ISSN 1342-6648

NIAES
Annual Report
2004

National Institute for
Agro-Environmental Sciences
Japan

Annual Report

2004

(April 2003 – March 2004)

National Institute for Agro-Environmental Sciences

About the symbol.....

The symbol's colors represent the research domains of NIAES: the sky is light blue, clouds and water are white, biota are green, and soils are brown.

Editorial Board

Contents

Message from the Director General

Conserve the Environment by Listening to the Wind, Observing the Soil, and Thinking of Our Future

Dr. Katsuyuki Minami

Possessed with the magic of science and technology, humanity has raced through the latter half of the 20th century in pursuit of material and economic growth. We humans have manufactured articles to make life easier in great abundance and now enjoy the most convenient lives ever achieved in history. However, as a result, various environmental problems have emerged, one after another.

The range of pollutants of which we are aware has expanded, from point-source pollutants (including heavy metals such as cadmium and mercury) and surface pollutants (such as nitrogen and phosphorus in rivers, leading to eutrophication) to global-scale pollutants such as carbon dioxide, methane, and nitrous oxide, which cause global warming. Our environmental problems have correspondingly expanded from points to planes to three-dimensional space.

Furthermore, we now know that the human-made chemicals that enrich our lives also threaten our fertility and intelligence and the very survival of future generations. Environmental threats have expanded beyond the space-time framework of our early awareness of these issues.

The mission of the National Institute for Agro-Environmental Sciences in the 21st Century is to study agriculture in environmental space-time. For this purpose, the institute was reorganized in 2001 to function with objectives that were more mission-oriented, and 3 years have passed already.

We believe that the following nine objectives are necessary to improve the function of our institute. We have endeavored in the last 3 years to constantly check our progress in light of these nine objectives.

- Reception (of ideas from the public, other disciplines, policy needs)
- Research (expansion to solve problems, engage new issues)
- Cooperation (with other disciplines and policymakers, signing international Memorandums of Understanding)
- Discussion (in seminars, extension, and public education)
- Accumulation (of information in an agro-ecological research resource inventory)
- Evaluation (of research, management, and institutional mechanisms)
- Transmission (to specialists, and to the general public during public evaluations of our work)
- Proposal (in the form of risk evaluations, environmental management plans)
- Dissemination (via the press, TV, and the Internet).

To focus the consciousness of our staff, we have chosen a catchphrase, key concepts, and logo for our institute.

Catchphrase: conserve the environment by listening to the wind, observing the soil, and thinking of our future.

Key concepts: security, safety, restraint, and the succession of environmental resources to future generations.

Logo: the symbol's colors represent the research domains of NIAES. The sky is light blue, clouds and water are white, biota are green, and the soil is brown.

Moreover, we have come to appreciate international, interdisciplinary, and interregional partnerships in advancing research in the agro-environmental sciences. To solve difficult environmental problems, we need to pursue not only domestic and international collaboration, but also collaboration between disciplines and collaboration between ecological research projects established in different field sites around the world. We must merge the international, interdisciplinary, and interregional.

To apply these ideas, we have become a founding member of two associations, one bringing together research institutes devoted to agriculture, forestry, and fisheries, and the other involving not only agricultural institutions but also industrial and more broadly environmental institutions. In addition, NIAES has signed MOUs with research institutes in Korea, China, Germany, and other countries.

International symposia bringing together researchers from Japan, China, and Korea, and cooperative projects with prefectural research institutes in Japan, are examples of our collaborative activities.

The products of our progress are presented in this annual report. I hope that the reports of our work in FY 2003 will inspire the further development of research on agriculture and the environment. A list of research papers published is included at the end of this report. Please do not hesitate to contact us if you would like to have a copy of a paper, or if you have questions concerning any aspect of agro-environmental research.

Katsuyuki Minami, Dr. Agr.
Director General

History of NIAES

1893 National Agricultural Experimental Station (NAES) of the Ministry of Agriculture and Commerce, a predecessor of the National Institute for Agro-Environmental Sciences (NIAES) was founded.

1950 The National Institute of Agricultural Sciences (NIAS) of the Ministry of Agriculture and Forestry was founded, succeeding NAES.

1980 The NIAS main campus was relocated from Nishigahara, Tokyo to Tsukuba, Ibaraki.

1983 The National Institute of Agro-Environmental Sciences (NIAES) of the Ministry of Agriculture, Forestry and Fishery was founded from NIAS to conduct advanced and basic technological development that pertains to the control, maintenance and utilization of the agro-environment including the biological environment.

2001 NIAES was turned into a semi-autonomous agency on April 1. The new NIAES (National Institute for Agro-Environmental Sciences) concentrates on the following basic research targets to fulfill its research missions on a global scale.

1) Strategies to ensure stable food supplies under global environmental change.
2) Assuring the safety of food and environment utilizing the natural circulation function of agriculture.
3) Succession of the agro-environmental resources to future generations.

The main building of NIAES.

Main Research Results

1. Phytoremediation of cadmium-contaminated paddy fields by a rice cultivar with high cadmium-accumulation properties

Cadmium is a heavy metal that exists in natural soils in trace amounts. However, the presence of cadmium in mining fines has led to high-level pollution of both the areas surrounding the mines and downstream paddy fields. Daily ingestion of brown rice grown in highly polluted fields was found to be the main cause of Itai-itai disease, and the Japanese government amended the Food Sanitation Law in 1970 to limit the cadmium concentration of brown rice to below 1 ppm. In 1971, the law declared paddy fields where brown rice with cadmium levels of 1 ppm or more was harvested to be designated areas, and soil dressings were applied to these fields to inhibit the absorption of cadmium.

Recently, however, Japan has needed to reduce permissible cadmium concentrations in crops still further. The Codex Alimentarius Commission of FAO/WHO is considering an international standard for cadmium levels in food, and consumer interest in food safety has increased. Moreover, soil dressing has many problems, including high cost, and new countermeasures are needed.

As one method of treating paddy fields where brown rice with high concentrations of cadmium is cropped, phytoremediation is considered to be promising because of its low cost. However, phytoremediation studies of paddy fields have not been conducted. Our laboratory began a study of phytoremediation of paddy fields because few research data were available on this subject.

First, we selected cultivars of rice, soybean, and corn from among those grown in upland fields converted from paddy fields, and we conducted cadmium absorption experiments in pots under upland-field conditions. The crops were grown for 2 months after sowing. We chose 'Milyang 23' rice as an experimental crop, and 'Suzuyutaka' soybean and 'Gold dent' corn as controls. The contaminated soils were a Gray Lowland Soil and an Andosol. We found that the levels of cadmium absorbed into the aerial parts of each plant from each soil were corn << soybean < rice (Fig. 1). Moreover, a comparison of cadmium concentrations in the soil (0.1 *M* hydrochloric acid extract) before and after cultivation of the crops revealed that the concentration decreased most in the rice plot (Fig. 2). Thus, we proved that 'Milyang 23' absorbed cadmium from the soil to the greatest extent.

Next, on the basis of the results of these pot experiments, we conducted cadmium absorption experiments using 'Milyang 23' in a paddy field in the Kyushu region (Fig. 3). The experiment showed that 'Milyang 23' could absorb cadmium at the rate of approximately 200 g ha^{-1} in one summer cropping.

We concluded that 'Milyang 23', which has a high ability to absorb cadmium, is the best cultivar for phytoremediation of paddy soils contaminated by cadmium.

At present, cadmium-absorbing rice cultivars that are

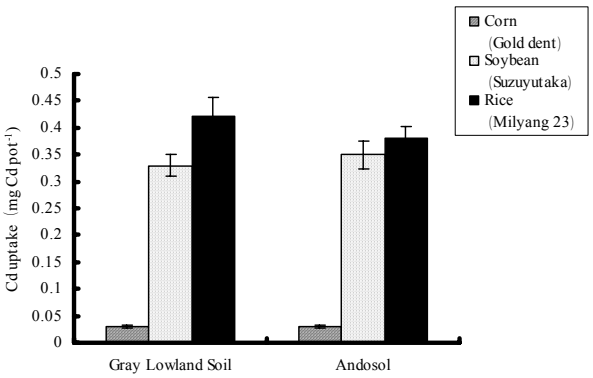


Fig. 1 Shoot Cd uptake of 3 plant species cultivated in 2 contaminated soils.

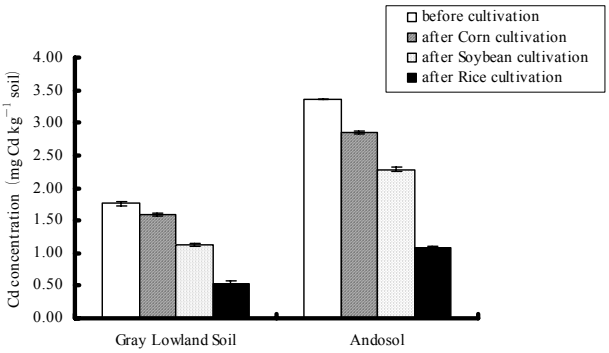


Fig. 2 Soil Cd concentration extracted with 0.1 M HCl before and after cultivation in 2 contaminated soils.

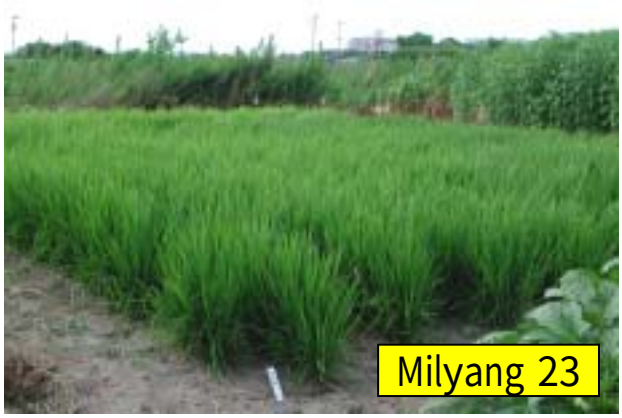


Fig. 3 Field experiment with rice cv. Milyang 23 in the Kyushu region.

suitable for the climate of each district are being selected. Moreover, cultivation techniques to increase the efficiency of phytoremediation are being tested in paddy fields on a national scale. Assay crops are being selected and measurement methods developed to enable the end-point of remediation to be judged easily. Rice crops harvested by machine will be incinerated and the cadmium in the ash collected. Thus, a consistent system of phytoremediation of cadmium-contaminated soil by rice cropping will be developed in the future. (M. Murakami, N. Ae, M. Sugiyama and S. Ishikawa)

2. Invasion and transmission of new strains of *Ralstonia solanacearum* parasitic to plants of the family Zingiberaceae in a Japanese agro-ecosystem

Ginger (*Zingiber officinale*) and mioga (*Zingiber mioga*) are important sources of spices or medicines and have long been cultivated for food in Japan. *Curcuma* spp., ornamental plants grown for the cut flower industry and belonging to the same family, the Zingiberaceae, were introduced to Japan from Thailand. In 1995, a bacterial wilt disease of *Curcuma alismatifolia* caused by *Ralstonia solanacearum* first occurred in the cultivated fields of a few localities in Kochi Prefecture, Japan's leading production center of these plants. The disease spread to ginger fields in 1997, and since 1999 it has expanded successively into mioga plantations in neighboring cities within the same prefecture (Fig. 4).

R. solanacearum is the causal agent of bacterial wilt disease and is widely distributed in tropical, subtropical, and warm regions worldwide. This bacterium is heterogeneous and is divided into 5 races and 6 biovars on the basis of host range and utilization of carbohydrates, respectively. Races 1 and 3 and biovars N2, 3, and 4 are known to exist in Japan; the race 1 and biovars N2 and 3 are pathogenic to mainly solanaceous crops such as tomato, tobacco, and eggplant, and the race 3 and biovar N2 are pathogenic to potato, respectively.

Bacterial wilt caused by a strain of *R. solanacearum* race 4 in zingiberaceous plants has been reported in several countries, but before 1995 no such disease had been

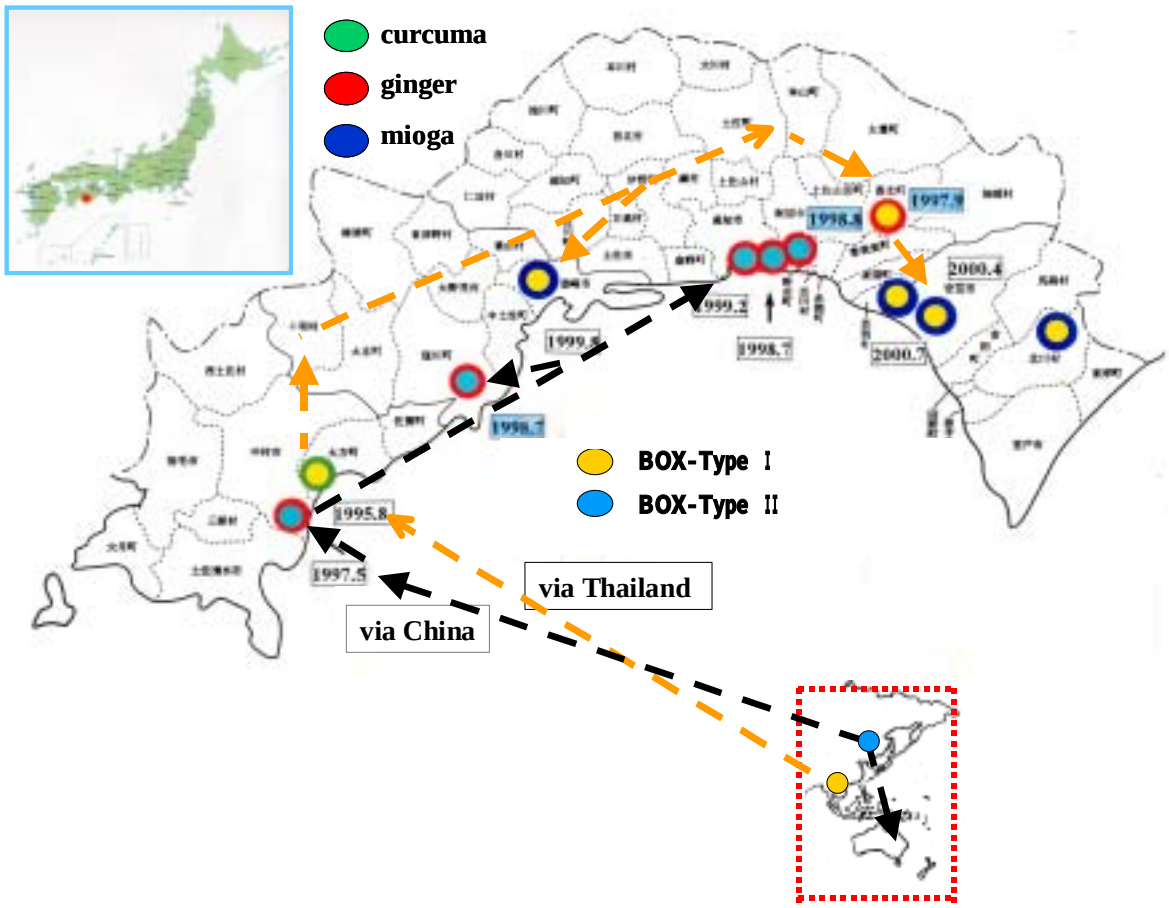


Fig. 4 Occurrence of bacterial wilt disease of plants of the Zingiberaceae, and presumed routes of invasion by, and transmission of, pathogenic strains in Kochi Prefecture.

recorded among the 14 families containing the 29 species of host plants reported in Japan.

We characterized the pathological, physiological, and molecular biological characteristics of the new strains infecting ginger, *Curcuma*, and mioga in Kochi Prefecture, and we compared these characteristics with those of the known indigenous strains and those obtained from other countries.

Disease symptoms in the 3 plants were similar. Yellowing and wilting started in the lower leaves and quickly spread upward until the whole plant became golden brown and wilted.

Physiological and biochemical tests revealed that all the isolates from the 3 diseased plant species in Kochi Prefecture were *R. solanacearum* biovar 4. Those from Thailand and Indonesia consisted of both biovars 3 and 4, and those from Australia and China were biovar 4.

Zingiberaceous plants other than ginger in which these biovar 4 strains in Japan caused severe wilting included potato and marigold. Tomato, tobacco, and sweet pepper did not wilt but showed vascular discoloration. Neither of the known Japanese races (1 and 3), nor the indigenous strains isolated from eggplant and tomato in Kochi Prefecture, wilted ginger.

We tested the genetic diversity of *R. solanacearum* strains by rep-PCR analysis using BOX, REP, and ERIC as primers. We analyzed selected strains on *Curcuma*, ginger, and mioga from Japan, Thailand, Indonesia, Australia, and China, as well as the known Japanese races and biovars.

The DNA profiles obtained were highly reproducible. Two distinct DNA fingerprints were observed among the strains on the zingiberaceous plants in Kochi Prefecture. (Fig. 5). The DNA pattern of Type 1 strains was identical to that of several strains infecting ginger and *Curcuma* spp. in Thailand, and that of Type 2 was identical to ginger-infecting strains that originated in Australia and China (Fig. 5). However, neither the DNA patterns of indigenous *R. solanacearum* strains isolated from other plants in Kochi Prefecture, nor those of representative Japanese races and biovars, were identical to either of the 2 types.

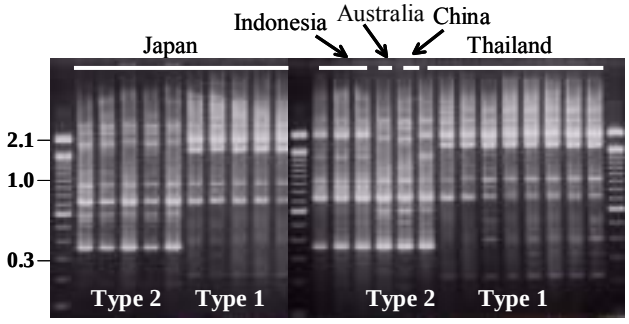


Fig. 5 rep-PCR (BOX primer) profiles of *Ralstonia solanacearum* isolated from plants of the Zingiberaceae in Kochi Prefecture, Japan and foreign countries.

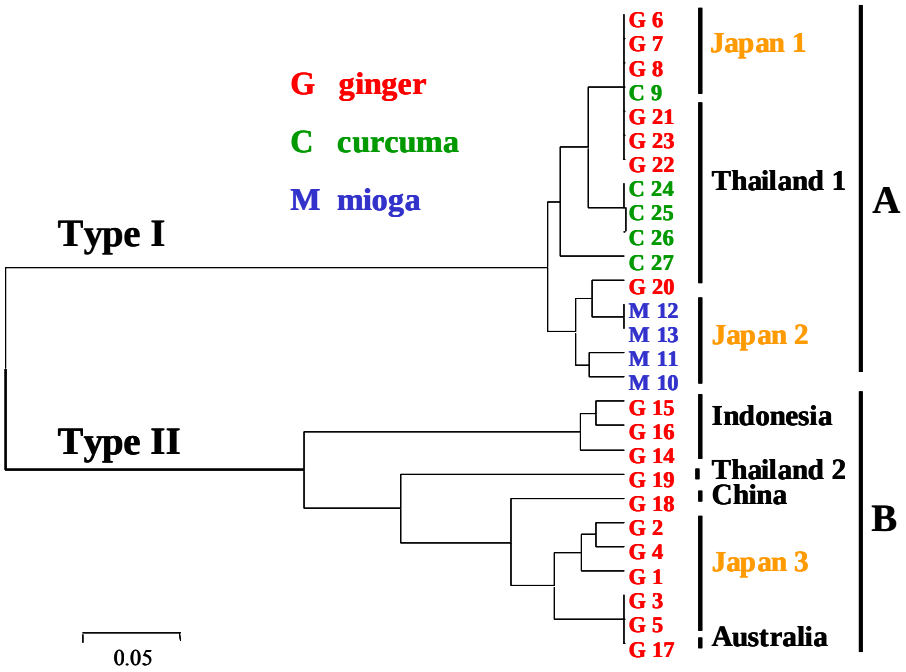


Fig. 6 Dendrogram showing the genetic diversity of *Ralstonia solanacearum* isolated from plants of the Zingiberaceae in Kochi Prefecture, Japan and foreign countries on the basis of rep-PCR.

A dendrogram constructed on the basis of the rep-PCR analysis revealed the genetic diversity and relationships among the strains tested. Group A (containing Type 1) consisted of all *Curcuma* strains, some ginger strains, and all mioga strains, whereas group B (containing Type 2) contained all ginger strains (Fig. 6).

From the results obtained, we consider it possible that Type 1 and Type 2 pathogenic strains from either *Curcuma* or ginger were introduced independently through contaminated seed materials imported in about 1995, and remained undetected until the first outbreak of infection in *Curcuma* spp. in 1995 and in ginger in 1997. Furthermore, Type 1 strains were found in mioga after 1999. We therefore concluded that the diseases caused by these 2 exotic *R. solanacearum* strain types had different origins and have been spreading in epidemic proportions by separate routes. (K. Tsuchiya, H. Sawada, M. Takahashi and T. Yoshida)

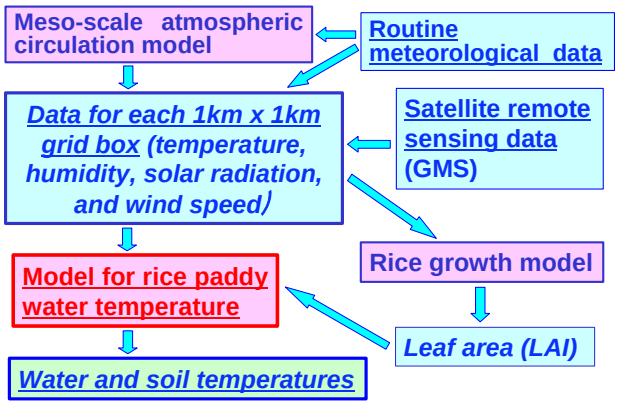


Fig. 7 Algorithm for calculating the regional distribution of daytime mean water and soil temperatures of rice paddies. Water and soil temperatures are calculated for each 1 km × 1 km-square grid box. GMS: geostationary meteorological satellite.

References

Tsuchiya, K., K. Yano, M. Horita, Y. Morita, Y. Kawada, and C. d'Ursel (2002) Occurrence and epidemic adaptation of new strains of *R. solanacearum* associated with Zingiberaceae plants in the Japanese agro-ecosystem. Abstracts 3rd Int. Bact. Wilt Symp. (February 4-8, South Africa), p. 89.

Tsuchiya, K., H. Sawada, T. Yoshida, and M.Takahashi (2004) Invasion, transmission and adaptation of new race strains of *Ralstonia solanacearum*, causal pathogens of bacterial wilt of Zingiberaceae plants in Japan. Phytopathology 94(6) (Supplement): S104.

3. Estimation of regional distribution of water and soil temperatures of rice paddies using satellite remote sensing and meteorological data

Not only are the water and soil temperatures of rice paddies important components of the agro-environment for growing rice, but they also influence rates of methane (CH_4) emission from paddy fields. We have developed a method of estimating the regional distribution of water and soil temperatures of rice paddies by using satellite remote sensing and routine meteorological data.

Figure 7 shows the algorithm used to calculate the regional distribution of daytime mean water and soil temperatures of rice paddies. In the first step, meteorological data (temperature, humidity, solar radiation, and wind speed) for each 1 km x 1 km-square grid box are created by a meso-scale atmospheric circulation model that combines the routine meteorological data at AMeDAS (Automated Meteorological Data Acquisition System) and satellite remote sensing data. Visible images from a geostationary meteorological satellite (GMS-5) are used for estimating downward solar radiation. The downward long-wave radiation for each grid box is calculated by using an empirical formulation with temperature, humidity, and solar radiation. In the next step, the water and soil temperatures of the rice paddies in each grid box are calculated by using a heat balance model for rice paddies. The leaf area index (LAI), which is defined as the total area of leaves per unit area of ground, is also needed for calculating the water and soil temperatures, and it is estimated by using a rice growth model with temperature and solar radiation for each grid box.

Three kinds of model are needed for estimating the regional distribution of water and soil temperatures of rice paddies. The meso-scale atmospheric circulation model (ANEMOS) developed by the Japan Weather Association and the rice growth model developed by Yajima (1996), are both used. The third model is the heat balance model that we developed for rice paddies. It can simulate the daily mean water and soil (0- to 5-cm depth) temperatures of rice paddies with an accuracy of about 1 °C. (The model assumes that the daily mean soil temperature at this depth range is the same as the daily mean water temperature.) Rice paddy water and soil temperatures, which depend on both the meteorological conditions and the vegetation density, can be calculated by solving the heat balance equation between the water surface and the atmosphere.

Figure 8 shows the regional distribution of daytime mean downward solar radiation (left) and water temperature of rice paddies (right) in the Tohoku district on 17 June 1997, as estimated by our method. Water temperature was higher in the areas where solar radiation

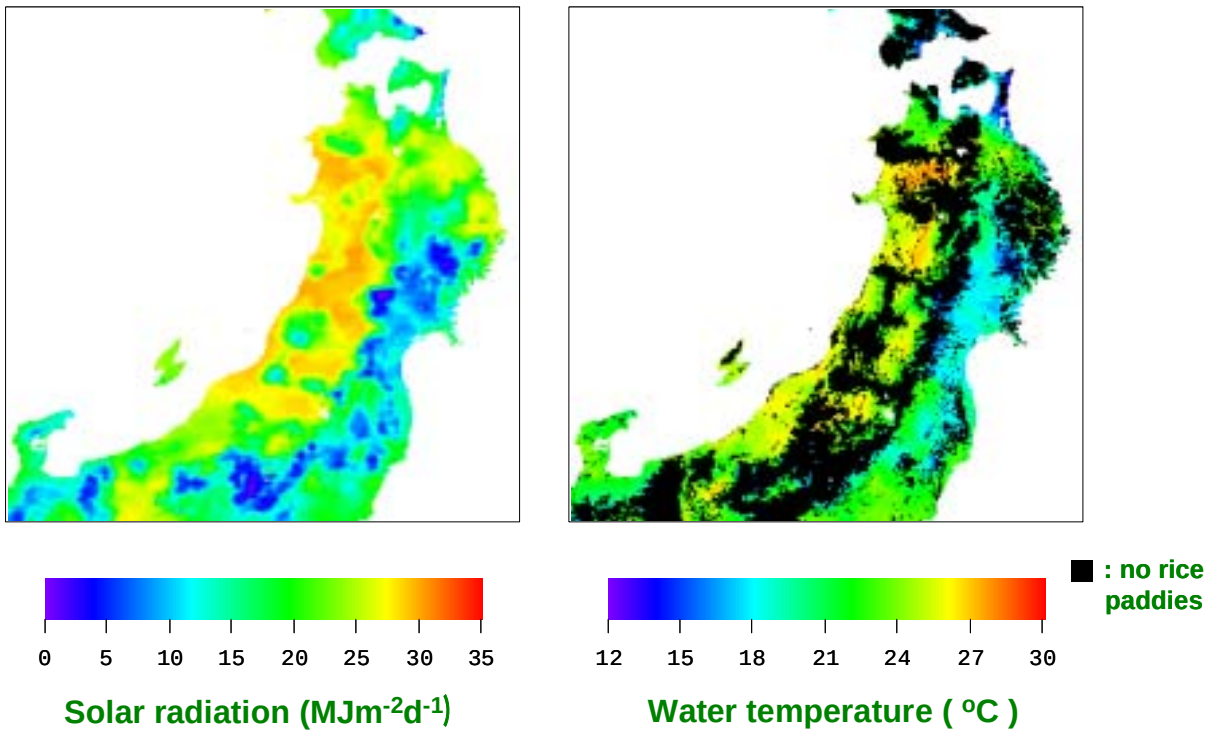


Fig.8 Regional distribution of daytime mean downward solar radiation (left) and water temperature of rice paddies (right) in the Tohoku district on 17 June 1997, as estimated by the method described in the text. There are no rice paddies in the black grids.

was stronger. The method developed in this study is useful for monitoring the regional distribution of rice paddy water and soil temperatures. (T. Kuwagata, Y. Ishigooka, T. Hasegawa, S. Yoneyama and M. Yokozawa)

Reference

Yajima, M. (1996) Monitoring and forecasting of rice growth and development using crop-weather model. Proc. 2nd Asian Crop Sci. Conf. ACSA, 280–285.

4. Trends in nitrogen balance of Japan's food and feed system

In the 1960s, Japan's economy began to develop rapidly, and Japanese eating habits began a process of Westernization and diversification. At the same time, the importation of human foods and animal feeds increased, and by the late 1990s Japan's level of calorie self-sufficiency had declined to about 40%. This decline in self-sufficiency has jeopardized the stability of the nation's food supply, and the vast amount of nutrients being brought in from overseas countries has placed the natural material cycles of our agro-ecosystem into disorder. As a result, the nitrogen balance was distorted, and we have recently seen a number of adverse environmental effects, such as eutrophication in lakes and marshes.

To determine the nitrogen load imposed on the environment by food and feedstuff including importation from a macroscopic viewpoint, NIAES has developed a "Domestic Nutrition Balance Estimation System" that represents the flow of production – processing – consumption of foods and feeds, and has published a number of nitrogen balances up to the year 1992. Because imports are continuing to increase, we have now estimated the nitrogen balance for 1997. In Figure 9, we show the trends in the nitrogen balance for 1997, 1992, 1987, and 1982.

The trend over this period can be summarized as follows:

1) The total quantity of nitrogen discharged into the environment (total annual consumption) peaked at 1,708,000t in 1992, and then slightly decreased in 1997. In contrast, on the supply side, domestic production has been decreasing since 1987, and the shortfall is being supplied by continuously increasing quantities of imports.
2) In the "Livestock industry", importation of meat and of milk for use in milk products is increasing, whereas feed import is decreasing. In other words, importation of products rather than raw materials is increasing dramatically. In addition, a trend of

increasing dependence on overseas countries for foods is recognized in every area, such as an increase in the proportion of import to the total supply to the "Food processing" sector, and a decrease in "Crop residues" in domestic production.

The total nitrogen load on the environment began to fall in 1997 after peaking in 1992, but the decrease has been small. In future, to further reduce this load, effective use of organic by-products, such as livestock excreta and processed food residues, and efforts to decrease the amounts of waste such as food leftovers from "Human consumption" will become more important. (K. Oda)

Notes:

1) Each set of four values corresponds to the flow or stock of nitrogen in 1982, 1987, 1992, and 1997, in descending order.

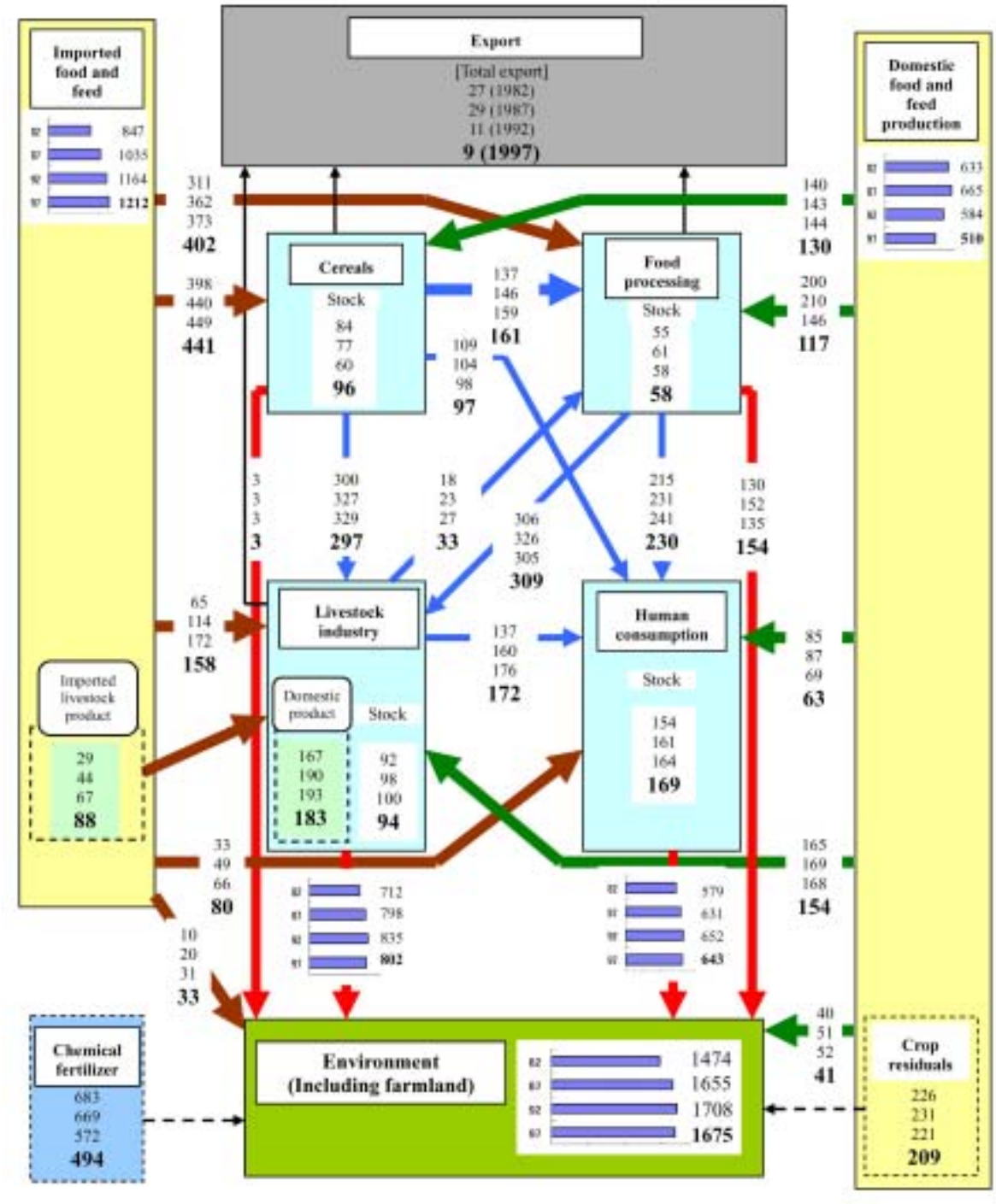


Fig. 9 Nitrogen balance in Japan's food and feedstuff system (units: '1000s of tons N).

2) Input to the “Livestock industry” means raw feedstuffs other than “Imported livestock product”; from these feeds “Domestic product” is produced.
3) The values for stock listed under “Livestock industry” and “Human consumption” are the amounts of nitrogen contained in the bodies of raising livestock and of human consumers.
4) “Chemical fertilizer” and “Crop residues” are shown as inputs from outside the system and are not included in this balance estimation.

5. National Soil Resources Inventory System

Prefectural research institutes in Japan have been conducting a nationwide soil survey. Although there is a defined data encoding form for the survey, the methods of digital file delivery vary and include the mailing of digital media by postal services. To accelerate data gathering and to minimize the time lag between gathering of the data in the field and processing in the data center, we have developed a National Soil Resources Inventory System (NSRIS). Users of this system can refer to soil information obtained by prefectural organizations during past surveys and input new data from the field or the laboratory.

The core components of the NSRIS database – the results of “Soil Monitoring”– are stored in a database server owned by the soil classification laboratory. The user can access this database online and use the following functions. Agricultural soil maps and monitoring points can be displayed by using the GIS function on 1/50,000 topographical maps. Information on soils or monitoring points can be displayed by clicking on part of the soil map or on a monitoring point on the screen (Fig. 10). Monitoring points can be found by selecting a monitoring period and a prefectural code. Monitoring results can be displayed after selecting a monitoring sheet, and the user can change or correct the data from this screen (Fig. 11). For statistical analyses, the minimum and maximum values and the mean can be displayed by specifying the monitoring period, the prefecture, and the horizon according to the land use, soil group, or soil series. Researchers can input newly obtained data by writing the code selection or measurements of each item on the screen displays, or data can be added in bulk from a separately prepared MS Excel file. The database system judges whether the input code is in the code table and whether the value was right. This function improves data reliability. A computer program of soil classification based on “the third approximation of the classification of cultivated soils in Japan” is attached to this system,

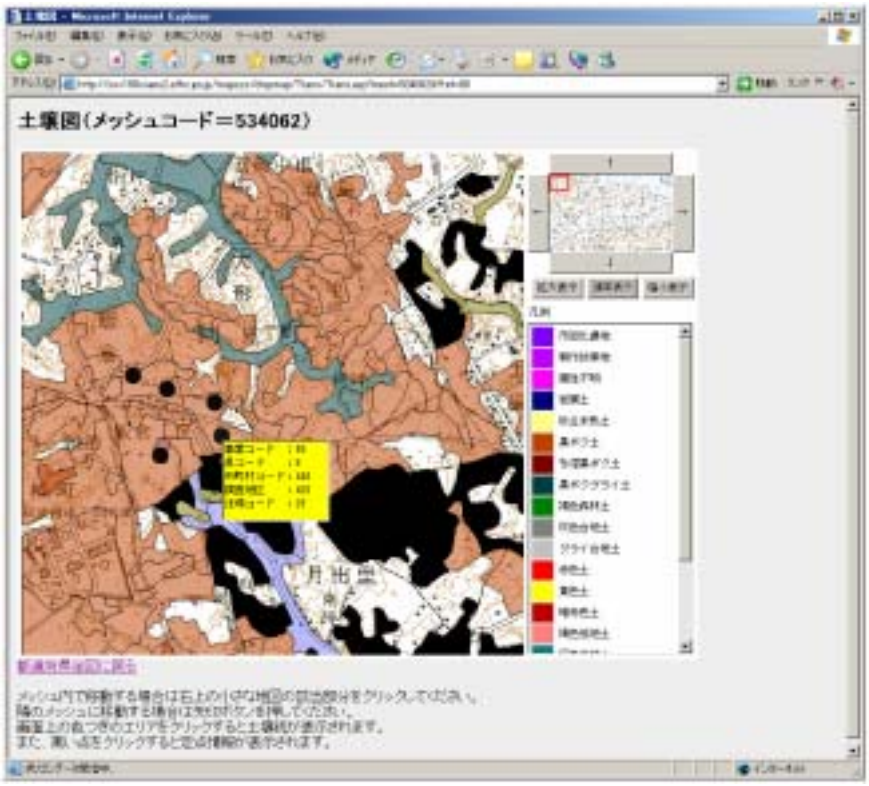


Fig. 10 Soil map overlaid on a geographic map.
（●: monitoring site; right-clicking reveals further information on the point）

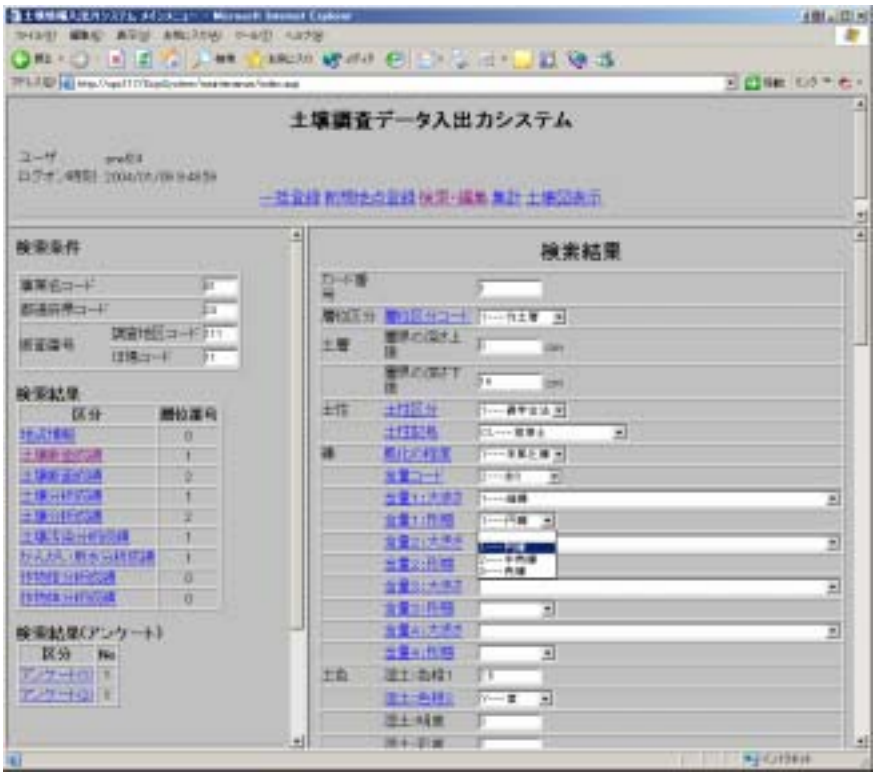


Fig. 11 Example of the result of a search.
(Data can be corrected from this screen.)

which can display the soil classification name by selecting a monitoring point.

An ID with a password is issued to each prefectural research institute conducting the soil survey. So far the system operates only with Internet Explorer. The display functions of thematic soil maps (e.g. soil property maps and maps of water-retaining capacity) is scheduled to be added in the future. Soil data sets will be disclosed after a consensus is obtained among the related organizations. (M. Nakai, H. Obara and T. Ohkura)

Major Symposia and Seminars

1. The 1st Meeting of Environmental Research Organizations in Japan

The 1st Meeting of Environmental Research Organizations in Japan, "An Approach to Cooperation in Environmental Sciences" organized by NIAES with other organizations was held July 24, 2003 at the Tsukuba International Congress Center. The objectives of this meeting were to present research results from 10 research institutes and to exchange the latest information on environmental sciences. Participants counted 184 including those from research institutions, universities and the private sector at the meeting. Following the opening address and research remarks given by Dr. Minami, Director General of NIAES, 10 speakers presented topics related to the atmosphere, material cycling, and biology.

Presentation by Dr. Ueji, NIAES.

Program of the Meeting

1) Prediction of meteorological and coastal hazards from global warming.
   T. Matsuura (National Research Institute for Earth Science and Disaster Prevention)
2) Present study and outlook on dust or yellow sand.
   Y. Satoh (Meteorological Research Institute)
3) Observation and analysis of CO_2 absorption in the ocean.
   Y. Nojiri (National Institute for Environmental Studies)
4) Observation of carbon cycling in the field.
   S. Yamamoto (National Institute of Advanced Industrial Science and Technology)
5) Dynamics and the control technology for dioxin in the agricultural environment.
   M. Ueji (National Institute for Agro-Environmental Sciences)
6) Development of new methods for redevelopment and evaluation of urban areas.
   K. Fujita (National Institute for Land and Infrastructure Management)
7) Biological function of shell fish in the carbon balance.
   Y. Nakamura (Fisheries Research Agency)
8) Experimental approach to the tidal flat ecosystem using a mesocosm.
   A. Kuwae (Port and Airport Research Institute)
9) Investigating methods for tracking wild animals using radio telemetry.
   M. Denda (Public Works Research Institute)
10) Issues on rare species as biodiversity indicators of a region.
    K. Ozaki (Forestry and Forest Products Research Institute)

2. International Seminar on Biological Invasions: their Environmental Impact, and the Development of a Database for the Asian-Pacific Region

The International Seminar on Biological Invasions was held from November 13 to 15, 2003 in Tsukuba under the joint sponsorship of the National Institute for Agro-Environmental Science (NIAES) in Japan and the Food & Fertilizer Technology Center for the Asian and Pacific Region (FFTC) in Taiwan. A total of 152 participants, including 18 speakers, came from Australia, China, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Taiwan, Thailand and the United States. Among the topics discussed in detail were: the ecological, physiological and molecular attributes of invasive species; the ecological and economic damage they cause; lessons learned from various experiences of control or eradication; and establishing a broad regional database of invasive species. In terms of a database, the APASD (Asian Pacific Alien Species Database) that is being developed by NIAES was introduced. The following recommendations were agreed on in the general discussion:

1) The number of exotic flora and fauna that move, naturally or as a result of human action, across national borders and become naturalized has been rapidly in-creasing. Some of these organisms have already spread widely through ecosystems of the region, and have had adverse ecological and economic impacts. Sustained action is urgently needed from all of us to overcome this threat.
2) The participating scientists agreed to collaborate and establish a database of exotic species to monitor their

Participants from foreign countries visited the Koibuchi College of Agriculture after the seminar.

