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Newsletter

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Demonstration/experimental field for extension officers in Thailand in collaboration with Japan (Photo by S. Kosugi)

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FOR INTERNATIONAL COLLABORATION

TARC

TROPICAL AGRICULTURE RESEARCH CENTER

Some Considerations on the Dissemination of Technology in Developing Countries

Ryozo Matsuyama

One of the major challenges for the agricultural extension systems in the developing countries is to bridge the wide gap between the yield level in the fields of experimental stations and that in farmers' fields. The differences between the yield levels, however, indicate the potential of extension services for raising the productivity in farmers' fields.

Since the dissemination of technology is ultimately targetted to farm, forestry and fisheries households, the techniques developed must be acceptable to them. For technology to be acceptable, it must generate profits, for example, it must bring about higher yields. At the same time, it must be applied under the socio-economic conditions prevailing in the respective countries. For example, regardless of whether new varieties are high-yielding, they will not be readily accepted by the farmers if the amount of fertilizers and pesticides required for their cultivation exceeds that used for the production of traditional varieties or if the farmers are not familiar with the use of such inputs, for example agricultural machines and if they cannot afford to buy them.

Before a technique is introduced to a developing country for dissemination, it is important to carefully assess the technology level of the country and the socio-economic conditions for its eventual acceptance by the farmers.

Unless a technique brings about a stable level of production, it cannot be readily adopted. In this regard, techniques can be classified into four groups based on the degree of stability of production and level of production.

1) low stability, low production
2) high stability, low production
3) low stability, high production
4) high stability, high production

Needless to say, although the ultimate objective is to disseminate techniques belonging to the fourth group, in many instances the conditions cannot be met from the beginning. It is thus preferable to start with the dissemination of techniques with a high degree of stability of production but low level of production (group 1) and gradually proceed to the dissemination of those characterized by a high degree of stability of production and high level of production (group 4). In the developing countries, in some cases, farmers apply techniques with a high degree of stability, even if the level of production is low (group 2). This situation does not imply that the farmers resist technological progress and are reluctant to abandon traditional techniques which they had practiced for so long. This attitude can be rather ascribed to the fact that these techniques have enabled the farmers to secure stable yields with a limited use of fertilizers or pesticides and yet to record a low rate of damage by pests and diseases due to the experience accumulated over a long period of time.

In many developing countries there are extension services as well as research institutes and stations. Yet the extension of technology is sometimes not successful because the techniques are not sufficiently backed up by field experiments carried out by the researchers themselves. To alleviate this shortcoming, the system adopted in Japan could be proposed. When a technique is developed at a research institute, it is carefully evaluated by technical experts from the extension services before being conveyed to extension officers who disseminate it to farmers after testing it in demonstration plots. In addition, the researchers at the institute confirm the suitability of the technique by carrying themselves field experiments.

In conclusion, since technology contributes largely to the stabilization and increase of production, continuous efforts should be made to develop and improve techniques adapted to the conditions prevailing in the respective developing countries along with promoting their gradual dissemination.

A substantial part of the resources, material as well as human, allocated to international cooperation should be directed to this objective. Means have to be identified and applied to make available to farmers new technologies. Strategies have to be devised to speed up the flow of information, by utilizing recent developments in mass media including audio-visual and electronic equipment which could provide farmers living in remote areas with ready access to up-to-date information on new farming technologies, as a substitute for printed materials which may be of limited use due to literacy gaps.

Mr. Ryozo Matsuyama, Adviser to TARC. Executive Director of Japan Agriculture, Forestry and Fisheries Promotion Association, President of Japan Rural Youth Education Promotion Association. (Please see the TARC Newsletter Vol. 3, No. 3, 1992)

In addition research should be promoted to develop methods to improve the marketing channels for farm products and motivate farmers to purchase inputs to increase agricultural production. Holistic approaches are needed, involving researchers in both natural and social sciences, for clarifying the mechanisms controlling the integration of the agricultural sector within the national economy as a whole. Extension of technology should greatly benefit from such knowledge, through the identification of the channels to which available resources would be directed.

International Symposium on Fruit Production in the Tropics and Sub-Tropics (Kyoto, 1994)

TARC is pleased to announce that the next International Symposium will be held in Kyoto, Japan, under the title: "Fruit Production in the Tropics and Sub-Tropics" during the period 23-24 August, 1994, as a satellite symposium of the XXIVth International Horticultural Congress.

