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Banjarmasin's Market, South Kalimantan
(Photo by J. Goto)

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JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

Orientation of Research Activities at JIRCAS

Dr. Keiji Kainuma
Director General

More than two years have passed since JIRCAS was established on October 1,1993. During that time I have had the opportunity of visiting a large number of countries and organizations where JIRCAS staff are engaged in or plan to carry out collaborative research. I have held discussions with both researchers and administrators, signed memorandums of understanding with several institutions and attended meetings organized by the CGIAR and its technical advisory committee.

During these visits, I was able to observe agricultural activities in a wide range of environments, including Southeast Asia where agriculture is centered on wetland rice cultivation and where emphasis should be placed on the development of a technology for the promotion of sustainable agriculture and on postharvest technology, China where agriculture is remarkably diversified, the semi-arid tropics of India, the sub-Saharan belt of Africa where attempts are made to increase agricultural production under the severe constraint of a very dry environment, Brazil and Colombia where the vast expanse of savanna is used for a form of agriculture combining crop production with animal husbandry, etc. In these regions where the climatic conditions and the level of infrastructure for research are so different, I became acutely aware of the importance of the requests for research cooperation with JIRCAS on the part of many countries to enable them to secure a sustainable production of food to match the increase in the population projected in the near future.

JIRCAS is currently engaged in comprehensive research activities covering all the fields of agriculture, including animal husbandry, forestry and fisheries worldwide. Based on the requests for research from organizations in a large number of foreign countries, detailed surveys conducted by JIRCAS staff members including myself and by researchers from various institutes affiliated to the Ministry of Agriculture, Forestry and Fisheries as well as the discussions held during the JIRCAS Advisory Committee Meeting, the priorities and orientation of research are determined, including the themes aimed at addressing urgent issues such as global environmental problems.

The major aspects of the medium-range plan for research (first term, until the year 2003) will be outlined in the following part.

1. Overseas activities

One of the characteristics of JIRCAS research activities overseas is the undertaking of comprehensive and multidisciplinary projects to address problems on a large scale such as systems of agriculture or global environmental problems. Such collaborative projects for which a memorandum of understanding has been concluded with various research organizations are currently being implemented in Thailand (Comprehensive Studies on Sustainable Agricultural Systems in Northeast Thailand), in Malaysia (Productivity and Sustainable Utilization of Brackish Water Ecosystems) and in Vietnam (Integrated Research on Farming Systems Combining Agriculture, Animal Husbandry and Fisheries in the Mekong Delta) or are being planned in Brazil (Development of Agropastoral Systems in the Subtropical Area of Brazil) as well as in China and other regions. Needless to say, for the formulation and execution of the projects, collaboration between researchers in fields of natural sciences and socio-economics is essential.

In addition to the comprehensive projects, emphasis is placed on projects for the solution of specific problems pertaining to agriculture, forestry and fisheries fields as well as on studies that could contribute to the generation of new projects. In 1995, more than 40 researchers were dispatched on long-term assignments to 15 countries to carry out collaborative research with national research institutes, universities, centers affiliated to the CGIAR, etc. In addition, each year approximately 180 researchers and administrators visit a large number of countries with the following objectives; to carry out research on a short-term basis, to investigate the possibility of future research collaboration, to hold discussions about the initiation or promotion of collaborative research, to sign documents, etc.

2. Importance of research carried out in Japan

The completion of the construction of the Tsukuba Campus facilities of JIRCAS should enable to further promote JIRCAS research activities in Japan which hitherto had been mainly carried out at the Okinawa Subtropical Station of the Center. Presently, facilities for research related to plant biotechnology and physiology, aquaculture of various fish and crustacean species, geological and remote sensing studies as well as econometric analyses are available. The use of these facilities should enable to address problems common to both foreign countries and Japan by providing a solid base for research overseas, by the implementation of the JIRCAS Visiting Research Fellowship Program at Tsukuba in order to train researchers and through the collaboration with other research organizations in Japan.

Photo: Signature of MOU between Cuu Long Delta Rice Research Institute (CLRRI), Cantho University (CTU) and JIRCAS

3. Role of Okinawa Subtropical Station

The Okinawa Subtropical Station located on Ishigaki Island in the southernmost part of Japan plays a major role in the promotion of research related to tropical and subtropical agriculture through studies on tropical and subtropical plant resources and investigations aimed at the introduction of new crops, in taking advantage of the climatic conditions prevailing in the subtropical zone. At the same time, the Station contributes significantly to the development of agriculture in the Okinawa area. In addition, the JIRCAS Visiting Research Fellowship Program whereby 10 post-doctoral researchers are invited each year from overseas countries plays a major role in the formation of researchers in the developing regions and paves the way for future research collaboration with a large number of countries. From now on, it will be necessary to further improve and promote this program.

4. Problems for the future

JIRCAS is currently working out plans for the strategy to adopt until the year 2003. In addition to research collaboration, JIRCAS will have to meet the demand for the training of researchers through the implementation of the visiting research fellowship programs, strengthening of the relations with various research organizations in the Asia Pacific Region, organization of workshops in collaboration with the CGIAR research centers, etc. The effective utilization of limited human and material resources is the major challenge that JIRCAS will have to address in future.

Current Studies on Forestry and Forest Products Carried Out at JIRCAS Forestry Division

— Promotion of Sustainable Utilization of Forests in Developing Countries —

Dr. Yasuo Osumi
Director, Forestry Division

Forests of developing countries, particularly tropical forests are extensively exploited because of their economic importance. However the exploitation of these forests is considered to be associated with global environmental changes such as global warming and changes in rainfall distribution worldwide. In this regard, UNCED criticized the destruction of forests and recommended the development of sustainable forest management systems. After the UNCED declaration, the ITTO countries for tropical forests, the European countries for temperate and boreal forests (Helsinki-Process) and the Pan-Pacific group for temperate and boreal forests (Montreal-Process) attempted to develop criteria and indicators for sustainable forest management. Last February, the meeting of the Montreal-Process at Santiago defined the criteria and indicators to be adopted for 87% of the forests in the world through the three processes to promote sustainable utilization of forests and rehabilitate devastated and degraded forest lands. Along this line, JIRCAS Forestry Division promotes research on forestry and forest products in developing countries targetted to local communities.

Forest destruction is closely related to the exploitation of farm lands, pastures and fish ponds which are sometimes abandoned due to low productivity. Therefore, harmonization among forestry, agriculture, livestock and fisheries activities is essential. The Forestry Division has undertaken a comprehensive research project for identifying criteria for sustainable management of brackish water areas with the fisheries sector in Malaysia. We also plan to initiate socio-economic studies on forest production systems for rural communities with the agriculture sector.

Since forest products are the major export commodity for more than 33 developing countries, emphasis is placed on production and less on global environment conservation. If forests could be well managed, environmental issues could also be addressed more effectively. Therefore, studies related to sustainable forest production and processing of forest products are the major targets of forestry research.

