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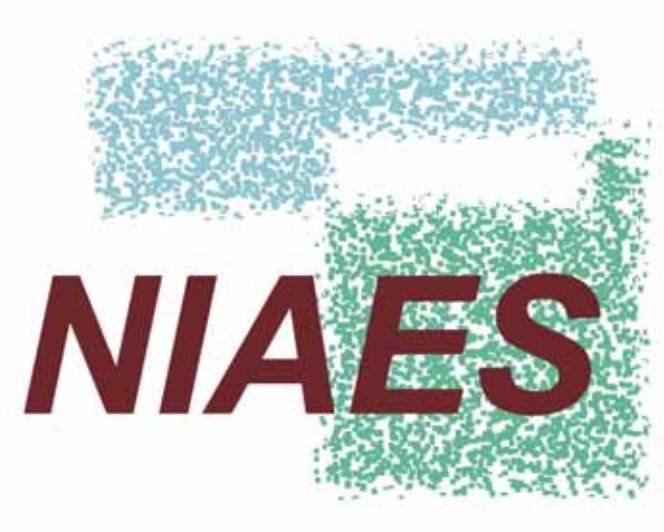
NIAES Annual Report 2008

National Institute for
Agro-Environmental Sciences
Japan

Annual Report

2008

(April 2007– March 2008)



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

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Ceaseless endeavor and innovation

Dr. Yohei SATO

Global prices of corn, wheat and other grain crops as well as soybeans have risen steeply over the past few years. In addition to crop failures caused by abnormal weather, rising demand for these crops in emerging nations, and increased use for bioethanol production, speculative investment is also thought to be driving up prices in the grain market. This is one example of the globalization that has picked up pace since around the end of the 20th century, and this economic globalization is in turn globalizing environmental problems. For example, tropical rainforest in Brazil's Amazon basin is being cleared to make way for more farmland to expand corn and soybean production, and biodiversity is suffering as a result. Another example is the damage caused by introduced species that have reached foreign shores through international trade.

The globalization of the grain trade is underpinned by innovations in transportation technology that have enabled the transport of damageable goods in a natural condition over long distances. The globalization of such technology over the 20th century has also caused global environmental problems such as ozone depletion and global warming. Addressing such global environmental issues requires the globalization of thinking, and the need for commonly held ideas is rising on various fronts. The agricultural sector is no exception. Assuming that global warming is indeed progressing, we need to consider its impacts on crops and agricultural ecosystems, and assuming the cause of global warming is the emission of greenhouse gases generated by human activities, we also need to investigate and address emissions generated by agricultural production.

As you know, NIAES's mission is to conduct basic research on the preservation and enhancement of the environment used to grow agricultural produce. Agriculture is essentially a matter of ecosystem control exercised through the biological control of a great many flora and fauna through mechanisms such as seed selection, pest control, and weed control, and the control of the physical elements of ecosystems through mechanisms such as tilling and irrigation. Ecosystem control under the modern model of intensive agriculture aimed at maximizing food production puts considerable burdens on the ecosystem. One example of such burdens is the contamination of rivers, streams, and groundwater due to the extensive use of fertilizer and agrochemicals to boost plant growth and crop yields.

However, prompted by the globalization of environmental issues mentioned above, the scope of present-day agro-environmental research has expanded beyond just environmental issues related to ecosystem control to encompass global environmental issues too.

Under our 2nd Medium Term Plan, we are working to achieve the following three objectives that focus on elucidating and assessing agro-environmental risks and developing techniques for controlling and managing those risks:

(1) Assessment of agro-environmental risks and development of risk management techniques
(2) Elucidation of the structure and functions of agricultural ecosystems and development of techniques for maintaining and enhancing natural cycles
(3) Basic research to help elucidate agricultural ecosystem functions

This endeavor is aimed at developing solutions to agro-environmental risks related to ecosystem control to ensure that agriculture plays no part in the indiscriminate exploitation of nature or irresponsible production, and also at developing the knowledge required to ensure that agriculture does not threaten the sustainability of global systems.

This annual report presents the work carried out at NIAES over AY 2007, reporting not just research achievements but all aspects of our institute's affairs, including evaluation and inspection both external and internal, public relations, research cooperation, and research support.

We are delighted to report here that in relation to the award of the Nobel Peace Prize to the Intergovernmental Panel on Climate Change (IPCC), three former and current members of NIAES received certificates of appreciation from IPCC chair Rajendra K. Pachauri in recognition of their contribution to the work that won the Nobel Prize.

Our institution's basic philosophy is to help solve the world's food and environmental problems through high-level research that aims to harmonize nature, society, and people. I hope that you find this report a useful aid in understanding our institute's activities. We look forward to receiving your candid comments and suggestions regarding this report and our activities.

Yohei Sato, Dr. Agr.
President

The National Institute for Agro-Environmental Sciences (NIAES) has endeavored to solve a wide range of environmental problems affecting agriculture, such as the contamination of agricultural crops by dioxins, radioactive substances, cadmium and other harmful chemical substances; the environmental impact of genetically modified food plants and exotic organisms; and the relationship between global environmental change and agriculture. There is increasing concern about the risks to human health and the environment, and researchers are being asked to offer solutions based on scientific findings.

The period of NIAES's phase II medium-term target, which started in April 2006, calls for emphasizing research on risks in the agricultural environment in order to ensure the environmental safety that underpins agricultural production. By means of exploratory and basic research on risk assessment and risk management, NIAES will develop risk mitigation technologies and pass the benefits of research on to society at large, as well as contributing to the policy measures of administrative authorities and international agencies.

NIAES has created the following Basic Philosophy, Code of Conduct, and Environmental Charter so that personnel will conduct themselves with a high sense of ethics and an awareness of their social responsibility, and undertake to conserve and improve the environment as they proceed with research under the new medium-term target and medium-term plan.

Basic Philosophy

NIAES conducts high-level research aiming at the harmony and coexistence of nature, society, and humans, thereby helping to overcome food and environmental problems throughout the world.

Code of Conduct

Philosophy of Conduct

To act with a strong sense of ethics and sound social judgment for the purposes of building a safe and worry-free society and preserving an agricultural environment to be passed on to the next generation. To pass the benefits of NIAES activities on to society at large.

Guidelines for Conduct

• Environmental Research

As a research institute in the forefront of agro-environmental research in Japan and abroad, NIAES actively conducts high-level research activities to solve environmental problems related to agricultural production.

• Legal Compliance

NIAES complies with the relevant laws and social norms to provide a sound and safe working environment, and as a member of society undertakes its program activities ethically and with sound judgment. In particular, there must be no impropriety committed through research activities. Furthermore, NIAES works to partner with society, assures transparency by upholding openness, fairness, and neutrality, and so enhances its trustworthiness.

• Technology Transfer

To protect and apply the results originating from our research as intellectual property, NIAES creates the conditions for providing patents and other information and for domestic and foreign technology transfers.

• Public Communications and Information Disclosure

By publishing the results of studies and research and by actively disseminating and communicating such results through public lectures and other means, NIAES provides for the dissemination of research meant to assure the safety of food and the agricultural environment and also works to release information on program activities.

• Cooperation, Partnership, and International Contributions

By reinforcing partnerships and collaboration with industry, academia, and government, NIAES promotes joint research and research cooperation, and extensively shares the research results with society. NIAES works to benefit the agro-environmental policies of administrative authorities and international agencies.

Environmental Charter

Environmental Philosophy

To vigorously carry out research activities on agro-environmental problems and take positive action to contribute to conserving and improving the environment and to building a sustainable recycling society.

Environmental Action Guidelines

• Raising Environmental Consciousness

To create organizations and institutions for environmental management and to work to raise environmental consciousness.

• Concern for the Environment

To reduce the burden on the environment by being diligent in everyday activities such as energy conservation, reuse, recycling, and green procurement.

• Publicizing Activities

For the purpose of improving environmental conservation and safety and health in program activities, to broadly publicize the results of environmental conservation activities by means including preparing environmental reports and posting on the Web.

• Symbiosis with Society

As a member of the local community and international society, to build a cooperative and symbiotic relationship with society and actively conduct environmental conservation activities.

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), is founded.

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

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

1983 National Institute of Agro-Environmental Sciences (NIAES) of the Ministry of Agriculture, Forestry and Fishery is 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 becomes a semi-autonomous agency on 1 April and begins its first research period (FY 2001 to FY 2005).

2006 NIAES becomes an autonomous agency on 1 April and begins its second research period (FY 2006 to FY 2010).

The main building of NIAES

Research Topics

1. Publication of "Manual for Assessing the Acute Toxicity of a Pesticide by using First-instar Larvae of the Caddisfly *Cheumatopsyche brevilineata*"

Paddy fields account for more than half of Japan's farmland and are connected to running water (lotic) environments such as streams and rivers via irrigation and drainage canals. Pesticide runoff from paddy fields poses a potential risk to lotic ecosystems. In the Japanese pesticide registration system, the effect of a pesticide on aquatic ecosystems is assessed by a set of acute toxicity tests based on OECD test guidelines (OECD TG 201, 202, and 203). A limited number of aquatic species—planktonic green algae (*Pseudokirchneriella*), water fleas (*Daphnia*), and fish (e.g. carp and killifish)—are commonly used as standard test organisms in acute toxicity tests. However, planktonic green algae and water fleas inhabit mainly standing water (lentic) environments such as ponds and lakes and do not seem to be important or representative organisms in lotic environments. Concern therefore remains about whether acute toxicity tests that use these lentic species can appropriately assess the effect of pesticides on lotic ecosystems. We have little information about the toxicity of pesticides to native species in lotic environments, and there is a need to develop a new acute toxicity test that uses an organism representative of those in lotic environments.

Aquatic insects that live some or all of their life cycles in running water are called 'lotic insects'. Lotic insects play important roles as primary consumers (herbivores) and food sources for fish in lotic ecosystems. The caddisfly, as well as the mayfly and stonefly, is considered to be one of the most important lotic insects in Japan. The net-spinning caddisfly *Cheumatopsyche brevilineata* is distributed widely in Japan and frequently dominates the benthic fauna of canals, streams, and rivers. Given the overlap between this habitat and rice cultivation areas, it is ecologically meaningful to use the caddisfly as an additional test species for assessing the effect of paddy pesticides on lotic ecosystems. We have therefore developed a new pesticide bioassay that uses first-instar larvae of the caddisfly, and we have published the first "Manual for Assessing the Acute Toxicity of a Pesticide by using First-instar Larvae of the Caddisfly *Cheumatopsyche brevilineata*" (in Japanese).

The manual illustrates the test procedure simply and presents information about the sensitivity of the caddisfly to 30 insecticides commonly used in Japan.

Chapters I and II cover the manual's introduction and purpose.

Chapter III of the manual reviews the ecology of the caddisfly and important traits of the first-instar larvae (Photo 1).

Chapter IV illustrates the procedure used in the acute toxicity test and describes how to handle larvae. The test method can be selected to suit the properties of the test chemical (e.g., the light conditions can be chosen to suit the degree of photostability of the pesticide, and the test vessel can be chosen in accordance with the octanol-water partition coefficient) (Fig. 1). Because newly hatched larvae swim toward the light source, we illuminate them continuously from beneath with white fluorescent light during the test period to prevent them from becoming trapped at the water surface ("constant light" conditions in Fig. 1). Forty-eight hours after the start of the exposure, the behavior of the larvae is assessed under a stereomicroscope. Normal larva can be easily distinguished

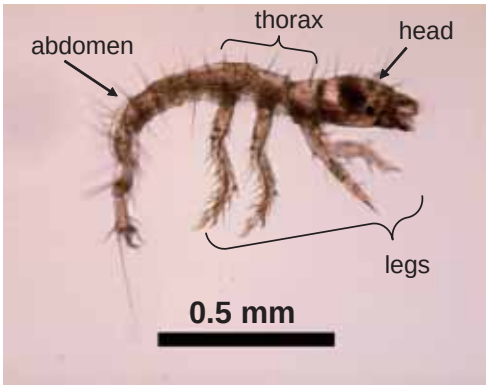


Photo 1 First-instar larva of *Cheumatopsyche brevilineata*.

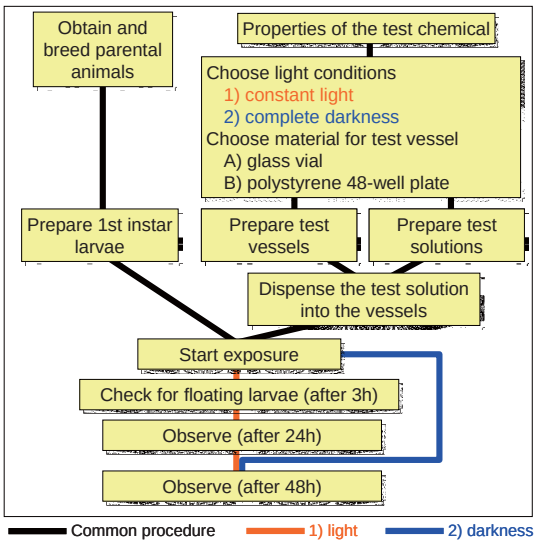


Fig. 1 Procedure for acute toxicity testing using first-instar larvae of *Cheumatopsyche brevilineata*.

from abnormal ones (see flow chart in Fig. 2). A larva is defined as normal if it swims in the test solution or crawls on the bottom, and also if it stretches its legs and abdomen shortly after the test solution is stirred gently with a glass pipette. A larva that does not exhibit a response to the stimulus (stirring) is defined as abnormal (moribund or dead) and is judged to be affected by pesticide exposure.

Chapter V presents the results of toxicity testing of 30 insecticides in a range of chemical classes (Fig. 3). The caddisfly was as sensitive as the water flea to organophosphates, carbamates, and pyrethroids. However, the sensitivities of the caddisfly to nereistoxins and neonicotinoids were up to 100 000 times higher than those of the water flea. These results suggest that the toxicity test method developed in this study is useful and valuable for assessing the ecological impacts of chemicals in lotic environments.

PDF versions of this manual and the "Mass-Rearing Manual for the Caddisfly *Cheumatopsyche brevilineata*" (in Japanese) can be downloaded from the NIAES website at:

http://www.niaes.affrc.go.jp/techdoc/techdoc.html

(A. Yokoyama, K. Ohtsu, and T. Horio)

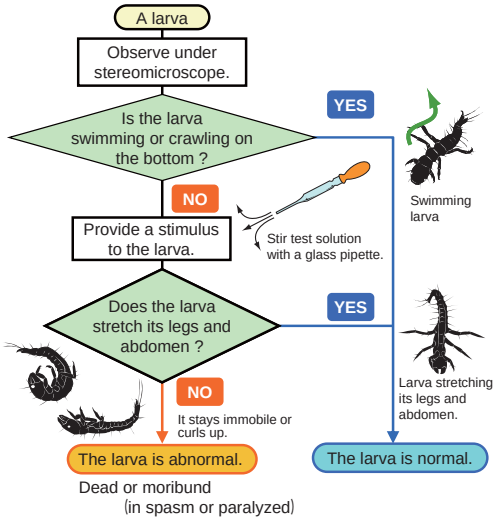


Fig. 2 How to distinguish between normal and abnormal larvae of *Cheumatopsyche brevilineata* after pesticide exposure.

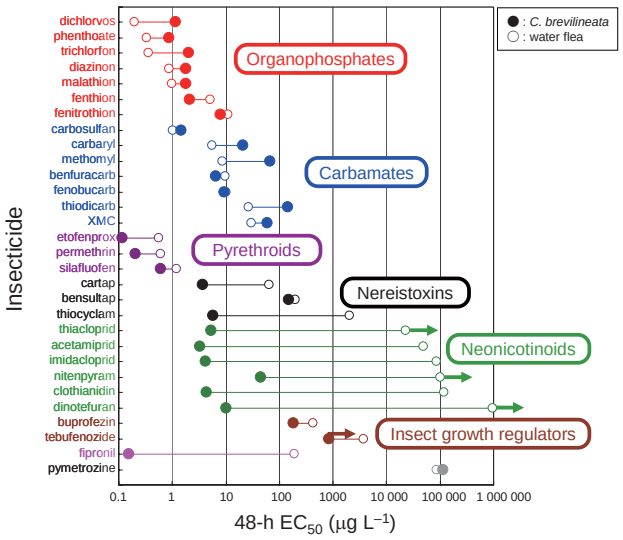


Fig. 3 Sensitivity of first-instar larvae of *Cheumatopsyche brevilineata* and water flea to 30 insecticides (48-h EC_{50}: 48-h half maximum effective concentration).
Data for water flea were cited from the literature.
Arrows mean that EC_{50}s are higher than the concentrations indicated here.

2. Development of a New Method of Soil Disinfestation with Diluted Ethanol

Preface

In Japan, to enable intensive agricultural production, soil is disinfested with agrochemicals and various non-chemical methods are used to exterminate soil pests that occur in continuously cultivated arable land. However, these methods do not always have desired effects, and there is also concern over the potential risks to human health and the environment of using agrochemicals for soil disinfestation. Such considerations point to the need for the development of new soil disinfestation techniques that have lower impacts on human health and the environment.

Screening for new soil disinfestation agents

We screened a wide range of substances as possible soil disinfestation agents. Russell et al. (1909) studied the effect of various organic chemical treatments on the numbers and activity of soil bacteria, although their study was not aimed specifically at disease-causing bacteria. Ethanol is mentioned as an organic agent that has little impact on nitrification and biological activity. Our experiments too showed that ethanol indeed has only limited soil disinfestation efficacy and did not diffuse widely through soil, suggesting that it is by no means a promising soil disinfestation agent. However, ethanol does offer many advantages including the abundance of information on its toxicity to humans (low toxicity) and the fact that it degrades easily and disappears (low environmental persistence), and so we looked at the possibilities for enhancing its efficacy in disinfesting soil through improving the treatment method.

Enhancing the soil disinfestation efficacy of ethanol through improving the treatment method

To assess soil disinfestation efficacy, we first treated air-dried soil directly with test substances, but efficacy proved to be limited. On considering how the treatment method could be improved, we developed a method that soaks soil (photo 1) to the desired depth with ethanol diluted in water to 2% or less (a normally inconceivable level of dilution for sterilization purposes), after which the soil is covered for at least a week with agricultural polyethylene films (photo 2). We found that this simple method was sufficiently effective in disinfesting the soil. Moreover, because ethanol homogenizes easily in water and causes no degradation of plastic and other materials, this method can be adapted easily. For example, perforated hoses could be first laid on the soil surface and the diluted ethanol applied using a drip system after covering the soil with polyethylene films. The purpose of the sheeting is to shut out air (oxygen) and prevent evaporation of the ethanol and water.

Although the concentration (maximum of 2%) of ethanol used in this soil disinfestation method is insufficient to directly kill bacteria and other pests, this diluted solution proved to be effective in controlling a wide range of pests, including bacteria, fungi, nematodes and other soil pests, and weeds (Table).

Photo 1 The dilute ethanol solution is applied until the soil is saturated.

Photo 2 The soil is covered with agricultural-use polythene sheeting.

We need to investigate in detail why this technique is effective in controlling soil pests, but the most likely reasons are a change in the soil environment from an aerobic to anaerobic state and a rise in the concentration of organic acids.

Type of ethanol used

We propose the use of pure alcohol (approx. 95%, costing ¥50–60 per liter) or the cheaper by-product alcohol (approx. 90%) obtained through the distillation of pure alcohol. If, for example, soil is treated with 100 L/m^2 of 1% ethanol made from pure alcohol, the cost of the required ethanol would work out at ¥60,000/1,000 m^2. By-product alcohol is not available commercially, but if it could be used for this purpose, costs could be further reduced, making this an economically feasible method when compared with other soil disinfestation techniques. If reducing ethanol concentration proves feasible, and even lower concentrations of ethanol prove to be equally effective, costs could be further reduced.

Next steps in the development of this soil disinfestation technique

Because ethanol degrades and disappears in soil within a few days, and so has little impact on the environment, and because its low toxicity to humans is also well documented, this technique represents a very safe soil disinfestation method. However, there are still a great many technical, and legal, aspects of this technique that need to be addressed. Technical issues include determination of the optimum ethanol concentration and treatment amount, simplification of the treatment method, elucidation of the actions of the diluted ethanol and its effectiveness with respect to the targeted pests, checking for any adverse effects, and assessment of the duration of efficacy. This project has been chosen for the Practical Technology Development Project for the Promotion of New Agriculture, Forestry and Fisheries Policy that started in 2008, and so we shall seek to resolve these issues under this project. We are also consulting with relevant agencies to ensure that this technique can be implemented under the laws when all technical issues have been resolved.

This technique is the outcome of collaboration between NIAES, Chiba Prefectural Agriculture and Forestry Research Center, and the Japan Alcohol Corporation.

(Y. Kobara)

Table Comparison of efficacy and material costs of low concentration ethanol treatment with other techniques

method	virus	bacteria	fungi	nematode	insects	weeds	amount/1,000m^2	material cost/1,000m^2
diluted ethanol	-	○	○	○	○	○	1kL	60,000yen*2
solar	×	○	○	○	○	△	-	-
hot water, steam	△～×	○	○	○	○	○～△	150kL(steam)	80,000yen(kerosene)
grafting*1	(○)	(○)	(○)	(○)	×	×	-	-
antagonistic plants, nematode suppressive crops	×	×	×	△	×	×	-	-
dazomet	×	○	○	○	○	○	30kg	30,000yen
metham sodium	×	○	○	○	○	○	40～60L	21,000～31,500yen
D-D	×	×	×	○	○	×	30L	10,000yen
chloropicrin	×	○	○	○	○	△	30L	30,000yen
methyl bromide	○	○	○	○	○	○	30L	65,000yen

○: Effective △: Somewhat effective ×: Ineffective

*1 Efficacy limited to certain crops (certain varieties), or not effective with all crops
*2 Import price of pure alcohol (from 2006 customs statistics). This price could be reduced through the use of by-product alcohol.

3. Effective use of briquetted rice husk gasification residues for rice cultivation aimed at zero emissions

Preface

Paddy rice cultivation is at the core of Japanese agriculture, not only producing the rice that is the staple food of the nation but also in recent years being considered in the light of global warming as a source of biomass energy. For the same reason, straw and husks derived from rice cultivation are also drawing attention as resources. Such considerations are expected to boost the importance of paddy rice cultivation, including the use of fallow paddy fields, from the perspectives both of raising food self-sufficiency and of producing resource crops. Any consideration of new directions in rice cultivation must of course pay attention to environmental issues. Monitoring river system in Japan has detected several pesticides (particularly herbicides for paddy use) and these concentrations appear to have adverse effects on the aquatic ecosystem. As one countermeasure, NIAES has investigated the use of charcoal from briquetted rice husks (carbonized rice-husk-briquettes, a material with different physical properties from that of conventional rice husk charcoal) in preventing the runoff of herbicides from paddy fields, and has established it as a rice cultivation technique that protects the river environment (NIAES Research Executive Summary, Volume 19, 2003).

Highly efficient, small-scale fixed-bed gasification and power generation systems are now coming into commercial use as a technology aimed at using biomass resource energy. Rice cultivation in Japan produces almost 2 million tons of rice husks a year. About 60% of this is recycled as bedding in livestock sheds and as compost, but the remaining 40% is wasted, being incinerated or disposed of in some other way. In recent years, gasification of these briquetted rice husks for power generation has been investigated. This technology results in residues in the form of large amounts of carbonized rice husks (rice husk gasification residues), the disposal of which is an issue that needs to be addressed. Use of these residues as a pesticide adsorption material to prevent the runoff of pesticides used in paddy fields into the surrounding environment would represent a biomass utilization technology that recycles a product of rice cultivation back into the process of rice cultivation.

Overview of closed-loop rice cultivation using rice husk gasification residues

Rice husk gasification residues that have previously been discarded after use of the biomass energy contained in rice husks can be recycled not only as an adsorbent to prevent the runoff of pesticides from paddy fields, but also as a silicate fertilizer that helps to improve percentage ripened grain and improve the taste. Because this technology returns CO_2 to paddy fields as fixed carbon, it would also contribute to the mitigation of global warming (Fig. 1).

Properties of rice husk gasification residues

Compared with conventional briquetted rice husk charcoal (carbon 50%, silica (SiO_2) 40%, specific surface area 140–150 m^2/g), carbonized residues from briquetted rice husk gasification contain less carbon (20%–25%) and more silica (70%–75%). Their specific surface area is also large (170–240 m^2/g), with a high volume of pores of about 400 nm diameter. Specific surface area and pore volume distribution have a particularly marked effect on pesticide adsorption.

Impact on efficacy of paddy herbicides and paddy rice growth

These rice husk gasification residues are crushed and separated into 1.2- to 2.5-mm granules. Our research has shown that if these granules are applied at 30 g/m^2 to a

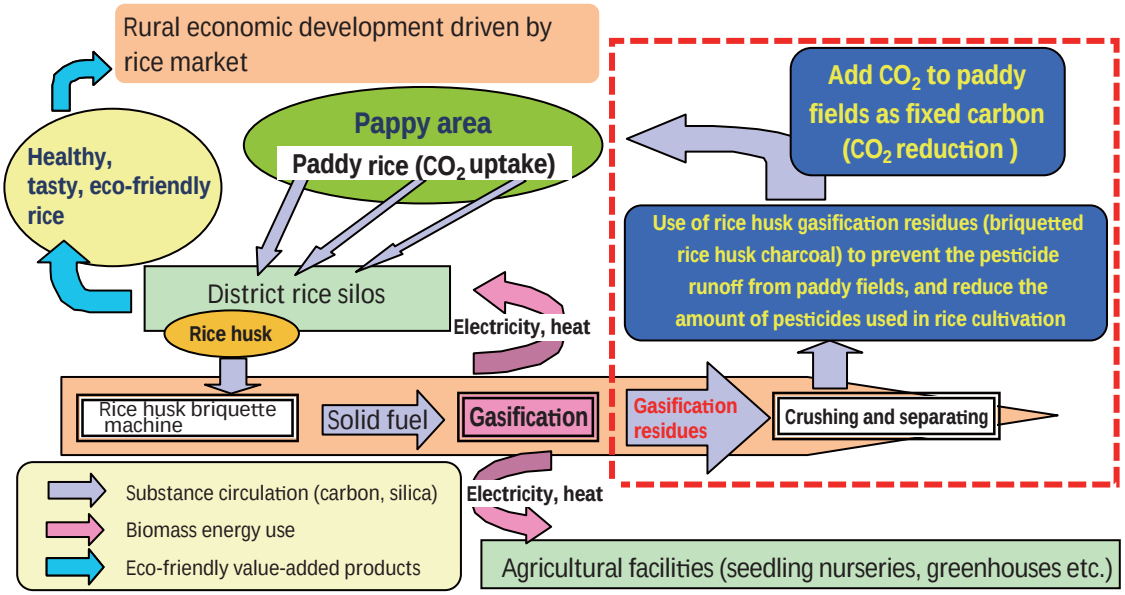


Fig. 1 System for production of eco-friendly, value-added rice through the use of biomass energy

Combining the developed technology (red square on the right) with briquetted rice husk gasification technology creates a very low environmental impact, closed-loop rice cultivation system that contributes to CO_2 reduction.

Table 1 Change in efficacy of herbicide as a result of use of rice husk gasification residues (35 days after herbicide application)

Test plot	Amounts applied (g/m^2)		*Echinochloa* spp.	*Cyperus difformis*	*Monochoria vaginalis*	*Lindernia* spp.	*Rotala indica*	*Scirpus juncoides*	*Sagittaria pygmaea*	Impact on paddy rice (observed over time)
	Herbicide	Gasification residues								
Untreated area	1	0	100	100	100	100	100	100	97	slight
50% reduction in herbicides + gasification residues	**0.5**	**30**	100	100	100	100	100	100	93	none

Note 1: The herbicide used was Sheriff 1 kg granules (combination of pretilachlor, cyhalofop butyl, imazosulfuron, and dimethametryn)
Note 2: Gasification residues (specific surface area: $235 m^2/g$, granule diameter: 1.2-2.5 mm) applied 1 day after herbicide application
Note 3: Herbicide efficacy and impact on paddy rice scored according to 101-point method applied to aerial growth (0: same as untreated area - 100: totally dead)
Rice husk gasification residues were found to have no adverse effect on herbicide efficacy or paddy rice growth.

paddy field on the day after herbicide application, the amount of herbicide used can be halved with almost no decrease in efficacy and no adverse impact on the growth of the paddy rice (Table 1).

