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Matang mangrove forest along Sangga Besar River
Inset: Homogeneous stand of *Rhizophora* mangroves
(Photo by K. Tanaka)

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JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Building New Structures for Collaborative Research

Nobuyoshi Maeno
Director General

During the time of the Tropical Agricultural Research Center (TARC), the predecessor of JIRCAS, collaborative research was conducted primarily in individual fields of research with particular research organizations in specific countries. There is no doubt that, based on unidisciplinary collaborative research efforts under such institute-to-institute relationships, we have obtained numerous valuable research results.

However, when TARC was reorganized into the present Japan International Research Center for Agricultural Sciences (JIRCAS) in 1993, the scope of our research objectives and, concomitantly, the number of partner countries and regions in our cooperative research program widened considerably. In order to respond to this newly expanded mandate within the constraints of limited resources, an emphasis on collaborative research and research structures differing from those previously utilized became necessary. As a result, a variety of new initiatives have been undertaken since the start of JIRCAS. One such initiative involves efforts to strengthen comprehensive research programs aimed at systematic multidisciplinary research in complement to the unidisciplinary approach characteristic of the past. At present, comprehensive research projects are underway in Thailand, Vietnam, Malaysia, the People's Republic of China, Brazil, Indonesia, etc.

As the scope of our research has broadened from unidisciplinary to multidisciplinary, the number of research organizations in partner countries with whom we maintain relationships has also quite naturally expanded. Consequently, institution-to-institution relationships of the past have become what might be called government-to-government relationships. As a result, relationships with partner countries have become more formalized and systematized.

These changes have allowed JIRCAS to pursue a broad range of additional international initiatives, some of which are described below.

Multinational Initiatives

In one new initiative, we have developed structures allowing us to implement research in collaboration with multiple countries regarding research problems spanning broad areas. Our collaborative soybean research project with the MERCOSUR countries (Brazil, Paraguay, and Argentina) provides one example. It marks our attempts since the days of TARC to move from cooperative relationships with individual countries toward cooperative multilateral relations within which we can work together with several countries simultaneously. Through these efforts, we have become better able with limited research resources to implement efficient and effective collaborative research for addressing problems common to several countries.

Furthermore, in the South American soybean project, we have created new research systems amenable to the participation of experts outside those organizations formally affiliated with the Ministry of Agriculture, Forestry and Fisheries. These arrangements might be described as the practical application of the power of post-doctoral research, as they allow JIRCAS to complement the abilities of its own staff by adopting, for relatively long periods of time, outside experts to assist with multinational research projects. Many of these researchers have previously accumulated invaluable experience in conducting collaborative research in targeted areas of the developing world.

Additionally, in our comprehensive project on the "Sustainable Production and Utilization of Major Food Resources in China," we have made possible the participation of researchers from Japanese prefectural agricultural research organizations, which often conduct research highly relevant to the developing areas with which JIRCAS is most concerned. Now, in cooperation with JIRCAS, these organizations can take advantage of opportunities to dispatch personnel overseas and develop links with foreign countries.

Through these initiatives, the Center hopes to be able to plan for further expansion in the ranks of researchers interested in international agricultural research collaboration, particularly with developing countries.

New Cooperative Relationships with CGIAR Centers

Since the beginning of Fiscal Year 1997, we have been promoting a project on "New technologies for agricultural research" in cooperation with the International Service for National Agricultural Research (ISNAR). The project will be funded with a special allotment to ISNAR from the Japanese Ministry of Foreign Affairs, but JIRCAS has been selected to cooperate in the implementation of technical matters. This marks for us a new cooperative relationship with one of the international research organizations under the umbrella of the Consultative Group on International Agricultural Research (CGIAR). Up to this point, we have had relationships in which JIRCAS researchers are dispatched to CGIAR research organizations and utilize available research infrastructure to implement particular research projects. Hereafter, however, it will be necessary to expand these types of new cooperative relationships.

With the restructuring of TARC into JIRCAS, our mandate has grown. Because it would prove difficult to respond to this new mandate using only established methods, new structures for research cooperation are becoming increasingly necessary. Therefore, in the future, by commissioning research to organizations in developing countries and by devising a variety of other new structures, we hope to realize more efficient, effective cooperative research.