Current research activities of the division involve studies for the development of silvicultural technology in logged-over tropical rain forests in Southeast Asia, including physiological performance of major forest components, mycorrhizal inoculation, natural regeneration methods, felling systems, enrichment planting, site suitability, mainly for Dipterocarp trees (on-site long term studies in Malaysia, Indonesia and the Philippines).

Over the wide area of severely degraded forests, particularly after shifting cultivation, since seed sources of indigenous trees for natural regeneration are not available locally, exotic or worldwide species such as acacia, encalypt, teak, mahogany, pine are introduced to establish pure plantations which are prone to attacks by insect pests such as the moth of Meliaceae trees and long-horn beetle of the Mimosa group. Methods of control of the beetle were developed in Indonesia and we are currently initiating studies for the control of the mahogany shoot borer in Malaysia.

In addition, for the rehabilitation of degraded lands,we are analysing the process of natural recovery of vegetation in Thailand under a long-term observation scheme supported by the Science and Technology Agency, Japan.

Timber shows a wide range of wood quality. Many kinds of timber, particularly from plantations of fast-growing trees, are easily degraded if stored in the field. In this regard, we are currently carrying out a study on wood preservation in Malaysia, and plan to initiate research on the development of wood processing technology for local communities to increase their income.

In addition to these "on-site" studies in the Southeast Asian tropical rain forest zone, we are exchanging information on forest sciences with research organizations in other ecological zones, including the cool temperate zone, for initiating research projects.

Although the Division consists of only nine staff members and covers various research fields for developing countries, it is supported by the Forestry and Forest Products Research Institute and its 500 researchers. In addition, we also exchange views with other NARS about programs in developing areas.

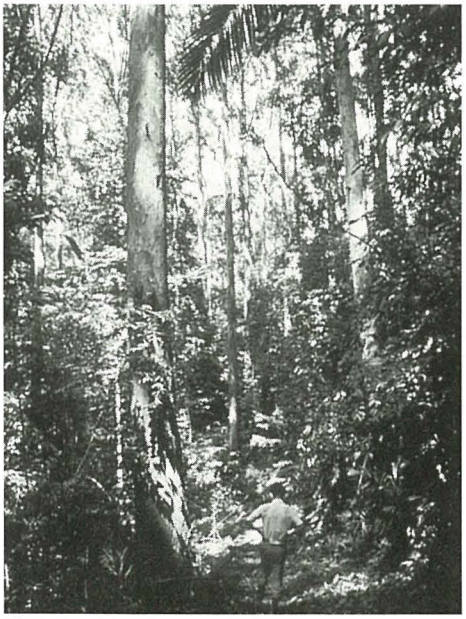

Photo 1: Natural stand of dipterocarps in Malaysia

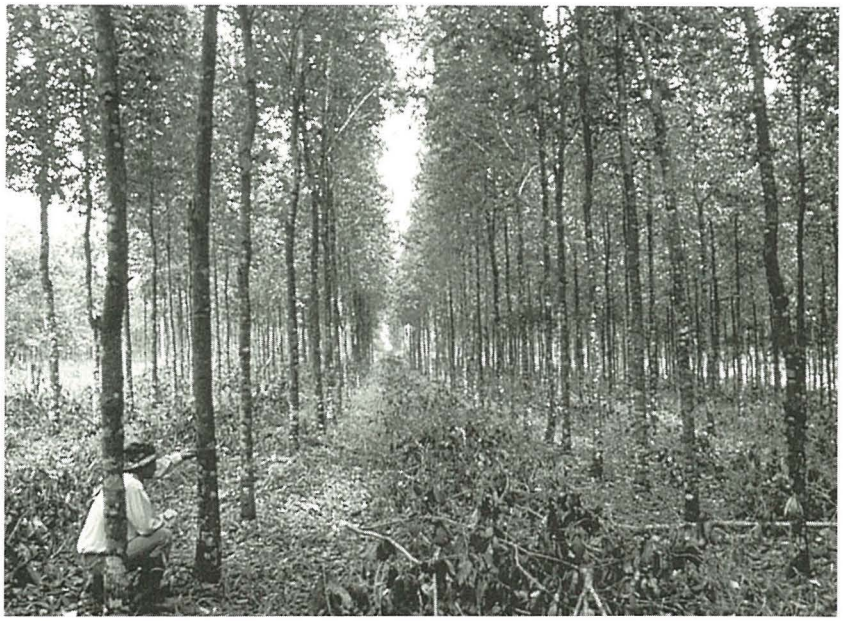

Photo 2: Schima plantation in Sumatra, Indonesia

Mycorrhizal Fungi Occurring in Indonesian Dipterocarp Forests

Akihiko Yokota

Dipterocarp tree species are very common and representative of the tropical rain forest in Indonesia. The importance and necessity of reforestation using indigenous species such as Dipterocarps in this country have been realized in view of the rapid decrease of Dipterocarp forest resources. Actually, reforestation using Dipterocarp tree species, especially in degraded areas in the tropical region is seldom successful, because almost all of the young seedlings transplanted from nursery into the reforestation area are exposed to very severe conditions such as drought, high soil temperature, nutrient-poor soil, etc. On the other hand, it is well known that seedlings with mycorrhizas are better adapted to a severe environment than those without mycorrhizas.

The aim of the cooperative research project between the Forest and Nature Conservation Research and Development Center of Indonesia and JIRCAS was to develop a reforestation technology using mycorrhizal fungi, and the first stage was initiated in March, 1993. The objective was to identify the mycorrhizal fungi which would associate well with Dipterocarp trees to use them as inocula for Dipterocarp seedlings by observing mycorrhizal fungi occurring in Dipterocarp forests and nurseries. A few nurseries, man-made and natural Dipterocarp forests were selected as research fields. The former ones were: Haurbentes experimental forest; Pasirhantap experimental forest and Perum Perhutani nursery in West Java, and the latter ones were forests in Laut island and Muarailai in South and West Kalimantan, respectively. The mycorrhizal fungi we observed during this stage consisted of about 40 species and they belonged to 22 genera such as *Amanita, Cantharellus, Cortinarius, Heimiella, Inocybe, Laccaria, Lactarius, Phylloporus, Ramaria, Russula, Scleroderma,* etc. The mycorrhizal fungi observed frequently in nurseries were *Scleroderma* sp., *Inocybe* sp. and *Laccaria* sp., while *Amanita* sp., *Russula* sp. and *Phylloporus* sp. were found in natural forests as well as in man-made forests. On the other hand, *Scleroderma* sp. were observed very often only in man-made forests. However, *Scleroderma* sp. exhibit a wider host-range than the others since they are associated with 7 Dipterocarp tree species. Though *Scleroderma* can be considered to be one of the optimum inocula for Dipterocarp seedlings, it appears that there are several species of this fungus because the morphological features of the fruiting body varied in size and shape. It would require more time and accumulation of further precise data to identify the mycorrhizal fungi that associate best with Dipterocarp tree species to achieve the objective of the project.

