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for INTERNATIONAL COLLABORATION

Sand dunes are encroaching on the fields of cotton and caraway which are drought-tolerant in Gansu Province, China. (Photo by K. Toriyama)

In This Issue

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

JIRCAS Forestry Research
− Until Now and Hereafter −

After the Japan International Research Center for Agricultural Sciences (JIRCAS) was restructured as an Incorporated Administrative Agency (IAA) in 2001, a new system was adopted under which research was mandated to be conducted under mid-term plans covering a period of five years each and regularly evaluated every year by outside experts. This year marks the first fiscal year of the Second Mid-term Plan. The major issue in the second term related to research at JIRCAS is that the previous respectively independent research system has been abolished and all research activities have been reorganized into projects. In addition, under the new system, the correlation between research resources (personnel and funds) invested in a project and the quantity of research outcomes can now be objectively evaluated. Currently, it is necessary to establish definite and specific step-by-step objectives and then evaluate our achievements in promoting forestry research every five years.

Forestry research at JIRCAS started in 1971, the year after the Tropical Agriculture Research Center (TARC), the predecessor of JIRCAS, was established. The forestry researches which have been completed so far can be roughly categorized into three areas: natural forests (research on regeneration technology for natural forests), man-made forests (research on forest rehabilitation of degraded areas) and forest industries (research on technologies for utilizing otherwise discarded forest biomass). The three new projects which the Forestry Division is initiating in the Second Mid-term Plan also fit into these three categories. The progress which has been made so far and the perspectives on the new projects in the three research areas are summarized below.

Research on Regeneration Technology for Natural Forests

The research on selective logging of hill dipterocarp forests which is ongoing, started in 1993 when TARC was restructured into JIRCAS and the Forestry Division was subsequently established. To evaluate the effects of selective logging against natural regeneration, we have carried out periodic measurements relating to the growth of regenerated seedlings and the environmental factors around them. This was in cooperation with the Forest Research Institute Malaysia (FRIM). Under the Second Mid-term Plan, we have initiated a new project, “Improvement of selective logging techniques for conservation of genetic diversity in the hill dipterocarp forests of Peninsular Malaysia.” In addition to the range of information accumulated, such as growth census and tree location maps at the experimental plots which we supervised for more than ten years, we will employ DNA analyses of selectively logged forests as a new method of research. We will likewise formulate guidelines for selective logging techniques to conserve genetic diversity over a period of five years.

Research on Forest Rehabilitation of Degraded Areas

This is a research project on man-made forests, including agroforestry and forestation using fast-growing species in wastelands, which we started in 1986, in collaboration with the University of the Philippines’ Faculty of Forestry. Today, this research on man-made forests is succeeded by the project “Development of agroforestry technology for the rehabilitation of tropical forests (1990-1996),” which is ongoing at the Forest Research Center (FRC) in Sabah, Malaysia. The project aims to rehabilitate dipterocarps by using a man-made forest of *Acacia mangium* as nurse trees. We have finally developed the technology to grow dipterocarps up to about four to five meters tall within three years of planting. Based on this achievement realized in tropical rainforests, we will carry out a project entitled “Development of techniques for nurturing beneficial indigenous tree species and combined management of agriculture and forestry in tropical monsoon regions” in northeast Thailand, which has a severe dry season, under the Second Mid-term Plan.

Research on Technology to Utilize Unexploited Forest Biomass

This is a relatively new research project on utilization of forest products which was started in 1995, in collaboration with the Science University of Malaysia (USM). We have developed a technology for producing paper pulp, using an environment-friendly technique, from empty fruit bunches of the oil palm that have been discarded after extracting their oil. This project was successfully finished in 2002. However, a new project, “Physical and chemical conversion of underused and unused tropical forest biomass into functional materials in the Tropics” is being launched under the Second Mid-term Plan. Objectives include development of technology to produce boards and biodegradable composites from palm oil and fiber from empty fruit bunches.