Exportation of banana, avocado, mango and pineapple from the tropics and subtropics contributes to the development of the national economy in the respective countries. Production of these fruits also plays a major role in the international food trade worldwide. On the other hand, fruits from the temperate zone are introduced to and cultivated in the tropics and subtropics for domestic consumption and as new export products. However, the environmental conditions prevailing in the tropics and sub-tropics are not always suitable for the cultivation of fruits from the temperate zone. To alleviate the constraints on the production of tropical, subtropical and temperate zone fruits in these regions, there is an urgent need to develop appropriate technologies.

During the symposium four subjects will be covered as follows: 1) collection and utilization of tropical and sub-tropical fruit tree genetic resources 2) pest control of tropical and sub-tropical fruits, 3) storage and postharvest physiology of tropical fruits, 4) cultivation of temperate zone fruits in the tropics and sub-tropics, as well as a keynote address on the role of fruit production in the tropics and sub-tropics.

Scientific advances and strategic papers on fruit production in the tropics and subtropics will be contributed on behalf of several countries (Thailand, India, Malaysia, Brazil, Philippines, Indonesia, etc.) and research organizations (IBPGR and TARC).

Reorganization of TARC into a new Center on October 1, 1993

The Tropical Agriculture Research Center which was established in 1970 has contributed to the development of agriculture in the developing countries by carrying out collaborative research aimed at increasing the output of agricultural and forestry products in the tropical and subtropical zones. Moreover the Center has promoted a wide range of collaborative research activities by compiling and evaluating information relating to technology overseas in addition to the development and systematization of techniques adapted to the conditions prevailing in the respective regions and the implementation of a research program on basic advanced technology in Japan.

However, in addition to the difficulties in securing enough food for the rapidly growing population of the developing regions, environmental problems occurring on a global scale must be addressed, including the disappearance of tropical rainforests, the progression of desertification, the erosion of genetic resources, etc. To solve these problems, the international community is confronted with the important task to promote collaborative efforts to achieve sustainable development of agriculture, forestry and fisheries in harmony with the environment. In particular, to fulfill its responsibility toward the international community, it is essential for Japan to further promote research collaboration in the field of agriculture, forestry and fisheries in the developing regions.

To achieve this objective, the TARC will be reorganized into a new center tentatively designated as "Japan International Research Center for Agricultural Sciences" on 1 October, 1993 to promote international research collaboration for agriculture, forestry and fisheries along the following lines.

Increase in the number of researchers: The number of staff members will be raised from 145 presently to 167, including 123 researchers in order to further increase the number of research projects as well as improve their quality. A multi-disciplinary approach will be adopted for certain research programs.

Expansion of the areas targetted for research collaboration: The areas targetted for research collaboration will not be limited to the tropical and subtropical zone but will cover all the developing regions.

Expansion of the fields for research collaboration: In addition to the research collaboration activities in the field of agriculture, animal husbandry and forestry, research will cover fisheries to provide a supplementary source of protein to the growing populations of the developing regions.

Promotion of collection and analysis of information: Plans are being made to further promote the collection and analysis of information pertaining to the developing regions as well as improve the coordination with related organizations in Japan so as to implement more effectively the programs of research collaboration. In addition, the Center will conduct surveys to strengthen socio-economic studies.

Promotion of closer links: The relations between the Center and Japanese organizations such as Japan International Cooperation Agency (JICA) as well as international agricultural research centers affiliated to the CGIAR will be promoted. In addition collaborative research on a trilateral basis, namely between the new Center and organizations from both developing and developed countries will be undertaken.

The establishment of the new Center should contribute to a more effective implementation of collaborative research programs in the field of agriculture, forestry and fisheries to address environmental problems so as to promote sustainable development of agriculture, forestry and fisheries in the developing regions along with enhancing the research capability of the researchers working in these regions and broadening the scope of research in Japan.

(continued from p. 5)

The clay mineralogical composition was not appreciably different among the horizons of each profile. All the profiles contained smectite, kaolinite, illite, vermiculite, chlorite and their interlayered minerals. In general, smectite was predominant or the major mineral in the soils, reflecting the weathering conditions associated with high salt contents. On the other hand, kaolinite was not a major mineral in the soils, suggesting that the parent materials were not appreciably different. Since the content of kaolinite did not differ significantly throughout the profile, it is suggested that kaolinite originated from parent materials and was not associated with the soil-forming process.