Photo 1: Mycorrhiza formed by Scleroderma *sp.*
Host tree: Shorea platyclados *V. Sl.*
(Perum Perhutani nursery)

Photo 2: Laccaria *sp. (close to* L.vinaceoavellanea *Hongo)*
Host tree: Shorea leprosula *Miq.*
(Perum Perhutani nursery)

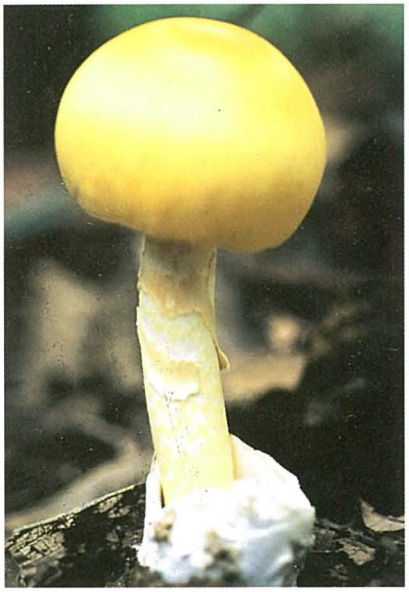

Photo 3: Amanita hemibapha *(Berk. et Br.) Sacc. subsp.* Javanica *Corner et Bas*
Host tree: Hopea bancana *V. Sl.*
(Haurbentes experimental forest)

Photo 4: Scleroderma *sp. associated with* Shorea stenoptera *Burck.*
(Haurbentes experimental forest)

Population Dynamics in Fields with Cruciferous Vegetables and Sensitivity to Insecticides of the Diamondback Moth, *Plutella xylostella*

Masahiko Kuwahara

The seasonal trend in the population density and biological characteristics such as body size, and sensitivity to insecticides of the diamond-back moth (DBM), *Plutella xylostella,* were investigated. The population trend of the insects was estimated by the traps baited with a sex pheromone lure placed in fields located in Pathum Thani, in the suburbs of Bangkok City in Central Thailand, where cruciferous vegetables are being grown all the year round using high-furrow farming systems. A large number of moths was captured all the year round regardless of the distinctive differences in climatic conditions, indicating a potential to maintain a high population level all the year round. The body size of the moths found in Thailand was small and constant throughout a year, as the temperature was always high with negligible seasonal changes. The size coincided with that of the moths found only in mid-summer in Japan. The sensitivity of DBMS to conventional insecticides was analysed by the leaf-dipping method. Although field colonies of DBM from various areas in Thailand have commonly developed a moderate to low level of resistance to anti-cholinesterase compounds such as prothifos and methomyl, the tolerance to other insecticides was unexpectedly low. The increase in resistance of a field colony selected with chlorfluazuron resulted in a high resistance within a comparatively short time. Upon the release from chlorfluazuron selection for six generations, the strain showed a rapid decrease in resistance, indicating the instability of the resistance in DBM when the colonies were maintained without exposure to chemicals. The growers have commonly used *Bacillus thuringiensis* (B. T.) products and abamectin which show a peculiar mode of action compared to that of conventional insecticides with a short time interval for the control DBM. Hence, the low resistance level of DBM to conventional insecticides is due, at least in part, to the replacement of these insecticides with B. T. and abamectin, and to the fact that field colonies had recovered their sensitivity after the removal of the pressure of these conventional insecticides.

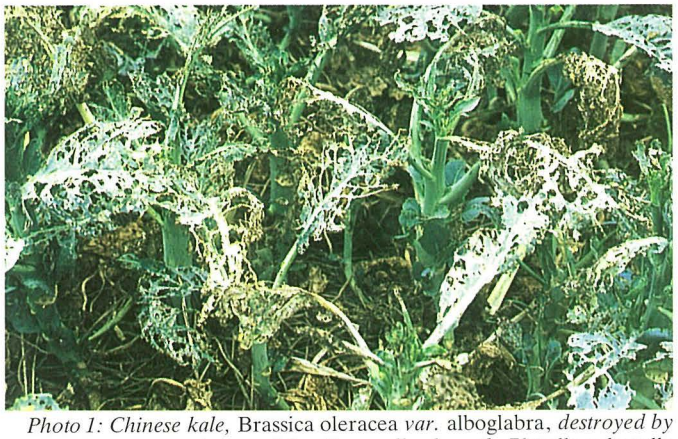

Photo 1: Chinese kale, Brassica oleracea *var.* alboglabra, *destroyed by larvae of the diamondback moth,* Plutella xylostella

Photo 2: Traps baited with sex pheromone lure in Chinese kale field

Construction of a Map Database for Resources Management and Application

Haruhiro Fujita, Yukiyo Yamamoto, Gustav Gintzburger***

1. Why "resources map database"?

In the processes of worldwide land degradation, human activities such as promotion of over-grazing, excessive wood cutting and inappropriate methods of cultivation, are directly or indirectly linked. To avoid degradation problems and to develop sustainable land use systems, it is essential to construct a map database of land-borne resources (such as topography, soil, vegetation) and of their utilization (such as grazing, wood cutting, cropping). The resources map database is very useful for resources management, since it supplies various maps such as land degradation hazard map, agricultural development map, environmental conservation planning map, etc.

2. Construction of resources map database in an arid marginal region

In dry areas, the agriculturally marginal regions which receive an annual rainfall between 200-300 mm are particularly prone to land degradation, since both cropping and livestock production are practiced in the same area. The Abdal Aziz mountain region in northeastern Syria is a typical marginal region characterized by a barley-rangeland small ruminant production system as it occurs in West Asia and North Africa. After the interpretation of a series of aerial photographs and field surveys, a geomorphological map, a soil map, a vegetation map, a land degradation map and a base map were prepared. Those maps were digitalized with a digitizer using a GIS (geographic information system). Map information of resources utilization, such as seasonal grazing areas and wood cutting areas was also digitized to construct a resources map database of the test zone.

3. Unique characteristics of the resources map database and its applicability to resources management

As multi-disciplinary thematic maps of the same region are constructed in multi-layers and each map is identically coordinate-coded in the resources map database, land resources (topography, soil, vegetation, degradation status) and their utilization (grazing, cropping) in any selected point or area can be simultaneously identified. Due to this unique characteristic, the database can be applied to analyse the effects of human

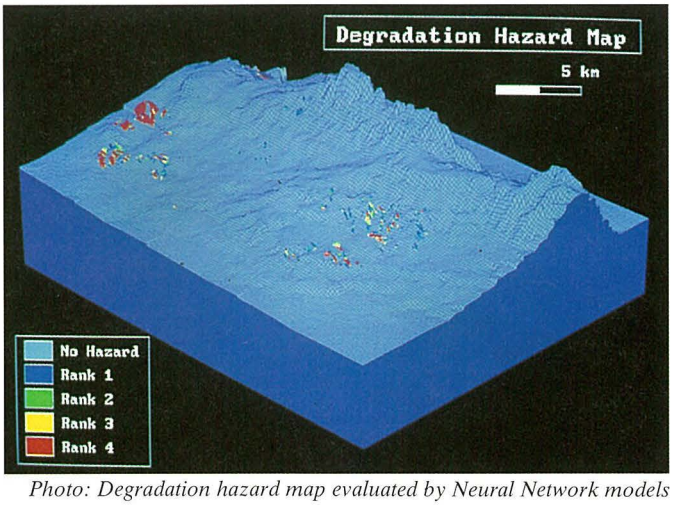

Photo: Degradation hazard map evaluated by Neural Network models

activities on land resources such as on soil (impact assessment), to factorial analyses to identify the causes of current land degradation, model construction such as soil erosion hazard evaluation caused by possible land use changes. Moreover, the analyses of these resources can be used for regional resources management planning, such as agricultural development, environmental conservation planning and resources management mapping.

