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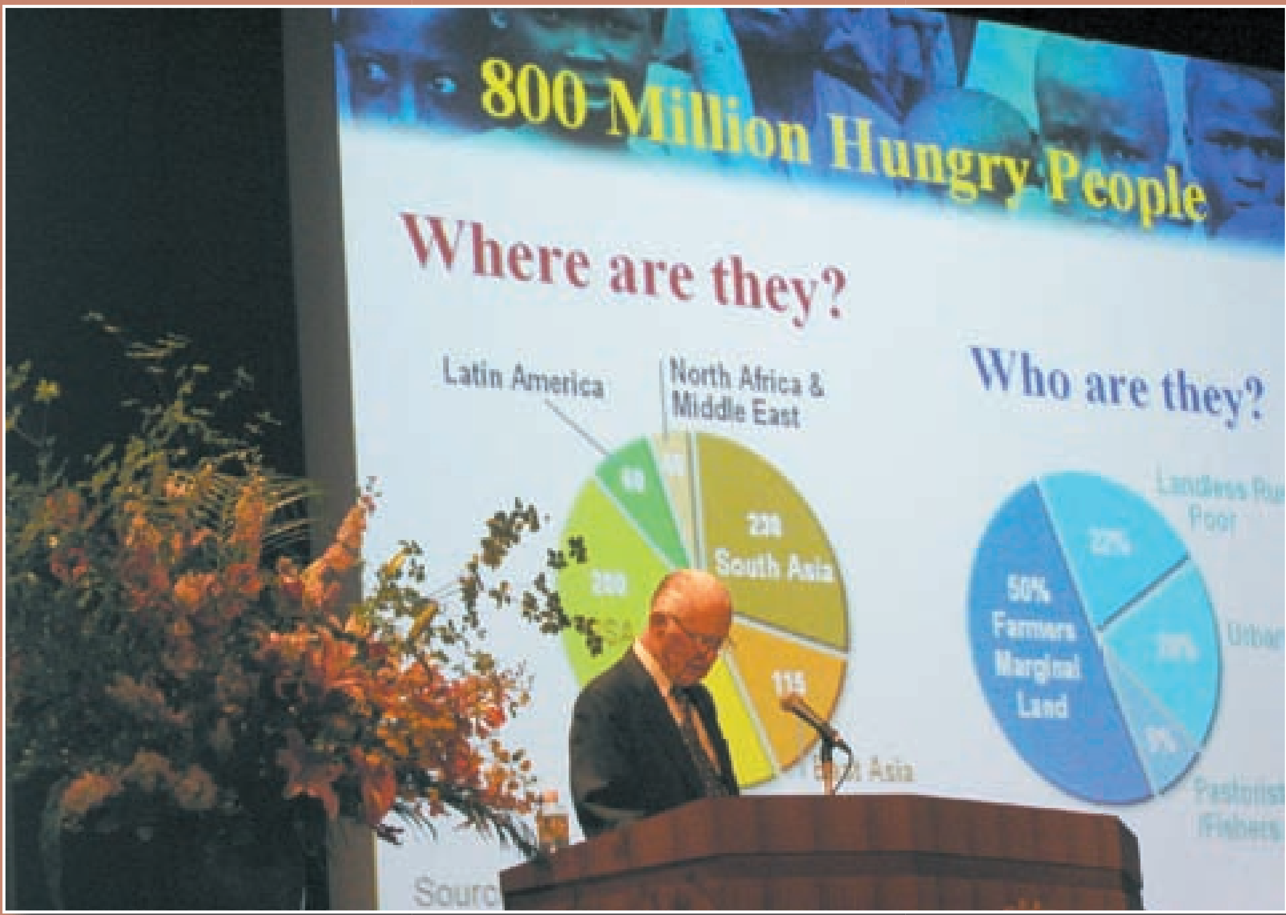
JIRCAS Newsletter for INTERNATIONAL COLLABORATION



A lecture delivered by Nobel Laureate Dr. Norman E. Borlaug(Photo by K. Kosaka)

In This Issue

JIRCAS
JAPAN INTERNATIONAL RESEARCH CENTER FOR AGRICULTURAL SCIENCES

New Goals and Plans for the Japan International Research Center for Agricultural Sciences

1. Introduction

With the ending of the First 5-year Mid-term Goals, the Ministry of Agriculture, Forestry and Fisheries assigned new Mid-term Goals for the second 5-year period to the Japan International Research Center for Agricultural Sciences (JIRCAS), an Incorporated Administrative Agency since April 1, 2006. JIRCAS is now set to pursue research for another five years based on the new Mid-term Plans to efficiently meet the new goals. It is noteworthy that JIRCAS will become a "non-specific" incorporated administrative agency in this new period, a research institute with non-government employees. Legally, the National Public Service Law has ceased to apply to JIRCAS, so it will have to conduct personnel and work management under the Labor Standards Law.