The soils from this area contain a large amount of mineral nutrients, and weatherable clay minerals as 2:1 type layer silicates. It is concluded that the soils exhibit a high chemical activity, and high capacity to preserve plant nutrients. If the water resources could be improved, this area may become good arable land.

* Xinjiang Institute of Biology, Pedology and Desert Research, Academia Sinica, PR China

	Colluvial fan				Colluvial fan	Dried delta and Small sand dunes	Alluvial plain		Colluvial fan	Eroded mountains
	Upper	Middle	Lower							
Soils	BD	BD, IC	M, CA		BD, IC	BD, WI, IC, AS	IC, CA, S, WI	Salt crust	BD	BD

Soils: BD, Brown desert soils; IC, Irrigated cultivated soils; M, Meadow soils; CA, Cultivated-aquic soils; WI, Warped irrigated soils; AS, Aeolian sandy soils; S, Solonchacks

Fig. 1. Relationship between the geographical conditions and soil characteristics and use in Turpan Basin

《Plant Physiology》

Influence of Heat Stress on Cabbage

Ottmar A. Welker, Shigeki Furuya and Daisuke Matsumoto*

The objective of the studies was to investigate the effect of high temperature on cabbage cultivars with different heading abilities and to determine whether there were cultivar differences in the properties of epicuticular wax, growth parameters such as leaf number, leaf area and dry weight, photosynthetic activity, transpiration and diffusive conductance and whether these factors contribute to head formation under heat stress. Four cabbage varieties including the Japanese heat-tolerant cultivar "Sousyu" were grown in pots at different temperatures in growth chambers.

The stability of wax differed with the varieties. The wax of "Kinsyun" melted at a temperature of 32°C during the day and 29°C during the night, while the wax of the other varieties was more stable. The density of the tubes, plates or fibrils could be observed by light reflection. For "Kinsyun" as the low density caused a low reflection, the leaf color was green, while for "Sousyu" the leaf color was blue/white, for "Akiou" green/blue and for "Braunschweiger" blue. In considering the fact that pictures taken by SEM are not easy to interpret and that the high humidity and low light intensity in the growth chambers also influenced the leaf surfaces, we concluded that the function of cuticular waxes in limiting cuticular transpiration is a product of the architecture of the deposits and the quantity of wax per unit area of leaf surface. In our experiment neither the wax structure nor the amount of surface wax of eight varieties could be correlated with their heading abilities.

Besides the contribution to dehydration avoidance, the influence on photosynthesis and yield was also demonstrated. Though glaucousness should adversely affect the potential yield due to the reduced photosynthesis associated with the increased reflectance of light, the accompanying lower transpiration rate both in the light and the dark suggests that leaves can photosynthesize longer under stress. At high temperatures the photosynthesis of the four varieties, measured with a stationary URAS was highest for "Akiou" which did not form a head under the high temperature conditions of our experiment while the other three varieties exhibited nearly the same total photosynthetic activity between 20°C and 40°C, the optimum activity occurring at about 25°C. The net photosynthesis decreased between 20°C and 35°C by 34%. The decrease of the real photosynthesis contributed 45% and the increase of the respiration rate 55% to this phenomenon, respectively. Therefore we conclude that the optimum temperature for the photosynthesis and heat tolerance in cabbage are not related and that other factors are involved.

It is suggested that phytohormones like abscisic acid may influence head-building.

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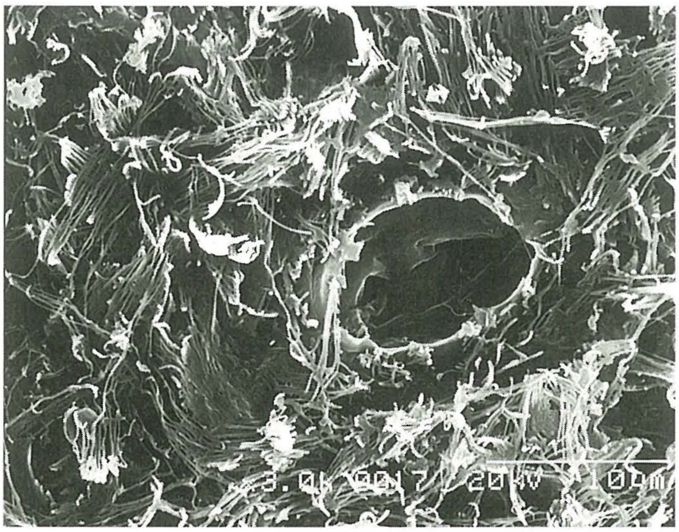