4. Application of the resources map database — land degradation hazard evaluation and mapping

Within the resources map database, characteristics relating to degradation degree, degradation extent, elevation, slope, aspect (direction of a slope), soil and vegetation of randomly extracted 214 points were retrieved. These characteristics were normalized to build a sampling data set of these parameters for data processing. A Neural Network program (Neuro92) can be applied to construct estimation models of degradation degree and degradation extent from other factors. Regarding the precision level of the models, correct estimation (assumption ratio) for degree and extent amounted to 86% and 79%, respectively compared with the original sampling data set. These two variables were mathematically multiplied to calculate the degradation hazard as an evaluation index. The distribution of the areas in which the degradation hazard was high was unique in two stony soil types. The ground truth using GPS (global positioning system) to identify specific points in the evaluation map was conducted. The evaluation was found to be valid in the northern foothills and plain areas, where gully erosion was present in various areas. However, in the very moderate southern slope, severe degradation could not be identified in the areas in which the degradation hazard was high. It was proposed that local climate and resources utilization variables should be included in the modelling.

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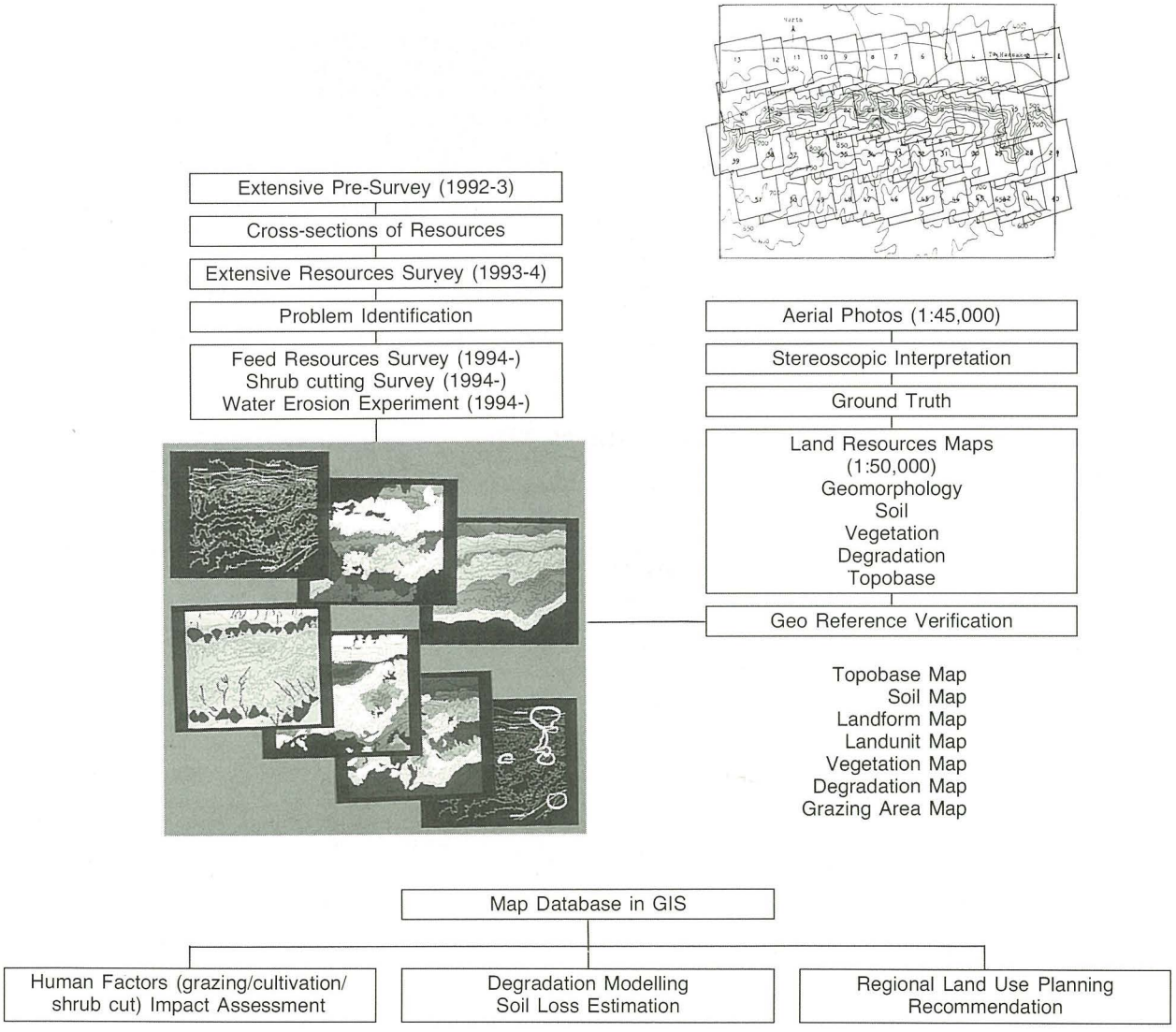

Fig. 1. Research flow for map data establishment and applications

Genetic Background of Tetraploid *Vigna* Species, *V. glabrescens*

Yoshinobu Egawa, Ithnin Bin Bujang, Somsong Chotechuen** and Norihiko Tomooka****

The subgenus *Ceratotropis* of the genus *Vigna* which originated in Asia contains cultigens such as mungbean, black gram, adzuki bean, rice bean, etc. The *Ceratotropis* species are diploid (2n = 22, 2x) except for the occurrence of two tetraploid species, *V. reflexo-pilosa* (wild) and *V. glabrescens* (cultivated). As *V. glabrescens* was found to exhibit resistance to major mungbean pests and diseases, AVRDC attempted to utilize it in the mungbean improvement program. However, the introduction of these valuable resistance genes from *V. glabrescens* to mungbean through interspecific hybridization was unsuccessful due to the difference in ploidy levels. The triploid hybrid between *V. glabrescens* and mungbean was completely sterile.

Isozyme analysis is a useful tool for estimating the genetic variation of plant species and for detecting interspecific relationships. In order to use *V. glabrescens* for crop improvement programs effectively, we tried to clarify the genome constitution of this tetraploid species at the diploid level, based on the isozyme banding patterns of the *Ceratotropis* species. Two tetraploid species, *V. reflexo-pilosa* and *V. glabrescens*, exhibited the same banding pattern which was intermediate between the banding pattern exhibited by two wild diploid species, *V. trinervia* and *V. minima* (Fig. 1). Isozyme analysis thus suggested that *V. reflexo-pilosa* originated from interspecific hybridization between *V. trinervia* and *V. minima* (Fig. 2). Since the hybrids between *V. trinervia* and *V. minima* were completely sterile, it is anticipated that they produced seeds as a result of spontaneous chromosome doubling and thereby produced tetraploid populations which had evolved into *V. reflexo-pilosa*.

