 covers the period from April 1, 2000 through March 31, 2001. Annual Report 2000 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, 2001, through March 31, 2002 (FY 2001).

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

JIRCAS ORGANIZATION AND STAFF AS OF APRIL 1, 2001

Main number: 0298-38-6313. Four-digit numbers are extensions that follow the first six digits

President
Takahiro Inoue (Tel.: 6301)

Vice-President
Yoshinori Morooka (Tel.: 6701)

Executive Advisor & Auditor
Kunihiko Kato (Tel.: 6702)
Shozo Fujimoto (Tel.: 6703)

International Research Overseer
Takasuke Ishitani (Tel.:6391)

Research Planning and Coordination Division
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