Dr. David Andow (University of Minnesota, USA) gave a keynote speech on 'Biological Invasions: Assessment and Management of Environmental Risk'.

movements in the Asian and Pacific Region. The database will be shared by the nations concerned as an information resource to manage the threat of invasive species.

3) In order to build the capacity of the database and identify related information needs, a follow-up workshop was proposed to be held in 2004 in Taiwan, co-sponsored by NIAES, FFTC and BAPHIQ (Bureau of Animal and Plant and Health Inspection and Quarantine), Taiwan ROC. In the selection of invited participants, preference will be given to regional scientists involved in active support for the database, such as providing data and organizing a flow of up-to-date information about inva-sive species in each country.

3. The 23rd NIAES Symposium, and the 1st International Symposium of Japan-Korea Research Cooperation "Promising Agricultural Practices and Technologies for Reducing Heavy Metal Contamination in Relevant Staple Crops –With a Special Emphasis on Cadmium Contamination"

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has been examining the international standard for tolerable Cadmium (Cd) intake. Maximized effort has been made in Japan to ensure the highest possible level of consumer health protection against Cd intake by reducing Cd concentration to a minimum in relevant staple crops, in particular, rice and soybean. Taking such international and domestic activities into account, the international symposium on "Promising Agricultural Practices and Technologies for Reducing Heavy Metal Contamination in Relevant Staple Crops –With a Special Emphasis on Cadmium Contamination" sponsored by NIAES and co-sponsored by AFFRC, Japan, and the National Institute of Agricultural Science and Technology, Korea, was held on November 20-21, 2003 at EPOCAL, Tsukuba.

For the oral sessions, 17 invited papers including those by 9 internationally well-known foreign scientists were presented. A poster session was concurrently held and 28 poster papers were presented. A total of 187 researchers, students, extension workers and policy makers from 9 countries participated. The symposium was composed of 4 sessions: 1) risk assessment of Cd in food and heavy metal transfer in the food chain, 2) heavy metal distribution in relevant arable soils and staple crops, 3) development of promising agricultural practices and technologies for reducing Cd contamination in staple

crops, and 4) general discussion.

In Session 1, general and international trends on risk assessment and the management of Cd in foods, were presented and discussed. In session 2, the status quo of heavy metal distribution in staple crops and in agro-environments was reported from France, Hungary, China, Korea and Japan. In Session 3, various new technologies for reducing Cd concentration in crops and to remediate Cd contaminated soil environments were reported from Canada, China and Japan. Posters on pytoremediation, crop physiology of Cd uptake, dynamics of Cd in soil-water environments were presented mostly by young scientists from China and Japan. In general discussion, the status quo of the research in this field was summarized. The attitude toward the new standard for Cd concentration in staple foods proposed by the Codex committee established by FAO and WHO differed from country to country. Although each county has a different approach and strategy for reducing Cd in foods, all participants agreed to establish an international network on this issue, to increase information exchange and to enhance international collaboration.

4. International Workshop on Prediction of Food Production Variation in East Asia under Global Warming

Since the late 20th century, we have witnessed environmental changes caused by human activities in various parts of the world. In 2001, the IPCC issued a report titled Climate Change 2001. According to this report, the average temperature at the surface of the entire earth is expected to rise by between 1.4°C and 5.8°C over about one hundred years from 1990 to 2100. Predictions for various effects of global warming were also made, with the concern that a North-South problem with food production may develop because food production in low latitude areas will decrease, while food production in high latitude areas will remain at the present level or increase. Food production is also affected by environmental changes in East Asia, where about two billion people, or about one third of the world's population lives. Therefore, a change in food production in East Asia is one of the most critical problems in this century in terms of food security.

Under these circumstances, in 2001, the National Institute for Agro-Environmental Sciences launched a research project, "Technological development concerning predictions for changes in food production due to global environmental changes", in conjunction with the Japan International Research Center for Agricultural Sciences. In this research project, a scenario was written for meteorological changes caused by increasing greenhouse gases in Japan and the world. Based on this scenario, factors limiting production in East Asia were predicted, such as exhausted water resources, the appearance of harmful insects and soil deterioration. With these changes in environmental factors taken into account, the project aimed to predict the potential production of staples. In addition, the project aimed to develop a method for predicting changes in food for future policy-making by partially modifying the current supply-and-demand models of world food, towards predicting the potential production capacity of foods.

To expand on the above research project, the international workshop on “Prediction of Food Production Variation in East Asia under Global Warming” was held March 17 – 19, 2003 in Tsukuba, gathering a total of 62 participants. This workshop examined the effects of global warming on agricultural production from the three topics of changes in the natural environment (Part 1), crop physiology and its modelling (Part 2), and socio-economics adaptation (Part 3). Respective keynote presentations were given by Dr. Erda LIN (China), Agrometeorology Institute, Chinese Academy of Agricultural Sciences, Dr. John R. Porter (Denmark), the Royal Veterinary and Agricultural University, and Mark W. Rosegrant (USA), International Food Policy Institute. Oral presentations were given by 17 participants, including 6 Chinese and 2 Korean speakers, which collectively showed that agriculture and food production may become the first to suffer the negative effects of long range trends.

Given this issue of climate change as well as the growing population and the decrease in farmland cultivation due to changes in land use, the importance has increased for predicting the feasible state of future agriculture in East Asia. Accordingly, the predictive work has provided much useful information about the impact of climate change for the whole of East Asia, with the focus increasingly on the problem of food security to

ensure that food production is not threatened.

International and Domestic Research Collaboration

1. Conclusion of MOU(memorandum of understanding)

MOU between NIAES and TUA

NIAES and Tokyo University of Agriculture (TUA) concluded a MOU. Dr. Katsuyuki Minami, Director General of NIAES and Professor Isoya Shinji, President of TUA, executed the agreement at the University, in Setagaya, Tokyo, on December 10, 2003. NIAES and TUA agreed on the education of TUA graduate students at NIAES and joint research by NIAES and TUA. The execution of the MOU will lead to a more comprehensive education for the graduate students and active advanced research by the parties, and will eventually contribute to the development of agro-environmental sciences.

Signing ceremony of the MOU.

MOU between NIAES and KCA

Dr. Katsuyuki Minami, Director General, and 3 staff members of NIAES visited the Koibuchi College of Agriculture (KCA) located in Uchihara Town, Ibaraki Prefecture, on February 2, 2004 to conclude the MOU to promote research and educational collaboration related to the conservation of the environment and sustainable cyclic agriculture. At the signing ceremony, Dr. Minami and Dr. Takahiro Inoue, President of KCA, emphasized the significance of long term monitoring data taken in the agro-ecological field of KCA for establishing a model for sustainable cyclic agriculture.

Hereafter, NIAES and KCA will undertake the following two collaborative research at KCA fields: 1) to clarify the material dynamics under cyclic use of organic matter, 2) to purify the sewage water through the effective use of the paddy field functions.

Signing ceremony of the MOU, the members of NIAES and KCA.

MOU between NIAES and ZEF of Bonn University, Germany

NIAES and the Center for Development Research (ZEF) of the Rheinische Friedrich Wilhelmes University of Bonn (Bonn University) concluded a MOU on March 4, 2004 to promote research collaboration projects related to ecology and resource management in various parts of the developing world.

The scope of activities under this agreement includes: 1) exchange of scientists, 2) exchange of graduate students, 3) exchange of technical information, 4) cooperative research consistent with ongoing programs of the two institutes.

The contact person for ZEF is Professor Paul L. G. Vlek, Director. At NIAES, Dr. Katsuyuki Minami, Director General, is the contact person.

Under this agreement, Dr. Toshiya Okuro, senior researcher of the Department of Biological Safety has started collaborative research at ZEF on March 25, 2004.

Signatures on the MOU Document.

Visitors

1. Science Camp 2003

Science Camp 2003 sponsored by the Japan Science Foundation was held for high school students to experience advanced science and technology at various institutes. The Science Camp at NIAES took place August 19 - 21, 2003, with 12 students. They participated in one of the three courses: A) Observation of insects in the farmlands and their vicinity, B) Genetic modification of microorganisms for environmental remediation, and C) Simple analyses of micro quantities of agro-chemicals.

After the opening ceremony, the students underwent an orientation to the Camp and a tour of the institute facilities. On the second and third days, they undertook experiments, observations and analyses with the institute specialists of each course in the laboratories or fields. After the course activities, the persons concerned convened to a meeting where the students presented their results obtained in the courses. The students seemed to have developed even more interests in agro-environmental sciences or advanced science and technology through their experiences. The director general handed the diploma of the Science Camp to each student at the closing ceremony.

The students studied in the laboratories or fields at the Science Camp.

Participants of the Science Camp including 12 students.

2. Open House Day at NIAES

The institute opened the door to the public on April 16 during the Science and Technology Week of 2003. The visitors were students and people in various professions, about 1,300 in total with some foreigners. They studied the panel displays on research topics, observed specimens, attended lecture meetings, tried sample hands-on experiments, or experienced vegetable picking in the field, which were all arranged under the general theme, "Let's hand down the rich lands and environments to the future generations." The result of the questionnaire collected indicated that this event was a great opportunity for the general public to learn about agro-environmental sciences.

About 1,300 people visited NIAES on the Open House Day.

The lecture on “Global Warming and Agriculture”.

Visitors observing the demonstration of soil bioremediation.

The last stop of the tour in the open house: the questionnaire spot and the take-home gift corner.

Advisory Council 2003

The Advisory Council 2003 met on April 23, 2003 at NIAES to provide outside opinions and recommendations on the management of NIAES. The members of the council are external experts, including a professor, a consumer representative and the directors of other national institutions (see Appendix).

Members were informed on the general activities of NIAES in 2002 and were presented six of the main research results in 2002.

The opinions expressed by the members were as follows:

1) I expect NIAES to develop technology based on reliable research data, because the research topics to be undertaken by NIAES rest not only in basic research but also in the area of administrative needs.

2) Please develop an evaluation method to measure the effectiveness of the technologies for sustainable agriculture and the conservation of the environment.

3) I believe that long-term monitoring research is at the foundation of the research activities at NIAES. Please introduce such research endeavors at the next council.

4) Please survey the kinds of research undertaken as basic research at the foreign research institutes that study agriculture and the environment.

5) The Ministry of the Environment has acquired ISO14000. Shouldn't NIAES also acquire some standard for environmental management, such as ISO14000?

6) The mission of NIAES is not conspicuous. Therefore, I propose that NIAES establish 1 or 2 cases of highly visible technology transfer to the private sectors through cooperative researches with some companies so that the cases will symbolically promote the importance of NIAES.

7) I thought that research results should be evaluated not only by the degree of progress but also by quality. The qualitative evaluation is usually determined by the number of publications in refereed papers. However, researche on natural resources inventory, analysis and monitoring, etc, should be evaluated through other methods than such publications.

8) The research carried out by NIAES has been remarkably useful in the urgent response investigations after the JCO accident, and toward solving the problems of arsenic and cadmium in crops. I thought such accomplishments should be evaluated highly, and methods should be developed for such evaluations. I suggest research results should be evaluated by the intricacy of the research rather than only the degree of progress.

9) The standard for the evaluation of any organization should not be rigid but rather accommodating to its missions. I propose that the standard for the evaluation reflects the missions of NIAES and appropriate activities along such missions.

10) I want to observe the tendency of how much more effort had been made in a year compared to the year before. So I would like reports submitted to the council that would show such a trend. Also, I want to know whether the trend was born out of internal efforts, external efforts, or some legislative backings. Please describe these points on the evaluation report.

Academic Prizes and Awards

1. The Award of The Phytopathological Society of Japan in 2004

Studies on fungicide resistance in phytopathogenic fungi

The Phytopathological Society of Japan presented its award to Dr. Hideo Ishii in 2004, for his outstanding research activities on fungicide resistance in phytopathogenic fungi.

Ishii has been at the forefront of research on fungicide resistance for nearly three decades. In 1975, Japanese pear trees were severely damaged by scab (*Venturia nashicola*) in many areas despite frequent applications of benzimidazole fungicides. This prompted Dr. Ishii to start studies on fungicide resistance, and since then he has continued close involvement in this research subject.

He demonstrated the fungicide resistance in *V. nashicola* and other pathogens. Through surveys on epidemiological characteristics of resistant fungal isolates in the field, he suggested strategies, such as applications of alternating benzimidazole fungicides or their mixing with unrelated fungicides would delay but not stop the build-up of resistance.

Ishii was the first to demonstrate that benzimidazole resistance controlled by a single major gene. To confirm this, he developed methods to artificially cross *V. nashicola*. Ascospore analysis suggested that the manifestations of three different levels of benzimidazole resistance, i.e. high, intermediate, and weak resistance were due to three allelic mutations in a single gene on a chromosome and that each level was controlled by one of the multiple alleles. He also showed that the increased sensitivity of highly benzimidazole-resistant isolates to *N*-phenylcarbamate and *N*-phenylformamidoxime compounds was controlled by a single major gene.

He elucidated the biochemical mechanism of benzimidazole resistance and negative cross-resistance to *N*-phenylcarbamates and *N*-phenylformamidoximes. In *V. nashicola*, *Botrytis cinerea* (grey mold), and *Gibberella fujikuroi* (Bakanae disease on rice), the binding of ^{14}C-carbendazim, the benzimidazole fungicide, to tubulin-like proteins was much lower in benzimidazole-resistant isolates than in sensitive isolates, suggesting that a decreased affinity of the fungicide to the target protein is a major factor of resistance. So far, this was the first report that the mode of inheritance of benzimidazole resistance was discussed with biochemical characterizations of resistance using isolates of phytopathogenic fungi collected from the field. Most benzimidazole-resistant isolates collected from the field exhibited codon changes either at positions 198 or 200 in β-tubulin genes. The substitution of glutamic acid (GAG) at codon 198 by alanine (GCG) resulted in high resistance to benzimidazoles. This point mutation was further associated with the negative cross-resistance to diethofencarb, the *N*-phenylcarbamate fungicide, and DCPF (*N*-(3,5-dichloro-4-propynyloxyphenyl)-*N*'-methoxyformamidine) as well.

He developed PCR-RFLP (polymerase chain reaction-restriction fragment length polymorphism) methods for identifying resistant isolates. Allele-specific PCR (ASPCR) primers were also designed and used for the diagnosis of resistance. SSCP (single-strand DNA conformation polymorphism) analysis was first introduced in the diagnosis of fungicide resistance.

Currently, strobilurin fungicides (QoIs) are the most important group of fungicides as they are highly effective against a wide variety of fungal pathogens on various crops. Unfortunately, however, QoIs are also known to possess high risk for resistance development in target pathogens. Ishii detected QoI-resistant isolates of downy mildew and Corynespora leaf spot on cucumber in an early stage of resistance development, and contributed to diminishing the occurrence of resistance in practice.

He found a single point mutation, i.e. one base change at codon 143, in the fungicide-targeted cytochrome *b* gene from resistant isolates of cucurbit powdery mildew, cucumber downy mildew, and others. Substitution of glycine at 143 in cytochrome *b* by alanine resulted in high resistance to QoIs strongly indicating that resistance to QoIs in field isolates of plant pathogens due to a target site alteration.

To develop rapid testing methods for QoI resistance, PCR-RFLP was successfully employed and this method is currently used for resistance monitoring in practice. When the use of QoI fungicides was stopped, intracellular selection of the normal wild-type DNA might have occurred in multi-copy mitochondrial DNA of resistant isolates resulting in a decrease in the proportion of mutated DNA.

2. The Award of The Phytopathological Society of Japan in 2004

Population Biology of Individualistic Plant Pathogenic Fungi and its Application to Disease Control

Dr. Naoyuki Matsumoto, Department of Biological Safety, won the award of the Phytopathological Society of Japan in 2004. His interest has been focused on population biology of "individualistic" plant pathogenic fungi. The population structure of these fungi was found to reflect their ecological strategy and environmental conditions. He has more recently presented the prospect of the use of fungal viruses to control root diseases of fruit trees caused by *Helicobasidium mompa* and *Rosellinia necatrix* as an application of fungal population biology.

(1) Detecting individuals

Field isolates of *Typhula incarnata*, *T. ishikariensis*, *Sclerotium rolfsii*, *H. mompa*, and *R. necatrix* were assigned to mycelial compatibility groups (MCGs) based on the presence or absence of a dark demarcation line produced between colonies in paired culture. MCG designation was used to distinguish individual strains. MCGs existed in the field, as a rule, in patches spatially separated from each other. The genetic identity of each MCG was confirmed by molecular markers with two exceptions where different genotypes constituted a single MCG.

(2) Predominant MCG of *Typhula ishikariensis* biotype A

Recent climatic change characterized by warm winters and deep snow cover in eastern Hokkaido favored the occurrence of a snow mold fungus, *T. ishikariensis* biotype A, on alfalfa. *T. ishikariensis* biotype B had originally predominated in this region, and the fungus does not attack dicots. As a consequence, alfalfa had practically been free from snow mold. Surveys in damaged fields in eastern Hokkaido on the population structure of biotype A elucidated the ubiquity of a certain MCG by the founder effect.

(3) Factors affecting population structure of *Typhula* spp.

The difference in life history strategy between *T. incarnata* and *T. ishikariensis* was reflected in the difference in population structure. Highly heterogeneous populations of *T. incarnata* is ascribed to its high birth rate and high mortality of genets, resulting in consistently complex population structure regardless of the extent of habitat disturbance. *T. ishikariensis*, on the other hand, is characterized by low birth rate and low mortality of genets due to its uninfectious basidiospores and to persistent sclerotia. Its life-history strategy is consequently liable to be affected by environmental conditions.

(4) Application of population biology to biocontrol

Dr. Matsumoto directed a biocontrol project on root diseases of fruit trees caused by *H. mompa* and *R. necatrix* using fungal viruses as an application of population biology. Field observations indicate that the population structure of both pathogens is prone to the spread of viral antagonists. The simple population structure of the pathogens, along with the high economic significance of fruit trees, favor the exploitation of fungal viruses. Results from the project revealed their prospect as biocontrol agents of root diseases of fruit trees caused by *H. mompa* and *R. necatrix.*

3. The Award of The Phytopathological Society of Japan in 2004

Molecular biological studies of Ralstonia solanacearum and related plant pathogenic bacteria

Dr. Kenichi Tsuchiya, Department of Biological Safety, won the Award of The Phytopathological Society of Japan in 2004. In connection with recent changes in agricultural systematics and global trade as well as the public demand for sustainable agriculture, effective detection and discrimination methods are necessary not only for elucidating the genetic diversity of foreign strains and of indigenous pathogenic strains but also to assess beneficial traits and potential risks of biocontrol agents. For these purposes, he conducted molecular biological studies of *Ralstonia solanacearum* (Rs) and related plant pathogenic bacteria to characterize their phenotypic and genetic properties as summarized below:

(1) Molecular biological studies of the strains of *Ralstonia solanacearum*

Rs is one of the most important pathogenic bacteria that causes wilt diseases of plants worldwide. Known to be a heterogeneous species, it has been classified according to a binary system of race and biovar.

Japanese strains were divided into four pathogenic groups according to race. Groups I to III were pathogenic to solanaceous plants such as tomato and eggplant, which corresponded to race 1. Group IV was pathogenic to mainly potato, and corresponded to race 3. In biovar determination based on utilization of carbohydrates,

strains were divided into N2, 3 and 4.

Based on 16S rDNA sequences, Japanese group 1 of *Rs* was found to be closely related to Asian and Australian biovars 3, 4 and 5, whereas Japanese group 2 was homogeneous with Indonesian biovars 2 and N2. Similarly, by rep-PCR analysis using REP (repetitive extragenic palindromic), ERIC (enterobacterial repetitive intergenic consensus) and BOX primers, Japanese strains consisted of two main groups: one with all race 1, and the other with only race 3 strains.

(2) Serological and molecular characterization of the phytopathogenic bacteria

Monoclonal antibodies (MABs) were produced against *Rs* and bacterial spots of tomato and pepper (*Xcv*) and of mango (*Xcm*). By using the MABs, serological relationships of Japanese *Xcv*s with worldwide strains have been demonstrated for the first time. All the Japanese *Xcm* strains turned out to be group I strains among those so far reported in the world. Thirteen MABs selected against *Rs,* were divided into groups based on specific reactivity to strains from tomato (race 1), potato (race 3) or ginger (race 4).

By PCR-RFLP (polymerase chain reaction-based restriction fragment length polymorphism) analysis of 16S rDNA, strains of soft rot bacteria *Erwinia carotovora* subsp. *carotovora* (*Ecc*) isolated in Japan, Korea and Thailand were differentiated into two groups. Most strains from Korea and Japan belonged to the same group. *Ecc* strains isolated from mulberry in Japan were unique, and may belong to a new subspecies of *Ecc*.

(3) Practical detection and molecular characterization of biocontrol agents

By combining ELISA (enzyme-linked immunosorbent assay) using specific antisera with selective media, certain species of pseudomonads were efficiently detected from rhizosphere soil. PCR-based investigation for antibiotics-related genes from bacterial isolates was successful. Antibiotic substances such as pyrrolnitrin (Prn) and 2,4-diacetylphloroglucinol were confirmed by TLC (thin layer chromatography), HPLC (high performance liquid chromatography) and so on.

The *Burkholderia cepacia* complex (Bcc) can control certain plant diseases. Combining a simple direct ELISA with a two-step incubation method on a selective medium, Bcc was specifically detected from soil. One MAB established was specific to serovar group A, which encompasses the majority of natural strains from the environment. Bcc strains derived from clinical sources were assigned to several Genomovars (Gvs.), whereas the majority of those from environmental sources belonged to Gv.I. All *esmR* (epidemic strain marker gene) positive strains belonged to Gv.III, whereas most *prnC* positive strains belonged to Gv.I.

4. The Japanese Society of Soil Science and Plant Nutrition Award for the Excellent Paper on Soil Science and Plant Nutrition

Uptake response of crops to potassium from Andosol and potassium-breaking minerals applied to Andosol

This paper published in the *Japanese Journal of Soil Science and Plant Nutrition* was awarded the Excellent Paper Award by the Japanese Society of Soil Science and Plant Nutrition. Ms. Megumi Sugiyama, senior author of this paper, is a researcher of the Soil Biochemistry Unit, Heavy Metal Group. In their paper, she and co-author Dr. Noriharu Ae, former leader of the same unit, elucidated a new aspect of potassium (K) uptake of plants from soil: if a crop has the ability to take up potassium (K) from the firmly held K minerals (non-exchangeable K) in soil, silicate (SiO_2), one of the major mineral constituents, is expected to be released from the soil and/or to be absorbed by the crop. To confirm this hypothesis, pot experiments were conducted using Andosol which is poor in K supplying power. They found that K uptake by crops differed among crop species, and that when the K uptake was large, the sum of crude silicate in the shoot of crop and available silicate (2.5% acetic acid extractable Si) in the soil after harvesting was larger than the amount of available silicate in the soil of un-planted pots. This supports the above hypothesis that crops absorb “non-exchangeable K” from soil minerals in association with the solublization of silicate mineral.

Seasonal Events

1. Summer Festival

The 20th Summer Festival was held on the baseball field of NIAES in the evening of August 7, 2003, by the volunteers of NIAES, the National Agricultural Research Center and the National Institute of Agrobiological Sciences. There were about 1,000 participants who included the staff members of the institutes, their families and neighbors around the institutes. A variety of foods, drinks and games were offered by numerous stalls managed by the staff members. The participants enjoyed the Bon-Odori Dance and fireworks. All had a good time, refreshing themselves and strengthening their friendship. (Photo 1, 2)

Photo 1 A family starting "Balloon Fishing" at the Summer Festival.

Photo 2 The center stage decorated with Chochin lanterns.

2. Harvest Festival

The NIAES Harvest Festival 2003 took place after work on November 6 to thank the gods and workers for a bountiful harvest and to enhance friendship among the staff members. The Director General expressed appreciation for the staff's services of the year at the opening address. After the rice harvesting ceremony was performed solemnly, about 200 participants had a good time, enjoying a variety of foods and drinks served by the staff members. (Photo 3, 4)

Photo 3 The rice harvesting ceremony at the Harvest Festival.

Photo 4 Staff members making rice cakes during the Harvest Festival.

Research Organization

Director General

Auditor

Executive Director

Department of Research Planning and Coordination
- *Division of Research Planning*
- *Division of Research Coordination*
- *Division of Research Information Systems*
- *Division of Documentation and Information*
- *Division of Experimental Farm Management*

Administration Department
- *General Affairs Section*
- *Accounts Section*

Department of Global Resources
- *Agro-Meteorology Group*
  - *Climate Resources Unit*
  - *Atmospheric Impacts Unit*
  - *Air Quality Conservation Unit*
- *Ecosystems Group*
  - *Agro-Ecological Sensing Unit*
  - *Statistics Unit*
  - *Material Ecocycling Unit*
  - *Ecological Management Unit*
  - *Remote Sensing Unit*
- *Greenhouse Gas Emission Team*
- *Food Production Prediction Team*
- *Ecosystem Gas Exchange Team*

Department of Biological Safety
- *Plant Ecology Group*
  - *Vegetation Ecology Unit*
  - *Landscape Ecology Unit*
  - *Chemical Ecology Unit*
- *Entomology Group*
  - *Introduced Insect Assessment Unit*
  - *Population Ecology Unit*
  - *Insect Semiochemicals Unit*
- *Microbiology Group*
  - *Microbiology Research Coordinator*
  - *Microbial Ecology Unit*
  - *Microbial Genetics and Physiology Unit*
  - *Nematology and Soil Zoology Unit*
- *GMO Assessment Team*

Department of Environmental Chemistry
- *Organochemicals Group*
  - *Environmental Pesticide Assessment Unit*
  - *Pesticide Mitigation Unit*
  - *Applied Soil Microbiology Unit*
- *Heavy Metal Group*
  - *Heavy Metal Behavior Unit*
  - *Soil Chemistry Unit*
  - *Soil Biochemistry Unit*
- *Water Quality and Solute Dynamics Group*
  - *Soil Physics Unit*
  - *Nutrient Dynamics Unit*
  - *Contaminant Hydrology Unit*
  - *Water Quality Conservation Unit*
- *Dioxin Dynamics Team*

Natural Resources Inventory Center
- *Soil Classification Laboratory*
- *Insect Systematics Laboratory*
- *Microbial Systematics Laboratory*

Chemical Analysis Research Center
- *Environmental Chemicals Analysis Laboratory*
- *Radioisotope Analysis Laboratory*

Department of Global Resources

The mission of the Department of Global Resources is expressed by 2 broad global environmental research goals: to assess the agro-ecological impacts of unusual climatic variations and global warming, and to develop adaptive technical and policy measures to reduce any adverse impacts by clarifying climate-change mechanisms and by monitoring and modeling. These missions are the concern of 2 research groups – the Agro- Meteorology Group and the Ecosystems Group – and 3 teams – the Greenhouse Gas Emission Team, the Food Production Prediction Team, and the Ecosystem Gas Exchange Team.

Research projects are initiated in domains such as 1) prediction of food production under global environmental variability; 2) elucidation of the impacts of global climate change on agro-ecosystems; 3) estimation of greenhouse gas emissions from agricultural activities and development of measures that can be used to minimize emissions; 4) determination of the effects of human activity mainly on the flow of carbon and nitrogen; 5) development of techniques for remote sensing and multivariate statistical analysis; and 6) assessment of changes in rural land use.

Some of our research projects are recently involved with the Global Warming Research Initiative and Water Resources Research Initiative, which are managed under the Council for Science and Technology Policy. The goal of our projects is to formulate an adaptable scenario of greenhouse gas emissions that will help stabilize climate change within a range that is compatible with human civilization.

1) Agro-Meteorology Group

The mission of the Agro-Meteorology Group is to clarify predictions of the impacts on, and atmospheric changes in, agricultural ecosystems caused by climate change and elevated atmospheric CO_2 levels. The Agro-Meteorology Group consists of 3 units: 1) Climate Resources Unit; 2) Atmospheric Impacts Unit; and 3) Air Quality Conservation Unit.

The research aim of the Climate Resources Unit is to develop monitoring techniques for evaluating the effects of climate change and elevated CO_2 on agricultural water resources, and to develop methods for predicting these changes. The research objective of the Atmospheric Impacts Unit is to develop models for predicting the effects of elevated atmospheric CO_2 on agricultural ecosystems by analysis of the results of free air CO_2 enrichment (FACE) experiments. The research of the Air Quality Conservation Unit is focused on clarifying the processes of emission, diffusion, and deposition of air components such as trace gases, pollens, and dust in agricultural ecosystems.

In FY 2003, the following research was conducted by the 3 units: 1) understanding and predicting spatio-temporal change in agricultural water resources; 2) assessment of the impact of climate change on agricultural production; 3) study of a model for estimating regional paddy water and soil temperatures by using routine weather data; 4) impact assessment of climate change from the viewpoint of agricultural production management; 5) prediction of the impacts of atmospheric CO_2 increase on crop production and water use; 6) process-based modeling of agricultural ecosystems under rising temperatures and increasing atmospheric CO_2 concentration; 7) impacts of increasing atmospheric CO_2 on heat stress in crop plants; 8) modeling and simulation of canopy microclimate and fluid dynamics for developing open-air warming systems; 9) modeling and estimation of emission and diffusion processes controlling air quality in agro-ecosystems; 10) examination of the relationship between ground surface conditions and aeolian dust outbreaks; 11) assessment of the effects of temporal and spatial variations in the bio-meteorological environment on alpine grassland ecosystems; and 12) assessment of the climate mitigation function of agricultural land.

Twenty-one original research papers were published in international and domestic journals in FY 2003. The 20th Meteorology Workshop, entitled “Evaluation of potential amount of, and effective use for, agricultural water resources” was organized by the Climate Resources Unit and held at NIAES on 24 February 2004.

Dr. K. Kobayashi, Chief of the Atmospheric Impacts Unit, was transferred on 1 October 2003 to a position as Professor at The University of Tokyo Graduate School of Agriculture and Life Sciences. In his time at NIAES, he achieved valuable outcomes in his research on the assessment of crop losses due to photochemical ozone in Japan and prediction of the impacts of atmospheric CO_2 increase on rice paddy ecosystems by FACE facilities. Dr. T. Hasegawa, formerly Associate Professor at the Graduate School of Agriculture, Hokkaido University, took over from Dr. Kobayashi as Chief of the Atmospheric Impacts Unit.

Topic 1: Does elevated CO_2 increase heat-induced spikelet sterility of rice?

Global warming can increase the probability of heat-induced spikelet sterility (HISS) of rice, which has a

direct influence on grain yield. Elevated CO_2 concentration ([CO_2]) can exacerbate HISS because it raises the canopy temperature through stomatal closure. The temperature of the panicles (T_p) at flowering is obviously the major determinant of HISS, but it is difficult to predict changes in T_p under elevated [CO_2], because T_p is determined by heat exchange among the panicles, the leaves, and the atmosphere (Fig. 1). We measured the thermal and transpirational environments surrounding panicles in the rice canopy at ambient (A-CO_2) and elevated [CO_2] (200 µmol/mol above ambient, E-CO_2) in China by FACE (Wuxi, China, 31°37′N, 120°28′E), and we developed a heat balance model to simulate T_p and panicle transpiration under elevated [CO_2].

FACE reduced leaf conductance by about 30% and raised leaf temperature by 1 or 2 °C. The canopy air temperature was raised by 0.5 to 1 °C, and the relative humidity was reduced by 5% to 8% (E-CO_2 minus A-CO_2; Fig. 2). Panicle transpirational conductance on flowering day was around 1 cm/s, which was comparable to the leaf conductance, but it had decreased to 0.3 cm/s by 3 days after flowering.

The model simulation showed that the increase in T_p solely due to FACE was 0.5 to 1 °C on flowering day, and that the temperature rise increased as the panicle dried (Fig. 2). This T_p increase by FACE can be large enough to exacerbate HISS, because sterility increases significantly in the thermal range of 1 to 2 °C higher than the critical temperature. The simulation also showed that panicle transpiration rate was larger under E-CO_2 than A-CO_2, because the panicle-to-air water vapor pressure deficit was larger because of the higher T_p and drier atmosphere. This suggests that elevated [CO_2] could accelerate panicle drying as well as panicle warming. (M. Yoshimoto)

Topic 2: Comparison of aeolian dust emission from desert and cropland

Dust generated by wind (aeolian dust) has great impacts on agriculture and on daily life in the arid and semiarid areas where it originates. Furthermore, aeolian dust, as the largest naturally released aerosols, directly or indirectly influences the atmospheric radiation balance and hence global climatic variations. The Gobi Desert and sandy deserts of northwest China are regarded as the primary sources of Asian aeolian dust. Dust generated

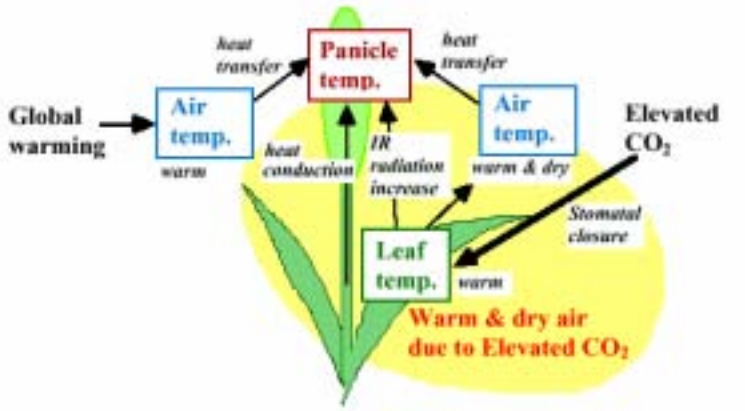


Fig. 1 Mechanism of panicle temperature increase as a result of global warming and elevated CO_2.

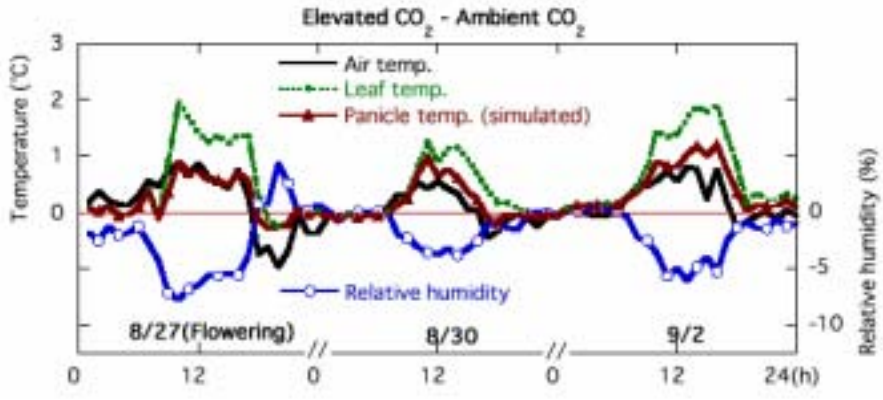


Fig. 2 Effects of FACE (E-CO_2 minus A-CO_2) on canopy microclimate and panicle temperature.

there by sandstorms can be transported to Japan (usually as particles called 'Kosa') and even to the Pacific Ocean and North America. With the increase in human activity in recent years, oases, and especially the dry cropland around or within the sandy deserts and the Gobi Desert, are also gradually turning into important dust sources.

We set up 2 automatic observation stations, one in the Gobi Desert and one in croplands in Dunhuang, China, one of the main regions where dust storms generated and pass through (Photo 1, top). These stations were set up for two reasons. The first is to clarify the process of generation of dust storm outbreaks and the relationship between ground surface conditions (such as surface soil vegetation cover, water content, and temperature) and these outbreaks. The second is to obtain basic data that can be applied to a dust storm outbreak model in the course of parameterization and verification by continuous observation of dust parameters and meteorological elements on different surfaces, that is, the desert and the agricultural field. The observation system consists of an automatic weather station, which monitors soil water content and temperature at several depths, a dust particle counter and an automatic visibility observation device for measuring dust concentration, a streamwise saltation particle counter, and a dust catcher.

Using the automatic visibility observation device and dust particle counter, we have developed a method for deducing the dust concentration without an AC power supply; this is very useful for measuring dust in the desert area. The streamwise saltation particle counter is a semiconductor laser device designed by RIKEN for the sequential measurement of streamwise saltation flux by detecting particle sizes and numbers when particles pass through the laser beam. This is the world's first direct measurement system for streamwise saltation flux and on 32 channels it can obtain the data on particles ranging in size from 38 to 650 μm.

It is well known that the water content of the surface soil (or sand) and soil texture play very important roles in dust emission. During spring, when dust emission is most frequent, most of the croplands in Dunhuang are bare fields. The surface of the soil is very hard before the spring cultivation as a result of irrigation in late autumn or early spring and surface compaction (Photo 1, middle). However, spring cultivation, including harrowing, leveling, plowing, fertilizing, and seeding, destroys the hard surface soil layer (Photo 1, bottom). The results of our observations and analysis show that, before the spring cultivation, dust emission from croplands in the Dunhuang oasis is limited mainly to the roads, which are covered in fine dust and pass between the fields. However, after the spring cultivation it is much easier for dust

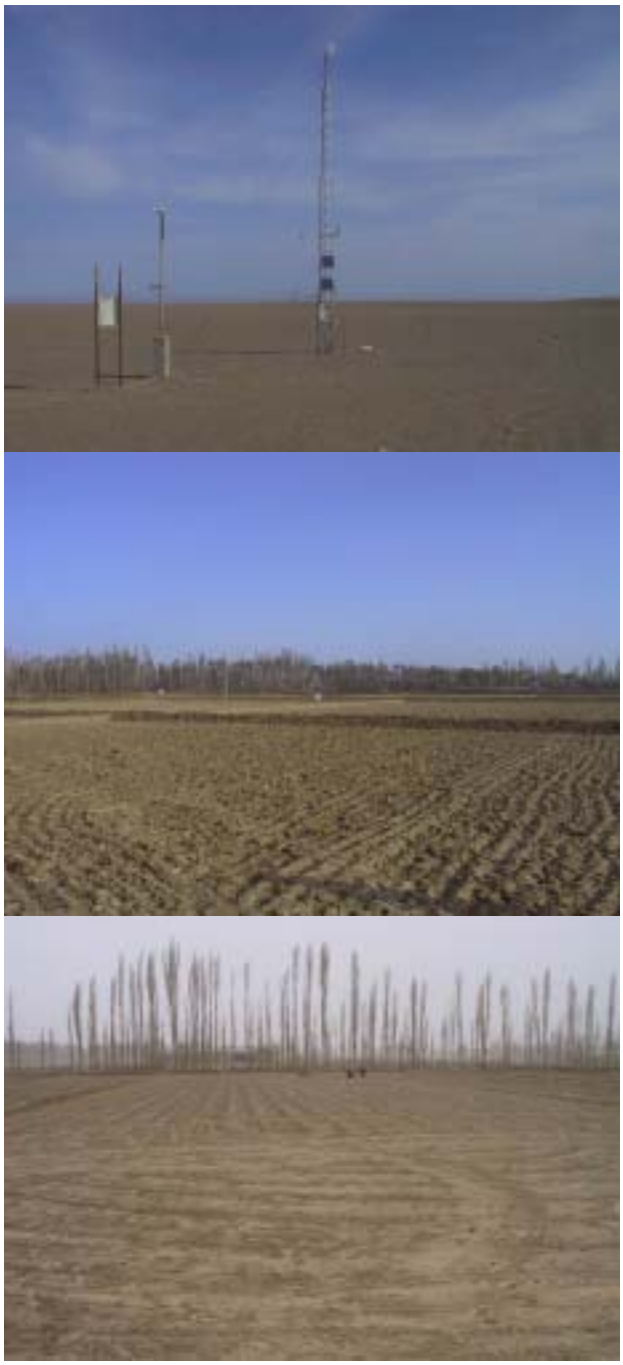


Photo 1 Dust observation stations and land surface conditions: Gobi Desert (top); nearby cropland oasis at Dunhuang before spring plowing (middle) and after spring plowing (bottom).

to be emitted from the croplands than from the desert. We found that the dust emission rate or vertical dust flux (F) is proportional to the third or fourth power of the friction velocity (u_*) or wind speed (U) when the wind is strong enough to reach threshold wind speed (U_t) or threshold friction velocity (u_{*t}). Our results show that u_{*t} and U_t for the croplands before the spring cultivation are

larger than for the desert. However, after the spring cultivation u_{*t} and U_t become lower in the croplands than in the desert.

By using Shao's dust emission scheme (2001) and our observation data (u_{*t}), we can simulate F for the different soil water (W) contents in the Gobi and at the cropland site. It is clear that, with Shao's model, there is no dust emission from the croplands when the soil volumetric water content reaches about 0.3 (m^3/m^3), which was the mean soil water content of the Dunhuang site at 20 cm depth during spring 2002. For the Gobi Desert, when W is very low (below 0.06 m^3/m^3), F would be only about 1/10,000 of that from the cropland at the same W. When W is larger than 0.3 m^3/m^3, there is no dust emission from the Gobi Desert, either. It is difficult for dust emission to occur when the surface of the cropland soil is hard (Fig. 3). However, when the surface becomes loose through agricultural activities such as spring plowing, dust emission becomes much easier and the amount released becomes several hundreds of times greater than that from the desert. (M. Du)

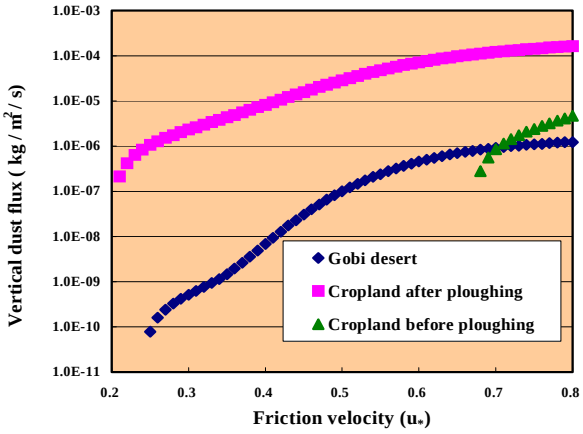


Fig. 3 Comparison of dust emission rates (or vertical dust flux) at different friction velocities in the Gobi Desert and at a nearby cropland site (Dunhuang, China) before and after plowing.

