ISSN 0919-8822
Jan. 2008
No.52

JIRCAS Newsletter

for
INTERNATIONAL COLLABORATION

Have you caught a lot of shrimps? (In the research site for freshwater shrimps in Na Pho Village, Luang Prabang Province, Lao PDR)
(Photo by S. Ito)

In This Issue

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Expected Activities of the Fisheries Division of JIRCAS

People in the world obtain approximately 16% of animal protein requirement from fisheries or aquatic products. The demand for fish and other aquatic resources is expected to further increase hereafter due to the rising preference of Westerners for fisheries products as health foods and the fast growth of the world population.

The production of fish and fisheries products in developed countries has been decreasing since 1980, while their exports in 2003 have increased 1.5 times as compared to 1980. On the other hand, in developing countries both production and exports of these products have increased twofold from 1980 to 2003. This reflects the fact that the total exports of developing countries have reached almost 50% of the total world exports. In the near future, the exports share of developing countries will surely exceed that of developed countries. These show that the exportation of fisheries products, especially in developing countries, strengthened its role in obtaining foreign currency (ref.: "Current status of international fisheries resources" in the website of the Japanese Fisheries Agency).

Accordingly, the role of the Fisheries Division of JIRCAS, which implements studies for development of sustainable fishery technologies in developing countries, will hereafter become more important.

By the way, fisheries as a whole include capture fisheries and culture fisheries or aquaculture. Capture fisheries are similar to the activities of hunting or collection of wild plants on land since these industries collect natural biological resources such as finfish, shellfish and seaweeds from natural waters. In contrast, aquaculture is similar to agriculture on land, since it produces these products under artificially controlled environment. These are the characteristics of fisheries.

World fisheries (capture fisheries and aquaculture) production reached a total of 140.5 million tons in 2004 and is still increasing (Fig. 1). Although, capture fisheries, especially marine capture fisheries production, are leveling off recently. However, they still account for 61% of global fisheries production. Thus, marine capture fisheries resources are still important for us. In contrast, both marine and inland aquaculture productions are increasing year by year and accounting for the increase in the total global fisheries production. Aquaculture production currently accounts for 32% of world fisheries production and is slightly increasing the ratio. In addition, aquaculture has grown most rapidly compared to every other animal food-producing sector with global annual growth rate of 8.8% per year since 1970.

Against this background, appropriate aquatic stock management for sustainable use so as not to deplete fisheries resources by overfishing is required in marine capture fisheries, whose production level is now leveling off. Development of eco-friendly sustainable culture technology which minimizes the environmental load is likewise required in aquaculture, which needs advancement for further increase in its production.

The Fisheries Division of JIRCAS is now implementing the following three projects under the current Second Medium Term Plan (FY 2006-2010), in collaboration with domestic and foreign research institutes, to meet the abovementioned needs or requirements:.

1. Research for suitable stock management in tropical/subtropical areas
2. Development of aquaculture technologies suitable for Southeast Asia
3. Technology to control reproduction in commercially important shrimp and prawn species

Although the explanation of these projects is omitted because of limitation of space, the Research Highlights of Projects 1 and 2 appeared in JIRCAS Newsletter No. 51 and No. 48, respectively, and that of Project 3 will appear in a coming issue of the same Newsletter. Please refer to them for more details and check the JICAS website with link below:
(http://www.jircas.affrc.go.jp/english/research/activites/project/pro01G-01.html)

These projects are in their second year of implementation now and some significant results have been steadily obtained so far. Please expect the forthcoming final outputs soon.