Shozo Nakamura
Director, Forestry Division, JIRCAS

Trees of the Dipterocarps shown growing successfully (Forest Research Center in Sabah, Malaysia: Kolapis Experimental Plot)

Improving Plants' Drought Stress Tolerance by Gene Transfer of a Transcription Factor AREB1 Involved in ABA-responsive Gene Expression

Drought, high salinity, and low temperatures are adverse environmental conditions that cause serious damages to plant growth and markedly decrease crop yields in marginal and arid lands in developing countries. Hence, it has become more important to breed environmental stress-tolerant crops to cope with the food crisis and environmental pollution. Genetic engineering has high potentials to improve the stress tolerance of crops using gene transfer technology. So far, several different approaches to improve the stress tolerance of plants by gene transfer have been attempted. In our approach to improve the stress tolerance, a gene encoding a transcription factor involved in ABA-responsible gene expression was used.

The plant hormone abscisic acid (ABA) is produced under drought and high-salinity stress conditions and plays important roles in tolerance to these stresses. Numerous drought- and high-salinity-stress-inducible genes have been reported in plants, and many of them are also activated by ABA. In the analyses of the promoters of such ABA-regulated genes, a conserved cis-element designated ABRE (ABA-responsive element; PyACGTGGC), which controls ABA-regulated gene expression, has been identified. The drought-responsive expression of an *Arabidopsis* gene, RD29B, is mainly mediated by ABA. Two ABREs play a crucial role in the expression of RD29B as cis-elements. By using yeast one-hybrid screening, we have cloned three different cDNAs encoding ABRE-binding proteins (AREB1, AREB2, and AREB3) of *Arabidopsis*. Expression of AREB1 and AREB2 is upregulated by ABA and drought and high-salinity stresses. Both AREB1 and AREB2 function as trans-acting activators, as identified by transient expression analysis in protoplasts.

To determine the temporal and spatial expression patterns of AREB1, we analyzed transgenic *Arabidopsis* plants expressing an AREB1 promoter-GUS reporter gene. GUS expression was observed weakly in roots, leaf vascular tissues and hydathodes in unstressed plants. By contrast, drought or ABA treatment of plants enhanced the AREB1 promoter activity in all tissues (Fig. 1). The subcellular localization of the AREB1 protein in plant cells was further analyzed using a GFP (Green Fluorescent Protein):AREB1 fusion protein. GFP fluorescence was detected in the nucleus indicating that AREB1 is localized in the nucleus of the plant cells.

We created transgenic plants overexpressing the AREB1 cDNA under the control of the CaMV 35S promoter. However, constitutive overexpression of intact AREB1 alone is insufficient to induce the downstream genes such as RD29B under normal growth conditions. The ABA-induced modification of the AREB1 protein seems to be also required for the expression of its downstream genes. To overcome the masked transactivation activity of AREB1, we generated an activated form of AREB1 (AREB1ΔQT) carrying the AREB1 internal deletion mutants containing the bZIP DNA binding domain and transcriptional active domain of AREB1. We generated transgenic plants overexpressing AREB1ΔQT (35S-AREB1ΔQT) and examined the stress tolerance of the transgenic plants. When plants grown in pots were not watered, almost all the wild-type plants died within 12 days. In contrast, nearly all the transgenic plants of two independent lines survived this level of drought stress and continued to grow when watering resumed, which indicates the enhanced drought tolerance of the transgenic plants (Fig. 2). We analyzed upregulated genes in the transgenic plants using microarray and found that eight genes in two groups were greatly upregulated: LEA-class genes including RD29B and ABA- and drought-stress-inducible regulatory genes such as HIS1-3 (encoding a linker histone H1), GBF3 and RD20. All eight greatly upregulated genes have at least two ABRE sequences in their promoter regions, and are known to be ABA and stress inducible. By contrast, an areb1 null mutant and a dominant loss-of-function mutant of AREB1 (AREB1:RD) with a repression domain exhibited ABA insensitivity. Further, AREB1:RD plants displayed reduced survival rate under dehydration. Thus, these data suggest that AREB1 regulates ABRE-dependent ABA-signaling that enhances drought tolerance in vegetative tissues. We think that the activated form of AREB1 may be useful to improve the stress tolerance of agriculturally important crops by gene transfer.