Although JIRCAS will be staffed by non-government employees, its role as a public agency that carries out work for the nation remains unchanged. In other words, the mission of JIRCAS is to promote international joint research for the advancement of agriculture, forestry and fisheries in the developing areas of tropical and subtropical regions. To fulfill this mission successfully, JIRCAS is scheduled to tackle the following targets over a period of five years from 2006.

2. Strategic Activities

(1) Strengthening partnerships

In 2004, JIRCAS, together with the Japan International Cooperation Agency (JICA), other universities and non-governmental organizations, inaugurated the Japan Forum on International Agricultural Research for Sustainable Development (J-FARD) as a venue for providing and exchanging information on international research into agriculture, forestry and fisheries. In 2005, the Center and J-FARD were able to jointly hold a symposium on African issues. Thus, the forum is starting to perform its intended function. JIRCAS aims to enhance domestic alliances, research exchanges and to promote international collaborative research by helping to rally domestic areas of expertise behind J-FARD and actively utilizing its functions.

The Consultative Group on International Agricultural Research (CGIAR) was established by the World Bank in 1971 to safeguard food supplies for developing countries. Funded by its 58 member countries, CGIAR is conducting agricultural research at 15 research centers around the world. In 2004, JIRCAS was designated as a “Focal Point Institution” by CGIAR head-quarters for its contribution to joint research by dispatching more than 10 researchers to research centers in other countries.

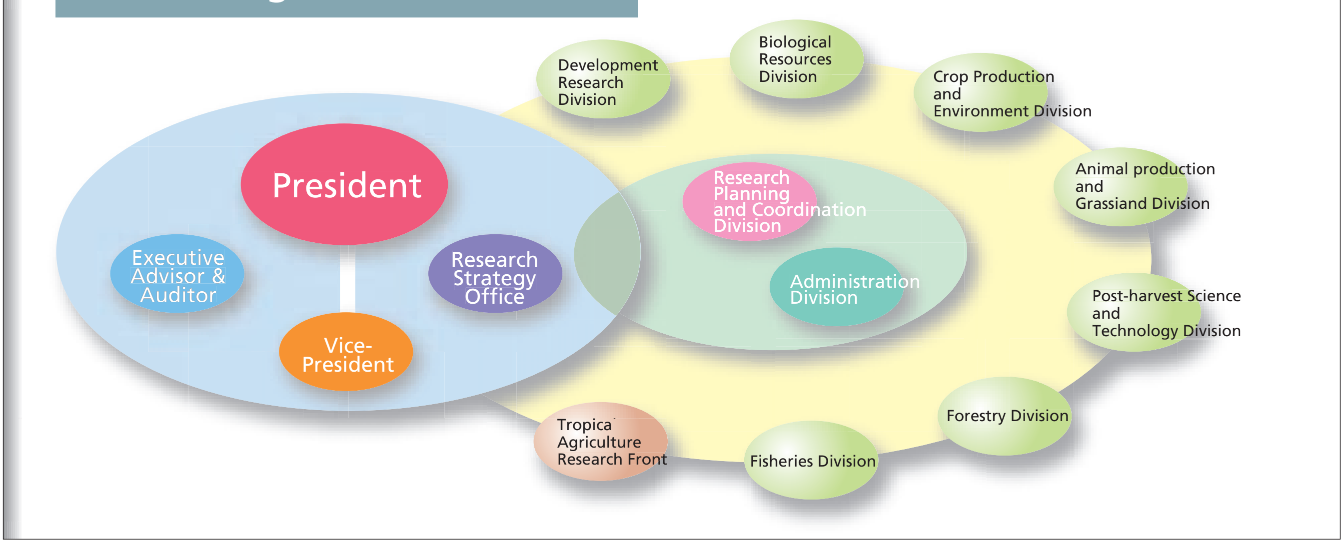
JIRCAS is committed to promoting an active alliance with CGIAR. It will likewise contribute to international research in a more visible way by clarifying the position and responsibility of its researchers working at the CGIAR research centers as “JIRCAS Scientific Representatives.”

(2) Clarification of research cost performance

Research subjects at JIRCAS are organized around the following three Major Tasks with their respective Mid-term Goals.

a. Development of technology for utilizing bio-resources to ensure steady crop production and promote their multiple uses in adverse environments
b. Development of technology for environmental resources management and production control for sustainable production

JIRCAS Organizational Chart



c. Development of technology for clarifying and coping with the impacts of global environmental changes on agriculture, forestry and fisheries

In the Mid-term Plans, there are 17 intermediate tasks aimed at realizing these goals. At the center, we are scheduled to implement the plans for the Second Mid-term Period by setting up one or two project research programs for each intermediate task and by steadily executing these programs after clarifying their research subjects, methods and goals. It will be possible for us to conduct research with a high rate of efficiency if we make clear the research resources (personnel and funds) and the results obtained.