Prevention of pesticides runoff

Under these conditions, the concentration of herbicide in the surface water of paddy fields can be reduced markedly (70% reduction compared with untreated fields). The gasification residues also adsorb foliage fungicides that have fallen onto the surface water after being applied to foliage at a later stage in growth, reducing the concentration of such fungicides by as much as 40% (Fig. 2). These results show that rice husk gasification residues can be used to achieve major reductions in the runoff of pesticides from paddy fields into surrounding river systems.
(K. Takagi)

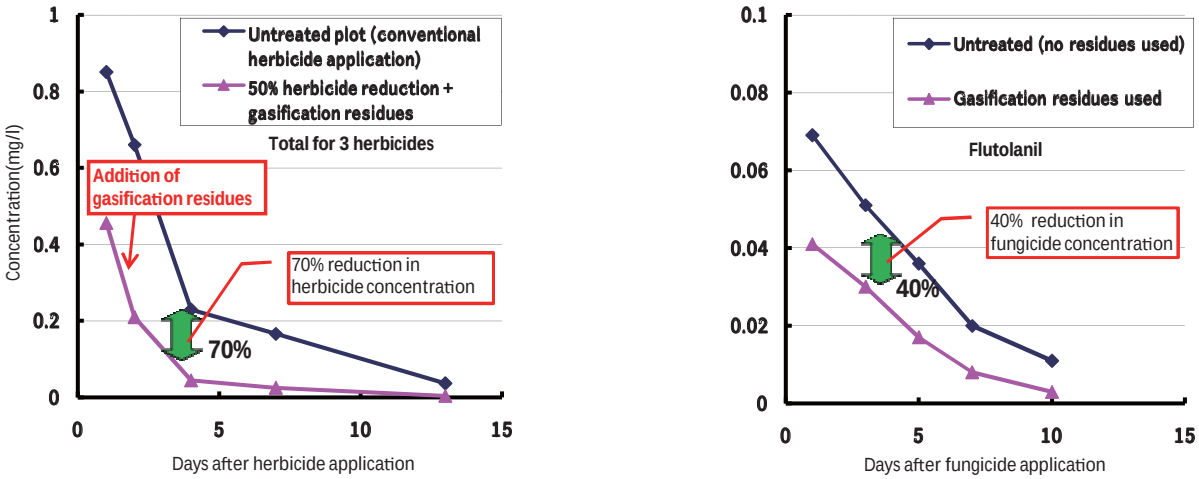


Fig. 2 Reduction in concentration of herbicide (left) and fungicide (right) in paddy field surface water as a result of application of rice husk gasification residues

Applying rice husk gasification residues markedly reduces the concentration of pesticides in paddy water, and accordingly markedly reduces pesticide runoff from paddy fields.

4. Decreasing cadmium uptake in eggplant by grafting onto *Solanum torvum* rootstock

Introduction

A maximum concentration of 0.05 mg Cd [kg fw]$^{-1}$ in fruiting vegetables has been adopted as a standard by the Codex Alimentarius Commission (2005). About 7% of 381 samples of eggplant (*Solanum melongena*), and 22% of 165 samples of okra (*Abelmoschus esculentus*) contained Cd concentrations above this limit in a field and market-basket study conducted from 1998 to 2001 in Japan (Ministry of Agriculture, Forestry, and Fisheries of Japan 2002). In light of these findings, we urgently need to develop technologies to suppress Cd absorption by crops.

Uptake of Cd by plants varies not only among plant species but also among cultivars. In studies of Cd-polluted Japanese soils, soybean seed Cd levels ranged from 0.46 to 2.7 mg kg^{-1} among 17 cultivars and Cd levels in rice grain ranged from 0.89 to 4.4 mg kg^{-1} among 31 cultivars.

Accumulation of large amounts of Cd in the root may limit the accumulation of Cd in above-ground portions of the plant. Sugiyama et al. (2007) found clear differences among soybean cultivars in terms of the influence of rootstock cultivar on shoot Cd concentration. In eggplant, grafting is a useful tool for coping with the problem of soil-borne disease: in Japan, grafted eggplant seedlings are used in 49% of field production and 97% of greenhouse production. The rootstocks used in Japan are eggplant (*S. melongena*), related species, and interspecific hybrids. The main objectives of our study were to determine Cd and other metal concentrations in eggplant fruits grown on different rootstocks in Cd-polluted soil and to determine the differences in uptake, translocation, and distribution of Cd among *Solanum torvum*, *S. melongena*, and *Solanum integrifolium* grown either in soil or in nutrient solution culture.

Differences among rootstocks in Cd concentration of grafted eggplants

In 2005, the Cd concentrations of eggplant fruits growing on Torubamubiga- (*S. torvum*, Fig. 1) and Daitarou (*S. melongena*) rootstocks in pots of Cd-polluted soil were 0.13 and 0.50 mg [kg fw]$^{-1}$, respectively (Table 1). In 2006, the Cd concentrations of eggplant fruits growing on Torubamubiga-, Tonashimu (*S. torvum*), and Hiranasu (*S. integrifolium*) rootstocks in pots of Cd-polluted soil were 0.15, 0.16, and 0.46 mg [kg fw]$^{-1}$, respectively (Table 1). In unpolluted soil, the Cd concentration in eggplant fruits growing on Torubamubiga- rootstock was 37% of the concentration in fruits growing on Hiranasu rootstock (Table 1). Grafting onto *S. torvum* thus reduced eggplant Cd concentrations by 63% to 74%. There were no significant differences in fruit concentrations of any metals other than Cd (Table 1). The average fresh weights of fruits were 82.6 g on Hiranasu, 86.0 g on Torubamubiga-, and 88.3 g on Tonashimu; there were no significant differences in average fresh weight of fruits between *S. torvum* and *S. integrifolium* rootstocks.

Fig. 1 Torubamubiga- (*Solanum torvum*)

Table 1 Metal concentrations in eggplant fruits grown from grafts on different rootstocks (mg kg^{-1} FW)

Rootstocks	Year	Experiment	Cd	Ca	Cu	Fe	K	Mg	Mn	Na	Zn
'Daitarou'	2005	pot	0.50*	155	1.3	3.0	1913	120	1.8	16.8	2.4
'Torubamubiga-'	2005	pot	0.13*	130	1.1	2.4	1696	114	2.0	7.2	1.9
Significant differences as determined by Student's t-test is indicated by * (P=0.01)											
'Hiranasu'	2006	pot	0.46a	112a	0.77a	2.5a	1655a	151a	1.8a	4.9a	2.0a
'Torubamubiga-'	2006	pot	0.15b	118a	0.87a	2.6a	1641a	146a	1.9a	8.6a	2.1a
'Tonashimu'	2006	pot	0.16b	123a	0.86a	2.7a	1563a	137a	2.0a	8.2a	2.0a
lsd			0.07	24	0.28	0.99	163	25	0.71	4.2	0.59
Values followed by the same lertter are not significant at the 1% level.											
'Hiranasu'	2006	field	0.033*	191	0.31	2.9	1926	169	1.1	1.1	1.3
'Torubamubiga-'	2006	field	0.012*	177	0.30	2.9	1825	136	1.4	0.8	1.3
Significant differences as determined by Student's t-test is indicated by * (P<0.01)											

Table 2 Metal concentrations in stems and leaves of scions grafted onto different rootstocks (mg kg^{-1} DW)

Rootstocks	Year	Experiment	Cd	Ca	Cu	Fe	K	Mg	Mn	Na	Zn
'Hiranasu'	2006	pot	21a	17773a	16a	153a	25552a	6742a	300a	316a	119a
'Torubamubiga-'	2006	pot	6.6b	18599a	27b	207a	31093b	5303a	291a	378a	132a
'Tonashimu'	2006	pot	6.6b	18474a	26ab	225a	26109ab	4770a	349a	319a	123a
lsd			1.7	5528	11	97	3750	2205	65	208	43
Values followed by the same lertter are not significant at the 1% level.											

Table 3 Metal concentrations in stems and leaves of self-rooted plants (mg kg^{-1} DW)

	Dry weight	Experiment	Cd	Ca	Cu	Fe	K	Mg	Mn	Na	Zn
	(mg)		(mg kg^{-1} DW)								
'Daitarou'	100a	cup	21.6a	14325a	14.2a	56a	22007a	5066a	118a	1010a	71a
'Sennryou2gou'	113a	cup	23.7a	13121ab	13.7a	58a	21309a	4987a	103a	1033a	70a
'Torubamubiga-'	45b	cup	6.0b	11797b	8.8b	62a	19935a	4571a	114a	855a	83b
lsd	37		3.3	2357	2.8	25	5298	859	31	406	11
Values followed by the same lertter are not significant at the 1% level.											

Table 4 Metal concentrations in xylem sap of self-rooted plants (mg L^{-1})

Rootstocks	Year	Experiment	Cd	Ca	Cu	Fe	K	Mg	Mn	Na	Zn
'Daitarou'	2006	pot	0.95*	405	0.58	1.1	410	111	10	47	6.2
'Torubamubiga-'	2006	pot	021*	385	0.72	1.7	281	121	11	24	5.4
Significant differences as determined by Student's t-test is indicated by * (P<0.01)											

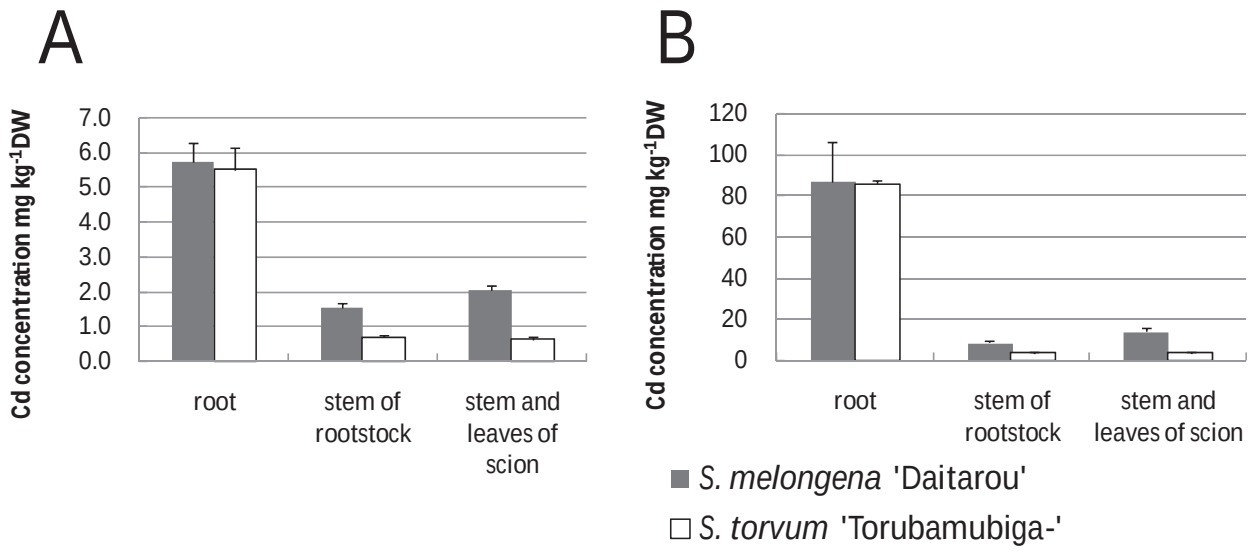


Fig. 2 Cadmium concentration of grafted eggplants that were grown on different rootstocks Cd concentration in solution A:0.09 μmol L^{-1} B:0.9 μmol L^{-1}.

Characteristics of Cd uptake in *Solanum torvum*

Stem and leaf Cd concentrations of scions on Torubamubiga- and Tonashimu rootstocks were about 30% of those on Hiranasu (Table 2), so Cd translocation from roots to shoots was apparently reduced in the grafted plants. The K and Cu concentrations of the stem and leaf of scions on Torubamubiga- were significantly higher than those on Hiranasu, but there were no significant differences between the concentrations of other metals in the stem and leaf of plants grafted on Hiranasu and those grafted on Torubamubiga- (Table 2). It is therefore likely that the concentrations of Cd and other metals in the shoots of the scion are controlled by independent mechanisms.

Stem and leaf Cd concentrations in self-rooted Torubamubiga- plants were significantly lower than those in Senryou2 (*S. melongena*) and Daitarou (*S. melongena*) plants (Table 3), indicating that Cd translocation from roots to shoots was also reduced in self-rooted *S. torvum*. There were no significant differences (P = 0.01) in stem and leaf metal concentrations between Daitarou and Senryou2 grown in polluted soil (Table 3).

In grafted plants grown in nutrient solution culture, the Cd concentrations in the stems and leaves of scions and the stems of rootstocks were low when the rootstock was *S. torvum*, but the Cd concentration in the roots of *S. torvum* was the same as that in the roots of *S. melongena* (Fig. 2). The Cd concentration in the xylem sap in the stems of self-rooted Torubamubiga- was 22% of that in the stems of self-rooted Daitarou (Table 4), so the reduced Cd translocation from root to shoot in Torubamubiga- could be explained by differential loading of Cd into the xylem. There were no significant differences in any other xylem-sap metal concentrations between Torubamubiga- and Daitarou (Table 4).

In conclusion, we have developed a practical method for reducing Cd concentrations in eggplant fruits by grafting onto *S. torvum* rootstock. Further investigation is needed to elucidate the mechanism responsible for the low Cd translocation characteristic of *S. torvum*.

This work was supported in part by a grant-in-aid (Hazardous Chemicals) from the Ministry of Agriculture, Forestry, and Fisheries of Japan.

(T. Arao)

5. Manual of microbial and nematode community analysis using soil DNA

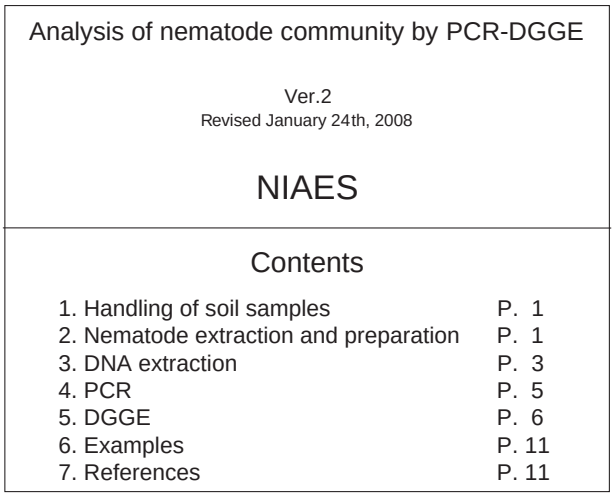
Introduction

To elucidate how soil microbes and nematodes are involved in agricultural field phenomena such as crop growth, pest infestation and suppression, and greenhouse gas emission, we need to collect as much information as possible on soil biota and compare the information across soil samples. For this purpose, an optimized and standardized analytical method is required for each group of soil organisms. Although PCR-DGGE (polymerase chain reaction – denaturing gradient gel electrophoresis), a method of analyzing microbial communities by using DNA fragments, has been in common use since 1990's, insufficient standard biological information has been collected because the experimental conditions differ among analyses. Therefore, to standardize the analytical conditions,

we have optimized the PCR-DGGE procedures for bacterial, fungal, and nematode communities and have published the results in a manual (Fig. 1).

Optimization of analytical conditions

For primer set selection—the most critical point of the analysis—we evaluated three sets for bacteria and four sets for fungi for amplification of soil-extracted DNA, and we conducted DGGE to compare the band numbers and diversities of the band patterns among the primer sets (Fig. 2, fungal test as an example). For nematodes, we selected a single primer set in advance on the basis of the clarity of the band patterns; we then confirmed its detection ability by comparing the community structures (frequencies of nematode taxa) revealed by clone type analysis with the primer set and those revealed by morphological identification under a microscope (Fig. 3). After these examinations we determined the most suitable primer sets for soil bacterial, fungal, and nematode analysis. For these primer sets, we also determined the optimum conditions for PCR amplification, electrophoresis, and other experimental steps (Table 1). In addition, we developed "DGGE markers"—sets of DNA fragments of known species—for the three organism groups, to compare DGGE band pat-


Analysis of nematode community by PCR-DGGE

Ver.2
Revised January 24th, 2008

NIAES

Contents

Fig. 1 The analysis manual (nematode version, cover and contents page)

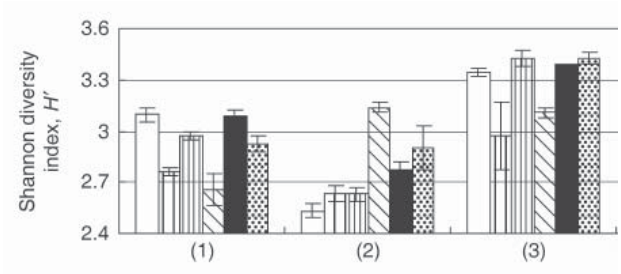


Fig. 2 Fungal diversity based on DGGE band patterns after PCR with primer sets (1), (2), and (3). Column patterns indicate soil types. We selected set (1) because its band patterns were both diverse and reproducible.

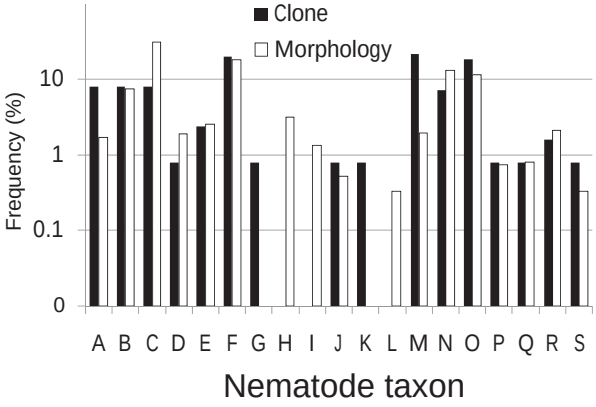


Fig. 3 Nematode taxa of a soil sample, as detected by clone-type analysis (black) and morphological identification (white). The correlation (r = 0.712) of frequencies between the two methods was statistically significant ($P < 0.01$).

Table 1 Primer sets and optimized experimental conditions.

	Bacteria	Fungi	Nematodes
Primer (forward/reverse)	F984GC/R1378	NS1/GCFung	SSU18A/SSU9R-GC
PCR cycle	94°C-2 min → [94°C-15 s, 55°C-30 s, 68°C -30 s] ×34	94°C-2 min → [94°C-15 s, 50°C-30 s, 68°C -30 s] ×30	98°C-3 min →[98°C -10 s, 54°C-15 s, 72°C-40 s]×27→ 72°C-10 min →15°C -∞
Electrophoresis			
Gel (%)	6	7	6
Gel gradient (%)	50→70	20→45	20→50
Temp. (°C)	58	60	60
Volt (V)	50	50	75
Time (hr)	18	20	16

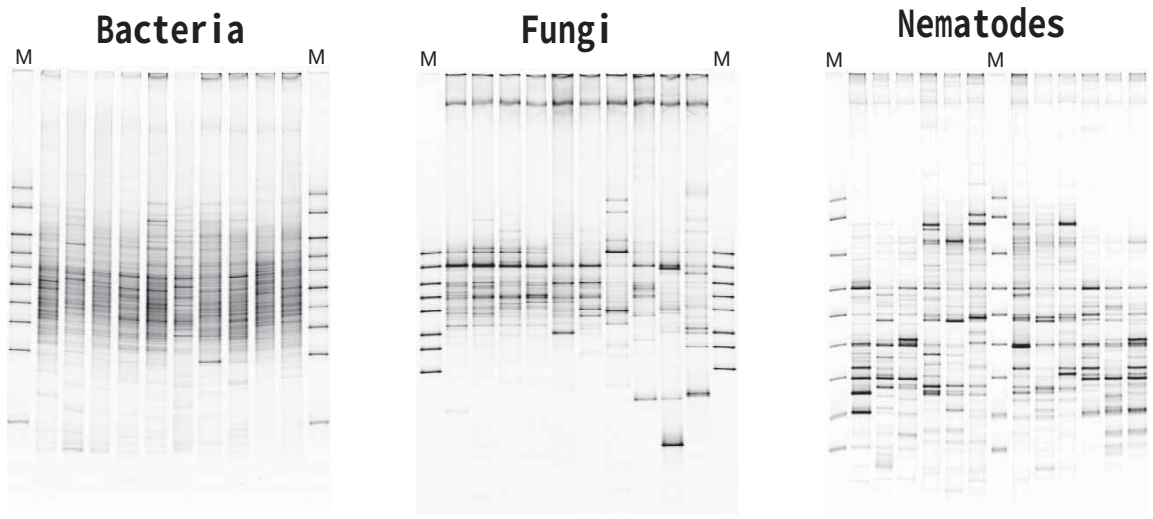


Fig. 4 Soil biological analyses by PCR-DGGE. After electrophoresis of DNA fragments that were extracted from soil and PCR-amplified, community structures could be evaluated as band patterns. Each lane represents a soil sample. “M” indicates the DGGE marker used to compare band patterns across gels.

terns across gels. These markers are now available commercially. Clear and sharp band patterns can be produced by using the standardized and optimized DGGE procedures that we developed (Fig. 4).

Soil DNA database

By analyzing the biological information obtained by using our standardized DGGE procedure we expect to elucidate the mechanisms by which soil biota affect agricultural production. NIAES is now collecting soil samples, or DNA extracted from soils, under various types of agricultural management at different localities from northern to southern Japan and is conducting DGGE to construct a soil DNA database. Our final goal is to determine the relationships between the biological properties revealed by DGGE band pattern analysis and soil physicochemical properties as affected by cultivation practice.
(H. Okada, S. Morimoto, and Y. Hoshino-Takada)

6. Plant surfaces are habitats for yeasts that decomposing biodegradable plastics

Introduction

Waste plastics are bulky and poorly degradable in the environment. About 10 million tons of waste plastics is exhausted in Japan each year, and 150 thousand tons of this is waste from the agricultural industry. Although half of this is recycled, increases in crude oil prices are making it difficult. Against this background, the use of biodegradable plastic (BP) has been promoted globally over the last 5 years. The range of potential applications in which BPs can replace other plastics is increasing because of their handling benefits in terms of biodegradability: as garbage bags, food service cups, and plastic wraps they can be degraded in compost with food wastes, and as mulch films, silage wraps, landfill covers, planter boxes, fishing nets, and bundling string they can be degraded in the field. Because the speed of degradation of BPs by microorganisms is controlled by the temperature, humidity, and nutrient content of the degradation environment, degradation control of BPs remains difficult, and these materials still often persist for a long time after use. If we are to increase the use of BPs we will need to develop further techniques for controlling their biodegradation.

Where can we find BP-degrading microorganisms?

We need to obtain microorganisms that possess a strong ability to degrade BPs. Normally, screening is performed in two steps (Fig. 1). The first step is to isolate microorganisms that can degrade BP-emulsion. The second step is to examine the ability of these microorganisms to degrade solid BPs. There have been many studies of the isolation of such microorganisms from the soil. However, the isolation efficiency of microorganisms degrading solid BPs from BP emulsion-degrading microorganisms is quite low.

Commercially available mulching films made from BPs are composed of mixtures of aliphatic biodegradable polyesters, such as poly-butylene succinate-co-adipate (PBSA), poly-butylene succinate (PBS), and poly ε-caprolactone (PCL). They are solid at room temperature and are synthesized from the polymerization of diols and dicarboxylic acids by esterification. The plant cuticle is composed of cutin, a chloroform-insoluble complex polymer. Cutin consists of a polymeric network of oxygenated

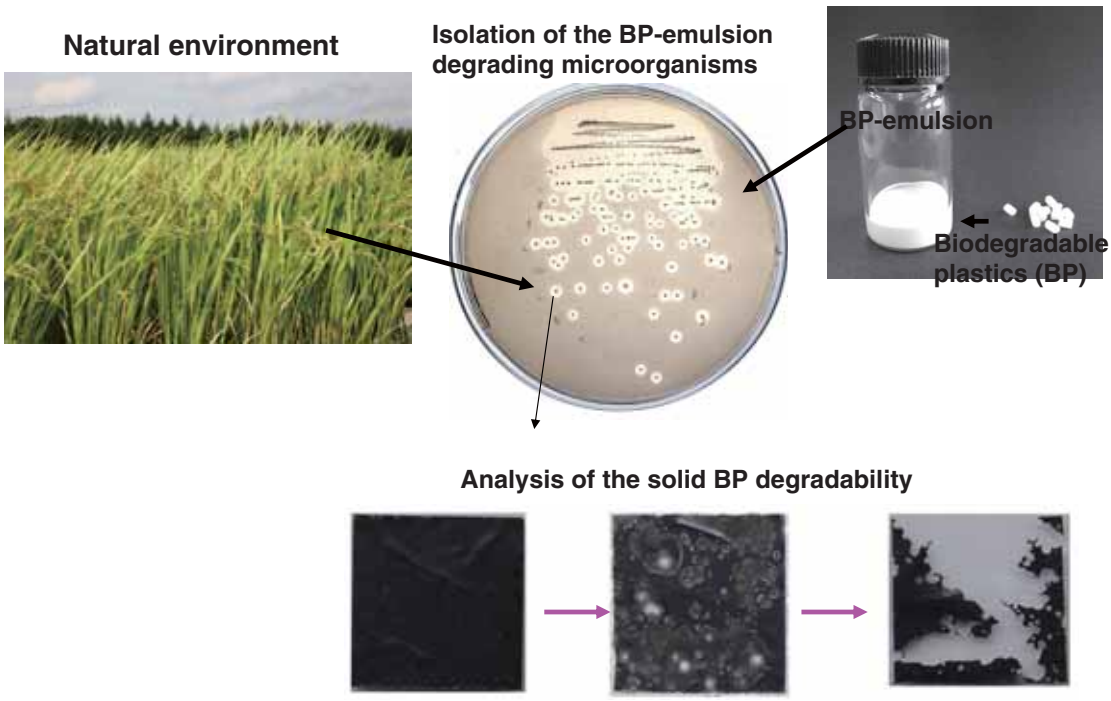


Fig. 1 Steps used in the isolation of BP-degrading microorganisms from the natural environment

C16 and C18 ω-hydroxylated esterified fatty acids, cross-linked by ester bonds. In this way, degradation of the polyesters of both BPs and cutin is eventually caused by cleavage of the ester bonds. We considered this similarity of the structures of BPs and the plant surface important to the BP degradation process. It is well known that phytopathogenic fungi produce cutinase. Plant-epiphytic yeasts (i.e., phylloplane yeasts) are predominant fungal colonizers of healthy leaves. As the yeasts can adhere to plant surfaces under severe weather conditions, we hypothesized that they have the ability to degrade the plant surface in order to create this adhesion. To examine the ability of phylloplane yeasts to degrade BPs, we attempted to isolate BP-degrading yeasts from among phylloplanes.

BP-degrading yeast is isolated from plant surface

From the leaves of the rice plant (*Oryza sativa*) we isolated yeasts capable of degrading solid BP (both PBS and PBSA). We also isolated yeast strains showing solid BP (both PBS and PBSA) degradability from rice seeds in the NIAS GeneBank that had been harvested in various areas in Japan. The yeast strains that degraded BP films were all identified as *Pseudozyma antarctica*. As yeast strains of the genus *Pseudozyma* are often isolated from plants, we wondered whether other species of this genus could degrade BPs. Out of 10 *Pseudozyma* yeast strains obtained from the culture collection of JCM (Japan Collection of Microorganisms, at the Riken Bioresource Center), four degraded solid PBS and PBSA films.

