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Northeast Thailand
(Photo by M. Kokubun)

CONTENTS

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Latest Research Topics in the Crop Production and Postharvest Technology Division
—With Emphasis Placed on Crop Protection—

Dr. Koji Kawashima
Director, Crop Production and Postharvest Technology Division

The Crop Production and Postharvest Technology Division is expected to cover various agricultural research fields such as the production of paddy rice, upland crops and fruit trees, plant protection, weed control, cultivation of cash crops, irrigation and drainage, agricultural engineering, postharvest technology, agricultural economics, etc.

At present there are 17 researchers in the Division including nine in the field of plant protection, two each in the fields of paddy production, irrigation, and postharvest technology, one each in the fields of upland crop production and agricultural economics. Out of 17 researchers, ten were dispatched abroad for collaborative research and seven are carrying out research in Japan.

Some of the collaborative research studies conducted abroad in this Division will be described, with emphasis placed on plant protection.

1. Study on the Biology and Control of Leaf Cutting Ants (collaborative research with Universidade Estadual Paulista, Campus de Botucatu, Brazil)

In the tropical and subtropical areas of the North and South American continent, leaf cutting ants attack almost every crop including pasture crops. Especially in Brazil, along with deforestation, the area of leaf cutting ants has expanded recently, including species that didn't used to be serious. Leaf cutting ants mow a large volume of plants that are stored in the nest underground to produce their food, a special kind of "mushroom." In order to eradicate the ants, poisonous feeds are scattered or strong pesticides are applied into the underground nest. However, since these methods are not as effective as expected and furthermore they bring about environmental pollution, alternative methods of control are being studied.

Photo1: Leaf cutting ant

A JIRCAS researcher has succeeded in raising ants for more than six months for the first time under artificial conditions in the laboratory. Then he selected the leaves which the insects prefer and sprayed them with pesticides so that the insects would take them into their nest. It was interesting to note that after the leaves were heated at 120℃ and that some components were removed, the ants consumed such leaves, suggesting that preference for a kind of leaves depends on the presence or absence of a repellent.

2. Biorational Control of Desert Locust (collaborative research with ICIPE, Kenya)

Even since the prehistorical era until now in North Africa, mainly in Sudan and Ethiopia, large swarms of locusts have occurred with occasional migration to eastern and western areas, resulting in serious damage to agricultural products and pastures in these areas.

To eradicate the desert locust, large amounts of various chemicals have been sprayed by airplane but due to the adverse impact on the environment alternative ways that are environmentally friendly are being sought.

A JIRCAS researcher is studying the effects of insect hormones and pheromones on the behavior of the locusts. These substances disturb the insect physiological behavior-oviposition, aggregation, sexual attraction, resulting in the decrease of locust survival. It was observed that when a hormone (NC-184) was applied

to young (3rd to 4th instars) or adult locusts, the body color became darker and the duration of the 5th instar was prolonged. Induction of abnormal sexual behavior of young locusts by the hormone may enable to control the desert locust.

3. Ecological Studies on Long Distance Migrating Planthoppers (collaborative research with Chinese Rice Research Institute, China)

Planthoppers are among the most serious insects for paddy rice in the monsoon area in East Asia. Since in Japan and in most of China planthoppers can not survive during the winter season, it is considered that outbreaks are due to the migration of a large number of insects from other areas. Ecological studies are essential to develop an accurate method for the forecasting and the control of planthoppers.

A JIRCAS researcher is staying in Hang Zhou, South China. He is investigating the immigration, multiplication and emigration of planthoppers in the paddy area of the southern Yangzi Jiang river and also the relation between the weather conditions and the behavior of the insect for migration. It has been reported recently that the population of the white-backed planthoppers has drastically increased. The reason for the increase is being investigated. Ecological studies on planthoppers during the winter season are also being carried out in the coastal area of South China. Genetic diversity of planthoppers is being traced geographically to clarify the center of origin of this insect.

4. Integrated Research on the Control of Biotic Agents in Rice Production (collaborative research with MADA and MARDI, Malaysia)

Alor Setar area in North Malaysia is the major rice granary in Malaysia. In the 1980s direct seeding of rice rapidly spread to this area due to labor shortage and it was gradually observed that direct seeding was associated with the growth of biotic agents, i.e. weeds especially during the first dry direct seeding season. Two JIRCAS researchers are carrying out studies on rice cultivation and weed control. In order to avoid weed hazard, it is recommended to sow an early variety of rice just before the onset of the rainy season. For this purpose some rice varieties have already been selected.

