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Newsletter

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Seeding macropellets at Carimagua experiment site, Colombia (Photo by N. Kitahara)

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FOR INTERNATIONAL COLLABORATION

TARC

TROPICAL AGRICULTURE RESEARCH CENTER

Land Reform for Sustainable Agricultural Development

Tsutomu Takigawa

1. Green Revolution and the Agricultural Revolution

The Green Revolution after the 1960s brought about a considerable change in agriculture in Southeast Asia. However it differed from the Agricultural Revolution in England which occurred from the latter half of the 18th century to the first half of the 19th century in that the Agricultural Revolution in England resulted in a reform of both farming systems and land ownership, whereas the Green Revolution modified the farming technology only and did not affect appreciably the land ownership.

The Agricultural Revolution in England was represented by the Norfolk Four Course Rotation System. Thereafter, the diffusion of the system was the core of the Revolution.Schematically, the system consisted of 4 equally divided fields where barley, wheat, clover and turnips were grown in rotation year by year. More than half of the land was cultivated with feed crops to raise sheep and cattle. The manures produced through sheep and cattle raising were returned to the fields and the soil fertility remained high enough to produce grains. The increase in grain and livestock production was achieved up to the Great Depression from 1873 to 1897. The system was a type of mixed farming combining grain and livestock production. It was evaluated as a modern system of agriculture.

The reform of the farming system was associated with that of land ownership. "Parliamentary enclosure" had been achieved through exchange of scattered landholdings and formation of large scale farms. For the tenant or capitalist farmers, the tenant right was secured during the Agricultural Revolution. The right allowed to borrow land in a 21- year term and compensate for the tenant-right (remaining value) when the lease contract ended. Through this practice, tenant or capitalist farmers were able to invest enough to improve the land. When Arthur Young, who was a major proponent of the diffusion of the Norfolk System, stated "The magic of property turns sand into gold" in his "Travels in France and Italy during 1787, 1788 and 1789", "property" did not refer to the land owned but to the secured right of tenure.

Thus, the Agricultural Revolution in England resulted in considerable changes in farming systems and in the formation of modern land ownership.In contrast, in the case of the recent Green Revolution in Southeast Asia, the land ownership system had not been improved to the level of modern land ownership. The land ownership was uneven and pre-modern land tenure systems prevailed widely in the rice-growing areas. Tenant farmers were frequently trapped in a vicious circle of poverty and debt due to the high rent and other costs incurred. The governments promoted the Green Revolution without concomitant reforms in the land ownership. In other words, the Green Revolution was considered to be a substitute for the land reform.

2. Sustainable Development

Recently, in the rice-growing areas of Southeast Asia where high inputs of chemicals have been applied, the decrease of soil fertility and deterioration of the ecosystems have become apparent. Under the pre-modern system of land ownership, poor farmers have been reluctant to improve their lands.

The Green Revolution did not address the equity issue and people migrated from rural areas to cities. Also with the increase of the population, the number of landless farmers increased. People expelled from the villages moved either to the city slums or to the highlands to clear public forest land through the slash-and-burn practice.

In the Philippines, these non-traditional slash-and-burn farmers were estimated to reach around 10 million to 13.5 million. Such a situation exacerbates the erosion problem while frequent floods and droughts adversely affect rice farming in the plains. Today, similar problems have arisen in most of the Southeast Asian countries. For sustainable rice cultivation in Southeast Asia, both land reform and measures for the protection of water resources should be implemented. Rice cultivation in the plains should be taken care of together with the mountainous areas where water resources originate.

3. Experience in Japan Reconsidered

Redistribution of land (land reform) can not be realized easily. In the case of Japan, where the land reform was remarkably successful, there were two favorable conditions; 1) the Allied Powers exerted supra-Constitutional pressures, 2) the power of the landlord class had been weakened through the industrialization after World War I, the enactment of the war-time Land Law and control over the rent (rent was considerably reduced and paid in cash instead of kind) through the enactment of the Food Control Law during World War II. Since the economic and social power of the landlords in the developing countries is still very strong, it is necessary to protect the right of small landholders and not to prevent them from organizing themselves voluntarily into cooperatives or associations.