Government of Japan Special Project at ICRISAT

Hiroshi Nakano

JIRCAS scientists have been involved in the Government of Japan (GOJ) Special Project carried out at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. In the research project, since 1994, the collaborative studies with ICRISAT scientists have dealt with the "Physiological and Genetic Adaptation of Sorghum and Pigeonpea to Low Nutrient Availability in the Semi-arid Tropical Environment". Mandate crops of ICRISAT are pigeonpea, sorghum, pearl millet, etc. which are cultivated in areas where the soil and climatic conditions are very severe in Asia and Africa. Drought stress in rainfed agriculture and low level of soil nutrients are the main constraints for the production of the crops in these areas. Many new varieties and hybrids of sorghum and pigeonpea have been released by ICRISAT and national institutes of tropical countries but these modern varieties require good cultivation conditions to perform well. However, many farmers can not use inputs for the production of such low income crops. Sorghum and pigeonpea are cultivated mainly under rainfed conditions and without fertilizer application. Recently many studies have been conducted to develop technologies for increasing the yield in low fertile land without irrigation and with limited application of fertilizer, that is, technologies for low input and sustainable agriculture. Scientists of the previous GOJ special project teams at ICRISAT also directed their attention to such research and they investigated the mechanisms whereby sorghum, pigeonpea, etc. take up low available soil nitrogen and phosphorus. We intended to expand the soil and plant nutrition studies by introducing genetic aspects.

Sorghum and pigeonpea were investigated through two main approaches; 1) screening of genotypes which are highly adapted to low nitrogen and low phosphorus contents in soil and 2) plant nutrition studies on nitrogen and phosphorus uptake and translocation and assimilation in the crop organs. Varieties of both crops show a wide genetic diversity in terms of plant morphological and physiological characteristics. For example, plant height which widely ranged from 50 cm to 300 cm reflected the high genetic diversity of the sorghum germplasm (Photo 1). ICRISAT preserves many germplasm accessions of both crops. We anticipate that some germplasm useful for the enhancement of adaptability to low available nitrogen and phosphorus will be identified in the large gene bank. Field screening tests of varieties of both crops have been carried out in experimental fields with low nitrogen and phosphorus fertility at the ICRISAT campus (Photo 2). The results indicated that genetic diversity could be detected in the adaptability of sorghum and pigeonpea to low soil phosphorus and in the adaptability of sorghum to low soil nitrogen availability. On the other hand, physiological studies on phosphorus uptake and assimilation in sorghum showed that there were genotypic differences in the "production efficiency of phosphorus" that is expressed by the plant biomass production per unit amount of phosphorus absorbed by roots. On the other hand, nitrogen studies in sorghum showed that the roots of some of the varieties display a high activity in soil nitrogen uptake, especially after the heading stage. We expect that these findings will contribute to further development of the studies carried out within the framework of the GOJ Special Project at ICRISAT.

Photo 1: Local sorghum variety with a long stem

Photo 2: Screening test of sorghum varieties at ICRISAT campus

Research on Mangrove Forests in Matang Forest Reserve, Malaysia

Ochiai Yukihito

About 200 km north of Kuala Lumpur, the capital city of Malaysia, the Matang Mangrove Forest Reserve near Taiping city extends over 40,711 ha. This forest reserve is famous for its sustainable management. With a 30-year rotation, *Rhizophora apiculata* (one of the major species of mangrove there) can be harvested for charcoal and also planted at the same time as harvest.

JIRCAS comprehensive research project entitled: "Productivity and Sustainable Utilization of Brackish Water Mangrove Ecosystems" is being carried out in this area. This project is implemented jointly by the Fisheries and Forestry Divisions of JIRCAS, University of Malaya, Fishery Research Institute of Malaysia and Forest Research Institute Malaysia. The participants in the project carry out investigations on mangroves, crabs, plankton, fish, human activities, etc. to evaluate the concept of sustainable management of mangrove forests.

The term "mangrove" refers to the plant community in an intertidal area. Mangroves capture and intercept any objects and organisms flowing from the upper stream, hence their importance for the production of fishery resources as well as their role in the protection of the environment.