Cultivar "Akiou", stomata and wax-like Fibrils

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"Kinsyun", three-month old leaves, wax-like small plates

《Geology》

Weathering Process of Rock in Tropical Dry Areas

Tamao Hatta

The mechanism of rock-weathering in tropical dry areas is important in studies on desertification. This study dealt with the changes in the chemical and physical properties of standard rocks during experimental weathering. The formation of secondary minerals and the behavior of chemical species in aqueous solution were studied by geochemical simulation which is an analytical method of rock decomposition. The physical weatherability of rocks as a cause of rock disintegration can be determined by the relation between the TMA (Thermo-Mechanical Analysis) values and pore ratio.

Chemical Weathering

The process of chemical weathering can be simulated as a reaction occurring between rock-forming minerals and an aqueous solution. The changes in the amount (grams) of chemical species/1000g of solution and the degree of saturation of secondary minerals were calculated as increments of the progression of the thermodynamical reaction in the hydrolysis of standard granite as an example. The formation of saturated mineral zoning by weathering is consequently represented by the reaction area ($10cm^2$) in the profile (Fig. 1). Satisfactory results were obtained in the alteration to laterite.

Physical Weathering

Physical weathering takes place when rocks on the earth surface are broken into fragments or grains. Weathering by thermal expansion only occurs under very hot and very dry climatic conditions. The behavior of thermal expansion and shrinkage of 14 standard rocks in the temperature ranges of 0 to +100°C and −125°C to +550°C was examined by TMA. Rock samples (3.54mm × 3.54mm × 20.00mm) were cut from large blocks. The TMA values were measured at a heating rate of $5°Cmin^{-1}$. The rocks characterized by a large thermal expansion contain a large amount of quartz. A new stability series of physical rock-weathering can be determined based on the thermal expansion-shrinkage coefficient and the pore ratio in each rock type (Fig. 2). This order reflects the geomorphological characteristics in a desert area.

Weathering Process in Tropical Dry Areas

Although there is no natural water at present, many hydrous minerals (e.g. goethite, gibbsite, kaolinite, etc.) occur on the earth surface in a desert area. The formation of these secondary minerals can be explained by geochemical simulation that describes the water-rock interaction. As natural water is essentially involved in soil genesis, it is considered that the secondary minerals forming soils in a tropical dry area have not been formed under the present climatic conditions.

The rock stability series in physical weathering indicates that the rocks characterized by a large thermal expansion are not prone to weathering, because the pores in rocks play an important role in the alleviation of various environmental stresses. The importance of the thermal expansion coefficient of rocks on the earth surface in tropical dry areas has been well documented. The physical weatherability of rocks can be studied by the determination of thermal coefficients and the physical properties of each rock type.

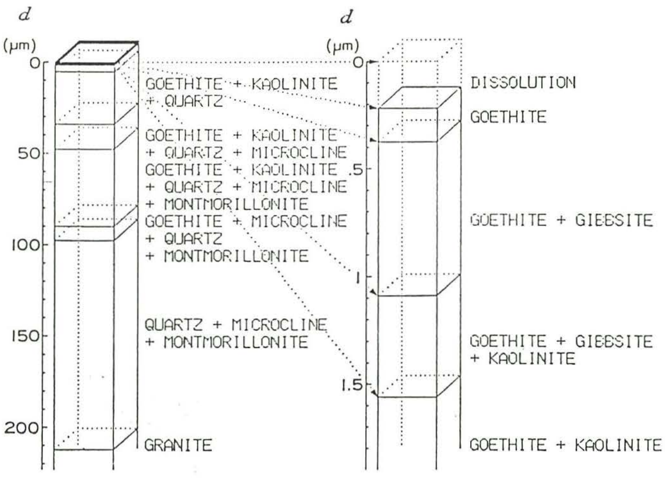

Fig. 1. Mineral zoning in simulated weathering profile d: depth from reaction surface.