Dr. Tsutomu Takigawa
Born in 1924. Graduated from Faculty of Agriculture, Tokyo University in 1948. Joined MAFF in 1948 and worked at the Bureau of Agricultural Improvement and Extension (1948-1951) and the National Research Institute of Agriculture (1951-1964).Joined IDE(Institute of Developing Economies) from 1964 to 1979. During this period, he was appointed as Visiting Research Associate, School of Economics, University of the Philippines (1972-1974), received a Doctorate Degree from Tokyo University (1977) and served as Director of Research Division, IDE (1975-1979). Thereafter he became Professor at the Institute of Agriculture and Forestry, Tsukuba University (1979-1988) and Professor at the College of Agriculture and Veterinary Medicine, Nihon University (1989-). He was appointed as Director General of RRIAP(Regional Research Institute of Agriculture in the Pacific Basin), Nihon University in 1991. Adviser for TARC since 1992. Research field: Agricultural Economics, especially agrarian reform in Asia. Publications: A Note on the Agrarian Reform in the Philippines under the New Society, 1974. Study on the Post-War Agrarian Reforms in the Philippines, 1976. Studies on Low-Income Strata in Rural Southeast Asia (ed.,), 1982. Studies on Agrarian Changes and Peasant Organizations in Southeast Asia (ed.,), 1985. New Agricultural Technologies and their Socio-Economic Impacts on Rural Societies in Southeast Asia (ed.,), 1987.

4. Socio-economic Approach in the new Center

TARC is now engaged mostly in technology research but I believe that the socio-economic approach should be strengthened because the dissemination of technology depends largely on the socio-economic background. Such subjects as landownership, rural community, marketing and trade, distribution system, price policy, credit and agricultural cooperatives in particular should be studied by TARC or the reorganized Center. When such a background is well understood, research planning and dissemination of modern technology may well be improved.

Prizes for Rice Breeders from Provincial and Central Governments of China

The first prize for "Progress 1991 in Science and Technology in Yunnan Province" and the second prize for "Progress 1992 in Science and Technology, Department of Agriculture of China" have been awarded to a group of breeders including twelve Japanese researchers who participated in the first phase of the Japan-China collaborative rice breeding program in Yunnan Province, China.

Since 1982, the Tropical Agriculture Research Center (TARC) of Japan and the Yunnan Academy of Agricultural Sciences (YAAS), Peoples' Republic of China, have been carrying out a joint research project entitled "Breeding of Rice Varieties for High-Yield and Resistance to Cold Weather and Blast Disease through the Utilization of Unexploited Genetic Resources".

Over the past five years, the breeders have released five elite varieties with high yield performance, disease resistance and cold tolerance, which were officially registered by the provincial government of Yunnan. These varieties are now grown over almost 100,000ha in and around Yunnan Province.

"We are now focusing on the breeding of rice varieties with high grain quality and good taste to meet consumers' demands" said Mr. Sunohara, one of the TARC's rice breeders who is currently engaged in the project.

Since a new breeding program utilizing biotechnological procedures has begun in the second phase (1992-1997) of this collaborative program between TARC and YAAS, we can anticipate that new varieties with good agronomic traits as well as grain quality will be bred by the end of the second phase.

TARC Researchers won Prizes

Encouragement Prize for Dr. Tomooka and Iso Prize for Winged Bean Breeders' Group from Tropical Agriculture Research Association of Japan.

The spring meeting of the Tropical Agriculture Research Association of Japan was held on 29-30 March 1993 at Tsukuba University. During the meeting, TARC researchers were awarded prizes from the Association.

Dr. N. Tomooka won the newly established Encouragement Prize for his work on "Genetic diversity and varietal differentiation of mungbean (*Vigna radiata*) in Asia". His work was briefly introduced in the TARC Newsletter Vol.2, No.2. Although Professor Vavilov considered that the center of genetic diversity of mungbean was in India, Dr. Tomooka's analysis on seed protein types suggested that it was in Western Asia (Afghanistan, Iran and Iraq). Dr. Tomooka was engaged in collaborative research work at Chainat Field Crops Research Center, Department of Agriculture, Thailand during the period 1987-1991.

The winged bean variety, "Urizun"(in reference to the early summer season in Okinawa), was bred by several TARC researchers at the Okinawa Branch of the Center. As this variety is not sensitive to photoperiod for pod production, it can be continuously harvested in summer in the temperate region. Mr. T. Hanada represented the group and gave a lecture on the breeding and cultural practices of the variety. The description of the variety was given in TARC Newsletter Vol.1, No.4.

Dr. Nakai was awarded the title of Emeritus Professor from the Xinjiang Institute of Biology, Pedology and Desert Research (XIBPDR)

Dr. M. Nakai, Senior Researcher, Marginal Land Research Division (currently at Research Planning and Coordination Division) carried out collaborative studies at XIBPDR from 1990 to 1993 on the "Analysis of Water Movement and Soil Characteristics of Arid Lands". When he left the Institute, he was awarded the title of Emeritus Professor by the Director General of the Institute, Professor, Dr. Li Shugang. The certificate stated that Dr. Nakai contributed so significantly to the advancement of pedological studies under arid conditions that the Institute bestowed this title on him.