(3) Research focus

One of the most important strategies for incorporated administrative agencies is to allocate limited research resources in order of priority. At the center, we will place emphasis on the following five items.

a. Targeting developing areas, we will carry out research aimed at contributing to the reduction of the world's hungry population by half as indicated in the United Nations' millennium development goals. With the collaboration of the CGIAR research centers, we will develop crops that are resistant to unfavorable environments, resulting from drought, salt damage and disease which make crop production unstable. The DREB gene, discovered by JIRCAS, will be used for the development of such crops.

b. In Asia, where closer scientific and technological strategic alliances are required under the Basic Science and Technology Plan for the Third Period, we will step up our research efforts toward resolving a number of problems from three different approaches-the utilization of bio-resources, environmental resources management and finding solution to global problems, specifically on the environment and food production.

c. Through research and development, we will help to fulfill Japan's pledge to the world to assist Africa, which was made at the Gleneagles G8 Summit in July 2005. To increase agricultural productivity in Africa, we plan to develop technology for improving crops and soil.

d. We will push ahead with the development of technology for local biomass utilization in Asia to help achieve the targets for reduction in carbon dioxide emissions as stipulated in the Kyoto Protocol.

e. There are many small islands in Asia and the Pacific regions. They are especially prone to environmental change, and production activities on these islands tend to disproportionately affect the surrounding environment. JIRCAS is committed to addressing these problems by strengthening operations at its branch on Ishigaki Island, Okinawa, a subtropical island, as a research hub, and taking advantage of its favorable location.

3. Providing information useful for Japan's global strategies

JIRCAS has a special mission, in addition to the duties normally assigned to independent research institutions, such as research, analyses, assessment and holding lectures. It is tasked with collecting, analyzing and providing information useful for gaining insight into global trends in food supplies and agriculture, forestry and fisheries as well as in farming and fishing villages.

No single country alone can solve the Earth's food and environmental problems. Trends in densely populated countries such as China and India, and even small changes in crop production in Russia and the United States, can affect the whole world. We hope to analyze information of this type about food and the environment and make the results of our analysis available to policy-making agencies and the nation as quickly as possible.

We at JIRCAS, where efforts are being made to accelerate research activities to achieve the New Mid-term Goals, will be happy to hear your honest opinions on these issues.

Masami Yasunaka
Director, Research Planning and Coordination Division, JIRCAS

Certificate of Appreciation Presented by Brazil's Agriculture Minister in Recognition of JIRCAS' Research Cooperation

Our research collaboration with Brazil, which started in 1972, has aimed at environment-friendly, sustainable soybean production by integrating agro-pastoral system into the conventional soybean cultivation. Brazil has commenced a program, wherein they plan to improve 22 million ha of degraded grasslands during the 10-year period using the agro-pastoral system, which is one of the major outputs of our collaboration.

Dr. Luis Carlos Guedes Pinto, Executive Secretary of the Ministry of Agriculture, Livestock and Food Supply, visited JIRCAS on March 18, 2006. Then, a Certificate of Appreciation in the name of the Minister of Agriculture was presented to honor JIRCAS' research cooperation through the years.

A Certificate of Appreciation was presented to JIRCAS for its contribution to Brazilian Agriculture on the 18th of March, 2006.

Efficiency of the Combination of Disease-Free Seedlings and Neonicotinoids to Reduce Damage by Citrus Greening Disease

Citrus greening disease is one of the most serious factors limiting citriculture in the world, and no decisive control methods have been established yet. At this moment, the combined management technology of the planting of disease-free seedlings and the application of neonicotinoids is assumed to be most efficient. Nonetheless, this method has not been undertaken widely, probably because no field studies have been performed to prove its efficiency.

Instead of testing the efficiency of this management by field studies directly, we attempted to evaluate the efficiency by asking questions about citriculture to a total of 118 farmers in the Mekong Delta Region. Questionnaires consisted of:1) the seedlings that the farmers used; 2) the use of neonicotinoids (exclusively imidacloprid in the Mekong Delta Region); and 3) the yield from their orchards. We also estimated the proportion of infected trees that showed any development of this disease by eye. In this study, we confined the citriculture in only king mandarin, since this variety is the most popular cultivar in this region. Taking into account the seedlings planted and insecticides used, we distinguished the management control into four groups: disease-free seedlings and neonicotinoids (Free/Chem), disease-free seedlings and no neonicotinoids (Free/No chem), seedlings which were uncertified to be disease-free and neonicotinoids (Uncert/Chem), and uncertified seedlings and no neonicotinoids (Uncert/No chem). The numbers of farmers who performed either of these disease managements were 21, 13, 53, and 31, respectively. Comparing the infection proportion and yield in Free/Chem orchards with those of other combinations, we evaluated the efficiency of this management.