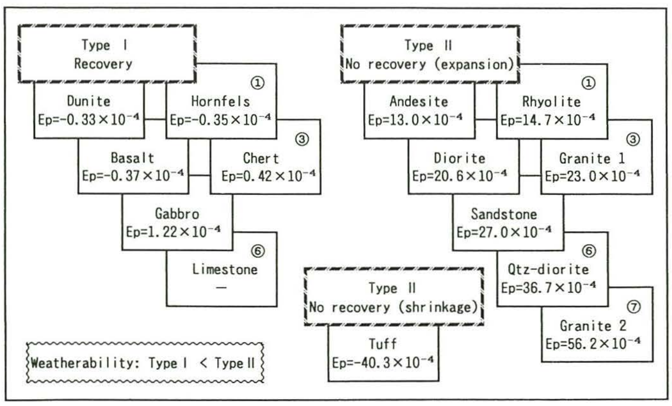

Fig. 2. Rock stability series in physical weathering $Ep = \alpha(1+e)^{-1}$, Ep: index of physical weathering, α: thermal expansion-shrinkage coefficient, and e: pore ratio.

≪Soil Science≫

Soil Properties in the Desert Region

*Makoto Nakai and Zhao Guihai**

In the desert region, climatic conditions are so severe that precipitation is very low and irregular, wind is very strong, and water supply is too low to support vegetation and for leaching of soils. The soils are very easily degraded by human activities, for example cultivation, grazing, or construction of buildings.

There are mainly two types of desert soil. One results from mechanical degradation without soil forming process, while in the other there is some evidence of soil genetic process. The distribution and the properties of desert soils were investigated in the Turpan Basin as an example of a typical arid land, in a collaborative research project, entitled "Environmental Resources of Arid Areas", between the Tropical Agriculture Research Center and the Xinjiang Institute of Biology, Pedology and Desert Research, Academia Sinica, China during the period 1989-1993.

Turpan Basin is located in the southern part of Tiangshan Mountains. The basin is a completely closed system surrounded by mountains without any river running out of the region. The climate is characterized as extreme specific inner-continental arid desertic with an annual precipitation of 16 mm.

Fig. 1 shows the soil distribution profile from north to south in this basin. In the front of the mountains, there are some colluvial fans, with a surface consisting of pebbles, called "Gobi" by the Chinese. The soils on the fans showed a coarser particle size, with a very weak soil genetic process, and small salt accumulation in the subsurface. Ground water level was very low. Outside of the fans, the soils showed a finer texture with a shallower groundwater level, and increase in salt content with the decrease of the altitude. These soils were used for cultivation. The soils around the Ayding-kor lake (elevation is −154 m) showed a very high groundwater level and salt content. A salt crust more than 1 m thick was formed on the earth surface.

The soils showed generally a strong alkalinity and high salinity, represented by high pH and EC values, respectively. The contents of exchangeable cations were also high, in particular the calcium contents. The organic matter content was low or very low in general with mostly less than 1% of organic carbon. The lower horizons were hard to very hard. In general, the closer to the Ayding-kor lake from the mountain area, the finer the soil texture, and the higher the salt contents, reflecting the conditions of sedimentation of the parent materials and soil genetic process.

The primary minerals were analyzed for determining the characteristics of the parent materials. Silt fractions contained predominantly quartz with a small amount of feldspar, while other minerals could not be detected by X-ray diffraction. As the sand fractions were similar to the silt fractions based on microscopic observation, it was assumed that the parent materials of these soils were not different.

(continues to p. 3)

Windblow on saline soil

Letters to the Editor from TARC Visiting Scientists
(Part 3)

Varietal Screening of and Physiological Studies on Rice Salt-Tolerance

Firstly, I would like to express my gratitude to TARC for selecting me as one of the members of the TARC Visiting Research Fellowship Program (TARC VRF Program).

I selected the theme, "Identification and Evaluation of Salt-Tolerant Crops". Dr. T. Senboku, Head of the International Collaboration Research Section, suggested that I take up the topic entitled "Varietal Screening and Physiological Studies on Salt-Tolerant Rice Varieties". I am working together with Dr. S. Tobita, the Japanese co-researcher.

The objectives of the studies are as follows: to analyse the response of rice varieties to salinity stress and, to investigate the mechanism of salt-tolerance in rice.

Soil salinity is one of the major constraints on rice production in South and Southeast Asia. In fact, a wide range of genetic variation in salt-tolerance can be detected among rice varieties. Therefore, it is possible to identify some types of salt tolerance and to introduce them to rice cultivars by adopting various breeding methods.

In the current study, we are investigating the salt tolerance of rice genetic resources with emphasis placed on screening at the seedling stage. We are also studying the physiological characteristics of salt-tolerant rice varieties, for example, through element analyses in the tissues, or protein and isoenzyme analyses. We have received rice seeds from the Rapid Generation Advance (RGA) Laboratory, TARC Okinawa and National Institute of Agrobiological Resources (NIAR), Tsukuba for these purposes.