Celebration Party for Mr. S. Okabe who was Awarded the Third Order of Merit

Mr. Shiro Okabe, who was Director General of TARC during the period 1977-1981, was awarded the Third Order of Merit with the Middle Cordon of the Rising Sun by the Government of Japan in April 1992. This award was granted for his outstanding contributions to national and international research and development programs in the field of agriculture. Among other things, the services he rendered in the early development stage of the TARC and the CGPRT Centre of the United Nations ESCAP are highly valued, since his achievements include the establishment of a sound basis for these institutions. A celebration party, organized by Dr. M. Kobayashi, DG of the TARC, and his senior colleagues, was held on the 9th of April 1993 in Tokyo. The party was attended by ninety-three of Mr. Okabe's old friends, who shared joys and sorrows with him over the last four decades at the Hokkaido National Agricultural Experiment Station, the National Research Institute of Agricultural Sciences, the TARC and the CGPRT Centre of the United Nations ESCAP.

In his thank-you address to the party, Mr. Okabe stated, "...I started working in developing countries when I turned fifty years old. It was my serious concern that it might have been too late in my career to be engaged in overseas assignments at this age. However, invaluable support from old and new friends of mine has enabled me to accomplish something. I would honestly like to say that I have not worked "for" the people in developing countries but "with" them. I do hope that more researchers in Japan will participate in overseas agricultural research programs..."

Mr. Okabe now works as a principal researcher at the Food and Agriculture Policy Research Center (FAPRC) in Tokyo. The FAPRC is a non-profit institution; one of its objectives is to improve communication between Japan and other countries. The FAPRC now plans to publish the English translation of a three-volume monograph, of over 2,000 pages, entitled Science of the Rice Plant (Inagaku-Taisei in Japanese). He is in charge of editing and issuing this English version. He is still actively involved in research programs relating to international issues.

(From left to right)
Dr. S. Yashima, Dr. F. Iwata, Dr. A. Naito, Mr. S. Okabe, Dr. M. Nara and Dr. T. Igarashi.
Five gentlemen except Dr. Naito are OBs of TARC.

≪Plant Nutrition≫

Nitrogen fixation of mungbean (*Vigna radiata*) in Thailand

Toshifumi Murakami, Settha Siripin[2], Precha Wadisirisuk[1], Nantakorn Boonkerd[1], Tadakatsu Yoneyama[3], Tadashi Yokoyama and Hideo Imai

Soils in the tropics are, in general, extremely infertile and crop productivity is very low. The effective use of symbiotic nitrogen fixation may enable to achieve high yield and decrease the cost of production. However, since information about nitrogen fixation in these areas is limited, we initiated a research project focusing on mungbean in Thailand (Fig. 1).

Several varieties (lines) of mungbean were grown in concrete pots or in an experimental field. The changes with growth and varietal differences in some parameters related to nitrogen fixation were analyzed. The nitrogen-fixing activity was determined by using the acetylene reduction assay (ARA) and the contribution of nitrogen fixation was analyzed by the ^{15}N natural abundance method. The percentage of nitrogen derived from air to total nitrogen (%Ndfa) was adopted as an index of the contribution to nitrogen fixation.

The root nodules started to form 6 to 7 days after sowing (DAS) and their number increased three fold during the growth of the plant regardless of nitrogen application. In the absence of nitrogen treatment, the nitrogen-fixing activity appeared at 12 DAS, increased rapidly after flowering (34 DAS) reaching a peak at 40 DAS and increased again at about 60 DAS. In the nitrogen treatment consisting of the application of 75 kgN/ha, the activity appeared at 14 DAS and remained low. The application of a large amount of nitrogen decreased the nodule number to 54%, nodule weight to 26%, nodule diameter to 72% and ARA to 19% compared with the absence of nitrogen treatment.

Nitrogen fixation of mungbean (%Ndfa) increased rapidly after 16 DAS, reached a value of 40% at the flowering stage and ranged from 40 to 60% in the absence of nitrogen treatment. The major nitrogen source of the plant was soil (seed) nitrogen from germination to the flowering stage followed by both soil and air nitrogen (Fig. 2). When nitrogen was applied, the %Ndfa was less than 10% during plant growth. The major nitrogen sources consisted of fertilizer and soil nitrogen until the flowering stage and thereafter of soil nitrogen. The part of stored nitrogen in the shoot was transported to the pods in both nitrogen treatments. The application of a large amount of nitrogen suppressed the absorption of air nitrogen, while fertilizer nitrogen was absorbed. In contrast, the application of a small amount of nitrogen may enhance the growth of seedlings in which nitrogen fixation had not yet been initiated. The effect of application of "starter nitrogen"was analyzed in the field. Although the application did not suppress nitrogen fixation, shoot weight and grain yield did not increase in 13 varieties. The %Ndfa of the 13 varieties at the pod maturing stage (64 DAS) ranged from 40 to 60% and small differences were detected between some varieties at 5% significance level. The mature mungbean plants collected from 36 farmers' fields bore few nodules and the %Ndfa was 23.2±18.1% on an average, a value 1/3 to 1/2 of those recorded in the pot or field experiments described above. It was assumed that indigenous rhizobium bacteria in farmers' fields may not match the cultivated varieties. The selection of rhizobium bacteria suitable for the host plant is important for enhancing nitrogen fixation. Basic studies including the classification of bacteria, especially in the tropics should be carried out for effective selection.