The proportion of infected trees was apparently reduced in orchards where neonicotinoids were applied (Fig. 1). Reduction in the infection was also seen in orchards where disease-free seedlings had been planted, while this reduction was not as clear as that by neonicotinoids. In orchards without neonicotinoids, infection proportion reached 50 % in five to six years after planting, but within seven to eight years in orchards with neonicotinoids. In particular, the Free/Chem management attained the highest reduction in infection rate among the four management techniques.

In the comparison of yields, similar results were obtained: the Free/Chem management promised both the largest yield and the highest longevity. In the orchards where disease-free seedlings had been planted, the first fruits were collected in the second year, while in the other in the third year. The yields in the orchard with neonicotinoids were maximised during the third to sixth years, while those without the chemicals only in the third to fifth years and their yields were much smaller. The longevity of the latter lasted until the sixth to seventh year, but the former still survived for nine years.

The results of our studies suggest that the combination of disease-free seedlings and neonicotinoids would promise the lowest risk of infection by citrus greening, the largest quantity of fruit yield, and the highest longevity for orchards (Fig. 1). However, many interactive factors that would influence the rate of disease infection and yield quantity should be involved in; e.g. the timing of both planting of seedlings and application of chemicals as well as the physical conditions of fields would change the invasion mode of the vector psyllid, inevitably resulting in different development patterns of the disease. Hence, we should perform field studies wherein we include these factors to be analyzed. This is a future issue that must be studied urgently.

Katsuya Ichinose[1], Doan Huu Tien[2], Ryuichi Yamada[3] and Takeshi Kano[4]
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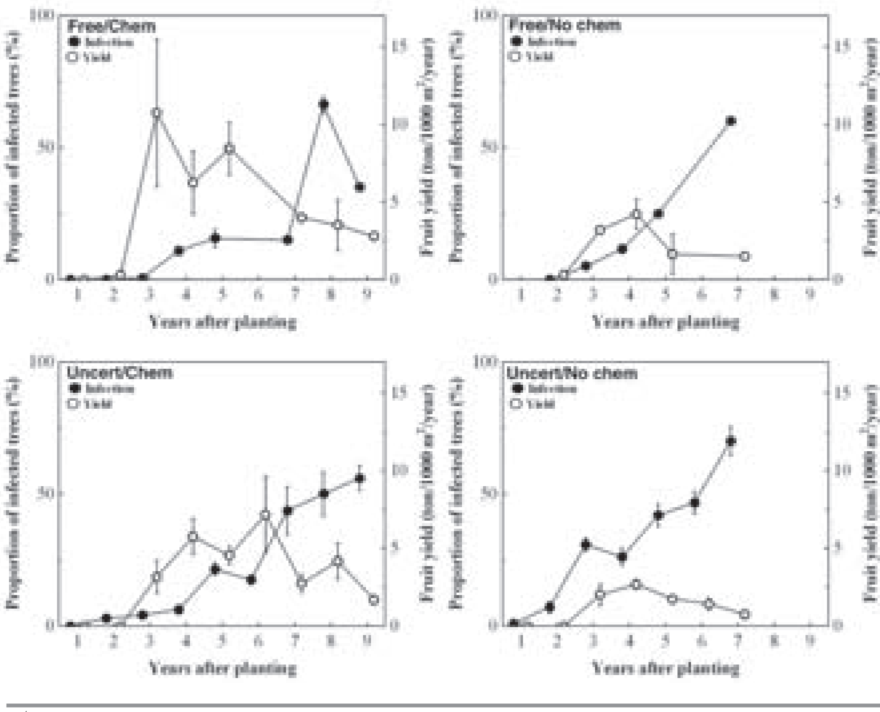


Fig. 1. Means (± SEM) of the proportion of infected trees and yield for each year after the planting of seedlings in orchards, distinguished into four management groups according to the seedlings planted and the application of chemicals: a) Disease-free seedlings planted and controlled by neonicotinoids (Free/Chem), b) Disease-free and no neonicotinoids (Free/No chem), c) Seedlings of which disease-free condition was not certified and neonicotinoids (Uncert/Chem) and d) Uncertified seedlings and no chemicals (Uncert/No chem).

Arachidonic Acid Can Help the Aquaculture Industry to Take-off in Developing Countries

"Hatcheries in the Tropics require arachidonic acid for stable fry production"

Aquaculture contributes significantly to food production, incomes and jobs in developing regions. But, the persistent constraint in aquaculture development is presently the supply of good quality seeds (fry) in quantity. Hatcheries are expected to provide a stable fry supply for farmers, but fry production is often highly variable due to low survival rates. During the period 2002-2005, the Southeast Asian Fisheries Development Center-Aquaculture Department (SEAFDEC/AQD, Iloilo, Philippines) and JIRCAS have collaborated on studies aimed at developing advanced diets to improve the quality and production of eggs, larvae and seedstock for tropical marine fishes.