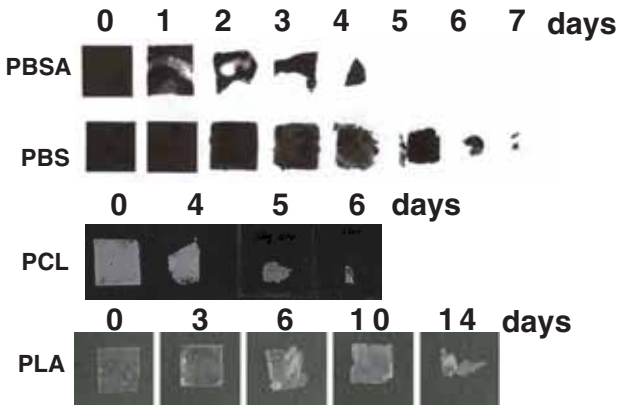


Fig. 2 Degradation of various BP films by a strain of the yeast *Pseudozyma antarctica* isolated from rice plants. PLA was prepared from a product made from 97% PLA and 3% biodegradable polyurethane.

Phylloplane yeasts can degrade various BPs

PBS, PBSA, and PCL are biodegradable at room temperature. In contrast, poly lactic acid (PLA), which is commonly used in waste food trays, plastic films, and plant boxes, is degraded very poorly at room temperature. However, the strain *P. antarctica* could degrade PLA at room temperature. These results showed that phylloplane yeasts could degrade various kinds of solid BPs (Fig. 2).

The yeast *P. antarctica* produces a novel BP-degrading enzyme

We isolated a BP-degrading enzyme from a strain of

BP-degrading *P. antarctica* and identified it as a novel enzyme. The purified enzyme could degrade films made from PBS, PBSA, PCL, and PLA.

We can now easily isolate BP-degrading microorganisms from phylloplanes. These strains show strong BP degradability covering a wide spectrum of compounds. These results will enable us to develop a new technology for degrading BPs.

This study was a collaborative effort of the National Institute of Advanced Industrial Science and Technology (AIST) and the University of Tsukuba.

(H. Kitamoto)

7. Model-coupled agro-meteorological database for estimating the effects of global warming and climate variability on rice production

Introduction

Rice production and quality will be strongly influenced by global warming and climate variability in the near future. In order to predict the effects of these changes on rice production and perform risk assessments of rice production changes under future climate scenarios, we need to examine the impacts of recent climate variability on rice production. We have developed a model-coupled agro-meteorological database for this purpose. The database has two unique characteristics; first it contains daily agro-meteorological elements, some of which are not routinely observed in Japan. Second, the database includes a micro-meteorological model of crop canopy and a rice growth model.

Structure of the database

Figure 1 shows the structure of the model-coupled agro-meteorological database, which contains daily meteorological data for 1980 to 2007 from Automated Meteorological Data Acquisition System (AMeDAS) stations (about 850 sites) and for 1961 to 2007 from surface meteorological stations (156 sites, not represented in Fig. 1). These stations cover the whole of Japan and are the main components of the observation network of the Japan Meteorological Agency (JMA). The daily meteorological information in the database consists of both basic meteorological elements (including air temperature, wind speed, and precipitation) and specific agro-meteorological elements (solar radiation, humidity, downward longwave radiation, FAO-56 reference evapotranspiration, and potential evaporation). Although the agro-meteorological elements are important for clarifying the relationships between meteorological conditions and crop production, they are not observed at AMeDAS stations. We can suc-

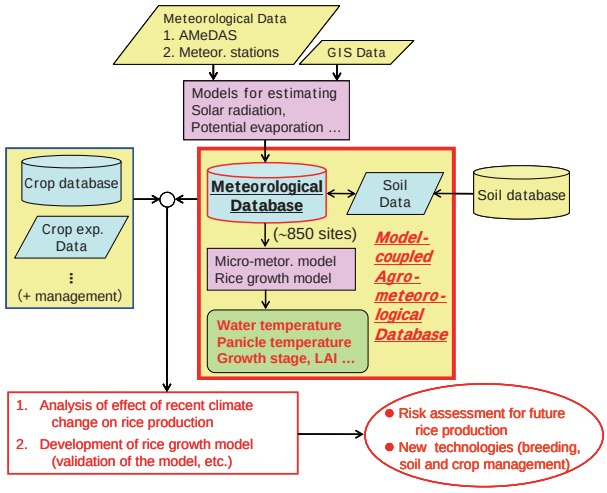


Fig. 1 Structure of the model-coupled agro-meteorological database. The main body of the database is the yellow box enclosed by the red line. LAI: leaf area index.

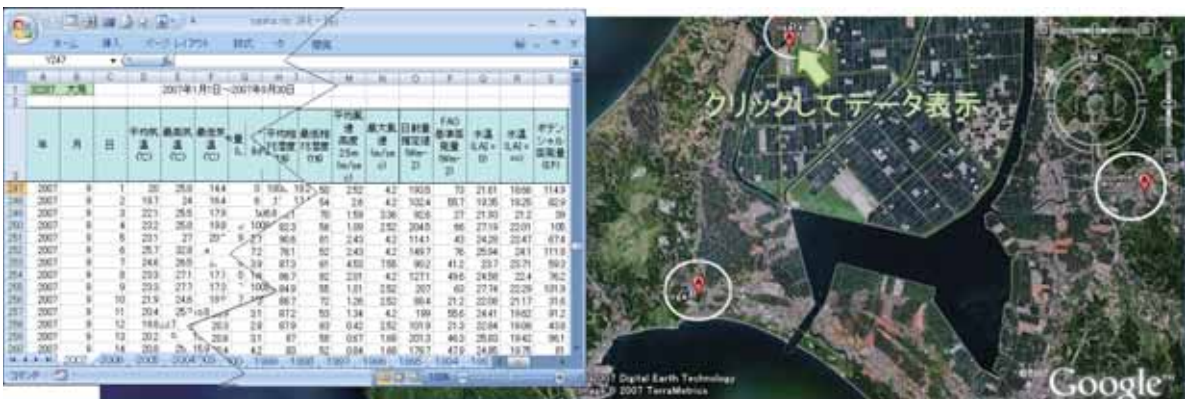


Fig. 2 Example of a screen used to download meteorological data from the model-coupled agro-meteorological database on a PC. The daily meteorological data at any AMeDAS (or surface meteorological) station, which are formatted as MS Excel 2003 (or CSV text) files, can be downloaded easily by selecting the point representing the station on Google Earth.

cessfully estimate those at each AMeDAS station from measured sunshine duration and the data at neighboring surface meteorological stations. Soil type at each AMeDAS station is also included in the database (Fig. 1). The daily meteorological data at any AMeDAS (or surface meteorological) station, which are formatted as MS Excel 2003 (or CSV text) files, can be downloaded easily by selecting the point representing the station on Google Earth (Fig. 2).

Both the micro-meteorological model of crop canopy and the rice growth model are coupled with the database. By applying these two models to the meteorological data at any stations we can easily evaluate the daily mean water temperature in a rice paddy during the growth period, the diurnal variation in rice panicle temperature during the flowering period (Yoshimoto et al. 2005), and the growth stage (heading date) and evolution of leaf area index in the main rice cultivars (Fig. 3). We have already validated the performance of each model by using several experimental data sets, and the models can be used in MS Excel 2003. Water temperature in the rice paddy is one of the most important factors affecting growth and yield of rice, and it can be input to the rice growth model. We have also found that rice panicle temperature during flowering is the most important agro-meteorological factor in heat-induced spikelet sterility of rice.

Usefulness of the database

The model-coupled agro-meteorological database is a powerful tool for use in several kinds of study of rice production under global warming and climate change. By using the database with actual experimental data on rice or statistical data on rice production, we can easily analyze the relationships between several meteorological conditions and rice production. We believe that this database will contribute widely to predictions of the impact of global warming and climate variability on rice production, as well as to the risk assessment of changes in rice production under future climate change and the development of new technologies (e.g. breeding, and soil and crop management) for future rice production.

A web site for the model-coupled agro-meteorological database (in Japanese only, http://meteocrop.dn.affrc.go.jp/) will open in March 2009, at which time a DVD version will also be ready.

(T. Kuwagata, M. Yoshimoto, Y. Ishigooka, and T. Hasegawa)

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Yoshimoto M., H. Oue, N. Takahashi and K. Kobayashi (2005): The effects of FACE (Free-Air CO_2 Enrichment) on temperatures and transpiration of rice panicles at flowering stage. *Journal of Agricultural Meteorology*, **60(5)**,597–600.

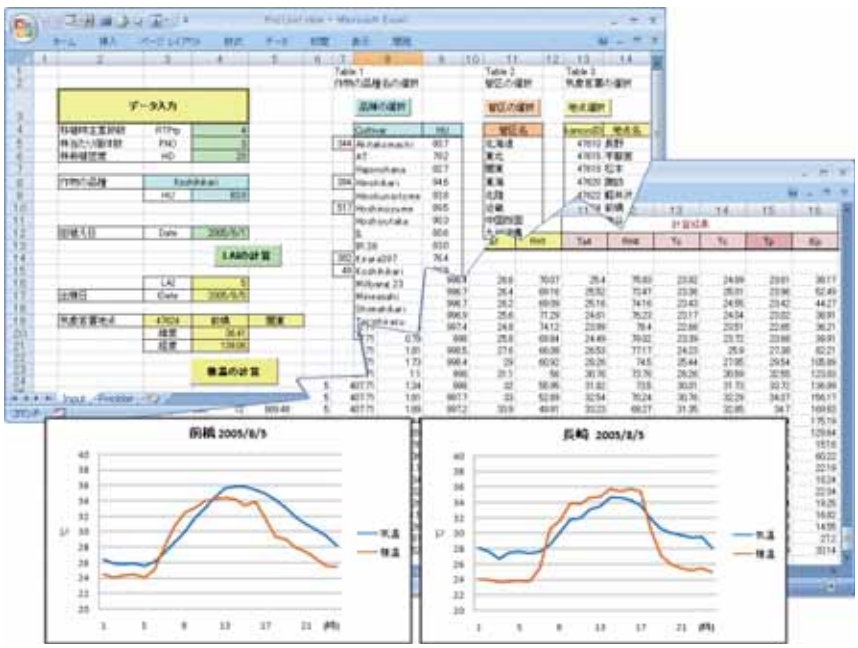

Fig. 3 Example of a screen used for rice-growth modeling and micro-meteorological modeling of the crop canopy from the database. By selecting a meteorological station, we can estimate heading date and leaf area index for the main rice cultivars (upper left) grown near that station and evaluate the diurnal variation of panicle temperature on flowering day (lower right).

8. Development of an automated analyzer for three greenhouse gases

Introduction

Agriculture acts as an absorption sink of Carbon Dioxide (CO_2) [the atmospheric concentration of which is about 383 parts per million (ppm)], because plants grow through photosynthesis, absorbing water and CO_2 during the daytime to produce Oxygen (O_2) and carbohydrates. However, agricultural fields also function as emission sources of CO_2, because the processes of soil and plant respiration occur 24 hours a day. Methane (CH_4) is another greenhouse gas; its atmospheric concentration is about 1.8 ppm—much lower than that of CO_2. However, this concentration of CH_4 is equivalent to 16 ppm of CO_2 in global warming potential (GWP) — GWP is radiative forcing of a unit mass of a given greenhouse gas relative to CO_2 — because GWP of CH_4 is about 25.

The largest global anthropogenic source of CH_4 is rice paddy fields. Anaerobic bacteria, which can produce CH_4, are generally active in wetlands. They are also active in rice paddy fields, which are a type of artificial wetland, because they decompose soil organic carbon. Substantial amounts of CH_4 are therefore emitted from rice paddies.

Rice paddy fields have both source and sink functions during the cultivation season. Photosynthesis by rice plants absorbing CO_2 is highest in mid-summer, and CH_4 emissions from the activity of anaerobic microbes is also highest in this season. Rice paddies have positive net GWP values, meaning that they warm the Earth.

In upland fields, because the soil conditions are aerobic, Nitrous Oxide (N_2O) can be emitted and CH_4 absorbed, rather than emitted. The GWP of N_2O is about 298, but the atmospheric concentration of N_2O, at about 0.321 ppm, is much lower than that of CO_2. N_2O is produced by microbial nitrification or by denitrification of nitrate originated from chemical or organic fertilizers. Therefore, we have to consider three major greenhouse gases—CO_2, CH_4, and N_2O—if we are to mitigate net emissions from agricultural fields, and we need to estimate the global warming potential of each agricultural field by calculating the aggregated GWP of CO_2, CH_4, and N_2O.

It is necessary to measure gas concentrations at least three times (e.g. at 0, 10, and 20 min of gas monitoring) per treatment event in order to plot emission rates in order to plot emission rates from the soil over time. To guarantee the reliability of the measurements we need to perform three replications using the same treatments but in three different patches of soil. Simultaneous measurement of the three gases plays an essential role in efforts to reduce net greenhouse gas emissions by minimizing net CO_2-equivalent gas emissions; it is particularly important for observations of the relationships among gas emission patterns. We therefore need (measurement at 3 times × 3 replications per time × 3 treatments =) 27 gas samples to assess the effects of three different fertilizing treatments of each upland field soil plot on the emissions of one gas. Because at least 5 minutes is spent in measuring each gas in each sample, the total time taken for a manual analysis of all three gases is 6 or 7 h (about 400 min). Thus, substantial effort and time are required to manually monitor greenhouse gas emissions from agricultural ecosystems.

Automated analyzer for three greenhouse gases

We developed an automated and simultaneous analyzer to reduce the effort required to measure the concentrations of the three greenhouse gases (CO_2, CH_4, and N_2O) and thus enable more frequent analysis. The system, named the 'Automated analyzer for three greenhouse gases', was developed through several ideas based on the gas chromatography (GC). Figure 1 shows the analytical system, and Figure 2 gives a system diagram. Gas samples are separated by the three separation column stages; complete gas separation had previously been technically difficult. CH_4, CO_2, and N_2O are separated completely by using the second column, which has very high separation efficiency for inert gases. Then, the third columns stabilize the flow of carrier gases. For detection of gases, helium carrier gas was used for necessity of CO_2 measurement, whereas a mixture of 95% argon and 5% CH_4 is used to detect N_2O. We use a helium carrier gas which was highly purified by chemical purifier to detect N_2O with high response, adding a small flow rate of N_2 (<20 mL/min) and CH_4 (<0.1 mL/min) to dope the electron capture detector (ECD). Simultaneous measurement of CH_4, CO_2 and N_2O is achieved, consequently. One of advantages of the system is that the measurements of the

Fig. 1 Overview of the automated three-greenhouse-gas analyzer.

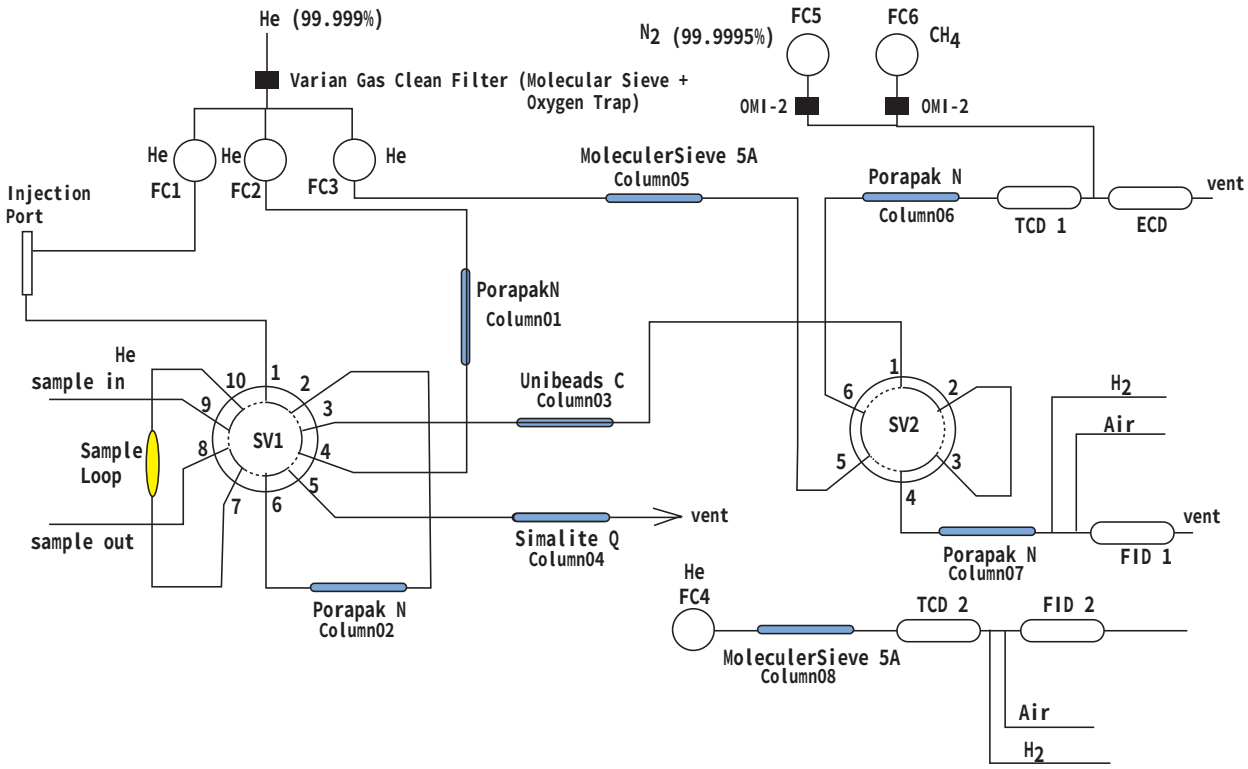

Fig. 2 System diagram of the automated three-greenhouse-gas analyzer.

three species are free from injection-volume differences, because the same sample is used for all three gas detections. The precisions of the system is equal to that of conventional measurement methods in terms of detection response reproducibility for the three gases in the same samples. For gas injection into GC (gas chromatography) systems, we developed an automated gas sample injection system equipped with a 2-mL gas-tight syringe and a modified commercially available headspace gas sampler. We designed a new cone-shaped needle guide through which the syringe needle penetrates the polymerized butyl rubber lid sealing the glass vial containing the gas sample.

The system can measure each set of 40 gas samples in 10 min. Specific manufacturers were not designated for the method because it is applicable to any company's GC system (the setup in Fig. 1 is just one example).

We hope that this analytical system will be used effectively in studies of reduction of greenhouse gas concentrations; in such studies the system will enable the use of shorter analytical intervals and greater precision of gas analysis than with conventional methods. The Japanese patent on this invention was published unexamined (application no. 2006-275844) in October 2006 in Japan.
(S. Sudo)

9. Online database for the wide-area collection and sharing of crop calendars

Preface

Crop calendars are records of growth over time recorded together with cultivation methods and other information. Crop calendars are created for various purposes, including promoting the spread of new cultivation methods, creation of a production area, organizing cultivation experiment results, and as part of local area research. Looked at another way, they could be seen as factual data showing what has actually been grown, or can be grown in a particular location. As such, they could be used to advantage in helping to interpret remote sensing images, or in combination with meteorological data to create sophisticated crop growth models.

However, crop calendars are prepared in a wide variety of formats according to purpose, and because little attention has been paid to preserving them after they have served their purpose, collecting and reusing them has involved a great deal of labor. We have accordingly created an Internet-based database that provides an easy means of collecting, storing, and using crop calendars.

Diverse crop calendars and their quantification

Because they have been created for various purposes and crops, crop calendars differ widely in both form and

content. For this database, crop calendars are saved by entering information into the following three tables: Overview (crop name, year, etc.), Quantification Rule (cultivation event entered, format, etc.), and Quantified Calendar (data based on quantification code) (Fig. 1). Using this method enables crop calendars in a wide variety of formats to be recorded in a unified format and enables crop calendars to be displayed as simple numerical tables. This allows the contents of crop calendars in the same format to be directly compared as numbers, and even with crop calendars of different formats, corresponding components can be compared with some relatively simple number processing. Outlines of the area to which crop calendars apply and photos of locations can also be stored on the database.

Collection and sharing of crop calendars

It is only when many crop calendars have been collected and are being used by all kinds of people that they create new value, and it is for this reason that we decided to built an online database and make it accessible to all (Fig. 2). Anyone can search and obtain crop calendars without any registration or other procedures by visiting http://dccw.dc.affrc.go.jp.

To collect as many crop calendars as possible, we have also enabled data to be entered via the Internet by researchers and research bodies who endorse this initiative to share calendars. Submitting crop calendars to the database enables researchers and research bodies to save valuable information in a form that is useful to society at large instead of allowing it to become scattered and lost.

In addition to this open data usage, the database includes a feature for disclosing specific crop calendars to designated users only. This feature enables research groups possessing crop calendars that are not yet ready for general disclosure to share valuable information among group members and thus boost research productivity. Once the research has been completed, such calendars can then be made available for re-use by people throughout the world.

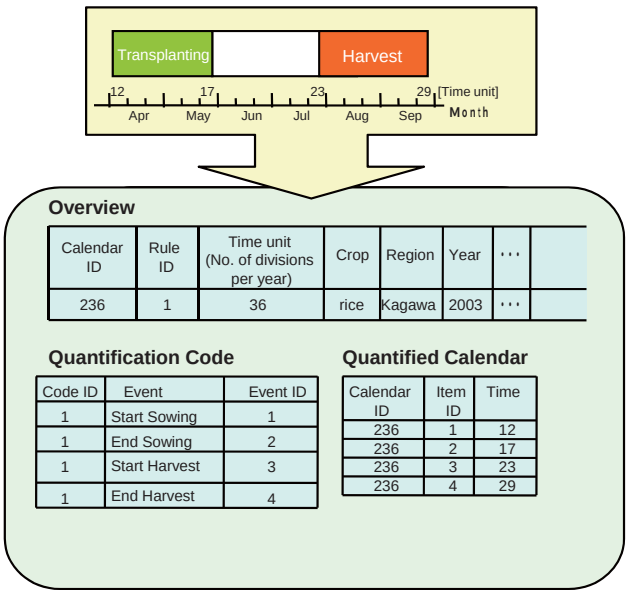

Fig. 1 Diagram showing format for recording crop calendars
Using a 2003 paddy rice crop calendar from the Kagawa district of Kagawa Prefecture, this diagram shows how a crop calendar is recorded in the database. Calendar data is entered into Overview, Quantification Rule, and Quantified Calendar tables.

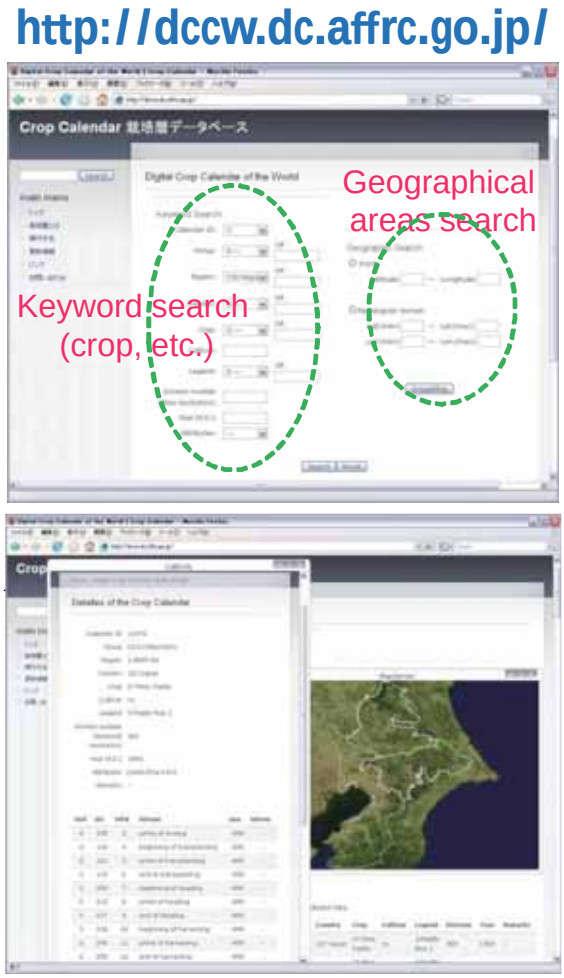

Fig. 2 Crop calendar database screenshots
Crop calendar data is posted on the Internet, and can be accessed and used by anyone with a Web browser (top). Searches using keywords (such as crop name) or geographical areas generate matching cultivation records and bring up relevant maps (bottom). Search results can also be downloaded.

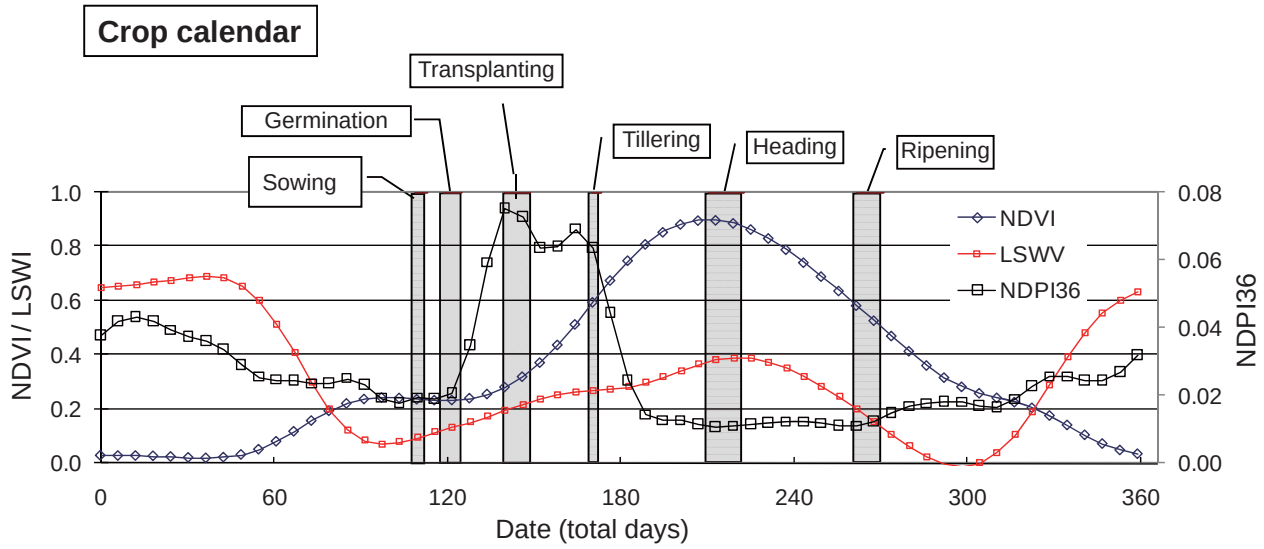

Fig. 3 Combination of a crop calendar for a paddy field in China's Heilongjiang Province (lat 46.94°N, long 130.28°E) with indices derived from satellite data

We processed daily satellite data from 2005–2007 to calculate average seasonal fluctuations, and combined this with the crop calendar. The indices calculated from MODIS images that correspond to vegetation (NDVI) and to wet surfaces (LSWI) reveal seasonal fluctuations in paddy rice cultivation. The NDPI36 index calculated from AMSR-E images also corresponds to water quantity conditions, rising steeply in the transplanting period, and then dropping back to a low level and increasing again from the harvest period.

An example of crop calendar database use

Observing paddy fields with satellite sensors such as MODIS and AMSR-E that have high time-frequency and then combining vegetation or wet surface indices with observation times provides a picture of seasonal fluctuations in such indices for paddy fields. We downloaded the crop calendar for China's Heilongjiang Province from the crop calendar database, and compared it with these satellite-based observations (Fig. 3).

As a result, we discovered that the distinctive change over time shown by NDPI36, an index calculated from AMSR-E images, corresponds to transplanting and harvest periods. The crop calendar thus holds promise as a means of ascertaining paddy rice transplanting and harvest periods from satellite images, something that has up to now been difficult to accomplish.