2) Ecosystems Group

The Ecosystems Group consists of 5 units. The Agro-Ecological Sensing Unit is developing remote sensing and modeling methods for monitoring plant and environmental dynamics in agricultural and natural ecosystems on the basis of optical and electromagnetic measurements ranging from leaf scale to regional scale (see Topic 1). The Statistics Unit is developing novel statistical methodologies for sampling, classifying, and analyzing agro-environmental data. The Material Ecocycling Unit is studying the nitrogen and nutrient flow in agro-ecosystems to evaluate the relationship between anthropogenic activities and material cycles in Japan and East Asia. The Ecological Management Unit is studying historical changes in the spatial structure of rural ecosystems, and the conservation and management of the wildlife that inhabits environments of the Kanto District (see Topic 2). The Remote Sensing Unit has been determining the environmental characteristics that can be observed at a regional scale through satellite imaging systems such as multi-band and multi-polarization synthetic aperture radar (SAR), NOAA/AVHRR, and TERRA/MODIS. In FY 2003, we carried out 10 research projects funded by MAFF (Ministry of Agriculture, Forestry and Fisheries), Ministry of the Environment, and MEXT (Ministry of Education, Culture, Sports, Science and Technology). Our researchers attended 8 meetings abroad related to anthropology, ecology, remote sensing, and statistics. Further, researchers made 10 overseas visits – to the United States, France, Australia, New Zealand, China, Korea, Laos, Malaysia, Cambodia, and Thailand – for fieldwork, cooperative projects, and research exchange. Domestically, we made a total of 31 presentations at academic meetings on statistics, remote sensing, geography, environmental sciences, and anthropology.

Topic 1: Potential of microwave backscattering signatures for remote sensing of crop growth and vegetation dynamics

Microwave remote sensing is expected to be useful, especially in monsoon Asia, because microwave signatures can be acquired under cloudy conditions, whereas optical observations are seriously affected by clouds and atmospheric conditions. Nevertheless, experimental results and the interpretation of microwave backscatter information have not always been definitive to date, because the backscatter signals from vegetated surfaces are affected by many factors, including plant biomass, structure (e.g. leaf size, stem density, leaf area index – LAI), soil moisture, and roughness of the observed surfaces, as well as by sensor configurations such as frequency, polarization, and incident angle. We therefore investigated the interaction of microwave backscatter signatures with rice canopy growth variables based on a comprehensive data set collected under the unique cropping conditions of paddy rice, i.e., with the background of water surface.

We obtained a unique data set that consists of daily microwave backscattering coefficients at all combinations of 5 frequencies (Ka: 35.25 GHz, Ku: 15.95 GHz, X: 9.6 GHz, C: 5.75 GHz, and L: 1.26 GHz), all polarizations (HH, VH, HV, and VV), and four incident angles (25°, 35°, 45°, and 55°) for the entire rice cropping

period from before transplantation until post-harvest cultivation (Inoue et al., 2002). The data set also includes a wide range of plant variables, such as LAI, the biomass of the whole plant and plant parts, weather conditions, spectral reflectance measurements, photographic image data of plant shape, and related eco-physiological canopy variables. The comparative analysis clearly showed some new aspects of the interaction between microwave backscatter and vegetation variables in rice. One important finding was that the microwave backscatter signatures at high frequency (Ka-, Ku-, and X-bands), especially at large incident angles, are sensitive enough to detect the thin rice seedlings just after transplanting. Rice biomass was best correlated with the L-band HH- and cross-polarizations (Fig. 4a), whereas LAI was best correlated with the C-band HH- and cross-polarizations (Fig. 4b). In contrast, higher frequency bands (Ka, Ku, and X) were poorly correlated with LAI and biomass. Stem density was estimated well by the X-band (Fig. 4c). Interestingly, head weight (nearly the weight of rice grains) was highly correlated with the Ka- and Ku-band backscattering coefficients (Fig. 4d), although it showed poor correlation with the other bands. These unique relationships were obtained presumably because the scattering processes and penetration depth into the canopy are frequency dependent (Fig. 5).

Our experimental results clearly showed a number of significant correlations between backscattering coefficients and plant variables, although we expect that these relationships will be obscured under infrequent and instantaneous measuring conditions because of a variety of error sources. These results provide a useful basis for the interpretation of backscattering signatures over vegetated areas, for numerical modeling approaches, and for wide-area monitoring of rice-cropping areas using space-borne SAR data in monsoon Asia. (Y. Inoue)

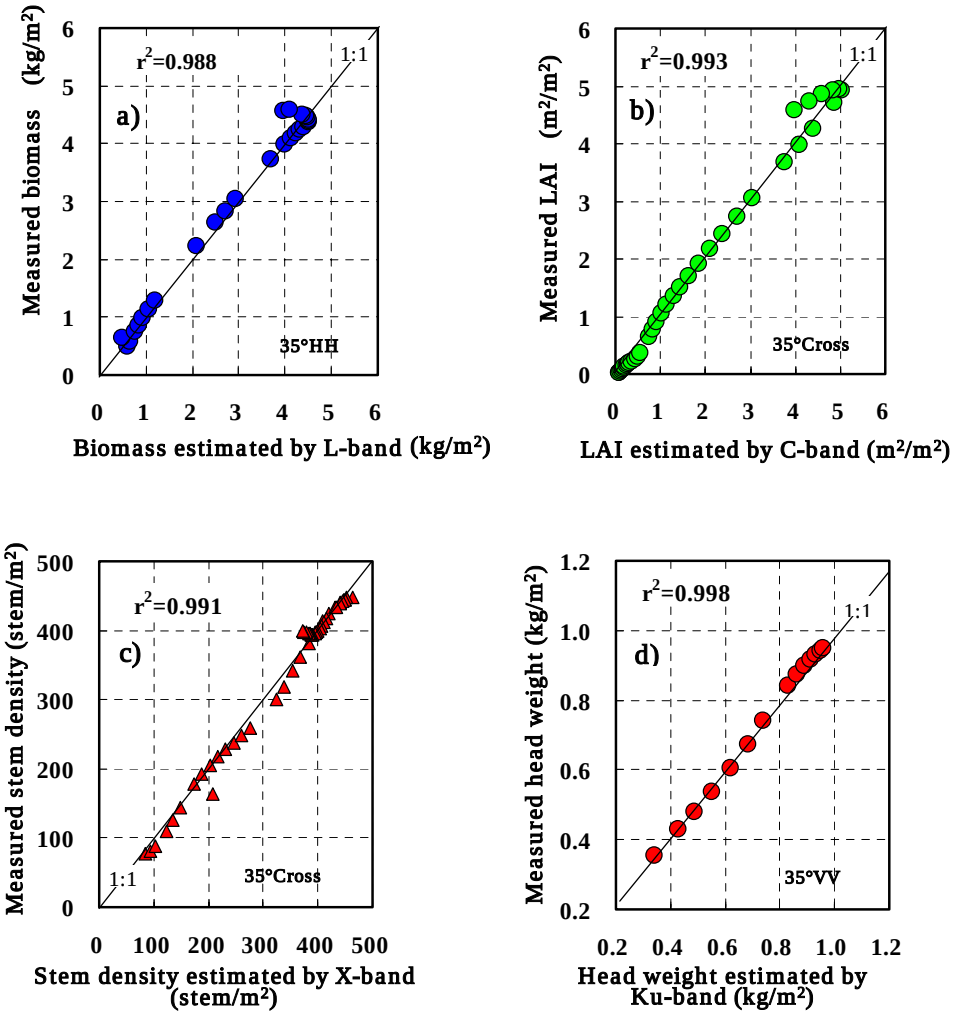


Fig. 4 a)–d) Modeling to estimate major growth variables of paddy rice using backscattering coefficients at various frequencies.

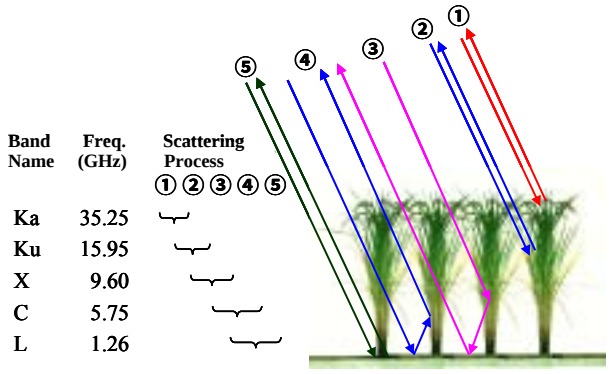


Fig. 5 Processes of backscattering microwaves at various frequencies in a rice canopy. Each frequency provides different canopy information, depending on the attenuation depth.

Reference

Inoue, Y., T. Kurosu, H. Maeno, S. Uratsuka, T. Kozu, K. Dabrowska-Zielinska and J. Qi (2002): Season-long daily measurements of multi-frequency (Ka, Ku, X, C, and L) and full-polarization backscatter signatures over paddy-rice field and their relationship with biological variables. Remote Sensing of Environment, 81: 194–204.

***Topic 2:* Grasslands and woodlands in southern Ibaraki Prefecture: 100 years of land use change in rural Japan**

In traditional Japanese agriculture, the main materials of fertilizers were grasses and leaves collected from grasslands and woodlands. Today, grasslands have almost vanished and rural woodlands, greatly diminished. The purpose of this study is to quantitatively analyze the loss of rural grasslands and woodlands, the most dramatic land use change in rural Japan in the last century. We chose for analysis the village of Ami, adjacent to Tsukuba in southern Ibaraki Prefecture.

We built a GIS database from topographic maps of the 1880s, 1920s, and 2000s. We investigated land use in the 1880s with the *Jinsoku-sokuzu* (Rapid Survey Maps), made by the Japanese Army in the 1880s. The *Jinsoku-sokuzu* is the oldest set of topographic maps based on modern cartographic methods in Japan. Land use maps of the 1920s and 2000s were made from topographic maps issued by the Geographical Survey Institute.

Figure 6 shows the land use in Ami in 1883, 1921, and 2000. In 1883, grasslands and woodlands occupied about 29% and 21% of Ami. The large grasslands were the commons shared by seven settlements. Woodlands

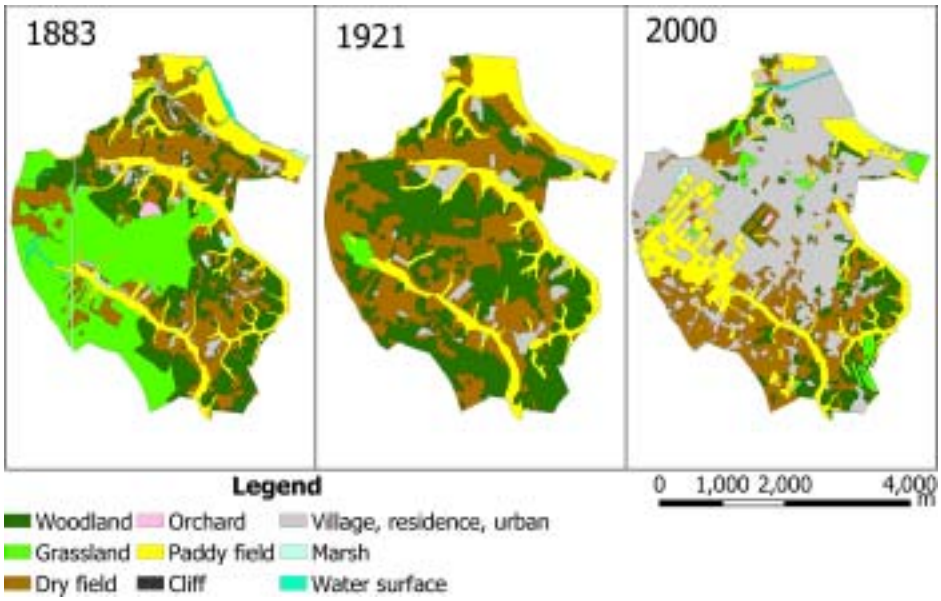


Fig. 6 Land use change in the village of Ami, southern Ibaraki Prefecture.

were mainly distributed on slopes between the lowlands and terraces. Dry fields and paddy fields occupied 26% and 18% of Ami. Dry fields were located on the higher and drier terraces, while paddy fields were distributed along rivers or the shore of Lake Kasumigaura. From 1883 to 1921, with the expansion of fields, grassland area declined to 1%, and almost disappeared. Dry fields and woodlands increased to 36% and 38% of Ami, respectively, mostly at the expense of grasslands; 32% of woodlands and 39% of dry fields were former grasslands. Between 1921 and 2000, the residential area increased drastically from 5% to 45% of Ami. In the residential area of 2000, former dry fields and former woodlands occupied 39% and 37%. Only 7% of the residential area was former village. Paddy fields increased slightly from 18% to 20%. However, paddy field location had shifted. One-third of the paddy fields in the 1920s had changed into residential areas, while former dry fields occupied 30% of the paddy fields in 2000, made possible by better irrigation. Although grasslands had increased slightly in this period, these grasslands were composed of a golf course and uncultivated farmland.

How was fertilizer-use by farmers related to the loss of grasslands and woodlands? In the 1880s, the quantity and quality of fertilizer were probably enough for subsistence agriculture in Ami, so most fertilizer was self-supplied by each farm household. From the 1880s to 1920s, the grasslands almost disappeared, and changed into dry fields or woodlands, leading to the lack of compost. Purchased fertilizer, such as soybean cake, became more popular, but most fertilizer was still self-supplied, using leaves supplied from the remaining woodlands. By the 2000s, most fertilizer was chemical. This meant that there was no longer any need to maintain woodlands as sources of fertilizer. Thus, woodlands changed into other land uses, especially residential areas and cities. Today, urban areas occupy 45% of Ami. (D. Sprague and N. Iwasaki)

3) Greenhouse Gas Emission Team

Considerable attention has been paid in recent years to the likelihood of significant changes in world climate due to increased atmospheric concentrations of greenhouse gases (GHGs). GHGs, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), can absorb thermal radiation from the surface of the earth and thus contribute to the warming of the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) has reported that concentrations of atmospheric GHGs and their radiative forcing have continued to increase as a result of various human activities.

Agriculture contributes to over 20% of global anthropogenic GHG emissions. In particular, 55% to 60% and 65% to 80% of total emissions of CH_4 and N_2O, respectively, are derived from agricultural sources. These GHGs are emitted to the atmosphere as a result of accelerated turnover of carbon and nitrogen in agricultural soils and the surrounding environment by increased input of chemical and organic fertilizers and other agro-materials (Fig. 7). This increased input also results in increased emission of nitrogen oxide (NO) and ammonia (NH_3), which are the precursors of acid rain, and in pollution of rivers and groundwater by leaching of nitrogen and carbon components.

The Greenhouse Gas Emission Team studies emission and absorption of these environmentally important gases in association with different land uses and agricultural management. The activities of the team are based on field measurements of GHG exchange, laboratory experiments, data interpretation, and modeling. The goals of the team are 1) to quantify and model the processes of GHG emission and absorption; 2) to estimate the rates of GHG emission and absorption; and 3) to develop promising and feasible technologies that reduce GHG emissions. The studies have been developed to address scientifically and socially important questions related to the environmental impacts of agriculture.

***Topic:* Nitrous oxide and nitric oxide emissions from chemical and organic fertilizer application to Japanese Andisol fields**

The current national greenhouse gases inventory of Japan is compiled on the bases of the IPCC Guidelines (IPCC, 1997) and Good Practice Guidance (IPCC, 2001). N_2O emission factors for chemical fertilizer application are estimated from field data sets. However, N_2O emission from animal manure application is estimated by using the emission factors for chemical fertilizer as substitutes, because few data are available (Ministry of the Environment, 2003). Various kinds of organic fertilizer, such as oil cake and fish meal, are also used in Japan, but these are not considered in the current inventory. Both chemical and organic fertilizers are also considered to be sources of nitric oxide (NO). NO is a precursor of tropospheric ozone, which is a greenhouse gas, and a precursor of nitrate, a cause of acid rain (Fig. 7). Relatively few studies of NO emission after organic fertilizer application have been reported, compared with the number of reports of the effect of chemical fertilizer application. We measured N_2O and NO emissions from chemical and organic fertilizer application and estimated these emissions from application of the same fertilizers to Japanese Andisols, which cover the largest area (about 50%) of Japanese upland fields.

N_2O and NO emissions were measured with an automated monitoring system at NIAES, Japan. Our results showed that N_2O and NO emissions varied widely among organic fertilizer treatments (Fig. 8). N_2O emissions from relatively low C/N organic fertilizer treatments (C/N ratio in brackets: oil cake (9.6), fish meal (4.2), swine manure (10.7), poultry manure (9.7)) were higher than those from urea treatment. In contrast, N_2O emissions from relatively high C/N organic fertilizer treatments (cattle manure (24.3) and dried cattle excreta (15.9)) were lower than those from urea treatment. NO emissions from organic fertilizer treatments were lower than those from urea treatment. The N_2O emission from the urea treatment in our field was similar to those from chemical fertilizer application to other fields in the Tsukuba area, and lower than the IPCC default value of 1.25% of applied N. Davidson et al. (1991) described a conceptual model whereby when the NO-N/N_2O-N ratio

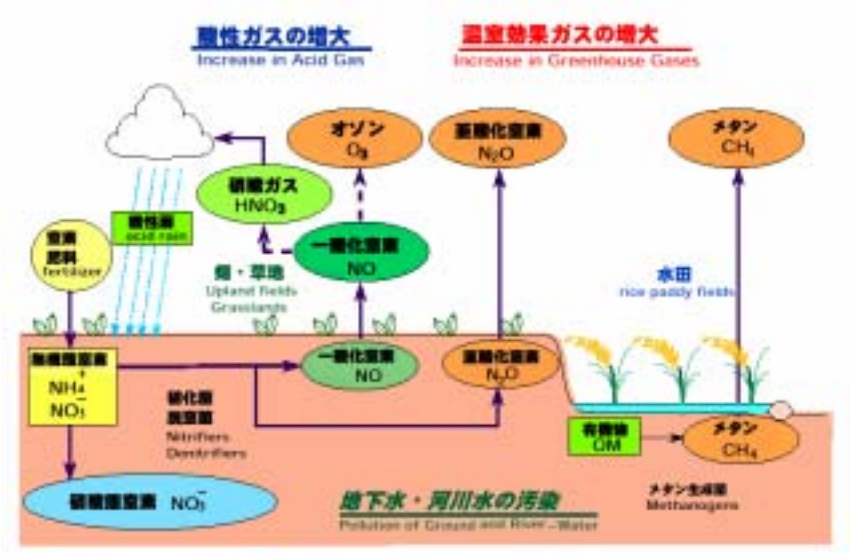


Fig. 7 Effects of chemical and organic fertilizer application on emissions of greenhouse gases as a result of accelerated turnover of carbon and nitrogen in agricultural soils.

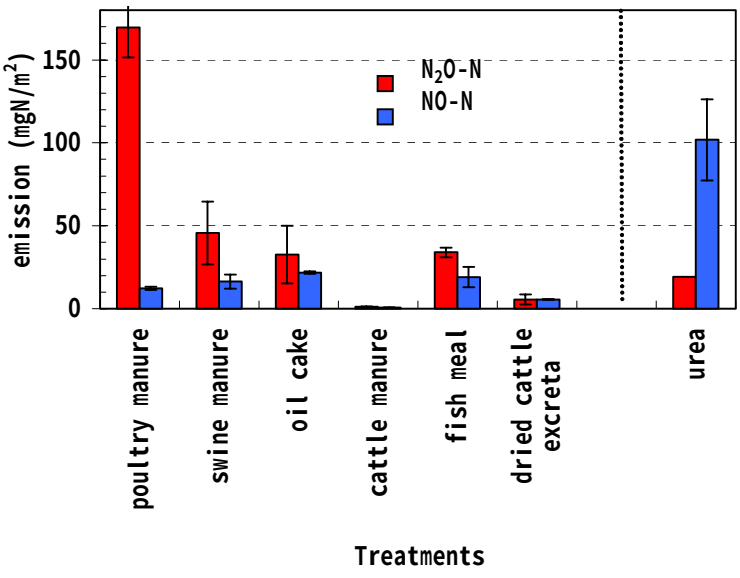


Fig. 8 N_2O and NO emissions over 30 days from an Andisol field after the application of different organic and chemical fertilizers. Emissions were measured with an automated monitoring system at NIAES. The N application rate was 15 g N m^{-2}. Pac choi or spinach was cultivated.

was higher than 1, nitrification was considered the dominant process, but when it was lower than 1, denitrification was considered dominant. Comparison of the NO-N/N_2O-N ratio in this study suggested that nitrification was more dominant in urea treatment, whereas denitrification was more dominant in the organic fertilizer treatments.

To compile national inventories for N_2O and NO emissions from the activity data in the Agricultural Census report, we differentiated between 'low C/N organic fertilizers' (e.g. oil cake, fish meal, swine manure, poultry manure) and 'high C/N organic fertilizers' (e.g. cattle manure). From our 4-year measurement, we estimated the N_2O and NO emission factors (emission rate of applied N) for chemical fertilizer and for low C/N and high C/N organic fertilizers on Japanese Andisols (Table 1). Our estimates showed that organic fertilizer application is an important source of N_2O, as is as chemical fertilizer application.

Table. 1 Estimate of N_2O and NO emissions from Japanese Andisol

		Organic fertilizer		
	Chemical fertilizer	'Low C/N organic fertilizer' [c]	'High C/N organic fertilizer' [d]	Organic fertilizer TOTAL
N_2O emission factor [a] (%)	0.21	0.55	0.08	
NO emission factor [a] (%)	0.56	0.10	0.05	
N input [b] (Gg N yr^{-1})	162	54	78	132
Estimated emission				
N_2O-N (Gg N yr^{-1})	0.34	0.29	0.06	0.36
NO-N (Gg N yr^{-1})	0.91	0.16	0.08	0.24

a: Estimated from our field data for a year.
b: Estimated from Agricultural Census data (2000) and Andisol field area.
c: This category include oil cake, fish meal, swine manure, poultry manure and other organic fertilizers with relatively low C/N ratio.
d: This category include cattle manure and other organic fertilizers with relatively high C/N ratio.

N_2O emissions generally differ with soil types. To estimate N_2O emissions for the whole of Japan from chemical and organic fertilizer application, emission data for soil types other than Andisols are needed, but soil type is not considered in the current Japanese inventory. In addition, the current IPCC methodology for organic fertilizer application, which gives the same default emission factor (1.25%) for all manures, needs to be improved. (K. Yagi, H. Akiyama, S. Sudo and S. Nishimura)

References

Akiyama, H. and H. Tsuruta (2003) Journal of Environmental Quality, 32: 423–431.

Akiyama, H. and H. Tsuruta (2003) Global Biogeochemical Cycles, 17 (4): 1100, doi:10.1029/2002GB002016.

Davidson, E. A. (1991). In Microbial Production and Consumption of Greenhouse Gases: Methane, Nitrous oxide, and Halomethanes, American Society of Microbiology, Washington DC, pp. 219–235.

IPCC (1997) Greenhouse Gas Inventory. Reference Manual. Revised 1996. Intergovernmental Panel on Climate Change Guidelines for National Inventories, Volume 3.

IPCC (2001) Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change.

Ministry of the Environment (2003) National Greenhouse Gas Inventory Report of Japan

4) Food Production Prediction Team

The mission of the Food Production Prediction Team is to assess both the impact of global environmental change on food production and the efficacy of technologies designed to mitigate these adverse environmental changes. Our major research domains are assessment of the impact of global warming on agriculture; monitoring and modeling of environment changes in agricultural ecosystems; development of regional climate change scenarios; and assessment of the variability of climate systems in Asian Monsoon countries. This year, all 17 researchers on the team went abroad for field surveys or presentations at international conferences. The team hosted 6 guest scientists from overseas and accepted 1 student from a domestic university.

The team has 9 activities, and the following 3 were completed in FY 2003: 1) analysis of the hydrological cycle and its variability in Asia; 2) studies of the distribution and patterns of fluctuation of agricultural water resources; and 3) development of an index for evaluating the environmental resource changes occurring with desertification in China.

Ongoing activities are 1) development of advanced techniques for projecting future climate change by using ocean–atmosphere coupled global climate models (GCM) and statistical methods; 2) prediction of the impacts of climate change on food supplies; 3) prediction of agricultural productivity change, incorporating responses to global warming; 4) development of a technique of risk assessment for agro-ecosystems in light of the variability and regionality of factors that can influence these systems; 5) construction of a model and development of a technique for estimating regional space–time soil carbon flux; and 6) evaluation of the impact of global climate change on soil environments in East Asia.

Topic: **Estimation of future regional-scale climate changes over East Asia by a statistical downscaling method**

General circulation models (GCMs) are advanced simulation tools for projecting future climate change as global warming in relation to increased atmospheric concentrations of greenhouse gases (GHGs). It is widely accepted that current GCMs are generally trustworthy for modeling large-scale atmospheric fields (e.g. geopotential height, pressure, wind fields), even with poor spatial resolution (over 200 km). However, the prediction or projection of future climates using this poor resolution is not suitable for investigating the impact of climate on agriculture, hydrological cycles or water resources, natural ecosystems, economies, and human society. In addition, some GCM-derived climate factors (e.g. precipitation, evaporation, soil moisture, and runoff that are especially associated with water) depend upon subgrid-scale physical and hydrological processes, but their reliability is questionable for simulating local climatic conditions. To resolve these problems there are 2 effective approaches. One is to use a regional climate model (RCM) to translate large-scale GCM-derived information physically and dynamically to the local-scale climate, and the other employs so-called statistical downscaling methods (SDSMs) to convert large-scale circulation fields such as sea-level pressure (SLP) or other circulation fields to local-scale climatic factors such as temperature and precipitation by using statistical or empirical relationships between the large- and local-scale variables. This year, we tried to project future regional-scale precipitation changes in Japan on 10-km-mesh scales by applying an SDSM in which the SLP anomaly over East Asia was used as an input parameter.

In the original CO_2 experiment driven by the Meteorological Research Institute atmospheric GCM (MRI-AGCM), precipitation increased to more than 110% of the normal value over the region from north China to the northern part of Japan, and an area with below-normal precipitation was seen only in the southern coastal area of Japan (Fig. 9). Precipitation change estimated by an SDSM using only the same SLP anomaly pattern derived from the MRI-AGCM is shown in Figure 10. Precipitation increased to approximately 110% of normal on the coast of the Sea of Japan, and reached more than 130% in part of this area, but in the Kanto and Tokai districts precipitation decreased to less than 90% of normal. In contrast, in the original CO_2 experiment driven by the atmospheric GCM of the Center for Climate System Research of the University of Tokyo and the National Institute for Environmental Studies (CCSR/NIES -AGCM), the North Pacific high was more intense and the area with positive SLP anomaly was located more northward; precipitation decreased to less than 90% of normal over almost all of Japan and increased to more than 130% over the East China Sea (Fig. 11). However, the SDSM-applied precipitation change estimated by using the SLP of CCSR/NIES-AGCM showed features different from the original. Precipitation increased to more than 130% over the coast of the Sea of Japan (excluding Hokkaido) and decreased to less than 70% over the Pacific coastal area from the Kanto to Kyushu districts (Fig. 12). The overall features of the regional distribution of precipitation change were different from the GCM original, but similar to those derived by SDSM using MRI-AGCM SLP.

An important result of this study is that the SDSM-applied precipitations achieved by using only SLP of the two GCMs were similar to each other, showing decreas-

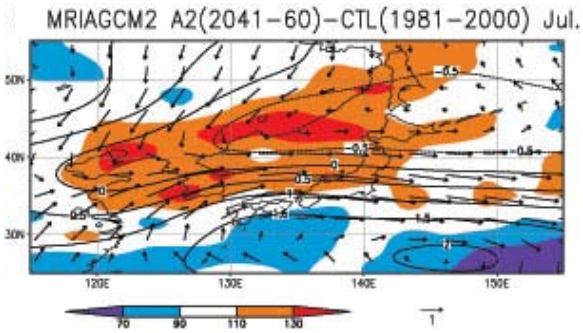


Fig. 9 Geographic distributions of mean sea-level pressure (hPa), wind vector at 850 hPa field (m/s), and precipitation change (%) according to an MRI-AGCM CO_2–experiment projection (July 2041–2060), compared with the GCM control-experiment values (1981–2000). (See text for explanations of abbreviations for all models.)

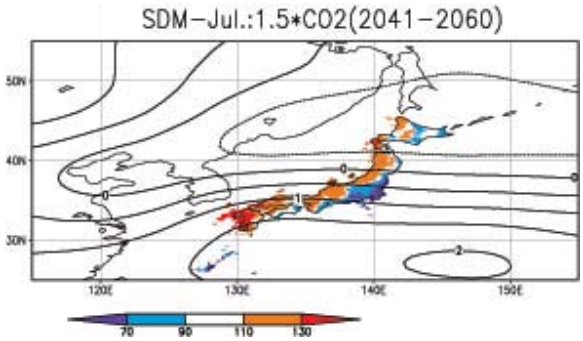


Fig. 10 Geographic distributions of mean sea-level pressure (hPa) and SDSM-applied precipitation change (%) according to an MRI-AGCM CO_2–experiment projection (July 2041–2060), relative to the observed values (1981–2000).

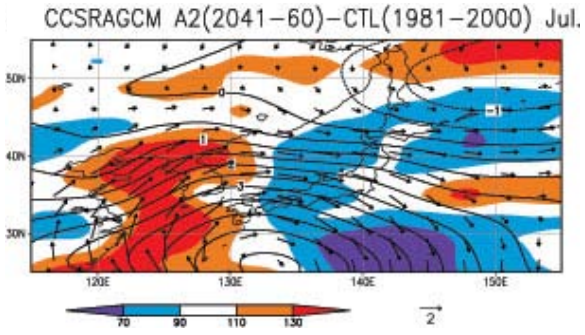


Fig. 11 Geographical distributions of mean sea-level pressure (hPa), wind vector at 850 hPa field (m/s), and precipitation change (%) according to a CCSR/NIES-AGCM CO_2–experiment projection (July 2041–2060), compared with the GCM control–experiment values (1981–2000).

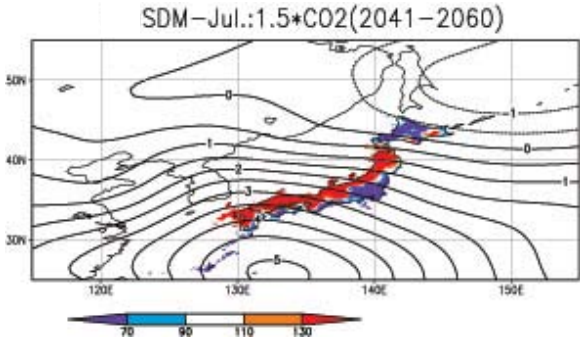


Fig. 12 Geographical distributions of mean sea-level pressure (hPa) and SDSM-applied precipitation change (%) according to a CCSR/NIES-AGCM CO_2–experiment projection (July 2041–2060), relative to the observed values (1981–2000).

ing precipitation over Kanto and the Pacific coast of Japan and increasing precipitation on the coast of the Sea of Japan (Figs. 10 and 12), even though there were several systematic differences between the two original GCM future precipitations (Figs. 9 and 11). This is because the two GCM-CO_2 experiments had large-scale features in common under global warming: the North Pacific High intensified and extended westward, while cyclonic activity intensified at mid-latitudes, although in the CCSR/NIES model these features both were much stronger. These findings are similar to the results of many other GCM experiments performed by many other institutes. According to these results, the Pacific coast would be covered with a relatively high pressure anomaly, which would be associated with decreased precipitation in that area. Therefore, this SDSM-applied precipitation change seems plausible, at least for Japan, although the decrease in precipitation over such regions was probably not reproduced in the GCM model because of that model's relatively coarse grid.

A merit of this statistical method is that spatial downscaling is possible not only with a 10 km mesh but also at any other spatial scale—for example 1 km or less—when a data set with such a spatial scale exists. On the other hand, we also need to note that the temporal scale of this SDSM is limited to monthly precipitation. Therefore, the increasing and decreasing trends of future precipitation change do not take into account the variable frequency or the duration of heavy rain. To consider daily timescales, it might be necessary to apply an entire different method such as weather pattern approaches or stochastic weather generators. (M. Nishimori and H. Toritani)

5) Ecosystem Gas Exchange Team

To investigate seasonal and inter-annual variations in carbon, water vapor, and energy exchange between agricultural ecosystems and the atmosphere, the Ecosystem Gas Exchange Team conducts long-term observations of gas and energy fluxes at 3 sites: a single-cropping rice paddy field in central Japan, a natural wetland in eastern Hokkaido, Japan, and a wet sedge tundra at Barrow, Alaska. In 2003, our main focus was on the paddy site: the tundra site was managed by the International Arctic Research Center (IARC) and observations at the natural wetland site were suspended. Process studies on carbon exchange utilizing stable isotopes are also conducted at the paddy site. Our studies are supported by MAFF and MOE.

Along with making standard measurements of meteorological and ecological variables, we are measuring the flux densities of carbon dioxide (CO_2), methane (CH_4), water vapor, and sensible heat by using the eddy covariance method. In 2003, the following measurements were added to the paddy site: 1) eddy covariance system intercomparison between open-path and closed-path systems; 2) soil CO_2 flux using chamber technique after harvest; and 3) stable isotopes of CO_2 as well as CH_4. There remains quantitative uncertainty about CO_2 exchange during winter, when the CO_2 flux density decreases to close to the detection limit of the eddy covariance method. To solve this problem, we made intensive measurements at the paddy site in the spring of 2003. Detailed analysis of the data obtained is now in progress. Not only measurements in the field but also data processing in the laboratory is important in long-term flux observations. The methodology of post-processing of eddy covariance data is still under development, and several problems are

still to be solved if we are to obtain a reliable estimate of annual carbon budget on the basis of the observed half-hourly fluxes. A considerable amount of our time is apportioned to quality control of flux data, filling in the gaps in missing data, and assessment of uncertainty in annual flux estimates. These studies are necessary to improve the reliability of our data and to promote data intercomparison between observation sites.

Our studies are closely linked to AsiaFlux, which consists of tower-based observation sites of carbon, water vapor, and energy exchange between terrestrial ecosystems and the atmosphere in eastern and southeastern Asia as part of the worldwide network FLUXNET. Through the activities of AsiaFlux, we are collaborating with domestic institutions such as Okayama University, Kyushu-Okinawa Agricultural Research Center, the National Institute of Advanced Industrial Science and Technology, and the National Institute for Environmental Studies. We are also collaborating with Bangladesh Agricultural University and IARC. We host a post-doctoral fellow funded by MOE, and 4 technical staff members under the Cooperative System for Supporting Priority Research (FY 2000–2005), sponsored by the Japan Science and Technology Agency.

Photo 2 Mase paddy flux site near Tsukuba, central Japan, in July. Instruments for eddy covariance flux measurement are mounted at the top of the 3-m mast at left, and the meteorological sensors are on the 6-m tower at right.

Topic: **Making annual data sets of energy budget and CO_2 flux at a single-cropping rice paddy field**

Rice paddy fields are widespread in monsoon Asia. In single-cropping rice paddies in eastern Asian countries, the ecological conditions can change drastically within a year in accordance with the cultivation practices. The paddy fields are irrigated during the growing period but left fallow after harvest. The live biomass changes from almost zero at the beginning of the growing period to about 2 kg m^{-2} dry matter at harvest. Energy and carbon exchange between the paddy fields and the atmosphere is greatly influenced by these seasonal changes of environment. To understand this seasonal variation in energy and gas exchange in the paddy fields and to estimate their annual budget and interannual variabilities, we have been continuing our long-term observations of energy and gas fluxes at our Mase site (36°03′N, 140°01′E), which is located in a rural area outside Tsukuba (Photo 2).

At the study site, rice (*Oryza sativa* L., cultivar Koshihikari) is cultivated in accordance with the local customary practices. We are measuring the flux densities of sensible heat, latent heat, and CO_2 by the open-path eddy covariance method. We are also monitoring meteorological and ecological variables such as short- and long-wave radiation; photosynthetically active radiation; air temperature and humidity; wind direction and wind speed; barometric pressure; precipitation; soil temperature; volumetric soil moisture content; soil heat flux, water depth and temperature; flow rate of irrigation and drainage; plant height and dry matter weight; and leaf area index of green leaves. Data observed on the fluxes and meteorological variables are processed on a half-hourly basis. The quality of the flux data is checked in accordance with the standard methodology of FLUXNET, and both missing and rejected data are filled with estimated values, to which tags are added to indicate modification. The quality-controlled and gap-filled half-hourly flux data, along with the meteorological data, are compiled into an annual data set, from which we can calculate the daily and monthly statistical values of each element.

As an example, the seasonal variation in daily values of fluxes and selected meteorological variables are shown in Figure 13. The Bowen ratio (the ratio of sensible heat flux to latent heat flux) was small for most of the year, because the larger part of the available energy was partitioned into the latent heat flux at the site (Fig. 13a). However, the Bowen ratio temporarily increased in spring 2002, when the soil dried out before irrigation. The CO_2 flux showed a clear seasonal variation: uptake by the paddy during the period of growth of the primary crop and release from the paddy in the remaining part of the year (Fig. 13b). Growth of a ratoon crop contributed to reduction of CO_2 emission from the paddy, especially in 2001, when plowing was delayed until the end of November. In this way, annual data sets of flux and meteorology help us to understand the seasonal variation in energy and CO_2 exchange at the site. The climate in the 2003 growing period was characterized by lower

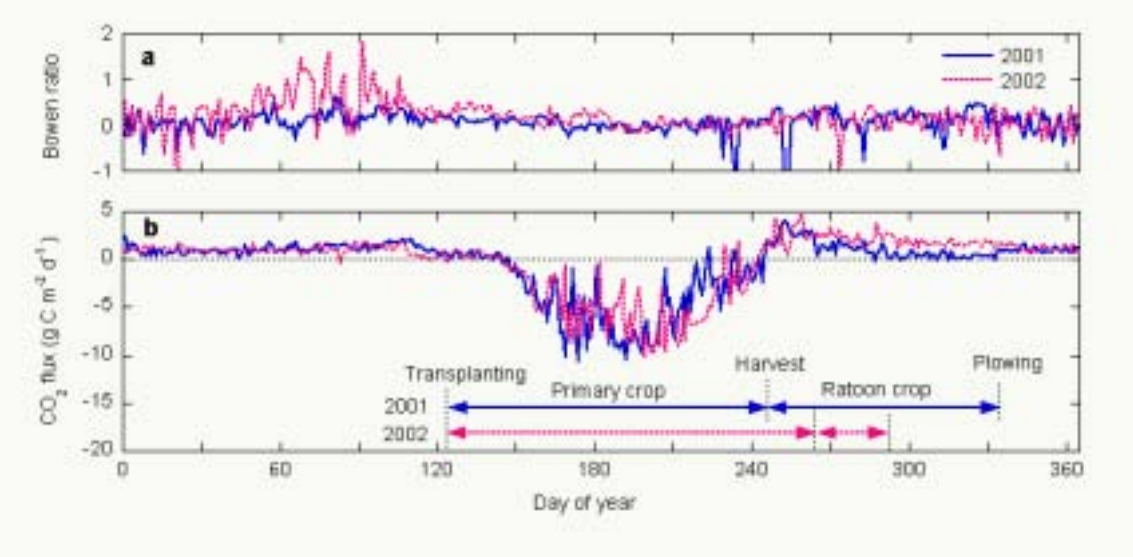


Fig. 13 Seasonal variation in (a) Bowen ratio (ratio of sensible heat flux to latent heat flux) and (b) CO_2 flux at the Mase site in 2001 and 2002. Plotted data are daily values calculated from half-hourly data. Negative CO_2 flux means uptake of CO_2 by the paddy, whereas positive flux means release from the paddy.

temperature and less solar radiation than in normal years, which affected the growth and yield of rice. Our preliminary analysis shows that the CO_2 flux in the 2003 growing season had a delayed peak, and there was a smaller amount of CO_2 assimilation than in previous years. The accumulation of data sets under various climate conditions, including in anomalous years such as 2003, is useful for assessing climatic impact on gas and energy exchange. The data sets can also be utilized as fundamental data in modeling energy and carbon exchange between rice paddies and the atmosphere. We will continue our observations at the Mase site in 2005. (A. Miyata)

Department of Biological Safety

The Department of Biological Safety includes the 3 research groups of Plant Ecology, Entomology, and Microbiology, as well as the Genetically Modified Organism (GMO) Assessment Team, as described below. The GMO Assessment Team was formed with the aim of using recent advances in biotechnology and bioindustry for environmental impact assessment of GMOs. The mission of the Department as a whole is to assess the environmental impact of GMOs as well as of alien invasive and introduced living organisms, and to investigate the interaction of biodiversity and agriculture in terms of biosafety and sustainable agriculture. The Department is developing advanced methods to use in these assessments.

The major research domains of the Department are: 1) evaluation of the influence of agricultural activities on agro-ecosystems and biodiversity; 2) environmental impact assessment of introduced natural enemies and alien invasive organisms; 3) identification of biologically active chemicals and their effects on organisms in agro-ecosystems; and 4) risk assessment of GMOs within agro-ecosystems. Research is performed in collaboration with other research groups within and outside NIAES, and the approaches cover a number of research fields, such as molecular, chemical, population, and landscape ecology.

The research of the Plant Ecology Group is focused on vegetation dynamics and conservation of vegetation, assessment of invasive and introduced plant species in agro-ecosystems, and plant diversity in relation to agricultural production. Current research topics are: 1) effects of sulfonylurea herbicides on plant species, including aquatic plants, in agro-ecosystems; 2) landscape ecological approaches to the prediction of vegetation dynamics in relation to farmland use; and 3) the search for allelochemicals and elucidation of allelopathic mechanisms for maintaining agro-ecological vegetation.

The Entomology Group focuses on the following 3 major targets: 1) ecological risk assessment of alien insects such as natural enemies of insect pests; 2) analysis of the population dynamics of insect herbivores responding to the spatial distribution patterns of plants; and 3) identification of semiochemicals and analysis of the mechanisms of sex pheromone resistance.

The Microbiology Group aims to characterize microbial communities and to develop technologies for effective management of microbial resources in agro-ecosystems. Current research activities are: 1) microbial diversity and interactions in the soil under different agro-ecosystems; 2) analysis of the effects of environmental factors, including microbial secondary metabolites, on the survival and diversity of microbes; and 3) taxonomy, biology, and ecology of nematode communities.