Every organism in a mangrove forest depends on the mangroves and productivity depends on that of the trees. As a part of this project, the Forestry Division of JIRCAS has analysed the litter fall in three different types of mangrove forests. Litter fall refers to anything that falls from mangrove trees. Three types of forests including a) mixture of *Avicennia* spp. and *Sonneratia* spp., b) *Rhizophora* spp. and c) *Bruguiera* spp. are common mangrove forests in this area. The distance separating type a) from the sea is shortest, followed by b) and c). According to the measurement of the water level, the maximum water level of type a) is about 90 cm above the land surface and that of type b) is 70 cm during the spring tide (Fig. 1). Type a) is under water 16 hours a day during the spring tide and 10 hours a day during neap tide, type b) 11 hours and 8 hours, while even during the spring tide, type c) is slightly above the water level most of the time. The difference in the type of vegetation is considered to be resulted from the water level.

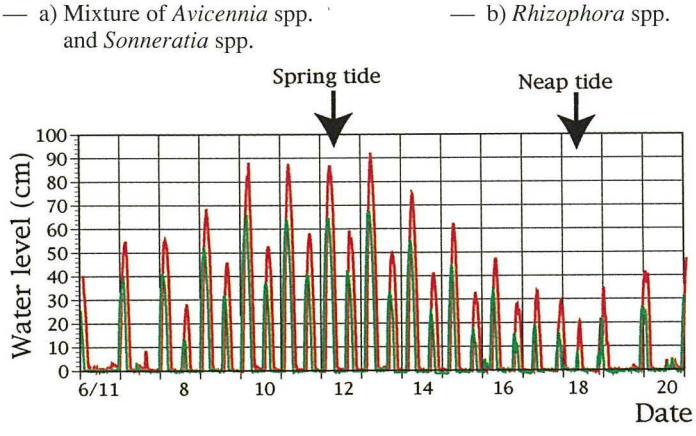

Fig. 1. Water level of forest type a) mixture of *Avicennia* spp. and *Sonneratia* spp. and forest type b) *Rhizophora* spp., measured from November 11 to 20, 1996.

Total weight of litter fall in types b) and c) is very similar (Fig. 2), while that of type a) is half that of b) and c). Despite the difference in total weight, the rate of leaf weight is similar in all the forest types. The leaves account for 56-58% of the total weight, which implies that leaves are the major components of litter fall in all the forest types, followed by branches.

The mangrove tree is unique not only by its shape but also by the movement of the fallen leaves. In lowland and hill forests which occur in Peninsular Malaysia, most of the fallen leaves are decomposed on the forest floor. On the other hand, in a mangrove forest, many fallen leaves are flown to the sea by water during both spring and neap tides in type a). In type b), the fallen leaves are flown by water during the spring tide although most of the leaves remain during the neap tide. Most of the leaves remain during both spring and neap tides in type c). The movement of the leaves determines the fertility of the soil and food chain of the mangrove ecosystem.

Although the flora of mangrove forests is relatively simple compared to that of the other forest types in Malaysia, it prevents the land from sinking in water and protects the sea from pollution with trash. Unfortunately, mangroves are disappearing rapidly due to the development of fish or prawn ponds and other human activities. Matang can be an outstanding example of sustainable forest management.