Shoji Kitamura
Director, Fisheries Division, JIRCAS

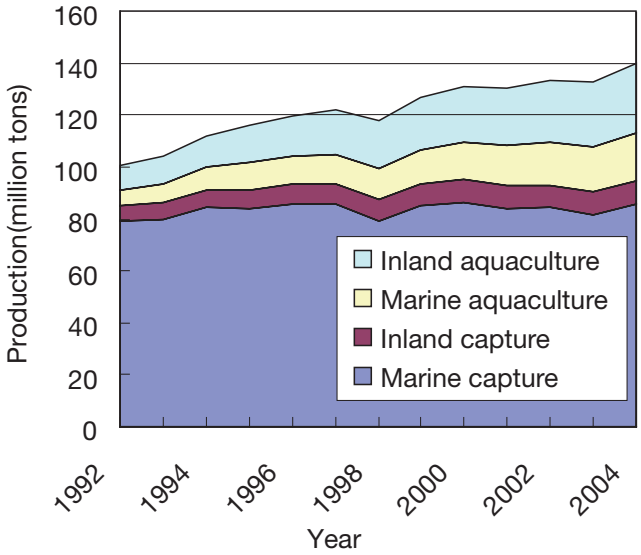

Fig. 1. World fisheries production

Development of Drought-Tolerant Rice Varieties for Africa

In Sub-Saharan Africa, the demand for rice has been growing due to the rapid population growth as well as the increasing rate of urbanization in the region. Rice in Sub-Saharan Africa is largely growing under rainfed condition, relying only on natural precipitation. Upland rice, accounting for 40% of total production area in these regions, has been hampered by a number of constraints including biotic and abiotic stresses. Among the abiotic stresses, drought is very destructive and it causes great losses of yield. Therefore, developing drought tolerance has been regarded as one of the urgent breeding targets in rice breeding for Africa.

The Africa Rice Center (WARDA) has developed 18 upland NERICA (New Rice for Africa) varieties through interspecific hybridizations between *Oryza sativa* and *O. glaberrima.* Although these 18 upland NERICA varieties are carrying the trait of adaptability to the upland rice ecosystem in general, higher level of drought tolerance would be required in rice for Africa, if we recall the harsh nature of the ecosystem in the Sub-Saharan region. In the JIRCAS project, "Stress-Tolerant Rice for Africa", several different approaches have been taken to tackle the problems. Among them, the screening and selection of a wide range of existing rice germplasm for drought tolerance, which have been conducted in collaboration with WARDA, will be introduced in this article.

For evaluation of drought tolerance at the seedling stage, diverse genetic resources which can be regarded to essentially cover the different genetic variations of rice were cultivated in experimental fields at multiple locations (Bouaké, Côte d'Ivoire and Ibadan, Nigeria). The irrigation was interrupted 14 days after seeding and water stress was applied. Responses of shoots under drought stress were monitored and drought-tolerant varieties were selected (Photo 1). As outputs, several accessions were selected as promising varieties. While the shoots of susceptible varieties had completely welted, the selected promising varieties maintained healthy shoots even after the application of drought stress. Now, genetic mapping of the drought tolerance of these candidates is undergoing to identify the DNA markers linked to drought tolerance at the seedling stage.

It is well accepted that drought tolerance is very complex and many traits are involved in the expression of this trait of tolerance. Thus, the evaluation and selection of drought tolerance is not easy. Among the many traits believed to be correlated with drought tolerance, root depth can be specifically pointed out (Yoshida and Hasegawa, 1982) because deep roots have higher probability to be able to access water in deep soil layers.

A wide range of rice germplasm was subjected to screening for root depth at the reproductive stage under field conditions. These germplasm were the same as those used for the screening of drought tolerance at seedling stage. At 14 days after heading, root lengths were monitored by core sampling method. Based on all the outputs from multiple locations (Bamako, Mali, and Ibadan, Nigeria) and multi-year trials within 3 years, the rice varieties, Malagkit Pirurutong (Photo 2) from the Philippines and Khao Dam from Laos, stably exhibited characteristics of deep rooting throughout the trials. Now, the root development of these candidate varieties under soils with different water contents and reactions to drought stress is being further investigated.

The tangible outputs of this particular project are credited to the identification of drought-tolerant germplasm and the acquisition of DNA markers linked to the tolerance. These research outputs/assets are anticipated to be applied efficiently towards practical breeding programs aimed at the development of drought-tolerant rice for Africa.

Hiroshi Tsunematsu
Biological Resources Division, JIRCAS
(Stationed at Nigeria Station of WARDA)

Photo 1. Drought-tolerant variety (Right) and susceptible variety (Left)

Photo 2. Candidate variety: Deep Root System rice, Malagkit Pirurutong

Toward an Efficient Beef Cattle Production by Improved Pasture of Elite *Brachiaria* Varieties in the Tropics

The genus *Brachiaria*, tropical gramineous grass, is not familiar in Japan, but some species belonging to this genus are cultivated in large areas in the tropics. It is important particularly in Central and South America, and there is an estimation that the pastures with *Brachiaria* sum up to 70 million hectares and that is in Brazil alone. This area is equivalent to approximately 40 times as large as the total area of cultivated paddy fields in Japan in 2007. In Australia and Southeast Asia, although in a smaller scale, approximately 300,000 hectares are used as *Brachiaria* pasture. Recently, some species of *Brachiaria* were introduced into Okinawa, and promising results have been obtained.