The research objective of the GMO Assessment Team is to investigate the effects of the release of GMOs on the environment. The principal fields of interest are: 1) clarification of the dispersal and transfer mechanisms of genes from GMOs to other organisms; 2) assessment of the impact of *Bacillus thuringiensis* (Bt) toxin in corn pollen on *Lepidoptera*; and 3) monitoring of changes in the composition of weeds, insects, and soil microorganisms caused by the cultivation of genetically modified crops.

The major activities of the department in FY 2003 were: 1) publication of 10 main research results, including one result achieved in cooperation with the Agro-Meteorology Group, in the *NIAES Major Research Topics Annual* , these results are described below as topics in the introduction of research groups and team; 2) organization of an international seminar on 'Biological invasions: their environmental impact and the development of a database for the Asian-Pacific Region,' (for details see Major Symposia and Seminars) and a domestic seminar on 'Alien plants in Japan and their ecological properties' (for details see Symposia and Workshops); 3) implementation and coordination of the research project 'Assurance of Safe Use of Genetically Modified Organisms,' and participation in several projects organized by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Education, Culture, Sports, Science and Technology (MEXT); and 4) attendance of departmental staff at many international symposia and workshops. Furthermore, two research unit leaders, Drs. N. Matsumoto and K. Tsuchiya, won Awards of the Phytopathological Society of Japan in March 2004 (see Academic Prizes and Awards).

Scientists transplanting rice seedlings in NIAES.

1) Plant Ecology Group

The Plant Ecology Group consists of the Vegetation, Landscape, and Chemical Ecology Units. These units individually carry out research on the impact of agriculture on plant diversity, methods for monitoring vegetation change in agro-ecosystems, and interactions among agricultural organisms depending on chemical materials. The major results obtained in 2003 are described below in research topics 1 to 4.

This Plant Ecology Group organized a domestic seminar on "Current status of alien plants in Japan and their ecological properties," held at NIAES on 5 March 2003. The seminar had two agendas: first, how to monitor the colonization and spread of alien plants, and second, how to assess the ecological impact of alien species on biodiversity conservation. More than 120 people participated in the seminar, discussing the risks and benefits of introducing alien species into agro-ecosystems (see Symposia and Workshops).

Topic 1: Evolution of sulfonylurea resistance in *Scirpus juncoides* var. *ohwianus*

Sulfonylurea (SU) herbicides are highly active and have been widely used all over the world. The continuous use of these herbicides has resulted in the evolution of SU-resistant biotypes. These herbicides have been used in Japan since 1989, and an SU-resistant biotype of *Scirpus juncoides* Roxb. var. *ohwianus* T. Koyama first occurred in Hokkaido Prefecture in 1997 and was found subsequently in Miyagi Prefecture in 1998 and in Fukushima Prefecture in 2001. We examined the inheritance of SU resistance in this species by performing hybridization tests using the F_1 progeny of SU-resistant heterozygotes with application of bensulfuron-methyl (one of the major SU herbicides). The segregation ratios of the F_2 progeny from selfing of the F_1 progeny were not significantly different from 3:1 (resistant:susceptible), indicating that SU resistance is controlled by a single, completely dominant allele (Table 1). We then developed a one locus – two alleles model of SU resistance to dem-

Table 1 Segregation ratios in F_2 progeny of *Scirpus juncoides* var. *ohwianus* from selfing of the sulfonylurea (bensulfuron-methyl)-resistant heterozygote (F_1)

Herbicide application rate (g/ha)	Total no. of seeds	Total no. of emerged seedlings	No. of emerged seedlings		Expected ratio (R:S)	χ^2	*P*
			Resistant (R)	Susceptible (S)			
24	120	116	87	29	3:1	0.00	1.00
120	120	118	94	24	3:1	1.37	0.24
240	120	119	91	28	3:1	0.14	0.71

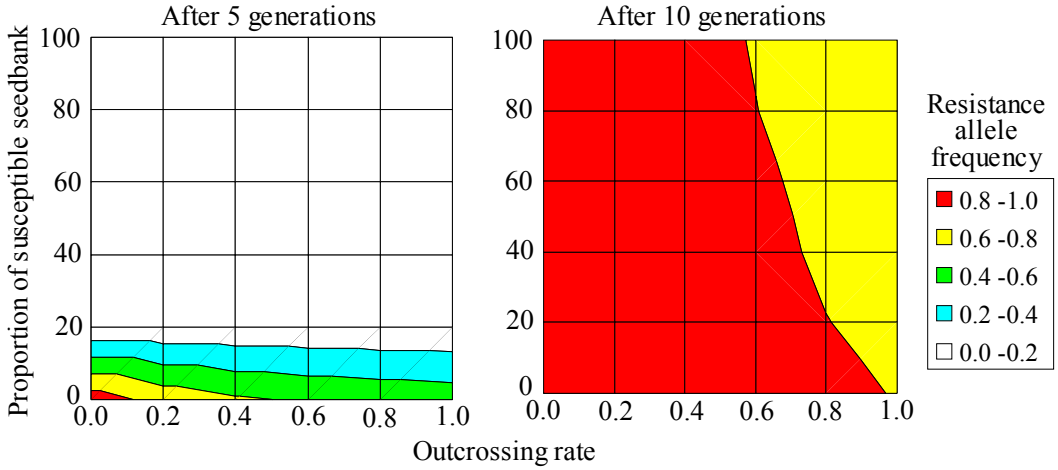


Fig. 1 Frequencies of sulfonylurea resistance alleles on a two-dimensional surface of outcrossing rate vs. proportion of susceptible seedbank. Initial frequency of resistance allele = 1.0×10^{-8}, rate of decrease of seedbank = 0.5, selection coefficient of sulfonylurea = 0.99, and proportion of susceptible seedbank = initial number of seeds in the seedbank / number of seeds produced by the first generation.

onstrate how outcrossing and seedbank influence the evolution of SU resistance in infinitely self-compatible weed populations. Model simulations with various parameter sets showed that the presence of both a high outcrossing rate and an SU-susceptible seedbank delays the evolution of SU resistance. However, the high selection pressure imposed by SU herbicides overwhelms the effects of the outcrossing rate and the seedbank, in most cases leading to predominance of the SU resistance allele within about 10 generations after mutation to SU resistance (Fig. 1). This result may explain the rapid spread of the SU-resistant biotype of *S. juncoides* var. *ohwianus* in Japan. (H. Ikeda)

Topic 2: **A new method for the bioassay of allelopathic activity in rhizosphere soils.**

Root exudates from plants in the soil influence the growth of other plants as one of the pathways of allelopathy. These exudates tend to be adsorbed to soil components and decomposed into other chemicals by soil microorganisms. To evaluate the allelopathic activity in soils, we have developed a new bioassay method termed as "Rhizosphere Soil Method".

Test plant species were grown in plastic pots using mixed soil (Andosol and a commercially available soil), and seedlings were cultivated for several weeks. The plants were then removed from the pots with minimal disturbance and the roots were shaken softly to remove the root-zone soils. The collected soils were sieved and fresh soil was used for bioassay with lettuce (*Lactuca sativa*) as a bioassay species. The assay technique used was almost the same as "Sandwich Method" (Fujii et al, 2003).

Using this method, several rhizosphere soils, especially soils from pots of hairy vetch (*Vicia villosa* Roth) and tall goldenrod (*Solidago altissima* L.) strongly inhibited radicle growth of lettuce (Fig. 2). The shape of the roots of each plant did not affect the allelopathic activity. Both plants are known to be allelopathicfrom filed observations, other bioassays and extraction of allelochemicals. A comparison of the results of the Rhizosphere Soil Method and the Plant Box Method (developed by our group for the evaluation of root exudates using plain agar medium, Fujii et al, 2000) revealed that the former was less sensitive, but more practical for evaluating the allelopathic activity in soil. These results suggest that the Rhizosphere Soil Method is useful as a primary screening test for evaluating the allelopathic potential of soils around the root. (Y. Fujii, S. Hiradate and H. Araya)

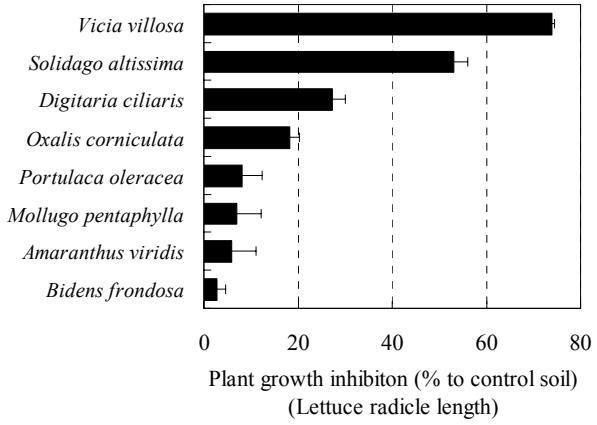
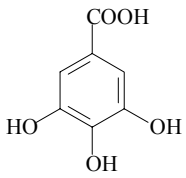


Fig. 2 Percentage lettuce radicle growth inhibition compared with control, as demonstrated by the Rhizosphere Soil Method.

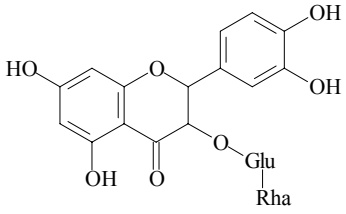
Topic 3: **Allelopathic activity of buckwheat: isolation and characterization of allelochemicals.**

We investigated the allelopathic potential of buckwheat (*Fagopyrum esculentum*). A 3-year field study showed that living buckwheat reduced weed biomass compared with plots without buckwheat. A laboratory study revealed that root exudates suppressed the root and shoot growth of weeds and reduced weed dry weight. Furthermore, aqueous and organic solvent extracts of the aerial parts of common buckwheat inhibited the root and shoot growth of lettuce seedlings. Upon sequential partitioning of aqueous ethanolic extracts of the aerial parts of buckwheat, the chloroform and ethyl acetate extracts showed maximum activity.

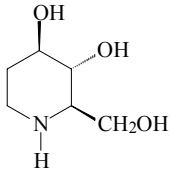
The allelopathic constituents of the buckwheat were



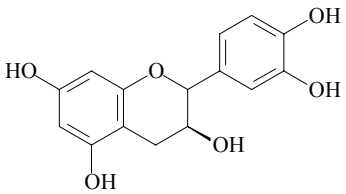
3,4,5-trihydroxy-benzoic acid (gallic acid)



quercetin 3-rutinoside (rutin)



2-hydroxymethyl-piperidin-3,4-diol (fagomine)



(+)-catechin

Fig. 3 Allelochemical candidates extracted from buckwheat.

isolated and identified as gallic acid, (+)–catechin, fagomine and rutin (Fig. 3) by NMR spectroscopy. Gallic acid and (+)–catechin were present in the upper parts of the buckwheat at concentrations of 0.02% and 0.01%, respectively, by fresh weight. Gallic acid was found to selectively and strongly inhibit root and shoot growth of the tested plants at 100 and 10 ppm. Fagomine, 4-piperidone, 2-piperidine methanol, and rutin caused 50% inhibition of radicle elongation in lettuce seedlings at concentrations of less than 100 ppm. These results suggest that buckwheat has allelopathic potential and that when it is utilized as a ground cover crop or as green manure it may produce inhibitors that could suppress weeds. (Y. Fujii, S. Hiradate, H. Araya and Z. Iqbal)

Topic 4: **Sources of carbon in humic substances in some Japanese volcanic ash soils, as determined by the carbon stable isotopic ratio δ^{13}C**

Volcanic ash soils (Andosols) are known to accumulate extremely large amounts of humic acids in their thick surface horizons. It has been proposed that the cultivated Japanese pampas grass (*Miscanthus sinensis* A.) and its charred materials are a major source of the carbon in humic acids. We determined the percentage contribution of pampas grass (a C4 plant) to the carbon in soil humic acids by measuring their stable isotopic ratio of carbon (δ^{13}C). In Japanese volcanic ash soils, we found that the humic acids had originated from both C3 and C4 plants, and that the percentage contribution of C4 plants (mostly pampas grass) ranged from 18% to 52% (Table 2). Highly humified (dark-colored) humic acids in the volcanic ash soils tended to have a higher percentage contribution from C4 plants than less humified humic acids, although a large part of the carbon in these humic acids was originated from C3 plants. The δ^{13}C values of crude soil samples were well correlated with those of humic and fulvic acids. A literature survey of the δ^{13}C values of crude soil samples also indicated that a large part of the carbon in humic substances originated from C3 plants rather than C4 plants, indicating the importance of C3 plants as sources of the carbon in humic substances in volcanic ash soils. (S. Hiradate, Y. Fujii and H. Araya)

2) Entomology Group

The mission of the Entomology Group is to prevent disturbance of the balance of agro-ecosystems by native and alien insects species and to assess the non-target effects of introduced insects. In FY 2003, the 3 units of the division studied 4 practical research subjects. Furthermore, the Entomology Group conducted studies in cooperation with the Food Production Prediction Team and the Plant Ecology Group.

The Introduced Insect Assessment Unit studied the feeding habits of *Dacnusa sasakawai,* an endoparasitic wasp of the leafminer, and compared them with those of an introduced endoparasitic wasp, *Dacnusa sibirica*. No difference was recognized between them. Each year, we followed the species composition and hybridization rates among introduced and native parasitoids, namely the chestnut gall wasps *Torymus sinensis* (introduced parasitoid) and *Torymus beneficus* (native one), using a nuclear DNA marker. Numbers of the larvae of *T. sinensis* in chestnut galls became higher than numbers of the larvae of *T. beneficus* year by year. However, larvae that were hybrids between *T. sinensis* and *T. beneficus* were

Table 2 Percentage contributions of C4-plants to the carbon content of soil humic acids purified from selected Japanese soils

Sample no.	Locality[1)]	Land use	Parent material	δ^{13}C (‰)	Contribution of C4 plants (%)
1	Hiruzen experimental forest of Tottori University, Okayama	Forest	Volcanic ash	–19.7	52
2	Yamaha, San-nohe, Aomori	Forest: hinoki (Japanese cypress, *Chamaecyparis obtusa*) plantation	Volcanic ash	–20.4	47
3	NIAES experimental field, Kan-nondai, Tsukuba, Ibaraki	Upland field	Volcanic ash	–20.6	46
4	NIAES experimental field, Kan-nondai, Tsukuba, Ibaraki	Paddy field	Volcanic ash	–22.1	35
5	Tonaisawa, San-nohe, Aomori	Forest: hinoki (Japanese cypress, *Chamaecyparis obtusa*) plantation	Volcanic ash	–22.8	30
6	Samuraihama, Kuji, Iwate	Forest: hinoki (Japanese cypress, *Chamaecyparis obtusa*) plantation	Volcanic ash	–24.5	18
7	NIAES experimental field, Kan-nondai, Tsukuba, Ibaraki	Paddy field	Alluvial material	–23.6	25
8	Yomitan, Okinawa	Upland field	Limestone and aeolian dust	–20.3	48
9	Mayogatai, San-nohe, Aomori	Peaty soil	Volcanic ash, fresh plant residue	–22.2	34

[1]All samples were collected in Japan.

detected only at a very low rate in 1 year out of 4. We inferred that the decrease in numbers of *T. beneficus* might not be a result of hybridization with the introduced parasitoid, *T. sinensis*. We also examined the interspecific competition between two sibling predators, *Chrysoperla carnea* (introduced species) and *Chrysoperla nipponensis* (native species) by studying competition between the larvae. We found that the introduced species was not especially superior to the native species.

The Population Ecology Unit studied the effects of the spatial distribution of host plants on the population dynamics of the ragweed beetle, *Ophraella communa*. To examine the dispersal ability of the ragweed beetle, ragweeds were distributed at 10-m intervals from the release point of marked adults. Most of the adults dispersed within about 60 m from the release point and moved no further throughout their lives. However, from an experiment that used a flight mill in the laboratory, we estimated that some adults dispersed over a long distance (Topic 1). These results will be used to make a model that simulates the relationship between insects and their host plants.

The Insect Semiochemical Unit studied and established a strain of the smaller tea tortrix moth, *Adoxophyes orana honmai*, resistant to a communication disruptant (containing the sex pheromone component, (Z)-11-tetradecenyl acetate) by selecting individuals that could mate in a flask containing the disruptant over 44 generations (Topic 2). First, in 1996, larvae for the selection experiment were collected from a tea plantation at Kanaya, in Shizuoka Prefecture, where the effectiveness of the communication disruptant had been reported to be inadequate. Male and female adults of the resistant strain can mate without exposure to fresh air after coexisting with 1 mg of communication disruptant for 10 to 12 h. On the other hand, adults of the susceptible strain can mate only when they are exposed to fresh air over 60 min after coexistence with the disruptant for 10 to 12 hr. The hybridization test revealed that resistance was caused by a change in the male.

The Insect Gene Bank Project was conducted by the above-mentioned 3 Units, together with the Insect Systematics Laboratory. This project started in 2000. The purpose of this project is to collect and rear useful insect species successively and strains such as natural enemies or various insects used for bioassay, and to supply the insects to laboratories that need them for research. In 2003, a predator of aphids, *Piocoris varius,* and one species destined for bioassay, *Liriomyza trifolii,* were added to the collection. A lady beetle, *Propylea japonica*, and a strain of the brown planthopper *Nilaparvata lugens* that is virulent to rice plants containing the planthopper resistance gene *Bph-3* were newly added to the active collection and will be considered for supply. We also evaluated the physiological and ecological characteristics of our various collections.

Topic 1: **Expansion of distribution of the ragweed beetle *Ophraella communa*, an exotic insect in Japan**

The ragweed beetle, *Ophraella communa* LeSage (Coleoptera: Chrysomelidae), which was originally distributed only in North America, was found in Japan (Takizawa et al. 1999) and Taiwan (Wang and Chiang 1998) in 1996 and in Korea in 2000 (Kwon et al. 2000) (Photo 1). In Chiba and several cities in 4 prefectures of the Kanto district of Japan, this exotic beetle was first found in 1996. In 1997, the beetles were found in Osaka Prefecture, far from the Kanto district. The distribution of the beetles has since expanded each year from these 2 areas, and by the end of 2001 they had been recorded in 39 of our 47 prefectures (Fig. 4). From these records, we

Photo 1 An adult ragweed beetle, *Ophraella communa*.

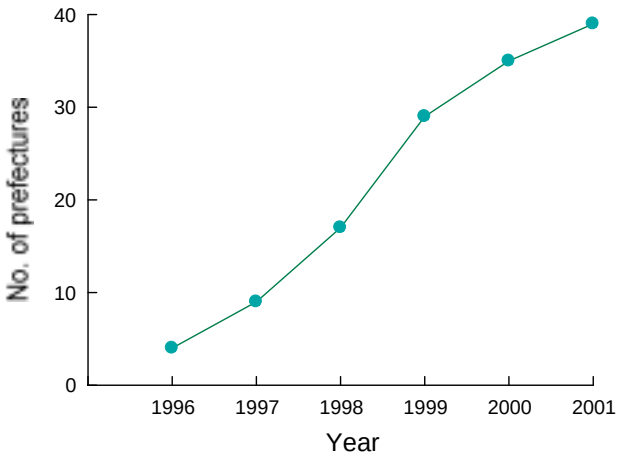


Fig. 4 Cumulative number of prefectures in which *Ophraella communa* has been found (modified from Moriya et al., 2002).

estimated that the beetle's range had expanded at more than 100 km a year over the first 3 or 4 years. This result suggests that the beetle has a high dispersal rate. To assess the dispersal ability of the beetles, we measured their flight activities using a flight measuring system (flight mills) in the laboratory. Some individuals flew for more than 5 h in a day. From their flying speed we estimated that they could move about 20 km a day in a 5-h flight. In the Kanto district, the beetles have 3 or 4 generations in a year. Therefore, they may disperse more than 100 km in a year if individuals can fly for a few days.

The main host plant is the ragweed, *Ambrosia artemisiifolia*, which produces seriously allergenic pollen. We have observed that *O. communa* often causes severe damage to ragweed, and sometimes kills the plants before flowering. To investigate the interaction of the beetles and ragweed, we surveyed an *O. communa* population in a 160-m^2 experimental ragweed field. Overwintering adults immigrated into the study field in early May and the females oviposited about 700 eggs (21 egg masses). The beetle population then increased rapidly. The third generation reached a peak density of about 100,000 adults in late August and completely killed the ragweed plants. We observed that many adults did not disperse but remained on the host plants, on which most of leaves had been consumed. The laboratory experiment showed that the flight activities of the beetles varied among individuals. We are investigating the factors affecting dispersal and the genetic variation in flight activities. (K. Tanaka)

Topic 2: **Selection of a resistant strain of the smaller tea tortrix (*Adoxophyes orana honmai*, Tortricidae, Lepidoptera) against a communication disruptant**

Photo 2 Female (left) and male of the smaller tea tortrix moth.

The smaller tea tortrix (STT) (Photo 2) is one of the most serious pests of tea trees. We identified the sex pheromone emitted by females to attract males as a 61:31:4:3 mixture of (Z)-9-tetradecenyl acetate, (Z)-11-tetradecenyl acetate (Z11–14Ac), (E)-11-tetradecenyl acetate, and 10-methyl dodecyl acetate. A communication disruptant containing one of the pheromone components, (Z)-11-tetradecenyl acetate, as the active ingredient has been used to control this pest since 1983. In 1995, control by this communication disruptant was reported not to be effective in some areas where it had been used for more than 10 years. It had been expected that the pests would not easily become resistant to communication disruptants because of the mechanism of action of these chemicals. Therefore, we considered that analysis of this case was very important in the development of new communication disruptants, which are expected to be efficient and useful for pest control without harming the environment. For this analysis, we selected a strain of the smaller tea tortrix that was

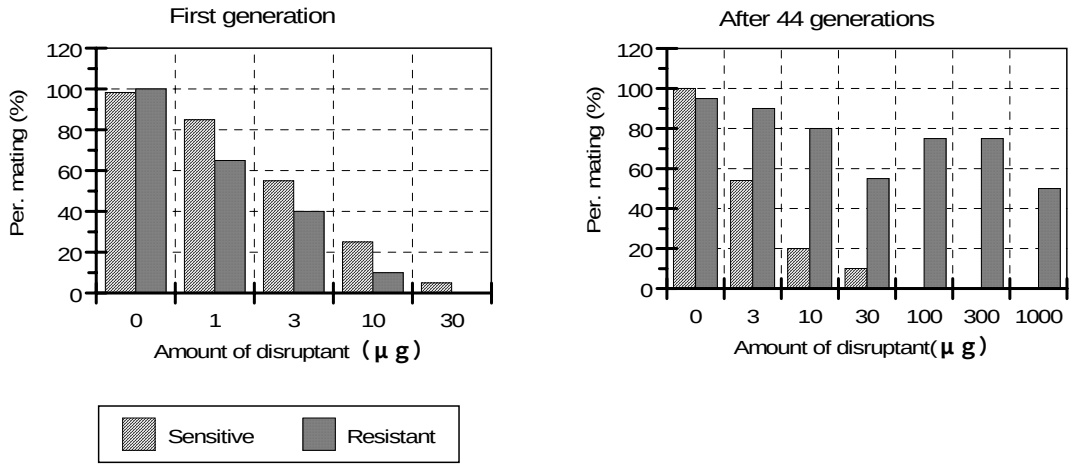


Fig. 5 Mating percentages of resistant and sensitive strains of the smaller tea tortrix under the communication disruptant (Z)-11-tetradecenyl acetate.

resistant to a communication disruptant. First, in 1996, larvae were collected from a tea plantation at Kanaya, in Shizuoka Prefecture, where the communication disruptant was reported to have become less effective. The male and female moths that developed from these larvae were then mated in the presence of Z11–14Ac. At first they could not mate under 30 μg of Z11–14Ac (Fig. 5, left) and their degree of resistance was almost the same as that of the sensitive strain that had been reared for more than 30 years at NIAES. However, the amount of Z11–14Ac used was gradually increased, and after 44 generations they could mate under 1mg of Z11–14Ac (Fig. 5, right). At this point, we considered that a strain resistant to the communication disruptant had been established. We then compared some characteristics of the resistant and sensitive strains. The resistant strain was also resistant to (Z)-9-tetradecenyl acetate – one of the pheromone components – but was sensitive to a 61:31:4:3 mixture of (Z)-9-tetradecenyl acetate, Z11–14Ac, (E)-11-tetradecenyl acetate, and 10-methyl dodecyl acetate. In accordance with these results, we added other pheromone components to the communication disruptant. The new communication disruptant is already being used in tea plantations to control tortrix moths (H. Noguchi and H. Sugie).

3) Microbiology Group

The Microbiology Group aims to characterize microbial communities in agro-ecosystems and develop technologies for effective management of microbiological resources. The group consists of a Microbiology Research Coordinator and 3 research units: Microbial Ecology, Microbial Genetics and Physiology, and Nematology and Soil Zoology.

Work is conducted on the following research themes: 1) investigation of the effects of soil microorganisms on the population dynamics of sclerotium-forming fungi; 2) investigation of the effects of secondary metabolites from microorganisms and plants on the multiplication of microorganisms; 3) genus- or species-level analysis of soil nematode communities in and around upland fields, and investigation of the biological characteristics of entomopathogenic nematodes.

Dr. N. Matsumoto (Chief of the Microbial Ecology Unit) and Dr. K. Tsuchiya (Chief of the Microbial Genetics and Physiology Unit) won Awards from the Phytopathological Society of Japan on March 2004 (see Academic Prizes and Awards).

The following activities were completed in fiscal year 2003.

The Microbiology Research Coordinator coordinated research and registration of microorganism genetic resources for related laboratories, which act as the NIAES sub-bank for the MAFF Genebank system. The Coordinator also improved a medium used to preserve bacterial isolates, with the aim of reducing loss of viability caused by repeated thawing and re-freezing (see Topic 1).

The Microbial Ecology Unit is investigating the effects of soil microorganisms on the population dynamics of sclerotium-forming fungi. Cultures of *Trichoderma* spp. isolated as contaminants of the white root rot fungus *Rosellinia necatrix* often include *Gliocladium catenulatum*, and we studied the interactions of these 3 fungi. An antagonistic effect of *Trichoderma* spp. on *R. necatrix* was revealed by inoculation experiments using plants: *Lupinus luteus* was reproduced by the soil-cover culture method, indicating its application for investigations of fungal interaction. The soil-cover culture method also revealed that *G. catenulatum* affected *Rosellinia–Trichoderma* interactions. PCR-DGGE analysis of the surface microflora of carrots inoculated with the violet root rot fungus *Helicobasidium mompa* detected the presence of a third fungus, *Myrothecium*, in association with the pathogen, suggesting the effectiveness of the molecular method in detecting the change in microbial community on the root surface of carrots. We found that a fluorescence probe, PAG59, that we developed reacted with different species of *Pantoea*, and pretreatment with a competitor nucleotide improved its specificity. These two probes may be combined for the specific detection of *P. agglomerans* associated with the southern blight fungus *Sclerotium rolfsii.* A reovirus present in *R. necatrix* is effective as a hypovirulence factor but tends to disappear from the mycelium. Efforts to prevent "virus-curing" were unsuccessful when we grew virus-infected strains on PDA with various fungicides, because the results were inconsistent.

The Microbial Genetics and Physiology Unit examined PCR-based detection of the synthetic genes of antibiotic substances – 2,4-diacetylphloroglucinol (Phl), pyrrolnitrin (Prn), and pyoluteorin (Plt) – by using specific DNA primers in collections of fluorescent pseudomonad strains isolated from the plant rhizosphere. These strains were antagonistic to such diseases as those caused by *Gaeumannomyces graminis* var. *tritici* (take-all of wheat) and *Rhizoctonia solani* (damping-off of radish). Presumable DNA amplification bands were produced in several strains, and the specificities of the respective bands were confirmed by Southern hybridization with standard strains. Some strains were positive for 1 (Phl) antibiotic substance, others for 2 (Phl, Prn), and the remaining strains were positive for all (Phl, Prn, Plt). Production of Phl and Prn was confirmed as expected in bacterial culture filtrates and was identified by TLC.

Strains that produced multiple substances (Phl, Prn, Plt) did not always show higher disease suppression ability than did those producing single (Phl) substances, suggesting amount of active compound against a kind of target pathogen.

To investigate the mechanisms responsible for the horizontal transfer of *argK-tox* clusters, we obtained BAC and plasmid clones containing the entire *argK-tox* clusters of *Pseudomonas syringae* pv. *actinidiae* and pv. *phaseolicola*, respectively. Sequencing of their insert DNAs revealed 34 open reading frames within the clusters, including 3 site-specific recombinase-encoding genes, which were tandemly located at the left end of the cluster and all belonged to the tyrosine recombinase family. These recombinases are supposedly involved in the site- and direction-specific insertion of the cluster into the chromosomes of *P. syringae*. Comparison of the 16S rDNA sequences of legume symbionts and their neighboring nonsymbionts revealed that there are regions highly specific to legume symbionts; these regions can be used to design specific primers and/or probes (see Topic 2).

The Nematology and Soil Zoology Unit identified the free-living soil nematodes in a no-till manure-amended field. Identification of bacteriophagous nematodes belonging to the Rhabditida continued. The genera *Bursilla* and *Caenorhabditis* were identified by abundant specimens derived from culture. The genera *Eucephalobus* and *Panagrocephalus* were newly identified among the Cephalobid nematodes.

In our investigation of the biological characteristics of entomopathogenic nematodes, we found that *Steinernema feltiae*, *Steinernema.* sp. MY2 and *Heterorhabditis indica* needed ample soil water content to kill lepidopteran larvae. *Steinernema* sp. MY2 from Sarufutsu showed higher pathogenicity against scarabaeid larvae than did *S. kushidai* at 15 and 10 °C. It reproduced even at 10 °C.

***Topic 1*: Improvement of preservation medium to reduce loss of viability through repeated thawing and re-freezing**

Microbiologists spend a lot of time maintaining and preserving cultures, from which they obtain a great deal of useful research evidence. Most bacterial isolates can be stored for many years by freeze-drying (lyophilization) or freezing. Preparation of the more than 10 ampoules of each isolate that are needed to ensure a wide margin of safety in long-term preservation is very expensive and requires a large amount of storage space. For convenience, we developed and now use a method whereby, when a sample is needed, the frozen specimen is melted and some of it removed, and then the remainder is frozen again immediately. Previously, we used a suspension medium that contains 10% skim milk and 1.5% sodium glutamate. However, we found that some bacteria, for example, those of the genus *Erwinia*, were less tolerant to repeated thawing and re-freezing. We therefore performed an experiment aimed at improving the suspension medium to reduce frost damage. The ultimate aim was to improve the longevity of specimens and thus remove the need to store so many ampoules. We tested suspension media in which trehalose had been added to basic media at concentrations of 0.2% to 5%. We then froze and thawed bacterial isolates 1, 8, and 12 times. The indicator bacterium was *Erwinia carotovora* subsp. *carotovora* MAFF 301393, a soft rot bacterium of Chinese cabbage. As shown in Table 3, after 8 and 12 thaw and freeze cycles, the isolate was recovered at the highest density from suspension medium containing 5% trehalose. In the other test strains, which belonged to the genera *Agrobacterium*, *Burkholderia*, *Clavibacter*, *Curtobacterium*, *Erwinia*, and *Pseudomonas*, recovery rates in suspension medium containing 5% trehalose were the same as, or higher than, in the basic medium after 12 re-freezings. The preventive effect of trehalose against frost damage was similarly achieved with maltose, sucrose, or lactose. We recommend a suspension medium

Table 3 Influence of concentration of trehalose on concentrations of bacteria (*Erwinia carotovora* subsp. *carotovora* MAFF 301393) that survived after repeated thawing and re-freezing

Concentration of trehalose (%)	Concentration of surviving bacteria (cfu/mL)		
	1 freeze/thaw	8 freeze/thaws	12 freeze/thaws
0.0	1.6×10^5	1.2×10^3	6.5×10^2
0.2	2.0×10^5	1.9×10^3	6.8×10^2
2.0	1.8×10^5	5.4×10^3	2.8×10^3
5.0	1.6×10^5	1.3×10^4	6.2×10^3

The test was conducted under the following critical conditions: frozen state –20 °C, thawed state 10 min at 23 °C once a day, initial concentration 10^6 cfu/mL.

that consists of 10% skim milk, 1.5% sodium glutamate, and 5% trehalose for convenient freezing preservation of plant pathogenic and related bacteria (K. Nishiyama).

Topic 2: **Comparison of the 16S rDNA sequences of legume symbionts and their neighboring nonsymbionts**

Bacteria that form nitrogen-fixing symbiotic associations with legumes have been confirmed in 13 genera (the genera *Rhizobium, Allorhizobium*, *Sinorhizobium, Ensifer, Mesorhizobium*, *Ochrobactrum*, *Bradyrhizobium, Blastobacter, Methylobacterium, Azorhizobium, Devosia, Burkholderia*, and *Ralstonia*). Phylogenetic analysis of these taxa containing legume symbionts, on the basis of their 16S rDNA sequences, showed that they are not clustered in 1 lineage but are distributed in the classes *Alphaproteobacteria* and *Betaproteobacteria* and are dispersed over 9 monophyletic groups, being intermingled with other taxa that do not contain legume symbionts (one of these monophyletic groups is shown in Figure 6).

Comparison of the 16S rDNA sequences of the legume symbionts and their neighboring nonsymbionts identified in the phylogenetic analysis revealed that there are regions highly specific to legume symbionts (Fig. 7); these can be used to design specific primers and/or probes. We expect that PCR assay using such primers will enable sensitive and reliable detection and monitoring of legume symbionts in agricultural fields and contribute to a better understanding of their population dynamics. (H. Sawada)

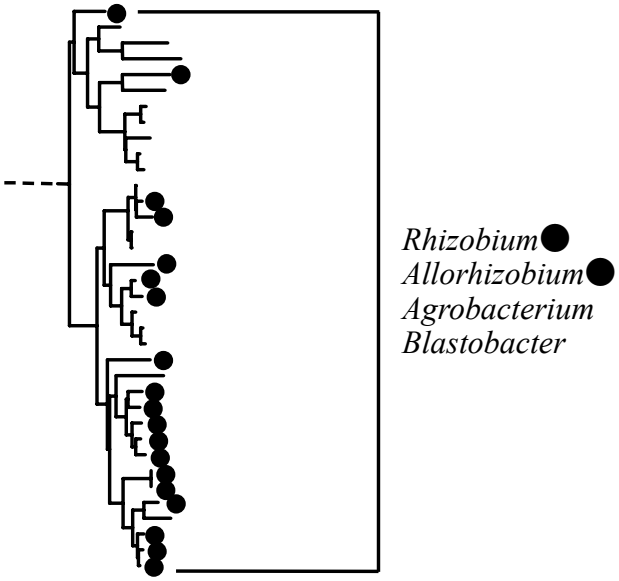


Fig. 6 Phylogenetic relationship among legume symbionts and their neighboring nonsymbionts inferred from 16S rDNA sequence divergence (1 of the 9 monophyletic groups containing legume symbionts is shown here).
The names of the genera contained in this group are listed on the right. The phylogenetic positions of legume symbionts and the names of the genera that contain legume symbionts are indicated by ●.

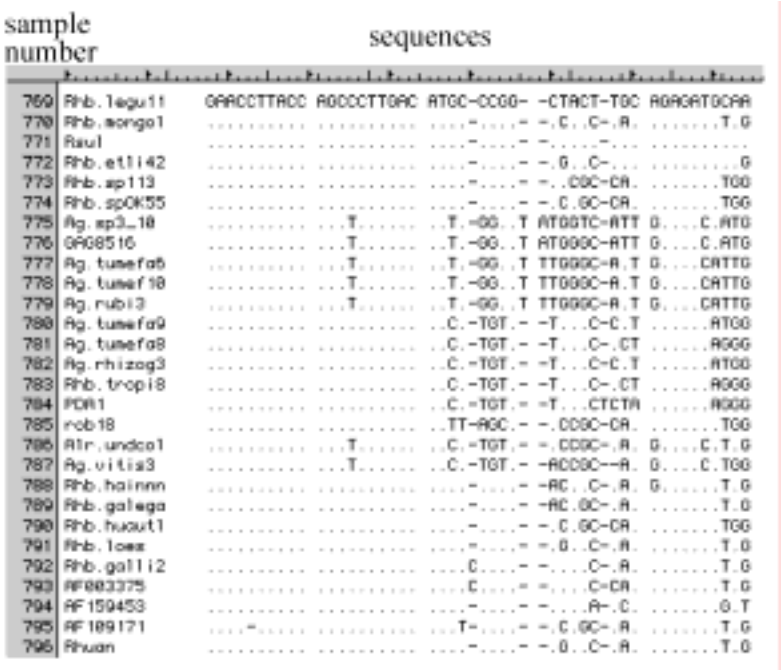


Fig. 7 Comparison of 16S rDNA sequences of legume symbionts and their neighboring nonsymbionts.
Only sequences that differ from those of *Rhizobium leguminosarum* (sample number, 769) are shown; identical ones are indicated by dots.

4) GMO Assessment Team

The mission of the GMO Assessment Team is to clarify the ecological impact of GMOs (genetically modified organisms), and to develop standards of risk assessment for them. Some results of our research projects are described below:

1) Monitoring of changes in the composition of weeds, insects, and soil microorganisms caused by the cultivation of genetically modified (GM) crops. The aim of this research project is to evaluate the environmental impact of continuous cropping of GM crops for 3 to 5 years. We conducted monitoring experiments on GM crops (corn, rice, canola, and soybean) at 4 national research institutes and centers to clarify the effects of these crops on organisms. As part of these experiments, since 2001 we have cultivated glyphosate-tolerant and conventional (non-GM) soybean cultivars in summer and glyphosate-tolerant and conventional (non-GM) canola cultivars in winter in a 0.2-ha field at the National Institute for Agro-Environmental Sciences (Photo 3). Weeds are controlled by glyphosate application in the GM experimental plots and by intertillage in the commercial soybean cultivars. All other crop management is the same for both experimental plots. We have investigated changes in vegetation, composition of insect populations, and soil microorganisms over the past 3 years.

2) Outcrossing rates in corn. One concern over cultivating GM corn is that transgenes may be transferred into conventional corn growing near the GM cornfields. To minimize the likelihood of such undesirable outcrossing, it is important that we improve our knowledge about the relationship between outcrossing rates and distance from pollen donors by monitoring for several years. Outcrossing rates estimated using conventional corn are available for gene flow studies in Japan, because the concerns of Japanese consumers about transgene dispersal into the agro-ecosystem have been eliminated. Therefore, we selected 2 commercial sweet corn varieties with different grain colors, “honey bantam” (pollen donor; yellow grain) and “silver honey bantam” (pollen recipient; white grain). Honey bantam was planted to windward of silver honey bantam. Recipient plants were harvested in rows at different distances from the pollen donor plants, and we used the xenia phenomenon to determine the percentage of outcrossing, as shown by the percentage of yellow grains on the ears of white recipients. The research has been conducted since 2001 on a small scale in a 0.14-ha field at NIAES in Tsukuba, with a maximum distance of 50 m between recipient and donor plants. Another study was initiated in 2002 at the National Center for Seeds and Seedlings at Tsumagoi in Gunma Prefecture in a larger field (4.5 ha), with a maximum distance of 400 m from donor plants, to determine the outcrossing rate over a minimum isolation distance of 200 m.

Photo 3 GM soybean (glyphosate-tolerant) and non-GM soybean (conventional cultivar) in an experimental field at NIAES, Tsukuba (26 July 2003). The monitoring field was 22 × 70 m and contained 2 experimental plots, each of GM and non-GM soybeans.

Outcrossing rates and distributions of hybrid plants in the fields have differed each year. However, recipient plants within a distance of 1 m from donor plants have shown the highest mean outcrossing rates (22.6% to 56.8% over 3 years at Tsukuba, and 32.0% to 43.2% over 2 years at Tsumagoi), and there have been no large differences between the 2 experimental sites in terms of the mean outcrossing rates of recipient plants and neighboring donor plants. These rates have decreased sharply with increasing distance from donor plants. In the small-scale research field at Tsukuba, the mean outcrossing rate for 2001 to 2003 decreased to 0.1% at 50 m. In the larger research field at Tsumagoi, the mean outcrossing rates for 2002 and 2003 decreased to 1.2% at 50 m, 0.23% at 100 m, 0.06% at 200 m, and 0.04% at 400 m (Matsuo *et al*., 2004).

3) Assessment of the impact of *Bacillus thuringiensis* toxin in GM-corn pollen on Lepidoptera, with a view to the development of a bioassay and immunoassay. The aim of this research is to clarify the effects of Bt-toxin-containing pollen on non-target insects consuming pollen that is dispersed and falls onto the leaves of plants around fields of GM corn. To clarify the range of effect of pollen from the GM cornfield on non-target insects, which are scattered, it is important to determine the relationship between the distance from the pollen source and the pollen count. We placed common Durham type pollen collectors, consisting of glass slides coated with pet-

rolatum, outside the conventional cornfield. Beside the pollen collectors, we cultivated sunflowers, whose leaves spread out widely, in pots. Pollen on the glass slides and on the sunflower leaves were counted every day. The number of pollen on the glass slides represented the maximum number of fallen pollen, without loss by wind dust and bird disturbance. The number of pollen on the leaves represented the actual number presumed to have an adverse effect on non-target-insects in the field. Such data on maximum and actual numbers of fallen pollen in the field as will become available in the development of bioassays and immunoassays for risk assessment of GM corn.

Reference

Matsuo K., K. Amano, H. Shibaike, Y. Yoshimura, S. Kawashima, S. Uesugi, T. Misawa, Y. Miura, Y. Ban and M. Oka (2004) Pollen dispersal and outcrossing in *Zea mays* populations: a simple identification of hybrids detected by xenia using conventional corn in simulation of transgene dispersion of GM corn. Proceedings of the 8th International Symposium on the Biosafety of Genetically Modified Organisms, p. 282, Montpellier France.

Department of Environmental Chemistry

Year-round production of large quantities of high quality agricultural products is associated with repeated heavy loading of farmland with fertilizers, pesticides, and livestock wastes. This, in turn, leads to air, water, and soil pollution with substances such as pesticides, nitrates, and heavy metals. With increasing combustion of refuse, lethal dioxins are being released to the environment. The Department of Environmental Chemistry has a mandate for food security and ecosystem conservation against a number of farm chemicals from the 3 broad standpoints of "risk assessment", "risk reduction", and "environmental remediation".

The Department consists of 3 research groups and 1 team corresponding to the chemicals targeted, namely: 1) a group researching organic chemical compounds such as farm chemicals; 2) a group researching heavy metals (in particular, cadmium); 3) a group researching nutritional salts, such as nitrogen and phosphate; 4) the dioxin research team. Each group, which is led by a group leader, has several research units. The major research fields of each group are described below.