The most striking difference between cold water fishes and tropical fishes is that arachidonic acid, which is found only in minor quantities in cold water fishes with their high EPA level, is one of the major essential fatty acids in the ovaries, testes, eggs and muscles of tropical fishes from mangrove areas or coral reefs in the Philippines, Malaysia and Ishigaki, Japan. It is notable that the major essential fatty acids in tropical fishes are DHA and arachidonic acid (not EPA) in a ratio of about 2:1(Fig.1). This result suggests that a dietary ratio of DHA/arachidonic acid (not EPA) of about 2:1 or greater can be recommended as an ideal regimen for broodstock of tropical fishes.

Thus, arachidonic acid is a major fatty acid widely distributed in tropical marine fishes and likely important to reproduction and larval/fry performance. However, most studies on essential fatty acids in relation to fry production have been focused on EPA and DHA, and the potential value of arachidonic acid has not been applied to fry production technologies for tropical and subtropical fishes.

In mangrove red snapper, the total egg production and total number of spawns can be clearly improved by being fed a formulated diet with arachidonic acid (5g/kg diet)(Fig.2). Moreover, this diet can increase the percentage of the normal larvae and the cumulative survival rate to more than twice the level of those on diets without arachidonic acid. Rabbitfish fry which are fed rotifers or brine shrimps enriched with a combination of DHA and arachidonic acid always showed the best survival rate(Fig.3). We conclude that adding arachidonic acid to broodstock diets or larval feeds improves seed production tremendously. Improved hatchery production of seedstocks can thereby help aquaculture take off in the developing tropical countries.

Hiroshi Ogata
Fisheries Division, JIRCAS
(Present: Tohoku National Fisheries Research Institute, Fisheries Research Agency)

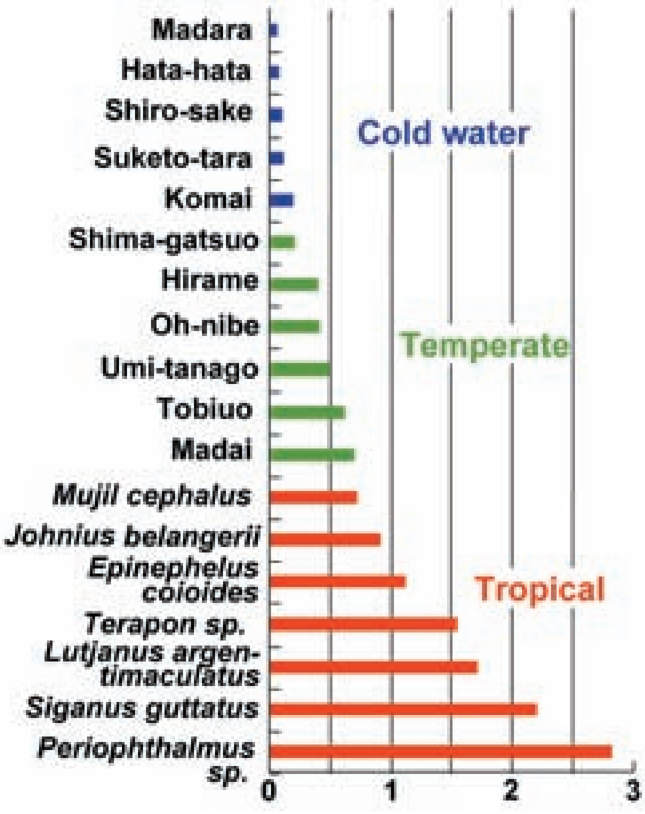


Fig. 1. Arachidonic acid /EPA ratio
Arachidonic acid level is higher in tropical fishes than in cold water fishes.

EPA : Eicosapentaenoic acid (Essential fatty acid)
DHA : Docosahexaenoic acid (Essential fatty acid)

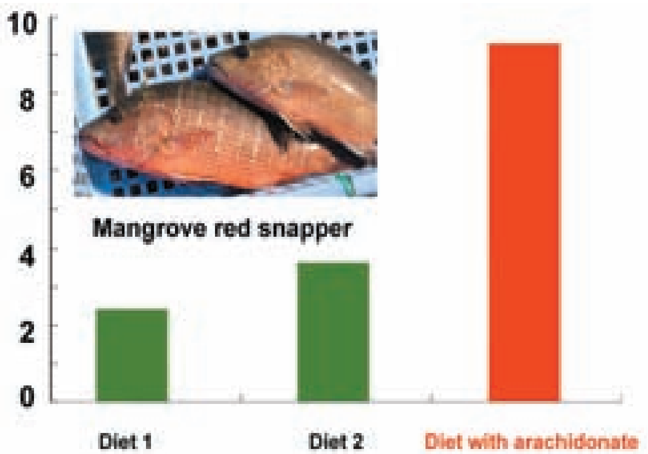


Fig. 2. Total egg production($\times 10^6$)
Dietary arachidonic acid improves egg production.