Pollen stainability of the hybrids between *V. glabrescens* and *V. reflexo-pilosa* was high, suggesting that *V. reflexo-pilosa* and *V. glabrescens* are phylogenetically closely related to each other. *V. glabrescens* is thus considered to be derived from *V. reflexo-pilosa* as cultivated type with erect growth habit as shown in Fig. 2. The cross between *V. trinervia* and *V. minima* was successful only when *V. trinervia* was used as seed parent. The data obtained from interspecific hybridization experiments thus showed that *V. trinervia* should be used as the seed parent rather than the pollen parent.

F_1 *hybrid*

V. glabrescens V. reflexo-pilosa

Photo: Hybrid plant between V. glabrescens *and* V. reflexo-pilosa

It is anticipated that *V. reflexo-pilosa*, *V. minima* and *V. trinervia* could be useful for the breeding program of the *Ceratotropis* cultigens in addition to *V. glabrescens*, since they are involved in the speciation of *V. glabrescens*.

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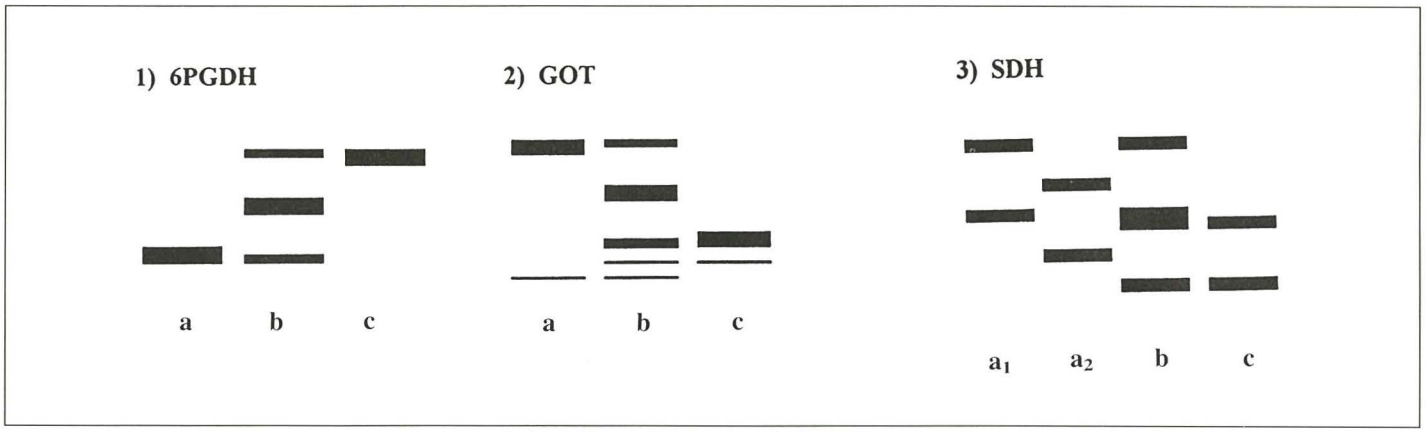


Fig. 1. Zymogram phenotypes for three isozymes of V. trinervia *(a type),* V. reflexo-pilosa *and* V. glabrescens *(b type) and* V. minima *(c type)*

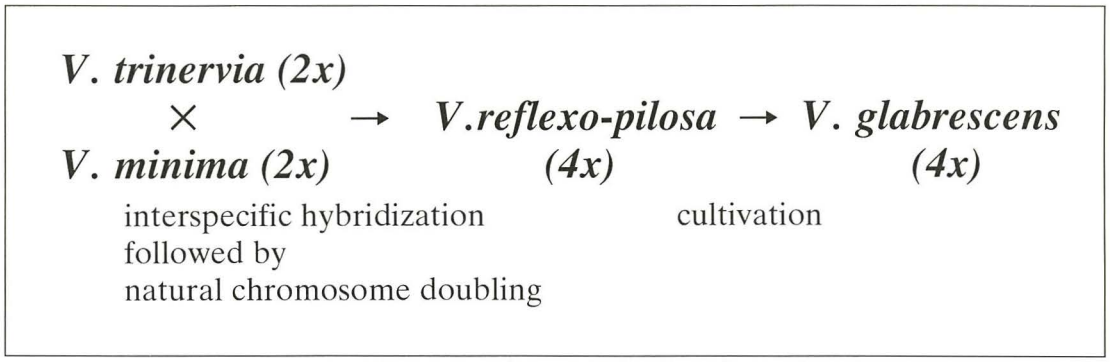


Fig. 2. Phylogenetic differentiation of tetraploid V. reflexo-pilosa *and* V. glabrescens

≪New Research Field≫

Desert Locust

Shigemi Yagi

Several grasshopper and locust species are a major threat to agricultural production and food self-sufficiency periodically in Africa and Asia. These include the desert locust, migratory locust, red locust, brown locust, tree locust, the Senegalese grasshopper, Sudan plague grasshopper and the variegated grasshopper. Damaging populations occur somewhere in the Sahel and sub-Saharan region each year, but massive outbreaks of different species may occur almost concurrently following periods of drought. The first four species are characterized by the propensity to shift from a solitary phase to a gregarious one, a phenomenon referred to as phase polymorphism. The other three grasshoppers do not show significant phase polymorphism, but demonstrate varying degrees of aggregation behavior at high densities and represent a continual threat to African agriculture. Among these species the desert locust, *Schistocerca gregaria* is an important pest in Africa (Photo 1). The gregarious form of this species has been one of the most exhaustively studied insects because of its mobility across several continents and its feeding habitats on a broad spectrum of crops and other types of vegetation. The gregarious immature nymphs crowd together in destructive marching bands, and adults in swarms that can fly over a distance of 150 km a day, with a potential to invade 29 million square kilometers, posing a threat to 60 countries in Africa and Asia which account for more than 10% of the world population. Control of the large swarms comprising hundreds of millions of individuals with pesticides is expensive, and often not cost-effective. Furthermore, the application of pesticides over such a vast area may cause incalculable damage to the environment and to non-target organisms.

Control of the desert locust has been largely reactive in approach and dependent on non-specific pesticides with all their associated problems for fragile ecosystems. The most appropriate approach would involve detecting and treating populations of locusts in their breeding areas during the early stages of outbreaks. This would require an understanding of the process of population build-up, i.e. process of gregarization. Furthermore, an effective surveillance system to detect the locusts and a control agent that is non-polluting are needed.