The *Brachiaria* genus consists of about 100 species, most of which are originated from Africa, and shows a wide range of environmental adaptability. The species being utilized in agriculture are limited to several species such as *B. brizantha, B. decumbens, B. humidicola*, and *B. ruziziensis*, all of which are originated from Africa. However, these are deemed to have no practical uses as pasture in Africa. Although its full-scale introduction and collection as genetic resource to South America began in the 1950's, the importance of this grass was recognized only after the introduction of *B. decumbens* cv. *Basilisk* from Australia in the 1970's. Breeding of *Brachiaria* varieties is actively performed at the Centro Internacional de Agricultura Tropical (CIAT) and the Centro Nacional de Pesquisa de Gado de Corte, Empresa Brasileira de Pesquisa Agropecuária (Embrapa GC). In fact, CIAT has released elite varieties such as "Mulato" from interspecific crossings.

Generally, as compared with temperate grasses, the digestibility of tropical grasses including *Brachiaria* is inferior, and trials to improve the digestibility have been performed in conventional breeding programs. In this project, in a research collaboration with Miyazaki University, we aim to introduce one of the genes responsible for the lignin biosynthesis pathway into existing varieties through transformation method in order to improve their digestibility by increasing their digestible lignin content. It was reported that the digestibility level was improved by such transformation method in the tall fescue (*Festuca arundinacea* Schreb.), gramineous grass (Poaceae) and in the birdsfoot trefoil ((*Lotus corniculatus* var. *corniculatus*) of Leguminosae.

For successful transformation, it is a prerequisite that plants can be efficiently regenerated from cultured tissue. In our project, we have developed an effective regeneration system in diploid *B. ruziziensis* and are currently investigating various conditions for the transformation process *Brachiaria* varieties are generally tetraploid and apomictic (can reproduce asexually or can naturally produce seeds without fertilization), while the diploid *B. ruziziensis* is sexual. Therefore, we need technologies for chromosome doubling and effective identification of apomixis in order to cross the transformants with elite varieties for selecting apomictic new varieties. So far, we have developed a chromosome doubling method using an *in vitro* system. In our collaboration with the Okinawa Prefectural Livestock and Grassland Research Center and Embrapa GC, we have selected molecular markers which are considered effective to be able to identify apomictic lines in *B. humidicola*.

We aim at the improvement of the digestibility level through transformation method. We will also try to enhance environmental adaptability through the introduction of genes which control adverse environmental tolerance, such as the *DREB* genes, into the species.

Kazuhiro Suenaga
Animal Production and Grassland Division, JIRCAS

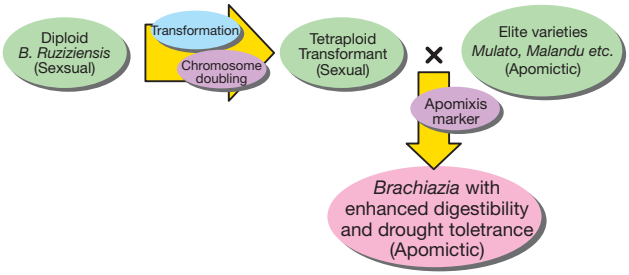

Fig. 1. Flowchart of project implementation

Fig. 2. Field of *Brachiaria* genetic resources at Embrapa GC

Approaches Suitable for Nurturing Indigenous Tree Species in Northeast Thailand

A lot of development support projects have been conducted in a wide range of fields in Northeast Thailand in order to overcome the low productivity of lands and lack of infrastructure maintenance. In the field of forestry, a couple of big projects had been implemented by JICA (RTR Project 1981-1993 and REX Project 1994-2004), for the purpose of reforestation in degraded agricultural lands and for promotion of forestry in Northeast Thailand. Thanks to these projects, techniques for nurturing exotic, fast-growing trees such as *Eucalyptus camaldlensis* and *Acacia mangium* had been established. On the other hand, silvicultural techniques and management methods for indigenous tree species such as teak (*Tectona grandis*) and *Hopea* spp. timbers, which are of high value and benefits, have not been established. A considerable amount of timbers of indigenous tree species are nowadays imported from neighboring nations and there is growing concern that forest resources will be depleted in the near future. From 2006, the Forestry Division of JIRCAS started the research project, "Nurturing beneficial indigenous tree species and combined management of agriculture and forestry in Northeast Thailand", in collaboration with the Royal Forest Department aimed at developing silvicultural techniques and forest management methods for indigenous tree species. This Project is comprised of the following two main research subjects:

1. Development of silvicultural techniques for nurturing beneficial indigenous tree species

This research subject is based on the research project, "Development of Agroforestry Technology for the Rehabilitation of Tropical Forests", which was conducted in Sabah, Malaysia and terminated last FY 2006. "Multi-layer operation", in which indigenous trees are planted under the canopy of fast-growing trees, is employed as a basic scheme of the current project. Under this, young seedlings of indigenous trees will be exposed to severely dry condition under the monsoon climate in Thailand, while those located in Malaysia will enjoy year-round precipitation. In the present research, we have already set up a thinning experimental plot in an *Acacia mangium* plantation and planted seedlings of indigenous tree species (*Hopea odorata, Hopea ferrea* and *Xylia xylocarpa*). We intend to find the most optimal thinning rate for indigenous tree seedlings by analyzing the soil moisture regime in the dry season and the survivorship rate of indigenous tree seedlings. Furthermore, we will restore the previous experimental plots that were established during the past JICA projects and collect data of existing indigenous tree species. We should be able to show a more general/typical operation system based on the growth model of indigenous trees which will be derived from the data of the previous plots.

2. Development of combined management techniques of agriculture and forestry

This research aims to be able to propose a sustainable forest management system focusing on teak which is an especially beneficial tree among indigenous tree species in Thailand. Socioeconomic approaches are the main components of this research subject. We will clarify the properties of teak plantation owners by analyzing existing statistical data and interview surveys for them. And then, we will analyze the characteristics of the teak market and distribution structures from the results of interviews and questionnaire surveys with wood processing companies and distributors. Moreover, various research approaches will be implemented in this study as follows; finding suitable sites for the best growth of teak by multivariate analysis, building up a GIS map which shows the suitable site for the teak, and growth promotion test for the teak while applying fertilizers. A combined agriculture and forestry management model will be proposed, integrating all the results of researches, during the final year of the project (2010). This project seeks to provide specific and comprehensive information in reply to the following questions:

a) Where are the most suitable sites for growing teak in Northeast Thailand?
b) How many years are the most ideal for the cutting rotation period with the best profit performance?
c) Will effective management be enabled if we put teak and agriculture together and how?
d) Do the profits of farmers rise if they take any kind of market strategy?

This project has already entered its second year of implementation and the research framework has been almost established with the full cooperation of the staff of the Royal Forest Department. We would like to continue and wrestle with our research, all the while dreaming of widespread successful indigenous tree forests in Northeast Thailand.

Atsushi Sakai
Forestry Division, JIRCAS

Photo 1. Field survey on the 18-year-old *Hopea odorata* plantation in Nakhon Ratchasima Province

Photo 2. Interview with the owner of a teak plantation in Udon Thani Province

Biological Control of the Invasive Insect Pest, *Brontispa longissima*, which Damages the Coconut Tree

The coconut tree is a very important plant in Asia because its fruit is a source of food and foodstuffs and the tree trunk and the shell fibres can be used as timber and industrial raw materials as well. It bears an important role, especially for small-scale farmers who live in developing countries of the subtropical and tropical regions, as a source of cash revenues and daily nutrition. In addition, the crop provides very significant landcover for coastal areas, and is a major feature of tourist industries in many countries.