Fig. 1. Mungbean grown in Tak-fa area in central Thailand (at pod-maturing stage)

1. Department of Agriculture, Thailand.
2. Kasetsart University.
3. National Agriculture Res. Center.

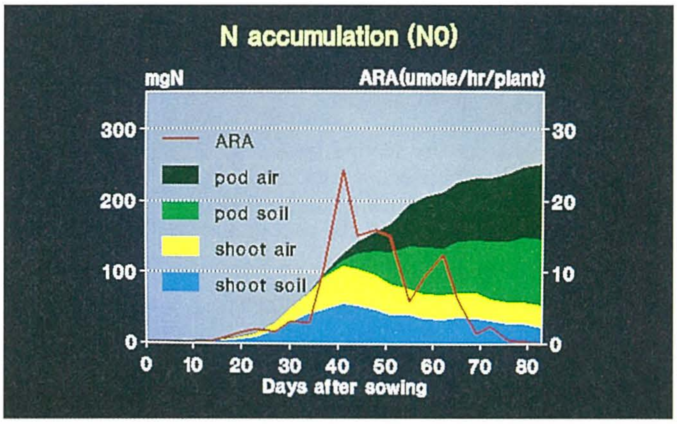


Fig. 2. Nitrogen accumulation by mungbean in the absence of nitrogen treatment
ARA: Acetylene reduction activity
Data were expressed as average values of the 3 varieties (lines)

≪Plant Physiology≫

Optimum salinity level for mangrove growth based on photosynthetic rate

Shigeki Furuya

Mangrove swamp forests in Yaeyama Islands, Okinawa mostly consist of two dominant species: *Bruguiera gymnorrhiza* (Bg, Fig.1) and *Rhizophora stylosa* (Rs).

Recently, attempts have been made to expand mangrove forests through artificial planting. However, sometimes the establishment of the seedlings was not satisfactory, and it was considered that environmental factors such as wave height of sea water, soil pH, salinity level and air temperatures may affect the growth of planted mangroves.

The effects of the salinity level and air temperature on plant growth were studied by measuring the photosynthetic rate (PSR) and stomatal conductance (STC) of leaves.

Seedlings of Bg and Rs were grown in 1/5000 a plastic pots irrigated with fresh water until the plants reached a height of 40-50 cm, when the treatments started.

Salinity treatments consisted of exposure to sea water at 1.5, 1, 1/2, 1/4, 1/8 and 0 concentrations. Temperature treatments included the exposure to 15, 20, 25, 30 and 35 ℃ conditions.

Two weeks after the salinity treatments, PSR and STC were determined with a portable photosynthesis-transpiration measuring system in a controlled glasshouse. For the temperature treatments, PSR and STC were determined with an infrared carbonic acid gas analyzer and hygrometer in the laboratory.

As shown in Fig.2, the PSR values were maximum at 1/8 and

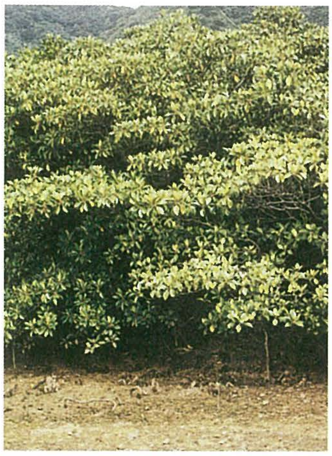


Fig. 1. Red mangrove, Bruguiera gymnorrhiza

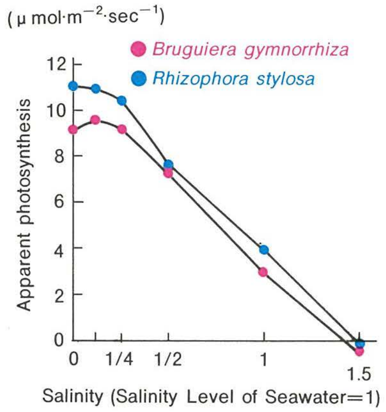


Fig. 2. Effect of salinity level of culture solution on apparent photosynthesis

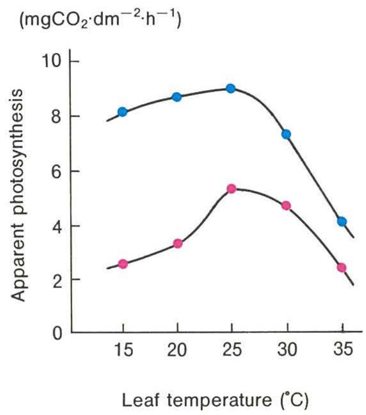


Fig. 3. Effect of leaf temperature on apparent photosynthesis

0 salinity concentrations for Bg and Rs, respectively. PSR values decreased with the increase in the salinity level. STC showed the maximum value at 1/8 and 0 salinity concentrations for Bg and Rs as in the case of PSR.