(H. Ohno*, N. Ishizuka and T. Sakamoto)

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10. Elucidating the mechanisms behind the high plant diversity in *yatsu* (valley floor) paddy field areas: how cutting grass around paddy fields helps to promote diversity

Preface

Rural areas in Japan once encompassed expanses of semi-natural meadow dominated by Japanese pampas grass (*Miscanthus sinensis*) but including a large diversity of other grassland flora. This grass was cut periodically as a source of fertilizer and livestock fodder. Changes in lifestyle and production methods have, however, led to a dramatic decrease in the area of these semi-natural meadows. As a result, as pointed out by the National Biodiversity Strategy of Japan, a great many grassland animal and plant species now risk extinction. Japanese pampas grass–based plant communities can be seen even today in abandoned farmland and abandoned development land, but such communities have apparently not been colonized by other grassland flora and fauna.

In contrast to such land, *yatsu* ("valley floor") paddy fields surrounded by hills or other high land feature grassy verges (referred to as "traditional verge meadows") at the base of adjacent forested slopes that are cut periodically to prevent vegetation from casting shade over the paddy fields. In an attempt to elucidate the mechanisms at work behind the rich biodiversity evident in the traditional

verge meadows surrounding *yatsu* paddy fields, we compared the biodiversity of these traditional verge meadows, which are also dominated by Japanese pampas grass, with that of cleared but abandoned land and previously investigated semi-natural grasslands.

Analysis of vegetation data

We surveyed plant communities in 66 locations in the southern region of Ibaraki Prefecture (the Tsukuba Inashiki Plateau). The locations included traditional verge meadows along the edges of *yatsu* paddy fields (Fig. 1), abandoned farmland on the top of the plateau, land that had been developed for housing or quarrying, and Japanese red pine (*Pinus densiflora*) forest floors (formerly meadows cut for their grass, and still periodically cleared of undergrowth). We chose locations dominated by Japanese pampas grass, and we recorded the degree of cover, sociability, and plant height for all plant species found in each of the chosen locations. On the basis of multivariate analysis of the survey data, locations were divided into the following types: valley floor (C1: largely yatsu paddy field traditional verge meadows), pine forest (C2: mostly Japanese red pine forest floor), and flatland (C3: fallow farmland on the top of the plateau and developed land) (Table 1).

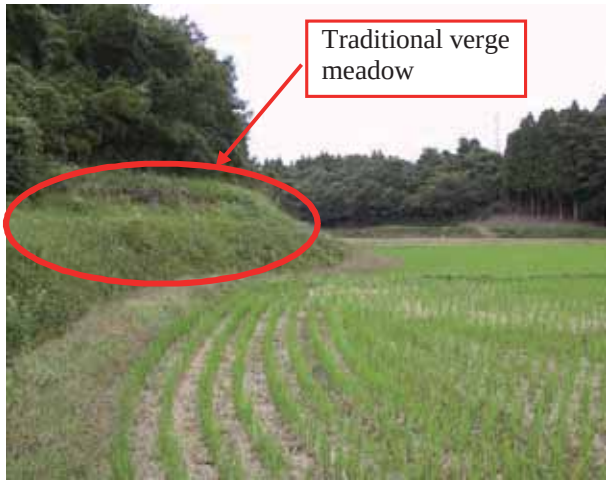


Fig. 1 Traditional verge meadow in a *yatsu* landscape

We compared the species composition (a combination of all species found in each location and the coverage of each species) of plant communities in each location type by using a multivariate analysis ranking method. We also referred to past vegetation survey data (obtained in the 1970s and 1980s on what were then semi-natural grasslands on the Kanto Plain) to compare present-day data with data from the era in which meadows were cut for fertilizer or fodder. Our comparison showed that traditional verge meadows (C1) and pine forest understory (C2) had a high diversity of native perennials such as *Sanguisorba officinalis*; this diversity was on par with the diversity shown by meadows surveyed in the past. The flatland (C3) type of habitat, on the other hand, showed a clear lack of diversity (Fig. 2). Compared with the pine forest type, which owes its high diversity to the abundance of forest floor species, the verge meadow type owes its high diversity, as did the semi-natural grasslands of the past, to the presence of many rarer plant species such as *Eupatorium fortunei*. This suggests strongly that the periodic cutting of the grass on the land adjacent to valley floor paddy fields is helping to sustain the plant diversity of the habitat.

Investigating change in area of traditional verge meadow by using RuLIS

Because of the difficulty of cultivating rice in *yatsu* paddy fields surrounded by forest, there are fears that a growing number of such paddy fields are falling into disuse. Accordingly, we estimated the length of paddy field

Table 1 Classification of grassland vegetation in Tukuba-Inashiki upland

Classification		Numbur of site				Nowing /every year	Numbur of species				Ratio of alien species	Indicator species
		Tatal	Traditional verge meadow	Unused glassland	Understory of pine forest		Total	Annuals	Perennials	Trees		
	C1	23	20	3	-	○	45.8	9.0	26.7	9.9	7.1	*Sanguisorba officinalis , Pleioblastus chino , Dioscorea japonica , Justicia procumbens , Thalictrum minus* var. *hypoleucum , Imperata cylindrica*
	C2	20	2	3	15	○	51.3	4.7	27.6	18.9	10.9	*Sanguisorba officinalis, Pleioblastus chino , Aster scaber , Dioscorea japonica , Pinus densiflora , Smilax china , Arundinella hirta , Solidago virga-aurea*
	C3	23	-	23	-	×	19.5	7.1	9.9	2.4	23.0	*Setaria faberi , Andropogon virginicus , Taraxacum officinale , Oenothera biennis , Erigeron canadensis , Lespedeza cuneata*
Refarence Data * (1970s～1980s)	P	19	-	-	-	○	31.2	0.7	13.5	17.0	0.1	*Sanguisorba officinalis , Pleioblastus chino , Potentilla freyniana , Thalictrum minus* var. *hypoleucum , Adenophora triphylla*

C1: Traditional verge meadow, C2: Understory of Pine forest, C3: Unused grassland, P: Reference data*
*Vegetation data of past seminatural grassland compiled in the 1970s and 1980s.

banks adjacent to forests in the case of *yatsu* paddy fields in the plateau area of the eastern Kanto Plain (Chiba–Ibaraki Prefectures), and we looked at changes in this length over time (Fig. 3). To do this, we applied RuLIS (Kusumoto et al. 2005), a survey information system currently being developed at NIAES, to quantitative land-use data compiled by the Geographical Survey Institute; these data quantify area according to land use within every cell of a mesh dividing the whole of Japan into 1-km^2 units. Our investigation revealed a marked decline between 1976 and 1997 in the number of cells containing a high total length of paddy field banks adjacent to forests, signaling that locations surrounding *yatsu* paddy fields that support high plant diversity as a result of periodic mowing are indeed declining in area.

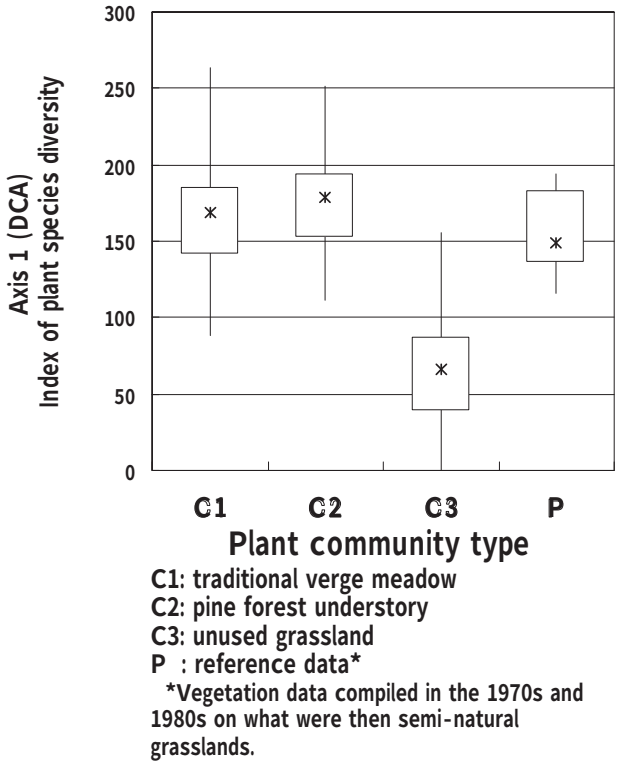


Fig. 2 Comparison of plant species diversity between past and present grassland.

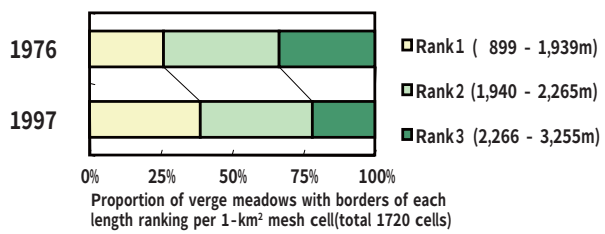


Fig. 3 Change in boundary length of traditional verge meadows between paddy fields and forest in *yatsu* landscapes.

Conclusion

Our research demonstrated that preserving the diversity of plant communities in areas of *yatsu* paddy fields requires the maintenance of traditional verge meadows lying between the *yatsu* paddy fields and the forests; this in turn requires the continued cultivation of rice in the *yatsu* paddy fields and concomitant periodic mowing of the verges as one of the processes essential to rice cultivation in such locations.

(Y. Kusumoto and S. Yamamoto)

Reference

Kusumoto Y. and S. Yamamoto (2005): Rural landscape information system(RuLIS) for conservation of biodiversity in rural area. NIAES Annual Report 2006, 8–9.

11. The impact of global warming on rice production
Lessons from spikelet sterility observed under the record hot summer of 2007

Spikelet fertility during the abnormally hot summer of 2007

Predicted levels of global warming will have a marked effect on the growth, yield, and quality of rice. In particular, even short spells of extreme heat around the time of flowering can cause a dramatic drop in grain yield as a result of poor pollination. Previously, many chamber experiments showed that a rise in temperature above 35°C during flowering of rice results in a high percentage of sterile spikelets due to failure of pollination, but the occurrence of sterility in actual paddy fields has not yet been sufficiently studied.

Many areas in the Kanto and Tokai regions of Japan experienced abnormal heat during the summer of 2007, with, for example, an unprecedented 40.9°C being recorded in August in Kumagaya and Tajimi. Such abnormally high temperatures were in the range that can cause heat-induced sterility which has not yet been reported in the Japanese rice industry. To better understand the potential risk of crop failure and the possible impacts of future global warming on rice cultivation, we needed to determine the degree of crop damage in the open fields during the hot summer of 2007. The National Institute for Agro-Environmental Sciences (NIAES) and the National Institute of Crop Science (NICS, an institute belonging to the National Agriculture and Food Research Organization [NARO]) jointly investigated sterility in 132 paddy fields located in five prefectures (Gunma, Saitama, Ibaraki, Gifu, and Aichi) between late July and late August of this year to identify and analyze any heat-induced damages on rice.

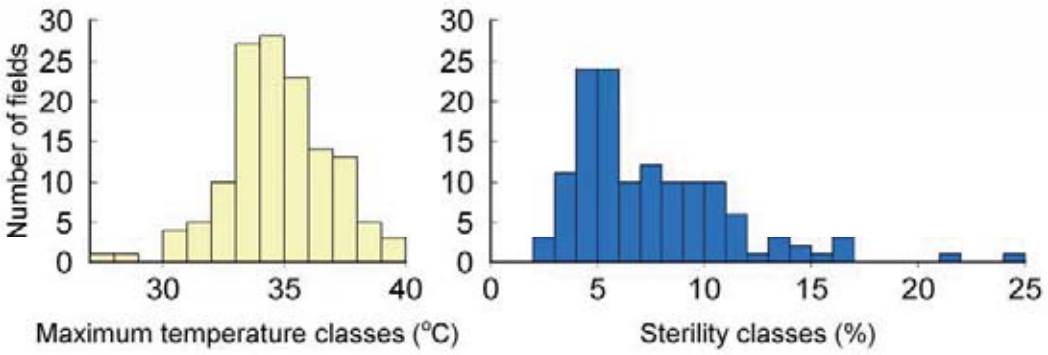


Fig.1 Frequency distributions of maximum temperature during the 5-d period around flowering in study fields (5 days) and percentage of sterile spikelets (for both Kanto and Tokai regions combined).

Occurrence of heat-related sterility under the field conditions

Examination of data recorded at the government meteorological stations and AMeDAS (Automated Meteorological Data Acquisition System) points near the studied paddy fields revealed that more than 40% of the paddy fields experienced maximum temperatures of over 35°C during the 5-d period around flowering. A sterility percentage of about 5% is generally expected under normal conditions, but about 20% of the paddy fields investigated showed sterility rates of over 10% (Fig. 1).

We collected panicle samples from 34 experimental plots at the NIAES paddy field, which differed widely in flowering dates depending on the plots, and measured the spikelet sterility. Sterility was below 10% in the plots where flowering occurred before August 10 and on August 20; the daily maximum temperatures were relatively low. A sterility rate as high as 23 % was observed in the plots where flowering occurred around the date when the maximum temperature of 38.6°C was recorded (Fig. 2). However, even in the plots where flowering occurred around the hottest day, sterility rates varied widely between 10% to 23% depending on the amount of nitrogen fertilizer used and the cultivar of rice planted. This suggests that technical options may be available to reduce the adverse impacts of high temperature.

Sterility rates of the same cultivar obtained from different prefectures tended to increase as temperature around flowering rose, but even where temperatures reached 38°C, sterility at some sites was not noticeably high (Fig. 3). Previously, chamber experiments showed that sterility increases almost linearly with temperatures above 35°C at the time of flowering to reach almost 100% at 40°C or higher, but the sterility rates observed in paddy fields in 2007 were lower than those that could be expected from the response to increased temperature in the previous chamber experiments (Figs. 1, 3).

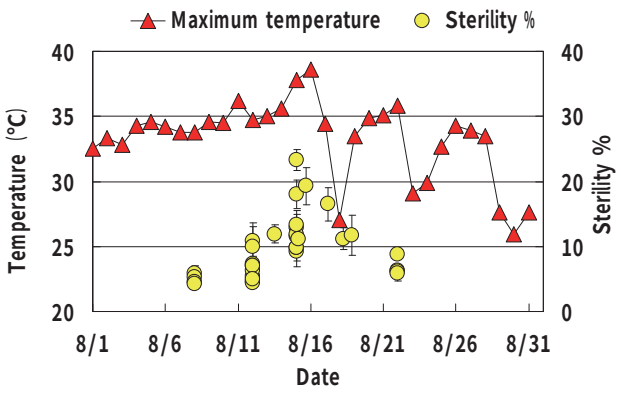


Fig. 2 Daily maximum temperatures and sterility rates of the rice plants of different flowering dates collected from the NIAES experimental paddy fields.

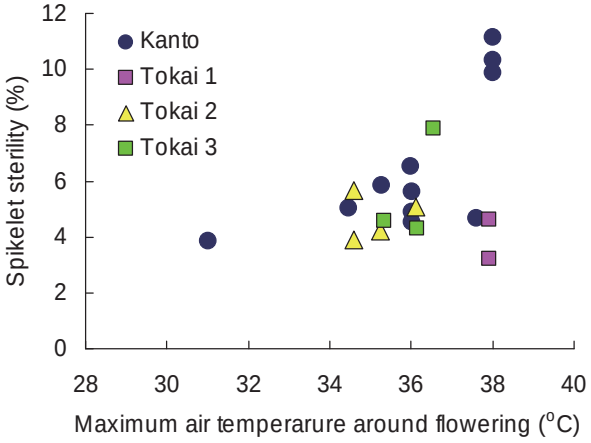


Fig. 3 Relationship between spikelet sterility and maximum temperature during the 5-d period around flowering for a widely planted cultivar. The results from the Fig. 1 field survey. Different symbols indicate different regions.

The difference between closed experiments and open paddy fields

One possible explanation for the fact that the actual sterility rate during the high temperature period in 2007 was below the sterility rate that could be expected from the maximum recorded temperature is that the temperature of the panicle that is the sensitive organ differed from air temperature. We accordingly estimated panicle temperatures in mid-August in the Kanto and Tokai regions, using a heat balance model that was previously developed to estimate panicle temperatures of rice. Spatial distribution of panicle temperature during the hours of rice flowering (10:00 - 12:00) does not necessarily match daily maximum temperature distribution (Fig. 4). This is because, in addition to the temperature during flowering hours being lower than daily maximum temperature, other meteorological factors such as solar radiation, wind speed and humidity also affect panicle temperature. The correlation between panicle temperature and sterility was higher than the correlation between daily maximum temperature and sterility. The above factors can be major reasons why the sterility rate was lower than expected given the high maximum temperature. It is also worth noting that within the whole region, the area of rice exposed to high temperatures during the flowering time was relatively small, and as a result, major yield losses due to heat-induced sterility did not occur.

Predicting sterility caused by high temperature and developing techniques for its avoidance

To date, the impacts of future global warming on agriculture have been based on changes in air temperature, but this study demonstrates that impacts cannot be accurately assessed on the basis of changes in air temperature alone. In the case of the Kanto and Tokai regions in 2007, estimated panicle temperatures were not necessarily as high as air temperature. However, high humidity or windless conditions may cause panicle temperature to exceed air temperature. The risks of yield losses due to heat-induced sterility, therefore, need to account for the effect of panicle temperatures, which can vary depending on various micro-climatic conditions. It is also worth noting that there is a considerable variation in spikelet sterility under extreme heat conditions, depending on cultivars and management practices such as fertilizer application, suggesting the possibility of reducing the damage due to high temperature. We believe that understanding these mechanisms influencing the occurrence of sterility will help to contribute to the development of countermeasures against damage caused by high temperature events, which may occur more frequently in the future.

We would like to express our heartfelt thanks to Gunma Agricultural Technology Center, Saitama Prefecture Agriculture and Forestry Research Center, Ibaraki Agriculture Institute, Aichi Agricultural Research Center, Gifu Prefectural Agricultural Technology Center, and Tono Toki Agricultural Extension Center (Gifu Prefecture) for their help in selecting paddy fields and collecting samples. We are also deeply indebted to the personnel at NIAES and NICS who measured the fertility of approximately 700,000 spikelets.

(T. Hasegawa, M. Yoshimoto, T. Kuwagata, Y. Ishigooka, M. Kondo* and T. Ishimaru*)

*NARO NICS Rice Physiology Research Team

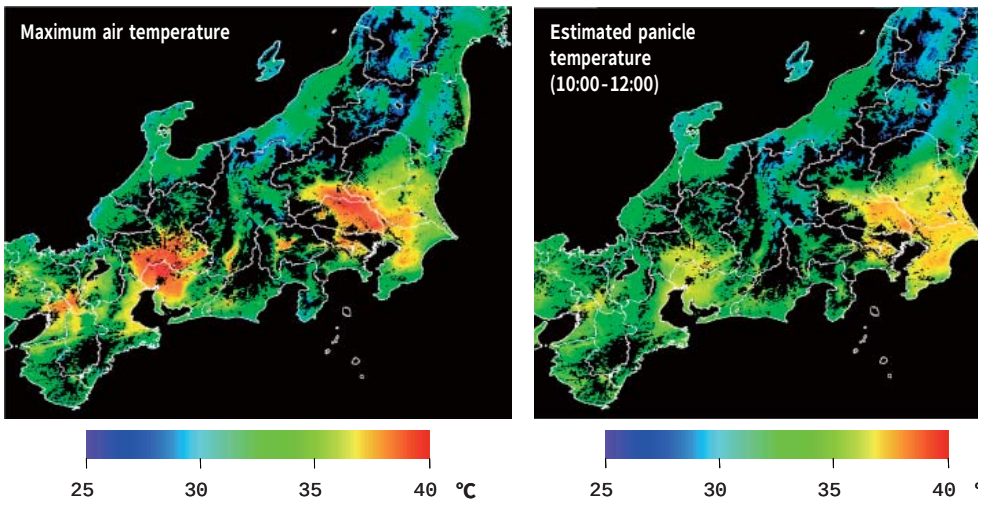


Fig.4 Maximum air temperature on August 16, 2007 (left) and estimated ear temperature for flowering hours on the same day (10:00 – 12:00) estimated using a panicle temperature estimation model (right).

Major Symposia and Seminars

1. The 27th Agro-Environmental Symposium, "Food vs. Energy: the Scramble for Grains has Begun"

Biofuels are in the spotlight as energy sources that will compensate for the depletion of fossil fuels and effectively combat global warming. However, the contest between the use of grain as food and its use as energy feedstock is becoming more apparent during the recent escalation of the price of oil. We need a wide-ranging discussion on food security in the face of this new era of competition.

Against this setting, the 27th Agro-Environmental Symposium, entitled "Food vs. Energy: the Scramble for Grains Has Begun" was held on 23 May 2007 at Iino Hall in Tokyo by NIAES with the support of the Ministry of Agriculture, Forestry, and Fisheries of Japan; the Graduate School of Agricultural and Life Sciences at the University of Tokyo; the Foundation of Agricultural Sciences of Japan; the Agriculture, Forestry, and Fisheries Technical Information Society; the Society for Techno-innovation of Agriculture, Forestry, and Fisheries; and Toyo Keizai Inc. Planning cooperation was provided by World-Watch Japan. There were a total of 321 participants.

The symposium opened with a speech by Yohei Sato, President of NIAES. Earth Policy Institute President Lester Brown delivered the keynote speech, entitled "Biofuels Threaten Our Dinner Tables".

A summary of his speech follows:

After the extensive damage caused in the US by hurricane Katrina in 2005, oil prices surged, leading to increased production and use of biofuel (ethanol) made from corn as a feedstock. It is anticipated that environmental problems such as deforestation and ecosystem damage will occur worldwide because of the increased allocation of acreage to biofuel crops. Rising grain prices will affect not only livestock production but also consumers' food budgets. Worldwide competition for grain between the 800 million who use motor vehicles and the 2 billion who live in poverty will result in the poor experiencing a severe blow, but resolution of this situation is currently being left to the market principle.

It is imperative that we stop now the new construction of ethanol plants; at the same time, we must proceed quickly with the development and use of plug-in hybrid vehicles, which use electricity for fuel, and with the increased use of wind energy and other renewables to generate the electricity for such vehicles. We must also analyze the impacts of biofuel manufacture on sectors such as food security, politics, the economy, and the environment; we must predict these impacts and take measures to address the anticipated events. As the situation now stands, we cannot stop the trend toward diversion of grains to biofuels, and we stand at a critical crossroads.

Following the speech, Brown and three panelists, Ryohei Kada (Amita Institute for Sustainable Economies), Ruan Wei (Norinchukin Research Institute Co., Ltd.), and Hiroyuki Suematsu (Ministry of Agriculture, Forestry and Fisheries Minister's Secretariat, Environmental Policy Section) held a panel discussion coordinated by Hiroko Akiyama (Senior Researcher at NIAES), with some questions from the floor.

The main points in the panel discussion were the following.

(1) Oil prices are anticipated to remain high, so increasing biofuel production will probably affect supplies and prices of animal feed and human food.
(2) The biofuel boom will have a heavy impact on Japan's livestock industry and food production. It is important to use idle farmland to cultivate biomass fuel crops; it is also important to perform research and development on the use of straw, other non-edible plant parts, and wastes to produce biofuels.
(3) It is necessary to create international rules for the production and trade of biofuels. Specifically, the rules should include performing life-cycle assessments of CO_2 emissions in the production, processing, and transport of biofuels; alleviating further environmental damage caused by farmland development; and, with a view to securing staple foods, not threatening the food security of small farmers and the poor.
(4) It is important that Japan raise its rate of food self-sufficiency. We must not forget that agriculture not only produces food but also provides environmental services such as securing water resources.
(5) International technical cooperation is needed in plant breeding, cultivation techniques, and other areas to raise the productivity of plants cultivated for biofuel feedstock. Japan should cooperate with other Asian countries in the effort to achieve energy production that does not interfere with food production. (T. Makino)

2. ESAFS8, "New Challenges of Soil Science for Harmonizing Food Production with Environments: Sustainable Agriculture to Take over Our Natural Resources the Next Generation"

The Eighth Conference of the East and Southeast Asian Federation of Soil Science (ESAFS8), entitled "New Challenges of Soil Science for Harmonizing Food

Production with Environments: Sustainable Agriculture to Take over Our Natural Resources to the Next Generation", was held from 22 to 23 October 2007 at the Tsukuba International Congress Center. This conference was organized and sponsored by the East and Southeast Asian Federation of Soil Science (ESAFS), the National Institute for Agro-Environmental Sciences (NIAES), the Japanese Society of Soil Science and Plant Nutrition (JSSSPN), the Japan International Research Center for Agricultural Science (JIRCAS), the National Agricultural Research Center (NARO-NARC), and the Food and Fertilizer Technology Center for the Asian and Pacific Region (FFTC). The conference was attended by a total of 305 participants, including 117 from 12 Asian countries.

ESAFS aims to promote research in soil and related sciences and to disseminate the acquired knowledge and technology for the benefit of member societies in the East and Southeast Asia region. By so doing, ESAFS will contribute to the sustainable development of the region through harmonization of agricultural production and environmental protection. ESAFS supports the international conference, which has been held every other year from 1991 at Osaka to exchange information about these aims.

On the first day of the conference, after the opening and welcome address by Prof. Tadakatsu Yoneyama (President, JSSSPN) and Dr. Yohei Sato (President, NIAES), the nine invited speakers gave excellent and informative lectures on the latest subjects in Asian soil science. The topics were:

- Water savings in irrigated rice: Implication on nutrient management and sustainability (To Phuc Tuong, IRRI, Philippines)
- Whether water saving reduces the global warming potential of irrigated paddies (Yasukazu Hosen, JIRCAS, Japan)
- Paddy-upland rotation induces deterioration of soil fertility (Mizuhiko Nishida, NARCT, Japan)
- Use of alkaline tolerant plant for the improvement of high alkali soil in Northeast China (Zhengwei Liang, CAS, China)
- P and Zn deficiency in rice: Tolerance mechanisms and underlying genetic factors (Matthias Wissuwa, JIRCAS, Japan)
- Enhancing tolerance in rice to low iron availability in calcareous soils (Naoko K. Nishizawa, The University of Tokyo, Japan)
- New aspect of collaborative research on the soil pollution, food safety and soil remediation techniques in Asia (Zueng-Sang Chen, National Taiwan University, Taiwan)
- Heavy metal pollution, risk assessment and remediation in paddy soil environment: Research experiences and perspectives in Korea (Jae E. Yang, Kangwon National University, Korea)
- Heavy metal pollution of soil and a new approach to its remediation, research experiences in Japan (Tomoyuki Makino, NIAES, Japan)

On the second day of the conference four oral sessions were held to discuss the current status of research and future research strategies, as follows:

- Oral Session 1: Reports from Member Societies.
  This session was organized by Prof. Makoto Kimura (Nagoya University). The 12 speakers—one each invited from Bangladesh, China, India, Indonesia, Japan, Korea, Malaysia, the Philippines, Sri Lanka, Taiwan, Thailand, and Vietnam—revealed the soil science issues and the current activities of soil science societies in each country.
- Oral Session 2: Distribution, Bioavailability, and Management of Heavy Metals
  This session was organized by Prof. Zueng-Sang Chen (National Taiwan University). The six speakers, invited from Japan, Korea, Malaysia, the Philippines, Taiwan, and Thailand, reported on the current status of heavy metal contamination in agricultural land and the development of control technologies, mostly for cadmium contamination.

- Oral Session 3: Soil Genesis, Classification, and Management
  This session was organized by Dr. Takeshi Ota (NARO-NARC). The six speakers, invited from China, Japan, Korea, Malaysia, and Sri Lanka, lectured on the development and application of soil information systems incorporating global information systems; fertility management in problem soils; and water management to save irrigation water.
- Oral Session 4: Plant Nutrition, Fertilizer Application, Microorganism, and Environment
  This session was organized by Dr. Takeshi Watanabe (JIRCAS). The six speakers invited from Japan, Korea, and Thailand reported on the evaluation of nutrient dynamics for sustainable agriculture; microbe control in soils, control of greenhouse gas emissions, and carbon sequestration for global warming mitigation.