For some of the main weeds, seed production, survival rate of seeds in soil and chemical tolerance are investigated. Recently it has been observed that weedy rice was a serious weed. Morphological and ecological studies are being conducted to develop methods of control of this weed.

JIRCAS RESEARCH HIGHLIGHTS

Production of Urea Molasses Blocks for Ruminant Animals in Malaysia

Akinori Oshibe, M. Wan Zahari and M. S. Nor Ismail

Despite the abundance of various agricultural by-products, Malaysia is still a net importer of feed ingredients with an estimated value of more than M$ 500 million annually. By using molasses, urea and other ingredients as supplements, these materials can be made into urea molasses block (UMB), a promising and practical feed supplement for ruminants. Recently, a suitable UMB formula using efficient processing technology has been developed at the Malaysian Agricultural Research and Development Institute (MARDI) for semi-commercial UMB production through the collaborative work between MARDI and JIRCAS. This paper reports on the method of UMB processing and its effects on the performance of ruminants.

We designed a UMB processing line that consists of an ingredient conveyance system, weighing system, a cutter mixer, a vertical twin shaft mixer and a single horizontal shaft mixer. A procedure that could be handled by a small number of operators and required a short time was developed. More than fifty formulae were examined based on the mixing efficiency, speed of solidification and palatability for animals. The composition of the formulae associated with a good palatability is shown in Fig. 1. Performance of the lambs was used as a criterion for the evaluation of the UMB. Fifteen lambs (mean live-weight 17.3 kg) were randomly divided into three groups. The first group which acted as a control was fed oil palm frond silage (containing 6% crude protein) *ad libitum*. The second and third groups received a similar type of diet supplementation with either imported UMB or locally made UMB (WZ42D), respectively. Changes in live weight and UMB intake were recorded weekly over the 6-week period of the experiment. At the end of the experiment, the total intake of WZ42D was approximately five times higher than that of imported UMB (Fig. 2), which may be due to the higher palatability. On the other hand, body weight of the control group decreased markedly during the trial (Fig. 3). It was evident that low UMB intake was a limiting factor in the use of imported UMB. Intake and live-weight gain of the animals supplemented with WZ42D were significantly higher ($P<0.05$) than those in the other groups. Within the conditions of the trial, It can be concluded that the performance of the animals which received WZ42D was higher than that of the animals fed imported UMB.