As shown in Fig.3, optimum temperature for PSR was 25 °C for both Bg and Rs. The decrease of PSR at low temperatures was less pronounced in Rs than in Bg. STC showed the maximum value at 20 °C for Rs and 25 °C for Bg. Rs showed a higher STC value than Bg at low temperatures.

Based on the results described above, it is suggested that mangrove growth could be improved at river mouths or in coastal areas where subterranean water emerges, due to the diluted salinity. (Okinawa Branch, TARC)

≪Plant Disease≫

Detection of Two Plant Viruses of Papaya by ELISA

Tetsuo Maoka and Tomio Usugi

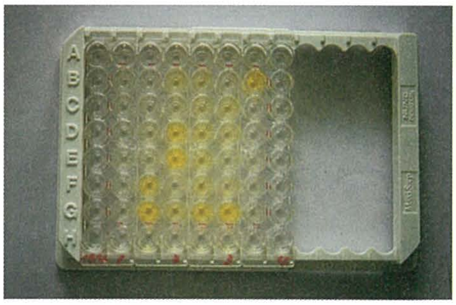
Papaya ringspot virus type P(PRSV-P) severely damages papaya plant (*Carica papaya* L.) by causing mosaic symptoms and distortion of leaves and ringspots on fruit. The disease is widely distributed throughout Hawaii, Florida, the Caribbean countries, South America, Africa, Australia, Thailand, Malaysia and Taiwan.

In Japan, a virus-like disease was first observed in the northern part of Okinawa island in 1954 and within 6 years, the disease had destroyed most of the papaya trees on Okinawa, Miyako and Ishigaki islands. At first the causal virus was considered to be PRSV-P since the symptoms on plants were similar to those induced by PRSV-P and the characteristics of the virus were also similar to those of PRSV-P. However, in 1987, it was found that the virus was different from PRSV-P serologically. The virus was newly designated as papaya leaf distortion mosaic virus (PLDMV) and it was considered that papaya virus diseases in Japan are caused by only PLDMV. However, we detected for the first time a Japanese isolate of PRSV-P from papaya on Miyako island in 1991.

Both PRSV-P and PLDMV belong to the potyvirus group and induce similar symptoms on papaya. Since it is not possible to distinguish the two virus diseases on the basis of the symptoms, we developed a field survey system based on ELISA (Enzyme Linked Immunosorbent Assay). The efficiency of the two antisera prepared for PRSV-P and PLDMV was evaluated by DAS-ELISA (Double-Antibody-Sandwich ELISA). The antisera were very sensitive and enabled to detect PRSV-P and PLDMV in crude extracts from infected papaya plants at dilutions of 10^3. The responses of the viruses to the antisera were specific enough to enable to distinguish the viruses.

One hundred samples of infected plants were collected from the fields on Ishigaki island and subjected to ELISA. PLDMV was detected in 88 plants, PRSV-P in 7 plants and both viruses in 1 plant. Although PLDMV accounted for the major part of occurrence, PRSV-P was also found in a low frequency. (Okinawa Branch, TARC)

Ringspot symptom on papaya fruit caused by PRSV-P



Detection of RPSV-P virus by ELISA method

Profile of New Directors

Dr. Hirofumi Hayakawa, Director of Research Division II.

Veterinary Entomologist.
Born in Fukushima in 1937.
Graduated from Faculty of Agriculture, Tokyo University of Agriculture and Technology in 1961.
Started his career at MAFF as Researcher, Beef Cattle Grazing Lab., Tohoku Nat'lAgr. Exp. Station, 1961-1984.
Head, Insect Pest Lab., Upland Farming Division, Nat'l Hokkaido Agr. Exp. Station, 1984-1988, Veterinary Entomology Lab., Nat'l Tohoku Agr. Exp. Station, 1988-1993.
Joined TARC as Director of Research Division II on April 1, 1993.
Received Dr.Med.Sci.from Faculty of Medicine, Niigata University in 1979.
Visiting scientist at Lincoln College in New Zealand and at CSIRO in Australia in 1972-1973.
Carried out research on dung beetles at Veterinary Toxicology and Entomology Lab., USDA in 1983.
Participated in a JICA project at Jos University in Nigeria in 1986 and 1987.
Awarded Academic Society Award from Japan Society of Sanitary Zoology for studies on blood-sucking Tabanidae in 1984.
Award for Distinguished Accomplishment in the control of livestock pests from MAFF in 1988.