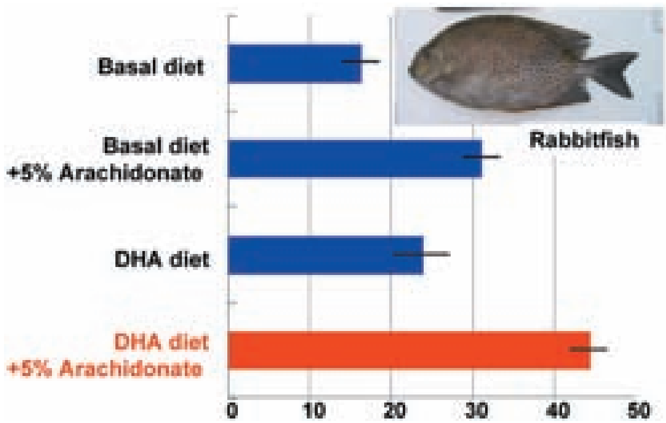


Fig. 3. Survival (%)
Arachidonic acid improves survival of rabbitfish fry.

Development of a Hydrologic Model in Rainfed Agricultural Areas

The simulation model expressing hydrologic processes has attracted interest as an effective tool to depict future prospects for efficient water use in watersheds. However there have been few efforts to apply such a model to crop yield estimations. In response to such indications, this study aims at developing a rice production model based on a hydrologic model.

However, few applicable methods have been proposed for quantitative analysis of rice production at the regional or watershed level. In order to obtain watershed level perspectives for rice production with efficient water use, up-scaling the model from plot unit to watershed unit is required. The objective of this study is to develop a distributed hydrologic model to execute rice yield prediction in a watershed level.

NS (Nong Saeng) Village which was selected for the study site is located about 30 km south of Khon Kaen City. The village is in the upper reaches of the watershed of Muang River, a tributary of Chi River, and has a slightly hilly land area. Lowlands are mainly used for paddy fields; uplands are covered by sugarcane and cassava. Since sandy loam and loamy sand are the typical soil types, the water-holding capacity is basically low.

The study site consists of the application site, the simulation site, and the modeling site. In the application site, grid map data such as land use and soil texture were collected and processed for executing model simulation. Satellite imagery ASTER with the resolution of 15 m/pixel was used for processing grid map data such as land use, surface gradient, flow direction and upstream catchment area. Soil texture map was obtained from soil series map. In the modeling site, rainfall, surface soil water content, ponding depth, and shallow groundwater level were observed; in the simulation site, rice yield estimation was carried out.

The aim of developing the model is to evaluate present rice production system for more efficient water use. For this purpose, a hydrologic model and a rice yield sub-model are required. The hydrologic model calculates the water budget in all the grid cells of the watershed on a daily basis. The modeling site was divided into 15m grid cells. Water budget and movement in a cell is expressed by using a three-story set of storage layers (Fig. 1). Surface layer storage represents ponding depths in paddy fields or depression storage in other land use. Top-soil layer storage represents soil water content from 0 to 20 cm depth; sub-soil layer storage represents the shallow groundwater level from 20 to 100 cm depth. The model computes vertical water movements, and horizontal water movements in 8 directions. The computations are executed from the upstream cells in the watershed.

The water conditions calculated in the hydrologic model are evaluated to predict rice yield in the rice yield sub-model. Rice yield is estimated from yield reduction caused by water deficit at each growth stage. The sub-model estimates rice growth stages on the basis of the timing of transplanting. Heading date is relatively fixed, since farmers in northeast Thailand usually plant photo-sensitive rice cultivars, and can be estimated simply with an empirical equation. We assume linear relationship between water deficits, namely evapotranspiration ratio and yield reduction in this sub-model. Because reduction of the growth length causes yield reduction, the period is also evaluated.

The values of the parameters were determined through simulation trials and field measurements; the same values were used for all calculations. Observed daily rainfall from April to December of each year at one station was used over the watershed as lumped input data in the calculations. In the modeling site, we measured surface soil water content at 30 points using soil moisture meter late in October 2003. The data contributed to confirm the precision of the parameters of the hydrologic model.