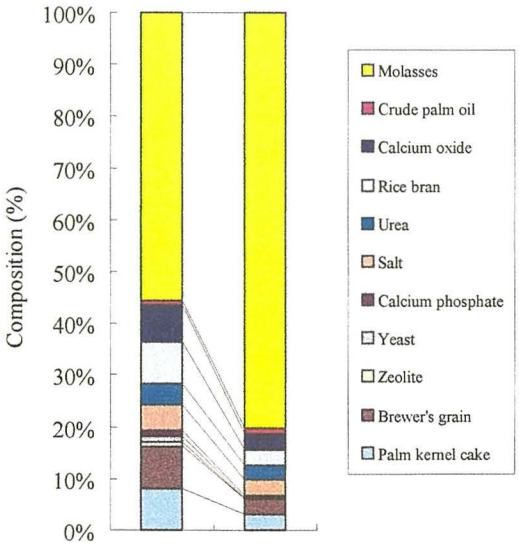


Fig. 1. Ingredients of formulae

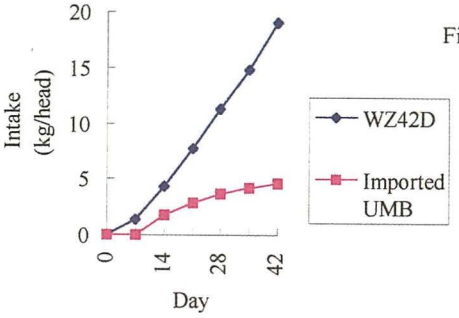


Fig. 2. Intake of UMB

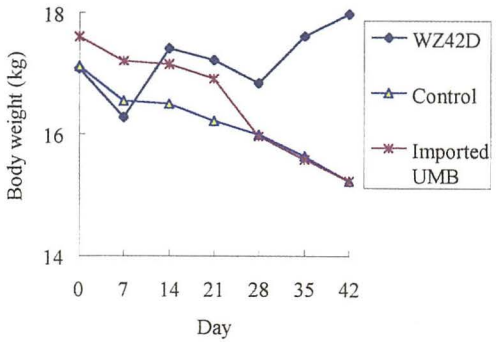
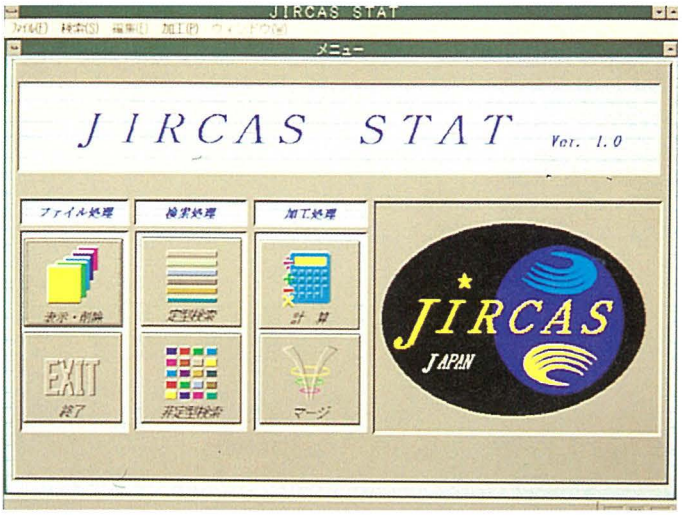


Fig. 3. Change in body weight

Statistical Database System for World Agriculture, Forestry and Fisheries JIRCAS-STAT

Osamu Koyama



In order to facilitate analytical work for the planning of research projects and to conduct research related to world food demand / supply projections, the Division has constructed a statistical database system which enables to handle a large variety of socio-economic time series data in an integrated manner.

With the database system, the user can look up the data needed by simply selecting the regions, items and years. The user can arrange the data in various types of tables. In addition, using the combined software, graphical display of the data and statistical / econometric analyses can also be easily carried out.

Until now, most of the relevant data published by the international organizations had been stored in a database with a common format. The database covers yearly statistics related to agriculture, forestry and fisheries fields. It also includes general indicators such as population, GDP, land use in addition to the data classified by products, e.g. production, trade, food balance sheets, food aid, etc.

The advantage of this system is that it is user-friendly. As it is based on the Windows operating system, the most popular system for personal computers, users do not need to learn any special commands. Due to the original approach of transforming a modern relational database structure into a structure suitable for the statistical time series data, the system affords a great efficiency in terms of both processing speed and data storage space.

The system is being used for the preparatory work of the econometric model analysis of the world food market carried out by the Division. It has been installed in several locations of the Headquarters of the Ministry. Within a year it will also be available through information networks to the remote users in the Ministry. In addition, a database system for documents and pictures is being constructed in the Division.

Table 1. Data Stored in the JIRCAS-STAT

Contents	Number of time series (in thousand)	Storage space (in MB)
Population, Land use and Production (FAO)	200	50
Trade (FAO)	310	99
Food Balance Sheets (FAO)	540	128
Forestry, Fisheries (FAO)	140	36
USDA · OECD · WB	130	113

≪Topics≫

Research Collaboration in Kazakhstan Has Started

JIRCAS initiated a collaboration with the Kazakh Institute of Agriculture (KIA) for a 5-yr (1996-2000) research project entitled: "Development of Sustainable Systems of Grassland Management and Animal Production in Central Asia". On this occasion, Dr. Keiji Kainuma, Director General of JIRCAS visited Kazakhstan at the beginning of July and signed the Memorandum of Understanding between the Kazakh Institute of Agriculture (KIA) and JIRCAS, as the last mission during his tenure at JIRCAS. Under the MOU, Dr. Kenji Sato, a pasture agronomist of JIRCAS, will be engaged in the new collaborative project at the Institute. The research project is the first to be implemented by JIRCAS in Central Asia.