Dr. Tadashi Yamashita Director of Okinawa Branch.

Born in Osaka in 1937.
Research Field: Plant Nutrition.
Graduated from Faculty of Agriculture, Tohoku University (BS. 1961, M.S. 1963, PhD. 1968).
Graduate Study at Department of Biochemistry, University of California, Riverside (1963-1964).
Started his career at MAFF as Researcher, Department of Chemistry, Sericultural Experiment Station (1968). Head of By-product Lab.(1975). Head of Radio Isotope Lab. (1980). Head of Mulberry Nutrition Lab. (1983). Head of Mulberry Physiology Lab. (1988).
He joined TARC as Chief of the International Relation Section in April, 1990.
Director of Okinawa Branch of TARC since April 1, 1993.

Letters to the Editor from TARC Visiting Scientists (Part 2)

VAM Utilization for LISA in Tropical Agriculture

The interest in biologically-based systems of farming has promoted the trend referred to as low-input sustainable agriculture (LISA). Inputs like chemical fertilizers and insecticides increase the cost of production and are associated with surface and ground water pollution. The role of soil microorganisms in the promotion of sustainable agriculture is becoming very important. In this context, Vesicular Arbuscular Mycorrhizal (VAM) fungi in the soil-plant system contribute to the enhancement of the development of the host plant by improving plant nutrition.

Phosphorus is often limiting to plant growth in tropical soils. The inoculation of VAM fungi can increase the uptake of phosphorus nutrient. Adequate root mycorrhizal association may increase the absorption range beyond the depletion zone. However the effectiveness of VAM depends on the indigenous fertility of the soil, types of indigenous VAM and soil reaction. VAM utilization especially for legumes may be more useful because legumes require large amounts of phosphorus not only for plant growth but also for nodulation and nitrogen fixation.

I am one of the visiting research scientists of TARC, working on the theme "Development of Techniques for Environmental Control by using Plant and Microorganisms Specific to the Tropics and Subtropics" with Dr. K. Adachi, the Japanese co-researcher under the able guidance of Dr. T. Senboku, Head, ICRS of TARC Okinawa Branch. My investigation is confined to the "Mycorrhiza Contribution to Phosphorus Nutrition and Interaction with Other Fertility Factors in Cowpea and Sorghum in Arid Soils". In particular, I am interested to determine whether it is possible to substitute partial phosphorus fertilizer with VAM utilization to achieve sustainable agriculture.

Research efforts are needed (1) to identify the cultural and environmental conditions which may be alleviated by the use of specific isolates, (2) to produce a large amount of isolates and (3) to provide the user with specific recommendations.

Dr. Brijesh D. Sharma
Scientist, Central Arid Zone Res. Inst.,
ICAR, New Delhi, India

A Note on my Activities at ICRS

I have been working at the International Collaboration Research Section (ICRS), TARC Okinawa Branch, Ishigaki Island as a visiting research fellow for the past eight months.

In China, I was engaged in research on rice biotechnology, genetic resources and breeding. I believe that rice studies can mainly be centered on two aspects: identification of special genetic materials and advanced techniques. I am interested in combining them to obtain better results. However, it is necessary to initially investigate the materials. In this regard, I decided to carry out research on rice genetic resources in relation to salt tolerance.

In my study, I applied the seed-hair scoring method, which was originally developed by Prof. K. S. Cheng to classify rice varieties morphologically, in order to analyze the variations in germination rates (GR) of seeds from different varieties subjected to 1.5%NaCl. The results showed that (1) Indica varieties displayed a higher salt tolerance than the Japonica ones and

Examination of cultured taro tissues

(2) that the seed-hair scores were highly correlated with the GR averages in the groups within these two subspecies. This was also confirmed by esterase isozyme analyses.

I know that my study is still limited. For example, although GR appeared to be different among rice varieties from various countries, I could not exactly determine where the centers of diversity of rice salt tolerance were located due to the limitation in the materials available. However, I believe and hope that ICRS can complete this kind of basic studies.