During the 2-day oral presentation, 195 posters were presented in the two conference rooms. The core time for discussion in front of the each posters was set at 13:00 to 14:00 on 23 October. A tour of Kanagawa, Shizuoka, and Aichi prefectures was held from 24 to 26 October. The 75 participants observed the soil profiles of volcanic ash soils and paddy fields, as well as Japanese sustainable agriculture.

3. NIAES International Symposium 2007, "Invasive Alien Species in Monsoon Asia: Status and Control"

The NIAES International Symposium, entitled "Invasive Alien Species in Monsoon Asia: Status and Control", was held from 22 to 23 October 2007 in Epochal Tsukuba, under the Monsoon Asia Agro-Environmental Research Consortium (MARCO): toward International Research Collaboration. This symposium aimed to facilitate the sharing of up-to-date information about invasive alien species with neighboring countries and to accelerate data input into APASD (the Asian-Pacific Alien Species Database) in order to establish ways to prevent the invasion and spread of alien species and minimize the economic and environmental damage caused by them.

The symposium opened with a speech by Dr. Y. Sato, President of NIAES, and a keynote speech entitled "The Biology and Ecology of Invasive Species—the Importance of International Collaboration in Predicting the Spread of Invasive Species" by Professor J. Silander (University of Connecticut, USA) . Sixteen speakers from eight countries (Malaysia, China, Thailand, UK, Vietnam, Taiwan, Philippines, and Japan) gave excellent reports on the following themes:

* A Review on Invasive Plants in Malaysia (Prof. Baki Hj Bakar, University of Malaya, Malaysia)
* Invasive Alien Plants and their Integrated Management in China (Dr. Sheng Qiang, Nanjing Agricultural University, China)
* Risk Assessment of Alien Plants and their Control (Dr. Yoshiharu Fujii, NIAES, Japan)
* Research on Alien Plants in Tropical Asia: Thailand (Dr. Siriporn Zungsontiporn, Department of Agriculture, Thailand)
* Development of RuLIS and its application for Survey of Invasive Alien Plants (Dr. Yoshinobu Kusumoto, NIAES, Japan)
* Asian Invasion: Himalayan Balsam (*Impatiens glandulifera* Royle) in Britain (Prof. Owen Smith, University of Plymouth, UK)
* Invasive Insects in Japan (Dr. Atsushi Mochizuki, NI-

AES, Japan)

* Status of Invasive Alien Insect Pests in China: Species, Impact and Management (Prof. Run Jie Zhang, Zhongshan University, China)
* Occurrence of Opogona sacchari in Japan (Dr. Shinichi Yoshimatsu, NIAES, Japan)
* Utilization of Native Predatory Fly, *Coenosia exigua* (Diptera: Muscidae), for biocontrol of *Liriomyza huidobrensis* (Dr. Amporn Winotai, Department of Agriculture, Thailand)
* Biological Control: an Ecological Approach to Manage Invasive Pest Insects (Dr. Takatoshi Ueno, Kyushu University, Japan)
* Alien Invasive Species in Vietnam (Dr. Dang Thi Dung, Hanoi Agricultural University, Vietnam)
* Invasion of Coconut Hispine Beetle, *Brontispa longissima*: Current Situation and Control Measures in Asia (Dr. Satoshi Nakamura, JIRCAS, Japan)
* Current Status and Management of Red Imported Fire Ants in Taiwan (Dr. Ker-Chung Kuo, BAPHIQ, Taiwan)
* Expansion of the Invasive Freshwater Mussel, *Limnoperna fortunei* (Mytilidae) in Japan (Dr. Kenji Ito, NIAES, Japan)
* Golden Apple Snails and Rice Black Bugs in SE Asia (Dr. R.C. Joshi, Philrice, Philippines)

In a general discussion, valuable comments were presented on "Invasive plants and ecology"(Dr. T. Yahara, Kyushu University, Japan); "Invasive alien snails: what did imprudent introductions of snails bring about?" (Dr. T. Wada, Kyushu Okinawa National Agricultural Research Center, Japan), and "IAS (Invasive Alien Species): issues and international cooperation"(Dr. K. Hirai, NIAES, Japan). Topics discussed after theses comments included 1) collaboration with the general public on surveys of alien species; 2) effective measures for dealing with invasive plants; and 3) discussions with scientists from the countries of origin of invasive alien species.

4. The 28th Symposium on Agro-Environmental Sciences

The 28th Symposium on Agro-Environmental Sciences, subtitled "What are the effects of global warming and how should we adapt? Impacts on and adaptation in agriculture, forestry and fisheries", was held on 11 December 2007 at the Shinjuku Meiji Yasuda Seimei Hall in Tokyo. Last year, we experienced several events that demonstrated the impact of global warming in our daily lives; they included a new record daily maximum air temperature in Japan, the awarding of the Nobel Peace Prize to the Intergovernmental Panel on Climate Change (IPCC), and the publication of the fourth assessment report of the IPCC. These events served to increase interest in global warming among the general public. Under these circumstances, the symposium was designed to enable more people to spread awareness of the impact of global warming on the current state and future of agriculture, forestry and fisheries and of the adaptations needed to respond to the changes brought by global warming. The lectures assessed the impact of global warming and evaluated adaptations to it, and poster presentations were given to explain the results. The symposium was attended by a total of 307 participants, consisting of 266 from government agencies, private companies, universities, public agencies, and corporations, and 41 from NIAES.

The symposium opened with speeches by Yohei Sato, President of NIAES, and Akio Shibata, Director of the

Akio Shibata, Director of the Marubeni Research Institute, delivering the keynote speech

Marubeni Research Institute in Tokyo, who gave a keynote speech entitled "Future Food Scenarios in Japan". Then Ryouji Samejima, Chief of the Climate and Land-use Change Research Team of the National Agricultural Research Center for the Hokkaido Region (NARCH), and Satoshi Morita, Senior Researcher at the National Agricultural Research Center for the Kyushu Okinawa Region (KONARC), reported on current productive conditions in the croplands of Hokkaido and Kyushu. Motoki Nishimori, Senior Researcher in the Agro-Meteorology Division of NIAES, presented the global warming predictions of the IPCC; he also discussed the use of a high-resolution prediction method to forecast the effects of climate change on agriculture in Japan and the results of predictions of rice yield in the middle of this century. Next, Toshihiro Hasegawa, Senior Researcher in the Agro-Meteorology Division of NIAES, talked about the effects of high atmospheric CO_2 levels and global warming on the growth and yield of rice, and about possible ways of adapting to these effects. Also, Toshihiko Sugiura, Senior Researcher at the National Institute of Fruit Tree Science (NIFTS), discussed the effects of global warming on agriculture in general, including the quality of paddy rice, other grains, fruits, vegetables, pasture and cattle, and countermeasures to the effects of global warming. Finally, Shinichi Itoh, Chief of the Tohoku National Fisheries Research Institute, talked about the effects of global warming on the ocean in terms of current movements and fluctuation of plankton levels, and predicted a change in saury (*Cololabis saira*) resources in the Northwest Pacific Ocean.

At the question-and-answer session after these presentations, there were discussions about the factors causing reduced rice quality in Japan, the effects on rice yields in Southeast Asia and on the countries to which they export rice, and the factors controlling ocean current movements. These discussions clarified that it is necessary to examine not only the relationship between global warming and food production but also the link between reduction of greenhouse gas emissions and food production, nutrient cycles in soils, and the threshold for global warming impacts on the environment.

A questionnaire on this symposium gathered the impressions and opinions of 171 participants. Many participants were interested in global warming, food production, and water resources, and most of the comments were positive, including "very timely" and "well designed programs and thorough explanations". In addition, many participants asked the presenters to publish the documents that were used during the symposium; we plan to make them available online in the near future. There was also a request for a symposium dealing with measures to reduce greenhouse gas emissions.

5. The 29th NIAES Symposium, "Toward the Conservation and Utilization of Biodiversity in Rural Landscapes"

The 29th NIAES Symposium, entitled "Toward the Conservation and Utilization of Biodiversity in Rural Landscapes", was held on 1 February 2008 at the Tokyo International Forum in Tokyo, with the support of the Ministry of Agriculture, Forestry and Fisheries and the Science Council of Japan. This symposium aimed to introduce topics of research activities in the field of biodiversity in rural landscapes and to discuss the conservation and utilization of biodiversity in order to gather valuable opinions on the direction of research and policy.

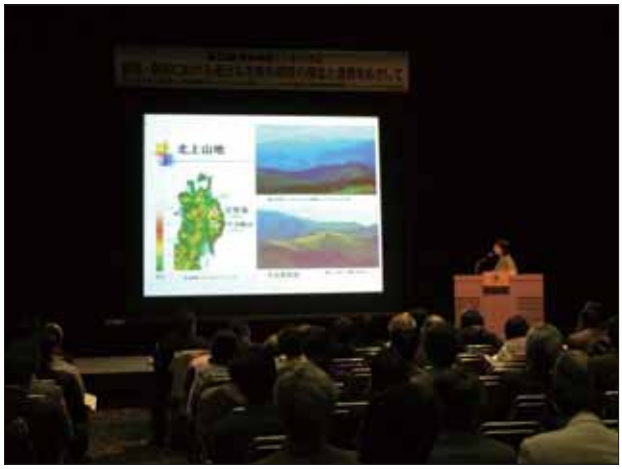
The symposium opened with a speech by Dr. Y. Sato, President of NIAES, and a keynote speech entitled "Landscape Classification and Management for the Conservation of Biodiversity" by Dr. M. Ohsawa, Professor at the University of Tokyo. Four speakers gave informative lectures on ecological structure and the characteristics of biodiversity in rural landscapes. The topics were:

* Relationship between Rural Landscapes and Biodiversity (Dr. S. Yamamoto, NIAES)
* Paddy Ecosystem Management for Conservation of Biodiversity (Dr. K. Hidaka, Ehime University)
* Functional Biodiversity for Agriculture (Dr. K. Tanaka, NIAES)
* Conserving the Biodiversity of Grassland by Pasturing: the Case of Butterflies at Mt. Akkamori in the Kitakami Region (Dr. N. Yoshida, Tohoku National Agricultural Research Center).

In a general discussion, Dr. Y. Takahashi (Kinki, Chugoku, Shikoku National Agricultural Research Center) made some excellent comments on "The Importance of Cyclic Use of Grassland in Conservation of Rural Bio-

diversity: Conserving Grassland in Wooded Country".

The symposium was attended by a total of 260 participants, including 101 from research institutes, 49 from private companies, 36 from government agencies and 26 from universities.



6. Open Symposia on the "Invasive Alien Plants" project

In 2007, NIAES held three open symposia on the subject of invasive alien plants. The symposia acted as outreach activities for our research project on these plants.

1) The 7th Open Seminar, on "Invasive Alien Plants" was held at Hokkaido University on 4th August 2007. The major topic was "Noxious alien invasive plants in northern Japan". After the symposium, participants visited the site of a serious *Rudbeckia laciniata* infestation.

Fig. 1 The 7th Open Seminar on Invasive Alien Plants was held at Hokkaido University

2) The 8th Open Seminar was an International Symposium held in Tsukuba on 22nd October 2007. The title of this symposium was "Invasive Alien Species in Monsoon Asia: Status and Control". Major presentations were as follows:
   1) Biology and Ecology of Invasive Species by Prof. John Silander (Connecticut University, USA).
   2) Invasive Plants in Malaysia by Prof. Baki Hj Bakar (University of Malaya, Malaysia)
   3) Invasive Alien Species in China by Dr. Sheng Qiang (Nanjing Agricultural University, China)
   4) Risk Assessment of Alien Plants and their Control: Report from the Japanese National Project by Dr. Yoshiharu Fujii (NIAES, Japan)
   5) Research on Alien Plants in Tropical Asia by Dr. Siriporn Zungsontiporn (Department of Agriculture, Thailand)
   6) Rural Landscape Information Systems by Dr. Yoshinobu Kusumoto (NIAES, Japan)
   7) Invasive plants in the United Kingdom by Prof. Owen Smith (University of Plymouth, UK)

Fig. 2 The total number of participants at the 7th Open Seminar was 168.

Fig. 3 *Rudbeckia laciniata*, one of the most noxious invasive alien plants in Hokkaido. After the seminar a field excursion was held by scientists from Hokkaido University.

Fig. 4 Dr Yohei Sato, Director General of NIAES, introduced the 8th Open Seminar, held in Tsukuba.

Fig. 5 The total number of participants at the 8th Open Seminar was 110.

3) The 9th Open Seminar was held in Kobe on 17th February 2008. This seminar was the final report of the project and the major research topics were explained by three sub-leaders. The topics were: 1) Current status of invasion of alien plants in Japan, and future problems (by Drs. S. Yamamoto and Y. Kusumoto); 2) Risk assessment of invasive alien plants—towards systematic risk management (by Dr. S. Kurokawa); and 3) A practical control method for invaded alien plants (by Dr. T. Muraoka). Finally, Dr. Y. Fujii, the project leader, summarized the project's results and explained future prospects for the control of alien plants in Japan. Prof. Y. Kadono (Kobe University) made final comments on the project and evaluated the important topics.

Fig. 6 The total number of participants at the 9th Open Seminar, in Kobe, were 148—beyond the seating capacity of the symposium hall.

Research Collaborations

1. Activities of the Research Consortium, MARCO

The Monsoon Asia Agro-Environmental Research Consortium (MARCO) was established in 2006 to foster international research collaboration in Monsoon Asia. In 2007 the following activities were conducted under the auspices of MARCO.

Two symposia were held:

1) The NIAES International Symposium 2007, "Invasive Alien Species in Monsoon Asia: Status and Control", held from 22 to 23 October 2007 at Tsukuba (see also pxx). For details, see http://www.niaes.affrc.go.jp/sinfo/sympo/h19/20071022e.html.
2) The ESAFS–JSSSPN–NIAES–JIRCAS–NARO-NARC–FFTC International Symposium (ESAFS8 International Symposium) on "New Challenges for Agricultural Science: Harmonizing Food Production with the Environment", held on 22 October 2007 at Tsukuba (see also p.26-28).

A geo-information science researcher was invited from China for a 2-month stay.

MARCO's website as a venue for the exchange of consortium information was opened in October 2007. For details, see http://www.niaes.affrc.go.jp/marco/index.html.

2. Conclusion of MOU between NIAES and the National Institute of Agricultural Science and Technology, KOREA

On 19 September 2007, NIAES and the National Institute of Agricultural Science and Technology (NIAST), Korea, concluded a Memorandum of Understanding (MOU) on research cooperation. NIAES and NIAST agreed to collaborate on agricultural and environmental research projects on subjects that share common Asian Monsoon conditions. The scope of activities under this MOU includes exchange of scientists, exchange of technical information, and cooperative research.

This MOU was a renewal of one signed in 2001.

Visitors

1. Open Day 2007

NIAES opened its doors to the public on 20 April during Science and Technology Week 2007. There were more than 1200 visitors, including students and various professionals. They studied displays on research topics, watched specimens in the exhibition rooms of the Natural Resources Inventory, attended mini lectures, tried hands-on experiments, and participated in vegetable picking in the field. All events were arranged under the general theme “Let’s hand over sound farmland and environment to future generations” (Photo 1).

Photo 1 Visitors looking at microscope images of soil-dwelling nematodes

2. Summer Science Camp 2007

Science Camp 2007 programs, organized by the Japan Science and Technology Agency (JST), were held at various institutes and universities. These programs aim to give high school students an excellent opportunity to experience advanced science and technology and expand their interest in the sciences.

Summer Science Camp 2007 at NIAES took place from 1 to 3 August 2007, with 12 high school students from various areas of Japan. Students participated in one of three courses: 1) monitoring of greenhouse gas emissions from cropland; 2) the study of water quantity and quality in small rivers in rural areas; and 3) remote-sensing techniques for monitoring the growth and physiological condition of rice plants (Photos 2, 3, 4).

Photo 2 Setting up greenhouse gas monitoring apparatus in a paddy field

Photo 3 Water flow monitoring and water sampling in a small stream

Photo 4 Learning remote sensing methods with a portable spectrometer

Advisory Council 2007

The Advisory Council 2007 met on 19 March 2008 at NIAES to provide outside opinions and recommendations on the management of NIAES. The members of the council are external experts and include a professor, a consumer representative, and the directors of other independent administrative institutions (see Appendix).

The following comments were made:

(1) NIAES's mission is closely linked with national policy, and it deserves praise for producing a steady stream of research results, but I hope that it also dares to tackle difficult research themes.

(2) Insofar as most people are now aware of the issue of global warming, and the cultivation of GM crops is fast becoming an issue that can no longer be ignored, the research being carried out by NIAES is of considerable interest to the general public. NIAES should endeavor to accelerate research in line with the needs of the age, and to inform the public of the results of its research to date.

(3) NIAES needs to produce research results that can be used at the front line of agriculture. NIAES conducts a lot of basic research, but it should also focus on activities aimed at promoting the practical application of results that lend themselves to such endeavor.

(4) One gets the impression that NIAES does not forge particularly close ties with farmers. I think that it is important for NIAES researchers to mix with farmers and ascertain if and how those on the agricultural front line are benefiting from their research.

(5) NIAES conducts research in biodiversity, and I would like it to present convincing arguments for the importance of biodiversity to agriculture from the perspective of agriculture. I also think that working with other environment-related research organizations would enable NIAES to conduct more efficient research.

(6) It is important to conduct research that addresses changing social circumstances. For example, NIAES should look into whether it needs to carry out research on biofuels in view of rising concern over the environmental impact of biofuel production overseas.

(7) Regarding the Monsoon Asia Agro-Environmental Research Consortium (MARCO), it is important for NIAES to consider the role it can play with respect not only to Japan but to the whole Asian region. I hope to see NIAES playing a central role in driving the initiative.

(8) NIAES symposiums and similar activities — particularly soil surveys and statistical training and such like — are very worthwhile to prefectural governments and public research organizations, and I hope NIAES continues to contribute to the regions through such activities.

(9) The presentation skills of NIAES researchers at seminars and symposiums have risen markedly, and they deserve praise.

(10) I appreciate the way NIAES enables individual researchers to build up their research careers, but I think it should also pay attention to its responsibility to society to nurture researchers over the medium to long term.

(11) NIAES is slated to be combined with two other research institutes in 2011 to create a new organization, and it is currently engaged in constructive planning for this development. I think that with regard to its position in the new organization, NIAES should be aware of the fact that its areas of research cannot be measured by the impact of research papers alone.

Academic Prizes and Awards

1. Prize of the Japanese Society of Soil Science and Plant Nutrition

Studies on the ecology and function of Actinomycetes in soil

Dr. Kiyotaka Miyashita, a Principal Research Director at NIAES, won the 2007 prize of the Japanese Society of Soil Science and Plant Nutrition. Soil is a habitat for diverse microorganisms, which are present there in huge numbers. These soil microorganisms play a crucial role in the cycling of carbon and other elements on Earth. Actinomycetes are typical bacteria that are abundant in soil, and they are considered to have evolved adaptations to the soil environment. Although Actinomycetes are major decomposers of organic matter in the soil, their ecology and function had not yet been studied intensively because of taxonomic confusion and a lack of suitable analytical methods. By developing new methods, Dr. Miyashita was able to conduct physiological, biochemical, and molecular biological studies on Actinomycetes from the viewpoint of ecology. The outline of his study is as follows.

Because the Actinomycetes are morphologically diverse, their taxonomic classification has been based on their morphology. Controversy, however, has abounded as to whether or not this morphology reflects their phylogeny. Dr. Miyashita has shown that chemo-taxonomy based on differences in the specific constituents of cells is useful in classifying Actinomycetes at the genus level, and that total-DNA relatedness is effective for classification at the species level. By using these techniques, Dr. Miyashita showed that the composition of species of *Streptomyces*, a major genus of Actinomycetes, in soil samples was phylogenetically highly diverse.

Potato scab, a major disease of potato, is caused by *Streptomyces scabies*. However, it has been claimed that morphologically different strains cause the same disease. Dr. Miyashita demonstrated that *Streptomyces* strains phylogenetically distant from *S. scabies* can also cause potato scab. The novel strains, identified as *S. acidiscabies*, were shown to be acidophilic and acid tolerant; these features enabled the species to dwell in potato field soils artificially acidified to prevent disease. Dr. Miyashita suggested that horizontal transfer of pathogen-related genes between the species has occurred.

Among the various hydrolyzing enzymes produced by *Streptomyces*, chitinase is unique in that it inhibits the growth of fungi, including plant pathogens. He studied the chitinase system of *Streptomyces* by using molecular and biochemical techniques. *Streptomyces* spp. showed an extraordinarily high multiplicity of chitinase genes, which differed in amino acid sequences and domain structure. This indicated that the high efficiency of decomposition by the chitinases in *Streptomyces* is at least partly due to the high multiplicity and diversity of these enzymes. *Streptomyces* produce chitinases only in the presence of a substrate, chitin. Production is regulated accurately at the level of transcription. A transporter of chitobiose (a product of the hydrolysis of chitin by chitinase) and regulatory proteins are involved in the regulation of gene expression.

Soil biology is often treated as a black box in soil science. Although bacteria—prokaryotic single-cell organisms with small genomes—are usually considered to be simple organisms, each bacterium has evolved to survive in a specific niche in the complicated soil ecosystem. Dr. Miyashita has developed a new field of soil microbiology by showing that elucidation of strategies for adaptation to the environment is inevitable if we are to understand the ecology of bacteria.

2. The 6th Progress Prize of the Foundation of Agricultural Sciences of Japan

Nutrient balance and heavy metal load on farmland and their environmental impact assessment

The Foundation of Agricultural Sciences of Japan presented the 6th Progress Prize to Dr. Shin-Ichiro Mishima. The foundation awarded a prize to young researchers (under 40 years of age) who contribute to the progress of agricultural sciences. The study undertaken by Dr. Mishima is outlined as follows:

1. Residual N and P defined as the unutilized N and P in agricultural production, were estimated from 1980 to 2002 on a Japanese national scale. Residual N and P per farmland area peaked in 1985—the same year in which chemical fertilizer application peaked—and then declined, and declined to 2002. Residual N among prefectures varied widely and was determined by the amounts of chemical fertilizer and livestock excreta. Utilization of controlled-release fertilizer in vegetable crops and promotion of the use of livestock excreta on forage crops would be helpful in reducing residual N levels in each prefecture. However, prefectures where excessive amounts of livestock excreta are being used on farmland and there is a lack of local land use have no mitigation protocols in place.
2. N and P outflows in the river waters of two medium-scale river basins were estimated, and agriculture-derived N and P loadings of the rivers were compared between the two basins. Although residual N and P levels were the same in the two river basins, agricul-

ture-derived N and P loads to farmland differed by 1.8 times. This difference would come from differences in the sources of residual N and P: namely, residual N and P derived from chemical fertilizer flowed more easily into the river water than those derived from livestock excreta. However, because intensive livestock production has been conducted in the area only during the last one or two decades, we were unable to quantify the effect of residual N and P derived from livestock excreta and, therefore, the true effect of this component on river water quality over the long term in each basin.

3. Cadmium, copper, and zinc in chemical fertilizers and sewage sludge manures were measured and their loadings to farmland evaluated. Cadmium loading was associated mainly with chemical P fertilizer application, although the Cd concentration in chemical fertilizer is now one-third of that in the 1970s. Copper and zinc loads were derived mainly from livestock excreta, and half of the copper and zinc in livestock excreta was disposed of with the disposal of livestock excreta, especially pig excreta. Therefore, promotion of the use of livestock manure would cause an increase in copper and zinc loadings. The levels of heavy metals in sewage sludge manure were the same as in pig manure; the contents of these metals have been decreasing or constant over the last three decades.

Dr. Mishima and his colleagues are working on the quantitative assessment of nutrient outflows from farmland, greenhouse gas emissions at the national and prefectural scale, and of residual N and P in each crop in each prefecture. The theme of his future work is the development of an integrated agro-environmental indicator for the realization of low environmental impacts and sustainable agricultural production from the viewpoint of manure and chemical fertilizer use.

3. Statistical GIS Promotion Prize: Statistical Information Institute for Consulting and Analysis 2007 prize recognizing outstanding GIS applications

Analysis of land use change over 120 years using a historical GIS database derived from the Rapid Survey Maps.

The Statistical Information Institute for Consulting and Analysis (Sinfonica) is a foundation established to disseminate national statistical data, such as the national population census, collected by the Ministry of Internal Affairs and Communication. As part of its activities, Sinfonica awards an annual prize to outstanding applications of statistical analysis using geographical information systems (GIS), called the Statistical GIS Promotion Prize. The 2007 prize was awarded to two NIAES researchers, David Sprague and Nobusuke Iwasaki of the Division of Ecosystem Informatics at the annual Statistical Information Seminar held by Sinfonica in Tokyo.

The prize recognized the expertise of Drs. Sprague and Iwasaki in building historical GIS databases integrating map data of various scales and map projections from multiple time periods, then using the database to analyze land use changes extending back 120 years. The base data of their historical GIS database are the Rapid Survey Maps (*Jinsoku Sokuzu*), the oldest topographic map series surveyed by modern cartographic methods in Japan. The Rapid Survey Maps were surveyed between 1881 and 1886, and cover most of the Kanto Plain surrounding Tokyo. These colorful maps show land use in great detail at 1/20,000 scale. Drs. Sprague and Iwasaki established methods to georeference the Rapid Survey Maps, and other early topographic maps, to modern map coordinates. They digitized the land use data into the GIS, and by combining this information with modern vegetation maps, they analyzed rural land use changes at multiple time intervals.

Through their research, Drs. Sprague and Iwasaki have found that the Japanese rural landscape of 120 years ago was utilized to support traditional agriculture, which required large areas as sources of natural resources. Even in the Kanto Plain, where the topography is relatively flat, large proportions of the landscape in the 1880s consisted of woodlands and grasslands. Through GIS analysis, they showed that many of the woodlands and grasslands were transformed into fields with the modernization of agriculture. More recent maps reveal that the rural landscape is undergoing rapid urbanization near cities and towns along major railways.

Historical GIS is a rapidly growing field of geographical analysis that is necessary for evaluating the ecological changes overtaking rural regions around the world. By developing GIS analyses using early maps, Drs. Sprague and Iwasaki are pioneering tools to quantify transformations in rural landscapes, measured against the historical baselines as depicted by early maps.

Further reading:

Sprague DS, N. Iwasaki, S. Takahashi (2007): Measuring rice paddy persistence spanning a century with Japan's oldest topographic maps: georeferencing the Rapid Survey Maps for GIS analysis. *International Journal of Geographical Information Science*, **21**, 83-95.

Statistical Information Institute for Consulting and Analysis, http://www.sinfonica.or.jp.

4. Certificates of Appreciation from IPCC for contributing to the award of the Nobel Peace Prize

The 2007 Nobel Peace Prize was awarded to the Intergovernmental Panel on Climate Change (IPCC) and former US vice-president Al Gore "for their efforts to build up and disseminate greater knowledge about man-made climate change."