Photo 1: Ceremony marking the signature of MOU; Dr. R. A. Urazaliev (left), DG of KIA and Dr. Keiji Kainuma (right), DG of JIRCAS

International Symposium on the Biosafety Results of Field Tests of Genetically Modified Plants and Microorganisms

Shigeo Matsui

From 29 countries all over the world, 220 scientists and administrators, including 90 from abroad, in the field of biotechnology met together on July 14-17 at Tsukuba Dai-ichi Hotel. It was the "4th International Symposium on the Biosafety Results of the Field Tests of Genetically Modified Plants and Microorganisms" which was held as the 3rd JIRCAS International Symposium at the same time. The participants were molecular biologists, plant breeders, food engineers, medical scientists, bacteriologists, virologists, geneticists, etc. Some of them are in charge of public acceptance or safety assessment in their governments or companies.

Recently, progress in biotechnology, especially in recombinant DNA technologies, has made the use of artificially gene-modified plants or microorganisms common and familiar to us. First gene-modified and commercially produced commodity "Flavr Savr" tomato which was released only two years ago is now followed for example, by cotton and potato plants with *B.t.* genes which produce insect-killing proteins, herbicide-resistant rapeseed, soybean and corn plants, virus coat protein-transferred tobacco and sugar beet plants which are tolerant to virus diseases, low ethylene-emitting carnations with long vase life, etc., as introduced by researchers from Monsanto, AgrEvo, PGS and Florigene, private companies. Moreover, gene-modified bacteria and viruses are being tested for use for bioremediation or to substitute chemicals conventionally applied to protect and stimulate crops. The papers presented at the symposium indicated that we are reaching a historical point in the era of new agriculture, indeed.

The effects of these transformed organisms on the eco-systems or on human health require that exhaustive field tests be performed. To discuss the results from such tests, the Symposium has brought together scientists with a wide range of expertise every other year since 1990, and this year, the conference coincided with the rapid increase of releases of genetically modified organisms (GMOs).

Photo 1: At the moderator round table of the Symposium, Dr. T. Medley, Administrator of APHIS, USDA, USA summarizes the papers and discussions on the international harmonization of safety issues in Panel VI which he chaired together with Dr. K. Hayashi, STAFF, Japan

This Symposium was also significant in that it was held in Asia for the first time and leading scientists from developing countries were invited to introduce the present situation of the biosafety issues in each country. Developing countries really need to develop those new crops to feed rapidly growing populations and to minimize environmental stresses and actually they are very eager to use transgenic crops, as typically reported by Dr. Chen from China.

Photo 2: Prof. Dr. S. Jia, Chinese Academy of Agricultural Sciences, reports on the drafted guidelines for biosafety regulation of GMOs in China in Panel III which is dealing with the biosafety capacity in developing countries

In order to evaluate biosafety, the development of new methods was presented. Allergen proteins from MGOs could be detected using IgE antibody-binding assay and immortalized cells, as reported by Dr. Lehrer from USA and Dr. Shinmoto from Japan, respectively. Dr. Ramos from Spain showed that the containment of recombinant microbes to the site of application was possible by using "suicide genes". Environmentally applied microorganisms can be detected by CCD camera if they are bioluminescent, as reported by Dr. Dane from USA. Regarding the risk assessment, commercial use of genetically modified virus insecticides was discussed by Dr. Wood from USA, and the possibility of natural gene transfer from transgenic plants to wild viruses aggravating the disease in crops was discussed by Dr. Tepfer from France.

Most of the speakers admitted that there is little possibility that the genetically modified plants or microorganisms will be dangerous to us and our environment. However, it is still essential that proper guidelines should be established and relevant field tests should be performed to confirm the biosafety before such organisms are released to the environment.

At the end of the Symposium, Dr. K. Kainuma, Director General of JIRCAS emphasized in his closing remarks that international collaboration is essential to promote the harmonization of biosafety guidelines for the development of transformed crops, in particular in the developing regions. He also indicated that he was much pleased to transfer his duties to Dr. Willy De Greef, who is accepting the responsibility to host the 5th Symposium in 1998 in Belgium.

Participants obviously enjoyed the opportunity to see each other after an interval of two years and to obtain up-to-date information. They also enjoyed the nice foods and beautiful sounds of the *koto* strings during the dinner held on the third evening of the Symposium.

≪Project Report≫

Sustainable Agricultural Systems in Northeast Thailand

Makie Kokubun

1. Constraints on agricultural development in Northeast Thailand

As a result of the rapid economic growth in the past decade, the relative economic importance of agriculture has remarkably decreased in Thailand. In Northeast Thailand, where the economy largely depends on agriculture, income per capita is only one ninth compared to that of Bangkok. Due to the low profitability of agriculture in the region, a large outflow of labor force from the region to urban areas has occurred, which has led to the shortage of workforce in agriculture, particularly young people.

