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Milking the cow to make yogurt
in Mongolia
(Photo by H. Nakano & T. Miyashige)

CONTENTS

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Information Activities at JIRCAS and Role of Research Information Division

Mr. Keiji Ohga
Director, Research Information Division

Obviously the word information has various connotations. Most of the people including myself who deal with information systems tend to use the word information in relation to computer technology. But here I will define information as the "knowledge acquired or derived for decision-making or taking a specific action." In this sense everybody at JIRCAS is engaged in some kind of information activity. Researchers collect and process data in the course of their research work. Staff members of the Research Planning & Coordination Division and of the Administration Division use and coordinate collected information to formulate research plans and draft administrative regulations, respectively.

What is the role of the Research Information Division? the Research Information Division of JIRCAS fulfills three functions. The first function is to carry out surveys to analyse activities relating to agriculture, forestry and fisheries mainly in countries located in developing regions. The second is to formulate and coordinate international collaborative research projects. The third is to develop and maintain computer-based information systems at JIRCAS.

During the surveys conducted overseas on activities relating to agriculture, forestry and fisheries in developing regions, information on agricultural sciences and related socio-economic conditions in these regions is collected and subsequently analysed. Surveys are conducted by two groups of research coordinators with a wide expertise in related research fields and international cooperation. The first group adopts a region-oriented approach covering five zones; monsoon Asia, arid and semi-arid Asia, Africa, Latin America, developed countries. They place emphasis on countries for which JIRCAS had limited information hitherto, such as Central Asia or Africa. The second group of research coordinators adopts a problem-oriented approach by conducting surveys on three topics; environment, food problems and rural development. Both comprehensive regional surveys and problem-oriented surveys are conducted on an interdisciplinary basis combining natural sciences and socio-economic fields.

Research coordinators also formulate and coordinate collaborative research projects based on the surveys and analyses of regional agriculture or agriculture-related problems. JIRCAS is currently implementing three integrated research projects in Vietnam (Mekong Delta), Malaysia and Northeast Thailand. For the comprehensive or multidisciplinary projects the research coordinators work in close collaboration with the directors of the research divisions and researchers concerned.

The Research Information Division is responsible for developing and maintaining research information systems based on computer networks at JIRCAS. Information scientists combine research on information processing with the operation of the computer system at JIRCAS. As applied information science is now an essential component of agricultural sciences, the

Division is developing comprehensive information systems, including statistical data, documents such as reports on surveys and image data based on PC windows and UNIX workstation since JIRCAS is involved in research related to socio-economic fields in connection with research on agricultural technology development in LDCs.

The Division is also in charge of a specific project dealing with projections of the supply and demand of major food commodities including cereals, animal products and oil seeds, based on econometric analyses in collaboration with organizations concerned in China, Indonesia, Malaysia and Thailand.

The three functions of the Research Information Division are all based on information activities and are closely interrelated. The Division plans to combine in future activities relating to interdisciplinary research with planning and supportive activities.

Intl. Research Coordinators	Areas, Research Fields and "Integrated Research Projects"
(Region-oriented approach)	
Mr. Akira Kobayashi	**Asia I***, Plant breeding, "Development of agriculture in Mekong Delta (1994-1998)"
Dr. Mitsunori Oka	**Asia II****, Cropping systems, "Development of agriculture in Northeast Thailand (1995-2001)"
Dr. Kozo Fujisaki	**Central and South America**, Animal production and health
Dr. Norihiko Kobayashi	**Africa**, Plant pathology
Mr. Shigeyuki Kawahara	**Advanced countries**, International agricultural research organizations, Fisheries biology
(Problem-oriented approach)	
Dr. Masaaki Suzuki	**Conservation of global environmental resources**, Soil science and plant nutrition, "Brackish water mangrove ecosystems (1995-1999)"
Dr. Yoshinobu Kitamura	**Rural planning and development**, Irrigation and drainage engineering
Dr. Mitsuhiro Nakagawa	**Food supply and demand**, Agricultural economics

*: East & Southeast Asia
**: West & South Asia

(Yoshinobu Kitamura)

1994 Annual Meeting for Review and Promotion of Research for International Collaboration

Dr. Nobuyoshi Maeno
Director, Research Planning and Coordination Division

1. Report on the meeting held at the new JIRCAS Headquarters

The 1994 Annual Meeting for the Review and Promotion of Research for International Collaboration was held on February 7, 1995 in the International Conference Room of the new JIRCAS Headquarters constructed in conjunction with the establishment of JIRCAS (the official inauguration of the facilities took place on April 18, 1995).

A total of 51 participants attended the meeting, including representatives from various institutes affiliated to the Ministry of Agriculture, Forestry and Fisheries along with delegates from the Ministry as well as the Director General, Directors of Research Divisions and several staff members of JIRCAS.

At first the collaborative activities pursued by JIRCAS during the fiscal year 1994 were reviewed and discussed, including information, research projects, international symposium, workshops, seminars, various meeting, Visiting Research Fellowship Program at the Okinawa Subtropical Station of JIRCAS, in addition to the orientation of JICA activities, etc.

During the present meeting, emphasis was placed on the Visiting Research Fellowship Program at Tsukuba which will be initiated on October 1, 1995. Under the program, a total of 6 researchers will be invited, of which 4 will undertake long-term projects for a period of 2 years at JIRCAS and 2 researchers will be engaged in short-term projects for a period of 5 months mainly at the National Institute of Agrobiological Resources. In addition, the report on the proceedings of the meeting organized on the previous day for reviewing TARC/JIRCAS collaborative research activities with Thai agricultural research organizations for the past 25 years and discussing the future orientation of research collaboration attracted a great deal of attention (see related article).

Thereafter discussions were held on an important topic, namely the possibility of undertaking research in the field of agriculture forestry and fisheries in areas that hitherto had not been targetted by TARC, including cold areas located in Central Asia, South America as well as Mongolia, in addition to the programs currently implemented in the tropical and subtropical zones. The results of short-term surveys conducted in this newly targetted region were analysed for further orientation of research. It was eventually concluded that although there is a definite potential for the development of agriculture, forestry and fisheries in these areas and there is a strong demand for research collaboration with JIRCAS to enhance this potential, it is still essential to collect more basic information about this region. In future, based on further information, it may be possible to promote collaborative research mainly centered on animal production and grassland management in such areas. Plans are currently being formulated for the implementation in the fiscal year 1996 of two research projects as follows: 1. Comprehensive studies on the development of sustainable agro-pastoral systems in the subtropical zone of Brazil and 2. Development of technology for grassland management and animal production systems. Short-term surveys will be conducted along with preliminary arrangements for the implementation of these projects.

The general discussion was centered on the strategy that should be adopted to promote integrated research as a challenge to the expansion of both research fields and areas targetted for research as well as on the Visiting Research Fellowship Program at Tsukuba.