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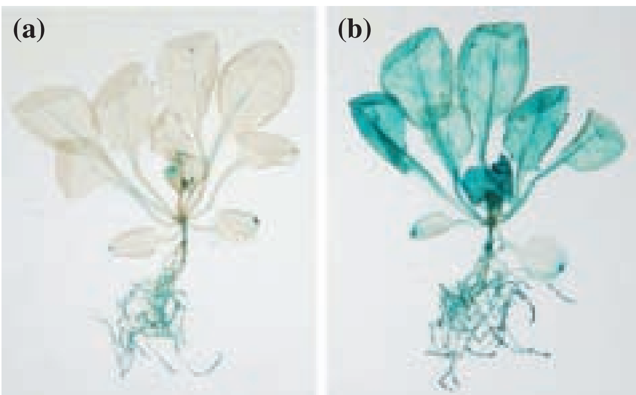

Fig. 1. Histochemical localization of AREB1 promoter-driven GUS expression in *Arabidopsis*: (a) 2-week old plant, (b) 2-week-old plant treated with 50μM ABA.

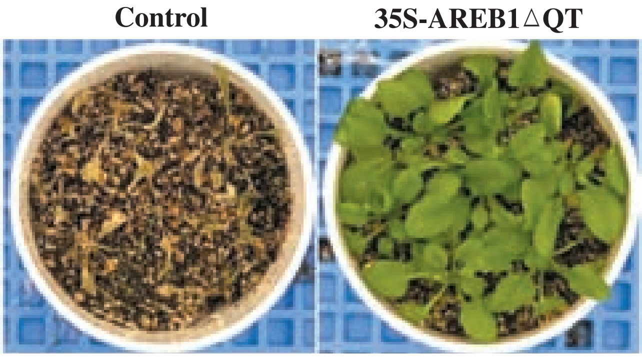

Fig. 2. Transgenic *Arabidopsis* plants overexpressing an active form of AREB1 display enhanced drought tolerance. Watering was withheld from these 3-week-old plants for 12 days, and then rewatering was done for 10 days, before the photograph was taken.

Development of Environmental Management Technology for Sustainable Crop Production in Tropical and Subtropical Islands

Water and soil resources in tropical and subtropical islands are generally poor and scarce. In these islands, recently increasing population has forced farmers to use marginal lands, including low-fertility and hilly areas. The use of these steep slopes for cultivation has however exacerbated drought stress damage to crops and caused river and seawater pollution by eroded soil. Utilizing infertile soils likewise negatively affects the crop yields.

In addition, economic development has allowed the introduction of machine plows and chemical fertilizers into these areas. The use of mechanical plows develops hardpan at the boundary plane between the plowed soil and the subsoil, which accelerates drought damage in crops due to poor infiltration of rainwater and low penetration to the roots. The utilization of chemical fertilizers likewise causes the leaching of nutrients into underground waters. Through this project, we will develop mitigating technologies to reduce water use for crop production, minimize soil erosion and nutrient leaching.

The project is conducted in cooperation with the Bureau of Soil and Water Management in the Philippines. It includes four research subjects as follows;

1. Development of cultivation technologies to increase yield with minimal water use

The advantages of developing a disruption technology for hardpan caused by mechanical plowing in order to maintain and accelerate deeper root penetration, the use of foliar water spray to increase stomatal conductance and a technique for regulating watering time per day to accelerate water absorption will be analyzed. And then, we will introduce these technologies to farmers in the Philippines for practical economic evaluation.

2. Development of soil management technologies to mitigate nutrient leaching

In this project, we are developing techniques to decelerate the release rates of nutrients by quick-acting fertilizers through enveloping techniques using covering paper or clay, or mixing with organic fertilizers. Thereafter, we will examine the effects of these techniques on the amount of nutrient leaching in the fields.