ICIPE's research on locust control over the past 6 years has concentrated on developing methods for biochemical, physiological, behavioral and ecological disruption of the swarming process. The target is to keep the locusts permanently solitary by interfering with their gregarization process. In this respect, a collaborative research project on locust management between ICIPE and JIRCAS has been initiated since 1995 for a period of 5 years. The objective of the project has been to gain a thorough understanding of the intra- and inter- specific signals modulating behavioral and phase changes in the locusts as well as of the ecological conditions inducing such transformations. Recent research shows that the pheromone system of the gregarious desert locust consists of a complex mixture of volatile substances emitted at different stages of development of the locust and their waste products such as feces. Recently, oviposition aggregating pheromones have been detected in the egg froth of the locust egg pods. These volatile substances stimulate the aggregation and egg-laying behavior of the gravid females. Other semiochemical and endocrinological studies related to moulting, maturation, mating and oviposition behavior of the locust are carried out in the Chemical Ecology Department (CED) of ICIPE (Photo 2).

In the project, attempts will also be made to identify new uses of commercial insects as well as insect pests such as locusts and grasshoppers as human food to increase their value for rural communities in Africa (Photo 3).

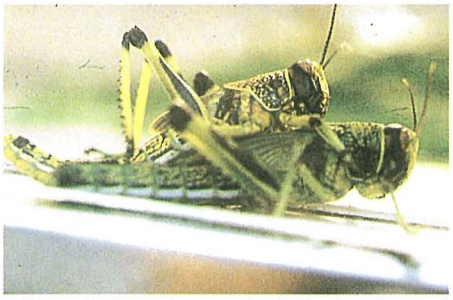
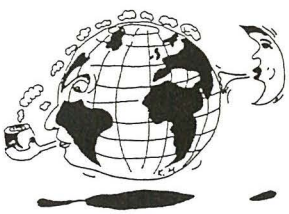


Photo 2: Precocious mating behavior observed in the last instar nymphs of S. gregaria *after treatment with a juvenile hormone mimic*

Photo: 1 Laboratory rearing of the desert locust, Schistocerca gregaria *under gregarious conditions in ICIPE Insectary*

Photo 3: Locusts and grasshoppers for human food sold at "Grand Marché" in N'Djamena, Chad

JIRCAS News



Dr. Kainuma Won the Alsberg-Schoch Award

Dr. Keiji Kainuma, Director General of JIRCAS was awarded the Alsberg-Schoch Award by the American Association of Cereal Chemists (AACC) for his outstanding contribution to research on starch science at the molecular level. Dr. Kainuma delivered the award address entitled: "The Winding Road to the Double Helix Structure of the Amylopectin Molecule", in which he outlined the approach adopted to assign a double helix structure to the amylopectin molecule, as the first double helix model of native carbohydrate proposed by Kainuma and French in 1972. The ceremony for granting the award was held during the annual convention of AACC in San Antonio, Texas, USA on November 6th, 1995.

Dr. Minami Won a Scientific Prize

Dr. Katsuyuki Minami, Director of Environmental Resources Division, JIRCAS and his research group were awarded the 5th Nikkei Excellence Prize for Global Environment Research sponsored by the Nihon-Keizai-Shinbun (Japan Economic Journal) for their exhaustive studies on the "Analysis of the Mechanism of Methane Emission and its Quantitative Assessment from Agro-ecological Systems" on November 16th, 1995.

≪Progress Report≫

Present Status of the Research Project Carried Out in the Mekong Delta in Vietnam

Akira Kobayashi

The research project "Evaluation and Improvement of Farming Systems Combining Agriculture, Animal Husbandry and Fisheries in the Mekong Delta" is the first research project implemented by the Japan International Research Center for Agricultural Sciences (JIRCAS) in collaboration with Vietnamese research institutions. The two cooperating institutions in Vietnam, Cuu Long Delta Rice Research Institute (CLRRI) and Can Tho University (CTU), are located in O Mon District and Can Tho City in Can Tho Province which is the center of the Mekong Delta. Northern Vietnam, consisting of three regions, and Southern Vietnam, consisting of four regions differ in terms of meteorological conditions and history. Mekong Delta, one of the regions in Southern Vietnam, is the most important area for agricultural production, accounting for 38% of the total arable land, 45% of food production and 50% of rice production in Vietnam.

A traditional farming system referred to as VAC (V: garden, A: pond, C: livestock) has tended to prevail in Vietnam. In order to develop appropriate farming systems to improve farmers' income, nutrition and welfare that would also be sustainable and compatible with the preservation of the environment, the Vietnam Farming System Research and Extension Network (VFSREN), consisting of 10 groups, was established in 1990 and is now playing an active role in farming system research and extension in Vietnam.

The ceremony marking the signature of the Memorandum of Understanding (MOU) for the research project was held at Can Tho City in August, 1995. Four to five Japanese researchers will be dispatched to Vietnam for the collaborative research project. Mr. T. Kon, an agronomist, has been working since June, 1995 and Dr. T. Noda, a plant pathologist, since November, 1995 at CLRRI. Dr. S. Yoshihara, an animal husbandry expert, has been working since October, 1995 at CTU. A fisheries scientist and agricultural economist will be sent to CTU and CTU·CLRRI next year, respectively.

By the implementation of this collaborative research project, it is anticipated that the farming systems in the Mekong Delta will be improved and further develop by using the abundant natural resources of the region and will pave the way for the promotion of future research collaboration between Japanese and Vietnamese organizations.

Photo : Farming System(s) Combining Agriculture, Animal Husbandry and Fisheries in the Mekong Delta

≪Topics≫

Mr. Matsumoto, Chairman of AFFRC, and Dr. Kainuma, DG of JIRCAS, Visited Brazil

Kozo Fujisaki

Mr. Sakuei Matsumoto, Chairman of the Agriculture, Forestry and Fisheries Research Council, AFFRC, Ministry of Agriculture, Forestry and Fisheries, MAFF, and Dr. Keiji Kainuma, Director General of JIRCAS visited Brazil in September 1995. They had the opportunity of meeting with his Excellency Marco Maciel, Vice-President of Brazil, the Honorable Jose Andrade Vieira, Minister of Agriculture, Food Supply and Land Reform of Brazil, and Mr. Antonio Cabrera Mano Filho, Minister of Agriculture and Supply of the Sao Paulo State. Mr. Matsumoto and Dr. Kainuma held consultations with them about collaborative research works and cooperation between Brazil and Japan in the future.

Mr. Matsumoto and Dr. Kainuma also visited the Brazilian Agricultural Research Corporation, EMBRAPA. They discussed in greater detail various aspects relating to the collaborative research project entitled "Development of Agropastoral Systems in the Subtropical Area of Brazil" to be implemented from the next fiscal year as well as learned more about the activities of research institutions affiliated to EMBRAPA. Dr. Kainuma signed the Memorandum of Understanding, MOU, between EMBRAPA and JIRCAS. To commemorate this occasion, Dr. Albert Duque Portugal, the President of EMBRAPA, presented Mr. Matsumoto with an impressive marble ornament in order to express his profound gratitude to Mr. Matsumoto for his invaluable and significant contribution to research collaboration between Brazil and Japan, in particular for the activities related to agricultural development in the Cerrados.