2. JIRCAS Visiting Research Fellowship Program at Tsukuba

On October 1, 1993, the Tropical Agriculture Research Center (TARC) was reorganized into JIRCAS.

Since its establishment in 1970, TARC has been engaged in collaborative research activities consisting of the dispatching of researchers to various institutes located in the tropics and subtropics to promote the development of agriculture, animal husbandry and forestry in these regions and substantial results were obtained.

However, recently there has been a growing awareness of the importance of conducting collaborative research in making use of the high level of research opportunities available in Japan, including advanced research fields of biotechnology to alleviate various constraints such as environmental problems occurring on a global scale. To achieve this objective, in addition to the dispatching of researchers to conduct collaborative research, the Visiting Research Fellowship Program has been implemented since 1992 to enable 10 outstanding researchers holding a doctorate degree from institutes located in tropical and subtropical countries to carry out collaborative research for a period of one year at the Okinawa Subtropical Station of the Center (Okinawa was selected in view of the similarity of the research priorities and climatic conditions to those in the tropical and subtropical regions).

To respond more adequately to the rapid and recent changes in the situation of agriculture and food supply worldwide, JIRCAS added fisheries to the research fields already covered and included temperate and cold regions into the areas targetted for research to address in a comprehensive manner the problems of food production and conservation of natural and environmental resources confronting the developing regions. Therefore, starting from this year, JIRCAS will implement the Visiting Research Fellowship Program at Tsukuba in taking advantage of the research environment of Tsukuba Science City, namely the strong base for research and development in the field of advanced science and technology, by inviting young promising researchers from counterpart institutes in the developing regions to carry out collaborative research in order to address the problems facing these areas.

The outline of the program is as follows:

Under the Fellowship Program, a total of 6 researchers will be invited to carry out research pertaining to one of the themes listed below. Four researchers will undertake long-term projects for a period of 2 years and 2 researchers will be engaged in short-term projects for a period of 5 months. The former 4 will carry out collaborative research at JIRCAS, while the latter 2 will conduct research at the National Institute of Agrobiological Resources (NIAR) at Tsukuba.

Research Themes

I Long-term Projects

1. Methods for optimum utilization of biological resources
   1) Analysis of plant responses to environmental stresses and gene expression
   2) Development of DNA-based essay for

indexing plant diseases
3) Development of practical methods for the evaluation of the quality of indigenous crops and for the analysis of components and functionality of foods
4) Methods for the development of livestock breeds with high productivity through crossing with indigenous species
5) Development of methods for the diagnosis and prevention of diseases affecting aquatic animals for fresh water and marine aquaculture

2. Analysis and evaluation of the impact of climatic and anthropogenic factors on environmental resources
1) Relation between climatic changes and biomass in agro-ecosystems
2) Investigations of the process of rock-weathering through the analysis of the rock surface by electron spectroscopy

II Short-term Projects
1) Methods for the analysis and preservation of biodiversity
2) Production of new biological resources through the application of biotechnological procedures
3) Methods for the analysis and control of biological functions

Fellowship Qualifications

(1) Applicants should be outstanding researchers who will play a major role in the activities of the counterpart institutes in future. After the completion of the Fellowship, they should continue to carry out research at the same institute.
(2) Hold a Master's degree in a field relating to sciences and technology or equivalent qualifications in related fields. Be preferably less than 35 years of age.
(3) Carry out research related to one of the themes listed under "Research Themes".
(4) Should enjoy good health.
(5) Have an adequate command of English or Japanese language.

Tenure

In principle, the long-term projects will cover a period of 2 years and the short-term projects will cover a period of 5 months.

Fellowship Conditions

(1) A round-trip airline ticket (economy class) will be available.
(2) Living allowance: 260,000.- per month. (including housing allowance)
(3) Housing: International Guesthouse 1-2, Kannondai,Tsukuba
(4) Fixed-rate insurance package (for injury, sickness and damage, etc.) will be covered under the JIRCAS Fellowship Program.

Application Procedure

Applicants are required to submit the following documents to the Director General of JIRCAS.
(1) Application form (Form I)
(2) Two recommendation letters (Form II) from the official representative or appropriate authority of the research organization in the respective research field
(3) Medical certificate (Form III)
(4) Copy of University Diploma

Deadline for Application
June 30, 1995
Notification

The Director General of JIRCAS will examine the application documents and notify the results of the selection to the successful applicants and their recommending authorities about two months after the deadline date for application.

Further information about the Visiting Research Fellowship Program can be obtained from the International Relation Section, Japan International Research Center for Agricultural Sciences, 1-2, Ohwashi, Tsukuba, Ibaraki, 305 Japan.
Tel.: 81-298-38-6335
Fax.: 81-298-38-6337
Telex: 3652456 JIRCAS J

Review of Thai-JIRCAS Collaborative Research for 25 years

Koji Kawashima

The meeting organized for reviewing TARC/JIRCAS collaborative research activities in Thailand during the past 25 years was held in Tsukuba, at JIRCAS Headquarters on February 6th, 1995. Two delegates from the Department of Agriculture (DOA), Thailand joined the discussions. It was the first meeting held at JIRCAS International Conference Room after the opening of the new building in December 1994. The review of Thai-JIRCAS collaborative research was particularly timely because in September 1994, a ceremony marking the 25th anniversary of the collaboration between the agricultural research organizations of Thailand and the research institutes affiliated to the Ministry of Agriculture, Forestry and Fisheries of Japan was held in Bangkok (JIRCAS Newsletter Vol. 2, No. 2).

The meeting chaired by Dr. K. Kawashima started with an opening address given by the Director General of JIRCAS, Dr. K. Kainuma, followed by an overview of the collaborative research activities (Dr. T. Murakami) and review of research in the field of soils and fertilizers (Dr. N. Nakaya) and plant protection (Dr. C. Noda), impact of research cooperation on the development of agricultural technology in Thailand (Dr. C. Wisit), review of research in the fields of postharvest technology (Dr. H. Nakakita), livestock and animal diseases (Dr. H. Hayakawa), future research priorities (Mr. C. Chunram) with final comments from nine resource speakers covering various research fields including forestry and fisheries.

JIRCAS is currently sending abroad approximately 40 researchers on long-term assignments every year and Thailand remains one of the most important counterpart countries.

During the past 25 years, nearly one hundred researchers with long-term assignments stayed in Thailand (26 for research in the fields of plant protection, 23 for soil and fertilizers, 14 for upland field crops, 13 for wetland rice, 12 for research on livestock and animal diseases, 5 for postharvest technology, etc. About 580 researchers with short-term assignments visited Thailand and from Thailand 108 researchers and administrators were invited to Japan.