3. Development of technologies to reduce soil erosion

The combination of the use of leguminous crop with no-tillage farming system will be examined and evaluated. This cropping system has a lot of advantages, such as the reduction of water runoff, soil erosion and weed growth as well as a corresponding yield increase due to improved soil fertility. Since this system is not common, the introductory phase of the system will be assessed through participatory approaches in the Philippines.

Photo 1. Floriculture on a hillside in the Philippines

4. Development of evaluation model for water pollution

Through this study, the pollution of groundwater and rivers by eroded soil and leached nutrients in Ishigaki Island will be measured. Likewise, the water purification effect in mangrove forests by aquatic animal activities will be evaluated. And then, models will be developed to evaluate the water pollution cycle. Models will likewise be used to obtain estimates of the large-scale effect of the introduction of developed technologies towards the reduction of soil erosion and nutrient leaching.

For the project, equipped lysimeters and artificially-developed slopes in the Tropical Agriculture Research Front are being utilized. These are also being made available for the use of all collaborative researchers who are allowed to join the project.

Kiyoshi Ozawa
Tropical Agriculture Research Front, JIRCAS

Photo 2. Measurement of water use in plants using weighing lysimeters

Photo 3. Analysis of soil erosion using artificially-developed slopes

Blast Research Network for Stable Rice Production

Rice blast (*Pyricularia grisea* (Cooke) Sacc.) is one of the most serious fungal diseases particularly prevalent in temperate regions, as well as upland areas and rainfed lowlands in tropical zones. Moreover, the damages and infections of blast are also often observed at irrigated rice cultivation areas in tropical regions, thus it is recognized as a big problem for rice cultivation worldwide. To protect from blast damage, many research activities have been carried out. Resistance genes are promised in rice breeding as one of the tools for rice cultivation which are durably resistant against the blast disease, but not enough germplasm for these resistance genes have as yet been identified.

Several scientists had developed some differential systems consisting of differential varieties and blast isolates to clarify the pathogenicity of blast (isolates) races and the resistance of rice varieties at the end of the 1970s. However, the differential system was not sufficient for resistance research of blast because the number of available differential varieties was limited and covered only twelve kinds of resistance genes. Furthermore, several differential varieties could not be applied to the blast isolates from the tropical areas, because these did not only contain specific target resistance genes, but also harbored additional resistance genes in their genetic backgrounds. This means that the differential varieties could not be used so widely and the survey of resistance germplasm still remains to be inadequate.

To solve these problems, a new international standard (universal) differential variety set has been developed under a collaborative research project between Japan International Research Center for Agricultural Sciences (JIRCAS) and International Rice Research Institute (IRRI). The differential varieties harbor only a single resistance gene in their genetic backgrounds and cover for twenty four kinds of resistance genes. In other words, this differential set targets the biggest number of resistance genes as compared with the previous ones and can be applied to the characterization of the pathogenicity of blast isolates (races) worldwide. Moreover, it will make possible the survey of resistance germplasm, development of a universal differential system and differentiation of blast races.

To establish the development of a durable protection system against blast disease, resistance breeding is promising to be one of the most useful methods in developing countries in Asia. It is important to grasp the damage situation in each area, the current research level and to develop a differential system which will be adaptable to each country as a first step. There are limitations to what can be achieved by only one country or organization hence an international collaboration based on network research, which enhances the exchanges of information, rice germplasms and blast pathogens may be the ideal solution for it.

JIRCAS is planning a research project "Blast Research Network for Stable Rice Production" which is targeting the development and distribution of a differential system in Asia, the elucidation of distribution and dynamics of blast pathogens and rice resistance genes as well as a survey of useful resistance germplasms in the Southeast and East Asian countries, such as Vietnam, Philippines, Indonesia and China, in a collaboration with the International Rice Research Institute (IRRI), from 2006 to 2010. For its first year, JIRCAS and IRRI held a workshop "Differential System for Blast Resistance for a Stable Rice Production Environment," which discussed the researches based on the differential system and network collaborations at IRRI, Los Banos, Laguna, Philippines, on the 29th of August, 2006.