Since the 1960s, a large acreage of forest has been cleared to make room for upland fields in Northeast Thailand, leading to a reduction of the water-holding capacity and to salt accumulation due to the elevation of the groundwater table. In addition, the deforestation of sloping land has made the land highly vulnerable to soil erosion by wind and rainfall. Soil fertility of the reclaimed fields, which was originally low, has further deteriorated after several years of cultivation, because of the inadequate application of fertilizers and organic materials. Moreover, precipitation is erratic and the dry season lasts for more than half a year in the region. These environmental constraints as well as the social problems facing Northeast Thailand have restricted agricultural development in the region.

Photo 1: Signature of comprehensive agreement between JIRCAS and Thai counterparts

Photo 2: Field with low soil fertility due to salt accumulation

2. Comprehensive project based on past JIRCAS (formerly TARC) and JICA achievements

To address these constraints and problems, JIRCAS initiated in 1995 a 7-year research project, "Comprehensive studies on sustainable agricultural systems in Northeast Thailand". This multidisciplinary research project includes soil, crop and livestock sciences as well as economic and social studies. The contents of the project are based on the knowledge and experience gained in previous collaborative research activities undertaken by JIRCAS (formerly TARC) and JICA in Northeast Thailand for the past few decades. Research activities are currently being carried out at the Agricultural Development Research Center in Northeast Thailand (ADRC) and other Thai research institutes affiliated to the Department of Agriculture (DOA), Department of Land Development (LDD), Department of Livestock Development (DLD), Khon Kaen University (KKU) and Asian Institute of Technology (AIT).

Visiting Researchers in Okinawa

Dianou Dayeri, Institut d'Etudes et de Recherches Agricoles (INERA), ***Burkina Faso***

Biological regulation of methane emission in paddy fields

Methane is an important greenhouse gas which contributes to global warming. As an important source of CH_4, rice fields account for approximately 10% of the global anthropogenic methane emission and it is considered that 80% is derived through the methane-generating bacteria (MGB).

CH_4 emission from rice fields is the net effect of CH_4 production and CH_4 oxidation. CH_4 oxidation by methane-oxidizing bacteria (MOB) consumes 1 to 10 % of the total global emission and MOB are considered to be important biological regulators of methane fluxes in nature.

My collaboration with Dr. Adachi aims to characterize the dominant MOB in Ishigaki paddy fields and to establish a model ecosystem *in vitro* to elucidate the mechanism of methane production and oxidation in paddy fields. I do hope that these studies will result in technological development for environmental control of methane emission and sustainable crop production in rice-growing countries.

Dr. Lukman Gunarto, Central Research Institute for Food Crops, Bogor, ***Indonesia***

Azospirillum study in lowland rice

It is well known that soil microorganisms are the driving force behind nutrient transformation in soils and thus contribute significantly to soil fertility. Especially for the availability of nitrogen, the involvement of soil microorganisms is indispensable.

Azospirillum are associative N_2-fixing bacteria. Inoculation of these bacteria to lowland rice may enable to increase the efficiency of N fertilization at a low cost. They also produce growth hormone for plant root growth and promote nutrient absorption by plant. Indigenous strains of *Azospirillum* have been successfully isolated from Ishigaki Island, Japan and two indigenous strains (V.S.2.2. and Vlll.P1.2) and one type culture (AZ 92-2) were selected as promising strains for the promotion of

growth of lowland rice. Present study focuses on the mechanisms of enhancement of the growth of lowland rice by *Azospirillum* .

Harvinder Singh Talwar, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), ***India***

Heat tolerance in grain legumes

Groundnut and chickpea are the two major grains in the semi-arid tropics (SAT) as an important source of dietary protein and fat. The average yield is around 0.8 t ha^{-1} which is far below their yield potential. High temperature is one of the major abiotic constraints on the adaptation of these two crops in tropical and subtropical areas.

High temperature affects primarily membrane-related processes and heat tolerance appears to be determined by the thermal sensitivity of primary photochemical reactions occurring in the thylakoid membrane system. Tolerance limits vary among genotypes but are also subjected to acclimation. These legumes are more sensitive during their reproductive stages than vegetative ones. Therefore, the objectives of the current research work are as follows:

1. To analyse the effects of high temperature on photosynthesis, flowering and pod setting processes.
2. To examine the genotypic variations in heat acclimation potential.
3. To determine the biochemical changes in leaf and floral parts of these crops.