The results of the interview survey were used for the parameters of rice yield sub-model such as requisites for the transplanting and attainable yield under actual conditions. The combined model was applied to the simulation site and the rice yield was estimated in the year of 2002 and 2003. The result coincides with the actual yield level; the estimated yield in 2002 is relatively higher than that in 2003 (Fig. 2).

The proposed model proved to be an effective tool for analyzing the land and water resources of rainfed paddy fields. Though the model was specifically developed for the application site, it should likewise be applicable to other similar watersheds in northeast Thailand. The model is also expected to be linked with other research activities in the future.

Kenji Suzuki
Crop Production and Environment Division, JIRCAS

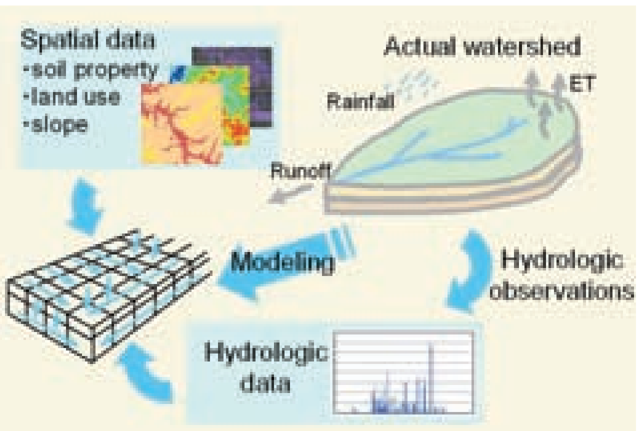


Fig. 1. Concept of the model.

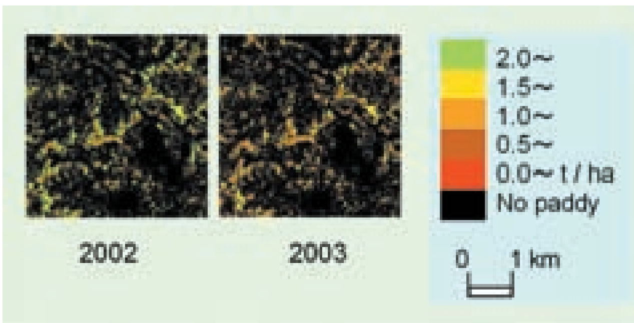


Fig. 2. Results of simulation for estimating rice yield.

Developing Rice That Grows Well Despite Insufficient P-Fertilizer

Phosphorus (P) is a nutrient required by all plants and plant roots usually take up P from the soil. Many tropical regions have soils that do not provide enough P for rice to grow well, so farmers need to buy P fertilizer. Poor farmers often can not afford this expense and as a result, their rice yields are very low.

However, not all rice varieties grow equally poor despite insufficient phosphorus fertilizer. Some tolerate the stress of not having enough P available better than others.

The aim of this project is to find genes that are responsible for this tolerance and to use them in the development of new rice varieties that can grow better and can produce more rice grains even with low P fertilizer.

For the most important gene, named as Pup1 (P uptake), the exact location on the chromosomes was determined and genetic markers were developed. This allowed us to bring Pup1 to intolerant varieties quickly.

NIL-Pup1 is the product of this transfer. It is 99% identical to Nipponbare but contains Pup1 from Kasalath. As a result of bringing Pup1 from Kasalath to Nipponbare, P uptake and plant growth improved fourfold.

By using genetic markers in selection, we avoided transferring undesirable traits of Kasalath (poor grain quality, grain shattering and lodging) together with Pup1.

Together with International Rice Research Institute (IRRI) collaborators, we are now transferring Pup1 into some popular tropical rice varieties that lack tolerance to P deficiency.

Matthias Wissuwa
Crop Production and Environment Division, JIRCAS

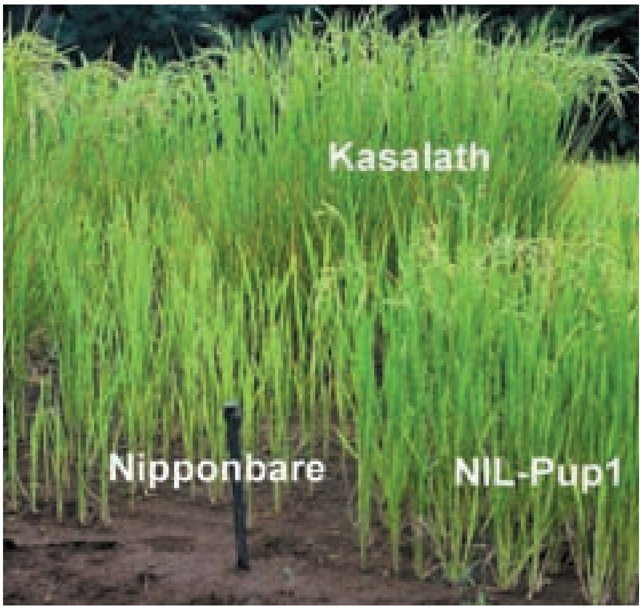


Photo 1. Growth of three rice varieties on a P-deficient soil without P fertilizer.
a) Kasalath, an old Indian variety, shows high tolerance to P deficiency whereas b) Nipponbare suffered from a lack of P. c) NIL-Pup1, the hybrid between Nipponbare and Kasalath with P-deficiency tolerance.