New international standard differential varieties (Universal differential variety series)

New differential varieties, which were developed under an IRRI-Japan collaborative research project conducted between JIRCAS and IRRI, harbor a single resistance gene in each genetic background and through these, the pathogenecities of blast isolates were elucidated. A total of 24 kinds of resistance genes were covered by the series and have been distributed to more than 30 research institutes in 15 countries.

Differential system

A method of characterization of the resistance and pathogenecity of rice varieties and blast pathogens, respectively, based on the reaction pattern between differential varieties and differential blast isolates.

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Photo 1. Leaf Blast

Photo 2. Panicle blast

Biological Nitrification Inhibition (BNI) - A Novel Approach for Genetic Exploitation of Nitrification Control Ability in Agricultural Systems

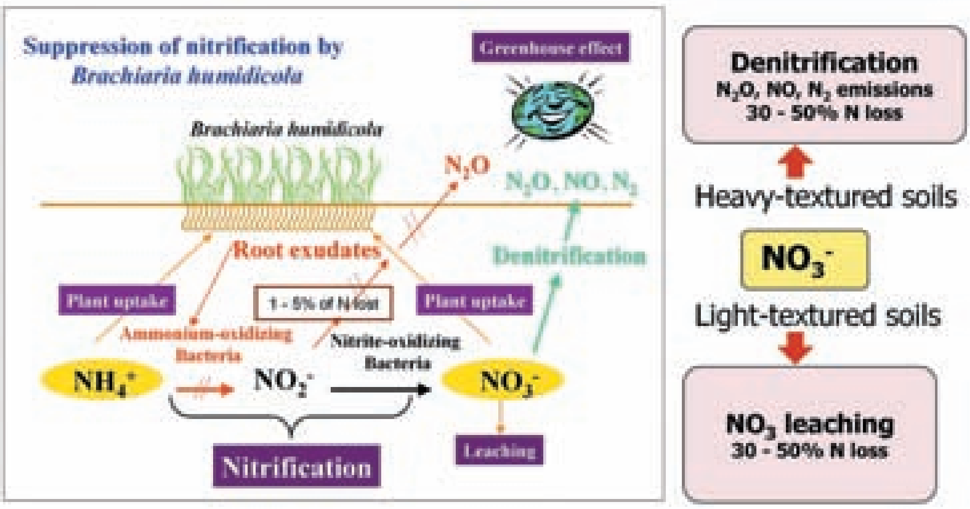
The nitrification or chemical breakdown of ammonium, NH_4^+, by the action of some special soil bacteria into nitrate, NO_3^-, results in the transformation of the relatively immobile NH_4^+ to highly mobile NO_3^-, that can result in nitrogen (N) losses from denitrification (conversion of nitrate into gaseous form) and NO_3^- (nitrate) leaching, causing environmental pollution and inefficient use of both soil N and applied N. Nearly 70% of the N fertilizer applied in agricultural systems is lost, valued at approximately US $17 billion annually worldwide. Nitrification is one of the major underlying mechanisms responsible for the inefficiency in nitrogen use. Suppression of nitrification and keeping soil N in NH_4^+ form can be a key strategy in extending N residence time, improving N recovery and agronomic nitrogen-use efficiency in agricultural systems. This has been amply demonstrated in experiments using synthetic nitrification inhibitors.