Mr. Matsumoto and Dr. Kainuma also had the opportunity of meeting with many young and old farmers of Japanese descent around Sao Paulo and Parana states, in particular with Mr. Shyunji Nishimura, the representative of farmers from Japanese descent and owner of Pompeia Agriculture and Industry High School, who contributed so significantly to forging close links between the Brazilian and Japanese agricultural organizations for all these years.

Photo 1: Meeting with the Vice-President of Brazil (From left to right): Mr. Kadowaki, Dr. Kainuma, the Honorable Maciel, Mr. Matsumoto, Mr. Yamaguchi

Photo 2: Visit of Pompeia Agriculture and Industry High School (From left to right): Mr. Nishimura, Dr. Kainuma, Mr. Matsumoto

≪Overseas Survey≫

Rural Development in Indonesia: Some Insights from the Outer Islands

Junko Goto

Twenty years ago, Indonesia was perceived as a sleeping giant, impossible to wake up in spite of the massive amount of foreign development aid which was poured into, for example, oil and water resources development. Population under the poverty line comprised more than half of the total population. Meticulously tended agricultural landscapes of Java and Bali showed that even the most favorably endowed nature in the tropics could not keep up with ever growing human pressure. Indonesia was the largest net rice importer in the world in the 1970s.

Indonesia today is completely different. Indonesia achieved self-sufficiency in rice in 1984 which was celebrated by the world at an FAO assembly in Rome. Emphasis on agricultural administration shifted gradually to the increase of land and labor productivity, crop diversification, and agribusiness development. Meanwhile, considerable effort has been made to promote the industrial and service sectors to compensate for a relative decline of profit from the oil industry. Since the early 1990s, Indonesia officially took an outward looking policy that was internationally highlighted at the APEC meeting in Bogor in November 1994. When the total national population is about to reach the two hundred million line, the annual GDP growth is still as high as over six percent; the per capita GDP, well above six hundred US dollars per year; and the percentage of the population under the poverty line decreased to below twenty. Indonesia is now marked as one of the most promising emerging economies in the world.

What is the role of rural development for Indonesia then? We may say that the general importance of rural development is much greater now than it was a decade ago, because rapid economic growth requires a more efficient system of food production, social and political stability, and a reasonably equitable redistribution of economic benefits across different regions in the country. While Java today is losing approximately fifty thousands hectares of paddies a year, critics say that agricultural development in the outer islands is meeting with only limited success.

It is easy to criticize how slow those development processes are, when one does know so little about them. In our one-month survey trip to Indonesia, we chose to spend much time visiting project sites in Kalimantan, Sulawesi, and Sumatra, including transmigration schemes. We identified at least three evidences of public commitment to rural development in addition to that of agricultural administration:

1. Rural development from transmigration point of view

Since its inception in 1950, the transmigration program helped approximately 1.7 million households to establish a new livelihood in Sumatra, Kalimantan, and other outer islands. Sometimes criticized as "poverty-relocation" program or "Javanization" scheme, transmigration provides younger but poorer families in Java and Bali with new land and jobs, and also encourages the construction of public infrastructure and the general improvement of the quality of life in those relatively underdeveloped regions in the country. While the average farm size is less than half a hectare in Java, each transmigrant family is allocated two hectares of land. Although problems of soil, water, and labor and capital shortage are still overwhelming, Indonesia's frontier has been thus constantly redefined physically as well as qualitatively through transmigration.

2. Rural development from local government point of view

There are already towns and villages in the so-called outer islands. Even those newly created transmigration settlements become eventually (five years in theory) incorporated into the existing system of local governance. Indonesia is divided into 27 provinces or states (*provinsi*), 241 regencies (*kabupaten*), and 3600 districts (*kecamatan*). In rural areas, the lowest level of government is *desa* (village) numbering some sixty thousands across the country. While liaison offices of the central government work closely with local governments at the provincial level, they tend to focus on projects and matters of strategic national importance. Now that the public finance is tight and the maintenance and improvement of small scale public infrastructure such as roads and waterways are critical, lower-level local governments play a very important role in upgrading the living standard of ordinary villagers and in promoting a more self-reliant rural development.

3. Rural development from the public works point of view

The Ministry of Public Works (called *Pekerjaan Umum, PU*) is in charge of roads, housing, and water resources development. The Water Resources Division plays a crucial role in the survey, planning, and implementation of large-scale development of new agricultural lands such as tidal swamp reclamation. Currently a detailed nation-wide survey of swamp areas is underway to identify areas with a high potential for reclamation that do not conflict with nature conservation. When the long-term food security is in question, opening up new agricultural lands is a top national priority. Sumatra and Kalimantan

Photo 1: Transmigration settlement in upland areas, South Kalimantan

Photo 2: "Surjan" of coconuts and rice paddies to cope with acid sulphate soils in reclaimed tidal swamp areas in South Sumatra

are said to have millions of hectares of those potential lowlands. Although PU has to lead the initial stage of development, coordination and cooperation with other ministries such as transmigration, agriculture, and home affairs is essential in the long-term process of development.

Under the sixth national five-year development plan, agro-industrial and agribusiness development continues to receive priority attention as a practical means of income-generation and diversification for the rural sector. However, food production for home consumption continues to be a matter of critical importance for this rapidly developing country, especially with respect to rice, in spite of the relatively low profile status it receives in the national media. In February 1995, the Ministry of Transmigration and Forest Squatter Resettlement proudly announced that the average annual income per capita in the transmigration villages was six hundred thousands Rp., about three times as high as the acknowledged poverty line in rural areas (219,000 Rp. per capita). While the media and foreign observers tend to welcome new objectives and measurable achievements, such an improvement in transmigration villages, for example, must be seen as resulting from the accumulation of trials and errors on the ground. We learned a great deal only by visiting local offices and villages. In closing, we cannot overstress the importance of coordination and cooperation between different disciplines and ministries in promoting rural development.

≪New Research Area≫

Cote d'Ivoire and WARDA in West Africa

Norihiko Kobayashi

1. Natural characteristics

Cote d'Ivoire is located in the northwestern part of the sub-Saharan region. It is bordered by 5 countries, Liberia, Guinea, Mali, Burkina-Faso and Ghana. "Republic of Ivory Coast" named after the trade of elephant ivory consists of four climatic zones. There are many lagoons in the coastal area. Agricultural zones include the Equatorial forest zone, 150 to 300 km wide, a belt of savanna zone and finally in the northern area a scrub vegetation zone.

2. Population

The capital was transferred from Abidjan to Yamoussoukro in 1983. However foreign embassies have remained in Abidjan and the population of this city with its strikingly modern architecture increased from 500,000 in 1975 to 2 million people in 1985. Bouake where WARDA is located is the second largest city and commercial town in this country. The official language is French.

3. Economy

From independence to 1970, high economic growth (8%) was maintained and reference is often made of "miracle Ivoirien" or "black Japan".

However, as a result of the increase in the interest rates of loans and the decrease in the price of cocoa and coffee in 1980, economic growth declined.