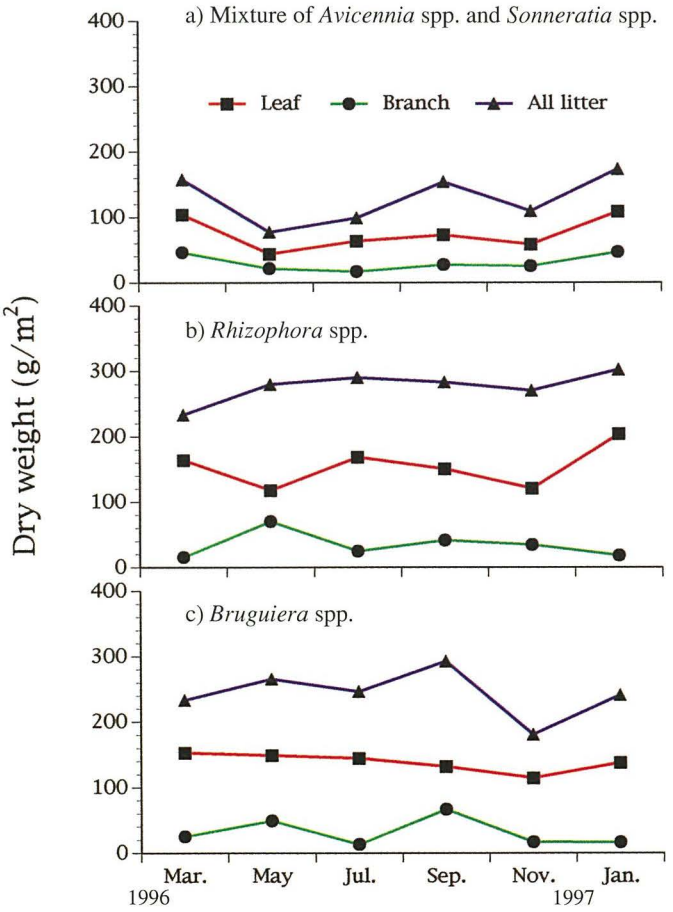

Fig. 2. Litter fall of three different forest types from January 1996 to January 1997.

Development of SURIMI Made from Freshwater Fish Meat in China

Yutaka Fukuda

It is no exaggeration to say that a new source of animal protein appeared in the latter half of the 20th century, namely freshwater fisheries resources produced mainly by aquaculture technology in inland water regions of China. The freshwater fisheries catches have increased rapidly after the economic reform movement, and reached 10,780,000 tons in 1995. This amount corresponds to about 10% of the world total catches and about 43% of the Chinese total catches. Freshwater fisheries play a significant role in the diversification of the food production structure in the world. Therefore, the developing countries which face a lack of animal protein are being encouraged by this success in China.

On the other hand, regardless of the rapid increase of the catches of freshwater fisheries resources, the infrastructure relating to the distribution, storage and processing is not well developed in China. Since most of the freshwater fishes are transported as live fishes without any treatments, their distribution sphere and storage period are very limited. Recently, postharvest loss of freshwater fishes has become significant. If this problem is not addressed, the plan for increasing the production of food resources in China might be jeopardized.

To improve the postharvest problems, JIRCAS launched a collaborative research project entitled "Development of Technology for Utilization of Freshwater Fisheries Resources" with the Shanghai Fishery University in 1996. We are promoting the development of processing technology for frozen "surimi" from freshwater fish meat. Surimi is originally a Japanese term and an intermediate foodstuff with high potential for long frozen shelf-life and for the production of a variety of texturized products such as crab analog. Surimi is generally manufactured by applying a simple technology through the washing of the minced meat by water, dehydration, and mixing with cryoprotectants.

We carried out studies on the gel-forming ability of the surimis made from Silver carp, Bighead carp and Grass carp, which are the main freshwater fish species in China, compared with Alaska pollack surimi, a typical commercial marine fish surimi which accounts for more than 60% of the production in the world.

The three-dimensional configuration of the gel strength which depended on the heating temperature and time was classified into two types (Fig. 1). That is, the surimi of Silver carp and Bighead carp showed the shape of a U character as in the case of Alaska pollack, while that of Grass carp showed the shape of a plateau.

The surimis of Silver carp and Bighead carp form a gel by heating at low temperature (around 30°C) and high temperature (around 85°C), though the gel tends to collapse by heating at an intermediate temperature (around 60°C). The formation of a gel of fish surimi by heating at a low temperature is called "setting". The strength of setting gels of both surimis was further enhanced by subsequent heating at 85°C for 30 min (two-step heating), though being slightly inferior to that of Alaska pollack. Consequently, it was demonstrated that Silver carp and Bighead carp surimis display a high gel-forming ability, though it is necessary to select a narrow range of heating temperatures.

Next, Grass carp surimi displays a wide range of optimum heating temperatures and time zones, though it does not show the setting phenomenon and the enhancing efficiency by two-step heating. Consequently, it was concluded that Grass carp surimi which forms a gel in a wide range of heating temperatures, is more advantageous although the gel-forming ability is lower than that of the former two.

We were able to determine that the main freshwater fish species of China can be utilized as raw materials of surimi.