The counterpart-institutes of JIRCAS in Thailand include DOA, Department of Livestock Development (DLD), Kasetsart University (KU) and Khon Kaen University (KKU). In addition, research is scheduled to be carried out at the Agricultural Development Research Center for Northeast Thailand (ADRC), Asian Institute of Technology (AIT) and Department of Land Development (LDD) in future.

During the meeting, Dr. C. Wisit highly evaluated the past collaborative research and as an example of successful research in the soil science area, he indicated studies on soil productivity which demonstrated that a low phosphorus content in paddy soil was associated with a low rice yield. Although the DOA plans to pay more attention to the preservation of the environment, Dr. Wisit stated that the im-

Thai-JIRCAS collaborative research

provement of crop productivity still remained one of the major objectives. Mr. C. Charus mentioned that the DOA plans to further promote collaborative research in the fields of postharvest technology, integrated pest management and environmental protection in future.

During the past 25 years, a total of two to three hundred Thai researchers were engaged in collaborative investigations with TARC/JIRCAS members on a long-term basis. In addition, it was emphasized that more attention should be paid to postharvest problems. In this regard, the DOA will be reorganized and a new institute for research on postharvest technology will be established. The utilization and development of livestock resources will be one of the future research subjects. In the field of fisheries, research collaboration which was initiated in 1994 at KU will be further promoted.

Also a comprehensive research project for the development of sustainable agricultural systems in Northeast Thailand for a duration of seven years will start in 1995, with the participation of five Thai organizations.

New Buildings for JIRCAS

Taiichiro Maekawa

Director, Administration Division. Born in Hyogo Prefecture in 1957. Graduated from Tokyo University, Faculty of Economics in 1980. Joined Ministry of Agriculture, Forestry and Fisheries in 1980. Director of Agricultural Division of Tokushima City in 1985. First Secretary, Permanent Mission to International Organizations in Geneva in 1991.

On April 18, 1995, a ceremony was held to mark the official inauguration of the new JIRCAS buildings (JIRCAS Main Building, Fisheries Science and Earth Science Laboratories and Biotechnology Unit). These buildings are located within a short walk from the Central Building where most of the research divisions remain. The new buildings with their simple and functional design and walls made of pale moss green ceramic tiles are well integrated within the surrounding landscape.

1. JIRCAS Main Building

This building where the headquarters of JIRCAS are located consists of three parts: Center, East Wing and West Wing.

1) Center: On the first floor there is a large entrance hall (567 m^2), "JIRCAS Hall" with an area for informal meetings and an information corner for the public. The walls are decorated with photographs illustrating various aspects of agriculture, forestry and fisheries worldwide taken by JIRCAS researchers during surveys or long-term assignments. The International Conference Room with a booth for simultaneous interpretation and a sophisticated projector is on the second floor.
2) East Wing: The first floor houses the Research Information Division, including an information processing room containing various types of computers. On the second floor the facilities of the Research Planning and Coordination Division as well as a lecture room are located.
3) West Wing: The facilities of the Administration Division are located on the first floor. The second floor houses the office of the Director General in addition to several other offices and meeting rooms.

2. Fisheries Science and Earth Science Laboratories

These facilities that are housed in a separate building contain advanced equipment for various analyses and experiments. The ESCA (Electron Spectroscopy for Chemical Analysis) apparatus enables to analyse the surface of materials at the molecular level. With the Aquatron, studies on the optimum conditions for aquaculture of freshwater, marine and brackish water fishes can be carried out. The Wind Tunnel enables to analyse the effects of climatic factors on crop cultivation, including changes in the atmospheric air stream, temperature and humidity levels. Among the apparatus, ESCA is of major interest as there are only five instruments of this kind in Japan. These facilities will be used to promote basic research related to fisheries science and earth science for application to various fields of agriculture, forestry and fisheries both in Japan and overseas.

3. Biotechnology Unit

This two-storied unit is equipped with the most advanced facilities to carry out research on gene transformation and regulation of expression in plants to develop transgenic plants tolerant to various adverse environmental conditions, including drought tolerance. There are also three P2-level laboratories and greenhouses where gene engineering studies can be conducted with maximum safety.

It should be emphasized that the facilities described above which will be used by researchers from both JIRCAS and various countries were built to contribute to the development of sustainable production in the field of agriculture, forestry and fisheries worldwide.

JIRCAS Main Building

JIRCAS Biotechnology Building

JIRCAS RESEARCH HIGHLIGHTS

Analysis of land degradation phenomena using remote sensing techniques

— Extraction of geomorphological characteristics and land coverage in eroded areas —

Satoshi Uchida, Shahid Ahmad and Rakhshan Roohi**

Studies on the geomorphological patterns which describe the specific characteristics of gullies caused by severe soil erosion were carried out in the Pothwar plateau area located in the northern part of the Punjab province, Pakistan. Various types of sensors loaded on remote sensing platforms in the upper atmosphere enabled to observe these patterns.

Examination of the spatial characteristics of satellite imagery of SPOT data showed that the variation in brightness of pixels within a distance of about fifty meters was considerably larger in severely eroded areas compared with other areas. The two-dimensional distribution of gully areas assumed a shape corresponding to the dissection of the valleys. Based on these observations, a model was constructed for automatically identifying eroded areas by image processing of remote sensing data. In some cases, it was possible to distinguish eroded areas from others although additional geographic information, such as the topography or location of settlements, may be necessary to improve the performance of the method.

Another attempt was made to analyse the relation between erodibility and ground surface conditions which could be estimated by the calculation of multispectral band data of LANDSAT-TM. It was observed that the erodibility was negatively correlated with the coverage index deduced from band 2 (green) and band 3 (red) data at the time of Rabi cultivation .

Soil erosion shows a dynamic behavior with temporal changes depending on environmental conditions. One of the advantages of remote sensing is that the same area can be observed repeatedly within a certain interval of time. This fact thus suggested that a model describing the dynamic behavior of soil erosion based on the results of this study can be constructed by analysis of multi-temporal data.

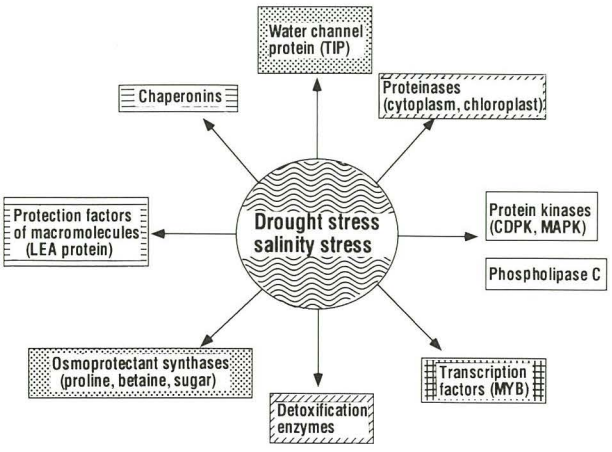
Eroded area appearing as dissected Valleys by SPOT panchromatic imagery.