In addition, in another study under the theme, "Identification and Evaluation of Salt-Tolerant Crops", mutation breeding of rice for salt-tolerance will be initiated using a mutagen, N-methyl-N-Nitrosourea, upon the suggestion of Dr. T. Nagamine, Head of RGA Laboratory.

I do hope that the TARC VRF Program will contribute to further promote the research collaboration between Japan and Indonesia.

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Genetic Resources of Vegetatively Propagated Crops in Bangladesh

Bangladesh is predominantly an agricultural country located in the northeastern part of South Asia between 24°.34'–26°.37' north latitude and 88°.01'–99°.41' east longitude.

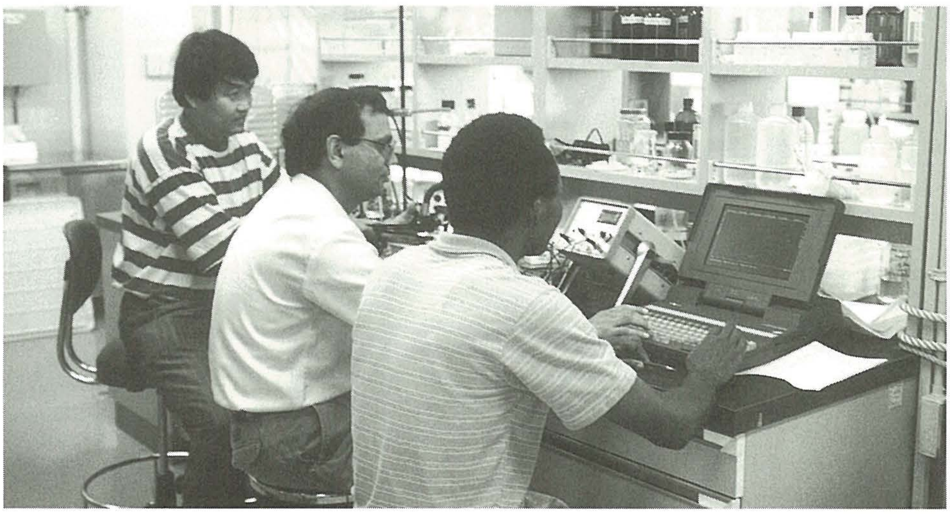
A variety of vegetatively propagated crops with a wide range of genetic diversity accounts for a significant proportion of the total agricultural production and national economy in Bangladesh. These include in the order of importance industrial crops (sugarcane, tea, mulberry, bamboo, betel), fruits (pineapple, banana, mango, litchi, citrus), root and tuber crops (potato, sweet potato, yams, aroids), vegetables [patal (*Cucurbita* sp.), spiney bitter cucumber, drumstick] and spices (turmeric, garlic, ginger). The germplasm of these crops is mainly maintained under field conditions by the institute responsible for the crops. Scientific management of the germplasm in vegetatively propagated crops for *in vitro* and cryo-conservation has not yet been developed in the country.

Bangladesh Agricultural Research Institute (BARI) has set up a Plant Genetic Resources Centre for all the crops except for rice, jute, sugarcane, tea and mulberry. The centre started its operation in 1987 and was in charge of mid- and long-term conservation facilities for crop seeds mainly. Facilities for *in vitro* and cryo-conservation have not been added to this centre due to technical and infrastructure constraints.

Besides the biotic factors, natural hazards like floods and cyclones are very common, leading to the loss of many valuable crop genetic resources. To address this problem and to preserve the genetic diversity within crop gene pool for future breeding needs, it is essential to rescue the land races, old and modern cultivars and also the wild relatives of available vegetatively propagated crops. In this regard, my participation in the TARC visiting fellowship program would go a long way in providing the advanced technical knowledge required in the field of *in vitro* and cryo-conservation of germplasm.

Dr. M. Obaidul Islam
Program Leader,
Plant Genetic Resources Centre,
BARI, Bangladesh

Preparation of samples for chemical analysis



Measuring the effects of heat stress on chlorophyll fluorescence

Study on Heat Tolerance of Broccoli and Chinese Kale on Ishigaki Island

Acid soil (pH=4.4), low soil fertility (Phosphorus=22.7 ppm), some pests and high temperature are major limiting factors for broccoli and Chinese kale production in summer on Ishigaki island (1993). However, proper liming treatment, split application of fertilizer, and appropriate irrigation could eliminate some of the limiting factors, except for high temperature.