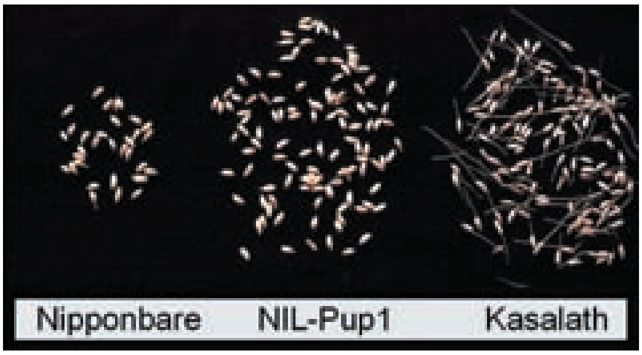
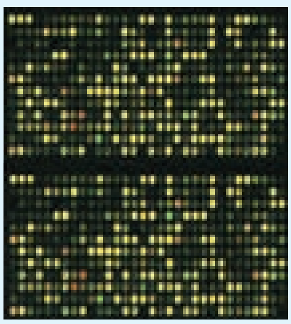


Photo 2. The improved Nipponbare (=NIL-Pup1) not only had higher P uptake thanks to Pup1, but grain yield also increased 4-fourfold.

Cloning the Pup1 gene

Genes like the one on the right (yellow circle) that are activated when stress due to P deficiency increases are good candidates. DNA microarrays (left), allowing us to look at 22,000 genes simultaneously is another tool to find out how Pup1 works. Once we fully understand the Pup1 gene, we can devise new strategies to use Pup1 even more efficiently in improving rice.



A Lecture Delivered by Nobel Laureate Dr. Norman E. Borlaug

- Issuing a challenge to young scientists and students toward international agricultural research -

Inviting over Nobel Laureate Dr. Norman E. Borlaug, the international lecture entitled "Perspectives of International Agricultural Research and Expectations for the Young Generation" was held at Tokyo University of Agriculture on the 29th of May, 2006. About 700 participants, mainly university students, gathered.

Dr. Borlaug insisted in his lecture on the great contribution of the Green Revolution to the global food supply, particularly in conserving the unused lands, and on the necessity of applying science and technology outputs, including transgenic technology, as key toward solving the persisting difficult problems in world agriculture. He also stressed that a wide-ranging support in the area of agricultural development, which is the foundation for peace-building and economic advancement, is essential.

In the panel discussion which followed the lecture, specialists from research institutes, aid agencies and universities, in addition to the lecturer himself, exchanged their views on the current issues of international agricultural research, including personnel qualification and profiles required for this field, as well as the future role of public researches. Dr. Borlaug enthusiastically encouraged the young generation to keep excellent targets for their own success. This lecture was co-organized by JIRCAS with the Japan Forum on International Agricultural Research for Sustainable Development (J-FARD), Tokyo University of Agriculture and Japan Association for International Collaboration of Agriculture and Forestry (JAICAF).

Osamu Koyama
Director, Research Strategy Office, JIRCAS

SYMPOSIUM

"Living with Desert Ⅱ: Dryland Science and Practices on the Ground"

Date/Time: August 25, 2006 / 10:00 - 17:45
Venue: U Thant Conference Hall (3F), United Nations University, Tokyo

The year 2006 was declared by the United Nations as the "International Year of Deserts and Desertification." To mark the celebration, JIRCAS and other Arid Lands Research-related Organizations are now planning this International Symposium.

Information in details will be available on the JIRCAS homepage soon:
http://www.jircas.affrc.go.jp/index.html

PEOPLE

Dr. Shigeo Matsui, the former Director General of the National Agricultural Research Center was appointed as Executive Advisor & Auditor. **Mr. Osamu Koyama**, formerly the Director of Development Research Division was appointed as Director of the newly-created Research Strategy Office. **Dr. Minoru Tada**, the former Senior Researcher of the Development Research Division was appointed as Director of the Development Research Division. **Dr. Shoji Kitamura**, former Associate Director for Research in the Freshwater Fisheries Research Division of the National Research Institute of Fisheries Science (NRIFS), Fisheries Research Agency (FRA) was appointed as the new Director of Fisheries Division in JIRCAS.


Dr. Shigeo Matsui


Mr. Osamu Koyama


Dr. Minoru Tada


Dr. Shoji Kitamura

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