Baiqing Lin, Institute of Vegetables and Flowers, Chinese Academy of Agricultural Sciences, ***People's Republic of China***

Physiological and biochemical mechanisms of heat tolerance in Brassicaceae and Legumes

Cabbage and Chinese cabbage form heads in a temperature range of 15-22 °C. Therefore their production in the tropical region is largely restricted to the cool highland areas. My research under the JIRCAS Visiting Research Fellowship Program 1995 aimed at elucidating the physiological and biochemical mechanisms of heat tolerance in the Brassicaceae.

Our results showed that the period of plant growth most sensitive to the temperature changes in cabbage and Chinese cabbage generally corresponds to 40-56 DAS (Days After Sowing) and 32-45 DAS, respectively in terms of heading failure. We then concentrated our attention on protein regulation during the heading process. At present we are interested in the purification and characterization of low molecular weight heat shock proteins (smHSP) in terms of identification of a 19.2 KD protein, confirmation of the inducible nature of the protein, investigations on cell water potential and component of solutes from various treated plants, etc.

Padmanaban Annamalai, University of Madras, ***India***

Cloning and characterization of heat tolerance genes in *Brassica* (Cabbage)

The productivity of plants is markedly affected by abiotic stresses and the genetic improvement of stress tolerance is an urgent need for sustainable agriculture. The effects of an increased incidence of heat shock, as a result of global warming for example, would be quite considerable, particularly with the occurrence of high temperatures on a number of consecutive days. Investigations into the molecular mechanisms of survival under high temperature stress could provide valuable information both on how plants survive and what genes are involved.

The Brassicas are subjected to a variety of stresses such as cold, heat and others. Stress is often associated with complex physiological changes and is mediated by alterations in the messenger RNAs (mRNAs) and proteins. My study aims to elucidate the regulatory mechanisms through cloning and characterization of heat tolerance genes in *Brassica oleracea* var. *capitata* by constructing cDNA libraries using mRNA and further to identify the heat-regulated transcripts by differential screening. The isolation and characterization of heat-regulated transcripts would lead to the identification of the molecular regulatory elements responsible for gene expression in response to heat tolerance.

Armenia B. Mendoza, University of the Philippines, Diliman, Quezon City, ***Philippines***

Physiological and biochemical mechanisms of genotypic variability in response to salinity in rice

Soil salinity restricts rice production in arid and semi-arid regions of the world. In irrigated agricultural lands without adequate drainage system, soil salinity will also pose a major threat to rice cultivation. Breeding of high-yielding salt-tolerant cultivars that can adapt to a saline environment is more practical than costly adjustments of stressed environments through engineering and chemical treatment. However, information regarding the mechanisms that affect rice growth and adaptation to salinity is scanty.

In my research, physiological and biochemical mechanisms of genotypic variability in response to salt stress in cultures of rice cells and tissues *in vitro* are studied based on the notion that metabolites that maintain homeostasis and growth are important criteria in the selection of salt-tolerant rice varieties. In addition, spontaneous genetic mutations that can be induced in tissue culture are exploited for introgression of salinity tolerance in rice. Changes in the activities of the enzyme system that minimize tissue and seedling damage under saline environment are also investigated.

Lin Hongxuan, China National Rice Research Institute, Hangzhou 310006, ***People's Republic of China***

Mapping of QTLs for salt tolerance of rice (*Oryza sativa* L.) using molecular markers

Accumulation of salt in soil causes deleterious effects and leads to a reduction in rice production. Saline soils cover about 950 million hectares of the earth surface. Improving the salt tolerance in rice is one of the major objectives of rice breeding programs.

Since 1985, rice germplasm for salinity tolerance has been evaluated and utilized from a large number of rice germplasm accessions in China. Signif-

icant progress has been made.

At the JIRCAS Okinawa Subtropical Station, I am identifying QTLs (quantitative trait loci) for salt tolerance in rice by using molecular markers. I hope that we will be able to identify marker loci linked to salt tolerance, evaluate the contribution of those genes to genetic variation, determine gene interaction, and understand the genetics and inheritance of salt tolerance as a basis for investigating the possible mechanisms involved in salt tolerance of rice in this program. I believe, that our research may be useful in improving salt tolerance in rice.