Selection of heat-tolerant cultivars and studies on some physiological characteristics of 9 broccoli and 9 Chinese kale cultivars, introduced from Thailand, Taiwan, China and Japan are my major objectives. The selection methods either by the application of the Cell Membrane Thermostability technique (CMT) or growth analysis of the crops grown under a regime consisting of 12 hours of 610 $\mu Em^{-2}s^{-1}$ PAR, 30.8/25.5°C in growth chambers enabled to screen cultivars of Chinese kale with a fairly high heat tolerance compared with that of broccoli cultivars. However, the selection by the CMT technique requires an effective killing temperature and suitable hardening process for particular crops. As suitable killing temperatures, 47.5°C and 50°C were selected for broccoli and Chinese kale, respectively. The effective hardening process that enabled to reveal relative injury differences among cultivars consisted of a 2-day hardening period at 35°C. The results also showed that the heat tolerance of cultivars of Chinese kale, selected by either the CMT or growth analysis method was nearly of the same order unlike that of the selected broccoli cultivars. Some Chinese kale cultivars also showed symptoms consisting of curled leaves at a high temperature unlike the broccoli cultivars.

In all the 5 selected heat-tolerant cultivars of each crop some physiological characteristics are being investigated in a glasshouse at 24°C and 30°C and under field conditions. Although, the temperature this summer ranged from 33°C-35°C in June and July, and was higher than the average temperature of the previous 10 yeares (28.9°C-30.8°C), three of five selected Chinese kale cultivars grew well under hot field conditions as well as low temperature conditions. Three out of the five selected broccoli cultivars exhibited flowering in this hot summer. However, the flowers were smaller than those at low temperatures. There was no correlation between high vegetative growth and flowering of broccoli. Photosynthetic rate, transpiration rate, diffusive resistance and root system are also being analysed to detect mechanisms of heat tolerance in these crops.

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Cooperative Research on Prevention of Drifting Sand in Arid Land

Mingyuan Du

TARC had carried out cooperative research on the prevention of drifting sand in arid land with a STA (the Science and Technology Agency of Japan) fellow, awardee of STA postdoctoral fellowship. The STA Fellowship Program was established by STA in 1988 in order to offer opportunities for young foreign researchers in the fields of science and technology to conduct research at Japan's national laboratories and public research corporations. As a national institute in Japan, TARC is one of the host research institutes. From December 1991 to June 1993, TARC hosted the first STA fellow from the Commission for Integrated Survey of Natural Resources, Chinese Academy of Sciences. The theme of the cooperative research was as follows: "Research on Technologies for the Prevention of Drifting Sand in Arid Land".

Drifting sand, or sand transport on desert surface and desertification have become very serious problems in the world, especially in the arid areas of China. One of the prevention technologies for these problems is the use of windbreaks. Windbreak forests have been used throughout the world, especially in China. However, it takes several years and water is needed to grow a windbreak forest in arid land. Thus, TARC introduced polyethylene russell windbreak nets to arid China for the prevention of drifting sand and wind erosion through the Japan-China Joint Research on Environmental Resources Project (1988-93, 1993-98).

The cooperative research focuses on the effects of windbreaks on the prevention of drifting sand and climate improvement, especially on the effects of windbreaks on real evapotranspiration. Experiments and observations concerning the effects of windbreaks (both windbreak forest and net) on the prevention of drifting sand were carried out at the Turpan Desert Research Station, Xinjiang Institute of Biology, Pedology and Desert Research, Chinese Academy of Sciences. Experiments and observations on the effects of windbreak nets on climate improvement were carried out at Tsukuba Experimental Field, TARC.

The results of the cooperative research have been presented at several international symposia and annual conferences of scientific associations of Japan. Over ten papers were published in journals and proceedings during the 18-month period of cooperative research.

The major achievement was to clarify the functions, processes and effects of windbreak forests and windbreak nets for the prevention of drifting sand and desertification and their effects on climate improvement. The results showed that a single windbreak belt (forest or net) is effective in preventing drifting sand as sand dunes are formed around the windbreak belt. However, sand can still flow through the belt. Therefore, it is suggested that wide multi-windbreak belts including shrub and grass shelter belts, windbreak nets and windbreak forest shelter belts should be considered in the marginal areas of oases to prevent drifting sand and desertification. Windbreak nets may be the frontal and initial belts due to their convenient setup and their benefits: protection of the vegetation against sand blast, control of soil wind erosion, and creation of a microclimate (reduction of evapotranspiration, etc.) conducive to vegetation growth.