Some plants release biologically active substances from roots that suppress nitrification, termed biological nitrification inhibition (BNI), (Fig. 1). A highly sensitive bioassay using the recombinant luminescent bacterium, *Nitrosomonas europaea*, has been developed at JIRCAS to quantify the amount of inhibitory activity produced by plants (referred to as BNI activity) and expressed in units which are defined in terms of the action of a standard inhibitor allylthiourea (AT). Our research results provided the first direct evidence for the existence of BNI activity in tropical pastures, specifically *Brachiaria* spp. *Brachiaria* pastures in general, and *B. humidicola* grass in particular, are known to have high degrees of adaptation to low-N production environments of South America, where they are extensively grown. Substantial amounts of BNI activity can be released from *B. humidicola*, ranging from 7 to 46 AT units activity g^{-1} root dry wt d^{-1}, depending on the genotype. Based on conservative estimations of root mass, at 3 t ha^{-1}, with BNI activity of 17 AT units g^{-1} root dry wt., it is estimated that nearly 51,000,000 units of BNI activity ha^{-1} day^{-1} can be released from *B. humidicola* under optimum conditions. The BNI activity when added to the soil (10 AT units g^{-1} soil), suppressed nearly 70% of the nitrification for up to 60 days.

Several high-BNI and low-BNI genotypes have been identified in the germplasm of *B. humidicola*. The BNI activity release is a highly regulated function and the presence of NH_4^+ in the root environment is critical for the release of BNI activity. The BNI activity, once released, is stable in inhibiting soil nitrification up to at least 60 days. When applied to the soil, BNI activity suppressed nitrate formation and N_2O emissions, and kept a major portion of the added N in NH_4^+ form. Recent (2004-2005) field studies confirmed the BNI function of *B. humidicola* in suppressing nitrification and N_2O emissions. The root exudates from crops such as soybean, in contrast, stimulated nitrification and N_2O emissions. Our ongoing field experiment at the CIAT Palmira experimental site in Colombia suggests that N_2O emissions from soybean field plots were nearly 8-fold higher as compared to those from the high-BNI genetic stock of *B. humidicola* (CIAT 16888).

The BNI activity from *B. humidicola* inhibits the *Nitrosomonas* function by blocking two of the enzymatic pathways (AMO and HAO), which are involved in the oxidation of NH_4^+ into NO_2^-. This is in contrast to the synthetic nitrification inhibitors such as nitrapyrin that inhibit *Nitrosomonas* function by blocking only the AMO (first of the enzymatic reactions in oxidation of NH_4^+) pathway. Thus, it is likely that BNI activity would be much more stable and effective, as the inhibitory action is directed at multiple sites, in suppressing nitrification than the synthetic nitrification inhibitors.

Our research on BNI function, using *B. humidicola* as a case study, shows the potential benefits from genetic exploitation of BNI capacity, a biological attribute. The current agricultural production systems are high-nitrifying as most field crops and pastures do not have the required BNI capacity to suppress nitrification. Our research demonstrates that BNI-capacity in *B. humidicola* is genetic in nature as several high-BNI genetic stocks were identified from its germplasm. It is thus possible to genetically exploit BNI function using the currently available genetic tools and breeding approaches to increase the BNI capacity in *Brachiaria* pastures initially and other tropical pastures (such as *Panicum* spp.) subsequently. Also, it is possible in the future to introduce the high BNI ability into field crops to develop crop varieties with built-in ability to inhibit nitrification through the release of high amounts of BNI activity on-demand (i.e when NH_4^+ fertilizers are added) to suppress nitrification. Our research on BNI thus provides novel approaches to genetically control nitrification and development of production systems that are less-nitrifying and low N_2O emitting, similar to some of the natural forest and grassland ecosystems.