Zhang Yaozhong
Yunnan Academy of
Agricultural Sciences,
P.R. China

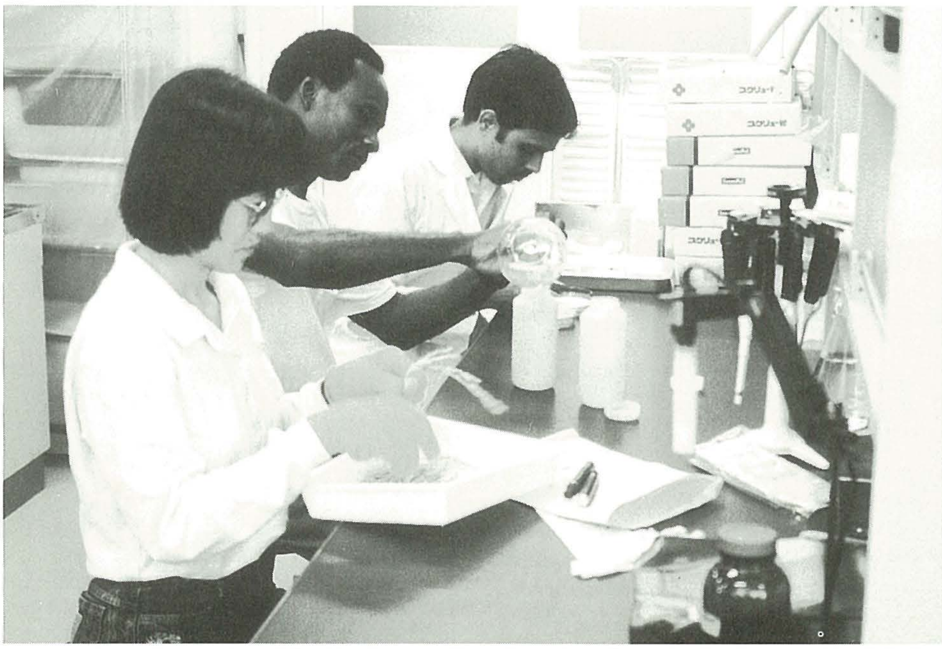
Role of Soil Microorganisms and Rice Straw Management in Soil Productivity in Relation to LISA

Concern about soil constraints including the increasing cost of production, energy conservation, agro-chemical pollution and environmental protection has promoted the need for the development of techniques with emphasis placed on low-input technology and sustainable crop production. One of the strategies worth considering is "organic matter recycling". Within this particular area, soil microorganisms' activities play a major role in the supply of soil nutrients, especially nitrogen for crop growth.

Based on these considerations, as a TARC visiting research fellow (October, 1992 to September, 1993), I am currently carrying out studies in close collaboration with Dr. K. Adachi, the Japanese co-researcher under the guidance of Dr. T. Senboku (Head of the Section), International Collaboration Section, Okinawa Branch of TARC. The investigation is divided into 2 sub-projects entitled:

(1) Effective utilization of biological nitrogen fixation (BNF) induced by the incorporation of rice straw and cellulose to paddy soil under waterlogged conditions and (2) Effect of rice residue management on nitrogen mineralization and rice plant growth. These studies are carried out under the theme: "Development of Techniques for Environmental Control by using Plants and Microorganisms Specific to the Tropics and Subtropics". The experiments were started since October 1992 and will be completed in September 1993 at the Okinawa Branch of TARC, Ishigaki. These studies may contribute to a better understanding of collaborative research activities among the countries as well as provide some information that may be used as guideline for the development of methods of improvement, with emphasis placed on low-input technology and sustainable crop production for rice-growing countries.

Dr. W. Chaitep
Soil Scientist, Rice Research Institute,
Department of Agriculture,
Bangkok, Thailand



Preparation of liquid culture media and staining of roots to detect mycorrhiza infection

IRRI-Japan Seminar and Shuttle Research Review

The meeting was held during the period 27-28 April at the Tsukuba Koryu Center (Tsukuba Bioscience Hall) which is located next to the National Institute of Agrobiological Resources.

The review was organized by IRRI and TARC supported the meeting as one of the collaborative institutes in the Shuttle Research Project initiated in 1990 by the fund provided by the Japanese government. Dr. S. Tsuru, former Director General of TARC and current IRRI Board Member, opened the meeting. Dr. M. Kobayashi, DG of TARC, welcomed the participants, about 60 in total.Eleven papers were presented. Drs. K. Nakashima and N. Murata of TARC presented a report on Rice Yellow Dwarf (RYD) disease which is caused by a Mycoplasma-like Organism (MLO).

Four scientists came from IRRI headquarters; Dr. K. S. Fisher, Deputy Director General for Research, Dr. T. W. Mew, Head of Pathology Division, Dr. J. Bennet, Senior Researcher, Plant Breeding, Genetics and Biochemistry Division and Dr. T. Hutchcroft, Head of Information Center.

Dr. Fisher Introduced New Frontiers in Rice Research. He emphasized the importance of striking a balance between the need for increasing food production and concern about the protection of the environment for the generations to come. To cope with the alarming trend in yield decline in the major irrigated rice areas, breakthroughs are needed.

Dr. N. Kurata of NIAR briefly introduced Rice Genome Research in Japan. New methods in genome analysis such as RFLP (Restricted Fragment Length Polymorphism) and RAPD (Random Amplified Polymorphic DNA) have been increasingly adopted. The meeting provided a good opportunity for researchers in general to learn about the recent advances in rice gene analysis.