Differences in surface water conditions due to differences in real evapotranspiration around two windbreak nets

Research collaboration relating to vegetable crops in Shanghai, China

Masami Morishita

Shanghai is located at latitude 31° N in the northern part of the sub-tropical zone. The mean temperature in a year is 15.7°C (the mean temperature in July and August is 27.8°C and the maximum temperature is 38.9°C). The Shanghai Academy of Agricultural Sciences (SAAS) operates nine research institutes. TARC is carrying out research in collaboration with the Horticultural Research Institute of SAAS. The collaboration research project of TARC with SAAS was initiated in 1986. From 1986 until 1991 studies on the development of heat-tolerant vegetable varieties and cultivation methods to achieve high and stable production of vegetable crops during the hot season were carried out in the first phase of the research collaboration. In 1992, the research program for the development of disease-tolerant vegetable varieties or breeding materials was initiated in the second phase.

Japan-China collaboration research team is composed of three research groups: cucumber, sweet pepper and strawberry groups. Presently there are nine researchers including a long-term researcher dispatched by TARC. The main activities of these research groups are as follows: 1) Analysis of occurrence of main diseases in Shanghai district 2) Development of screening techniques for disease tolerance

Horticultural Research Institute of Shanghai Academy of Agricultural Sciences

3) Breeding of disease-tolerant varieties or materials by using Japanese and Chinese genetic resources 4) Development of disease control techniques by grafting and alteration of sowing time.

The main diseases studied in this project are Fusarium wilt (*Fusarium oxysporum*) and Downy mildew (*Pseudoperonospora cubensis*) of cucumber, in addition to virus diseases of sweet pepper and Crown rot (*Colletotrichum fragariae*) as well as virus diseases of strawberry. Until now, it was observed that the prevalent viruses of sweet pepper in the Shanghai district were TMV-P and CMV. Also some disease-tolerant breeding materials with high quality are being developed in the case of cucumber and sweet pepper. In the case of strawberry, superior seedlings were selected from hybrid-populations between Japanese and Chinese genetic resources and virus-free plants of the leading varieties 'Hokowase', 'Toyonoka' and 'Reiko' were produced by stem culture technique.

Breeding material of cucumber derived from Japanese variety 'Rensei' (Photo by Q. Xu)

Studies on leaf-cutting ants at UNESP, Brazil

Katsuya Ichinose and Luiz Carlos Forti

Leaf-cutting ants (Hymenoptera: Formicidae) belong to the tribe Attini, which is composed of about 200 species. They cut leaves, flowers and fruits in order to culture fungi in their nests. When the fungi grow they form a confluent mass of ball-like particles, gonglidia, which the ants use as food. Since leaf-cutting ants do not directly live on raw materials from plants and exhibit physiological mechanisms to reduce toxins in plants, there are few species of plants which they cannot, or just do not, use for the culture of fungi. In particular, since they prefer cultivated plants to native ones, before World War II, sometimes farmers were forced to abandon areas infested with the ants. Thus, the ants were recognized as the most important pests in the New World since human beings started agriculture there.

In the 1950s, a very strong pesticide, named Mirex, was developed in the U.S.A. The chemical was found to be effective also for the control of leaf-cutting ants and many farmers used it in their fields. However, since the chemical was considered to be a carcinogen in the 1970s, its application to fields had been banned until the early 1990s in all the countries, including Brazil where the use of the pesticide was prohibited in 1992. The use of Mirex had enabled to control leaf-cutting

An abandoned forest of eucalyptus due to damage by leaf-cutting ants

Leaf-cutting ants carrying a soybean grain. The ant on the bean is protecting the loading ants from parasitic flies

ants from cultivated areas until the "ban". At present, although Sulfluramide is being used as a suitable substitute for Mirex, some problems remain to be solved: e.g. concentration, dose, effect on the environment, etc.

Two strategies for controlling leaf-cutting ants can be proposed. First we could develop other pesticides which show an effect comparable to that of Mirex but would be less toxic. The second strategy which we are currently adopting is to control the ants by using biological factors; e.g. predators, possible competitors, natural substances or plants, etc. To achieve this objective, it is important to analyse the distribution of various species of leaf-cutting ants, their number and the extent of the damage they inflict. Furthermore, studies on their eco-physiological characteristics are essential.

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