(* National Agricultural Research Center, Pakistern)

Structure and function of dehydration-inducible genes in higher plants

Kazuko Yamaguchi-Shinozaki and Tomio Terao

The genetic improvement of drought tolerance is an important problem for the future of agriculture in desert and savanna areas of developing countries. Biotechnology has the potential to improve the drought tolerance of crops using transgenic plant technology. The limiting factors for developing this technology are the isolation of genes that function in drought tolerance and the precise understanding of the molecular process of drought tolerance. As higher plants are immobile they must adapt to conditions of severe environmental changes in order to survive. Plants respond to these environmental changes with a number of physiological and developmental changes to tolerate these stresses. Drought, one of these stresses, severely affects plant growth. Plant hormone, abscisic acid (ABA) is produced under water deficit conditions and plays an important role in drought tolerance. A number of genes respond to dehydration as well as exogenous ABA treatment at the transcriptional level. However, there are few reports on the dehydration stress-induced expression of genes prior to the accumulation of endogenous ABA. We used *Arabidopsis thaliana* as a plant material for the analysis of molecular processes of drought tolerance. In order to analyse the early response of plants to dehydration stress at the molecular level, we isolated cDNA clones for drought-inducible genes expressed prior to the accumulation of endogenous ABA. When *Arabidopsis* plants were subjected to dehydration stress, they lost water gradually, reaching a plateau of 90% water loss after 10 hr of dehydration stress. Accumulation of ABA began to increase after dehydration stress for 2hr and reached a maximum level at 10 hr. We constructed a cDNA library from polyA RNA prepared from 1-hr dehydrated *Arabidopsis* plants. We isolated 26 cDNA clones from the cDNA library by applying the differential screening method. The cDNA clones were classified into 16 groups based on Southern blot hybridization, and named ERD (Early Responsive to Dehydration). All the genes, named *erd*, corresponding to ERD cDNAs were induced by 1hr-dehydration. Nucleotide sequences of the DNA inserts of the 16 ERDs have been determined and homologies to these 16 sequences were examined in a protein sequence data base. These analyses of the cDNAs revealed that genes induced by dehydration encode proteins that may play a role in the protection of cells from dehydration as shown in Figure 1. For instance, they encode putative proteinases that may degrade denatured or unnecessary proteins, chaperonins that probably renature proteins, water channel proteins that function in controlling the osmotic potential of stressed cells, LEA proteins that may protect plant cells against dehydration, and so on. These genes could be used as useful sources for the construction of transgenes to transform crop plants in order to produce drought-tolerant transgenic crops in the near future.



Drought- or salinity stress-induced genes and their functions in stress tolerance in higher plants

Micro-climatic improvement associated with the use of windbreaks made of a combination of various tree species

Taichi Maki

It is important to improve the micro-climate in marginal areas of arid lands where desertification is expanding. It was shown that the micro-climatic conditions improved or could be alleviated by the construction of multiple rows of windbreaks made of a combination of various tree species in an agricultural field, and that crop growth and development were promoted and the yield increased under high temperature conditions with dry and strong wind at Turpan, China. The height of the windbreaks made of *Ulmus pumila* L., *Elaeagnus angustifolia* L. and *Populus euphratica* Oliv. was 8.0 m and the tree density was 70%.

The wind speed decreased by 40% on the windward side of the first windbreak, then it increased by 80% gradually near the windward side of the second windbreak. However, the wind speed decreased with the increase of the number of windbreak rows. The negative effect of the decrease of the wind speed on the increase of the air-soil temperatures was considerable during the day. However the humidity which is important in arid lands increased and its effect became more pronounced with the increase of the number of windbreak rows.

The decreasing pattern of the wind speed during the night was similar to that during the day. The air and soil temperatures increased near the windbreaks, but decreased by radiation cooling between the 1st and 2nd windbreaks. The effect of humidity during the night was more pronounced than that during the day in particular when the number of windbreak rows increased.

The height of cotton plants at the early stage of growth and development was large from 1 to 10 H (distance from the windbreak expressed as multiples of windbreak height, H) for the 1st windbreak and for the 2nd windbreak from 5 H on the windward side. At the maturation stage, crop height was large from 3 to 8 H on the leeward side from the 1st windbreak and at around 2 H on the windward side for the 2nd windbreak. The effect of the windbreak on cotton yield was more pronounced than that on crop height.

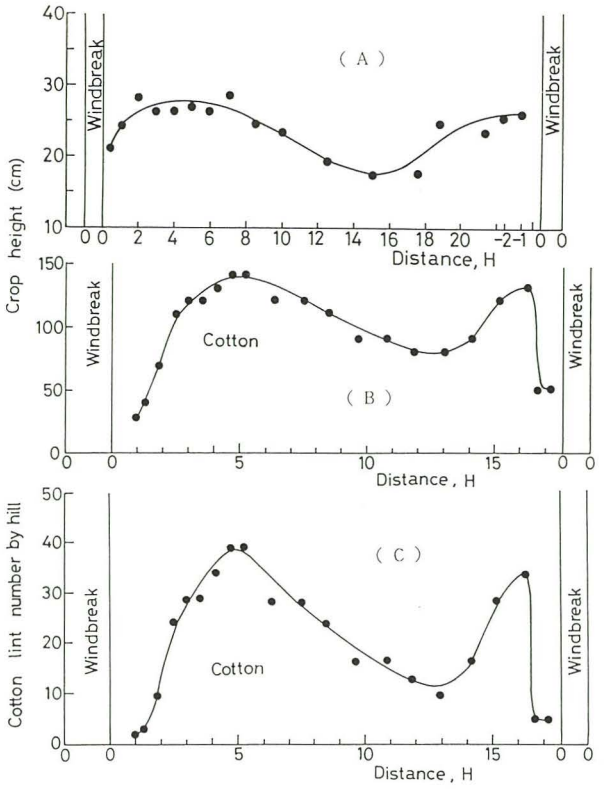


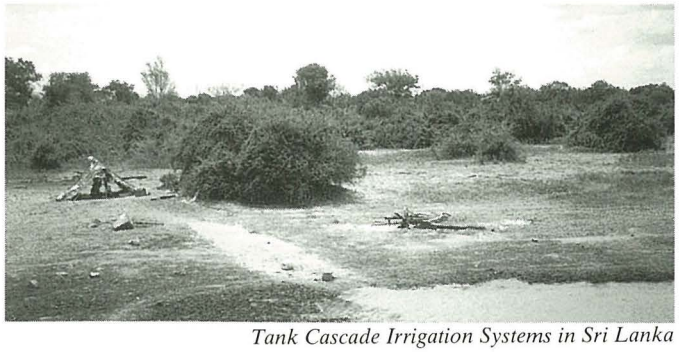
Fig. 1. Variations of crop height of cotton at (A) young stage and (B) mature stage, and (C) cotton lint number per hill at mature stage caused by the windbreaks made of a combination of tree species.