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Final Evaluation Meeting on the "New Soybean Project"

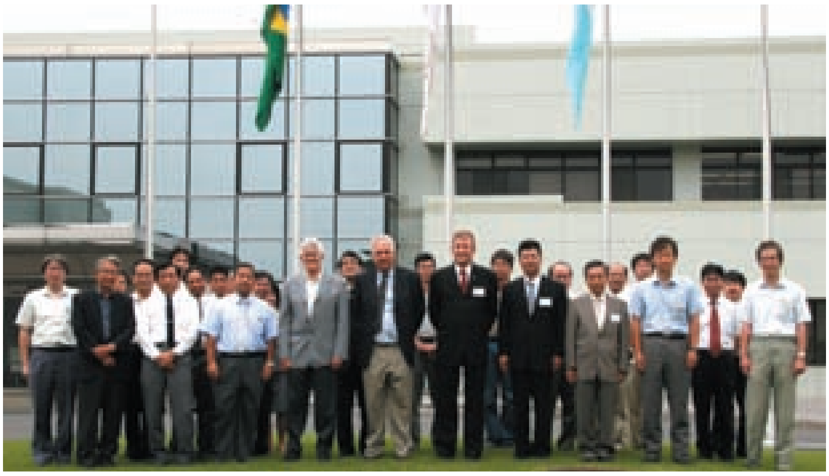
Several South American countries including Brazil, Argentina and Paraguay are major producers of soybean, accounting for almost half of global soybean production. These countries have increased their soybean production year by year, and in recent years have collectively become an extremely important region for the stable supply of soybean in the world. However, the region has suffered serious damages due to a dramatic expansion of total production areas and soybean monoculture.

The New Soybean Project, spanning 4 years from Fiscal Year 2003 to 2006, was launched by integrating and reorganizing the Agro-pastoral Project (1996 to 2002) and Soybean Project (1997-2006). With the completion of the first period of the Mid-term Plan of our Center in Fiscal Year 2005, we also moved up by one year the date when the New Soybean Project was completed. The main purpose of this project was to develop a technology for sustainable soybean production in terms of genetics/breeding, ecological and pathological aspects and by using an agro-pastoral system.

In July 2006, a final evaluation meeting was held to assess the outputs of the past three years of the New Soybean Project, from Fiscal Year 2003 to 2005. The meeting was attended by four members of the Evaluation Committee, including Chairperson Dr. Peter Kerridge, as well as researchers from national and international collaborative research organizations. Although comments from each committee member were favorable as a whole, a more detailed evaluation of individual subjects is being organized. The importance of future efforts for practical uses and follow-up studies was noted. Major outcomes were as follows:

(1) Soybeans in which the DREB gene was introduced were produced, and some of these displayed increased drought resistance under greenhouse conditions. A further detailed analysis of the molecular genetics and a field evaluation will be conducted, aimed at breeding a new soybean variety that is tolerant to drought, which has often occurred in recent years.

(2) In searching for the ability in plants which can inhibit nitrification, a wide range of variation in the genus *Brachiaria*, a forage grass in the tropical regions, was found. Those lines which have a high ability to inhibit nitrification will be utilized for breeding materials.



Final Evaluation Meeting participants

Soybean field in Paraguay

(3) Considerable differences were found between soybean rust pathogens collected from various regions in Brazil. On the other hand, molecular markers for the major genes resistant to soybean rust, which are still effective in South America, were selected. These markers will be used for selecting highly resistant lines to soybean rust in the future.

(4) The main race of cyst nematode in Paraguay was identified as Race 3. This finding will be important for future studies on breeding for resistance.

(5) In agro-pastoral studies in Paraguay, soybean was found to have a higher productivity in areas converted from grassland than in those where soybean had been continuously cultivated.

(6) In the northern part of Argentina, where weight loss of beef cattle in winter is a problem, feeding agricultural by-products from soybeans resulted in weight gain. Therefore, an attempt has been made to establish a feeding standard for commercialization.

Seven researchers, as long-term dispatched experts, and 19 researchers, as short-term dispatched experts, were sent within a period of three years to South America, while 12 counterpart researchers were likewise invited to Japan. In the future, subjects such as breeding of drought-resistant soybean, soybean rust and nitrification inhibition ability will continue to be studied as individual projects.

A Letter of Appreciation was presented by the Soybean Research Center, Embrapa, Brazil, in recognition of the contribution of JIRCAS to the projects.