Organochemicals Group: Pesticides play a vital role in food security and will remain indispensable unless more effective and less risky replacements can be developed. There is much concern about the ecotoxicity of pesticides in air, water, and soil from farmlands. This group is responsible mainly for the development of innovative and sophisticated technologies for studying the influence of pesticides on the environment and how to decrease the amounts of chemicals used. Major research topics are: 1) the dynamics of pesticides in soils, water, and the atmosphere; 2) risk assessment of pesticides in aquatic organisms such as algae, aquatic midges, and medaka fish; 3) development of environmentally friendly crop protection systems; and 4) development technologies for bioremediation of recalcitrant organic compounds, involving a) molecular genetics and genetic diversification of bacteria that degrade chlorobenzoates, PCBs, and 2,4-D, b) *in situ* bioremediation of soils contaminated with recalcitrant organic compounds, and c) risk assessment of recombinant bacteria.

Heavy Metal Group: The Codex Committee, established jointly by FAO and WHO, has been developing a new international safety standard for cadmium in foods to minimize its human intake. Under the current circumstances, it is a matter of urgency that we elucidate the behavior of heavy metals in soils and the mechanism of their absorption by crops, and that we develop technologies to suppress hazardous metal absorption by crops. The Heavy Metal Group has 3 ongoing research projects: 1) evaluation of heavy metal loadings in arable soils and elucidation of the mechanisms of their absorption by crops; 2) elucidation of the chemical forms of heavy metals in soils and development of technology for suppression of their absorption by crops; and 3) determination of differences in the abilities of various staple crops to absorb heavy metals.

Water Quality and Solute Dynamics Group: Recently, public concern has risen over the contamination of various river basins and lakes by nutrient solutes such as nitrate nitrogen and phosphate. Since the implementation of new regulations against NO_3^--N and NO_2^--N contamination began in 1999, a number of agricultural activities have been placed under strict surveillance to ensure that NO_3^--N and NO_2^--N levels in groundwater do not exceed the critical concentration of 10 ppm. There is an urgent need to formulate an effective solution for this problem. There are 3 ongoing projects in this group: 1) study of the dynamics of nitrate nitrogen and other nutrient solutes in soils and small- and medium-sized watersheds; 2) development of methods for monitoring levels of nutrient solutes in medium-sized river basins; and 3) evaluation of methods for enhancing the denitrification capabilities of natural mass flows and development of technologies for alleviating negative loadings of nutrient solutes.

Dioxin Dynamics Team: Contamination of agricultural products with dioxins has become a serious concern for both consumers and producers. There is an urgent need for the production of dioxin-free agricultural products. In this regard, there are 2 ongoing projects: 1) study of the dynamics of dioxins in crops and farmland; and 2) development of technology for the physico-chemical and biological decomposition of dioxins.

1) Organochemicals Group

The mission of this group is to assess and reduce the environmental risk caused by application of pesticides and persistent organic pollutants (POPs) in agro-ecosystems and also to develop bioremediation techniques to restore environments contaminated with recalcitrant organic chemicals. The group consists of 3 research units: the Environmental Pesticide Assessment Unit, the Pesticide Mitigation Unit, and the Applied Soil Microbiology Unit.

In FY 2003, the group studied the following major research subjects: 1) risk assessment of pesticides in aquatic organisms; 2) multimedia modeling to describe the fate of POPs; 3) mechanism of systemic acquired resistance induced in plants by some organic chemicals;

4) molecular genetics and molecular ecology of bacteria that degrade chlorobenzoates and 2,4-D in soil; and 5) *in situ* bioremediation of pesticide-contaminated soil by using charcoal enriched with consortia of degrading bacteria.

Eleven original research papers were published this FY. In September 2003, the group organized the third Seminar on Organic Chemicals Studies: Effect of Chemicals on Ecosystems to discuss how to develop higher-tier aquatic risk assessment of pesticides. It also organized the 20th Research Meeting on Pesticides: Evaluation of Residual Pesticides in Minor Crops to discuss analytical methods for residual pesticides in minor crops (see Symposia and Workshops). Dr. H. Ishii, Chief of the Pesticide Mitigation Unit**,** won an award from the Phytopathological Society of Japan in March 2004 (see Academic Prizes and Awards).

The Environmental Pesticide Assessment Unit clarified the effects of herbicides on algal production using native algal species bioassay (see Topic 1). To assess the effects of insecticides on aquatic invertebrates in river ecosystems, the Unit selected the larva of the caddis fly – a representative insect in Japanese rivers – as a keystone species and began to develop a breeding method. For POPs, a multimedia modeling study was started to describe and simulate the fate of POPs emitted from Asian countries.

The Pesticide Mitigation Unit met the challenge to develop an alternative chemical – a resistance inducer or 'plant vaccine' – for the control of fungal plant diseases, which currently relies largely on the use of ordinary fungicides. As an alternative chemical, the Unit selected acibenzolar-S-methyl (ASM) and studied the mechanism of long-lasting induction of systemic resistance in plants. Biochemical and electron microscopic studies strongly suggested that active oxygen species act as mobile signals in ASM-treated cucumber plants and are closely associated with the rapid induction of systemic resistance, leading to the expression of various defense responses. In addition, the Unit successfully applied the PCR-Luminex system, a novel method of single nucleotide polymorphism (SNP) analysis, to the identification of isolates of the rice blast fungus resistant to MBI-D (melanin biosynthesis inhibitors that target scytalone dehydratase). This is the point mutant in the fungicide-targeted enzyme gene that causes resistance.

The Applied Soil Microbiology Unit studied the mechanisms that regulate the expression of the chlorobenzoate and 2,4-D degradative genes of *Burkholderia* spp., and the chitinase genes of *Streptomyces*. The Unit analyzed the characteristic of plasmids with 2,4-D-degrading genes. A culture-independent method, PCR-DGGE (denaturing gradient gel electrophoresis), revealed that numbers of 3-chlorobenzoate (3CB)-degrading bacteria increased in a forest soil after addition of 3CB compared with those in liquid enrichment culture containing the soil and 3CB (see Topic 2). Furthermore, to develop *in situ* bioremediation of pesticide-contaminated soil, bacterial consortia that decomposed both quintozene (PCNB) and simazine were constructed in charcoal. The simazine-decomposing bacterial consortia were found to be composed of *Arthrobacter* sp., *Bradyrhizobium japonicum*, and a novel strain of β-*Proteobacteria.*

Topic 1: **Use of native algal species bioassay to assess effects of herbicide on algal communities**

More than half of the agricultural land in Japan is paddy fields, and most of them are treated with pesticides. Runoff from paddy fields is the main cause of pesticide pollution of surface waters in Japan. In particular, rice herbicides run off easily because they are applied directly to the flooded water of the paddy field. Therefore, some rice herbicides are detected frequently in river water, albeit at low levels (in the order of ppb), for a couple of months after rice-planting, and there is concern about their adverse effects on aquatic ecosystems.

Algal communities are important for maintaining the proper function of aquatic ecosystems. Algae associated with plankton and periphyton form the basis of food chains, produce oxygen, and play important roles in the cycling of nutrients. Disturbance of algal communities as a result of toxic stress may affect the structure and function of the whole ecosystem. Therefore, it is important to assess the effects of rice herbicides on algal communities in the aquatic ecosystems of Japan.

Under the Japanese pesticide registration system, the adverse effects of pesticides on aquatic organisms are evaluated critically before the pesticides are released for commercial use. With this evaluation system, the influences of pesticides on fish (fish acute toxicity study), crustaceans (daphnia acute immobilization study), and unicellular green algae (algal growth inhibition study) are the main factors evaluated. Risk assessment of the effects of pesticides on algal communities in aquatic ecosystems is conducted only on the basis of the results of a "unicellular green algae growth inhibition study". Because Japanese rivers are steep, the flow rates are very fast, and the residence times of floating algal species such as unicellular green algae at any particular point in the river are much shorter than their life spans, periphytonic algae (those found on the streambed) – mainly diatoms and blue-green algae – are more important organisms for assessing algal communities in Japanese aquatic ecosystems. Therefore, we need to develop a new test

method that evaluates the adverse effects of pesticides on diatoms and blue-green algae.

The objectives of this study are to improve the OECD algal growth inhibition test by using native algal species and comparing the relative sensitivities of various algal taxa (Fig. 1) to herbicides.

Figure 2 compares the EC_{50} (median effect concentration) of 14 rice herbicides on 4 unicellular freshwater algae. The 4 algal species were the axenic unicellular freshwater algae *Selenastrum capricornutum* Printz ATCC 22662 (green alga), *Chlorella vulgaris* Beijerinck NIES-227 (green alga), *Achnanthes minutissima* Kuetzing NIES-71 (diatom), and *Merismopedia tenuissima* Lemmermann NIES-230 (blue-green alga). *S. capricornutum* and *C. vulgaris* have been recommended by OECD as standard strains for the algal toxicity test. *A. minutissima* is a periphytonic pinnate diatom that is commonly observed in Japan's aquatic ecosystems. Because of its small cell size and fast growth rate, *A. minutissima* is suitable as a toxicity test species. *M. tenuissima* is a kind of blue-green alga that is also commonly observed in aquatic ecosystems of Japan and belongs to the same order of algae as the genus *Microcystis*, which causes blue-green algal waterblooms. Although subculture of

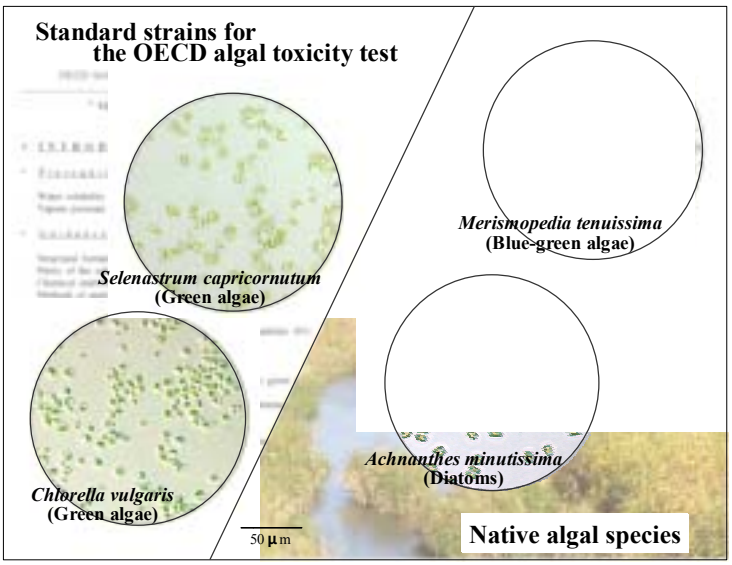


Fig. 1 Standard strains used for the OECD algal toxicity test, and the native strains that we tested.

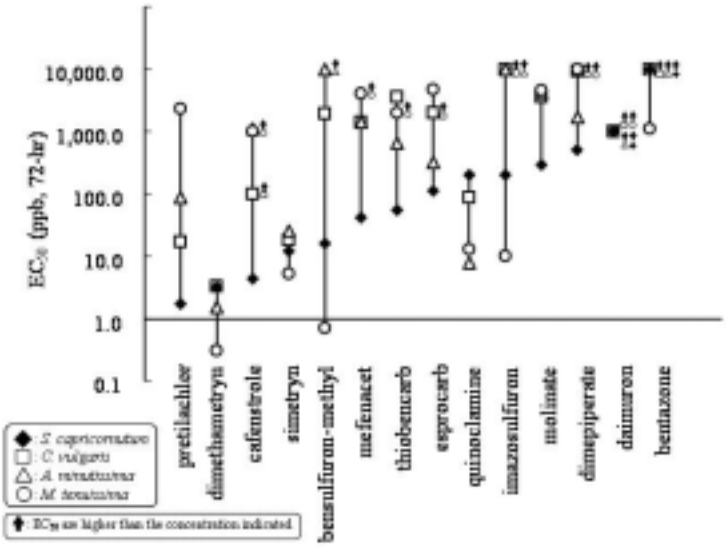


Fig. 2 EC_{50} values for 14 rice herbicides in 4 unicellular freshwater algae.

blue-green algal species on solid media is usually difficult, *M. tenuissima* has the advantage of easy subculture on solid media and is highly suitable as a toxicity test species.

S. capricornutum is the most popular algal species for toxicity tests and was highly sensitive to the tested herbicides. The herbicide susceptibility of *S. capricornutum* was not always the highest among the 4 tested species. *M. tenuissima* and *A. minutissima* showed higher sensitivity to some herbicides than did *S. capricornutum* (Fig. 2).

Sulfonylurea herbicides such as bensulfuronmethyl or imazosulfuron are applied widely to Japan's paddy fields. There was great variability in the sensitivities of the different algal taxa to these herbicides. In particular, the blue-green alga *M. tenuissima* showed high sensitivity to these herbicides (Fig. 2).

In conclusion, it is doubtful whether we can evaluate the effect of herbicides in runoff on the algal communities in Japanese rivers by using only the results of toxicity tests on floating algal species such as *S. capricornutum*. To develop higher-tier risk assessment, we propose that additional algal species, especially periphytonic diatoms and blue-green algae such as *A. minutissima* and *M. tenuissima*, should be included in single-species tests. (S. Ishihara)

***Topic 2*: Detection of 3-chlorobenzoate-degrading bacteria in soil by PCR-DGGE**

Chlorinated aromatic compounds have been widely used in agricultural and industrial applications. Because some of these compounds, such as polychlorinated biphenyls (PCBs), are harmful to humans or ecosystems and persistent in the environment, the pollution caused by them is one of our most serious environmental problems. Chlorobenzoates (CBs) are key intermediates in the degradation of PCBs or some herbicides, and CB-degrading bacteria are useful for bioremediation of environments contaminated with these compounds. Until now, several CB-degrading bacteria have been isolated from various environmental samples. Most of these bacteria were selected for their degrading abilities in culture conditions, such as in liquid enrichment culture containing CB as the sole carbon source. But it is uncertain whether these bacteria are predominant or even active in their original habitats, because the culture conditions are quite different from natural environmental conditions. In addition, recent progress in molecular microbial ecology has revealed that traditional culture methods can recover only a small proportion of microorganisms in the environment. This means that a wealth of degraders might have been missed. To overcome these limitations of culture methods, we need to establish a new approach to degraders under environmental conditions by using culture-independent methods.

Using a culture-independent method, PCR-DGGE (denaturing gradient gel electrophoresis), we compared 3-chlorobenzoate (3CB)-degrading bacteria in a forest soil to which 3CB had been added with those in a liquid enrichment culture containing soil and 3CB. We extracted DNA from the soil and the liquid enrichment culture at appropriate intervals after the start of incubation with 3CB. From these DNA samples, partial nucleotide sequences of bacterial *benA* genes encoding the benzoate-1,2-dioxygenase alpha subunit involved in degradation of 3CB were amplified by PCR, and then the products were subjected to DGGE analysis. The DGGE band patterns derived from the soil consisted of more than 30 bands, whereas the patterns of the enrichment culture were composed of very few bands (Fig. 3). This indicates that the enrichment culture only increased the numbers of those degraders that could adapt to the culture conditions. Furthermore, the intensity of the major bands that increased remarkably in the enrichment culture after 3CB addition were different from the intensity of the bands that increased in the soil after 3CB addition. This suggests that the degraders isolated from the enrichment culture do not represent the actual degraders

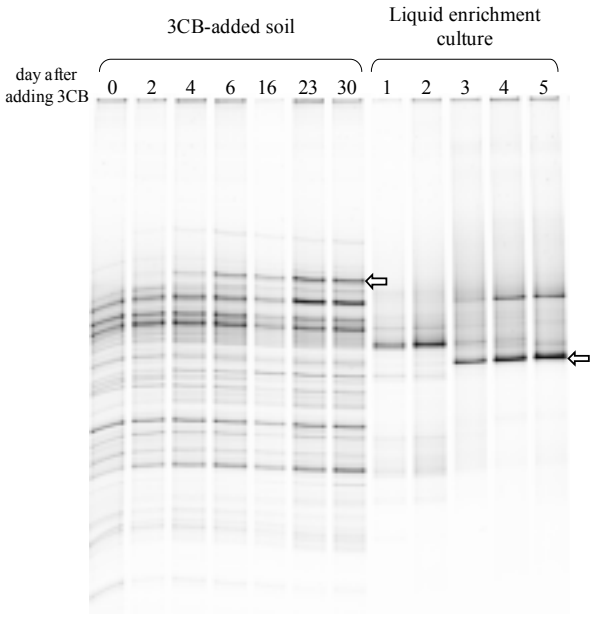


Fig. 3 Banding patterns of PCR-DGGE targeting *benA* genes derived from soil treated with 3CB and from soil in liquid enrichment culture with 3CB. Arrows show the bands that increased intensity remarkably after 3CB addition under each condition.

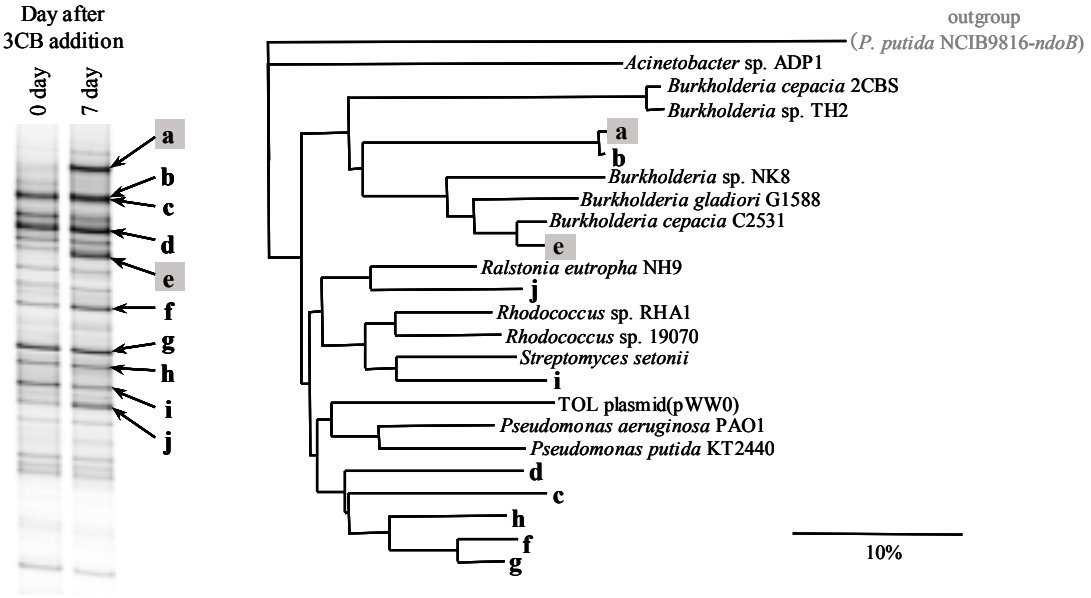


Fig. 4 Phylogenic tree of *benA* gene sequences from major bands (a to j) in the DGGE profiles of 3CB-treated soil and from several known isolates. The bands induced by 3CB are highlighted with gray.

in the soil. The major DGGE bands in the soil were sequenced and compared with known *benA* sequences by phylogenic analysis (Fig. 4). The phylogenic tree showed that the 2 bands induced by 3CB addition were both most closely related to *benA* of *Burkholderia* spp. This suggested that some of the *Burkholderia* spp. groups could play major roles in 3CB degradation in the soil.

From these results, we conclude that PCR-DGGE that targets *benA* is a very useful method of revealing the actual degraders in the soil environment, and this method can help us to find efficient bacteria for the bioremediation of CB-contaminated environments. (S. Morimoto, N. Ogawa, A. Hasebe and T. Fujii)

2) Heavy Metal Research Group

The mission of the Heavy Metal Research Group is to elucidate the input–output balance of heavy metals such as cadmium in arable soils and to clarify the mechanisms by which these metals are absorbed and translocated by paddy rice and soybean.

In FY 2003, the group studied the following major topics: 1) phytoremediation of cadmium-contaminated paddy fields by a special rice variety (see Main Research Results); 2) cadmium input from rainfall in the city of Tsukuba (see Topic 1); 3) a method of identifying the place of production of Welsh onions by using strontium isotope ratios (see Topic 2); 4) remediation of cadmium-contaminated paddy soil by washing with chemicals; 5) application of a ^{113}Cd tracer technique to the evaluation of cadmium uptake by soybean; 6) effects of paddy field water management on the absorption of cadmium by rice; 7) screening of soybean varieties for low Cd uptake and low accumulation in grains; 8) mechanisms of absorption and translocation of Cd in low-Cd-absorbing varieties of soybean and rice; and 9) evaluation of heavy metal loading of arable soils by fertilizers.

Topic 1: Cadmium input from rainfall into fields in the city of Tsukuba

One of the most important sources of Cd loading of farming areas is rain. We therefore collected rainwater in Tsukuba with an automatic rainwater sampler from May to December 2003 and measured its Cd concentration.

The average soluble Cd concentration in rainwater was 74.1 pg g^{-1} (ppt). This was a little higher than those of normal river water, reported in our Annual Report for 2003. The Cd concentration fluctuated greatly with every fall and was inversely correlated with the amount of rain. We calculated the load of soluble Cd by the product of Cd concentration and volume of rainfall. We found no significant difference among rainfall episodes, but the load was lower in summer than in spring and autumn (Fig. 5). The load of Cd from a total precipitation of 1039 mm through the sampling season was 408 mg ha^{-1}. Because the annual precipitation in the Tsukuba area (based upon AMEDAS data) was 1287 mm, the estimated annual load of soluble Cd was 505 mg ha^{-1}. This value is similar to, or a little higher than, that of the Cd load from irrigation water to paddy fields, as found in

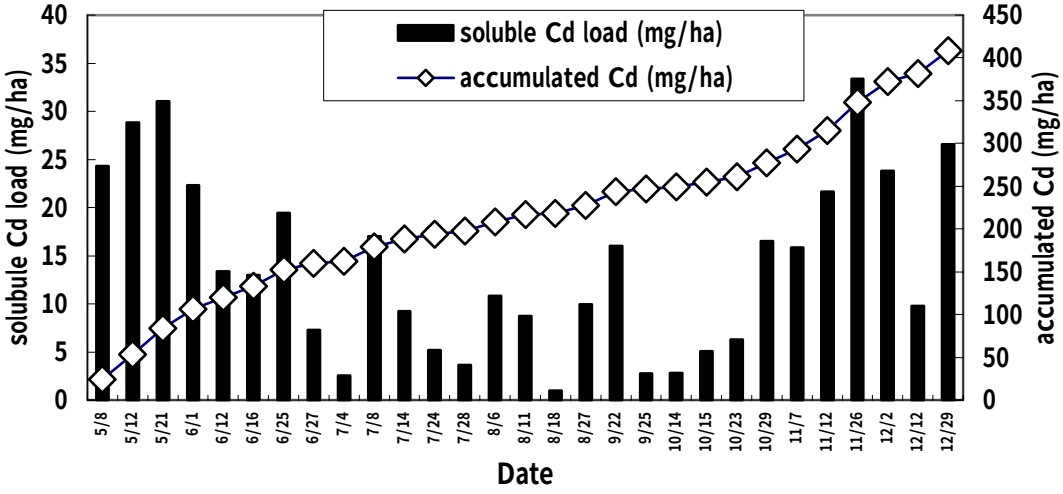


Fig. 5 Cd loading from rainwater in Tsukuba.

our other studies. (T. Saito)

Topic 2: **Identification of production origin of Welsh onions using strontium isotope ratios**

In Japan, regulations requiring the addition of labels stating where all perishable foods were grown were enacted in 2000. However, false labeling has been continuing for agricultural products such as Welsh onions (*Allium fistulosum*). To ensure compliance with the regulations, we need to establish an accurate method of determining the production origin of such perishables.

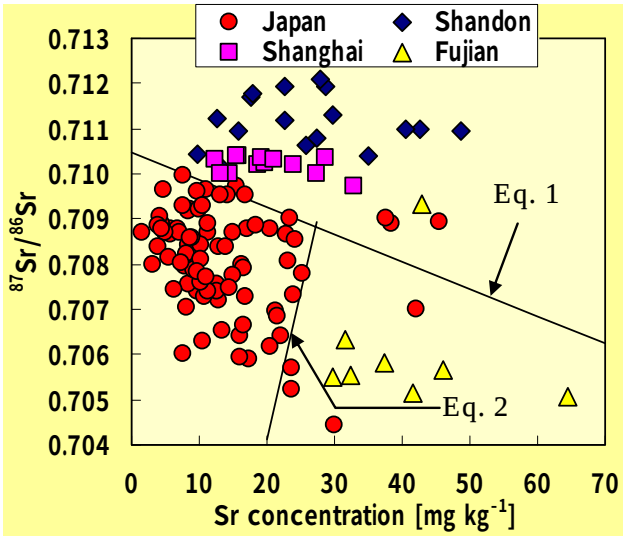


Fig. 6 Scatter plot of strontium concentration and strontium isotope ratio of Welsh onion samples. Lines indicate linear discriminant functions: Eq. 1, $0.154x + 2547y - 1809 = 0$; Eq. 2, $0.364x - 550y + 380 = 0$; where x and y are the concentration and isotope ratio, respectively, of Sr.

The areas where the Welsh onions sold on our market are grown are distributed throughout China (Shandon Province, Shanghai, and Fujian Province) and in Japan. We attempted to identify the origins of Welsh onions by using the strontium isotope ratio $^{87}Sr/^{86}Sr$.

1) Strontium isotope ratios of Welsh onion:

The strontium concentrations and $^{87}Sr/^{86}Sr$ ratios determined in a total of 104 Welsh onion samples are shown in Figure 6. The $^{87}Sr/^{86}Sr$ ratios of Welsh onion grown in Shandon ranged from 0.710 to 0.712, whereas those from Shanghai were about 0.710. The $^{87}Sr/^{86}Sr$ ratios of

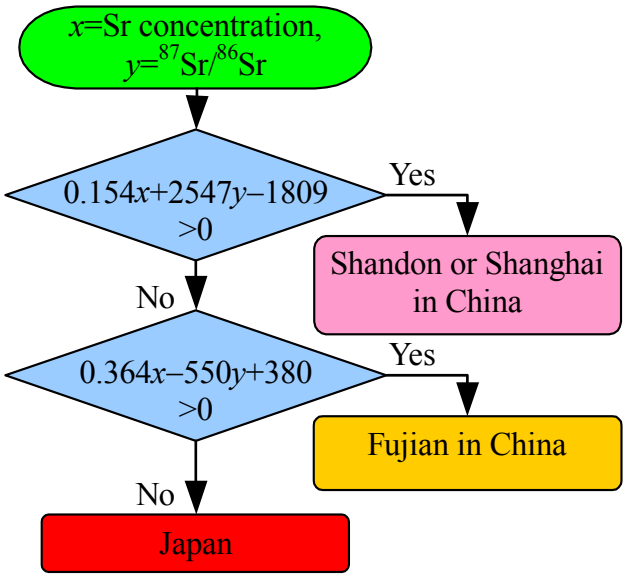


Fig. 7 Flow diagram for identification of origin of Welsh onions using the concentration and isotope ratio of strontium.

Fujian samples were lower, ranging from 0.706 to 0.709. The $^{87}Sr/^{86}Sr$ ratios of Japanese samples were also lower, ranging from 0.704 to 0.710. The $^{87}Sr/^{86}Sr$ ratios in Fujian samples were therefore almost the same as in the Japanese ones. However, the average Sr concentration of Fujian samples, at 37 mg kg^{-1}, was much higher than that of Japanese samples at 14 mg kg^{-1}.

2) Determination of the geographic origin of Welsh onion by linear discriminant analysis

To determine whether Welsh onions had been grown in Japan or China, we performed linear discriminant analysis (LDA), using the $^{87}Sr/^{86}Sr$ ratios and Sr concentrations. Using the flow chart procedure (Fig. 7), we correctly identified 35 Chinese samples out of 36 and 5 Japanese samples out of 6. We concluded that the use of $^{87}Sr/^{86}Sr$ ratios is a highly reliable method of determining the origins of Welsh onions. (H. Oda and A. Kawasaki)

3) Water Quality and Solute Dynamics Group

The mission of the Water Quality and Solute Dynamics Group is to clarify the dynamics of solutes such as nitrate-nitrogen passing through arable lands to water bodies; to develop technologies to monitor loadings of nitrate-nitrogen and other pollutants; and to reduce these loads on the environment. We have 4 ongoing projects: 1) elucidation of the mechanisms of solute movement through the soil and below ground; 2) development of monitoring methods for nitrate-nitrogen and other pollutants in medium-sized river basins; 3) development of a technology for alleviating the agricultural nitrogen load on the environment by enhancing denitrification; and 4) construction of a model adaptable to medium-sized river basins for prediction of nitrogen load and effluent. In FY 2003, we estimated the travel times of water and nitrate to shallow and deep aquifers under field conditions (see Topic 1) and also developed a database system for estimating the nutrient balances associated with agricultural production in various types of administrative district (see Topic 2).

Topic 1: Travel times of water and nitrate to shallow and deep aquifers

Determination of the travel time of, and routes followed by, water and nitrate to reach shallow and deep groundwater bodies is a prerequisite for predicting diffuse pollution of groundwater systems by nitrate and for evaluating the effects of soil and crop management in mitigating nitrate leaching from crop root zones in agricultural croplands.

To determine water fluxes through the vadose zone (the unsaturated zone above the water table) and shallow aquifers, since 1995 we have conducted long-term field monitoring of soil water conditions and shallow groundwater level distributions in an Andosol field at NIAES. Soil water fluxes at different depths (Fig. 8) and the time (τ) taken by water to travel through different layers (Table 1) are calculated from field data and from soil hydraulic properties. We also determine the penetration depth (z_p) of water, starting from the fertilized layer, by applying the 'piston displacement' theory under transient soil water conditions (Fig. 9 top).

The travel time of water within the unsaturated zone varied highly between dry and wet years, decreasing with the annual precipitation (Table 1). It took 0.8 to 2.5 years for water infiltrated from the soil surface to pass the crop root zone (τ_{0-1}), and 1.6 to 6.0 years for it to reach the water table ($\tau_{0-1} + \tau_{1-h}$). In contrast, the water travel time within the saturated zone, from the water table to the second aquifer ($\tau_{h-2.6} + \tau_{2.6-4.8}$) underlying the low-permeability layer, remained almost constant at 8.2 to 8.3 years, and was much less influenced by annual precipitation. The time of arrival of water at depths of 1 and 1.5 m coincided with that of the liquid phase NO_3^- concentration peak at these depths (Fig. 9 bottom), sug-

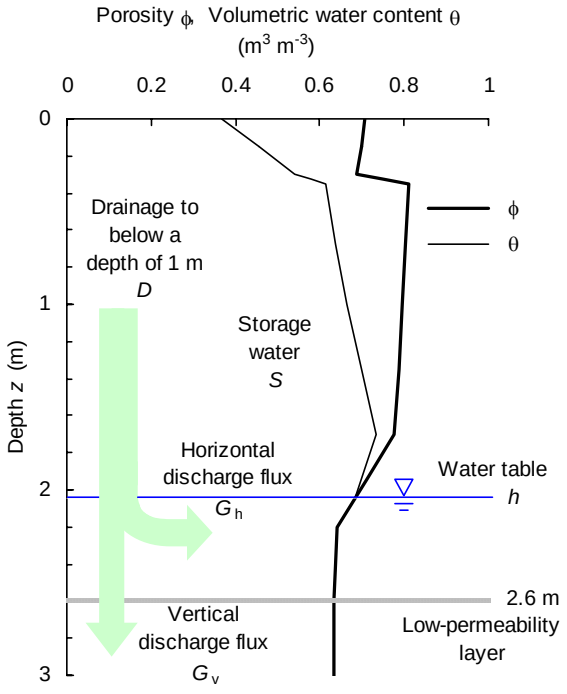


Fig. 8 Schematic diagram of drainage water flux to a depth of below 1 m. D, drainage water flux across 1-m depth; G_V, vertical groundwater discharge flux; G_h, horizontal groundwater discharge flux. The water discharged vertically through the low-permeability layer with a thickness of 2.2 m recharges the second aquifer, encountered at a depth of 4.8 m.

gesting that the travel time of nitrate can be approximated by that of water in this soil.

The contribution of the horizontal (G_h) and vertical discharge fluxes (G_v) in the shallow aquifer to the total discharge flux changed drastically with the annual precipitation (Table 1). Vertical discharge flux (G_v) represented more than 90% of the total discharge in the dry year of 1997, whereas in the wet year of 1998 more than 70% was attributed to G_h. Horizontal discharge flux (G_h) ranged widely from 22 to 549 mm y^{-1}, as opposed to G_v, which remained within a relatively narrow range of 208 to 226 mm y^{-1}. These results suggest that the low-permeability layer plays a significant role in keeping the deep groundwater recharge flux constant, regardless of the annual precipitation, and in protecting the deep aquifer from exposure to the dangers of rapid contaminant invasion from the overlying soil. (S. Eguchi)

Topic 2: **Database system for estimating the nutrient balance associated with agricultural production in administrative districts**

To alleviate the environmental pollution caused by excessive application of livestock excreta and chemical fertilizers, agricultural policymakers, extension workers, and researchers must 1) understand the quantities of crops produced, the abundance of livestock excreta, and the application rate of chemical fertilizers; and 2) make up a balance sheet of nutrients such as nitrogen and phosphorus for the district in question. In this study, we established a database system in which we estimated the nutrient balance in arable lands on the basis of statistical information collected in administrative districts such as prefectures, cities, and towns.

The newly developed database system contains two

Table 1 Changes in annual average water flux at different depths; the shallow water table, h; and the travel time of water, τ, through different layers, as affected by annual precipitation

	1997	1998	1995–2003
	Dry year	Wet year	Average
Water flux[a]		mm y^{-1}	
P	987	1531	1211
D	227	760	469
G_v	208	226	213
G_h	22	549	254
Water table		m	
h	2.12	1.88	2.04
Travel time[b]		y	
τ_{0-1}	2.54	0.79	1.24
τ_{1-h}	3.41	0.83	1.56
$\tau_{h-2.6}$	1.49	2.09	1.68
$\tau_{2.6-4.8}$	6.72	6.18	6.54

[a] P, Precipitation; D, Drainage to below a depth of 1 m, G_v, Vertically downward and G_h horizontal discharge fluxes of shallow groundwater.
[b] Subscript numerals represent the upper and the lower boundary depths of the layers to be passed through by water. Numeral 0 corresponds to the soil surface; 1 to the maximum rooting depth; h to the depth to the shallow groundwater surface; 2.6 to the depth to the low-permeability layer; and 4.8 to the depth to the second aquifer.

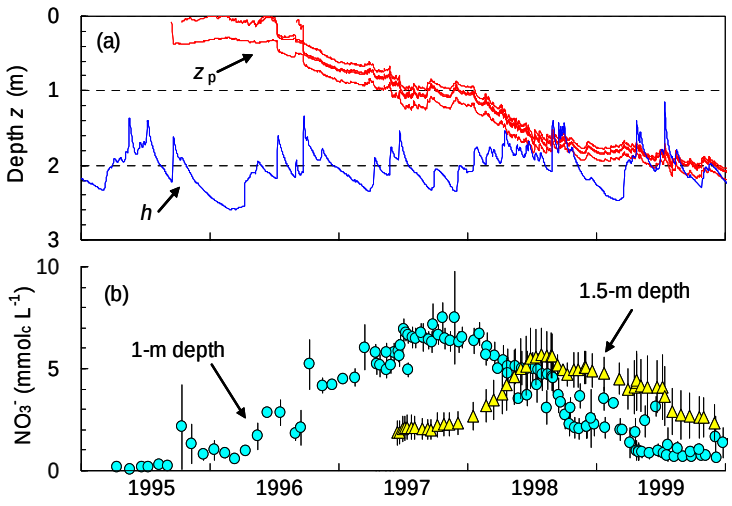
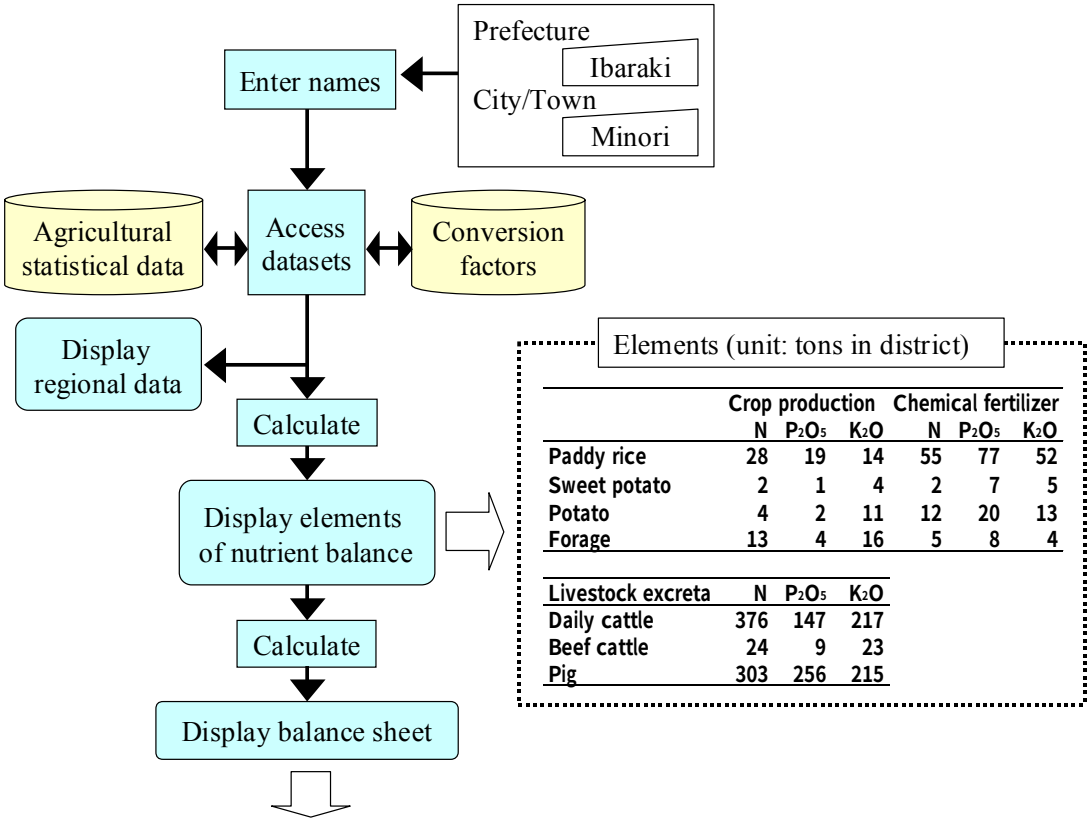


Fig. 9 Changes in (a) penetration depth of water, z_p, starting from the fertilized depth of 7.5 cm; shallow groundwater level, h; and (b) liquid phase concentration of NO_3^- at depths of 1 and 1.5 m. The water penetration depth, z_p, was determined for 4 fertilizations conducted during the period September 1995 to September 1996, when the application rate of nitrogen was higher than in other periods.

data sets: statistical data and the conversion factors needed to convert the statistical data to the amounts of nutrients (Fig. 10). For statistical data in administrative districts, we utilized the following basic numerical data stored in the Computer Center of Agriculture, Forestry and Fisheries Research Council: 1) the area of arable land of all prefectures, cities, and towns in 1997; 2) the acreage of 70 crops and their yields; and 3) the number of head of 5 kinds of livestock. For the latter data set, we estimated the conversion factors needed, i.e., the crop nutrient content, the amount of chemical fertilizer applied to each crop, and the amount of livestock excreta, all of which have been published in the literature and in the answers to a questionnaire conducted by the Statistical Department of Ministry of Agriculture, Forestry and Fisheries of Japan. We used the other statistical information to obtain the application and disposal rates of excreta from each type of livestock onto arable lands.

When users enter the name of a district into the database, the following tables are immediately created: amount of input (chemical fertilizers, livestock excreta, nutrients through rainfall and irrigation water and nitrogen fixation); amount of output (agricultural production, removal of by-products, and denitrification); and the environment load potential (Fig. 10). The environment load potential indicates the amount of excessive nutrients. This system can supply basic information that can be used to gain an understanding of the quantity of organic resources such as livestock excreta and rice straw within a district. It can then be used to promote not only the effective use of the district's resources but also their circulation over a wide area. MS Excel is required to use the system, which is available without charge. (S. Mishima, A. Matsumori and T. Inoue)



	Crop production			Chemical fertilizer		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Paddy rice	28	19	14	55	77	52
Sweet potato	2	1	4	2	7	5
Potato	4	2	11	12	20	13
Forage	13	4	16	5	8	4

Livestock excreta	N	P_2O_5	K_2O
Daily cattle	376	147	217
Beef cattle	24	9	23
Pig	303	256	215

Inputs	N	P_2O_5	K_2O
Chemical fertilizer	145	182	123
Livestock excreta	106	49	69
N_2-fixation etc.	27	0	2
Total	278	231	194

Outputs	N	P_2O_5	K_2O
Crop production	57	22	56
By-product	1	0	2
Denitrification	37		
Total	95	22	58

Environmental load potential	N	P_2O_5	K_2O
	183	209	136

Fig. 10 Structure of the newly developed database system for estimating the nutrient balance of arable lands in administrative districts.

Dioxin Dynamics Team

The mission of the Dioxin Dynamics Team is to elucidate dioxin dynamics in the agro-environment and to develop technologies to remediate dioxin-contaminated soils. In FY 2003, we conducted research in the following areas: 1) patterns of dioxin contamination of crops; 2) analysis of temporal changes in dioxin accumulation in Japanese paddy soils to determine pollutant sources (see Topic 1); 3) accumulation and behavior of dioxins in arable lands of Japan and Korea; and 4) development of a technology for reducing dioxin outflow from paddy fields (see Topic 2).

Topic 1: Temporal changes in dioxin accumulation in Japanese paddy fields

Polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) are persistent toxic contaminants. PCDD/Fs are released into the environment through incineration of wastes. In Japan, PCDD/F concentrations in paddy soils are higher than those in uncultivated soils, because some herbicides such as pentachlorophenol (PCP) and 2,4,6-trichlorophenyl 4-nitrophenyl ether (chlornitrofen, CNP), which were used from the early 1960s to the mid-1990s, contained considerable amounts of PCDD/Fs as impurities. It is, therefore, important that we understand the temporal trend of PCDD/F concentrations in paddy soils so that we can predict future contamination levels. Paddy soils collected periodically from all over Japan since 1960 are preserved at NIAES. We analyzed these preserved soils to trace changes in PCDD/F concentrations and to determine the sources of these pollutants.