Development of water balance model for Tank Cascade Irrigation Systems in Sri Lanka

Jun Itakura

In the dry zone of Sri Lanka, the construction of interconnected tank (reservoir) irrigation systems used to be a traditional method of irrigation to alleviate water shortage. A series of tanks had been linked in a small watershed to facilitate the reuse of return flow. Such irrigation systems referred to as "Tank Cascade Irrigation Systems (TCIS)" enabled farmers to use small watersheds and were extensively developed in ancient times.

However, the use of TCIS declined during the colonial period. The over-exploitation of tanks and poor management had disturbed the water use within watersheds. At present, the rehabilitation of TCIS is one of the major agricultural policies in Sri Lanka. To achieve this objective, JIRCAS and IIMI initiated a joint research project in 1991, to develop a water balance model of TCIS in order to rehabilitate the TCIS.



Tank Cascade Irrigation Systems in Sri Lanka

One typical TCIS was selected as a study site. Based on a two-year analysis of the water balance, seepage & percolation loss rate of the system was estimated at 4.7 mm/day. It was found that wasteful consumption of water (including seepage & percolation loss, evaporation loss) accounted for over 50% of the total water consumption in the watershed. These figures underline the ineffective aspect of TCIS.

Water balance analyses indicated that the return-flow (inflow from the upstream tank to the last downstream tank) ratio accounted for 20 - 40% of the total outflow consisting of seepage & percolation loss and water discharge from the upstream tank. These findings confirm that the re-use of return-flow is a very important factor for water use in TCIS.

In the basic design of the water balance model, three coefficients (runoff percentage,seepage & percolation loss rate, return flow ratio) essential for the construction of a water balance model were determined. To incorporate these coefficients into the model, fluctuations of tank water storage volume were simulated and compared with actual fluctuations. Although this model was very simple, the similarity of the two fluctuation curves was very close and it was considered that the model may enable to develop techniques for improving long-term water management and rehabilitation of TCIS.

Due to the deleterious effect of overcrowding of tanks such as increase of water use and water pollution, the possibility of streamlining tanks in TCIS was studied with the model. It was considered that the tank in the most upper-stream position could be eliminated and combined with the second upper-stream tank at the expense of water use. For the management of TCIS in future, streamlining of tanks should be examined.

Procedure for simultaneous analysis of productivity and adaptation traits in indigenous cattle in Africa

Kenji Togashi

Indigenous cattle in Africa, through natural selection, have developed characteristics which make them well-adapted to adverse environmental conditions such as diseases, parasite infestations, climatic and nutritional stress. Thus, indigenous breeds are valuable genetic resources which need to be maintained and improved to implement livestock breeding programs. There is a great potential for improving livestock productivity by utilizing genetic adaptation of African indigenous livestock. However, unless the structure of genetic variation in a livestock population in Africa is analysed, future livestock development may be difficult due to the loss of the genetic diversity which evolved over millennia. In low input and highly variable environments such as those prevailing in the tropics, especially in smallholder systems, selection pressure on females for production traits such as milk yield is nearly zero. Thus, how long a cow remains in a herd is closely linked to her overall adaptation. Under such circumstances herd-life can be considered to be a measure of adaptation. At any point in time, the period during which a particular animal remained in the herd can be considered to correspond to herd-life. However, such animals still may stay in the herd beyond the period of measurement. Thus, herd-life is right-censored. If censoring is ignored in the analyses, information may be lost and bias may be introduced. Several methods have been developed for analysing survival data in cattle. However, none of these took into account censoring. A procedure for simultaneous analysis of productivity traits, for example (milk yield) and adaptation traits (herd-life) was developed in which location parameters (sire or animal breeding value) for herd-life (right-censored) and milk yield (uncensored) were estimated. A subset of the data on Kenyan Friesian was used to illustrate this procedure. The estimates for heritability for milk yield, heritability for herd-life, genetic correlation and residual correlation were 0.172, 0.424, -0.452 and 0.210, respectively. Particularly genetic correlation was negative, suggesting that selection for the increase of milk yield may adversely affect adaptation, that is, we may lose the genetic adaptation which evolved over millennia in indigenous cattle in Africa if we keep selecting only for productivity trait, for example the increase in milk yield. The productivity of indigenous cattle in Africa could be improved without a concomitant loss of adaptability by using the simultaneous procedure developed in the cooperative studies between ILRI (International Livestock Research Institute) and JIRCAS.

Cattle market in Addis Ababa

Letters to the Editor from JIRCAS Visiting Scientists

In Vitro Selection and Introduction of Salt Tolerance into Cultivated Rice Varieties from Their Wild Relatives

Salinity affects about 400 million hectares of land in the world. In Bangladesh approximately 1 million hectares of land are affected by salinity problems in the coastal regions, and not suitable for rice cultivation. This saline area is increasing day by day along with the expansion of shrimp culture. Over the past 25 years, with the active cooperation and financial support of the International Rice Research Institute (IRRI), the Bangladesh Rice Research Institute (BRRI) has so far developed more than 20 high-yielding rice varieties adapted to different agro-ecological regions of the country. However, none of the modern varieties developed by BRRI are salt-tolerant. Actually in the past, BRRI had attempted to develop or improve high-yielding rice varieties suitable for favorable environments only. Since the population of the country is increasing rapidly, the demand for an increase in rice production is also growing. It is therefore, essential to develop modern rice varieties adapted to stress environments along with favorable environments. Recently BRRI has undertaken research projects to develop modern rice varieties adapted to stress environments. Salinity is one of the problem areas that is targetted.

JIRCAS visiting scientists in 1994; From left to right, Mohamad Hassan Rashad, Tie Gang Lu, Ancha Srinirasan, Bayani Espiritu, L. Gunarto, Nampiah Sukarno, Abdul Baset, Xu Ningsheng, Nguyen Tien Thinh and Mbangu Musoko

As a recipient of the JIRCAS Visiting Research Fellowship Program 1994, I am carrying out some studies on *in vitro* selection of proline & hydroxyproline-resistant varieties of cultivated rice that could be utilized in the salt-tolerant rice variety development program. I am also trying to incorporate salinity tolerance gene(s) into cultivated rice varieties from their wild relatives using appropriate biotechnological procedures. I hope that the research experience and knowledge that I am acquiring through this fellowship will be useful for the development of salt-tolerant rice varieties in Bangladesh in future.