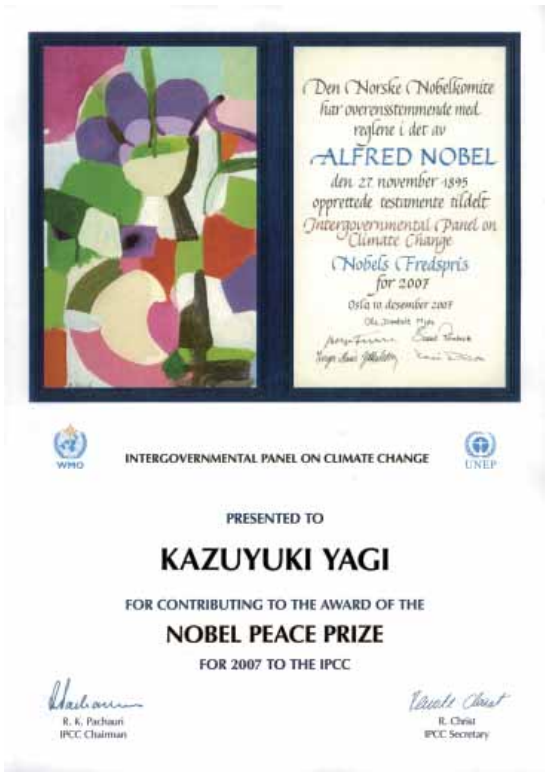
IPCC, which was established jointly by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988, has a membership of about 3,000 scientists from 130 countries. From the publication of its First Assessment Report in 1990, the IPCC has issued forecasts on global warming and its impacts based on scientific evidence, and has proposed measures for adapting to and mitigating global warming. In its Fourth Assessment Report issued in 2007, the IPCC concluded that warming of the climate system is unequivocal and that it is having definite impacts on the natural environment and human societies worldwide. It predicted that if greenhouse gas emissions continue to rise, the climate system will undergo further large-scale warming. The IPCC has also issued a number of special reports on topics such as carbon dioxide capture and storage, and methodology reports such as its Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

In April 2008, the IPCC sent Certificates of Appreciation to Japanese researchers who participated in preparing its reports to date for contributing to the work that won it the Nobel Peace Prize. Among NIAES researchers, former NAIES Director General Katsuyuki Minami, former Greenhouse Gas Emission Team Leader Haruo Tsuruta, and Carbon and Nutrition Cycles Division Senior Researcher Kazuyuki Yagi received certificates. Dr. Minami has been a member of the IPCC since its inauguration, and helped to author the First and Second Assessment Reports. Dr. Tsuruta was one of the authors of the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, and Dr. Yagi helped to author both the Good Practice Guidance and the Guidelines for National Greenhouse Gas Inventories.

NIAES will continue to contribute to the IPCC and other organizations and farmers, both in Japan and overseas, through monitoring of global warming and through research to assess the impacts of global warming on the agricultural environment and research into global warming mitigation measures.

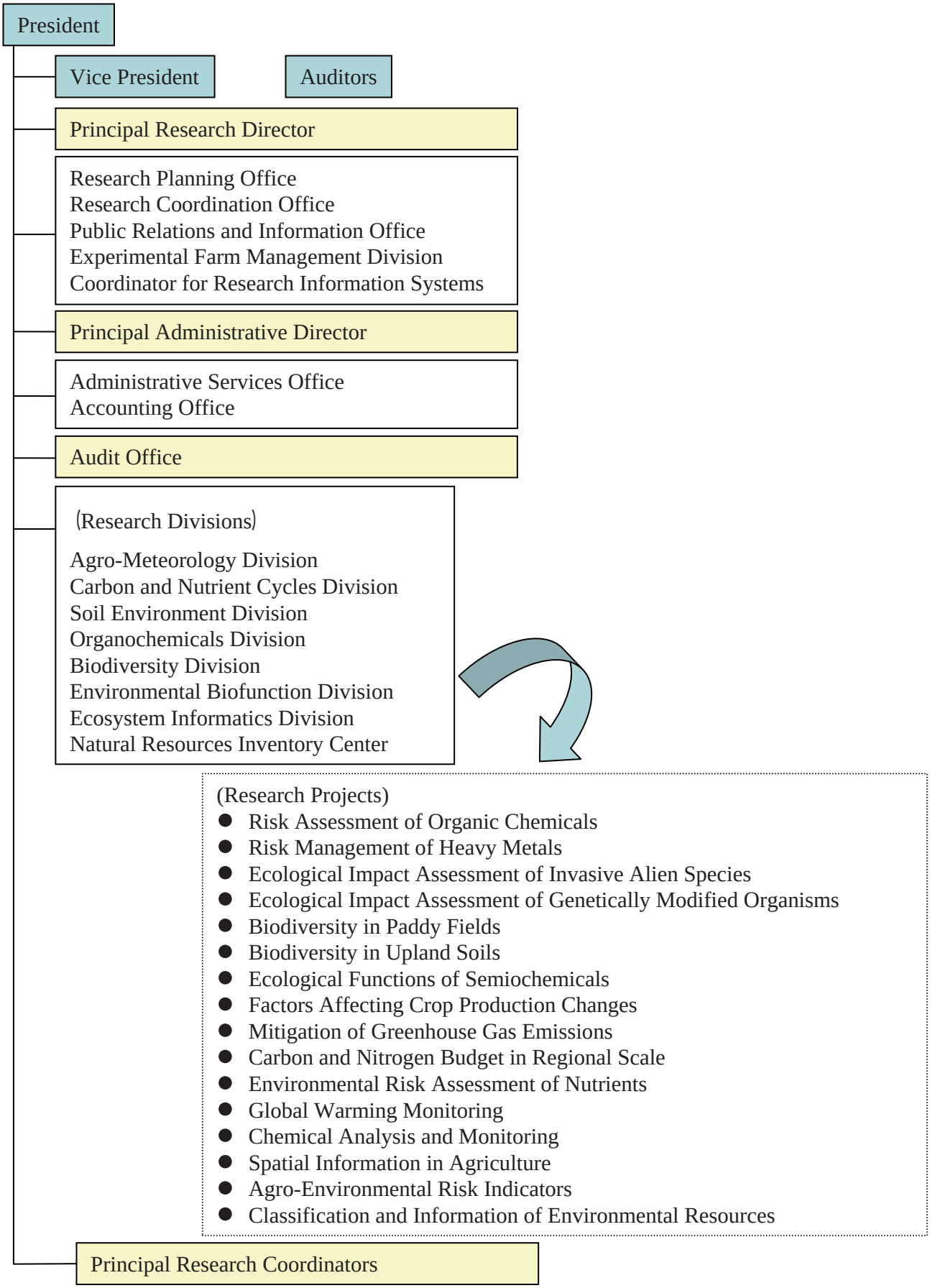
Cover photograph explanation

Certificate of Appreciation sent by the Intergovernmental Panel on Climate Change (IPCC) to NIAES researchers in recognition of their contribution to the award of the Nobel Peace Prize to the IPCC.



Research Overview in 2007

Research Organization



Summary of NIAES Research Projects

During the new medium-term research period (2006–2010), the National Institute for Agro-Environmental Sciences is emphasizing research in the following three fields while continuing to provide for the specialization and prioritization of basic studies and research with the goal of assuring the safety of agricultural production environments.

A. Assessing and managing agro-environmental risks
B. Elucidating and managing the structure and function of agro-ecosystems to maintain and enhance the function of natural circulation
C. Basic study to support elucidation of the functionality of agro-ecosystems

This report describes the implementation plan and goals during the five-year medium-term research period, and provides an overview of research implementation in FY2006.

A. Assessing and managing agro-environmental risks

1) Development of risk management technology for hazardous chemical substances in agro-ecosystems

(1) Development of assessment methodology and management technology for agro-environmental risks by hazardous chemical substances

Research Plan for 2006–2010

To reduce the risk of pollution in agro-environments by chemicals and substances such as cadmium, arsenic, radioactive materials, and persistent organic pollutants (POPs), including drin-family pesticides, we will elucidate the dynamics of such substances and develop technologies to reduce their risks. For pesticides and other organic chemicals, this will entail developing models to predict their behavior in the environment, and developing environmental risk assessment methods using such means as exposure experiments with aquatic arthropods and other organisms. Additionally, we will develop technologies such as chemical washing and bioremediation for remediating soil contaminated with hazardous chemicals, and develop technologies for using cultivars which have low uptake of these substances.

Summary for 2007

On the risk assessment and management of organic chemicals, we developed a multimedia model capable of assessing the global dispersion of contamination by organic pollutants, and showed that the pesticides used in Japan in the past reach as far as the Arctic. It also became possible to use this model to estimate and predict the wide-area transport of pesticides currently in use or to be developed in the future. We prepared an "Acute Toxicity Test Method Manual for Pesticides using First Instar Caddisfly Larvae" (Figure 1). To develop a remediation technology for contaminated soil, we clarified the metabolic pathway of new species of decomposing bacteria that can assimilate hexachlorobenzene (HCB). Laboratory experiments showed that charcoal enriched with the decomposing bacteria decomposed at least 30% of the HCB in soil and a metabolite PCP within four weeks. As a technique to remediate soil contaminated with drin family pesticides, we planted successive crops of zucchini in a test using pots, and were able to reduce by 30%–50% the drin concentration of cucumbers subsequently grown in the soil. In a bid to develop a technology to replace methyl bromide, we developed a new soil sterilization method using low-concentration ethanol (chosen by the Ministry of Agriculture, Forestry and Fisheries of Japan as one of the 10 major research results of 2007).

With respect to risk assessment and management for cadmium and other inorganic chemicals, our research found a soil cadmium extraction method (Mehlich 3 extraction) that has a high correlation with the cadmium concentration found in soybean seeds and brown rice. There are hopes that it will lead to the development of a method of using soil analysis to assess the risk of cadmium contamination in crops. Researchers also determined that although organic arsenic increases in soil that is flooded, little of it is taken up into brown rice. In the development of remediation technology that uses a chemical remediation method for cadmium-contaminated soil, it was confirmed that the efficacy is maintained even in the fourth year after treatment. A phytoremediation technique using high-absorption rice plants for cadmium-contaminated soil was able to reduce the cadmium concentration in brown rice by 40%–60%. In the development of low-absorption cultivars, cultivation of eggplant grafted onto Solanum torvum rootstock reduced cadmium concentration in the eggplant fruit to between one-half and one-fourth regardless of soil, cropping type, or scion cultivar, and it was shown that this technique is adaptable to anywhere in Japan.

2) Development of risk management technology for invasive alien species and genetically modified organisms in agro-ecosystems

(1) Assessment of ecological impact and development of risk management technology for invasive alien

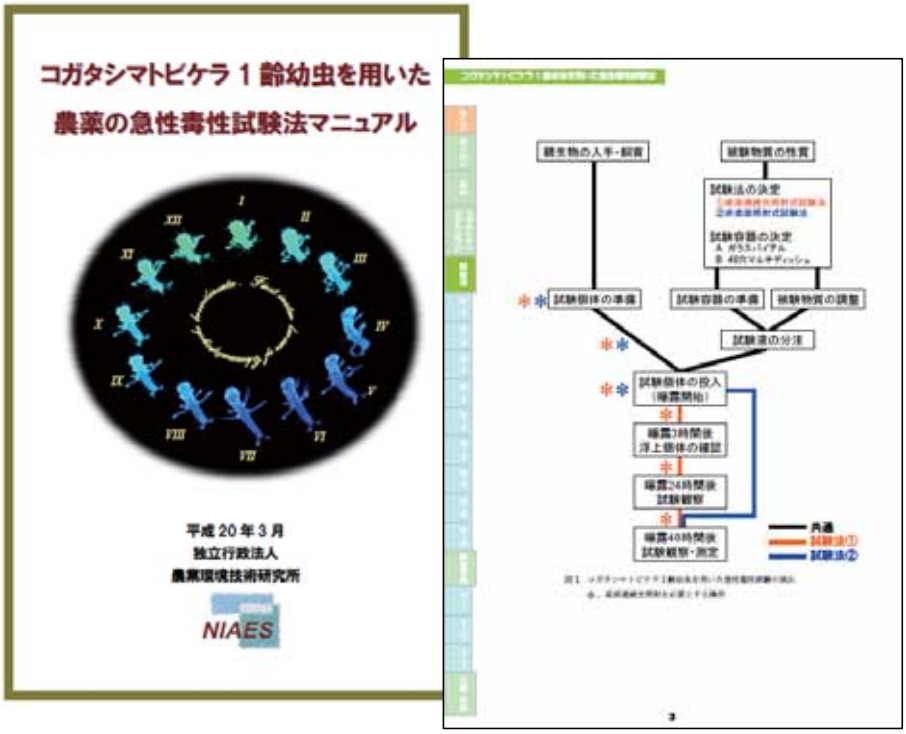


Fig. 1 Acute Toxicity Test Method Manual for Pesticides using First Instar Caddisfly Larvae.

species and genetically modified organisms

Research Plan for 2006–2010

To prevent the disruption of and damage to agro-ecosystems by exotic organisms (those which have invaded and those which were introduced), we will elucidate the growth and breeding characteristics, allelopathy, and other characteristics of exotic organisms, and determine the current state of damage caused by these organisms. We will also predict their future ecesis, diffusion, and damage. Further, we will determine where exotic organisms originate, and estimate the probability of them invading. Further, we will analyze the impacts of exotic organisms, such as exotic natural enemy insects, on closely related native species from aspects including competition and hybridization; assess the risks that exotic organisms present to agro-ecosystems; and also develop technologies using molecular markers and other means for the early detection and monitoring of exotic organisms whose species are hard to identify. To appropriately assess the impacts of genetically modified (GM) organisms on ecosystems, we will develop technologies that use DNA markers and other means to detect hybridization between GM crops and closely related species, such as GM soybeans and wild soybeans, and shed light on the ecosystem impacts of hybridization. To provide for the coexistence of GM and non-GM crops, we will develop models to predict hybridization rates and technologies to suppress hybridization through cultivation methods such as assuring isolation distance.

Summary for 2007

To study the exotic organism situation, we investigated the widespread infestation of exotic plants around rice fields in the Tone River watershed. We found that the infestation types can be divided into three patterns, and we selected 15 exotic plant species that require attention. A study of the competition between and the ecesis of exotic and native plants found that exotic species whose seeds were large and dispersed by water, and which grow faster than native species, established themselves readily. We also suggested a technique using buckwheat as a cover crop to prevent the widespread infestation of giant ragweed (*Ambrosia trifida*) and other plants. To determine the distribution of the golden mussel (*Limnoperna fortunei*), a specified exotic species, we surveyed the Tone River from its mouth to a point about 130 km upstream, and determined that it is found not only in Lake Kasumigaura but also in the Tone River. For the purpose of determining the probability of invasion of an exotic plant species, and assessing its risk, NIAES improved the procedures for weed-risk assessment released by the FAO in 2005 and assessed 600 exotic plant species. As a result, we proposed that itchgrass (*Rottboellia exaltata*) and other plants be designated as hazardous exotic plants (Table 1). We also developed an exotic plant risk assessment method that adapts Australia's weed-risk assessment model

to Japan, and found that using this method makes it possible to estimate the weediness of a plant before its introduction into Japan. From among the stiff darnel (*Lolium rigidum*) seeds mixed into wheat imported from Australia, individuals with strong herbicide resistance were found with high frequency.

For the purpose of early detection and monitoring of exotic organisms, NIAES developed a method based on nuclear DNA information to distinguish between the exotic natural enemy insect *Torymus* sinensis and its closely related native species *Torymus beneficus*, as well as the foreign and native species of the predatory natural enemy green lacewings (Chrysopidae). To estimate the appearance time and other characteristics of hybrid dandelions, we used chloroplast DNA markers to analyze pressed specimens at the Hiratsuka City Museum and found that 97% of the pressed specimens made in 1979 were hybrid dandelions.

Table 1. Results of using an improved weed-risk assessment method to assess specified exotic organisms, plants designated as exotic organisms requiring caution, and plants with a risk of being introduced into Japan

Plants designated as specified exotic organisms have high scores. In the exotic organisms requiring caution category, *Salvinia molesta*, *Eichhomia crassipes*, *Leucaena leucocephala*, and others have high scores rivaling those of the highly ranked specified exotic organisms. In the category of plants not yet in Japan, those requiring caution include *Rottboellia exaltata*, *Macroptilium lathyroides*, and *Bromus rigidus*, which are toxic weeds having irritating hairs.

	Japanese name	Scientific name	Aquatic plant	Weeds in same species	Dispersed by human activity	Has thorns or spines	Toxic or harmful to humans or animals	Allelopathic	Climbing plant or highly covering	Seed lifetime at least one year	Vegetative propagation	Resistance to cutting tillage and burning off	Risk score with improved FAO method	Risk score with former FAO method	Application
Specified exotic organisms (12 spp.)	Botan-ukikusa	*Pistia stratiotes* L. var. cuneata *Engler*	3	2	2	0	0	1	1	0	1	1	11	11	Aquariums
	Mizuhimawari	*Gymnocoronis spilanthoides* DC.	3	2	2	0	0	1	1	0	1	1	11	10	
	Buraziruchidomegusa	*Hydrocotyle ranumculoides* L.f.	3	2	2	0	0	1	1	0	1	1	11	10	Aquariums
	Nagaeturunogeitou	*Alternanthera philloxeroides* Griseb.	3	2	0	0	0	1	1	1	1	1	10	11	
	Arechi-uri	*Sicyos angulatus* L.	0	2	2	1	0	1	1	1	0	1	9	10	
	(no Japanese name)	*Azolla cristata* Kaulf.	3	2	2	0	0	1	0	0	1	0	9	8	
	Oofusamo	*Myriophyllum brasilense* Cambess.	3	2	2	0	0	0	0	0	1	0	8	8	Aquariums
	Ookawadisya	*Veronica angallis-aquatica* L.	3	2	0	0	1	1	0	0	0	0	7	7	
	(no Japanese name)	*Spartina anglica* C.E. Hubbard	3	2	0	0	0	0	0	1	0	0	6	7	
	Oohangonsou	*Rudbeckia laciniata* L. var. *laciniata*	0	0	2	0	1	0	1	1	0	0	5	6	
	Ookinkeigiku	*Coreopsis lanceolata* L.	0	0	2	0	0	0	1	1	0	1	5	5	Revegetation plant
	Narutosawagiku	*Senecio madagascariensis* Poir.	0	2	0	0	1	1	0	0	0	0	4	5	
Exotic organisms requiring caution (top 10)	Oosansyoumo	*Salvinia molesta* Mitch.	3	2	2	0	0	1	1	1	1	0	11	11	Aquariums
	Hoteiaoi	*Eichhornia crassipes* (Mart.) Solms-Laub	3	2	2	0	0	0	1	1	1	0	10	12	Aquariums
	Gin-nemu	*Leucaena leucocephala* (Lam.) de Wit	0	2	2	1	1	1	1	1	0	1	10	11	Revegetation plant
	Kisyuu-suzumenohie	*Paspalum distichum* L. var. *distichum*	3	2	2	0	0	0	1	1	0	1	10	12	Revegetation plant
	Hari-enjyu	*Robinia pseudacacia* L.	0	2	2	1	0	1	1	1	1	1	10	10	Nectar plant
	Ookanadamo	*Egeria densa* (Planch.) St. John	3	2	2	0	0	1	0	0	1	1	10	9	Aquariums
	Kokanadamo	*Elodea nuttallii* (Planch.) H. St. John	3	2	2	0	0	1	0	0	1	1	10	9	Aquariums
	Seitaka-awadachisou	*Solidago altissima* L.	0	2	2	0	1	1	1	1	1	0	9	10	Horticultural plant
	Syokuyou-gayaturi	*Cyperus esculentus* L.	0	2	2	0	1	1	0	1	1	1	9	9	Unintentional
	Kisyoubu	*Iris pseudoacorus* L.	3	2	2	0	0	0	0	1	1	0	9	10	Horticultural plant
Plants that risk being introduced into Japan (top 10)	Tuno-aiashi	*Rottboellia exaltata* (L.) L.f.	0	2	0	1	1	1	1	1	1	1	9	11	
	Nanbanaka-azuki	*Macroptilium lathyroides* (L) Urban	0	2	2	0	0	1	1	1	0	0	7	8	Green manure crop
	Higenagasuzumenochahiki	*Bromus rigidus* Roth.	0	2	0	1	0	1	1	1	0	1	7	9	
	Amerikatakasaburou	*Eclipta alba* (L.) Hasskarl	3	2	0	0	0	0	0	1	0	0	6	8	
	Shimanishikisou	*Euphorbia hirta* L.	0	2	0	0	1	1	1	1	0	0	6	7	
	Nisekarakusakeman	*Fumaria capreolata* L.	0	2	0	0	1	1	1	1	0	0	6	7	
	Kurobanamouzuika	*Verbascum nigrum* L.	0	2	2	0	0	0	0	1	0	0	6	7	Horticultural plant
	Amerika-kingojika	*Sida spinosa* L.	0	2	0	0	1	0	0	1	1	1	6	8	
	Maruba-tsuyukusa	*Commelina bengalensis* L.	0	2	0	0	0	0	1	1	1	1	6	7	
	Harinasubi	*Solanum sisymbriifolium* Lam.	0	2	0	1	1	0	1	1	0	0	6	8	

In the area of impact assessment and risk management of GM organisms on ecosystems, NIAES found that the reason for the very low natural hybridization between herbicide-resistant GM soybeans and wild soybeans in the previous year's experiment was that their flowering times were offset by a certain period. At a study site in Kashima Port where oilseed rape (*Brassica napus* L.) seeds had spilled, both GM and non-GM plants appeared in large numbers along sidewalks, below median strip curbing, and inside median strips, but most of them disappeared before flowering, and did not aggressively invade communities in the vicinity. We improved a model for predicting pollen dispersion, and compared the pollen dispersion mitigation effects of windbreak walls and nets. Results indicated that nets were more effective.

B. Elucidating and managing the structure and function of agro-ecosystems to maintain and enhance the function of natural circulation

1) Elucidation and evaluation of the structure and function of agro-ecosystems

(1) Elucidation of synecological dynamics and biodiversity in agro-ecosystems

Research Plan for 2006–2010

To conserve the biota that is nurtured by agriculture, and that biota's biodiversity, we will investigate the dynamics of the plants, birds, insects, nematodes, microorganisms, and other organisms living in and around farmland. We will then determine the impacts on the makeup and biodiversity of these organisms caused by tilling and the use of chemicals, by crop rotation and fallowing, by changes in methods of managing peripheral vegetation and irrigation ponds, and by changes in rice paddies and the structure of their surrounding landscape. Using the results obtained, we will build a model to predict the dynamics of populations, such as those of indicator insects, occurring in conjunction with changes in agricultural activities, such as land use, and use the model to determine what factors stabilize populations.

Summary for 2007

On biota dynamics, we carried out a second vegetation study in the Tone River watershed monitoring area and updated land-cover data. This study found that the progress made in reviving abandoned rice fields depends on the extent of succession of plant communities when the fields were fallow. In our work on the "Rural Landscape Information System (RuLIS)", we created total data sharing specifications meant for the integrated use of multiple data sets, set up a wide-area landscape structure spanning multiple years and integrated datasets on the distribution of organisms in RuLIS, and endeavored to be an international information provider. As a result, the OECD is conducting a continuing review, South Korea is considering application within its own country, and Switzerland is conducting a comparison with the methods of European countries. With regard to the PCR-DGGE standard method for analyzing microorganism biota, we determined the characteristics and detection limits of primer sets for bacteria and filamentous fungi, and we also found the detection limit of this standard method for nematodes. NIAES prepared and released the "DGGE Soil Analysis Manual for Bacteria, Filamentous Fungi, and Nematodes".

Regarding the impacts of farmland management methods and changes in landscape structure on biota, to determine the impacts of agricultural activities on birds, we analyzed the relationship between the percentage of land cultivated for rice and the spatial distribution of intermediate egret (*Ardea intermedia*) individuals on the southern shore of Lake Kasumigaura. We found that the birds often used lotus root fields in the second half of April, while they used unused rice fields from May through early June. We found that the diversity of rice field environments had a positive influence on the habitation of bird species that use summer rice fields as feeding areas. To elucidate the long-term impact of chemical use on vegetation, we used *Penthorum chinensis*, which is an endangered species with high sensitivity to rice-field herbicides, to build a nonlinear model that shows the relationship between the intrinsic rate of natural increase (the maximum rate of increase in the number of individuals exhibited by a species under the given environmental conditions) and herbicide concentration based on the herbicide toxicity at each life-history stage. We created a model that uses geographical information on a pond and its surroundings to predict the number of dragonfly indicator species and used it to predict the impact of land-use changes around ponds; we found that the percentage of forested land in the area and the percentage of concrete banks was very influential.

(2) Elucidation of semiochemicals affecting the function of agro-ecosystems

Research Plan for 2006–2010

To contribute to maintaining and improving agro-ecosystem functions, we will determine and elucidate the functions of various substances such as those involved in the interactions between organisms (such as the physiologically active substances produced by Rosaceae plants and semiochemicals involved in the reproduction of Pyraustinae moths and other insects) and substances that control the expression of genes in bacterial groups such as *Burkholderia* sp. that can break down chemicals such as persistent chlorinated aromatic compounds.

Summary for 2007

Regarding the functions of organisms in agro-ecosystems, we found that cyanide gas and cis-cinnamoyl glucosides respectively inhibit the growth of willowleaf cotoneaster (*Cotoneaster salicifolius*) and bridalwreath (*Spiraea prunifolia*). We also found that with the fresh leaves of Thunberg's meadowsweet (*Spiraea thunbergii*), which strongly inhibit plant growth, the inhibitory effect is 10 to 100 times as strong after falling off the plant. In addition to discovering new sex pheromone components, we found that the male of the insect pest *Ostrinia scapulalis subpacifica* reacts broadly to sources of sex pheromones of various component ratios, and we determined that this is one reason for the decline in effectiveness of sex pheromone preparations. We created a simple bioassay method for the indoor analysis of the interactions among plants, herbivorous insects, and their natural insect enemies. In addition to being the first in the world to detect the expression of a gene that decomposes 3-chlorobenzoic acid in soil environments, we identified the location that recognizes the inducer of the protein that controls expression of the decomposition gene. NIAES isolated from nature and assessed many fungi that break down biodegradable plastics. From one of these with particularly high decomposition activity (*P. antarctica*), we refined a decomposition enzyme and successfully obtained the gene encoding the enzyme.

2) Elucidation of mechanisms causing changes in agro-ecosystems and development of mitigation technology against the changes

(1) Impact assessment of global environmental changes on agro-ecosystems and risk assessment of the change on crop production

Research Plan for 2006–2010

To assess on a field scale the changes in rice harvest yield caused by global warming and weather extremes, we will develop a comprehensive rice field ecosystem response model that includes water, soil, rice cultivars, and cultivation management conditions. We will also develop a simple regional-scale yield model, predict the changes in rice yield mainly in Japan and other Asian countries at about the mid-21st century judging from yield and water resources, and develop a method for wide-area assessment on a regional scale of the risk of decline in rice yields. Based on the results, we will build a scenario to predict the impact of climate change on food production.

Summary for 2007

To research the impacts of global warming on agro-ecosystems, we gathered data and findings to verify and improve our rice field ecosystem response model by means of a rice field free air CO_2 enrichment (FACE) experiment with increased water temperature, and by joint Japan–China FACE analyses. The FACE/global warming experiment and the FACE inter-site comparison analysis were the first such attempts in the world. We developed a "Model-Linking Crop Climate Database" that links climate and cultivation tests, and used it in research including multi-site, multi-year verification of field-scale rice plant growth models; analyses of temporal and spatial changes in yield; and analyses of crop conditions under the unusually high temperatures in the summer of 2007. We developed a model that simply estimates changes in regional rice yield in Thailand and China from water use and nitrogen inputs. We showed that in the Mekong Delta salt concentration influences rice production through the annual area planted, and we determined the structure of a model for assessing vulnerability. Additionally, a simple yield estimation model that closely mirrors the actual situation was developed from input data that are also easily obtained in the Mekong River watershed. We showed that the regional climate model in its current state is unable to reliably reproduce extreme values such as daily maximum temperatures during a hot summer, and we established the direction to take for creating high-resolution climate change scenarios by using statistical methods in conjunction with the model.

(2) Elucidation of effects of agricultural activities on carbon and nutrient cycles

Research Plan for 2006–2010

To help solve regional and global environmental problems relating to agricultural emissions, such as emissions of greenhouse gases and nitrogen, we will illuminate the impacts of agricultural activities on material cycles and find ways to mitigate environmental burdens. With respect to greenhouse gases, we will propose a technological system to efficiently mitigate environmental burdens by quantitatively assessing the efficacy of cultivation and soil management techniques to limit the generation of greenhouse gases. At the same time, we will use soil-related databases to examine and improve models that describe soil carbon dynamics, and we will then predict changes in soil carbon storage occurring in conjunction with climate change and changes in the management of Japan's farmland soil. Also, stocks and flows of nitrogen that result from factors such as food production, imports, and exports will be estimated on the basis of statistical data, a model of the dynamics of acidifying materials, and other such information. We will elucidate the wide-area cycle of nitrogen and its environmental burden for the entire East Asian watershed or on the country level, and make predictions for the future situation. On the

watershed level, we will carry out research to ascertain the runoff dynamics of nitrate nitrogen, phosphorus, and other nutrient salts in the pedosphere, including shallow groundwater, and develop methods of assessing vulnerability to water pollution.