4. Food production and food preference

Moreover, rapid demographic expansion and urbanization led to changes in food preference toward rice and bread, which can be more easily prepared and cooked than traditional foodstuffs such as dishes based on sorghum and cassava. As the demand for rice is increasing year by year, the government imports the commodity from other countries.

Such a remarkable increase in the population and rice demand reflects the abnormal situation in which self-supply of food has never kept pace or caught up with the population growth.

This situation has led to the intensification of upland rice-based production systems, along with the degradation of natural resources and decrease of land productivity.

Even today, the increase of food production remains a priority.

5. Rice production and WARDA (West Africa Rice Development Association)

The increase of rice production, is hampered by a number of constraints, including weed infestation, inadequate water management, fertilizer application, and varieties. WARDA under the CGIAR emphasized varietal improvement, while neglecting research on important environmental factors.

Recently WARDA plant breeders have made substantial progress in the promotion of interspecific hybridization, using fertile populations from *Oryza sativa* (characterized by a high yield) × *Oryza glaberrima* (which can suppress weeds). Crosses have been made up to the F7 generation after two back-crossings to *O. sativa*. These crosses include a significant percentage of intermediate types combining the earliness, seedling vigor, high tillering and weed suppression traits of *Oryza glaberrima* with the panicle and grain type characteristics of *O. sativa*. Efforts are made to develop materials that would be better adapted to the management practices of resource-poor farmers and higher-yielding than the currently available local germplasm. New generation of high-yielding and stress-tolerant varieties will be beneficial to farmers.

When we visited WARDA on August 3, 4, 1995, the Director, E. Terry suggested the implementation of research collaboration with Japan in order to increase rice yield by screening good hybrid varieties suitable for the "continuum" system from hill to inland valleys recommended by WARDA.

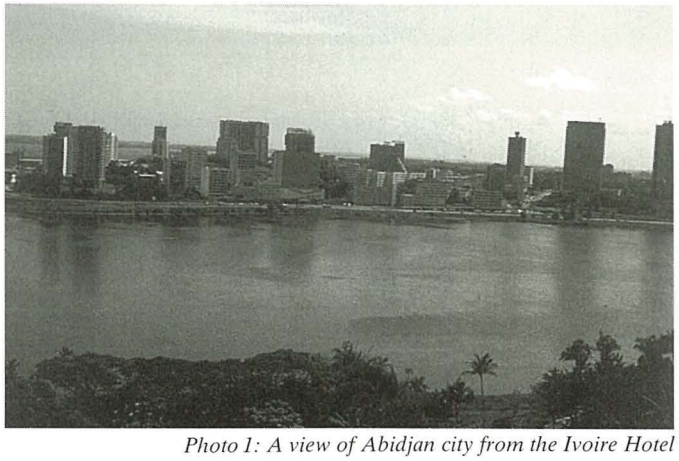


Photo 1: A view of Abidjan city from the Ivoire Hotel

Photo 2: Experiments on rice cultivation, for "continuum" system at WARDA.

≪Research Collaboration≫

Collaborative Research at CIP-Quito

Koshun Ishiki

The International Potato Center (CIP) with headquarters in La Molina near Lima in Peru celebrates its 25th anniversary this year. It started with a mandate to carry out research for potato food security. Subsequently this mandate was expanded to include research on sweetpotato and Andean Root and Tuber Crops (ARTCs). CIP established a research station in Ecuador in 1989 within the site of the National Agricultural Research Institute (INIAP) on the outskirts of the capital city, Quito. CIP-Quito is located at Latitude 0'22"S, Longitude 78'33"W, and at an altitude of 3058 meters above sea level, which makes it the closest to the equator and second highest among CIP's worldwide network of research sites.

Ecuador, one of the richest countries in terms of biodiversity, is divided into three eco-regional areas. Mountainous highlands run in the center of the country from north to south and tropical lowlands lie in the coastal plain and in the Amazon basin to the west and east of the mountains. Among its biodiversity, Ecuador provides a large number of plant species as food crops. The wide range of climatic conditions from the tropical rain forest on the east coast and the Amazon jungle to the cold zone in the highlands of the Andes, has resulted in the development of a broad variety of species.

In addition to the well-known potato, the Andes are home to nine other lesser-known root and tuber crops: achira (*Canna edulis,* Cannaceae), ahipa (*Pachyrhizus ahipa,* Leguminosae), arracacha (*Arracacia xanthorrhiza,* Umbelliferae), maca (*Lepidium meyenii,* Cruciferae), mashua (*Tropaeolum tuberosum,* Tropaeolaceae), mauka (*Mirabilis expansa,* Nyctaginaceae), oca (*Oxalis tuberosa,* Oxalidaceae), ulluco (*Ullucus tuberosus,* Basellaceae), and yacon (*Polymnia sonchifolia,* Compositae). However due to a variety of reasons, most of these crops are seldom cultivated today in the Andes. The ARTCs were lost from the scientific scope until recently in spite of their importance as high-yielding food crops on the Andean highlands and their potential for new food materials as well as for industrial and medicinal uses.

The lack of basic biological information on ARTCs has hindered their improvement as well as the management of these genetic resources. In order to gain basic biological and agronomical information and to help improving and maintaining ARTCs, in 1993, the Japan International Research Center for Agricultural Sciences (JIRCAS) initiated a joint project entitled "Cytogenetical Characterization and Evaluation of Andean Root and Tuber Crops" with CIP, which is being carried out at CIP experiment station in Quito, with the assistance of INIAP.

The major research achievements are as follows: Yacon has at least 2 different basic chromosome numbers, and the normal cultivar is octaploid. We also observed a decimodiploid cultivar which could be derived from an intervarietal hybrid between 2 morphological groups. Yacon is one of the major natural sources of fructooligosaccharides, accounting for about 90% of the total sugar content. Our research may help pave the way for increased utilization of this plant through hybridization breeding for ploidy manipulation and fructan production.

Another ARTC, achira, produces the largest starch granules in plant species. Since the starch is highly digestible and has a low gelatinization temperature, it has a great potential for food and industrial uses. We noted that achira has a fragile part on a single particular chromosome. We observed broken chromosomes at the centromere in root tip cells of all varieties, which may account for the fact that researchers considered that there were aneuploid varieties. We also found that the rhizome position is very important for starch production regardless of polyploidy level. There are 3 rhizome positions; epigeal, endogeal and hypogeal. The cultivars with epigeal rhizome always produce a large amount of total starch. This character could be used as a breeding index for improving starch production. We are currently attempting to promote triploid breeding for improving achira for starch production.

In addition to cytogenetic studies, research on the ecophysiological characteristics of these crops with emphasis placed on adaptation to various environmental conditions as well as studies on the biochemical composition of the crops should be promoted. We anticipate that the results obtained through this collaborative project should contribute to the conservation and better utilization of these valuable genetic resources, ARTCs.

Photo 1: Andean root and tuber crops

*Photo 2: Achira (*Canna edulis, *Cannaceae)*

Photo 3: The project members at CIP-Quito

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