Dr. Abdul Baset
Senior Scientific Officer
Bangladesh Rice Research Institute
Gazipur-1701, BANGLADESH

Crop Production in Hot and Dry Environments — A Growing Challenge to Agricultural Sustainability

Hot weather and moisture deficits cause substantial reductions in crop productivity. Breeding of stress-tolerant crops is of considerable significance for two reasons. First, there is a growing need to use more marginal land for food production due to increasing pressures of rising human population and degradation of favorable land and natural resources. Secondly, the predictions on climate change indicate that in future carbon dioxide concentrations will increase, periods of hot weather may be more frequent and extreme, and that water limitation may be more severe than now. Progress in breeding cultivars adapted to these climates is, however, slow due to the limited knowledge on genetic diversity for tolerance, and the lack of simple and reliable screening techniques.

Legumes are important sources of protein and fat in many developing countries but their cultivation is being increasingly relegated to marginal lands. Improvement of stress tolerance in legumes can ensure sustainability. I have been carrying out studies on heat tolerance of legumes since October 1993. The results suggest that groundnut and soybean are more tolerant than pigeonpea and chickpea, and that each legume shows a wide genetic diversity. Refinement of screening methods, and analysis of the mechanisms of tolerance during pod set are in progress.

Ancha Srinivasan
JIRCAS Visiting Research Fellow
(1993-1995)
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Knowing More About Bacteria Which Filter out Methane in Rice Paddies

Methane is an important greenhouse gas that significantly contributes to global warming. It has been associated with past climatic changes in the world. Today, the concentration of methane in the atmosphere increases by about 1% every year. A significant proportion of methane global emissions is derived from rice paddies through the methane-producing microorganisms. Much is known already about methane production but less on its regulation.

While there are bacteria which produce methane, there is another group that eats up methane. These are the methane-oxidizing bacteria (MOB) and they are considered to play a major role in regulating the fluxes of methane from important methane sources such as wetlands and rice paddies. The MOB are obligately aerobic bacteria that can utilize methane as the sole source of carbon and energy for growth. They are important biological regulators of methane in nature.

Very limited information is presently available on the levels of populations of MOB and their activities in different environments such as rice paddies. We are now conducting experiments on these aspects which may enable to improve management practices or to identify inputs to control methane emissions.

For this reason, I feel that we are really doing some pioneering studies here at JIRCAS. I am working on MOB with a Japanese co-researcher, Dr. K. Adachi, under the guidance of Dr. T. Senboku, our section head.

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***Azospirillum* Inoculation to Lowland Rice: Enhancement of Plant Growth and Increase of Nitrogen Fertilization Efficiency**

Fertilizers are considered to be very important inputs leading to increased yields : they were responsible for approximately 55% of the increase in yields in developing countries. The expansion of fertilizer use is expected to be rapid during the next two decades, averaging 8.5% a year. Since the foreign exchange cost of fertilizer to importing countries is high, accounting for more than half of the total cost, and as its cost to the producer in relation to total monetized inputs is also high, priority should be given to research aimed at increasing the efficiency with which inputs are used.

Nitrogen is the most common nutrient whose deficiency affects the production of crops. Studies on the increase of N fertilization efficiency have been carried out mostly through the manipulation of the form and application of N fertilizer. The inoculation of *Azospirillum* to lowland rice may enable to increase the efficiency of N fertilization at a lower cost and in turn increase the benefit of the farmers. *Azospirillum* which are associative N2-fixer bacteria are able to produce a growth hormone leading to the improvement of the growth of plant roots and to the enhancement of the ability of the plants to absorb nutrients.

Presently, I am trying to isolate endogenous *Azospirillum* bacteria from Ishigaki island, Japan and screen them to select a promising isolate that may enable to promote the growth of lowland rice. I am also trying to determine to what extent *Azospirillum* can minimize the rate of N fertilizer applied to lowland rice. These studies may contribute to a better understanding of the means to improve the technology for increasing N fertilization efficiency compatible with the preservation of the environment.

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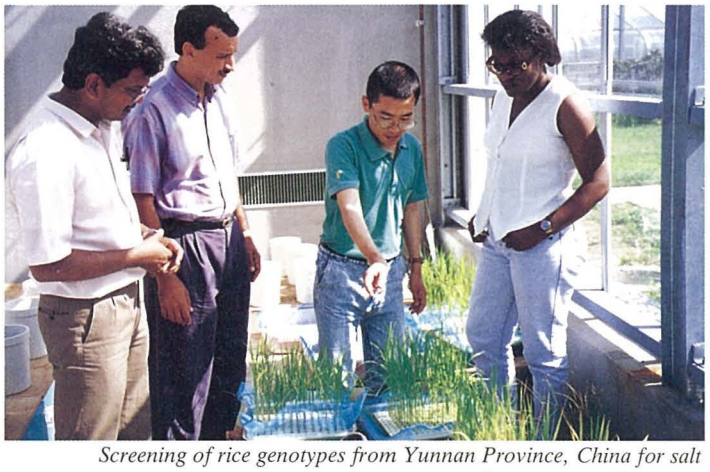
Mycorrhizas: Colonists of Plants and Soil and Their Role in Sustainable Agriculture

World agriculture faces an unprecedented problem: that of achieving long-term sustainability in the supply of food for domestic and international consumption. Sustainability of crop production depends on many factors including the maintenance of optimum soil physical structure and chemical and biological balances in the soils. Conventional agriculture has highlighted the problems of soil degradation arising from the excessive use of pesticides and chemical fertilizers, the removal of organic matter from the topsoil, erosion and compaction. This has led to a call for change from production-oriented agriculture to production and protection-oriented one. Such a call is very appropriate for many African countries where the cost of chemical fertilizers is prohibitive to a large number of small scale farmers, and where population pressure has led to markedly reduced fallow periods to enable adequate soil fertility recovery. There is increasing evidence showing that the integrity and resilience of the soil-plant system in the face of natural and cultural stresses depend on a myriad of microorganisms such as mycorrhizas.

Mycorrhizal fungi penetrate living cells of plant roots without harming them and their hyphae utilize bulk soils, thereby linking plants and soils and act as mineral transport agents. The potential of the



Screening of rice genotypes from Yunnan Province, China for salt tolerance at seedling stage

vesicular-arbuscular type of mycorrhizas to increase plant productivity is well recognized though insufficiently exploited. My studies in Ishigaki are aimed at selecting efficient indigenous strains of mycorrhizal fungi, establishing a germplasm bank and selecting optimum fungi/host plant combinations to enhance crop production.

Dr. Mbangu Musoko
International Institute of Tropical Agriculture
Ibadan, NIGERIA

Physiological Studies on the Mechanism of Heat Tolerance in Cabbage Varieties

Cabbage is considered to be one of the most popular vegetables for human beings. Increase of productivity is essential to meet the demand of the population. In Egypt, cabbage plants are always grown in the winter season.