The coconut hispine beetle, *Brontispa longissima* (Coleoptera: Chrysomelidae) is potentially one of the most serious insect pests of coconut and ornamental palm plants. Infestations by the beetle turn the leaves brown and decrease fruit production. Successive severe defoliation will lead to the death of the tree. The beetle is believed to be endemic to an area which includes Indonesia and Papua New Guinea, and was accidentally introduced into several other countries in the Pacific, Taiwan and Okinawa in the 20th century. However, the pest was not reported from continental Southeast Asian countries until the late 1990's when it was found at the Mekong Delta of Vietnam in 1999. Around the same time, the pest was introduced into the Maldives. It is suspected that this pest was accidentally introduced into both countries with a shipment of ornamentals. The pest has been expanding in areas around Southeast Asian countries, and it was found in Myanmar in 2004, followed by the Philippines in 2005. The pest seemingly continues to spread further westward, and thus the region of South Asia, including India, Sri Lanka and Bangladesh is at great risk of invasion. Since there are a large number of coconut industries in these countries, the pest incursion would be catastrophic. Now, the African continent is facing the same serious threat of its invasion.

Chemical controls were used in most of the countries that the pest invaded. However, the use of pesticides was not practicable. Pesticides are generally expensive for local farmers who obtain only a small profit from coconuts. Pesticide application on tall coconut trees also poses great risks to the health of the people, domestic and wild animals, and the environment. Furthermore, the effectiveness of insecticides was questionable because the larvae and adults of this pest spend most of the time hiding in unopened buds of coconut trees. Therefore, alternative control measures against this pest were needed, and studies were focused on the natural enemies of this pest and their use for biological control.

In 2003, FAO introduced the larval parasitoid wasp, *Asecodes hispinarum* (Hymenoptera: Eulophidae), imported from Western Samoa into Vietnam. The wasp was released in the central and southern parts of Vietnam, and some other countries in Southeast Asia were also provided with the wasp from Vietnam to try to stop the outbreaks of the pest afterwards. In 2006, the Thai government conducted a project of mass rearing and releasing of the wasp in the country. Most of the coconut trees in heavily infested areas are now almost recovering and the parasitoid wasp seems to be working in some areas. But, there are still some plants with heavy symptoms of damage existing in patches even in these same areas. Pest-parasitoid interactions and population dynamics fluctuate considerably within the first few years following the introduction of the natural enemy.

At the time of the parasitoid introduction as mentioned above, strategies geared towards controlling the pest have only focused on the promotion of activities related to the rearing and releasing of the parasitoid, whilst studies on the biology and ecology of the pest and the parasitoid were neglected. Although some biological aspects of *B. longissima* had been studied, there were inconsistencies in some descriptions such as the number of larval instars and developmental rate. No sampling method was as yet developed to estimate the local populations of the insects. So far, we have carried out investigations on the ecology and behaviour of the insects and found not only some environmental key factors for the development of the insects, but also a contact sex pheromone of the pest which is essential for its reproduction. To establish effective methods for surveying population dynamics and parasitization of the insects, several field sites for a periodic survey have been established under the collaborations with research organisations in Thailand and Vietnam. We believe that these studies will help towards a better understanding of the insects; the information and the established sampling methods could be useful and enhance successful control of the beetle in any place where the pest is spreading.

Satoshi Nakamura
Crop Production and Environment Division, JIRCAS

Fig. 1. *Brontispa longissima* damaged coconut plants in southern Thailand.

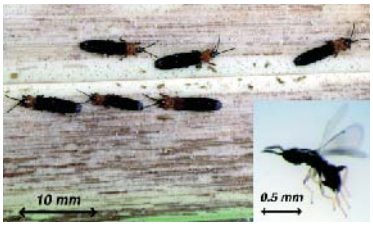

Fig. 2. Adults of *B. longissima* on a young coconut leaf and *(inset)* a female of *A. hispinarum*.

J-FARD & JIRCAS International Symposium "Contribution of Japanese Agricultural Scientists towards the Millennium Development Goals"

- Recommendations for Domestic Collaboration and Human Resource Development -

The Japan Forum on International Agricultural Research for Sustainable Development (J-FARD) and the Japan International Research Center for Agricultural Sciences (JIRCAS) held an international symposium on September 12 - 13, 2007 at U Thant Conference Hall, United Nations University in Tokyo. This symposium was co-sponsored by the Japan International Cooperation Agency (JICA), the Consultative Group on International Agricultural Research (CGIAR) and the United Nations University (UNU), and supported by the Ministry of Foreign Affairs (MOFA), the Ministry of Agriculture, Forestry and Fisheries (MAFF) and many other related organizations.