Concentrations of PCDD/Fs in paddy soils increased during the 1960s and 1970s. Afterward, the concentration of PCDD/Fs then began to decrease, and has generally continued this trend into the present (Fig. 11). Temporal changes in PCP and CNP production (as measured by the amounts of active ingredient) in Japan and in concentrations of the dioxin congeners OCDD and 1,3,6,8-/1,3,7,9-TeCDD in paddy soils are shown in Figure 12. OCDD and 1,3,6,8-/1,3,7,9-TeCDD are major impurities in PCP and CNP, respectively. The temporal changes in the concentrations of these congener concentrations agreed well with those of PCP and CNP production, indicating that the marked increase in PCDD/F concentration was due to the use of PCP and CNP in paddy fields. We conducted a principal component analysis to determine the temporal changes in PCDD/F sources (Fig. 13). Before the use of PCP became nationwide, PCDD/Fs emitted from incinerators seemed to be the major sources in paddy soils. In the 1960s and 1970s, both the concentrations and compositions of PCDD/Fs in paddy soils changed markedly corresponding with the

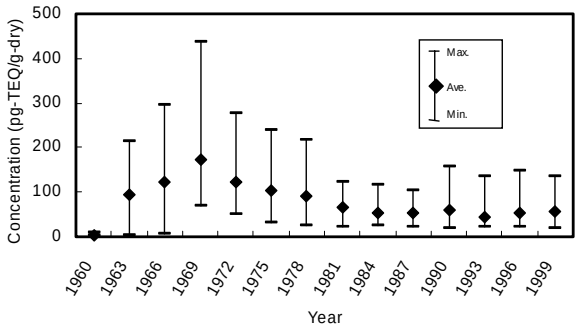


Fig. 11 Temporal change in PCDD/F concentrations in Japanese paddy soils.

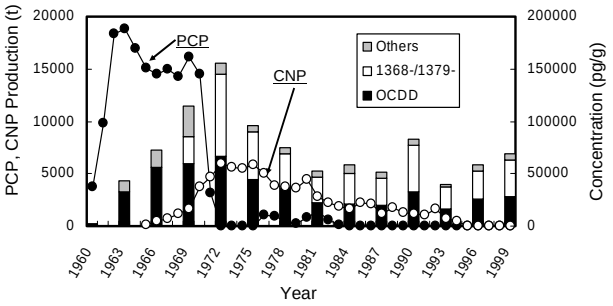


Fig. 12 Temporal changes in herbicide (PCP and CNP) production in Japan and dioxin congener (OCDD 1,3,6,8-/1,3,7,9-TeCDD) concentrations in paddy soil.

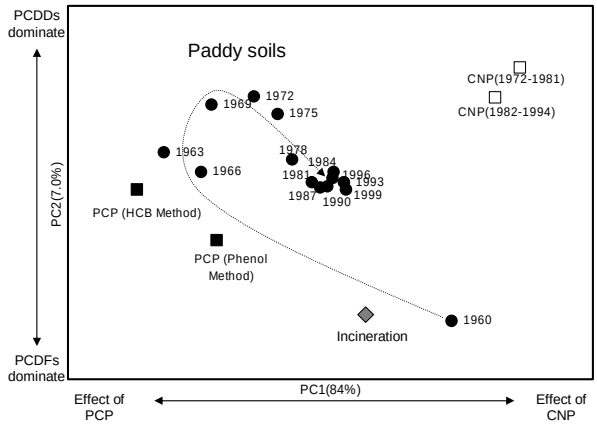


Fig. 13 Principal component analysis plot, showing temporal changes in sources of the PCDD/F in paddy soils.

widespread use of PCP and CNP. From the 1980s onward, only negligible changes in PCDD/F composition were observed because of reduced PCDD/F emission owing to reduced PCP and CNP use. Instead, the proportion of PCDD/Fs of incinerator origin has gradually increased in paddy soils in the last 20 years. (N. Seike and T. Otani)

Topic 2: **Use of flocculation aids to prevent dioxin outflow from paddy fields**

The herbicides pentachlorophenol (PCP) and 2,4,6-trichlorophenyl 4-nitrophenyl ether (CNP), containing dioxins as impurities, were commonly used from the 1960s to the 1990s on paddy fields in Japan. Although the registrations of these herbicides have expired, the amount of dioxins accumulated in paddy fields cannot be overlooked (see Topic 1). Rice does not absorb dioxins in the soil (see NIAES Annual Report 2003). Therefore, the dioxins accumulated in paddy fields do not affect human health as long as they stay in the fields. However, because dioxins are adsorbed to soil particles in paddy fields, they flow out together with suspended solids (SS) in drainage from the fields when paddy soil is puddled and dispersed. This can cause environmental pollution outside the paddy fields by dioxins. We studied ways of preventing the discharge of dioxins from paddy fields by promoting settlement of SS through the use of soil flocculation aids at the time of puddling.

The yellow soil in paddy fields is easily dispersed by puddling, leading to high concentrations of SS in the drainage. We applied calcium chloride or potassium chloride to a field as a flocculation aid at puddling time. The SS concentration in the paddy water was reduced to 5% to 11% of that in the control plot by this procedure (Fig. 14). The SS particle-size distribution, as measured by the laser scattering method, showed that the proportion of coarse-grained SS was higher when the flocculation aids were applied. With application of flocculation aids, the dioxin concentrations in paddy water had decreased to between 5% and 9% of that of the control plot by 3 h after puddling (Fig. 15). Because this rate of decrease corresponded well with changes in the SS concentration and almost no dioxins were contained in the liquid phase, we presumed that promotion of the settling of SS decreased the dioxin concentration. Although the concentration of exchangeable potassium increased slightly with application of potassium chloride, no significant changes were observed in other soil properties as a result of application of the flocculation aids. Application of these flocculation aids did not significantly affect growth, yield, or nutrient absorption of rice (Fig. 16). (T. Makino, T. Otani, N. Seike and K. Sugahara)

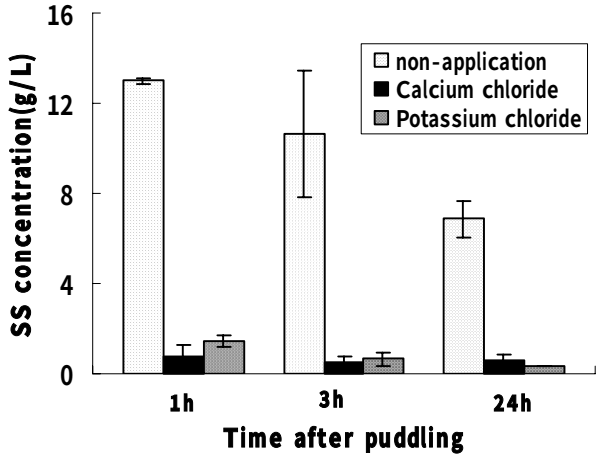


Fig. 14 Changes in suspended solids (SS) concentration in paddy water after application of flocculation aids.

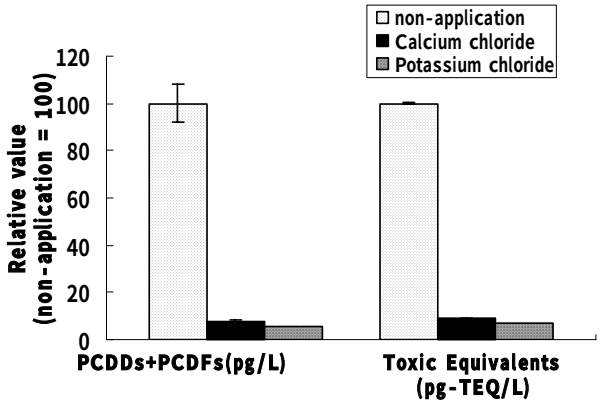


Fig. 15 Changes in dioxin concentrations in paddy water after application of flocculation aids.

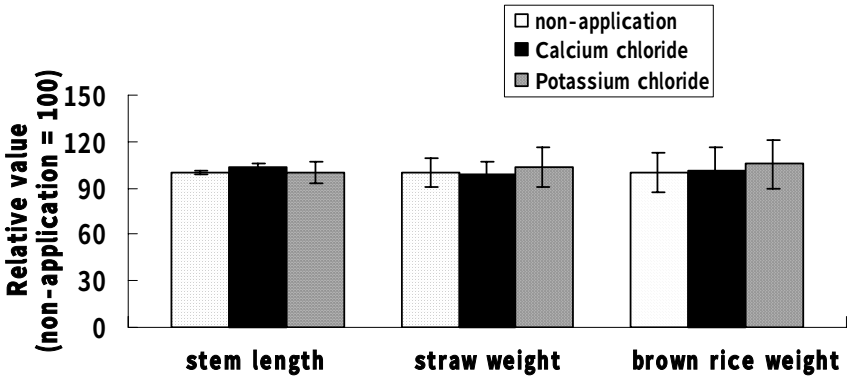


Fig. 16 Changes in rice growth and yield after application of flocculation aids.

Natural Resources Inventory Center

The mission of the Natural Resources Inventory Center is: 1) to perform fundamental research on the classification, identification, characteristics, and functions of agro-environmental resources such as soils, insects, and microorganisms; 2) to promote and support research in these areas through collection, preservation, exhibition, lending, and donation of specimens and samples; 3) to store all agricultural environment information collected in databases, and to develop inventory systems that can be accessed with the aid of tools such as the Internet; and 4) to collect and evaluate microbial and insect genetic resources as a sub-bank under the MAFF Genebank Project, in collaboration with related research groups.

The Natural Resources Inventory Center has 3 laboratories: Soil Classification, Insect Systematics, and Microbial Systematics. Each laboratory has its own Museum. In accordance with the NIAES mid-term research plan formulated in FY 2001, these laboratories have carried out the following research: 1) classification and elucidation of the functions of soils, and construction of a framework for a soil inventory; 2) construction of a database for type specimens of insects, and construction of a framework for an insect inventory; 3) classification and identification of the microorganisms inhabiting gramineous plants, analysis of their functions, and construction of a framework for a microorganism inventory; and 4) collection and evaluation of insects and microorganisms as genetic resources.

Major topics covered in 2003–04 are described in the *Topics* that follow and in the main Research Results.

***Topic 1:* Publication list and images of NIAES insect type specimens on the Web**

The name of organisms is composed of generic and specific name, and the type specimen is usually a single specimen by which the specific name is confirmed as being connected to an actual species. Type specimens sometimes need to be examined to enable the precise identification when researchers are faced with taxonomic problems. However, it is not always easy to examine type specimens, because they are often deposited in foreign countries. Moreover, the location of the depository of the type specimen is occasionally uncertain. Therefore, publication of a list of type specimens and their images on the Web should make it easier to find depositories and observe the morphological characters of the type specimen without the risk of loss or damage during transportation.

Presently, NIAES holds more than 500 primary type specimens at our Insect Museum, and we have published a list of 508 type specimens on our website. We have also published digital images and label information, together with the original references to 279 type specimens (10 Neuroptera, 233 Coleoptera, and 36 Hymenoptera) (Fig. 1). This information can be seen at the fol-

Fig. 1 Screen display of *Images of NIAES Insect Type Specimens* on the Web.

lowing URL: http://www.niaes.affrc.go.jp/inventry/insect/inssys/typelst.htm. We will acquire the images of the remaining type specimens within the next 2 years. These efforts will help researchers in searching for specimens and examining their characters.

The number of institutes that publish information on their type collections will increase in the future. We anticipate that the resultant connected image database of type specimens will act as a pictorial book on the Web, forming an identification support system. (Y. Nakatani, K. Yasuda and S. Yoshimatsu)

***Topic 2:* Construction of a microbial inventory and its exhibition on the Web**

Microorganisms present in the agro-environment play important roles in conservation of the agro-ecosystem, and their various functions are also used in agriculture and industry for crop production, food production, and bioremediation. In addition, since the Convention on Biological Diversity, which Japan has signed and ratified, more information on global biodiversity has been required worldwide. However, we still do not have enough information on microorganisms recovered from the environment – for example, from plants, soils, and water. We are therefore developing an inventory of microorganisms isolated from the agro-environment.

The microbial inventory, which we have named *microForce*, was constructed for exhibition on our website (http://www.niaes.affrc.go.jp/inventry/microorg/index.html) (Fig. 2). The system consists of 3 new databases: 1) a microorganism museum specimen database; 2) a 2,4-D-degrading microorganism database; and 3) a *Burkholderia cepacia* complex bacterial database. In addition, we have developed an integrated retrieval system by modifying a system constructed by Dr. S. Miyazaki of the National Institute of Genetics, Shizuoka. Users of this integrated retrieval system can simultaneously retrieve from all 3 databases all the information associated with particular keywords. Details of the 3 new databases are as follows:

Fig. 2 The microbial inventory *microForce*, available on the Web (Japanese version).

1) Microorganism Museum specimen database

This database lists information on 448 specimens collected by the Microorganism Museum of NIAES since 1880. Color pictures of specimens of microorganisms that cause various diseases (e.g., rust, powdery mildew, smut), together with the isolation year, place, and source of each microorganism, are exhibited on the website.

2) 2,4-D-degrading microorganism database

The database of 2,4-D-degrading microorganisms (161 records) was constructed from reference information. It contains isolate numbers, scientific names, isolation years and sources, and the name of the gene involved in the degradation. Updated information on 2,4-D-degrading microorganisms is exhibited on the website.

3) *Burkholderia cepacia* complex bacterial database

Burkholderia cepacia complex bacteria are versatile microorganisms. They have been reported as pathogens of humans, animals, and plants, and also as biological control agents and bioremediation agents. For these reasons, information on these bacteria is required in various fields, including research, industry and administration, and by consumers. Scientific names, isolate numbers, isolation sources, and functions (including pathogenicity to humans, animals, and plants) are exhibited on the website.

The microbial inventory *microForce* also contains all the microbial databases, such as the Index of Parasitic and Symbiotic Microbes on Wild Plants in Japan, which has been exhibited on the website of the Microbial Systematics Laboratory since 2001, and the Biosafety Level Bacterial Database constructed by the Japanese Society for Bacteriology.

Construction of an English version of *microForce* is in progress. (S. Tsushima, S. Yoshida and H. Shinohara)

Chemical Analysis Research Center

The Chemical Analysis Research Center has been developing new methods for analyzing environmental chemicals and has been researching the fate of these compounds in plants, animals, water, and soils.

The Environmental Chemicals Analysis Laboratory has developed a new method of analyzing diphenylarsinic acid and phenylarsonic acid detected in the groundwater of Ibaraki Prefecture. A new method of analyzing cadmium in rice grains has also been developed using an LA-ICP-MS (laser ablation inductively coupled plasma mass spectrometry) system (see Topic 1). The limit of detection of cadmium by this method is less than 0.02 ppm. Furthermore, this Laboratory has developed a convenient method of cleaning up samples for dioxin analysis. Gel permeation chromatography is the most effective way of removing the waxes and lipids contained in plant and meat samples destined for dioxin analysis. Laboratory staffs are also engaging in studying enzyme-linked immunosorbent assays for pesticide residues in crops (see Topic 2).

The Radioisotope Analysis Laboratory has been surveying the fallout of artificial radioisotopes such as ^{137}Cs and ^{90}Sr in wheat, rice, and soils since 1957. These data were analyzed to help develop a method of predicting contingencies of contamination by radioactive fallout in wheat and rice (see Topic 3). This Laboratory is also studying the fate of ^{129}I discharged from nuclear fuel processing plants, and has developed a method of pre-estimating desertification using the concentration of the natural radioactive nuclide ^{210}Pb in soils.

Dr. Eun Heesoo, a researcher at the Environmental Chemicals Analysis Laboratory, was awarded a "gratitude plate" by the Director General of the National Veterinary Research and Quarantine Service, Ministry of Agriculture and Forestry, Republic of Korea.

***Topic 1:* Direct determination of cadmium content in rice by LA–ICP–MS**

Recently, at its 36th Session, the Codex Committee on Food Additives and Contaminants (CCFAC), an international organization created by FAO and WHO to develop food standards, revised its draft maximum level for cadmium in rice from 0.2 to 0.4 mg kg^{-1}. Because the cadmium concentration of rice varies widely depending on the breed and source, many samples must be analyzed to evaluate the cadmium risk. It is laborious and time-consuming to analyze so many samples by conventional methods. Therefore, we have developed a novel method for direct determination of cadmium content in rice flour by LA–ICP–MS. This superior quantitative method needs none of the conventional, laborious sample pretreatments such as decomposition and extraction. To construct the calibration line and estimate the detection limit, we used 3 certified reference materials as rice flour – NIES nos. 10a, 10b, 10c – and a mixture of 10a and 10b. These were contaminated with cadmium at 4 different concentrations (0.023, 0.32, 1.82, and 0.17 mg kg^{-1}, respectively). The 4 rice flours were finely ground and pressed into disks for analysis. A laser (wavelength 213 nm) was used to irradiate the disk surface, and volatilized cadmium was introduced into the ICP torch. Figure 1 is a scanning electron micrograph of an ablated disk surface. The calibration line showed good linearity in the cadmium concentration range 0.023 to 1.82 mg kg^{-1} (Fig. 2), and the detection limit was 0.005 mg kg^{-1}. The determination did not require internal standardization, and the analysis time was 60 s per sample. (K. Baba)

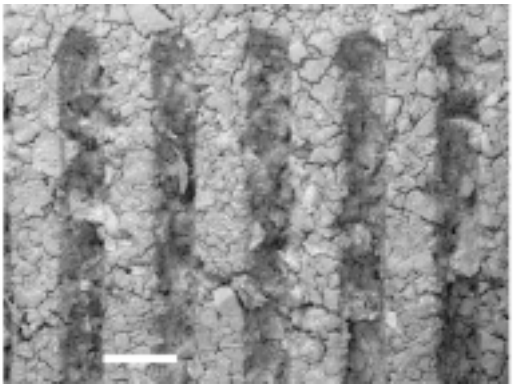


Fig. 1 SEM image of a laser-ablated rice disk (45×). The solid white line represents 500 μm.

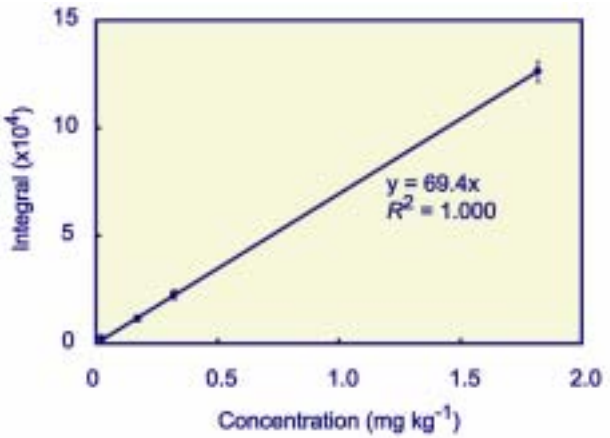


Fig. 2 Calibration line for ^{111}Cd using the selected reference materials (NIES 10a, 10b, 10c, and a mixture of 10a and 10b). Error bars represent the standard deviation of 6 measurements.

***Topic 2*: Rapid and simple immunochemical analysis for residual imidacloprid in agricultural products**

Antibody-based determination (i.e. immunoassay) is a selective and sensitive analytical methodology. Because immunoassay methods are rapid, sensitive, and reliable and are generally cost-effective for large sample loads, they have been applied to residual analyses of various pesticides in agricultural products and environmental media as powerful screening tools. Therefore, we have evaluated the performance of a monoclonal antibody-based enzyme-linked immunosorbent assay (ELISA) for determining the presence of the neonicotinoid insecticide imidacloprid, and have applied it to some real agricultural products. The ELISA has satisfactory sensitivity (0.1 ng/g) for residue analysis, and has high selectivity besides clothianidin. To extract imidacloprid from agricultural products (apple, cucumber, eggplant, lettuce, and green pepper) as simply and rapidly as possible, we examined some extraction methods and found that extraction with hand-shaking for 5 min was the best method. When imidacloprid was extracted directly with methanol and the extracts were diluted 10-fold and more with water before ELISA analysis, no significant interference by the sample matrix was observed (Fig. 3). The recovery values from fortified samples and the reproducibility were very good. As shown in Figure 4, the results obtained with ELISA were well correlated with those by the reference method (conventional HPLC analysis) for each sample ($r \geq 0.91$). The ELISA is a suitable screening method for quantitative and reliable determination of imidacloprid in agricultural products, even without sample clean-up; this saves time and money and considerably increases the sample throughput. (E. Watanabe)

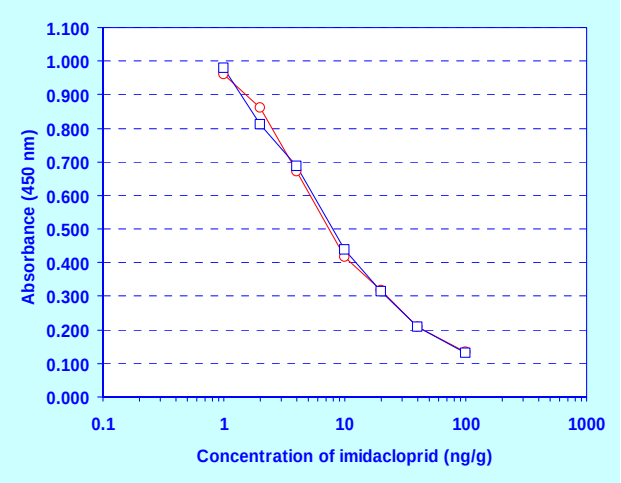


Fig. 3 ELISA inhibition curves showing no matrix interference by apple extract.

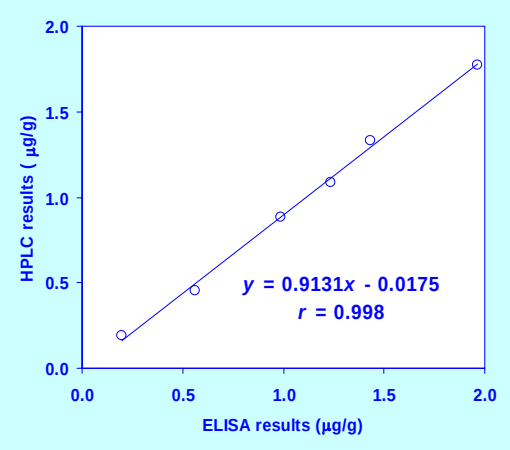


Fig. 4 Correlation of ELISA and conventional HPLC results from apple samples fortified with imidacloprid.

***Topic 3:* Method of predicting radioactive contamination levels in rice and wheat in case of contingencies**

Radioactive fallout derived from past nuclear test activities caused contamination of food by ^{90}Sr and ^{137}Cs in Japan. Since 1964, when the maximum contamination was observed, the ^{90}Sr and ^{137}Cs contents of rice and wheat have declined. Therefore, the risk of internal exposure by eating staple foods is currently negligibly low. However, despite the prohibition of nuclear test activities, the risk of accidental exposure to radioactive fallout cannot be totally obliterated because of the potential threat of problems with nuclear power plants all over the world. Therefore, we need to prepare a proper assessment system to predict food contamination by radioactive fallout in the event of a nuclear accident.

Since 1959, ^{90}Sr and ^{137}Cs levels in rice and wheat have been monitored at 17 observation plots located at agricultural research stations throughout Japan. Our continuous observation has shown that levels of ^{90}Sr and ^{137}Cs accumulated in fallout during the cultivation period (fallout data were provided by Japan Meteorological Agency) were highly correlated with those in husked rice, polished rice, and wheat kernels (Fig. 5). The regression equations in terms of national average of ^{90}Sr and ^{137}Cs in fallout and crops, defined as the estimate equations, are listed in Table 1. The accuracy of these estimate equations was verified by using observation data from the Chernobyl accident in 1986 for ^{137}Cs (Fig. 6). The data sets used for the estimate equations were collected between 1959 and 1982, when levels of radioactive fallout were relatively high. The estimate equations successfully predicted ^{137}Cs contamination levels in husked rice, polished rice, and wheat kernels. Note that these estimate equations are reliable when ^{90}Sr and ^{137}Cs in

fallout are in the range of 1 to 1000 Bq/m^2.

In conclusion, these estimate equations would be valuable in contingencies for the quick prediction of contamination levels in rice and wheat on the basis of the ^{90}Sr and ^{137}Cs contents of fallout. (N. Yamaguchi)

Table 1 Estimate equations for rice and wheat contamination by ^{90}Sr and ^{137}Cs in fallout

		N	Estimate equation	Correlation coefficient
^{90}Sr	Husked rice	24	$Y = 41\ X^{0.70}$	0.936^{***}
	Polished rice	24	$Y = 13\ X^{0.49}$	0.893^{***}
	Wheat kernel	24	$Y = 123\ X^{0.71}$	0.947^{***}
^{137}Cs	Husked rice	22	$Y = 86\ X^{0.70}$	0.949^{***}
	Polished rice	24	$Y = 52\ X^{0.86}$	0.918^{***}
	Wheat kernel	19	$Y = 47\ X^{0.97}$	0.972^{***}

***: $P < 0.001$

Y: ^{90}Sr and ^{137}Cs in rice and wheat (mBq/kg)

X: ^{90}Sr and ^{137}Cs in atmospheric fallout during the cultivation period (Bq/m^2)

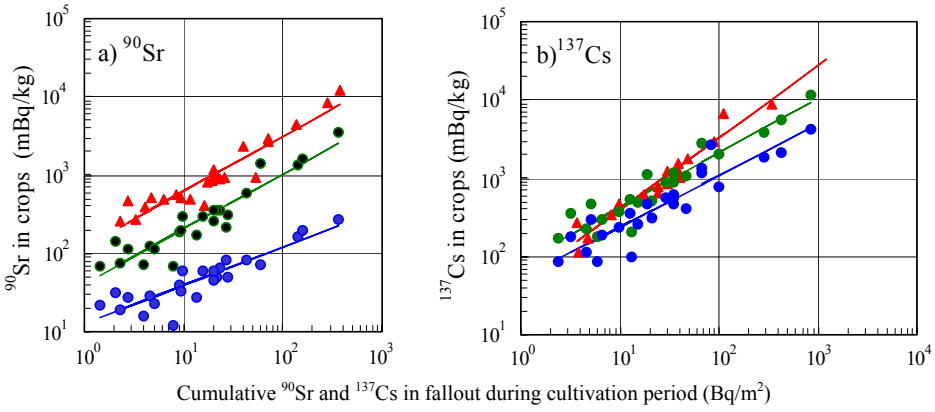


Fig. 5 Relationships between radioactivity in fallout and in crops (wheat kernel (▲), husked rice (●), and polished rice (●)): a) ^{90}Sr, b) ^{137}Cs.

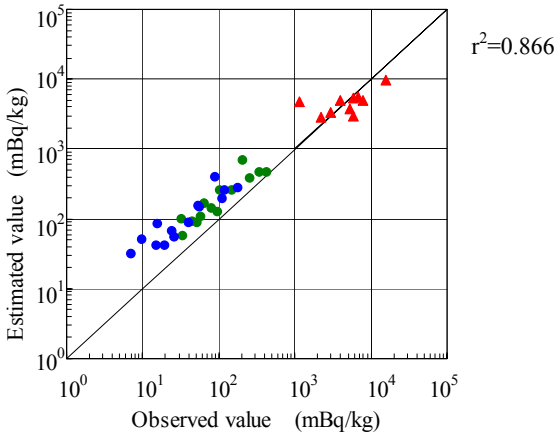


Fig. 6 Evaluation of estimate equations using observed ^{90}Sr and ^{137}Cs in 1986, the year of the Chernobyl accident (wheat kernel (▲), husked rice (●), and polished rice (●)).

Research Projects

1. Japan-Korea Cooperative Research Project on Water Quality Conservation in Agro-Eco System and Risk Assessment to the Environment

Japan and Korea are located in the Asia-Monsoon Climatic Zone, so that both countries share many problems related to water quality under the rice-based production system. In October 2001, NIAES and National institute for Agricultural Science and Technology (NIAST) of Rural Development Agency (RDA), Korea, signed a memorandum of understanding (MOU) to promote the two countries' international research collaboration on the common environmental problems in agro-ecosystems. Under the MOU, a new cooperative project started from FY 2003 on water quality conservation in the agro-ecosystem and risk assessment for the environment. The project is supported by the Agriculture Forestry, Fisheries Research Council (AFFRC), MAFF, Japan, and will be ended in FY 2007. The cooperative research project aims at 1) cooperatively elucidating the accumulation and behavior of nutrient solutes, heavy metals, farm chemicals, and dioxins in agro-ecosystems of both countries, 2) cooperatively developing feasible technologies to protect the agro-ecosystem against hazardous organic and inorganic chemicals mentioned above, and 3) contributing to the promotion of agro-environmental policy in both countries.

The outline of the project is as follows:

1) Effect of agricultural activities on water quality in the agro-ecosystem.
   (1) Evaluation of the spillage of nutrient solutes from arable lands.
   (2) Evaluation of the spillage of farm chemicals from arable lands.
   (3) Elucidation of the mechanism for indirect emission of greenhouse gases associated with the spillage of the nutrient solutes.
   (4) Effect of farm chemicals on aquatic creatures.
2) Development of a PC based model for use in fields predicting water quality and promising technologies for water quality conservation.
   (1) Development of PC based model for water quality prediction and its verification.
   (2) Development of technologies for enhancing the denitrification capabilities of natural mass flows.
3) Elucidation of hazardous substance loading in arable lands and methodology development for risk assessment for agro-ecosystems.
   (1) Elucidation of heavy metal loading in arable lands.
   (2) Elucidation of dioxins loading in arable lands.

2. Integrated Risk Management for Chemicals Hazardous to Human Health and Agroecosystems

Public concerns have icreased on food safety issues. Some chemicals such as dioxins and cadmium (Cd) persist in the environment and tend to accumulate in human's body through food intake. Therefore, it is a matter of urgency to manage the risk of these hazardous chemicals. Furthermore, the Joint FAO/WHO Expert Committee on Food Additives has been examining a new international safety standard for Cd in foods to minimize its human intake. Under such circumstances, we should endeavor toward securing the food safety, especially to minimize Cd concentration in rice. In 2001, to prevent human contamination from persistent organic pollutants (POPs), the Stockholm Convention on POPs was adopted. We should elucidate the behavior of POPs in the environment and evaluate their risk.

A new 5-year project, "Integrated Risk Management for Chemicals Hazardous to Human Health and Agroecosystems", supported by the Agriculture Forestry, Fishery Research Council (AFFRC), MAFF, was started from FY 2003 on the initiative of the Council for Science and Technology Policy within the Cabinet Office. This project aims at 1) evaluating the behavior of hazardous chemicals and their effects on organisms and agroecosystems, and 2) developing new technologies such as bioremediation to minimize the risk of hazardous chemicals.

The outline of the project is as follows:

1) Evaluation of contamination and behavior of hazardous chemical in environments.
   (1) Development of highly sensitive analytical methods for hazardous chemicals.
   (2) Behavior of hazardous chemicals in soil, water and atmospheric environments.
   (3) Development of simulation models to predict the behavior of hazardous chemicals.
2) Development of methods to assess the risk of hazardous chemicals in agro-, forest- and fisheries environments.
   (1) Clarification of mechanisms of hazardous chemicals against organisms.
   (2) Development of methods to assess the environmental risk of hazardous chemicals.
3) Development of technologies to minimize the risk of hazardous chemicals through their decomposition and detoxification.

(1) Clarification of mechanisms of the decomposition process of hazardous chemicals in the environment.
(2) Development of technologies to prevent hazardous chemical contamination from spreading.
(3) Development of technologies to detoxify hazardous chemicals.
(4) Development of technologies to extract hazardous chemicals from soil for remediation.

3. Grouping of So-called Minor Crops for Pesticide Residue Assessment and Development of a Prompt Pesticide Residue Detection Method in these Crops

Pesticides are indispensable for sustaining the stable production of agricultural crops. Because pesticides have high bioactivity not only on target pests but also all biota, the residual concentration of pesticides has to be kept lower than the tolerance limit. We have, therefore, been conducting a research project entitled,"Grouping of so-called minor crops for pesticide residue assessment and development of prompt pesticide residue detection method." This project started in FY 2003 and scheduled to end FY 2005 is composed of the following two subjects: (1) Various factors influence pesticide residue, and crops need to be grouped according to the decreasing type and velocity of residues. Several cereals, cucurbitaceous, labiate, and apiaceae crops were chosen for this study. Tested crops are divided into several groups according to survey results in order to facilitate and quicken the registration process of pesticides for so-called minor crops easy. (2) Development of a rapid analytical method for pesticide residue. Residue analysis results should be obtained before shipping of the crops to prove the safety of each commodity. However, the present methods of pesticide residue analysis, such as gas-chromatography and high performance liquid chromatography, are rather time consuming and, at the same time, require much knowledge and technical experience. Therefore the development of a prompt and simple analytical method such as enzyme-linked immunosorbent assay (ELISA) is urgently needed. Pragmatic applications of the ELISA method is expected as a fruition of this project.

4. A Research Project on the Non-target Impact Assessment and Guideline for the Exotic Beneficial Insect Introduction

This study is supported by the Ministry of Environment of Japan for the Research on Pollution Prevention and Control (FY 2003-FY 2005). Beneficial insects from overseas have been introduced to control invasive insect pests. However, serious concerns over the impacts of introduced exotic insects on native ecosystems have been raised by a number of prominent ecologists and conservation biologists. In Japan, new exotic beneficial insects – natural enemies – are being introduced without prior assessment of their non-target impacts. The non-target effects need to be assessed to minimize their impact on ecosystems, even after introduction. In this study, we focused on exotic predacious natural enemies, and assessed their non-target impact to reflect the results on the guideline for their introduction.

We analyzed the non-target effect of the introduced *Chrysoperla carnea* (Neuroptera; Chrysopidae) and predacious mites as case studies. A green lacewing, *C. carnea*, a generalist predator, has been commercially imported from Germany and sold as a biological pesticide since 2001 in Japan. A native sibling species, *C. nipponensis* is widely distributed in Japan. In 2003, we examined the direct competition between the introduced green lacewing, *C. carnea*, and the native sibling species, *C. nipponensis*. Our results suggest that the size was the most important factor in determining the symmetry of the interspecific predation between *C. carnea* and *C. nipponensis*. Populations of *C. nipponensis* will not decrease by interspecific predation from *C. carnea* without extreme mass releases of *C. carnea* in a small area. Hybridization between *C. carnea* and *C. nipponensis* was also studied in the laboratory. They could copulate in a small case and some progenies were fertile. But the copulation rate of *C. carnea* (♂) x *C. nipponensis* (♀) was low (14.29%). The F1 male of the *C. nipponensis* (♂) x *C. carnea* (♀) could not copulate with other females. The mating songs of the two species are very different. So they can't copulate freely in an open field. It is necessary to investigate their copulation rate in wider cages.

Symposia and Workshops

1. Conference, Workshop and Research Meetings

Title	Place	Date	Participants
The 1st Meeting of Environmental Research Organizations in Japan "Approach to Cooperation in Environmental Sciences"	Tsukuba International Conference Center	July 24, 2003	184
The 3rd Seminar on Organic Chemicals Studies "Effect of Chemicals on Ecosystems, How to Evaluate ? "	NIAES	September 11, 2003	181
The 20th Research Meeting on Pesticides "Evaluation of Residual Pesticides in Minor Crops"	NIAES	September 12, 2003	120
International Seminar "Biological Invasions -Environmental Impacts and the Development of a Database for the Asian-Pacific Region -"	Hotel Grand Shinonome	November 13〜14, 2003	152
The 23rd NIAES Symposium and the 1st International Symposium of Japan-Korea Research Cooperation "Promising Agricultural Practices and Technologies for Reducing Heavy Metal Contamination in Relevant Staple Crops"	Tsukuba International Conference Center	November 20〜21, 2003	187
The 20th Meteorology Workshop "Evaluation of Potential Amount and Effective use of Agricultural Water Resources"	NIAES	February 24, 2004	91
The 21st Seminar on Soil and Water "Promising Remediation Technologies for Heavy Metal Polluted Soils"	Tsukuba Agriculture and Forestry Hall	February 25, 2004	325
The 6th Seminar on Vegetation Science "Current Alien Plants in Japan and Their Ecological Properties"	NIAES	March 5, 2004	142
International Workshop "Prediction of Food Production Variation in East Asia under Global Warming"	Tsukuba Center for Institutes	March 17〜19, 2004	62

2. The 3rd Seminar on Organic Chemicals Studies: *Effect of Chemicals on Ecosystems, How to evaluate?*

The symposium was held September 11, 2003 with 7 domestic speakers and 181 participants in the NIAES conference hall.

In 2002, OECD examined the national environmental performance of Japanese government and put forward 60 recommendations that could help strengthen Japan's environmental performance. To improve the effectiveness and efficiency of chemical management including pesticides, OECD recommended to extend the scope of regulation to include ecosystem protection. In 2003, the Japanese government adopted pesticide registration schemes requiring registrants to assess their potential ecological risks through a tiered testing system. Preliminary testing requirements include the generation of acute and chronic toxicity data with fish, invertebrates and aquatic algae. However, several controversial issues remain on how to develop higher-tier aquatic risk assessment when a preliminary risk characterization indicates potential concerns.

In this symposium, seven speakers from government, industry and academia, experienced in regulatory aquatic risk assessment of pesticides, were invited. The following topics were presented: 1) Policy of environmental risk management of chemicals reflecting ecological effects (Y. Hayakawa, Agricultural Chemicals Control Office, Ministry of Environment), 2) Current ecological risk assessment of pesticides in the EU and US (T. Hoshino, Bayer CropScience), 3) Risk assessment of herbicide effects on algae in river ecosystems (S. Ishihara, NIAES.), 4) Ecological risk assessment of pesticides in outdoor microcosms or mesocosms (T. Fujita, Jpn. Plant Protect. Assn.), 5) Field studies for assessing ecological effects of pesticides in rice paddy areas (T.

Houjou, Eco-Science Corp.) 6) Ecological definitions for risk assessment of chemicals (H. Ikeda, NIAES), and 7) Future perspectives on ecological risk assessment of pesticides (H. Yamamoto, Shimane Univ.).

The symposium identified a number of potential techniques (additional single-species studies, laboratory multi-species tests, and field studies) that could be taken to further characterize potential aquatic risks identified in preliminary assessments. Participants agreed that internationally standardized methods are essential for the ecological risk assessment of pesticides, but care should be taken as to how representative the standard test organisms are of the range of sensitivities that occur in nature.

3. The 20th Research Meeting on Pesticides: *Evaluation of Residual Pesticides in Minor Crops*

To ensure comprehensive food safety, the Japanese government tightened food safety rules and revised the Agricultural Chemicals Control Law in December 2002 after several incidents of illegal distribution of unauthorized pesticides for several crops nationwide, and the detection of pesticide residues exceeding safety limits in imported vegetables. As a result, very few pesticides can be used legally on minor crops currently. Therefore, there is a growing demand nationwide for expanding authorized pesticides which can be used for minor crops. To discuss this issue, the symposium was held September 12, 2003 with 6 speakers and 120 participants in the NIAES conference hall.

Here in this symposium, in order to share information on analytical methods for residual pesticides in minor crops, six speakers were invited to the symposium, and the following topics were presented and discussed: 1) Revision of Agricultural Chemicals Control Law (K. Ogura, Agricultural Chemicals Office, MAFF), 2) Current status of pesticide use for minor crops and their pesticide residues (T. Wada, Nagano Agri. Exp. Stn.), 3) Analysis of pesticide residues in various minor crops (M. Kameshiro, Tokushima Agri. Exp. Stn.; M. Yamada, Aichi Agri. Exp. Stn.; Y. Masuda, Aomori Agri. Exp. Stn.), and 4) Analytical method of pesticide residues in agricultural crops (H. Kobayashi, Res. Inst. Japan Plant Protect. Assn.).

In the second half of the meeting, report concerning the topical issues (detection of the banned pesticides such as aldrin, dieldrin and endrin in cucumber plants) and the effect of pesticide on aquatic organisms were presented, and information were exchanged.

4. The 20th Meteorology Workshop: *Evaluation of potential amount and effective use of agricultural water resources*

This workshop was held February 24, 2004 with 7 speakers and about 90 participants in the NIAES conference hall.

Since global warming is certainly advancing, the global water cycle will also change in the future, and gravely affect food production and the environment. According to current research related to global water circulation, it is presumed that global warming does not appear uniformly on the global scale, and presents complexity on the regional scale, for example, the occurrence of simultaneous flooding and drought. In such unstable water cycles, a technical development for water conservation to enable a stable food supply in agriculture is one of the pressing issues. On the other hand, supply and demand for daily water for consumption and for increased industrial use due to economic development will result in a scramble for water use between agriculture and industry. The amount of water to be used in the agricultural sector may tend to decrease in the future. However, the demand for good quality agricultural water is expected to increase with the increase in food demand due to the increase in population. This workshop was held to probe the possible directions for future research to solve the agricultural water resource issues of the 21st century.

Topics presented were as follows: 1) Precipitation change and rice farming in monsoon Asia under global warming (A. Matsumoto, The University of Tokyo), 2) Monitoring of snowfall water resources using remote sensing techniques (H. Ono, NIAES), 3) Evaluation of the spatial and temporal variation in distribution characteristics of agro-water resources in East Eurasia (Y. Ishigooka, NIAES), 4) Deficiency in agricultural water resource and its influence in China (A. Kondo, Chiba University), 5) Crop research relating to recent water saving cultivation and water use of rice plants in Japan (A. Kamoshita, The University of Tokyo), 6) Water saving cultivation of crops using lower layer ground reservoir water (K. Ozawa, Japan International Research Center for Agricultural Sciences), and 7) Re-distribution of soil water through water uptake by tree roots and its effect on neighborhing crops (T. Sakuratani, Kyoto University)

On the evaluation of agricultural water resources (topics 1 to 4), the following reports were discussed. In Bangladesh, rice production increased after a moderate but not heavy flooding, though expansion of the area for *Boro* rice cultivars in the dry season and by introducing irrigation facilities. Dissolution of snow coverage was

detectable by remote sensing with microwave radiation. The water cycle in East Eurasia could be simulated by a water circulation model for evaluating agricultural water resources on a continental scale. There were many water issues in North China Plain, such as suspension of water flow of the Yellow River, decrease in the amount of ground water and salinity accumulation on cropland soil. On the effective use of water (topics 5 to 7), the current status of water-saving cultivation technology for rice and vegetables, and their possible technological development, a possible use of water-transport power from lower layer soil to the vicinity of surface soil by tree roots (hydrolic lift) in agro-forestry and its quantitative evaluation was discussed.

Water issues have a complex background, such as the close interrelations between food and financial issues, and cannot be separated from the human psychology of aspiring to a more comfortable life. Therefore, research results from a variety of related fields and the concentration of talented scientists are necessary to solve the agricultural water resource issues.

5. The 21st Seminar on Soil and Water: *Promising remediation technologies for heavy metal polluted soils*

This seminar was held February 25, 2004 with 7 speakers and 325 participants in the Norin-hall at Tsukuba .