Investigations on the metabolic responses to temperature of different cabbage varieties have been carried out at different potassium and nitrogen levels, as well as plant hormonal concentrations (GA3,IAA).

The process of acclimatization to high temperature involves the acceleration of the photosynthetic activity, sugar accumulation, increase in growth and cuticle layer accumulation rates and decrease in transpiration and evaporation rates.

I am thus analysing various physiological characteristics of cabbage varieties under high temperature conditions compared with the control temperature to develop positive correlations between heat stress, nutrient levels and plant hormonal concentrations to increase vegetable production.

Mohamed Hassan Rashad
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Use of Vesicular-Arbuscular Mycorrhizas as Biofertilizer to Improve Crop Production

Vesicular-arbuscular mycorrhizas (VAM) induce mutualistic symbiosis between plant and fungus. This symbiosis is found in most (over 90%) of the major plant families including agriculturally important plants such as maize, soybean, onion, upland rice, citrus and cacao. Numerous experiments have shown that a wide range of plant species benefit from infection with VAM fungi, primarily through enhanced phosphorus (P) uptake, especially in P-deficient soils. The fungus benefits from this association by obtaining its carbohydrate requirements.

P deficiency is one of the common nutrient problems which limit plant growth particularly in acidic soils. The role of VAM fungi is important under such conditions because external hyphae in the soil can compensate for poor root growth by taking up nutrients particularly P, after which the fungi in the roots transfer the nutrient to the plant, which in turn enhances plant growth.

The aim of the project is to isolate and evaluate VAM fungi which are efficient in taking up P from the soil and subsequently promoting the growth of the plant primarily in acidic soils on Ishigaki island. The project may contribute to the isolation and screening of acid-tolerant fungi which are efficient for enhancing plant growth, able to function with low inputs of P fertilizer and responsive to a wide range of crops.

The results from the research outlined above will be further applied at Bogor Agricultural University (IPB), Bogor, Indonesia after the completion of the fellowship, to promote basic research on the mechanism of acid tolerance of VAM fungi and their utilization, particularly in acidic tropical soils to enhance crop production in the field. The studies may contribute to the development of sustainable agriculture compatible with the preservation of the environment on a global scale.

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Preservation of Plant Genetic Resources in Vietnam

Although Vietnam is a small country in Southeast Asia, the specific geographical and climatic conditions make it rich in plant genetic resources. This natural receptacle for a long time, however, has been subjected to various types of erosion, of which the Vietnam War and the post-war poverty could be the two major factors. As a result, some valuable species have already become extinct and many others are disappearing. Recently, international programs of assistance in the collection and preservation of plant germplasm have been implemented in Vietnam.

Along these lines, I am fortunate to have the opportunity to carry out studies on the cryopreservation of plant genetic resources of one of the important tuber crop plants in Vietnam, Taro (*Colocasia esculenta* Schott.) under the JIRCAS Fellowship Program.

Such studies which are among the first in this field in Vietnam should contribute to the development of a firm base for further undertakings in the preservation of natural resources through biotechnology.

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Collection, Evaluation and Conservation of Genetic Resources of Vegetatively Propagated Crops

Because of the large size and geological and climatic complexities, China is rich in plant genetic resources. A large number of germplasm accessions have not been collected, evaluated, conserved and used up to now. With the increase in the developmental activities of mankind, plant genetic resources especially those of vegetatively propagated crops, are being rapidly lost because they are mainly conserved in the field and are easily destroyed by human intervention and natural disasters.

Biodiversity has become one of the most important research topics in China since the signature of the World Treaty on Biodiversity in 1992. At the Institute of Botany, Academia Sinica in Beijing, more than 100 researchers are engaged in research on these subjects. Collection, evaluation and conservation of genetic resources are the main aspects of such research. I feel that the protection of plant genetic resources is essential for the survival of mankind.

At the JIRCAS Okinawa Subtropical Station, I am studying various aspects related to the conservation and evaluation of yam germplasm. I hope that I shall be able to apply the various new techniques learned in this program in my future studies on vegetatively propagated plants such as medicinal plants and fruit trees, which play an important role in China's agriculture, medicine and economy.

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Evaluation of Rice Germplasm for Salinity Tolerance

Salinity limits rice yields or prevents rice planting over large land areas around the world. Population pressure and loss of favorable land require research to develop varieties that can more effectively tolerate salinity. To achieve this objective, the evaluation and utilization of rice germplasm accessions are essential.

There are abundant rice germplasm resources in Yunnan province, China, which is considered to be one of the center of diversity of cultivated rice. Since 1982, Yunnan Academy of Agricultural Sciences has cooperated with TARC and subsequently with JIRCAS, to evaluate and utilize rice germplasm and significant progress has been made.

As a researcher from the Yunnan Academy of Agricultural Sciences, I am evaluating the salt tolerance of rice germplasm from Yunnan province. I have studied about 200 Yunnan varieties from the Gene Bank in Japan. I have detected salt-tolerant varieties, among which upland rice varieties. I plan to investigate various physiological characteristics. This information, I believe, may enable us to analyse tolerance mechanisms that could contribute to the development of salt-tolerant varieties.

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Tsukuba Seminar on the Occasion of Japan-IRRI Day

Shoji Miyazaki

The seminar entitled "Recent progress in Rice Research and Challenges toward the 21st Century", sponsored by JIRCAS was held in cooperation with the International Rice Research Institute (IRRI) in the auditorium of the Tsukuba Office of the Secretariat of the Agriculture, Forestry and Fisheries Research Council, Tsukuba City, on November 24, 1994.

The Tsukuba seminar, one of the two important meetings organized on the occasion of Japan-IRRI day, focused on scientific aspects and was followed by the Tokyo meeting for public awareness which was held on the next day in Tokyo. Approximately 400 participants including ten scientists from IRRI were gathered together to review recent progress in rice research and also discuss future prospects at the seminar.

"More than one thousand children die every hour because of hunger and hunger-related diseases" said Dr. Klaus Lampe, Director General of IRRI in his keynote address. "From soil preparation to harvesting, what have been the standard practices over thousand of years will in all likelihood change drastically before the middle of the next century. Our ultimate goal is harmony between the need for doubling food production and our obligation to protect the resources on which this production is based."

Japan-IRRI Day in Tsukuba

After another keynote address entitled "Genetic Restructuring of Rice Plants" presented by Dr. Hiroshi Fujimaki, Director General of the National Institute of Agrobiological Resources, seven papers were presented by rice researchers as follows : G.S. Khush, Challenges in Rice Breeding and Biotechnology; M. Yano, Genome Research and Breeding Strategies in Rice Plants; M. Yamauchi, Direct Seeding Technology; R. Ikeda, Rice Breeding in Japan; P.S. Teng, Sustainability in Rice Growing; K. Ohtsubo, Grain Quality and Utilization in Rice; T.W. Mew, IRRI-Japan Shuttle Program Strengthens Rice Research.