At the symposium, four keynote speeches, including "Reinforcement of science and technology diplomacy" by Dr. Taizo Yakushiji, Executive Member, Council for Science and Technology Policy and "Roles of agricultural research for achieving development goals" by Prof. Rudy Rabbinge, Chair, the CGIAR Science Council, were presented; followed by reports on the global trends of agricultural research for development (ARD) from international research centers, as well as reports on the evaluation of Japanese and counterpart researchers engaged in past collaborative researches. At the end, a panel discussion among the representatives of research institutes, universities and aid agencies were organized with the theme of domestic collaboration and human resource development.

At the panel discussion, the following recommendations were agreed upon.

- It is essential that Japanese institutions related to agriculture, forestry and fisheries research as well as international development agencies, through activities such as those conducted by J-FARD, should establish mechanisms which enable regular and continuous dialogues among them, and promote a more flexible collaboration across the missions of the different Ministries and institutions. Multi-layered and strategic research activities which include the private sectors and NGOs should be organized through the acceleration of joint participation in field development projects, networking researches and publicly-offered study projects.
- In order to foster young researchers with the qualifications needed for overseas activities, such as international understanding, problem-oriented mind, language ability, on-site activity capacity, strategy-setting ability and so on, it is essential to increase and enhance opportunities which provide real experiences on the field, by taking advantage of CGIAR Centers' activities, in addition to the improvement of specialized education at universities. Support programs for young researchers and coordinating functions, which JIRCAS and others currently carry out, must be extended further.
- In order to increase the opportunity of competent human resources in domestic research institutes and universities to work abroad, it is highly recommended that the institutes and universities introduce an evaluation system which appraises the overseas field experiences as a merit in their career path. In addition, there is a need to establish and enhance the function of human resource exchanges at JIRCAS, universities and so on, so that the flow of human resources and temporal suspension of work can be supported.

Tadahiro Hayashi
Public Relations Office, JIRCAS

J-FARD & JIRCAS International Symposium 2007 at UNU in Tokyo

JAPAN-CGIAR Fellowship Program 2007-2008

The JAPAN-CGIAR Fellowship Program has been commissioned by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan to JIRCAS. With the full cooperation of CGIAR, about 10 young researchers are dispatched to CGIAR Centers every year for two months. Since 2004, a total of 43 young researchers have been dispatched to 13 CGIAR Centers in 16 countries. For this year, 32 research themes were proposed by CGIAR Centers. Twenty applicants from 13 universities and one institute went through the selection process, first by documents screening and finally by interviews. Selected fellows and their host CGIAR Centers are shown below.

CGIAR Fellows (2007-2008) and Host CGIAR Centers

Host CGIAR Center	Location	Name and Affiliation
Africa Rice Center	Benin	Chiharu Sone (Okayama University)
Bioversity International	Kenya	Takashi Fukushima (The University of Tokyo)
CIAT	Colombia	Naomi Asagi (Ehime University)
CIMMYT	Mexico	Yohei Terasawa (Yokohama City University)
CIP	Peru	Shinji Fukuda (Kyushu University)
ICRISAT	India	Minehiko Fukuoka (National Institute for Agro-Environmental Sciences)
IRRI	Philippines	Mana Kanou (Nagoya University)
		Takahiro Goto (Kyushu University)
World Agroforestry Centre	Cameroon	Yosuke Okimoto (Saga University)
	Kenya	Kazuya Wada (Hitotsubashi University)
WorldFish Center	Cambodia	Tomoyuki Okutsu (Tokyo University of Marine Science and Technology)

The fellows attending this year's Orientation Program

Successful applicants attended an Orientation Program which provided relevant information such as the outline of CGIAR and dispatch procedures. Thereafter, the fellows contacted their host scientists to discuss their schedules. The fellows are expected to learn about their host institutes, to develop a good relationship with their fellow researchers, and to broaden their views about foreign cultures. It is anticipated that this fellowship would accelerate the fellow's activities geared towards their participation in international research projects in the near future.

Kunimasa Kawabe
International Relations Section, JIRCAS

JIRCAS Newsletter
Japan International Research Center for Agricultural Sciences (JIRCAS)

January 2008-No.52
Publications and Documentation Section
1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN
Phone. +81-29-838-6340 Fax. +81-29-838-6656
http://www.jircas.affrc.go.jp/