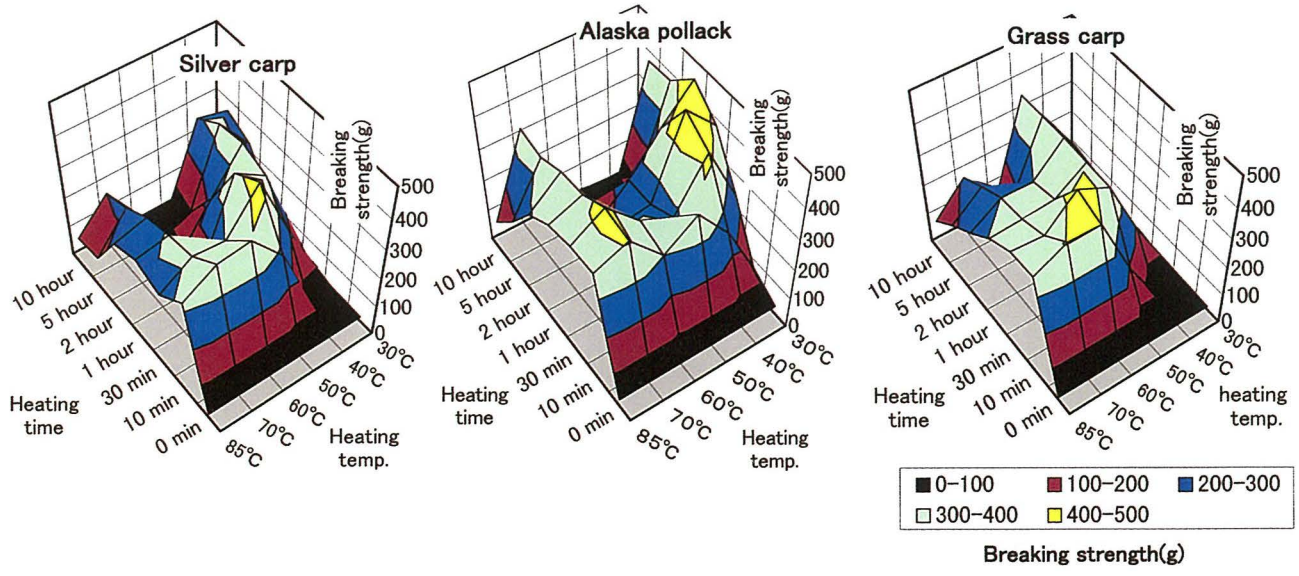

Fig. 1. Gel-forming properties of surimis of freshwater fishes in China and Alaska pollack depending on the heating temperature and time.

Introduction of Small Machinery into Upland Cropping Systems in Northeast Thailand

Improvement of field operations is indispensable for the development of sustainable agriculture since crop production largely depends on human labor. Therefore, it is necessary to reduce heavy work and to develop efficient production systems to increase the income of farmers.

Recently, within the framework of the collaborative research project entitled: "Comprehensive Studies on Sustainable Agricultural Systems in Northeast Thailand", JIRCAS has introduced several agricultural machines consisting of a tractor and attachments, and some small items of equipment to facilitate field operations. The tractor (25ps) was purchased in Thailand and four attachments, i.e., rotary tiller, drill seeder, flail mower and boom sprayer were sent from Japan. Soil manipulator or small hand tractor and shoulder broadcaster for crop tending between rows of crops were also introduced.

For the setting-up of machinery and guidance for operation, an expert in agricultural machinery Mr. Haruo Tamura, Head of Field Management Section, Crop Production and Postharvest Technology Division, JIRCAS was dispatched to Thailand. To complete the technology transfer, a demonstration entitled "Use of small machinery in farming" was held on June 17, 1998 at Khao Suan Kwang Demonstration Farm, International Training Center for Agricultural Development (ITCAD) to illustrate the use of this machinery for field operations. Some 60 people from agricultural administration, extension offices, research institutes and Khon Kaen University participated in the demonstration and exchanged views on farm mechanization. Highlights of the demonstration are as follows.