Summary for 2007

On the part that agricultural activities play in GHG emissions, we carried out a test in which rice fields and dry fields were alternated. We determined that the total of methane (CH_4) and nitrous oxide (N_2O) emissions from dry fields that are converted from rice fields is sometimes the same as that of successively cropped rice fields and sometimes markedly lower, depending on the difference in CH_4 emissions from rice fields. Tests in andosols determined large quantities of N_2O emitted from composted chicken manure pellets and indicated the possibility that much N_2O will be emitted depending on differences in methods used to manage fertilizer application. We created a database on nitrogen application in Japan and showed the characteristics of N_2O emissions from the agricultural sector by prefecture; we also found that emissions are tending to decline nationally. An improved DNDC (DeNitrification-DeComposition) model (Figure 2) was able to effectively assess the efficacy of rice-field straw and fertilizer management methods in reducing CH_4 emissions over a wide-area, as was verified with experimental data (Figure 3). We found that CH_4 emissions during the rice growing season increased greatly when temperatures rose. We modeled the process of nitrogen mineralization as part of creating an integrated carbon–nitrogen model for nationwide predictions of the dynamics of soil organic matter in Japan.

Regarding nitrogen stocks and flows in conjunction with food imports and exports, we employed a scenario for food supply and demand change in Southeast Asia to show the possibilities for future production of energy crops by means of a realistic increase in yield and showed the resulting changes in the nitrogen load. We refined the estimation of amounts of ammonia volatilized from farmland due to fertilizer application, and showed that although excessive additional fertilizer causes volatilization, the usual fertilizer application in Japan causes hardly any volatilization; however, in other East Asian countries, ammonia volatilization from fertilizer is a major cause of the nitrogen load from the atmosphere.

In connection with vulnerability to water pollution on the watershed level, we established a method to analyze the stable isotope ratio of nitrogen and oxygen in the nitrate ions of small samples. Use of the method suggested that in drainage basins comprising rice fields in tablelands and valleys, denitrification is the main cause of decline in nitrate ion concentration. In the Arata River watershed in Aichi Prefecture, we used a surface runoff model to predict the runoff load of suspended solids and total phosphorus into the river, but the predicted value was far lower than actual readings. It was suspected that the contribution to the load from livestock buildings and other sources other than farmland is large. A column experi-

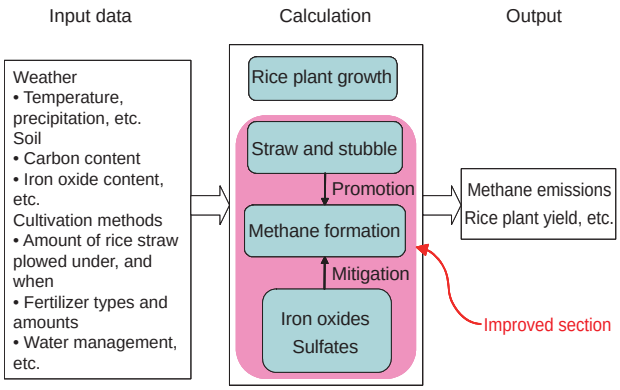


Fig. 2 Improvement of the DNDC model.

The DNDC (DeNitrification-DeComposition) model is a numerical model that takes data on weather, soil, and cultivation methods and estimates rice plant growth and methane emissions. In a new model (DNDC Rice) we made improvements regarding the effects that rice straw and fertilizer management have on methane emissions.

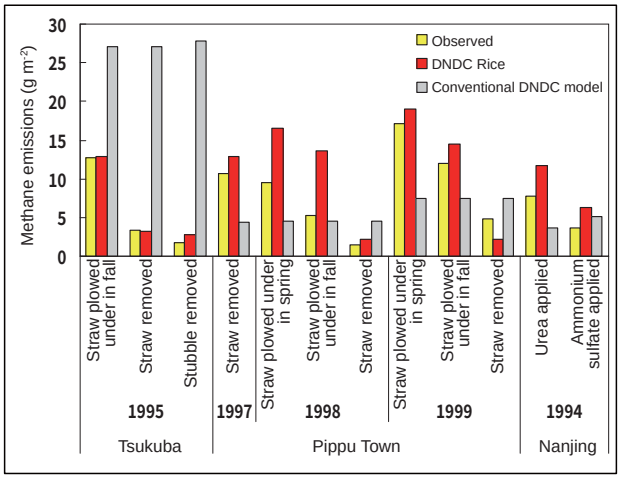


Fig. 3 Comparison of methane emissions observed during the rice growing season with estimations obtained from the DNDC model before and after improvement.

The conventional DNDC model could not estimate the effects of straw management or fertilizer type. However, despite a large error in the estimation of methane emissions in Pippu Town in 1998, the improved DNDC model (DNDC Rice) was able in general to estimate the change in methane emissions due to straw management and fertilizer type.

ment determined that in sandy soil there is a great risk of eutrophication of the water system and other groundwater contamination due to phosphorus runoff percolating into the soil, and that suspended particulates account for 10%–30% of phosphorus runoff. We found that the percentage of runoff that passes through forestland is effective as a land use chain index for the nitrogen removal ability of a watershed.

C. Basic study to support elucidation of the functionality of agro-ecosystems

1) Long-term environmental monitoring research in relation to agriculture

(1) Long-term agro-environmental monitoring and development of simple and accurate methods of analysis

Research Plan for 2006–2010

To detect changes in agro-environment resources at an early date, we will perform long-term monitoring of the physical environment that constitutes the baseline of agro-ecosystems. We will also conduct long-term monitoring of greenhouse gas fluxes (including carbon dioxide and methane) and levels of ^{137}Cs, ^{210}Pb, and other isotopes in crops and the soil. In addition, we will develop a method to analyze organic arsenic and other trace chemicals in the environment, including crops, and a simple but highly precise measurement method for monitoring these substances.

Summary for 2007

In the area of global warming monitoring, we monitored the physical environment and greenhouse gas fluxes in Japan, including rice fields in the Mase area of Tsukuba City, Ibaraki Prefecture, and at overseas sites. Except for one overseas site, the monitoring proceeded fairly well, and we were able to accumulate several years' worth of data (Figure 4). By incorporating the latest research results on the quality control and error assessment for flux measurements, we upgraded and quickened data processing for the eddy correlation method.

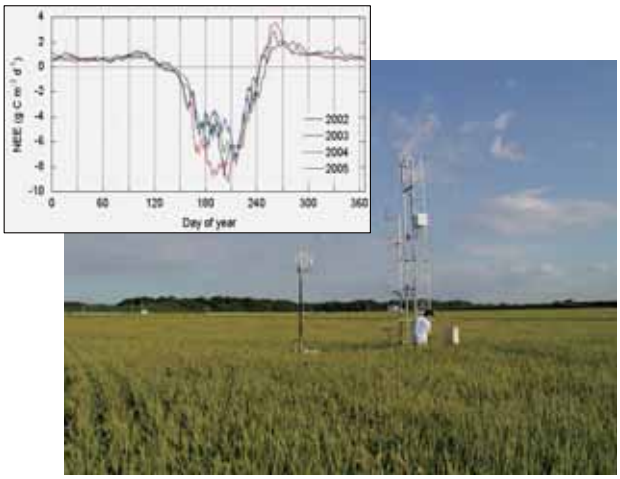


Fig. 4 Observations being performed at a rice field site in the Mase area of Tsukuba City, Ibaraki Prefecture, and an example of four years of CO_2 flux data accumulated in the database.

Radioactivity monitoring found that the 2006 concentrations of ^{90}Sr and ^{137}Cs in the rice and barley from radiation reference fields throughout Japan, and soil of those fields, as well as the concentrations of ^{137}Cs, 210Pb, and other nuclides in spinach and chingensai (*Brassica campestris* L. chinensis group) were at the same levels as in 2005. We made a plant reference sample from shiitake mushrooms in a 1-L container, and by using it for comparison, we were able to measure the very low concentration of ^{137}Cs in overwinter spinach, on the fresh-weight order of 1 m Bq/kg.

In the development of analysis and measurement methods, we confirmed that one of the two new types of precipitation gauges used in meteorological observation monitoring was able to precisely measure total snowfall amount in midwinter. It was confirmed that unknown arsenic compounds detected in a soil culturing experiment under flooded conditions could be identified by using methods such as TOF-MS (time-of-flight mass spectroscopy). We developed a rapid cadmium analysis method for spinach and soil using immunochromatography, showing that this analysis method can also be applied to things other than rice. In analyses of cadmium in brown rice using voltammetry, the extraction rate using 1 M hydrochloric acid in fractions with particle sizes of 1 mm or smaller was at least 90%, thereby demonstrating the effectiveness of simple extraction methods.

2) Collection, classification, and digital archiving of environmental resources

(1) Development of a natural resources inventory and its utilization

Research Plan for 2006–2010

To comprehensively assess agro-environments, we will develop technologies to analyze remote sensing data from sources including microwave measurements and the high time-resolution satellite-borne Moderate Resolution Imaging Spectroradiometer (MODIS), and we will use the Geographic Information System (GIS) and other means to develop new methods of ascertaining the state of agricultural land use and indicators relating to habitats. In addtion, we will develop a method for linking individual databases which have the GIS as their shared platform, and develop a new information recording and collection system, thereby contributing to the formulation of agro-

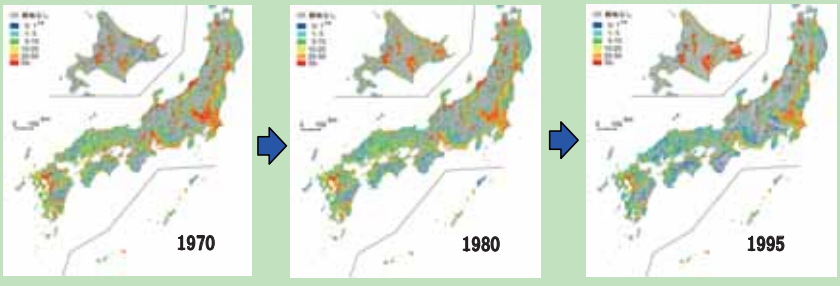
environmental indicators. We will also expand individual environmental resource databases, publish a tentative soil classification that includes functional assessments of deep soil, and build a comprehensive soil database of cropland and non-cropland. Further, to efficiently use inventory data and other information, we will develop tools such as basic statistical techniques and methods of visualizing the results. We will cooperate as a sub-bank of the gene bank run by the National Institute of Agrobiological Resources.

Summary for 2007

In the creation of indicators using remote sensing technology and the GIS, we completed time-series data sets, including one for vegetation indices, from MODIS images and other frequent-observation satellite images. We made a trial conversion equation to asses the history of change in rice field acreage over a wide area, and made a trial improved agricultural land-use map by combining time-series data on vegetation and water body indices. We created a device for measuring mid-infrared reflection characteristics in the field and established a method for interpreting the measurements, and we demonstrated its applicability to assessing rice yield, including degree of ripeness. We built and published a web-based database that gathers a wide range of information on crop cultivation (crop calendars) from Japan and other countries in order to preserve and share this information. We created trial indicators to assess the degree of isolation of forests and the continuity of adjacent rice fields and forest, and we determined the change since the 1880s in the distribution of the interface between rice fields and forests in valley-floor rice field areas.

By way of new systems for recording and gathering information, we created a prototype for a system that gathers information on insects, made a microorganism inventory system more convenient, and set up a high-speed key-word search system.

In the development of basic statistical methods and other tools, we set up a database capable of calculating basic land area data for each crop type on 1-km grid cells, and offering that information to external users (Figure 5). To improve the accuracy of indicators for soil erosion risk, we improved the accuracy of soil erosion risk maps by using estimates of inclines and slope lengths, and by this means produced maps that show the distribution of areas in Japan with high soil erosion risk. To create risk indicators for biodiversity, we developed a program that calculates the Gromov product, which is a measure of phylogenetic diversity, and elucidated the relationship between the state of growth of exotic plants in agro-environments and various categories of agro-ecosystems. We proposed a method to calculate “risk reduction points” from such comparison criteria as the pesticide application system. By using “environmental risk indicators” for rice field pesticides based on these “risk reduction points”, we calculated the concentration of excess nitrogen in water based on the amount of excess nitrogen from sources such as chemical fertilizers.



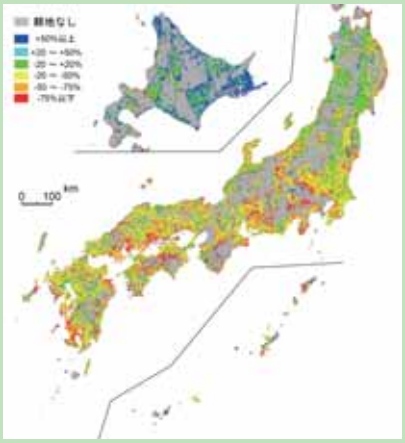


Fig. 5 Changes in farmland acreage in Japan expressed on a grid with 1-km cells.

This includes the data at five-year intervals from 1970 to 1995. These data can be used in combination with numerical land data and existing 1-km gridded data such as gridded climate values.

Increase/decrease of cropland from 1970 to 1995
“+” indicates cropland increase, “–” indicates decrease.
“+50% or more” includes farmland developed since 1970.

To expand and enhance our environmental resource databases, we added the data on 450 microorganisms and insect specimens and 1,040 smoke-damaged specimens to the agro-environment inventory. We also added the information to the agricultural statistics grid data. To establish reference soil profiles, we conducted surveys at 15 sites. We also created a database of the fertilization improvement records of about 3,500 profiles, created about 700 new farmland soil maps, and created soil maps according to subgroups in the third draft proposal for soil classification. We added 6,000 ground beetle specimens, 43 volumes on Diptera from the Mitsuhashi Notes, and data on 2,925 items for which identification was requested from 1948 to 1964. Additionally, we added 51 items of information on microorganisms and 39 specimens of microorganisms on pressed leaves, and published soil nematode images based on a gene bank project plan (Figure 6), we added and assessed the characteristics of insects, filamentous fungi, and bacteria.

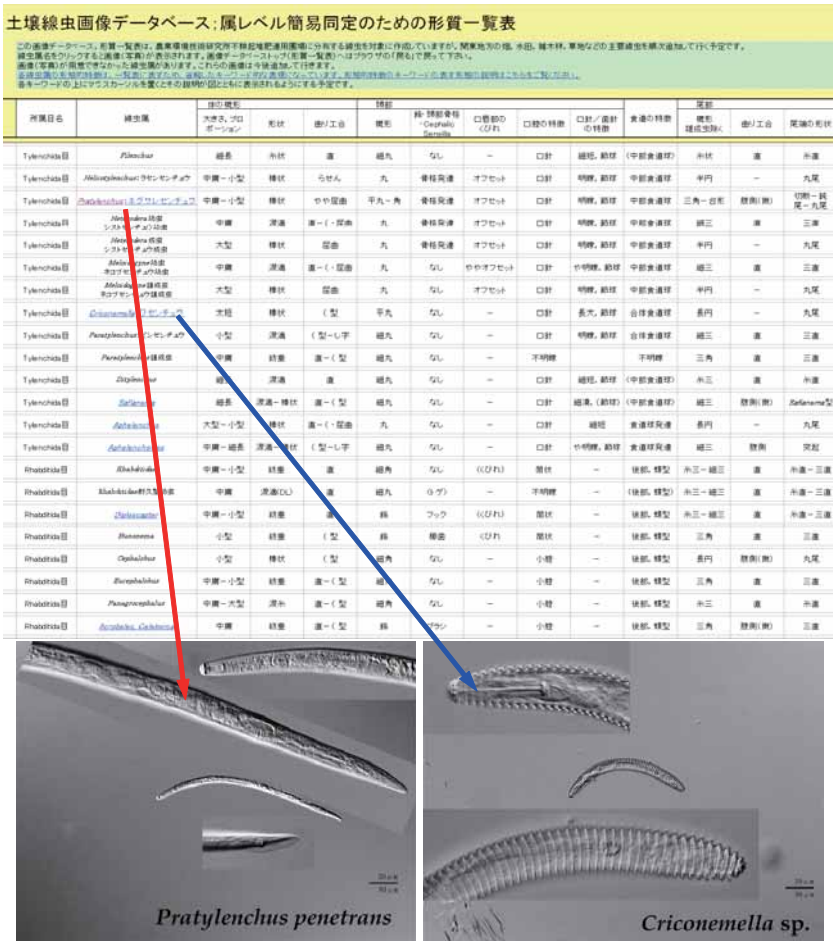


Fig. 6 Soil nematode image database published on the web.
Clicking a nematode genus name brings up an image.

Special Research Projects

1. Development and evaluation of mitigation technologies for CH_4 and N_2O emissions from agroecosystems

Agriculture contributes to about 40% of the respective global emissions of methane (CH_4) and nitrous oxide (N_2O). These greenhouse gases (GHGs) are emitted to the atmosphere from soils and by livestock during agricultural production processes. A research project entitled "Development and evaluation of mitigation technologies for CH_4 and N_2O emissions from agroecosystems", which focused on bridging the gaps in our knowledge of CH_4 and N_2O mitigation in the agricultural sector, was completed in FY2007 after 5 years of activity. The project was sponsored by the Global Environmental Research Fund (S2-3a) of the Ministry of the Environment, and NIAES was in charge of leading seven national institutes, six prefectural institutes, and two universities.

In experiments in croplands and animal production industries in Japan and other Asian countries, the study demonstrated feasible options for mitigation of agricultural CH_4 and N_2O emissions. Also, the compilation of GHG source databases and their analysis determined emission factors and the quantitative influences of the various factors controlling them. In addition, a mixed ecosystem analysis and development of a process-based model enabled the formulation of Tier 2 or 3 estimations of GHG emissions from agroecosystems. The results of this study will contribute to the promotion of policies for global environmental conservation in Japan and other Asian countries; these policies include MAFF strategies, the National GHG Inventory Report of Japan, and IPCC Guidelines.

2. Assessing land use and ecosystem carbon stock for carbon sequestration and food security in shifting-cultivation regions of Southeast Asia

In the tropical mountains of Southeast Asia, slash-and-burn agriculture is the most important food production system and is widely practiced in many countries. The ecosystem carbon stock in this land use is linked inherently with food security and sustainability of forest resources, and also with carbon exchange with the atmosphere. However, despite the importance of the system, we still have little geospatially based quantitative information on carbon stock in these regions. The objectives of this project were therefore 1) to provide quantitative information on dynamic changes in shifting cultivation ecosystems at a regional scale in terms of land use, vegetation change, and carbon budget; and 2) to propose new land-use and ecosystem management options that would improve rice productivity and the carbon sink capacity of the ecosystem. The research project was conducted during FY2003–2007. The northern part of the Lao People's Democratic Republic was selected as the study area.

Wide-area assessment of land use and ecosystem carbon stock by using remote sensing and GIS was a crucial part of this study. To assess the ecosystem carbon budget, we measured carbon in the soil and fallow vegetation and derived semi-empirical models. Another important part was the examination of alternative crops and cropping systems. Most importantly, all of these data, information, and models were synthesized for regional assessment of ecosystem carbon stock and for comparison between alternative land-use and cropping scenarios. This synergistic linkage of all modules worked efficiently in our research, yielding innovative outputs and useful outcomes.

We obtained the first intensive and systematic data on carbon stock in the soil and fallow vegetation of slash-and-burn ecosystems. Our database, which consists of time-series satellite imagery and topographic and climatic data, may be one of the most powerful databases so far developed for the region. Land-use history, fallow-age distribution, and ecosystem carbon stock were assessed by combining satellite imagery with the use of semi-empirical carbon models. Comparison of various land-use scenarios suggested that alternative land-use and ecosystem-management scenarios (e.g., longer fallow with the use of new agricultural technologies) would improve regional food production, farmer incomes, and carbon sequestration. This research work provides a scientific basis for carbon sequestration strategies through ecosystem management in developing countries, where agricultural or forest resources and environmental issues are strongly coupled.

3. Synthetic evaluation of the effect of acidic load on material flows in East Asian catchments

Consumption of food and energy has been increasing markedly in East Asia because of rapid economic development and population growth. These changes have enhanced the emission of acidic substances, including reactive nitrogen. The presence of too much reactive nitrogen in the environment causes serious pollution via such processes as nitrate pollution and eutrophication. It also af-

fects material balances in natural ecosystems through atmospheric deposition.

We used field measurements and mass balance modeling to conduct a 3-year research project to estimate the present and future status of atmospheric nitrogen deposition and material cycles in East Asian ecosystems. Field measurements of atmospheric nitrogen deposition and soil and streamwater chemistry were carried out in several areas in China and Thailand in cooperation with researchers in those countries. In order to predict future scenarios, we focused on changes in food production in East Asia (nine countries including China and Thailand), because ammonia emission from agriculture is considered to be the main contributor to atmospheric nitrogen deposition in Asia. On the basis of these measurements and estimations, we estimated the changes in the spatial distribution of nitrogen concentrations in stream water from 1980 to 2030.

The major findings of the research were as follows: 1) Ammoniacal substances accounted for about two-thirds of nitrogen deposition in China; application of the nitrogen balance model also suggested that agriculture was the major source of nitrogen loads. 2) Stream waters in areas of southern China with acidic soils had extremely high nitrate concentrations and low pH; nitrogen deposition in these areas exceeded 40 kg N ha^{-1}. 3) Per capita food consumption in urban and rural areas was strongly related to household income. In light of this relationship and projected scenarios of food trade, population growth, and immigration from rural to urban areas, we estimated that the ammonia emission rate from agriculture in East Asia in 2030 will be 1.6 to 2.0 times that in 2000. 4) Nitrogen cycle modeling showed that nitrogen concentrations in stream water will increase along the east coast of China, around the lower reaches of the Changjiang River, and in Viet Nam in the next 10 to 20 years.

This project was carried out in cooperation with Shinshu University, Tokyo University of Agriculture and Technology, The University of Tokyo, and the Acid Deposition and Oxidant Research Center; it was supported by the Global Environment Research Fund (C-052) of the Ministry of the Environment, Japan.

4. Risk assessment and control of invasive alien plants

Japan, which is located at the eastern end of Monsoon Asia, where precipitation is fairly heavy and geographical features extend over a wide latitudinal range, is characterized by wide floral variation. Crops and other plant species introduced from abroad, intentionally or unintentionally, have undergone further diversification under these climatic conditions to enrich the “indigenous” habitat.

However, a large number of alien plant species on these islands are known to be threatening the islands’ already stabilized ecological systems. A research consortium with NIAES as its principal unit attempted to assess the risks associated with newly introduced or invasive plant species in terms of disturbance of natural habitats—sometimes threatening to cause extinction of indigenous plants—and to analyze the chemical background of any adverse effects.

The “Invasive Alien Species Act” was enacted in 2005 to prevent invasion of alien species in order to control invasive alien species from specifically designated exotic organisms. In order to support this Act, a competitive research project, “Risk assessment of invasive alien plants and their control” was started in July 2005. The total budget was $5.4 million and 32 scientists participated from 5 organizations, carrying 25 themes in this project. NIAES was the responsible body, and Dr. Yoshiharu Fujii of NIAES was the research leader. Major results were as follows:

1) Drs. M. Ide, S. Yamamoto, and Y. Kusumoto evaluated the risks posed by invasive alien plants by using RuLIS, a newly developed Rural Landscape Inspection System; they found that abandoned agro-ecosystems are prone to invasion by new invaders. They evaluated the plants that have invaded and drew attention to the risks in agro-ecosystems posed by *Alternanthera philoxeroides* (alligator weed). In connection with these surveys, Dr. S. Hiradate and co-workers evaluated the relationship between soil pH and invasion by alien plants and found that decreasing of soil pH by humans increase the chances of new invasion of alien plants.
2) Dr. T. Nishida developed a new weed risk assessment (WRA) system modified from an Australian model by using 49 questions; she showed that this model was also applicable to Japan and is useful for the evaluation of pre-invasion evaluation of the risks posed by alien plants. Dr. Y. Fujii and co-workers evaluated the FAO (Food and Agriculture Organization) Weed Risk Assessment (FAO-WRA) system and developed a modified FAO-WRA model that uses 10 questions. This model is the simplest available for the quick evaluation of post-entry and pre-entry of alien plants. The most important factors were “aquatic plants”, “other members of the same genus are weed in somewhere”, and “allelopathic or toxic plants”. Application of this model revealed that the species posing the highest risk as weed were (1) *Sicyos angulatus*, (2) *Hydrocotyle ranunculoides*, (3) *Gymnocoronis spilanthoides*, (4) *Pistia stratiotes var. cuneata*, and (5) *Alternanthera*

philoxeroides.

3) Dr. Oki and co-workers studied strategies for mitigation of the effects of the above-mentioned aquatic invader weeds. She found two ecotypes of *Pistia stratiotes*.
4) Dr. Fujii and co-workers used specific bioassay systems to evaluate the allelopathic activity of 600 potential alien invaders. Biologically functional compounds were identified in 11 species, some of which were recognized allelopathic agents and others of which were highly toxic to mammals or display pharmaceutical potential. They compiled data on the toxic chemicals from alien plants and made two booklets that will act as a structural database.
5) Dr. H. Shibaike and co-workers studied the gene flow of dandelion and found that gene flow from the Japanese dandelion to the western type of dandelion has occurred. Using chloroplast DNA analysis, they found that more than 85% of western dandelions had hybridized with the Japanese type.
6) Drs. A. Konuma and Y. Shimono studied the unintentional introduction of alien weed seed in imported grains and found that imported wheat grains from the United States, Canada, and Australia contains weed seeds at about 0.1% to 0.2%. It was noted that we have no quarantine systems for this kind of introduction of alien weed seeds.
7) Dr. H. Ikeda and co-workers evaluated the effect of alien weeds on ecosystems and also the effects of the introduction of glyphosate to control heavy invasions of alien plants; they found that this herbicide has little effect on biodiversity if it is carefully applied.
8) Dr. Fujii and co-workers successfully tested a system of using buckwheat, a traditional crop with high allelopathic activity, to control *Ambrosia trifida* (Giant Ragweed), a noxious invasive weeds.

Additional species that have aquatic or marshy land habitats and pose potential risks are (1) *Egeria densa*, (2) *Elodea nuttallii*, (3) *Eichhornia crassipes*, (4) *Salvinia molesta*, (5) *Cabomba caroliniana*, (6) *Bacopa monnieri*, (7) *Nymphoides aquatica*, (8) *Sagittaria graminea*, (9) *Iris pseudacorus*, and (10) *Juncus* sp. Most of the species of this group have been introduced intentionally as ornamentals or even for use in environmental management. As their potential to disturb ecological systems is quite evident, development of measures to minimize their adverse effects will be needed in future.

Major results of our project can be viewed on the following web sites:

1) http://www.niaes.affrc.go.jp/project/plant_alien/index.html (in Japanese)
2) http://www.rib.okayama-u.ac.jp/wild/index.sjis.html
3) http://www.japr.or.jp/ (in Japanese)

5. Evaluation of pesticide residues in minor crops

In Japan, crops which are produced at the rate of 30,000 t/year or less are classified as minor crops. They include many regional and traditional crops. Because various pests infest these crops, many kinds of pesticides are needed for their stable production. However, for pesticide registration we need to submit data on crop residues, efficacy, and crop tolerance. Crop residue analysis, in particular, is expensive. Therefore, to date, only a few pesticides have been registered for each minor crop. Since the "Positive List System" to regulate pesticide residues in food began in May 2006 under the Food Sanitation Law, prompt registration of pesticides for use on minor crops has become important for the maintenance of crop production and supply.