Somsong Chotechuen,
Chai Nat Field Crops Research Center,
Field Crops Research Institute, Department of Agriculture,
Thailand

Physiological and biochemical studies on genotypic variability in rice (*Oryza sativa* L.) in response to salt stress

Salinity is one of the substantial stress factors affecting crop production in many countries. In Thailand, saline soils are widely distributed along the coastal areas and cover approximately 5.9 million hectares in the Northeast region. Basic principles of stress injury and resistance in plants should be elucidated in order to breed salt-tolerant genotypes and to ensure better agricultural development in these areas.

My study at JIRCAS focuses on the responses of rice seedlings to salinization and induced mutation for salt tolerance in rice. The research outcome of this study will be relevant to my responsibility in Thailand for breeding plants resistant to various environmental stresses, such as mungbean and some other crops suitable for rice-based cropping systems, in order to achieve sustainable agricultural production in the country.

Nguyen Tien Thinh,
Nuclear Research Institute,
Viet Nam

Cryopreservation of germplasm of vegetatively propagated tropical monocotyledonous plant species

A large number of plant genetic resources in the tropics consist of vegetatively propagated monocotyledonous species. These genetic resources are non-renewable and are among the most essential among the world's natural resources. For the use of present and future generations, it is necessary to preserve them.

Recently, cryopreservation has become an ideal tool for the long-term preservation of plant germplasm since it is a safe, economical and compact way of storage in comparison with *ex situ* conservation through field genebanks and *in vitro* tissue culture conservation. At JIRCAS Okinawa Subtropical Station, I am studying the development of cryopreservation techniques for the germplasm of several tropical monocotyledonous species. The research has successfully proceeded and several efficient cryoprotocols have been developed for the preservation of shoot meristems of taro, tannia, banana, rice and orchid.

P. M. Kyesmu,
University of Jos,
Faculty of Natural Sciences,
Department of Botany,
Nigeria

Developing protocols for the cryoconservation of the West African tuber crop 'Rizga' (*Plectranthus esculentus* N. E. Br.).

P. esculentus, a minor tuber crop that belongs to the mint family-Lamiaceae, is cultivated vegetatively within the semi-arid regions of Sub-Saharan Africa. Its germplasm is continually being eroded as a result of the decline in its cultivation and preference for exotic tuber crops. Hence the need to develop conservation protocols in order to conserve its genetic base since it provides the raw materials for development either through traditional plant breeding or the use of biotechnological tools. Cryoconservation is one of such protocols which is being developed at the JIRCAS International Collaboration Research Section (ICRS). This technological development which is currently rudimentary in developing countries such as Nigeria should contribute to the conservation and storage of genetic resources of economically and biologically important crop plants leading to the improvement of agricultural activities in these countries.

PEOPLE

Nobuyoshi Maeno became Director General of JIRCAS on August 1, 1996, succeeding Dr. Keiji Kainuma who retired after serving as the first DG of JIRCAS since 1993. Dr. Maeno, a pasture agronomist with extensive experience in collaborative research on tropical pastures, was until recently Director of JIRCAS's Research Planning and Coordination Division. As for the profile of Dr. N. Maeno, please see pg 3 of the JIRCAS Newsletter Vol. 2, No. 2, December 1994.

Keiji Ohga, an agricultural economist and former Director of JIRCAS's Research Information Division, succeeded Dr. Maeno as Director of JIRCAS's Research Planning and Coordination Division. As for the profile of Mr. K. Ohga, please see pg 8 of the JIRCAS Newsletter Vol. 2, No.1, June 1994.

Kunio Tsubota, an agricultural economist, succeeded Mr. Ohga as Director of JIRCAS's Research Information Division. Mr. Tsubota was until recently Deputy Director of Asian and African Division, National Research Institute of Agricultural Economics. He served as an agricultural economist at OECD in Paris (1982-1986) and project economist at the Asian Development Bank in Manila (1990-1993) along with working at the Headquarters of the Ministry of Agriculture, Forestry and Fisheries (MAFF).

Message from Dr. Kainuma, former DG, to the Editor of the Newsletter:

"At the time of leaving JIRCAS, I would like to express my deep gratitude to the members of the organizations with which JIRCAS collaborated, for their continuing support and friendship during my tenure."

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