Dr. Yoshimura, Kyushu University, and Dr. Mew, IRRI, reported the results of BLB (Bacterial Leaf Blight) resistance gene analysis based on the studies on gene identification carried out by Drs. Ogawa and Yamamoto at IRRI.Dr. H. Kato, Nat. Agr. Res. Center, reported on Allelic Relationship in Wide Compatibility Genes in place of Prof. H. Ikehashi, who had initiated the studies of compatibility at the Okinawa Branch, TARC.

In general, the projects are carried out over a three-year period. Seven projects out of 10 were completed in 1993. Three of the completed projects were suitable for new developments. IRRI now invites applications from Japanese researchers to the new projects for the next 3-year period.

Under the IRRI-Japan Special Collaborative Project, two researchers, Drs. M. Yamauchi, a plant physiologist and T. Imbe, a plant breeder, are currently carrying out research at IRRI in addition to Dr. H. Koganezawa, a plant virologist, who is an IRRI member.

Challenge to sustainable development of savanna
— Collaborative research program between CIAT and TARC —

Norihisa Kitahara and Kensuke Okada

The vast expanse of grasslands with scattered trees and bushes as far as the eye can reach is one of the typical landscapes in the SAVANNA. The South American continent consists of 240 million hectares of savanna only utilized for low-input extensive cattle grazing. Although the savanna is characterized by a warm climate and abundant rainfall in general, the productivity is very low and management is difficult. In areas where intensive agricultural development was initiated (e.g. some parts of the Cerrados in Brazil), the soils are undergoing severe degradation.

Thus, in order to increase the productivity of the savanna in a sustainable manner, TARC initiated collaborative research projects with the International Center for Tropical Agriculture (CIAT) in Colombia and has sent seven researchers to both the Tropical Forages Program and Rice Program of CIAT so far.

CIAT implements 4 programs (Tropical Forages, Beans, Cassava and Rice) and has contributed to the improvement of these crops for more than 20 years. However CIAT has been reorganized and it has added 4 new programs (Savanna, Hillside, Forest Margin and Land Use) in 1992 to meet the new challenge of resource management. The savanna is one of the major target eco-regions.

Development of improved pastures

TARC's collaboration for the improvement of native grass pastures to increase the productivity was initiated in 1977 and six researchers have been dispatched to the present.

The theme of the collaborative studies in the first stage (1977-84) was as follows: 1) development of a simple method for quantitative evaluation of the status of pastures, 2) studies on the relationship between burning, grazing and vegetation changes. At the same time, the importance of the use of legumes was emphasized.

For the second stage since 1984, studies on the improvement of tropical pastures through the introduction of legumes have been promoted by the use of macro-pellets of fertilizers with coated forage seeds for overseeding.

The macro-pellet method aims at low-cost pasture establishment. The placement of the fertilizer and seeds in the same area reduces the amount of fertilizer and seeds used compared with conventional methods for establishment. The most appropriate components, size of pellets and concentration of fertilizers in the pellets have been determined by the researchers. A field trial of this method using herbicides and no-tillage system was undertaken at Carimagua in the Eastern Plain of Colombia. The use of seed-coated macropellets has resulted in satisfactory early-establishment and subsequent vigorous growth of legumes.

The method consisting of direct sowing of macro-pellets can also be applied to hillsides or mountainous sites where the use of machines is difficult and where run-off prevails. This method is suitable for farmers with small holdings who do not own machines for cultivation.

The sowing time most suitable for the establishment of the seedlings to minimize stresses associated with insect attacks and drought should be determined.

In future, the collaboration of TARC with the Tropical Forages Program of CIAT should be expanded and include animal production as well as pasture improvement to promote the increase of beef and milk production in Latin America.

An Arachis pintoi plant emerging from a macropellet (Photo by N. Kitahara)

Improved upland rice variety (tolerant to acid soils) grown in the Llanos (Photo by K. Okada)

Upland rice tolerant to acid infertile soils

A new collaborative project with the Rice Program of CIAT was initiated by dispatching a crop physiologist in 1992. This study aims at analyzing the physiological mechanisms controlling the adaptation of upland rice to acid and infertile savanna soils. Although the combination of rice and savanna may not be familiar, a new technology referred to as "rice-pasture system" is in fact changing the savanna dramatically.

Research carried out at CIAT for a period of 10 years and the national program of Colombia enabled to develop the first high-yielding rice variety adapted to the savanna soils. In the rice-pasture system, farmers plant this variety of rice and improved pasture crops at the same time. Rice is harvested after four months and cattle are grazed on the pasture. Rice is the most important crop for direct human consumption in tropical Latin America. The studies carried out at CIAT have shown that the application of this technology results in the increase of both rice and beef production significantly.

In this collaborative project, 1) the analysis of the physiological mechanisms of acid-soil tolerance, 2) development of screening methods and 3) identification of the genes responsible for the tolerance will be pursued for further genetic improvement of upland rice in the savanna.

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