Land preparation with rotary tiller drew a great deal of attention. Although mechanized disk plough is commonly used for tillage to plant cassava or sugarcane, soil is not fine enough for seed bed preparation for legumes, vegetables or corn. It was shown that the use of a rotary tiller enabled to improve labor by fine harrowing of the field. Drill seeder, attached to the back of a rotary tiller, can perform the following operations: grooving, fertilizer application, seed laying and soil compaction in a single operation. This system is useful to save labor and also to secure good germination of crop seeds through elaborate land preparation and constant depth of seeding. Flail mower is used for cutting weeds or green manure into small fragments. Many questions were raised on the suitability of the machinery for green manure application or mulching since management of organic matter is laborious under tropical conditions. Boom sprayer is used for the application of pesticides or herbicides by tractor drive. Application is uniform and accurate with the use of a boom which extends horizontally over a distance of 5 m.

Soil manipulator for weeding and ridging and shoulder broadcaster for the application of granular pesticides and fertilizer are used for crop tending. Small and light body is suitable for transportation to the field and for the operation without requiring much experience. Price and means of introduction were the main interest of the participants in terms of availability of the machinery.

Although the purpose of machinery introduction in this project was mainly for the convenience and promotion of field research, the demonstration may have attracted the attention of the participants to the possibility of developing agricultural mechanization in Northeast Thailand. However, prior to the introduction of such machines, it is necessary to conduct a detailed economic analysis on the advantages of agricultural mechanization along with studies on soil erodibility in this region and on the design of machines most adapted to the conditions prevailing in Northeast Thailand.

(Nobuyuki Kabaki)

a)

c)

b)

d)

Photos:

a) Seeding of corn with rotary drill seeder

b) Cutting of green manure with flail mower

c) Weeding with soil manipulator

d) Herbicide application with shoulder broadcaster

Opening Ceremony of JIRCAS Beijing Office

日本国际农林水产业研究中心(JIRCAS)驻北京办事处成立仪式

On June 10, 1998, Japan International Research Center for Agricultural Sciences (JIRCAS) held the official opening ceremony of the JIRCAS Beijing Office. Actually, in November 1997, JIRCAS had opened the office in a room of Beijing Friendship Hotel near the Chinese Academy of Agricultural Sciences (CAAS) after consultation with the bureau concerned of the People's Republic of China (P. R. C.).

From Japan, 15 persons including Mr. Sakue Matsumoto, Chairman, Agriculture, Forestry and Fisheries Research Council (AFFRC), Ministry of Agriculture, Forestry, and Fisheries (MAFF), Mr. Toshiaki Namba, Director, International Research Division, AFFRC, Dr. Nobuyoshi Maeno, Director General, JIRCAS, and the members of the Embassy of Japan at Beijing, attended the ceremony.

From P. R. C., 31 persons were on hand to celebrate the occasion. Main guests were Mr. Lu Ming, Vice Minister, Ministry of Agriculture, Mr. Gan Zuofu, Minister-Counselor, the Embassy of P. R. C. at Tokyo (former Deputy Director General, Department of International Cooperation, Ministry of Agriculture), Mr. Du Ying, Director, Department of Policy, Reform & Law, Mr. Wang Youtian, Assistant Counselor, Department of Science and Technology, Ms. Chen Fengrong, Deputy Director, Department of Agricultural Resources Management and Regional Planning, Ms. Ye Zhen Qin, Deputy Director General, Department of Agriculture, Mr. Liu Guangming, Research Center for Rural Economy, Professor Lu Fei Jie, President, CAAS, the staffs of the Institutes of CAAS, the members of Jilin Academy of Agricultural Sciences, the members of institutes affiliated to the Chinese Academy of Sciences, and Mr. Wang Wenzhe, President, China National Food Industry Association. Representatives of the Chinese press such as the Hsinhua News Agency, Renmin Ribao (the People's Daily News) and the Farmers' Daily News were also invited.

The ceremony started with opening remarks by Mr. Matsumoto followed by addresses by Vice Minister Lu, and then by Dr. Maeno. Dr. Maeno emphasized, in his address, that JIRCAS planned to collaborate actively in solving "problems in agricultural fields" which are a major issue in P. R. C. Dr. Maeno mentioned that such an objective could be achieved based on the results obtained during the studies carried out formerly by the Tropical Agriculture Research Center (the predecessor of JIRCAS) or JIRCAS in collaboration with various research institutes of P. R. C., including the development of rice varieties with cold or disease tolerance, and of high-yielding varieties through the utilization of genetic resources at Yunnan Academy of Agricultural Sciences, as well as the first comprehensive research project with P. R.C. (from 1997 to 2003) on the "Development of Sustainable Production and Utilization of Major Food Resources in China" by integrating the existing collaborative research projects.