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Events Commemorating the International Year of Deserts and Desertification 2006

The UN General Assembly declared the year 2006 as the International Year of Deserts and Desertification (IYDD) because 10 years have passed since the United Nations Convention to Combat Desertification (UNCCD) entered into force in 1996. Hence, several institutions including the UNCCD Secretariat, United Nations University (UNU), Tottori University's Arid Land Research Center (ALRC), JICA and JIRCAS held a series of events commemorating the IYDD.

The first event, an international symposium on "Living with Deserts Ⅱ-Dryland Science and Practices on the Ground"was held at UNU in Tokyo on the 25th of August 2006, with 242 participants. Invited speakers from international institutions such as the UNCCD, UNU, the International Center for Agricultural Research in Dry Areas (ICARDA) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) made keynote speeches and joined in the panel discussions. Issues related to deserts and desertifications were tackled via two approaches, from the research angle and from the development side. In the discussions on the research for desertification, it was stressed that the current related researches have not yet caught worldwide attention because the issues were considered to be confined to developing countries. However, as desertification progresses, it destroys vegetation resulting in the decrease of global carbon sequestration potential and biodiversity, as well as the increase of conflict/competition among peoples deprived of the use of their own lands due to land degradation. Thus, desertification issues should be treated as seriously as the global warming issues which have awakened worldwide attention because of their close linkages to developed countries. A need for proactive technologies to predict the occurrence and progress of desertification was also emphasized. From the development side, more collaboration between research and development endeavors should be established and knowledge-sharing must be enhanced through the collation of success stories in development work focused on degraded arid lands.

The second event ,entitled "Role of Citizens in International Contributions," was held in Tottori, Japan, on August 27, 2006 with panelists, including the governor of Tottori Prefecture and the attendance of more than 300 citizens, where the citizenry's role in combating desertification was discussed. A common understanding was reached that Japan's partial dependence for its food consumption on foreign countries threatened by desertification, gives Japan a close connection to desertification issues. The important thing is for the local citizens to recognize this fact, which can activate citizenry actions toward combating desertification.

Finally for the 3rd of the series of events, JIRCAS held its international seminar "Outlook of the Agricultural Research for Dry Areas" on the 29th of August,2006 in Tsukuba City, which was joined in by 63 participants from research institutes and development agencies. Dr. Mahmoud Solh, Director-General of ICARDA, presented a lecture entitled "Reversing Desertification: New Science, New Approach, New Hope." He elucidated the causes, impacts and solutions of desertification with special reference to the CWANA Region (Central and West Asia and North Africa). Stressing the vicious circle between desertification and poverty and the need for proactive research, he likewise mentioned several research topics from ICARDA, including the integrated research for crop-livestock farming in northern Syria, the "Water Benchmark Research" in CWANA region, etc. Dr. Barry Shapiro, Director of ICRISAT, presented a lecture entitled "From Desert to Oasis: the Role of Science and Research in Combating Desertification in Semi-arid Sub-Saharan Africa." In the lecture, he discussed some research topics from a systemwide collaborative research partnership on desertification among CGIAR centers, named "Oasis." Both speakers mutually stressed the need for proactive research to find good desertification indicators. Finally, Dr. Akinori Noguchi, Vice President of JIRCAS, introduced some ongoing JIRCAS research targeting desertification problems such as the "Development of abiotic stress-tolerant crops," "Improvement of the fertility of sandy soils in the semi-arid zones of West Africa through organic matter management" and "Development of a sustainable agro-pastoral system in dry areas of Northeast Asia," among others. Participants made suggestions/comments on the possibility of using saline water for irrigation, utilizing wild relatives for breeding drought-tolerant crop varieties, etc. That same day, the JIRCAS seminar was featured on the NHK news broadcast.

IYDD Symposium in UNU, Tokyo, Japan

As mentioned above, the series of events commemorating IYDD presented an ideal opportunity for the general public as well as for the researchers to raise worldwide awareness for the desertification issues and to recognize the need for collaborative activities to combat desertification, which is as urgent a problem as global warming in this century.

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