Recently, public concern has increased over heavy metal pollution of soils. The Codex Committee established jointly by FAO and WHO has been examining a new international safety standard for cadmium in foods to minimize its human intake. Under such circumstances, it is a matter of urgency that we elucidate the behavior of heavy metals in soils and the mechanism of their absorption by crops, and that we develop technologies to suppress hazardous metal absorption by crops. In this seminar, a variety of promising techniques for reducing heavy metal pollution of soil was discussed:

1) Phytoremediation: Some plants are known for their ability to absorb large quantities of heavy metal from soil. If these plants are grown in the polluted lands, heavy metal can be absorbed and removed from the soil. Some relevant plants and technologies were presented by 4 speakers from NIAES, Plant Engineering Institute, Akita Prefectural Exp. Station and Fujita Co., respectively. 2) Chemical remediation: New soil remediation methods were introduced by 2 speakers from NIAES and Shiga Prefectural University. One used soil-washing with chemicals, and another used electrophoresis technique. The efficiency of cadmium removal with calcium chloride washing was 17.1% in the experimental field. Chromium(VI) migrated to the anode and was removed from soil through the drainage water. In general discussion, strategies for developing new soil remediation technologies was discussed.

6. The 6th Seminar on Vegetation Science: *Current Alien Plants in Japan and Their Ecological Properties*

The sixth seminar on vegetation science was held at NIAES on 5 March 2004. The main title of the seminar was “Current alien plants in Japan and their ecological properties.” The seminar comprised two agendas: first, how to monitor the colonization and spread of alien plants, and the second, how to assess the ecological impact of alien species on biodiversity conservation.

Nine speakers gave presentations, and their topics were: 1) The aim of this seminar (by Y. Ogawa, NIAES), 2) Conservation ecology for maintaining biodiversity (by T. Yahara, Kyushu University), 3) A national net work for monitoring alien plants by using a mailing list system (by H. Morita, National Agricultural Research Center), 4) Introduction of new groundcover-crops for vegetation management on slopes (by A. Fukushima, Hyogo Pref.), 5) The invasion of *Robinia pseudo-acasia* on riversides in Nagano Pref. (by M. Maekawa, Nagano Pref.), 6) Allelopathy in the plants growing on riversides of Tama-river (by S. Uraguti, Tokyo Univ. of Agri. and Tech.), 7) Toxic components in introduced plants and their chemical/ecological properties (Y. Fujii, NIAES), 8) Legislation to manage the risk of invasive species (M. Horikami, Ministry of Environment), 9) Proposition of methods for the assessment of ecological impacts of introducing new plants (by T. Ohkuro, NIAES).

The highlight of the seminar was the discussion concerning the risks and benefits of alien species used for agriculture. Some scientists and local government officials had many questions to the speaker from the Natural Conservation Section of the Ministry of Environment, who explained the new law for control or eradication of invasive species. Most of those questions were centered on regulation systems in the new law. More than 120 people participated in the seminar.

7. Technical Training Course on the Bio-safety Assessment of GM Crops 2003

The Japanese Government ratified the Cartagena Protocol on Biodiversity of the Convention on Biological Diversity in November 2003 and enforced the Cartagena Protocol Domestic Law and related regulations/guidelines in February of the following year. Hereafter the bio-safety assessment of any GMOs (genetically modified organisms) needs to be performed with proce-

dures of either Type 1 use (GMOs in experimental fields including isolated fields) and Type 2 use (GMOs in greenhouses) under the domestic law and related regulations/guidelines.

Before the enforcement of the domestic law, we held a technical training course for the purpose of transferring 1) our experience and information for smooth management in isolated experimental fields, and 2) assessment techniques to researchers and technicians who conducted the bio-safety assessment of GM crops on October 10, 2003 in NIAES. About 40 participants joined the training course from other research organizations and private sectors. The training course included three programs: 1) a lecture on the current situation of bio-safety assessment of GM crops and on introduction to the assessment system and various seasonal procedures conducted in the isolated experimental field in NIEAS, 2) a visit to the isolated experimental fields, and 3) technical transfer of the bio-assay methods to assess the impact of *Bacillus thuringiensis* (Bt) toxin in corn pollen on *Lepidoptera*. The methods were developed in the Department of Biological Safety, as described in the NIAES Annual Report (April 1999 – March 2000). Future training courses will be held for technical transfer of concurrent methods with respect to the bio-safety assessment of GM crops as the need arises.

Participants visiting the isolated experimental field of NIAES.

Foreign Visitors

1. Foreign Scholars

Name	Affiliation	Research Subject	Duration
Krirk Pannanngpetch	Thailand, Khon Kaen University	Observation and modeling for studying the impacts of water resource constraints on food production	July 21～ August 3, 2003 December 1～ December 6, 2003
Jae-Seok Lee	Korea, Konkuk University	Data analysis on soil carbon dynamics change with vegetation transition	October 14～ October 19, 2003
Su-Myeong Hong	Korea, National Institute of Agricultural Science and Technology	Elucidation of dioxins loading in arable lands	November 16～ November 25, 2003
Dal-Soon Choi	Korea, National Institute of Agricultural Science and Technology	Elucidation of dioxins loading in arable lands	November 16～ November 25, 2003
Jae-Chun Shim	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003
Moon-Hee Park	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003
Hae-Keun Lee	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003
Seon-Woong Hwang	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003
Han-Kang Kwak	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003

Name	Affiliation	Research Subject	Duration
Won-Il Kim	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～November 23, 2003
Goo-Bok Jung	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～November 23, 2003
Byung-Jun Park	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～November 23, 2003
Hee-Joong Jun	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～November 23, 2003
Kwang-Lai Park	Korea, National Institute of Agricultural Science and Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～November 23, 2003
Michael John Mclaughlin	Australia, CSIRO Land and Water	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Tamas Nemeth	Hungary, Hungarian Academy of Sciences	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
John Miles Clarke	Canada, Agriculture and Agri-food Canada	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Michel Mench	France, INRA Centre Bordeaux Aquitaine	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Preeda Parkpian	Thailand, Asia Institute of Technology	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Joni Munarso	Indonesia, Indonesian Agricultural Postharvest Research Institute	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Dong-Mei Zhou	China, Chinese Academy of Sciences	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003

Invitations, Training and Information Events

Name	Affiliation	Research Subject	Duration
Yong-Ming Luo	China, Chinese Academy of Sciences	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Rufus Lee Chaney	USA, USDA-Agricultural Research Service	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 19～November 22, 2003
Xianbin Xu	China, Heilongjiang Academy of Agricultural Sciences	Assessment of impacts, adaptation and vulnerability of natural ecosystems to global warming	December 15～December 25, 2003
Xinquan Zhao	China, Chinese Academy of Sciences	Research on global warming effects and carbon budget in Alpine grassland ecosystem	January 22～February 3, 2004
Guo Yiling	China, Quindao Institute of Architecture and Engineering	Assessment method for ecosystem acidification and eutrophication caused by acidic deposition on the basis of material cycles in catchments	February 1～February 7, 2004
Yingnian Li	China, Chinese Academy of Sciences	Research on global warming effects and carbon budget in Alpine grassland ecosystem	February 9～February 22, 2004
Xianfang Song	China, Chinese Academy of Sciences	International symposium on water resource and its variability in Asia in the 21st century	February 29～March 3, 2004
Jun Xia	China, Chinese Academy of Sciences	International symposium on water resource and its variability in Asia in the 21st century	February 29～March 3, 2004
Erda Lin	China, Chinese Academy of Agricultural Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003
Yinlong Xu	China, Chinese Academy of Agricultural Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003
Fengmei Yao	China, Chinese Academy of Agricultural Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003
Yao Huang	China, Chinese Academy of Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003
Xiu Yang	China, Chinese Academy of Agricultural Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003
Guirui Yu	China, Chinese Academy of Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～March 20, 2003

Name	Affiliation	Research Subject	Duration
Yuling Fu	China, Chinese Academy of Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～ March 20, 2003
Xuezheng Shi	China, Chinese Academy of Sciences	International workshop on prediction of food production variation in East Asia under global warming	March 16～ March 20, 2003
Jeong-Teak Lee	Korea, National Institute of Agricultural Science and Technology	International workshop on prediction of food production variation in East Asia under global warming	March 16～ March 20, 2003
Jin-Chul Shin	Korea, National Institute of Agricultural Science and Technology	International workshop on prediction of food production variation in East Asia under global warming	March 16～ March 20, 2003
John R.Porter	Denmark, The Royal Veterinary and Agricultural University	International workshop on prediction of food production variation in East Asia under global warming	March 16～ March 20, 2003
Mark W.Rosegrant	USA, International Food Policy Research Institute	International workshop on prediction of food production variation in East Asia under global warming	March 17～ March 20, 2003
Edmond.R.Ranatunge		Meso-scale analysis on the relationship between agricultural land-use and precipitation in Indochina peninsula	April 14～June 30, 2003
Mathias Wissuwa	Philippines, International Rice Research Institute	Developing new markers to map the QTL to single BAC clone for phosphorus uptake	May 22～June 2, 2003 September 4～ September 15, 2003
Velusamy Jayakumar	India, Tamil Nadu Agricultural University	Classification of microorganisms inhabiting on gramineous plants and construction of microbial inventory frame	May 23～ November 14, 2003
Jihao Fang	China, Chinese Academy of Agricultural Sciences	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Josie Lynn A.Catindig	Philippines, International Rice Research Institute	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Byeong Chul Moon	Korea, National Institute of Agricultural Science and Technology	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Mashhor Mansor	Malaysia, Malaysia Science University	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003

Name	Affiliation	Research Subject	Duration
Karden Mulya	Indonesia, Indonesia Agricultural Biotechnology and Genetic resources Research institute	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Banpot Napompeth	Thailand, Kasetsart University	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Surapol Yinasawapun	Thailand, Department of Agriculture, MOA	International seminar on biological invasions: Environmental impacts and the development of a database for the Asian-Pacific region	November 12～ November 16, 2003
Jeong-Teak Lee	Korea, National Institute of Agricultural Science and Technology	Development of the technology for the prediction of food production variation under global climate change	November 16～ November 21, 2003
Kyu-Ho So	Korea, National Institute of Agricultural Science and Technology	Development of the technology for the prediction of food production variation under global climate change	November 16～ November 21, 2003
Jae-Saeng Lee	Korea, National Institute of Agricultural Experiment Station	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003
Chan-Won Park	Korea, National Institute of Agricultural Experiment Station	International symposium on promising agricultural practices and technologies for reducing heavy metal contamination in relevant staple crops	November 18～ November 23, 2003

2. Fellows

	Name	Affiliation	Research Subject	Duration
JSPS Postdoctoral Fellowship	Xiangkui Yan		Phytoremediation of heavy metals in contaminated soils amended with sewage sludge by cultivated crops	March 10, 2002～ March 9, 2004
JSPS Postdoctoral Fellowship	Shenqiang Wang	China, Chinese Academy of Science	Burden and behavior of Cd derived from the fertilizer in the Lysimeter experiment using the ^{113}Cd Tracer technique	March 26, 2002～ March 25, 2004
JSPS Postdoctoral Fellowship	Weiguo Cheng		Study on the effects of elevated carbon dioxide on methane emission from paddy soil by stable isotope technique	April 1, 2002～ March 31, 2004
JSPS Postdoctoral Fellowship	Mohamed Faize	France, INRA Angers	Activation of defense mechanisms in plants and development of technology for reducing pesticide input to the environment	July 13, 2002～ July 12, 2004
JSPS Postdoctoral Fellowship	Wuyunna	China, Inner Mongolia University	Development of numerical prediction methodology for the global warming and rainfall fluctuation impact to the plant production in East Asia	November 26, 2002～November 25, 2004
JSPS Postdoctoral Fellowship	Youbin Si	China, Anhui Agricultural University	Pesticides in-situ biodegradation in the unsaturated subsoil and aquifers	April 1, 2003～ March 31, 2005
JSPS Postdoctoral Fellowship	Mohammad Bannayan Avval	Iran, Ferdowsi University of Mashhad	Biogeochemical modeling of the impacts of increasing atmospheric CO^2 on agricultural ecosystems	July 14, 2003～ September 30, 2003
JSPS Invitation Fellowship (Short term)	Xiangyu Tang	China, Chinese Academy of Science	Analytical method on bioavailability of Cd in soils	November 16, 2003～December 14, 2003
JSPS Invitation Fellowship (Long term)	Warsim Ahmad	India, Aligarh Muslim University	Soil nematodes in Agro-ecosystems: their identification, taxonomy and diversity	June 21, 2002～ April 19, 2003
Eco-Frontier Fellowship	Fulu Tao	China, Chinese Academy of Science	Vulnerability assessment of agro-ecosystem to global warming and its risk modeling	April 1, 2003～ March 31, 2004
Eco-Frontier Fellowship	Edmond.R. Ranatunge		Meso-scale analysis on the relationship between agricultural land-use and precipitation in Indochina peninsula	July 1, 2003～ March 31, 2004
Winter Institute (by JKF)	Hyunjung Lee	Korea, Sangmyung University	Development of strategic survey and database systems on biodiversity in agro-ecosystems	January 13～ February 19, 2004
Winter Institute (by JKF)	Sung Eun Lee	Korea, Seoul National University	Phytoremediation of heavy metal polluted soils	January 13～ February 19, 2004
JICA	Mario Miyazawa	Brazil, Agronomic Institute of Parana	Monitoring and ambiental control of swine residues	April 2～April 25, 2002

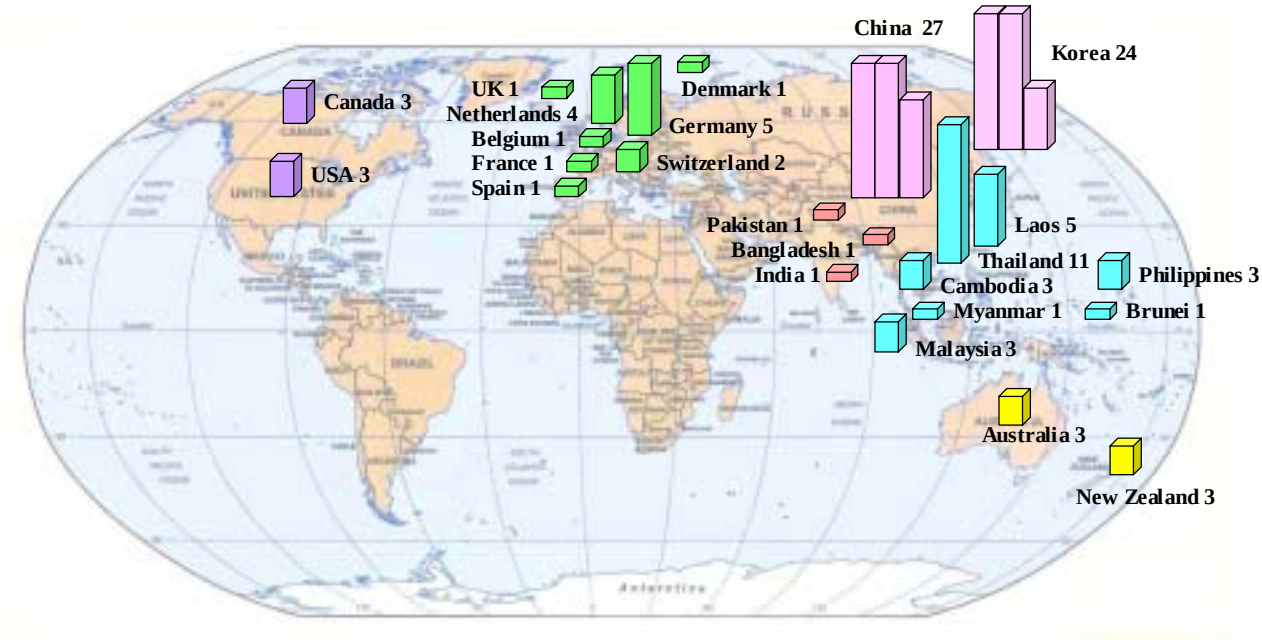
	Name	Affiliation	Research Subject	Duration
JICA	Elizabeth Ying Chu	Brazil, Agroforest Research Center for Eastern Amazon	Control of Fusarium diseases and methods for testing fungicide sensitivity	July 14, 2003～ July 18, 2003

3. Training

	Name	Affiliation	Research Subject	Duration
Technical Training	Teajin Choi	Korea, Yonsei University	Micrometeorological measurements and theory	April 1, 2003～ July 16, 2003
Technical Training	Syeda Shahnaz Parvez	Tsukuba University	Identification of Allelopathic substance of Tamarind	April 1, 2003～ March 31,2004
Technical Training	Villa Joselito Evangelista	Gifu University	Experimental analyses of diversity of environmental microorganisms	April 1, 2003～ March 31,2004
Technical Training	Lydia Faize	France, Grand Saloir Saint Nicolas	Activation of defense mechanisms in Plants	April 1, 2003～ March 31,2004
Technical Training	Nguyen Hoang Traymy	Tokyo University of Agriculture and Technology	Analytical method of herbicides in polluted water using gas chromatograph	April 9, 2003～ April 23, 2003
Technical Training	Wong Boonsuebsakul	Tokyo University of Agriculture	Experimental analyses of diversity of environmental microorganisms	June 1, 2003～ July 31, 2003
Technical Training	Hong Cai	China, Chinese Academy of Science	Impacts of climate on agricultural production in China	June 23, 2003～ October 31, 2003
Technical Training	Boonpanya Jirapa	Fukushima National College of Technology	Analytical method of heavy metals in agro-environmental water	July 28, 2003～ August 1, 2003
Technical Training	Habib Nasir	IBEX Co,.Ltd	Identification method of allelopathic substance of *Lycoris radiata* bulbs	October 1, 2003 ～February 24, 2004

Overseas Research and Meetings

1. Research trips overseas by NIAES staff (frequencies for each country)



2. Overseas Meetings attended by NIAES Staff

Conference, Workshop and Research Meeting	Venue	Date	Participants
72nd Annual Meeting of American Association of Physical Anthropologists	USA	2003.4.23～4.26	1
2nd International Conference on River Basin Management and 2nd International Conference on Water Resources Management	Spain	2003.4.28～5.2	1
Korea-Japan Joint Conference on Applied Entomology and Zoology, 2003	Korea	2003.5.29～5.31	4
3rd Pan Pacific Conference on Pesticide Science	USA	2003.6.1～6.4	4
4th International Conference on Ecosystems and Sustainable Development	Italy	2003.6.4～6.6	1
7th International Conference on the Biogeochemistry of Trace Elements	Sweden	2003.6.15～6.19	1
IGBP Congress	Canada	2003.6.19～6.24	1
14th International Symposium of Fertilizers	Hungary	2003.6.22～6.25	1
Regional Consultation Capacity Building in Biosafety of GM Crops in Asia	Thailand	2003.7.7～7.9	1
5th International Nematology Symposium	Russia	2003.7.13～7.17	1
Workshop on Global and Regional Land Use/Cover Changes	Russia	2003.7.17～7.20	1

Invitations, Training and Information Events

Conference, Workshop and Research Meeting	Venue	Date	Participants
2003 International Geoscience and Remote Sensing Symposium	France	2003.7.21～7.25	2
XXII Willi Hennig Meeting	USA	2003.7.20～7.25	1
4th International Conference on Mycorrhizae	Canada	2003.8.10～8.15	1
54th International Statistical Institute Session	Germany	2003.8.13～8.20	1
23rd International Symposium on Halogenated Organic & Persistent Organic Pollutants	USA	2003.8.24～8.29	4
2nd International Conference on Mathematical Ecology	Spain	2003.9.5～9.9	1
The Pseudomonas 2003 Meeting	Canada	2003.9.6～9.10	1
2003 Remote Sensing and Photogrammetry Society Meetings	UK	2003.9.10～9.12	1
2nd Workshop on Mineral Dust	France	2003.9.10～9.12	1
IPCC Expert Group Scoping Meeting	Switzerland	2003.9.16～9.18	1
2nd International Symposium on Phosphorus Dynamics in the Soil-Plant Continuum	Australia	2003.9.21～9.26	1
Methyl Bromide Technical Options Committee	Belgium	2003.9.22～9.24	1
SETAC Asia/Pacific -Australasian Society of Ecotoxicology Symposium 2003	New Zealand	2003.9.28～10.1	2
ILEAPS International Open Science Conference	Finland	2003.9.29～10.2	1
IUPAC-KSPS International Workshop on Pesticides 2003	Korea	2003.10.13～10.16	1
Seminar on Becontree of Root Diseases of Fruit Trees with Fungal Viruses	Korea	2003.10.7～10.10	1
International Symposium on Assessing and Management of the Agro-Ecosystem for Clean and Friendly Future Environment	Korea	2003.10.22～10.24	2
2003 ASA-CSSA-SSSA Annual Meetings	USA	2003.11.2～11.6	1
2003 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions	USA	2002.11.3～11.6	1
APEC/ACWG Conference on Agricultural Biotechnology Crops in Centres of Origin	Mexico	2003.11.5～11.8	1
3rd International Conference on Contaminants in the Soil Environment in the Australasia-Pacific Region	China	2003.11.16～11.19	3
6th ESAFS International Conference on Soil Management Technology on Low-productivity and Degraded Soils	Taiwan	2003.11.24～11.29	2
International Conference of Research on Water in Agricultural Production in Asia for the 21st Century	Cambodia	2003.11.25～11.28	1
International Workshop on Flux Observation Research in Asia	China	2003.12.1～12.3	1
12th International Conference of Historical Geographers	New Zealand	2003.12.9～12.13	1
SCOPE-NFRAP Workshop	Uganda	2004.1.12～1.16	1
3rd Workshop on Aeolian Dust Experiment on Climate Impact	Korea	2004.1.28～1.31	1

Conference, Workshop and Research Meeting	Venue	Date	Participants
Workshop on GC-ECD Application for Measuring N_2O Emission from Terrestrial Ecosystem	Thailand	2004.2.16～2.17	1
Workshop on Evaluation and Development of Sustainable Agriculture in China	China	2004.2.17～2.18	1
The OECD Expert Meeting on Farm Management Indicators and the Environment	New Zealand	2004.3.8～3.12	2
International Workshop on Development of Biocontrol Agents of Diseases for Commercial Applications in Food Production Systems	Spain	2004.3.24～3.27	1
227th American Chemical Society National Meeting	USA	2004.3.28～4.1	1
Secretary Committee Meeting of the International Workshop on the Database Development of Invasive Species in Asian Pacific region	Taiwan	2004.3.28～3.30	1

3. Long-term Overseas Research Personnel

	Name	Delegated Institution	Research Subject	Duration
JSPS Overseas Research Fellowship	Seiichiro Yonemura	Germany, Max-Planck Institute for Chemistry	The exchanges of trace gases between biosphere and the atmosphere	March 26, 2002～ September 25, 2003
NIAES Overseas Scholarship	Shigenobu Yoshida	USA, University of Minnesota	Ecological studies on epiphytic microorganisms of plants	June 10, 2003～ May 30, 2004
NIAES Overseas Scholarship	Toshiya Okuro	Germany, Rheinische Friedrich Wilhelms University of Bonn	Modeling vegetation changes in the semi-arid region of the Volta Basin	March 25, 2004～ March 25, 2005

Appendix

Publications

1. Official publications

1) Bulletin of the National Institute for Agro-Environmental Sciences
2) Miscellaneous Publication of the National Institute for Agro-Environmental Sciences
3) NIAES Series
4) NIAES Monographs
5) Major Research Topics Annual

2. Research Papers published by the NIAES staff

Scientific Papers	English	116
	Japanese	41
	Others	4
Proceedings (incl. Abstracts)	English	136
	Japanese	311
Others	English	31
	Japanese	167
	Others	4

3. Research staff activities (English papers)

Department of Research Planning and Coordination

Kajiwara, H., T. Kaneko, **M. Ishizaka,** S. Tajima and H. Kouchi (2003) Protein profile of symbiotic bacteria *Mesorhizobium loti* MAFF303099 in mid-growth phase. Bioscience, Biotechnology, and Biochemistry 67: 2668-2673

Department of Global Resources

Tao, F., **M. Yokozawa, Y. Hayashi** and E. Lin (2003) Changes in agricultural water demands and soil moisture in China over the last half-century and their effects on agricultural production. Agricultural and Forest Meteorology 118: 251-261

Ranatunge, E., B. A. Malmgren, **Y. Hayashi,** T. Mikami, W. Morishima, **M. Yokozawa** and **M. Nishimori** (2003) Changes in the southwest monsoon mean daily rainfall intensity in Sri Lanka: relationship to the El Nino-Southern Oscillation. Paleogeography, Paleoclimatology, Paleoecology 197: 1-14

Okamoto, K., H. Kawashima (2003) Evaluation of change in rice cropping in the marginal zone. Proceedings of SPIE: Remote Sensing for Agriculture, Ecosystems, and Hydrology IV 4879: 391-399

Tao, F., **M. Yokozawa, Y. Hayashi** and E. Lin (2003) Future climate change, the agricultural water cycle, and agricultural production in China. Agriculture, Ecosystems and Environment 95: 203-215

Shirato, Y., T. Hakamata and **I. Taniyama** (2004) Modified Rothamsted carbon model for Andosols and its validation: changing humus decomposition rate constant with pyrophosphate-extractable Al. Soil Scence and Plant Nutrition 50: 149-158

Tao, F., **M. Yokozawa, Y. Hayashi** and E. Lin (2003) Terrestrial water cycle and the impact of climate change. Ambio 32: 295-301

Shirato, Y. and **I. Taniyama** (2003) Testing the suitability of the Rothamsted carbon model for long-term experiments on Japanese non-volcanic upland soils. Soil Scence and Plant Nutrition 49: 921-925

Yokozawa, M. (2003) The mode of competition and spatial pattern formation in plant communities. Morphogenesis and Pattern Formation in Biological Systems: 237-246

Yokozawa, M., S. Goto, Y. Hayashi and Hiroshi Seino (2003) Mesh climate data for evaluating climate change impacts in Japan under gradually increasing atmospheric CO_2 concentration. Journal of Agricultural Meteorology 59: 117-130

Okamoto, K., J. Shindo and H. Kawashima (2003) Sustainable rice cropping and water resources in Asia. Advances in Ecological Sciences : Ecosystems and Sustainable Development IV 19: 1057-1065

Shindo, J., K. Okamoto and H. Kawashima (2003) A model based estimation of nitrogen flow in the food production-supply system and its environmental effects in East Asia. Ecological Modelling 169: 197-212.

Okamoto, K., J. Shindo and H. Kawashima (2003) Estimation of available water resources and potential irrigation land area in Asia. Water Resources Management II: 279-287

Okamoto, K., J. Shindo and H. Kawashima (2003) Estimation of the environmental effects of excess nitrogen caused by intensive agriculture in East Asia based on global nitrogen balance. Advances in Ecological Sciences: Ecosystems and Sustainable Development IV 18: 49-58

Okamoto, K., J. Shindo and H. Kawashima (2003) Land-use, water resources and nitrogen load in major river basins in Asia. River Basin Management II: 423-429

Okamoto, K., T. Sakamoto, J. Shindo, H. Toda and H. Kawashima (2003) Detecting land-cover change using standardized multitemporal Landsat TM data. RSPSoc 2003: Scales and Dynamics in Observing the Environment: 1-8

Ono, K., H. Sasaki, T. Hara, **K. Kobayashi** and K. Ishimaru (2003) Changes in photosynthetic activity and export of carbon by overexpressing a maize sucrose-phosphate synthase gene under elevated CO_2 in transgenic rice. Plant Production Science 6: 281-286

Aoki, N., K. Ono, H. Sasaki, S. P. Seneweera, **H. Sakai, K. Kobayashi** and K. Ishimaru (2003) Effects of elevated CO_2 concentration on photosynthetic carbon metabolism in flag-leaf blades of rice before and after heading. Plant Production Science 6: 52-58

Inubushi, K., W. Cheng, S. Aounuma, M. M. Hoque, **K. Kobayashi, S. Miura,** H. Kim and M. Okada (2003) Effects of free-air CO_2 enrichment (FACE) on CH_4 emission from a rice paddy field. Global Change Biology 9: 1458-1464

Kim, H., M. Lieffering, **K. Kobayashi,** M. Okada, M. W. Mitchell and M. Gumpertz (2003) Effects of free-air CO_2 enrichment and nitrogen supply on the yield of temperate paddy rice crops. Field Crops Research 83: 261-270

Anten, N. P. R., T. Hirose, Y. Onoda, T. Kinugasa, H. Kim, M. Okdada and **K. Kobayashi** (2004) Elevated CO_2 and nitrogen availability have interactive effects on canopy carbon gain in rice. New Phytologist 161: 459-471

Kim, H., M. Lieffering, **K. Kobayashi,** M. Okada, S. Miura (2003) Seasonal changes in the effects of elevated CO_2 on rice at three levels of nitrogen supply: a free air CO_2 enrichment (FACE) experiment. Global Change Biology 9: 826-837

Harazono, Y., M. Mano, **A. Miyata,** R. C. Zulueta and W. C. Oechel (2003) Inter-annual carbon dioxide uptake of a wet-sedge tundra ecosystem in the Arctic. Tellus 55B: 215-231

Akiyama, H. and H. Tsuruta (2003) Global Biogeochemical Cycles 17: 1100, doi: 10.1029/2002Gb002016

Li, Z., **K. Yagi, H. Sakai and K. Kobayashi** (2004) Influence of elevated CO_2 and nitrogen nutrition on rice plant growth, soil microbial biomass, dissolved organic carbon and dissolved CH4. Plant and Soil 258: 81-90

Prasad, V. K., K. V. S. Badarinath, P. K. Gupta, C. Sharma, A. P. Mitra, **S. Sudo, S. Yonemura** and H. Tsuruta (2003) Methyl halide emissions from biomass burning of tropical secondary mixed deciduous forests of Eastern Ghats of India. Asian J. Energy Environ 2: 273-303

Akiyama, H. and H. Tsuruta (2003) N_2O, NO, and NO_2 fluxes from soils after the application of manures

and urea. Journal of Environmental Quality 32: 423-431

Nishimura, S. and K. Itoh (2003) Spatial heterogeneity and diurnal course of photon flux density on paddy-field water surface under rice plant canopy. Weed Biology and Management 3: 105-110

Inoue, S. and K. Yokoyama (2003) Estimates of snowfall depth, maximum snow depth, and snow pack conditions in Japan by using five global warming predicted data. J. of Agricultural Meteorology 59: 227-236

Prasad, V. K., K. V. S. Badarinath, H. Tsuruta, **S. Sudo, S. Yonemura,** J. Cardina, B. Stinner, R. Moore, D. Stinner and C. Hoy (2003) Implications of Land Use Changes on Carbon Dynamics and Sequestration—Evaluation from Forestry Datasets, India. The Environmentalist 23: 175-187

Du, M., S. Yonemura, T. Maki, Z. Shen and W. Wang (2003) Observational study on the relationships between ground surface condition and dust outbreak in Dunhuang, China. Arid Land Geography 26: 25-31

Gu, S., Y. Tang, **M. Du**, T. Kato, Y. Li, X. Cui and X. Zhao (2003) Short-term variation of CO_2 flux in relation to environmental controls in an alpine meadow on the Qinghai-Tibetan Plateau. Journal of Geophysical Research 108: 4670-4678

Tang, X., H. Yang, **M. Du**, Q. Zhao and R. Li (2003) Soil Redistribution Investigations by Combined Use of Soil ^{137}Cs and Selected Chemical Properties. Soil Science and Plant Nutrition 49: 557-566

Wang, G., G. Cheng, **M. Du** and P. Shen (2003) The impacts of human activities on the hydrological processes in the arid zones of Northwest China in recent 50 years. IAHS Publications 280: 93-103

Inoue, Y (2003) Remote sensing and GIS for spatial assessment of agro-ecosystem dynamics. Proc. International Symposium "Assessment and Rational Management of the Agro-Ecosystems for Clean and Friendly Future Environment": 111-119

Li, F., H. Zhang, L. Zhao, **Y. Shirato,** and X. Wang (2003) Pedoecological effects of a sand-fixing poplar (*Populus simonii* Carr.) forest in a desertified sandy land of Inner Mongolia, China. Plant and Soil 256: 431-442

Li, F., H. Zhang, **Y. Shirato,** and T. Zhang (2003) Variations of sand transportation rates in sandy grasslands along a desertification gradient in northern China. Catena 53: 255-272

Nagler, P. L., **Y. Inoue,** E.P. Glenn, A. L. Russ and C. S.T. Daughtry (2003) Cellulose absorption index (CAI) to quantify mixed soil-plant litter scenes. Remote Sensing of Environment 87: 310-325

Shibayama, M. (2003) Prediction of the ratio of legumes in a mixed seeding pasture by polarized reflected light. Grassland Science 49: 229-237

Qi, J., C. Wang, **Y. Inoue** and R. Zang (2003) Synergy of optical and radar remote sensing in agricultural applications. Proc. SPIE International Symposium on Optical Science and Technology 5153: 153-163

Department of Biological Safety

Mochizuki, M. (2003) Effectiveness and pesticide susceptibility of the pyrethroid-resistant predatory mite *Amblyseius womersleyi* in the integrated pest management of tea pests. BioControl 48: 207-221

Yamamura, K., M. Kishita, N. Arakaki, F. Kawamura and Y. Sadoyama (2003) Estimation of dispersal distance by mark-recapture experiments using traps: correlation of bias caused by the artificial removal by traps. Population Ecology 45: 149-155

Kishita, M., N. Arakaki, F. Kawamura, Y. Sadoyama and **K. Yamamura** (2003) Estimation of population density and dispersal parameters of the adult sugarcane wireworm, *Melanotus okinawensis* Ohira (Coleoptera: Elateridae), on Ikei Island, Okinawa, by mark-recapture experiments. Applied Entomology and Zoology 38: 233-240

Shinoyama, H., **A. Mochizuki,** M. Komada, Y. Nomura and T. Nagai (2003) Insect resistance in transgenic Chrysanthemum [*Dendranthema xgrandiflorum* (Ramat.) Kitamura] by the introduction of a modified d-endotoxin gene of *Bacillus thuringiensis*. Breeding Science 53: 359-367

Yamamura, K. (2003) Population estimation by a one-release, two-capture experiment. Applied

Entomology and Zoology 38: 475-486

Nomura, K., H. Osaki, T. Itanami, **N. Matsumoto** and Y. Ohtsu (2003) Clonning and characterization of a totivirus double-stranded RNA from the plant pathogenic fungus, *Helicobasidium mompa* Tanaka. Virus Genes 26: 219-226

Ikeda, K., H. Nakamura and **N. Matsumoto** (2003) Hypovirulent strain of the vilet root rot fungus *Helicobasidium mompa*. Jounal of General Plant Pathology 69: 385-390

Wei, C. Z., H. Osaki, T. Iwanami, **N. Matsumoto** and Y. Ohtsu (2003) Molecular characterization of dsRNA segments 2 and 5 and electron microscopy of a novel reovirus from a hypovirulent isolate W370, of the plant pathogen *Rosellinia necatrix*. Jounal of General Virology 84: 2431-2437

Ikeda, K., H. Nakamura and **N. Matsumoto** (2003) Mycelial incompatibility operative in pairings between single basidiospore isolates of *Helicobasidium mompa*. Mycological Research 107: 847-853

Suzaki, K., A. Sasaki, S. Kanematsu, **N. Matsumoto** and K. Yoshida (2003) Transmissibility of viral double-stranded RNA between strains of the violet root rot fungus *Helicobasidium mompa* and the potential for viral dsRNA infection to this fungus using monokaryotic strains. Mycological Research 44: 139-147

Sawada, H., D. Kuykendal and J. Young (2003) Changing concepts in the systematics of bacterial nitrogen-fixing legume symbionts. Journal of General and Applied Microbiology 49: 155-179

Young, J., D. Kuykendall, E. M. Romero, A. Kerr and **H. Sawada** (2003) Classification and nomenclature of *Agrobacterium* and *Rhizobium*: a reply to Farrand et al. (2003). International Journal of Systematic and Evolutionary Microbiology 53: 1689-1695

Tsuchiya, K. and C. C. M. d' Ursel (2004) Development of a sensitive ELISA using three monoclonal antibodies against lipopolysaccharides (LPS) to detect *Xanthomonas campestris* pv. *Vesicatoria*. Journal of General Plant Pathology 70: 21-26

Villa, J. E., **K. Tsuchiya,** M. Horita, M. P. Natural, N. L. Opina and M. Hyakumachi (2003) DNA analysis of *Ralstonia solanacearum* and related bacteria based on 282bp PCR-amplified fragment. Plant Disease 87: 1337-1343

Seo, S., N. Furuya, C. K. Lim, Y. Takanami and **K. Tsuchiya** (2003) Phenotypic and genetic characterization of *Erwinia carotovora* from mulberry (*Morus* spp.). Plant Pathology 52: 140-146

Tsuchiya, K., C. C. M. d' Ursel and Y. Nozu (2004) Production and preliminary characterization of monoclonal antibodies raised against *Xanthomonas campestris* pv. *Mangiferaeindicae*. Journal of General Plant Pathology 70: 27-33

Tsuchiya, K., C. C. M. d' Ursel, M. Horita and Y. Nozu (2003) Relation of Japanese *Xanthomonas campestris* pv. *vesicatoria* with worldwide strains revealed with three specific monoclonal antibodies. Journal of General Plant Pathology 69: 310-315

Takahashi, M., C. Goto, K. Ishikawa, I. Matsuda, S. Toriyama and **K. Tsuchiya** (2003) Rice stripe virus 23.9K protein aggregates and forms inclusion bodies in cultured insect cells and virus-infected plant cells. Archives of Virology 148: 2167-2179

Boonsuebsakul, W., **K. Tsuchiya,** N.Matsuyama, N. Thaveechai, M. Horita and K. Suyama (2003) Using of biovar type system and host specific pathogenicity to grouping of the bacterial caused bacterial wilt diseases of economic crops in Thailand. Thai Journal of Agricultural Science 36: 173-184

Otuka, A., **T. Yamanaka** (2003) An application for insect field surveys using a handheld computer. Agricultural Information Research 12: 113-124

Nakahata, T., N. Itagaki, T. Arai, **H. Sugie** and S. Kuwahara (2003) Synthesis of the sex pheromone of the citrus mealybug, *Pseudococcus cryptus.* Bioscience, Biotechnology, and Biochemistry 67: 2627-2631

Arai, T., **H. Sugie**, **S. Hiradate**, T. Morimoto and K. Ohtani (2003) Identification of a sex pheromone component of *Psueudococcus cryptus*. Journal of Chemical Ecology 29: 2213-2223

Sunohara, Y. and **H. Ikeda** (2003) Effect of exogenous ethylene on leaf morphology in broadleaf plantain. Grassland Science 49: 174-176

Appendix

Sunohara, Y. and **H. Ikeda** (2003) Effects of trampling and ethephon on leaf morphology in trampling-tolerant *Plantago asiatica* and *Eleusine indica*. Weed Research 43: 155-162

Iqbal, Z., **S. Hiradate,** A. Noda and **Y. Fujii** (2003) Allelopathic activity of buckwheat: isolation and characterization of phenolics. Weed Science 51: 657-662

Parvez, S. S., M. M. Parvez, **Y. Fujii,** and H. Gemma (2003) Allelopathic competence of *Tamarindus indica* L. root involved in plant growth regulation. Plant Growth Regulation 40: 139-148

Iqbal, Z., A. Furubayashi and **Y. Fujii** (2004) Allelopathic efect of leaf debris, leaf aqueous extract and rhizosphere soil of *Ophiopogon japonics* Ker-Gawler on the growth of plants. Weed Biology and Management 4: 43-48

Fujii, Y. (2003) Allelopathy in the natural and agricultural ecosystems and isolation of potent allelochemicals from Velvet bean (*Mucuna pruriens*) and Hairy Vetch (*Vicia villosa*). Biological Science in Space 17: 6-13

Parvez, S. S., M. M. Parvez, **Y. Fujii,** and H. Gemma (2003) Analysis of chemical components and oxygen radical absorbance capacity of *Tamarindus indica L.* Japanese Journal of Tropical Agriculture 47: 243-249

Fujii, Y., T. Shibuya, **K. Nakatani,** T. Itani, **S. Hiradate,** and M. M. Parvez (2004) Assessment method for allelopathic effect from leaf litter leachates. Weed Biology and Management 4: 19-23

Hiradate, S., T. Nakadai, H. Shindo and T. Yoneyama (2004) Carbon source of humic substances in some Japanese volcanic ash soils determined by carbon stable isotopic ratio, $\delta^{13}C$. Geoderma 119: 133-141

Nishihara, E., M. M. Parvez, **H. Araya** and **Y. Fujii** (2004) Germination growh response of different plant species to the allelochemical L-3,4-dihydroxyphenylalanine (L-DOPA). Plant Growth Regulation 42: 181-189

Nakano, H., E. Nakajima, **Y. Fujii, S. Hiradate,** K. Yamada, H. Shigemori and K. Hasegawa (2004) Growth inhibitory alkaloids from mesquite (*Prosopis juliflora* (Sw.) DC.) leaves. Phytochemistry 65: 587-591

Araya, H., M. Kobayashi, M. Ebina, H. Nakagawa, E. Nishihara and Y. Fujimoto (2003) Identification of two 5a,8a-epidioxyergostan-3b-ols from the endophyte, *Neotyphodium lolii*. Biochemical Systematics and Ecology 31: 1337-1339

Nakano, H., E. Nakajima, **Y. Fujii,** K. Yamada, H. Shigemori and K. Hasegawa (2003) Leaching of the allelopathic substance, L-tryptophan from the foliage of mesquite (Prosopis juliflora (Sw.) DC.) plants by water spraying. Plant Growth Regulation 40: 49-52

Tomita-Yokotani, K., **Y. Fujii,** H Hashimoto and M. Yamashita (2003) Reduced allelopathic inhibition of lettuce (*Lactuca sativa*) growth caused by velvet bean (*Mucuna pruriens*) under 3D-clinorotation. Biological Science in Space 17: 14-17

Fujii, Y., S. S. Parvez, M. M. Parvez, Y. Ohmae and O. Iida (2003) Screening of 239 medicinal plant species for allelopathic activity using the sandwich method. Weed Biology and Management 3: 233-241

Araya, H. (2004) Studies on annonaceous tetrahydrofuranic acetogenins from *Annona squamosa* L. seeds. Bull. Natl. Inst. Agro-Environ. Sci 23: 77-149

Parvez, S. S., M. M. Parvez, E.Nishihara, H. Gemma and **Y. Fujii** (2003) *Tamarindus indica* L. leaf is a source of allelopathic substance. Plant Growth Regulation 40: 107-115

Hiradate, S. and N. U. Yamaguchi (2003) Chemical species of Al reacting with soil humic acids. Journal of Inorganic Biochemistry 97: 26-32

Yamaguchi, N. U., S. Hiradate, M. Mizoguchi and T. Miyazaki (2003) Formation and disappearance of Al tridecamer in the presence of low molecular weight organic ligands. Soil Science and Plant Nutrition 49: 551-556

Ahmad, W., **M. Araki** and H. Okada (2003) Description of *Nygolaimoides andrassyi* sp. n. (Nematoda: Dorylaimida) from northern Japan. Nematode Morphology and Systematics 6: 37-42

Ahmad, W. and **M. Araki** (2003) Four new and two

known species of the family Qudsianematidae (Nematoda: Dorylaimida) from Japan. Japanese Journal of Nematology 33: 23-40