During the seminar, the auditorium was full of participants including numerous young scientists as well as students who are involved in rice research. We hope that many of these young people will join our effort to fill up billions of empty rice bowls with rice, with emphasis placed on the sustainability of agricultural production.

≪New Research Area≫

Research Collaboration with Mongolia

Nakano H. and T. Miyashige

Mongolia is a country of highlands surrounded by Russia and China. Although the land area of Mongolia is four times larger than that of Japan, its population is only about two millions which is equivalent to one fiftieth of Japan population. Recently Japanese mass media have given a wide coverage of the nature, people, culture and society of Mongolia after the opening of Mongolia to foreign countries. These programs reflect the deep interest of the Japanese people in Mongolia. Collaboration with the Japanese Government has also been initiated in many fields. However, it was the first mission of JIRCAS to determine whether a form of collaboration in the field of agriculture could be initiated with Mongolian organizations.

Country of grasslands

Mongolia is a country of grasslands and nomads. A Mongolian proverb says "Mongolians are born on the back of a horse and grown there". Sheep, goats, cattle and yaks,camels in addition to horses are also very important animals for nomadic people who account for about half of the population. Grasslands cover 80% of the land area. From on airplane, in summer, Mongolia appears as a vast green grassland where many wheel tracks connect towns and camping sites of nomads. Ulan Bator was hidden in the grassland. In Mongolia, we were surprised to observe such a variety of traditional foods made of livestock products. Most of the nomads have lived only with these foods without consuming any cereals and vegetables.

After World War II, mechanized farming for upland crops and large-scale livestock production were introduced in the country in order to increase the agricultural productivity and meet the demand of the consumers in newly built cities. Thereafter the production of cereals and vegetables was promoted. Currently people living in the cities consume a large amount of foods of plant origin as well as livestock products. However, along with the introduction of a market economy after the collapse of the socialist system, the productivity of modern agriculture in this country has experienced a decrease. The supply of agricultural chemicals such as fertilizers was discontinued and agricultural machines, irrigation facilities and plant equipment for food processing factories became obsolete.

Mongolian boy on a horse

Mongorian nomad family

For future development in agriculture

Climatic conditions are very harsh in Mongolia. Since from October to April there is a long winter, the nomads must protect their animals from the intense cold. Heavy snow makes it difficult for the animals to graze on withered grass. In the cropping season from May to September, the productivity of cereals such as wheat and barley is low and very unstable due to cold stress and drought stress. Strong wind in spring and fall causes severe soil erosion of the cultivated fields. The soil fertility is gradually declining due to soil erosion and the insufficient application of organic materials. Scarce rainfall contributes to salt accumulation in soil, too.

Moreover, the changes in the eating habits of the Mongolian people mainly in cities are associated with an ever-increasing demand for vegetables, rice, sugar and vegetable oil as well as livestock products. The development of agricultural technology for producing the foods must be promoted to achieve self-sufficiency. In future, preservation of native grasslands will be an important subject for increasing livestock production. Mongolian researchers discussed prospects for the future and emphasized the role of agriculture in the economy of the new country. They hope that research collaboration with JIRCAS will be initiated to address these problems.

Farewell and meeting again

We remember with great pleasure a party held in the camp of nomadic families who invited us. We were served sheep meat cooked in the Mongolian style and kumiss, on alcoholic beverage made of mare's milk. After the party, we were taken to a small hill and drank together again. It is a ceremony whereby Mongolian nomads bid farewell, hoping to see their guests again.

The people in Mongolia, who lead a secluded life in vast grasslands, obviously enjoy meeting their friends. We do hope that it will be possible to initiate a form of collaboration between Mongolian and Japanese scientists.

≪Research Collaboration≫

Collaborative Research Project with CIMMYT on Wheat × Maize Crosses

Masanori Inagaki

The International Maize and Wheat Improvement Center (CIMMYT) was established in 1966 in Mexico, following the implementation of a special research program sponsored by the Mexican Government and the Rockefeller Foundation. CIMMYT, with headquarters at El Batan, 45 km northeast of Mexico City, and with 15 regional offices in the developing countries, implements research and training programs related to the production of maize and wheat. Major activities include the development and worldwide distribution of improved varieties, the conservation of genetic resources, and the production of documentation related to new knowledge about these crops.

New wheat varieties developed by CIMMYT in the 1960s are characterized by a stable stem rust resistance, photoperiod insensitivity and semi-dwarfness. These characters allow adaptation of the wheat varieties far beyond Mexico to other developing countries. The resulting rapid growth in wheat production led to the term of "Green Revolution". In the Post-Green Revolution phase, various agroecological regions or mega-environments of the developing countries have been defined in order to develop effective breeding strategies. The methodology for wide adaptation and high yielding potential involves shuttle of breeding materials between alternate sites in Mexico. Rapid development of the varieties is another aspect to meet the demand for increasing production.

Use of haploids is of great interest to wheat breeders, since the production of haploid plants followed by chromosome doubling enables to obtain genetically homozygous lines. The successful production of doubled haploids provides the most rapid method for developing homozygous breeding lines with favorable uniformity in selection procedures, and complements conventional breeding programs. JIRCAS (formerly TARC) has been promoting technical development of wheat haploid production through wide crosses in collaboration with the International Center for Agricultural Research in the Dry Areas (ICARDA). It is possible to obtain wheat haploids from wide crosses using wheat as female parent and a perennial species, *Hordeum bulbosum* L. as pollen parent. After fertilization, the chromosomes of the pollen parent are eliminated from the hybrid zygote resulting in the production of wheat haploids. This method is limited since the success of haploid production strongly depends on the wheat genotypes used for crosses.

CIMMYT Headquarters at El Batan with Maize and Wheat fields.

Recent reports have indicated that crosses of wheat with maize pollen resulted in the production of wheat haploids across diverse wheat genotypes. In addition to maize, selected species from the Panicoides subfamily, such as pearl millet and sorghum, also provide an alternative pollen source for wheat haploid production. A collaborative research project between CIMMYT and JIRCAS has been carried out since 1993 and has focused on the development of wheat × maize crosses for producing and utilizing wheat haploids for breeding purposes and genetical analyses. The current cooperative studies related to wheat haploids include the development of method for long-term storage of maize pollen, genetic analysis of drought tolerance, and evaluation of various breeding schemes. Technical development for efficient production of wheat haploids should contribute to the promotion of basic research projects as well as conventional breeding programs.

Embryos of wheat seed

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