Photo 1: Dr. N. Maeno, DG of JIRCAS, giving his address at the opening ceremony of the JIRCAS Beijing Office

Returning the compliment, CAAS President Professor Lu delivered a congratulatory address in which he stated that he expects that the new Japan-China comprehensive research project will be successful and contribute to further development of Japan-China collaboration in research in the field of agriculture.

The new comprehensive research project is composed of wide-ranging research fields from social sciences to natural sciences, involving 10 research institutes of P. R. C., 8 research institutes of MAFF including JIRCAS, and several prefectural research institutes. Exchange of information and researchers between P. R. C. and Japan along with the opening of the Beijing office should contribute to further promoting the Japan-China research collaboration.

(Yoshihiko Nawa)

Photo 2: Japanese delegates for the opening ceremony standing in front of the JIRCAS office in the Friendship Hotel, Beijing (From right to left): Dr. Maeno, Mr. Matsumoto, Mr. Sakamoto, Mr. Kawahara, Mr. Namba, Dr. Ikegami

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International Symposium on "Plant Signaling"

The International Symposium on "Plant Signaling: Molecular Responses to Environmental Stimuli and Stress" organized by Japan International Research Center for Agricultural Sciences (JIRCAS), in conjunction with the RIKEN Institute and BRAIN (Basic Research Activities for Innovative Biosciences) was held at JIRCAS, Tsukuba, on August 12, 1998. This symposium was organized to gather scientists who are focusing their research on plant signal transduction and responses to the biotic and abiotic environmental stresses and exchange information and ideas for the future.

In recent years, food supply and environmental deterioration problems on a global scale have become increasingly critical, especially in the developing regions. Biotechnology could be a useful method to increase food production through the development of crops with improved tolerance to biotic and abiotic environmental stresses. To develop stress-tolerant crops, basic research on plant molecular biology is important. Recently, considerable progress has been made in understanding how plants sense and respond to various stimuli in their environment.

Molecular and genetic approaches have led to considerable progress in elucidating how environmental stimuli and stress elicit the production of second messengers, how plant cells perceive the messengers, as well as in the induction of specific responses and the physiological consequences. The most active scientists in the area of research on molecular responses to environmental stimuli and stress were invited to present papers at the symposium. From 10 countries, 191 scientists participated in the symposium. Dr.

Photo: Discussions at the International Symposium on "Plant Signaling"

Nobuyoshi Maeno, Director General of JIRCAS and Dr. Keiji Kainuma, Vice President of BRAIN gave the welcome address. A keynote lecture was delivered by Prof. Nam-Hai Chua, Rockefeller University, USA and 10 foreign scientists from USA, France, Germany, England, Austria and 4 Japanese scientists presented papers during the three sessions as follows: Ethylene signaling and biotic stress response, ABA signaling and water stress response and Short talks. The symposium was successful and valuable information was exchanged throughout the discussions.

(Kazuko Yamaguchi-Shinozaki)

PEOPLE

Takasuke ISHITANI, an agricultural chemist and expert in postharvest technology, became Director of JIRCAS's Research Planning and Coordination Division on September 1, 1998, succeeding Dr. Takahiro INOUE who was appointed Deputy Director General, Tohoku National Agricultural Experiment Station (TNAES). Before joining JIRCAS, Dr. Ishitani was Head of the Department of Research Planning and Coordination at TNAES. He has gained an extensive experience in the field international collaboration in agriculture and fisheries, as a lecturer for various training courses on postharvest technology in China, Peru, India and ASEAN countries and as a guest speaker at international meetings.

Mitsugu SHIMIZU, veterinarian (animal virology), succeeded Dr. Eitaro IMAIZUMI as Director of JIRCAS's Animal Production and Grassland Division on September 1. He carried out research at the National Institute of Animal Health (NIAH) (1968-1995). During his assignment at NIAH, Dr. Shimizu was posted as a visiting scientist at USDA, Plum Island, USA for two years (1973-1975) and was involved in the JICA's animal health projects in Mexico (1981-1982, 1985-1986 and 1992). Before joining JIRCAS, he was Head of the Planning Section, Department of Planning and Coordination, NIAH.

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