Yoshida, M. (2003) Intraspecific variation in RFLP patterns and morphological studies on *Steinernema feltiae* and *S. kraussei* (Rhabditida: Steinernematidae) from Hokkaido, Japan. Nematology 5: 735-746

Ahmad, W. and **M. Araki** (2003) New and known species of the family Dorylaimidae (Nematoda: Dorylaimida) from Japan. International Journal of Nematology 13: 37-56

Ahmad, W. and **M. Araki** (2003) New and known species of the family Tylencholaimidae (Nematoda: Dorylaimida) from Japan. Nematode Morphology and Systematics 6: 1-26

Ahmad, W., **M. Araki** and S. Kaneda (2003) Two new species of the genus *Paravulvus* Heyns, 1968 (Nematoda: Nygolaimidae) from Japan. International Journal of Nematology 13: 57-64

Department of Environmental Chemistry

Guruge, K. S., **N. Seike,** N. Yamanaka and S. Miyazaki (2003) Contamination status of animal feeds by PCDDS, PCDFS and dioxin-like PCBS. Organohalogen Compounds 64: 435-438

Seike, N., M. Matsui, Y. Kashima and **T. Otani** (2003) Temporal change of dioxin-like activity in paddy soil extracts fractionated by gel permeation chromatograpy. Organohalogen Compounds 60: 94-97

Seike, N., H. Eun and **T. Otani** (2003) Temporal change of persistent organochlorines concentrations and compositions in paddy soil. Organohalogen Compounds 62: 432-435

Uegaki, R., T. Otani and **N. Seike** (2003) The fate of PCDD/Fs co-PCBs in silage corn leaf: Relationship between biomass and concentration. Organohalogen Compounds 61: 393-396

Arao, T., N. Ae, M. Sugiyama and M. Takahashi (2003) Genetic differences in cadmium uptake and distribution in soybeans. Plant and Soil 251: 247-253

Arao, T. and **N. Ae** (2003) Genetic variations in cadmium levels of rice grain. Soil Science and Plant Nutrition 49: 473-479

Katou, K. (2004) Determining competitive nitrate and chloride adsorption in an Andisol by the unsaturated transient flow method. Soil Science and Plant Nutrition 50: 119-127

Okamoto, M., K. Okada, T. Watanabe and **N. Ae** (2003) Growth responses of cereal crops to organic nitrogen in the field. Soil Science and Plant Nutrition 49: 445-452

Hayashi, K., M. Okazaki, N. Itsubo, and A. Inaba (2004) Development of Damage Function of Acidification for Terrestrial Ecosystems Based on the Aluminum Toxicity on Net Primary Production. International Journal of Life Cycle Assessment 9: 13-22

Hayashi, K. and M. Okazaki (2003) Effect of Volcanic Fumes from Mt. Oyama, Miyakejima Island, on Atmospheric Deposition, Soil Solution, and Soil Properties in Kumagaya, Central Japan II. Soil Properties. Soil Science and Plant Nutrition 49: 503-511

Muraoka, S., R. Okumura, **N. Ogawa,** T. Nonaka, K. Miyashita and T. Senda (2003) Crystal structure of a full-length LysR-type transcriptional regulator, CbnR: unusual combination of two subunit forms and molecular bases for causing and changing DNA bend. Journal of Molecular Biology 328: 555-566

Ogawa, N., K. Miyashita and A. M. Chakrabarty (2003) Microbial genes and enzymes in the degradation of chlorinated compounds. The Chemical Record 3: 158-171

Muraoka, S., R. Okumura, Y. Uragami, T. Nonaka, **N. Ogawa,** K. Miyashita and T. Senda (2003) Purification and crystallization of a LysR-type transcriptional regulator CbnR from Ralstonia eutropha NH9. Protein & Peptide Letters 10: 325-329

Kobara, Y., S. Endo, T. Horio, S. Ishihara and **K. Ohtsu** (2003) Photolysis of Polychlorinated Dibenzo-p-dioxins and Enhanced Detoxication by Titanium Dioxide Photocatalyst on the Soils Surface. Organohalogen Compounds 63: 369-372

Someya, N., S. Numata, M. Nakajima, **A. Hasebe,** T. Hibi and K. Akutsu (2003) Biological control of rice blast by the epiphytic bacterium *Erwinia ananas*

transformed with a chitinolytic enzyme gene from an antagonistic bacterium, *Serratia marcescens* strain B2. J. Gen. Plant Pathol. 69: 276-282

Numata, S., S. Ui, M. Tomiyama, **A. Hasebe,** M. Nakajima and K. Akutsu (2004) Cloning of various promoters for foreign gene expression in *Erwinia ananas*. J. Gen. Plant Pathol. 70: 69-73

Saito, A., **T. Fujii** and K. Miyashita (2003) Distribution and evolution of chitinase genes in Streptomyces species: involvement of gene-duplication and domain-deletion. Antonie van Leeuwenhoek Journal of Microbiology 84: 7-15

Kawase, T., A. Saito, T. Sato, R. Kanai, **T. Fujii,** N. Nikaidou, K. Miyashita and T. Watanabe (2004) Distribution and phylogenetic analysis of family 19 chitinases in *Actinobacteria*. Applied and Environmental Microbiology 70: 1135-1144

Shiraishi, S., I. Watanabe, K. Kuno, **H. Ishii** and **Y. Fujii** (2003) Soil drenching with water extracts of *Oxalis articulata* savigny suppress Fusarium wilt of tomato. Weed Biology and Management 3: 184-188

Natural Resources Inventory Center

Yoshimatsu, S. and K. Takeuchi (2004) Description of *Helicoverpa sugii* sp. nov. (Lepidoptera, Noctuidae, Heliothinae) from the Ogasawara (Bonin) Islands, Japan, with brief biological notes. Transactions of the Lepidopterological Society of Japan 55: 34-38

Murakami, H., **S. Tsushima,** T. Akimoto, T. Kanno and Y. Shishido (2003) Effects of cultivation of preceding plants on the development of Fusarium wilt of cucumber and daikon. Soil Science Plant Nutrition 49: 703-710

Chung**,** W. H., **T. Tsukiboshi** and M. Kakishima (2004) Phylogenetic analyses of *Uromyces viciae-fabae* and its variaions on Vicia, Lathyrus and Pisum in Japan. Mycoscience 45: 1-8

Yoshida, S., S. Tsuyumu and **T. Tsukiboshi** (2003) Macerating enzymes produced by *Rhizopus oryzae* in infected mulberry roots. Journal of Phytopathology 151: 436-441

Chemical Analysis Research Center

Eun, H., E. Watanabe, K. Baba, S. Hiradate, and **M. Ueji** (2003) Characterization and clean-up of interfering species for dioxin-like PCBs analysis in vegetables. Organohalogen Compounds 60: 25-28

Ikenaka, Y., **H. Eun, E. Watanabe** and Y. Miyabara (2003) Congener profiles of PCDDs, PCDFs, and coplanar-PCBs in sediment from Lake Suwa in Japan. Organohalogen Compounds 62: 69-72

Watanabe, E., H. Eun, K. Baba, M. Ishizaka and **M. Ueji** (2003) Distribution and source of PCDD/Fs and Co-PCBs in the Tone River area, Japan. Organohalogen Compounds 62: 112-115

Miyake, S., **Y. Ishii,** Y. Yamaguchi, K. Ohde, M. Motoki, M. Kawata, S. Ito, Y. Yuasa and H. Ohkawa (2003) Simple determination of herbicides in rice Paddy water by Immunoassay. Environmental Fate and Effects of Pesticides 853: 124-138

Eun, H., N. Seike, E. Watanabe, K. Baba and **M. Ueji** (2003) Temporal variation of dioxin compounds in Japanese upland. Organohalogen Compounds 61: 365-368

Baba, K., E. Watanabe, H. Eun, M. Ishizaka (2003) Direct determination of cadmium in rice flour by laser ablation-ICP-MS. Journal of Analytical Atomic Chemistry 18: 1485-1488

4. Patents

1) Method for designing a three-dimensional free-form surface and apparatus for executing the same.
Patent number: 6590575 (USA)
Date of application: 24. 03. 1993
Date of registration: 08. 07. 2003
Inventors: Kunio Takezawa

5. Collaborative Research

No.	Research Subject	Collaborating Organization	NIAES Partner	Duration
1	Development of organic fertilizer with high function.	Nissin Seifun Group Inc.	Soil Biochemistry Unit	2001.4.1〜2004.3.31
2	Observational Studies on effects of atmospheric aerosols and clouds on buget of radiation and water in Asian region.	Japan Science and Technology Agency	Greenhouse Gas Emission Team	2000.4.3〜2004.10.31
3	Analysis of crystal structure of LysR-type transcriptional regulator.	National Institute of Advanced Industrial Science and Technology	Applied Soil Microbiology Unit	2002.4.1〜2005.3.31
4	Agricultural monitoring systems by satellite remote sensing data	The Japan Aerospace Exploration Agency	Ecosystems Group	2001.10.9〜2004.3.31
5	Technology for phytoremediation of cadmium-contaminated field by some rice cultivars with high cadmium-absorption ability.	Plantech Research Institute	Soil Biochemistry Unit	2002.4.1〜2005.3.31
6	Development of bioremediation techniques for removal of pesticides from agricultural drained water using industrial wastes.	Kowa Co.,Ltd.	Applied Soil Microbiology Unit	2002.4.1〜2005.3.31
7	Agro-environmental observations using spectropolarimeters	Japan Aerospace Exploration Agency	Head of Ecosystems Group, Agro-Ecological Sensing Unit	2002.4.1〜2005.3.31
8	Environmental safety evaluation of potato line transformed with the sucrose-phosphate synthase (SPS) gene of maize in the isolated field.	National Institute of Agrobiological Sciences	Plant Ecology Group, Microbiology Group	2003.4.1〜2004.3.31
9	Development of micro analysis methods for organic pollutants in agro-environment.	Horiba Biotechnology Co., Ltd.	Environmental Chemicals Analysis Laboratory	2003.6.1〜2006.3.31
10	Development of the cleanup technology for heavy metal contaminated soils by the extraction with chemicals.	Taiheiyo Cement Corporation	Soil Chemistry Unit	2003.5.1〜2005.3.31
11	Development of analytical method of gene expression of soil bacteria by selective PCR.	Aisin Cosmos R&D Co. Ltd.	Applied Soil Microbiology Unit	2003.9.1〜2005.3.31
12	Assessment of environmental safety in transgenic rice lines (HW1 and HW5) over-expressing modified rice anthranilate synthase alpha subunit gene.	National Agriculture and Bio-oriented Research Organization (National Institute of Crop Science)	Chemical Ecology Unit, Vegetation Ecology Unit, Microbial Ecology Unit	2003.2.20〜2004.3.31
13	Environmental safety assessment of corn lines (E4497.45.2.24, E4497.45.2.16, E4497.59.1.21) transformed with coleopteran resistant (cry34Ab1/cry35Ab1) and glufosinate tolerant (pat) genes.	Du Pont Kabushiki Kaisha, Society for Techno-innovation of Agriculture, Forestry and Fisheries	Head of Plant Ecology Group, Head of Entomology Group, Microbiology Group, Organochemicals Group	2003.6.1〜2004.3.31

Appendix

No.	Research Subject	Collaborating Organization	NIAES Partner	Duration
14	Environmental safety assessment of corn line (E4497.71.1.33) transformed with coleopteran resistant (cry34Ab1/cry35Ab1) and glufosinate tolerant (pat) genes.	Du Pont Kabushiki Kaisha, Society for Techno-innovation of Agriculture, Forestry and Fisheries	Head of Plant Ecology Group, Head of Entomology Group, Microbiology Group, Organochemicals Group	2003.6.1〜 2004.3.31
15	Development of screening method for effective strains to degrade dieldrin.	Tokyo Metropolitan Agricultural Experiment Station	Applied Soil Microbiology Unit	2003.11.1 〜 2006.3.31
16	Development of a new method to apply plant-associated microorganisms as a creature material.	Tokyo University of Agriculture, Nippon Soda co., Ltd.	Microbial Systematics Laboratory	2004.3.5〜 2006.3.31
17	Development of methods for SNP (single nucleotide polymorphism) analysis of fungicide resistance genes.	Hitachi Software Engineering Co.,Ltd.	Pesticide Mitigation Unit	2004.3.4〜 2006.3.31

Advisory Council and Staff List

1. NIAES Advisory Council (2003)

Kazuyoshi Fujita	President of "Daichi-o-Mamoru-Kai"
Yohichi Gohshi	Director General, National Institute for Environmental Studies
Makoto Kimura	Professor, Faculty of Agriculture, Nagoya University
Eitaro Miwa	Director General, National Agricultural Research Organization
Toru Nagata	former Professor, School of Agriculture, Ibaraki University
Masami Nakamura	Editor, Nihon Keizai Shimbun, Inc.
Yoshio Ogawa	Director General, Ibaraki Agricultural Center Horticultural Research Institute
Masamichi Saigou	Head of Environmental Policy Coordination Office, Policy Planning and Evaluation Division, Minister's Secretariat, MAFF
Kiyoshi Tanaka	Director General, Forestry and Forest Products Research Institute
Hisashi Yamada	Director General, National Research Institute of Fisheries and Environment of Inland Sea, Fisheries Research Agency

2. STAFF (April 1, 2004)

Administration

Katsuyuki Minami, *Director General*
Tsuyoshi Mitamura, *Exective Director*
Susumu Sugihara, *Auditor*
Hiroshi Takahashi, *Auditor*

Department of Research Planning and Coordination

Masako Ueji, *Director*

Division of Research Planning
Ichiro Taniyama, *Head*
Keiya Inao, *Senior Researcher*
Masumi Ishizaka, *Senior Researcher*
Jyun Tabata, *Researcher*
Takahiro Satoh, *Assistant Head*
Nobuyuki Sudou, *Coordinating Chief*
Akiko Shibata, *Coordinating*
Kazunori Ino, *Planning Chief*
Keiko Kato, *Planning*
Shunsuke Fujimaki,

Division of Research Coordination
Tsunehisa Inoue, *Head*
Ryosuke Kimura, *Senior Researcher*

Division of Research Information Systems
Toshihiro Kadosawa, *Head*

Division of Documentation and Information
Shinichi Nagaoka, *Head*
Kouichi Iizuka, *Assistant Head*
Yumi Nakaiwa, *Documentation Chief*
Mihoko Ohshita, *Documentation*
Sachiko Niizeki, *Information Chief*

Division of Experimental Farm Management
Hitoshi Tsutsui, *Head*
Fumio Suzuki, *Chief*
Hayao Matagawa
Hiroshi Kamimura
Yoshiyuki Iizumi
Koukichi Matsumoto
Tadao Suzuki
Katsuo Abe
Hironori Wakabayashi
Hiroshi Yamaguchi
Toshiyuki Okada
Terushi Kamada
Koji Watanabe
Takahiro Ara

Administration Department

Hiroyuki Hataya, *Director*

General Affairs Section
Noriyuki Hashizume, *Head*
Hideo Azechi, Assistant *Head*
Hiroyuki Ohkubo, *General Affairs Chief*
Mayumi Satoh, *General Affairs*
Kiyoaki Sakurai, *General Affa*irs
Maki Kouda, *Document*
Atsuko Tujishima, *Social Affairs Chief*
Izumi Maekawa, *Social Affairs*
Osamu Tanaka, *Assistant Head*
Masaki Shiraishi, *Personnel Chief*

Tsuyoshi Kido, *Personnel*
Asako Onodera, *Personnel*
Masayuki Matsumoto, *Employee Chief*

Accounts Section
Hiroaki Shimada, *Head*
Katsuhiko Nomiya, *Assistant Head*
Hideya Oyama, *Budgeting Chief*
Harumi Sawasato, *Budgeting*
Yuri Miyamoto, *Expenditure Chief*
Chizuko Nishimura, *Expenditure*
Michiyo Noguchi, *Judge Chief*
Yoshiharu Nagai, *Assistant Head*
Kiyoyuki Sunaoka, *Acceptance Chief*
Atsuko Maeda, *Acceptance*
Masaki Kikuchi, *Contract Chief*
Sunao Hatanaka, *Contract*
Tomohiro Takahashi, *Contract*
Norio Nagayama, *Facilities Chief*
Tadahisa Akiyama, *Facilities*

Department of Global Resources

Yousay Hayashi, *Director*

Agro-Meteorology Group
Isamu Nouchi, *Head*

Climate Resources Unit
Masayuki Yokozawa, *Chief*
Tsuneo Kuwagata, *Senior Researcher*
Yasushi Ishigooka, *Researcher*
Shinkichi Goto, *Researcher*

Atmospheric Impacts Unit
Toshihiro Hasegawa, *Chief*
Mayumi Yoshimoto, *Senior Researcher*
Hidemitsu Sakai, *Researcher*

Air Quality Conservation Unit
Shigeto Kawashima, *Chief*
Mingyuan Du, *Senior Researcher*
Seiichiro Yonemura, *Senior Researcher*
Satoshi Inoue, *Senior Researcher*

Ecosystems Group
Toshiaki Imagawa, *Head*

Agro-Ecological Sensing Unit
Yoshio Inoue, *Chief*
Michio Shibayama, *Senior Researcher*

Statistics Unit
Tetsuhisa Miwa, *Chief*
Nobuhiro Minaka, *Senior Researcher*

Material Ecocycling Unit
Kenjiro Oda, *Chief*
Junko Shindo, *Senior Researcher*
Tamon Fumoto, *Senior Researcher*
Noriko Oura, *Senior Researcher*

Ecological Management Unit
David S. Sprague, *Chief*
Nobusuke Iwasaki, *Researcher*

Remote Sensing Unit
Hiroyuki Ohno, *Chief*
Toshihiro Sakamoto, *Researcher*

Greenhouse Gas Emission Team
Kazuyuki Yagi, *Chief*
Shigeto Sudo, Senior *Researcher*
Seiichi Nishimura, Senior *Researcher*
Hiroko Akiyama, *Researcher*

Food Production Prediction Team
Hitoshi Toritani, *Chief*
Katsuo Okamoto, Senior *Researcher*
Motoki Nishimori, Senior *Researcher*
Yasuhito Shirato, Senior *Researcher*

Ecosystem Gas Exchange Team
Akira Miyata, *Chief*
Masayoshi Mano, *Researcher*

Department of Biological Safety

Mitsunori Oka, *Director*

Plant Ecology Group
Yasuo Ogawa, *Head*

Vegetation Ecology Unit
Hiroaki Ikeda, *Chief*
Naokuni Harada, *Senior Researcher*
Akihiro Konuma, *Senior Researcher*

Landscape Ecology Unit
Makoto Ide, *Chief*
Toshiya Ohkuro, *Senior Researcher*
Yoshinobu Kusumoto, *Researcher*

Chemical Ecology Unit
Yoshiharu Fujii, *Chief*
Syuntaro Hiradate, *Senior Researcher*
Hiroshi Araya, *Researcher*

Entomology Group
Masaharu Matui, *Head*

Introduced Insect Assessment Unit
Atsushi Mochizuki, *Chief*
Masatoshi Mochizuki, *Senior Researcher*
Kaori Yara, Senior *Researcher*

Population Ecology Unit
Koichi Tanaka, *Chief*
Kohji Yamamura, *Senior Researcher*
Takehiko Yamanaka, *Researcher*

Insect Semiochemicals Unit
Hajime Sugie, *Chief*

Microbiology Group
Toshiki Shiomi, *Head*
Koushi Nishiyama, *Microbiology Research Coordinator*

Microbial Ecology Unit
Naoyuki Matsumoto, *Chief*
Ikuko Okabe, *Senior Researcher*
Yuko Hoshino [Takada], *Researcher*
Microbial Genetics and Physiology Unit
Kenichi Tsuchiya, *Chief*
Hiroyuki Sawada, *Senior Researcher*
Mami Takahashi, *Senior Researcher*
Takanobu Yoshida, *Senior Researcher*
Nematology and Soil Zoology Unit
Masaaki Araki, *Chief*
Hiroaki Okada, *Senior Researcher*
GMO Assessment Team
Kazuhito Matsuo, *Chief*
Yoichi Shirai, *Senior Researcher*
Hiroyuki Shibaike, *Senior Researcher*
Yasuyuki Yoshimura, *Senior Researcher*
Hiroyuki Sawada, *Senior Researcher* (concurrent)
Yoriko Sakai, *Researcher* (concurrent)

Department of Environmental Chemistry

Masanori Saito, *Director*
Organochemicals Group
Akira Hasebe, *Head*
Environmental Pesticide Assessment Unit
Akira Hasebe, *Chief* (concurrent)
Takeshi Horio, *Senior Researcher*
Yuso Kobara, *Senior Researcher*
Kazuhisa Ohtsu, *Senior Researcher*
Satoru Ishihara, *Researcher*
Pesticide Mitigation Unit
Hideo Ishii, *Chief*
Ken Suzuki, *Senior Researcher*
Applied Soil Microbiology Unit
Takeshi Fujii, *Chief*
Kazuhiro Takagi, *Senior Researcher*
Naoto Ogawa, *Senior Researcher*
Yoriko Sakai, *Researcher*
Sho Morimoto, *Researcher*
Heavy Metal Group
Shinichi Ono, *Head*
Heavy Metal Behavior Unit
Hisao Oda, *Chief*
Akira Kawasaki, *Senior Researcher*
Soil Chemistry Unit
Shinichi Ono, *Chief* (concurrent)
Yasuhiro Sakurai, *Senior Researcher*
Tomoyuki Makino, *Senior Researcher*
Yuji Maejima, *Researcher*
Soil Biochemistry Unit
Shinichi Ono, *Chief* (concurrent)
Megumi Sugiyama, *Senior Researcher*
Takayuki Saito, *Researcher*
Masaharu Murakami, *Researcher*
Satoru Ishikawa, *Researcher*
Water Quality and Solute Dynamics Group
Kazuo Sugahara, *Head*
Soil Physics Unit
Hidetaka Katou, *Chief*
Sadao Eguchi, *Senior Researcher*
Keiko Nakano, *Researcher*
Katsuhiro Suzuki, *Researcher*
Nutrient Dynamics Unit
Michio Komada, *Chief*
Shinichirou Mishima, *Senior Researcher*
Contaminant Hydrology Unit
Kenji Banzai, *Chief*
Kenichi Kanda, *Senior Researcher*
Yasuhiro Nakajima, *Researcher*
Water Quality Conservation Unit
Makoto Takeuchi, *Chief*
Sunao Itahashi, *Senior Researcher*
Kentaro Hayashi, *Senior Researcher*
Dioxin Dynamics Team
Takashi Otani, *Chief*
Ryuichi Uegaki, *Senior Researcher*
Nobuyasu Seike, *Researcher*
Tomoyuki Makino, *Senior Researcher* (concurrent)

Natural Resources Inventory Center

Masashi Uwasawa, *Director*
Soil Classification Laboratory
Makoto Nakai, *Chief*
Hiroshi Obara, *Senior Researcher*
Toshiaki Ohkura, *Senior Researcher*
Kazuki Togami, *Researcher*
Misako Komamura,
Insect Systematics Laboratory
Koji Yasuda, *Chief*
Shinichi Yoshimatsu, *Senior Researcher*
Yukinobu Nakatani, *Researcher*
Microbial Systematics Laboratory
Seiya Tsushima, *Chief*
Shigenobu Yoshida, *Senior Researcher*
Hirosuke Shinohara, *Researcher*

Chemical Analysis Research Center

Syozo Endo, *Director*
Environmental Chemicals Analysis Laboratory
Tomohito Arao, *Chief*
Heesoo Eun, *Researcher*
Koji Baba, *Researcher*
Eiki Watanabe, *Researcher*

Appendix

Radioisotope Analysis Laboratory

Nobuharu Kihou, *Chief*

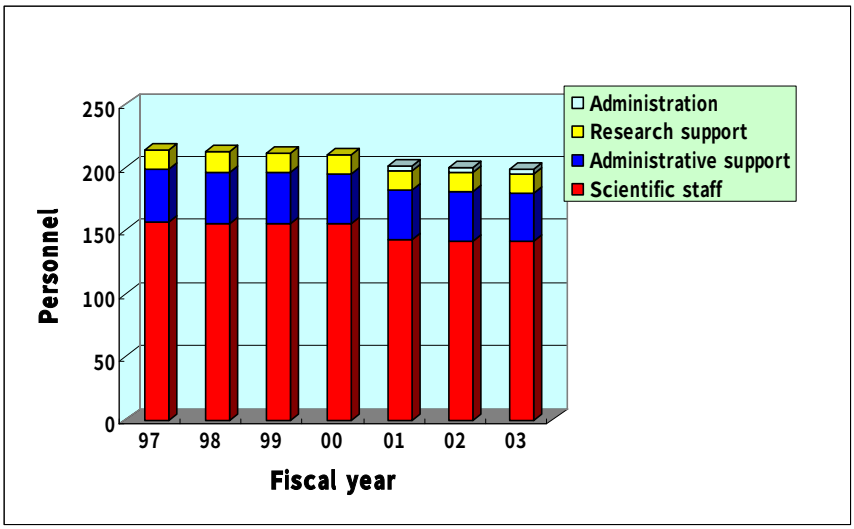
Noriko Yamaguchi, *Senior Researcher*

Hideshi Fujiwara, *Researcher*

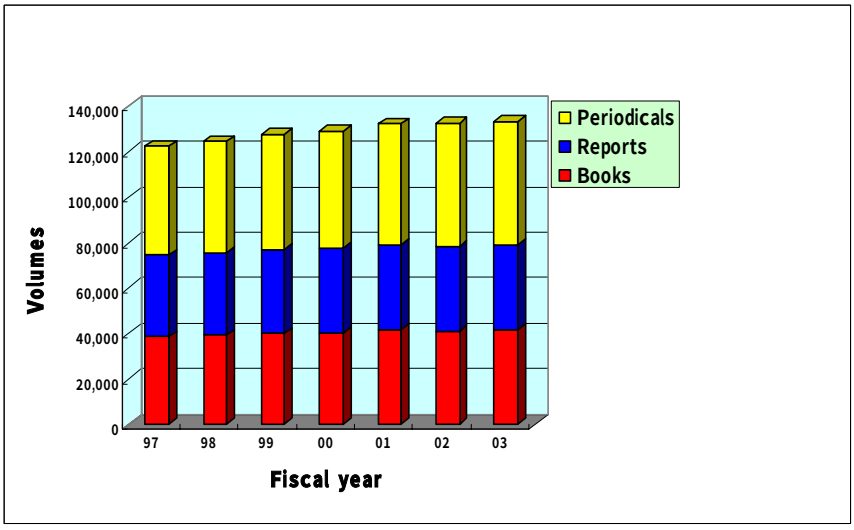
Budget in the FY 2003 (Million yen)

Operational Budget	3,467
Facilities Maintenance Subsidy	62
Project Research Budget	878
Miscellaneous Income	2
Patent and Copyright Income	1
Other Income	1
Total	4,409

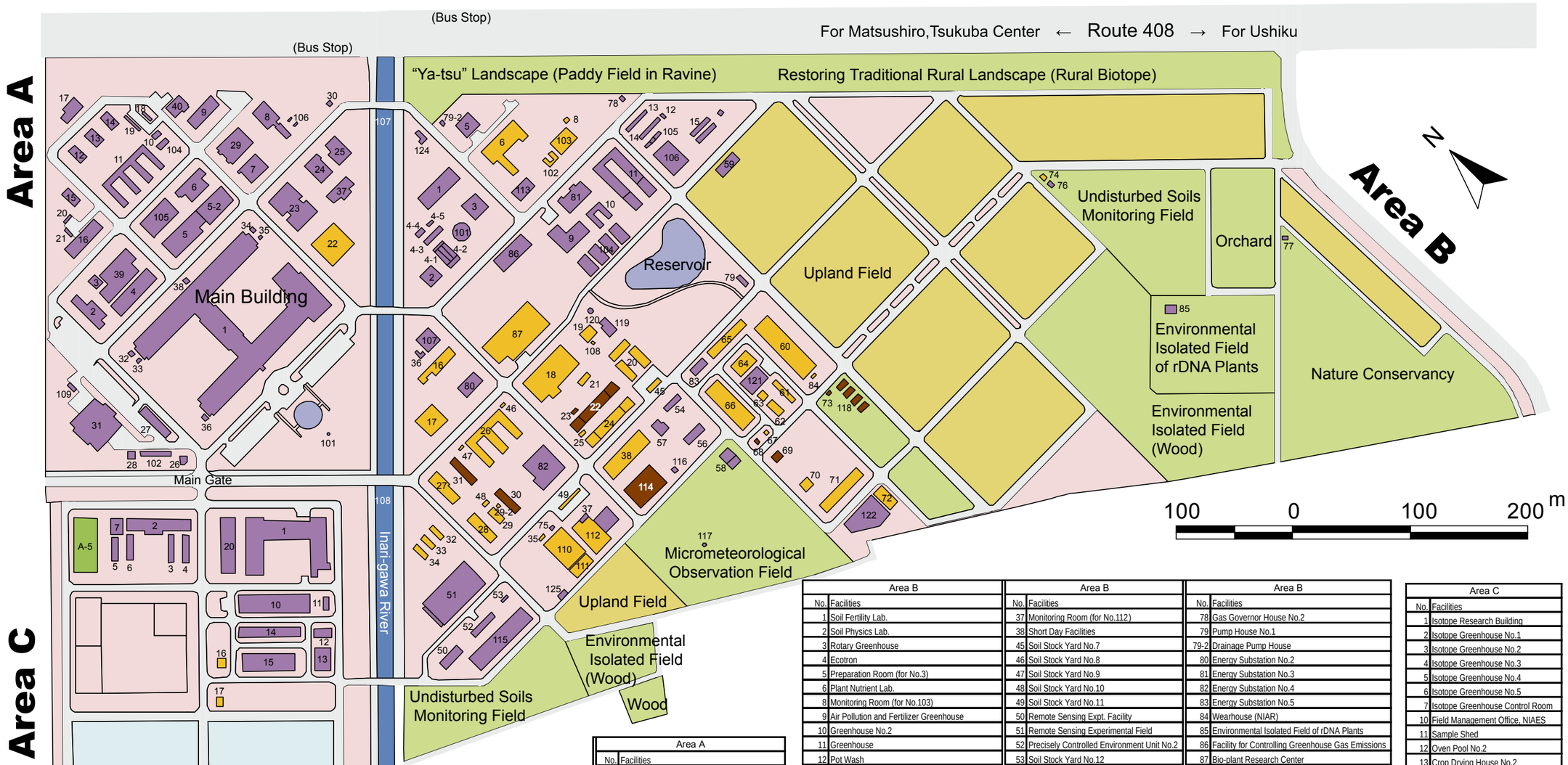
Staff Numbers



Library Holdings



NIAES Campus Map



Area A	
No.	Facilities
1	Main Building
2	Wind Tunnel
3	Extreme Low-temperature Lab.
4	Insectron
5	Herbarium and Insect Museum
5-1	Analytical Lab. for Environmental Studies
6	Phytotron (Plant protection)
7	Environmental Chemicals Assessment Lab.
8	Nematode Biology Workshop
9	Greenhouse No.3
10	Soil Sterilization Room
11	Greenhouse No.1
12	Screen House No.1
13	Screen House No.2
14	Screen House No.3
15	Small Animal Rearing House
16	Greenhouse No.2
17	Environmental Chemicals Assessment Lab.
18	Soil Stock Yard No.1
19	Soil Stock Yard No.2
20	Soil Stock Yard No.3
21	Soil Stock Yard No.4
22	Germplasm Seed Storage Center

Area A	
No.	Facilities
23	Soil Survey and Conservation Lab.
24	Rhizobia Lab.
25	Experimental Fertilizer Plant
26	Gatehouse
27	Garage
28	Storage for Flammable Materials
29	Energy Substation No.1
30	Gas Governor House No.1
31	Waste Water Treatment Plant
32	Gas Cylinder Storage No.1
33	Gas Cylinder Storage No.2
34	Gas Cylinder Storage No.3
35	Gas Cylinder Storage No.4
36	Gas Cylinder Storage No.5
37	Microbial Biotechnology Lab.
38	Water Levle Control Valve House
39	Analytical Facility for Environmental Chemicals
40	Insect Quarantine Facility
101	Weather Monitoring Station
102	Parking Place for Bicycles
104	Growth Chamber Yard No.1
105	Growth Chamber Yard No.2
106	Growth Chamber Yard No.3
107	Bridge No.1
108	Bridge No.2
109	Container Test Yard No.1

Area B	
No.	Facilities
1	Soil Fertility Lab.
2	Soil Physics Lab.
3	Rotary Greenhouse
4	Ecotron
5	Preparation Room (for No.3)
6	Plant Nutrient Lab.
8	Monitoring Room (for No.103)
9	Air Pollution and Fertilizer Greenhouse
10	Greenhouse No.2
11	Greenhouse
12	Pot Wash
13	Soil Stock Yard No.5
14	Soil Stock Yard No.6
15	Lysimeter
16	Inoculation and Aseptic Greenhouse
17	Breeding Cycle Shortening Greenhouse
18	Environmental Botany Lab.
19	Systematic Growth Control Facilities
20	Plant Growth Regulator Screening Greenhouse
21	Auto-feeding Water Culture House
22	Soil Moisture Controlled Facilities
23	Monitoring Room (for No.22)
24	Rainfall-free Greenhouse
25	Monitoring Room (for No.24)
26	Multi-purpose Greenhouse
27	Post-introduction Nursery
28	Isolated Nursery
29	Outcrossing Plant Nursery
29-2	Refrigerator Room
30	Gravel Culture Greenhouse
31	Winter Crop Greenhouse
32	Crossing Room No.1
33	Crossing Room No.2
34	Crossing Room No.3
35	Monitoring Room (for No.110)
36	Herbicide Dissolveing Plant

Area B	
No.	Facilities
37	Monitoring Room (for No.112)
38	Short Day Facilities
45	Soil Stock Yard No.7
46	Soil Stock Yard No.8
47	Soil Stock Yard No.9
48	Soil Stock Yard No.10
49	Soil Stock Yard No.11
50	Remote Sensing Expt. Facility
51	Remote Sensing Experimental Field
52	Precisely Controlled Environment Unit No.2
53	Soil Stock Yard No.12
54	Environmental-controlled Greenhouse
56	Climatron
57	Weighing Lysimeter
58	Micrometeorological Observatory
59	Ecology Workshop
60	Field Management Office, NIAR
61	Warehouse
62	Oven Pool No.1
63	Thermal Power Drying House
64	Crop Drying House No.1
65	Farm Implements Shed No.1
66	Workshop No.1
67	Fumigation Room
68	Water-bath Disinfection House
69	Tuber Storage
70	Fertilizer/Agrochemicals Storage
71	Farm Machinery Pool
72	Compost Shed
73	Framed Nursery Control Room
74	Rest Room No.1
75	Lavatory No.1
76	Lavatory No.2
77	Lavatory No.3

Area B	
No.	Facilities
78	Gas Governor House No.2
79	Pump House No.1
79-2	Drainage Pump House
80	Energy Substation No.2
81	Energy Substation No.3
82	Energy Substation No.4
83	Energy Substation No.5
84	Wearhouse (NIAR)
85	Environmental Isolated Field of rDNA Plants
86	Facility for Controlling Greenhouse Gas Emissions
87	Bio-plant Research Center
101	Rotary Greenhouse
102	Thermostatic Water Culture Facilities
103	Hydro-automatic Culture Facilities
104	Nursery Beds
105	Auto-watering Facilities
106	Pot Test Yard
107	Herbicide Evaluation Area
108	Systematic Controled Greenhouse
110	Framed Paddy-Plot Unit
111	Water Level Controlled Paddyfield
112	Groth Chamber Yard No.4
113	Groth Chamber Yard No.5
114	Framed Upland-plot Unit
115	Precisely Controlled Environment Unit No.1
116	Evapotron
117	Micrometeorological Observatory
118	Framed Nursery
119	Water Tank
120	Water Tower
121	Concrete Floor No.1
122	Concrete Floor No.2
124	Container Test Yard No.2
125	Container Teat Yard No.3

Area C	
No.	Facilities
1	Isotope Research Building
2	Isotope Greenhouse No.1
3	Isotope Greenhouse No.2
4	Isotope Greenhouse No.3
5	Isotope Greenhouse No.4
6	Isotope Greenhouse No.5
7	Isotope Greenhouse Control Room
10	Field Management Office, NIAES
11	Sample Shed
12	Oven Pool No.2
13	Crop Drying House No.2
14	Farm Implements Shed No.2
15	Workshop No.2
16	Agro-ecology Workshop No.1
17	Agro-ecology Workshop No.2
18	Rest Room No.2
19	Lavatory No.4
20	Energy Substation No.6
21	Pump House No.2
A-5	Stack Room

NIAES

89 buildings (29,545/58,046㎡)

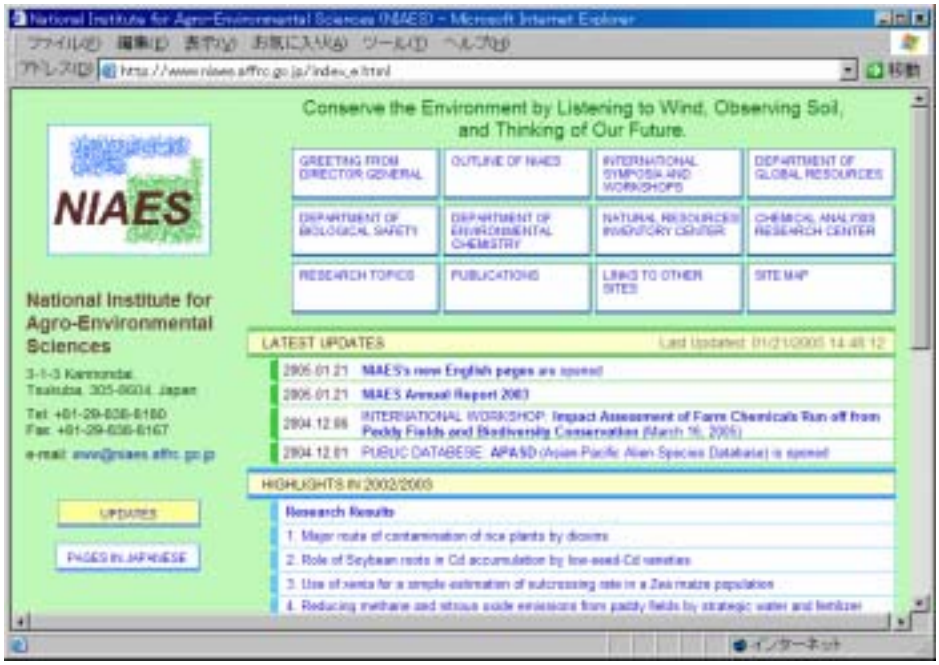
NARO

NIAS

AFFRC Tsukuba Office

Internet Web Site of NIAES

NIAES has an official Internet Web site written in English (http://www.niaes.affrc.go.jp/index_e.html). Through this site, NIAES has provided relevant information on the institute and results of its research including “Distribution maps of net primary productivity (NPP) of natural vegetation and related climatic resources”, “The Ecosystem Database”, “Index of parasitic and symbiotic microbes on wild plants in Japan” and “microForce”.

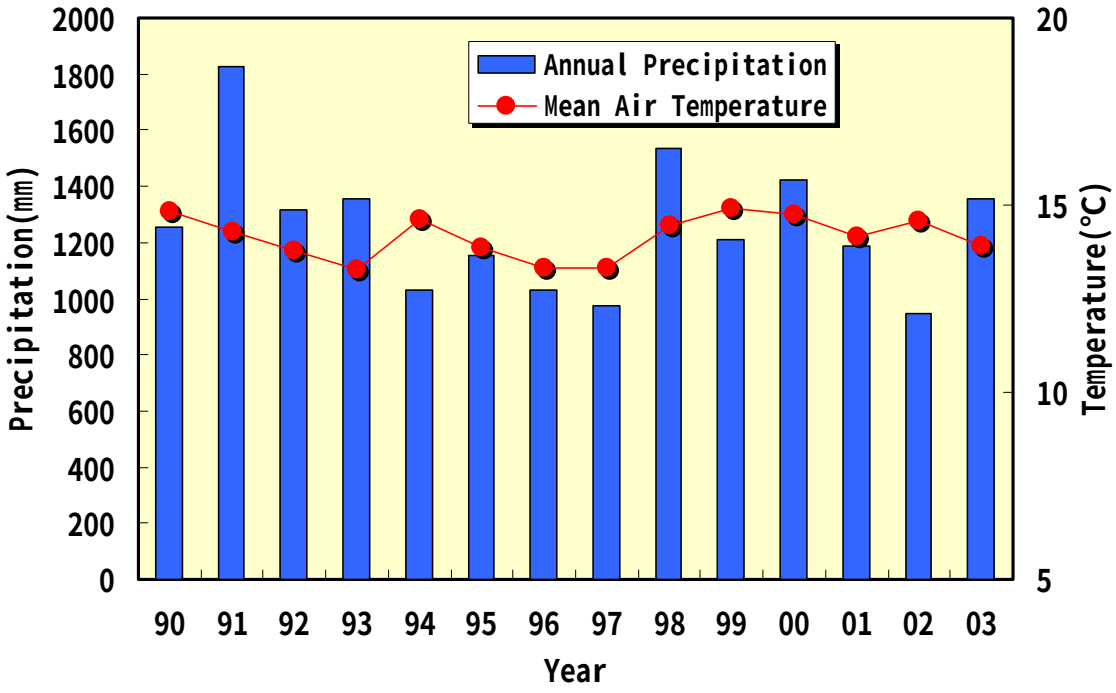


URL http://www.niaes.affrc.go.jp/index_e.html

Map of NIAES Official Site

- Japanese Top page
- English Top page
  - Updates
  - Message from Director General
  - Outline of NIAES
  - Organization of NIAES
    - Department of Global Resources
    - Department of Biological Safety
    - Department of Environmental Chemistry
    - Natural Resources Inventory Center
    - Chemical Analysis Research Center
  - International Symposia and Workshops
  - Research Topics
    - Distribution Maps of Net Primary Productivity (NPP) of Natural Vegetation and Related Climatic Resources
    - Ecosystem Database
    - Asian-Pacific Alien Species Database (APASD)
    - Index of Parasitic and Symbiotic Microbes on Wild Plants in Japan
    - microForce
  - Publications of NIAES
    - Bulletin of the NIAES
    - Miscellaneous Publication of the NIAES
    - NIAES Annual Report
    - NIAES Series
  - Links to Other Web Sites

Meteorological Information



Annual Report 2004

Published by

National Institute for Agro-Environmental Sciences
3-1-3 Kannondai, Tsukuba, Ibaraki 305-8604, Japan
Tel. (Japan +81) 29-838-8180
Fax. (Japan +81) 29-838-8199

NIAES Annual Report 2004

National Institute for Agro-Environmental Sciences

Conserve the environment
by listening to wind, observing soil
and thinking of our future