From FY2005 to 2007, we conducted a research project in cooperation with the Japan Plant Protection Association to characterize and classify pesticide residues in fruits and leafy vegetables. We have developed a pesticide residue evaluation model for these vegetables and fruits. In leafy vegetables, the parameters of this model were the amount of pesticide sprayed by a square meter, crop coverage rate, crop weight at harvest, and wettability of leaf surface. In fruits and fruiting vegetables, the parameters of this model are fruit weight at spraying and harvesting, and wettability of peel surface. Each model was validated under field conditions.

Consequently, we established an extrapolative evaluation scheme for pesticide residues in minor crops by using the models developed by us. The proposed pesticide residual evaluation method can be used for the registration of foliar-applied pesticides in minor crops. In addition, this model will be utilized as a decision criterion to classify minor crops into groups on the basis of commodities with similar potential to contain pesticides residues, and to design effective tests for pesticide residues in crops.

6. Study and Surveillance of farmer and environmental safety in tank mixing of pesticides

Tank mixing of pesticides is a very popular way of reducing the workload needed to apply pesticides. Farmers utilize the "Case study data on tank mixing of pesticide combinations (Zen-Noh)", which gives information on the crop safety and efficacy of various pesticide combina-

tions, and is periodically revised. However, we have very limited data on the safety of tank mixing for humans and the environment.

This project was conducted by NIAES, Chiba University, The Institute of Environmental Toxicology, and the Japan Agricultural Cooperatives from FY2005 to FY2007, and was subsidized by the Ministry of Agriculture, Forestry and Fisheries. The purposes of this project were (1) to survey the important tank-mix combinations of pesticides in vegetables and fruits; (2) to design methods for testing pesticide on skin irritation in humans, activity in insects, and pesticide drift; (3) to conduct these tests with the selected combinations; and (4) to contribute to the risk management of tank mixes of these chemicals.

We selected 64 representative tank-mix pesticide combinations out of 184 cases as suitable for vegetable application, and 42 out of 249 combinations as suitable for fruits, based on questionnaires and interviews. We also surveyed the status quo of shipment and use of the surfactants in tank mixes. An *in vitro* skin irritation test method was developed by using a three-dimensional cultured human skin model. This method could detect the mixing effect, i.e., whether additive, synergistic, or antagonistic. It was also appropriate for Tier 1 testing [*1] , because all synergistic actions were pseudopositive [*2] reactions based on comparative *in vivo* skin irritation testing in rabbits. An acute toxicity test system was developed to evaluate the effect of each combination on the house fly and honeybee; it effectively detected mixing effects of not only pesticide combinations but also pesticide-surfactant combinations. And synergistic, additive and antagonistic effects were clearly detected. A pesticide droplet-detection device was developed by using a wind tunnel and laser particle spectrometer, enabling us to measure droplets less than 30 μm in diameter. The droplet size affects on the distance of the drift and how deeply reached in lung. This device enabled us to evaluate the effect of tank mixing, including the addition of various surfactants, on spray drift. Tank mixing affected droplet size and number; in the combination mixes these values ranged between half and double those of each single pesticide.

Consequently, we were able to develop laboratory test methods for a wide range of tank mixes of pesticides and surfactants. Our results suggest that application of tank mixing of pesticides seldom exacerbates the adverse effects of application of single pesticides on farmer's health and the environment, although further studies are needed.

1: Tier system grades the several levels (steps) of actions for selection, judgment, evaluation and so forth, Tier 1 is the initial step of this system.
2: pseudopositive means the test (assay) result is positive but it is not confirmed the truth.

7. Development of comprehensive management system of hazardous chemicals in agricultural, forestry and fisheries ecosystems

Cadmium (Cd) and persistent organic pollutants (POPs) can affect humans and the environment by persisting in the agricultural environment for extended periods of time. Although international safety standards for these substances have been tightened, procedures for the risk assessment and management of such hazardous chemical substances are demanded both domestically and globally.

Against this background, projects were initiated in 2003 and have continued for 5 years supported by a grant-in-aid (Hazardous Chemicals) from the Ministry of Agriculture, Forestry, and Fisheries of Japan, with NIAES playing the leading role. The research focused on two major issues: 1) the development of general technology for controlling Cd absorption and accumulation in staple crops, and 2) the development of general technology for controlling organic chemical substances, which included four subtopics as a whole. Many researchers from national, prefectural, and private universities, as well as independent administrative corporations', prefectural, and private companies' research institutions took part in the projects.

In Cd, phytoremediation technique for Cd-contaminated paddy fields by rice cultivar with high Cd accumulation properties was developed. Soil washing technology by $FeCl_2$ was developed for Cd-contaminated paddy soils, and washed out Cd was adsorbed by special resin and clean water was drained. The low Cd absorption rice/soybean varieties were discovered, and its genetic analysis was studied. A quick and simple method for the analysis of Cd content in rice by using a laser beam was also developed.

In POPs, several risk assessment technologies were developed, such as simulation model for the prediction of pesticide behavior in rivers, arable land soils and the atmosphere. Several risk management technologies, mainly targeting POPs such as drins, were also developed, such as bioremediation by microbes, phytoremediation by cucurbit, reduction of absorption by pumpkin as a stock, and by active charcoal.

Consequently, more than 150 research papers and several manuals were published, several patents were applied, and several technologies were done press release.

8. Analysis of bacterial flora on phylloplanes by molecular techniques

Bacteria that inhabit plants play important roles in ecosystems. Of those bacteria that inhabit the soil, bacteria that are considered 'culturable'—i.e. able to be isolated by plating techniques—account for about 1%; the remainder are considered unculturable. In contrast, little is known about either the culturable or unculturable bacteria that inhabit plants. The plant surface has recently come to be seen as the extreme environment, and the epiphytic bacteria that live on this surface are now regarded as having evolved special adaptations for living there. On the surface of the plant, bacteria encounter various environmental stresses daily, including rain, desiccation, ultraviolet radiation, and exposure to chemicals, implying that the bacteria living on the plant surface have many functions that differ from those of bacteria in other environments, e.g. gene regulation systems that enable the bacteria to adapt to rapid climatic changes over short periods; ultraviolet resistance; and the ability to attach to the plant's surface. Similarly, bacteria inside the plants—endophytic bacteria—survive by adapting to elements of the plant's defense system, such as plant-produced toxins. These facts suggest that if we are to understand ecosystem mechanisms and utilize plant bacteria we will need to be able to assess total bacterial populations, including those of the unculturable bacteria, on and in plants.

The objectives of this project are therefore to develop a method for monitoring total bacteria on and in plants by using a dyeing method and to clarify the proportion of unculturable bacteria in the total bacterial population.

We are now developing a new monitoring method using rice and wheat cultivated in the fields at NIAES. To monitor epiphytic bacteria, we obtained bacterial suspensions by washing the leaf sheaths of rice and staining them with ethidium bromide. The stained bacteria can be clearly observed under a fluorescent microscope (Fig. 1). The results suggest that this method is useful for monitoring epiphytic bacteria. We are now performing a study aimed at increasing the rates of recovery of bacteria. In addition, we are developing a method of monitoring endophytic bacteria.

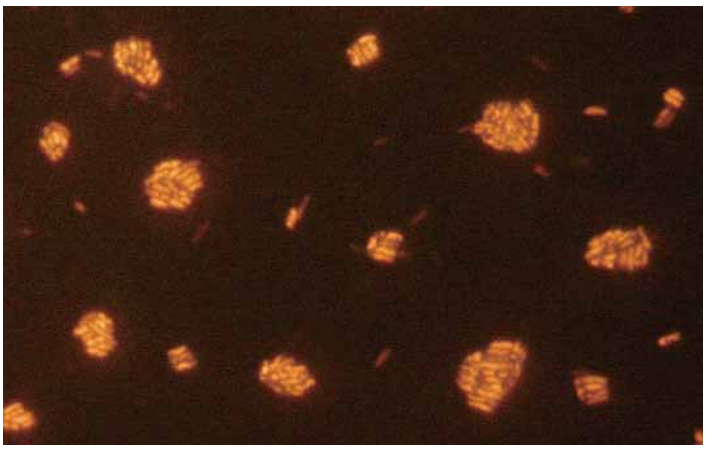


Fig. 1 Bacteria stained orange by ethidium bromide on a plant surface. Magnification: x 1,000.

Symposia and Workshops

1. Conferences, Workshops and Research Meetings

Title	Place	Date	Participants
The 27th Symposium on Agro-Environmental Sciences: Food vs. Energy: It Begun Scramble for Cereal.	Tokyo Iino Hall	May 23, 2007	330
The 7th Seminar on Risk Assessment and Prevention of Invasive Alien Plants: Problems in Hokkaido Area and Application of Afforestation Plant and its Risk.	Hokkaido University	August 4, 2007	91
J-FARD&JIRCAS International Symposium: Contribution of Japanese Agricultural Researcher to Goal of Millennium Development – Domestic Coalition and Cultivation of Human Resources –	United Nations University	September 12-13, 2007	
The 7th Seminar on Organic Chemical Studies: For Risk Management of Agrochemicals – Thinking about Life Cycle Assessment–	NIAES	September 19, 2007	107
The 24th Research Meeting on Pesticides: For Risk Management of Agrochemicals – What is Required for Pesticide Analysis –	NIAES	September 20, 2007	113
The 8th Conference of the East and Southeast Asian Federation of Soil Science: – New Challenges of Soil Science for Harmonizing Food Production with Environments –	Tsukuba International Congress Center	October 22, 2007	300
NIAES International Symposium: Invasive Alien Species in Monsoon Asia: Status and Control	Tsukuba International Congress Center	October 22-23, 2007	110
Open Seminar: Cultivation of Genetically Modified Crops and its Impact Assessment on Ecology	Tokyo Sankei Plaza	November 3, 2007	97
AFFRC International Workshop on “Assessment of Changes in Water Cycles on Food Production and Alternative Scenarios” – Implications for Policy Making –	Tsukuba International Congress Center	November 22, 2007	56
Symposium on Hazardous Chemicals in Agro-Ecosystem – Seeking Safety of Foods and Environment –	Tsukuba International Congress Center	November 29, 2007	198
The 28th Symposium on Agro-Environmental Sciences: What is Happened by Global Warming and How We Respond it – Evaluation of Warming Effect on the Agriculture, Forestry and Fisheries Industry –	Tokyo Shinjuku Meiji Yasuda Hall	December 11, 2007	307
The 5th Symposium of Environmental Research Institutes in Japan	Tokyo Hitotsubasi Memorial Hall	December 19, 2007	400

Title	Place	Date	Participants
The 29th Symposium on Agro-Environmental Sciences: Aiming for Conservation of Biodiversity and its Application in Agriculture and Agricultural Community	Tokyo International Forum	February 2, 2008	260
The 9th Seminar on Risk Assessment and Prevention of Invasive Alien Plants: Final report and Future Prospects	Kobe Convention Center	February 17, 2008	148
The 25th Seminar on Soil and Water: Research of Soil and Water and Our Healthy Life	Tsukuba Office, Agriculture, Forestry and Fisheries Research Council Secretariat Hall	February 20, 2008	148
The 24th Meteorology Workshop: Verifying a Effect of Unusual High Temperature in 2007 Summer on Rice Production	NIAES	February 27, 2008	165

2. The 7th Seminar on Organic Chemical Studies: Toward risk management for pesticides—thinking about life cycle assessment

The Seventh Seminar on Organic Chemical Studies was held on 19 September 2007 at the NIAES conference hall. Six domestic speakers experienced in life cycle assessment (LCA) were invited from university, independent administrative institutions, and the private sectors. There were a total of 107 participants.

The concept of LCA, in which products are assessed from the cradle (resource) to the grave (scrap), was recently introduced in evaluations of the environmental impact of anthropogenic materials, and ISO14040 [*1] is used as an international standard for environmental management. There are several approaches that target the concepts of the "environment preservation society" and "zero-emission" domestically. In agriculture, the environment is an essential element that is affected by farming in terms of such impacts as decreased biodiversity and increased eutrophication. The objectives of this seminar were to understand the relationship between LCA and pesticides, and to discuss the directions of further studies on the risk management of pesticides.

The following topics were presented at the seminar: 1) Role of LCA in an environment-preserving society (K. Tanaka, Eco-Management Institute); 2) Development and application of LCA to local measures (Y. Genchi, National Institute of Advanced Industrial Science and Technology); 3) Approaches to, and future issues in, LCA in agriculture (S. Mishima, NIAES); 4) Environmental impact assessment in pesticide development from an LCA viewpoint (O. Saika, Nisso Chemical Analysis Service Co., Ltd); 5) LCA analysis of risk mitigation technologies for pesticide-polluted soils (Y. Inoue, Nagoya University); and 6) Impact assessment of pesticides in LCA of agricultural production systems—agenda for plant-protection accounting in terms of the economic and environmental impacts (K. Hayashi, National Agricultural Research Center).

Panel discussion was conducted to promote understanding and the exchange of opinions on how we can introduce the LCA concept to pesticide management. The participants brought with them a mutual understanding of the urgency and significance of these issues.

1: ISO14040 describes the principles and framework for life cycle assessment (LCA), which includes the definition of the goal/scope, the life cycle inventory analysis, the life cycle impact assessment, the life cycle interpretation, and so forth.

3. The 25th Seminar on Soil and Water

The 25th Seminar on Soil and Water, "The Study of Soil/ Water and Our Healthy Life", was held on 20 February 2008 at the Tsukuba Norin Hall and was sponsored by

NIAES. Following the opening address by President of NIAES Y. Sato, lectures on the following six topics were delivered: 1) Science targeting a coalition among agriculture, environment, and medical fields (K. Minami, Kitasato University); 2) Delivering widespread training on the soil environment and linking communities, schools, and families (K. Tamura, Tsukuba University); 3) Therapy through horticulture—growing, producing, and eating plants (Y. Tosaka, Ibaraki Horticulture Therapy Institute); 4) An approach to learning from the soil—the Special Agriculture Education Zone in Kitakata City, Fukushima Prefecture (H. Watanabe, Kitakata City Board of Education); 5) Water purification using plants in rural areas (K. Abe, NIAES); and 6) Identifying crop locations on the basis of correlations between soils and trace elements (A. Kawasaki, NIAES).

In total, there were 148 participants from the national government, prefectural governments, private companies, universities and independent administrative corporations. The lectures were wide-ranging, including health (coalition between agriculture and medical practice), education of food and agriculture, environmental integrity, and food safety. The audience was also diverse, including private companies, the general public, as well as universities and testing and research organizations.

4. The 24th Meteorology Workshop: Verifying the effects of abnormally high summer temperatures in 2007 on rice production

The 24th Meteorology Workshop was held at NIAES on 27 February 2008. On 16 August 2007 a daily maximum air temperature of 40.9 ºC—the highest on record—was recorded in the cities of Kumagaya in Saitama Prefecture and Tajimi in Gifu Prefecture, and August and September 2007 were unusually hot in many areas of Japan. These abnormally high temperatures were within the range for high-temperature sterility of rice, which has not been a significant issue in the past. In collaboration with the National Institute of Crop Science (NICS) and National Agricultural Research Center (NARC), NIAES conducted a field survey and reported the results at the workshop. The workshop was attended by a total of 165 participants, comprising 133 from government agencies, private companies, and universities and 32 from NIAES.

At the workshop it was reported that, in many areas of the Kanto and Tokai regions, heading and flowering just occurred from the end of July to the beginning of August. Additionally, according to a model developed by NIAES, the atmospheric temperature and rice panicle temperature in paddy farming regions and the temperature of paddy rice communities had not increased substantially compared with an average year, therefore the 2007 rice yield was not substantially affected by the high temperatures. Moreover, the incidence of poor quality in rice (as exemplified by e.g. chalkiness) was not very high compared with an average year.

However, when heading and flowering occurred during the record high temperatures, the level of sterility was above 20% in some areas. In addition, sterility rates were influenced by rice variety and fertilization rate, whereas quality was affected by number of hours of solar radiation and transpiration rate in the ripening period.

This NIAES study produced a large amount of valuable information on the effects of high temperatures on rice production and the measures that can be taken to combat these effects.

Foreign Visitors

1. Foreign Scholars

Affiliation	Subject	Duration
Korea, GyeongGi-Do Agricultural Research and Extension Services	Risk assessment and management of agro-environment	May 07, 2007~ May 18, 2007
Landcare Research New Zealand Ltd.	Corporative Research between NIAES and Landcare Research under MOU	May 28, 2007~ June 06, 2007
Landcare Research New Zealand Ltd.	Corporative Research between NIAES and Landcare Research under MOU	May 28, 2007~ June 06, 2007
Korea, National Institute of Agricultural Science and Technology	Corporative Research Project on “Exposure and risk assessment on the persistent organic pollutants(POPs)”	July 21, 2007~ August 18, 2007
Korea, International Technical Cooperation Division	Corporative Research Project on “Exposure and risk assessment on the persistent organic pollutants(POPs)”	September 01, 2007~ September 09, 2007
Korea, National Institute of Agricultural Science and Technology	Corporative Research Project on “Exposure and risk assessment on the persistent organic pollutants(POPs)”	September 01, 2007~ September 09, 2007
Spain, Institute for Prospective Technological Studies, European Commission-Joint Research Center	Assurance of Safe Use of Genetically Modified (GM) Organisms	September 24, 2007~ September 29, 2007
Spain, Institute for Prospective Technological Studies, European Commission-Joint Research Center	Assurance of Safe Use of Genetically Modified (GM) Organisms	September 24, 2007~ September 29, 2007
France, The National Institute for Agricultural Research(INRA)	Assurance of Safe Use of Genetically Modified (GM) Organisms	September 24, 2007~ September 29, 2007
Thailand, Plant Protection Research and Development Office	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 28, 2007
Thailand, Plant Protection Research and Development Office	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 25, 2007
Vietnam, JIRCAS	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 25, 2007
Taiwan, Bureau of Animal and Plant Health Inspection and Quarantine	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 28, 2007
Philippine rice Research Institute	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 25, 2007
China, Nanjing Agricultural University	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 25, 2007
University of Malaya	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 27, 2007
China, Zhongshan University	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 25, 2007

Affiliation	Subject	Duration
USA, University of Connecticut	NIAES International Symposium 2007 “Invasive Alien Species in Monsoon Asia: Status and Control”	October 21, 2007~ October 27, 2007
China, Institute of Applied Ecology	Cooperative Research Project on “Control of CH4 and N2O from Agro-Ecosystem”	October 21, 2007~ October 30, 2007
UK, Rothamsted Research	Open Seminar “Cultivation of Genetically Modified crops and Evaluation of ecological effects”	November 01, 2007~ November 05, 2007
Korea, National Institute of Agricultural Science and Technology	Corporative Research Project on “Exposure and risk assessment on the persistent organic pollutants(POPs)”	December 13, 2007~ December 15, 2007
Korea, International Technical Cooperation Division	Corporative Research Project on “Exposure and risk assessment on the persistent organic pollutants(POPs)”	December 13, 2007~ December 15, 2007
Nanjing Agricultural University, China	Corporative Study on Geo-Information Science and Technologies for Agro-Ecosystem and Environmental Applications	January 27, 2008~ April 05, 2008
University of Malaya	Agrobiodiversity Seminar “Ecological effects of GM crops and Invasive Alien Species on biodiversity”	February 17, 2008~ March 01, 2008

2. Fellows

Fellowship	Affiliation	Research Subject	Duration
JSPS Postdoctal Fellowship	Poland, Warsaw Agriculture University	DNA microarray studies of allelochemicals from buckwheat	August 02, 2005~ August 01, 2007
	Nihon University	A Comparative study of POPs exposure in Japan and Korea agro-environment based on the high-precision POPs analysis	September 01, 2005~ August 31, 2007
	UK, Rothamsted Research	Molecular methods for screening QoI resistance in powdery mildews in Japan	September 14, 2005~ September 13, 2007
	Iran, Shahrekord University	A study to improve consistency between morphological and DNA-using identification of soil nematodes	November 23, 2005~ November 22, 2007
	Benin	Microbial community on sclerotia of Sclerotium rolfsii	November 30, 2005~ November 29, 2007
JSPS Invitation Fellowship	Landcare Research New Zealand Ltd.	Developing a new formula of controlled release nitrogen fertilizers	March 29, 2007~ April 27, 2007
Eco-Frontier Fellowship	Thai, King Mongkut's University of Technology Thonburi	Modeling Methane and Nitrous Oxide Emissions from Agricultural Land in Asian Countries	April 01, 2007~ October 27, 2007
	Vietnam, Southern Institute for Water Resources Research	Risk Assessment about Changing Amount and Quality of Water Resources, and Its Effects for Rice Production in Mekong Delta Area	June 13, 2007~ March 31, 2008
JICA	Mongolian Agricultural University	Diversity of Grasses	November 05, 2007~ November 09, 2007

3. Training

Affiliation	Subject	Duration
Vietnam, Ibaraki University	GIS using techniques	April 02, 2007~ October 31, 2007
Peru, University of Tokyo	Screening of Allelopathic Activity and Analyze of Plant Growth Regulators	May 07, 2007~ March 31, 2008
Iran, University of Tsukuba	Molecular Biological Analysis of Soil Microorganisms	November 05, 2007~ March 31, 2008
Pakistan Museum of Natural History	The Study of Advanced Taxonomic and Conservation Techniques Applying on Plants Species with Toxic or Other Biologically Functional Ingredients Implied Market as well as Environment	November 16, 2007~ November 15, 2008
Korea, Yokohama National University	Trace Analysis of Toxaphene	November 21, 2007~ February 06, 2008
Korea, Yeongnam Agricultural Research Institute	Behavior of pesticides for evaluation of their impact	December 10, 2007~ June 06, 2008
China, Ibaraki University	Effect of Farm Management for Soil Microdiversity	March 03, 2008~ March 31, 2008

Overseas Research and Meetings

1. Overseas Research Trips

Area	Country	Number of Times	Area	Country	Number of Times
Asia	China	35	Europe	Czech	2
	Korea	22		Netherlands	2
	Thailand	13		Slovak	2
	Vietnam	10		Spain	2
	Taiwan	4		Switzerland	2
	Bangladesh	2		France	1
	Philippines	2		Italy	1
	Indonesia	1		Norway	1
	Laos	1		Russia	1
	Mongolia	1		UK	1
Oceania	Australia	1	America	USA	4
				Peru	1
			Africa	Benin	1

2. Overseas Meetings

Meeting	Venue	Date	Participants from NIAES
75th Western Snow Conference	USA	April 16, 2007~ April 19, 2007	1
15th International Symposium on Modern Fungicides and Antifungal Compounds	Germany	May 06, 2007~ May 10, 2007	1
11th International Space Conference of Pacific-basin Societies	China	May 16, 2007~ May 18, 2007	1
27th Annual Conference of International Association of Impact Assessment	Korea	June 02, 2007~ June 09, 2007	2
10th International Congress on Biotechnology in the Pulp and Paper Industry	USA	June 10, 2007~ June 15, 2007	1
1st International Symposium on Nematodes as Environmental Bioindicators	UK	June 12, 2007~ June 13, 2007	1
2nd International Symposium on Trace Elements and Health	Finland	June 18, 2007~ June 20, 2007	1
4th International Temperate Rice Conference (TRC2007)	Italy	June 25, 2007~ June 28, 2007	1
5th International Conference on Multiple Comparison Procedures	Austria	July 08, 2007~ July 11, 2007	1
CHEMRAWN and ICCDU Conference on Greenhouse Gases	Canada	July 08, 2007~ July 12, 2007	1

Meeting	Venue	Date	Participants from NIAES
9th International Conference on the Biogeochemistry of Trace Elements	China	July 15, 2007~ July 19, 2007	9
Workshop on fundamentals of biofilm research	USA	July 23, 2007~ July 24, 2007	1
Ecological Society of America, Annual Meeting	USA	August 05, 2007~ August 10, 2007	1
3rd Asian Conference on Plant Pathology	Indonesia	August 20, 2007~ August 23, 2007	1
IGU/IGCC Central Europe Conference 2007	Slovenia	August 28, 2007~ September 04, 2007	1
International Workshop on: Tropical Rain Forest and Boreal Forest Disturbance and Their Affects on Global Warming	Mongolia	August 29, 2007~ August 30, 2007	1
6th International Conference on Ecosystems and Sustainable Development	Portugal	September 05, 2007~ September 07, 2007	2
British Ecological Society Annual Meeting 2007	UK	September 10, 2007~ September 12, 2007	1
The 9th International Conference on the Ecology and Management of Alien Plant Invasions	Australia	September 17, 2007~ September 21, 2007	4
3rd International Conference on Mechanisms of Organic Matter Stabilization and Destabilization in Soils and Sediments	Australia	September 23, 2007~ September 26, 2007	1
The annual Free and Open Source Software for Geospatial 2007	Canada	September 24, 2007~ September 27, 2007	1
Regional Workshop on Weed Risk Assessment	India	September 25, 2007~ September 28, 2007	1
International Commission on Irrigation and Drainage (ICID) 2007	USA	September 30, 2007~ October 06, 2007	1
NITROGEN 4th Conference	Brazil	October 01, 2007~ October 05, 2007	4
21st Asian Pacific Weed Science Society Conference	Sri Lanka	October 02, 2007~ October 06, 2007	1
8th Chinese Congress on Weed Science	China	October 09, 2007~ October 10, 2007	1
XVI International Plant Protection Congress	UK	October 15, 2007~ October 28, 2007	1
Asia Flux Workshop 2007	Taiwan	October 19, 2007~ October 21, 2007	4
Phytotechnologies to Promote Sustainable Land Use and Improve Food Safety (COST ACTION 859) Workshop	Israel	October 23, 2007~ October 25, 2007	1

Meeting	Venue	Date	Participants from NIAES
International Symposium on Intelligent Information Technology in Agriculture 2007	China	October 26, 2007~ October 29, 2007	1
2nd IWA-ASPIRE Asia-Pacific Regional Group Conference & Exhibition	Australia	October 28, 2007~ November 01, 2007	2
2007 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions	USA	October 29, 2007~ November 01, 2007	3
31st Annual Meeting of the Waterbird Society	Spain	October 30, 2007~ November 03, 2007	1
5th International Symposium on Biocontrol and Biotechnology	Thai	November 01, 2007~ November 03, 2007	1
The International Annual Meetings of ASA,CSSA,SSSA	USA	November 04, 2007~ November 08, 2007	2
18th International Symposium of Environmental Biogeochemistry	New Zealand	November 11, 2007~ November 16, 2007	1
28th Asian Conference on Remote Sensing	Malaysia	November 12, 2007~ November 16, 2007	1
IIASA Conference '07	Austria	November 14, 2007~ November 15, 2007	1
4th International Symposium on Persistent Toxic Substances	China	November 18, 2007~ November 21, 2007	1
Third International Conference on Co-existence between Gene-Modified and non-GM based Agricultural Supply Chains	Spain	November 20, 2007~ November 21, 2007	3
American Anthropological Association 2007 Annual Meeting	USA	November 28, 2007~ December 02, 2007	1
Carbo East Asia Meeting 2007	China	November 30, 2007~ December 01, 2007	1
Asian Young Leaders Climate Forum	Indonesia	December 03, 2007~ December 10, 2007	1
International Congress on Modeling and Simulations	New Zealand	December 10, 2007~ December 13, 2007	1
Carbo East Asia Workshop	Korea	February 19, 2008~ February 21, 2008	2
Workshop on POPs monitoring of atmospheric pollution and Asian dust	China	March 02, 2008~ March 03, 2008	2

Publications

1. Official publications

1) NIAES Annual Report 2007

2) NIAES Research Executive Summary (Japanese ed.) (Kenkyu seika joho), No.24

3) Annual Report of National Institute for Agro-Environmental Sciences (Japanese ed.) (Nogyo kankyo gijutsu kenkyusho nenpo), No.24

4) NIAES News (Japanese ed.) (No-kan-ken nyusu), No.75 - No.78

2. Research Papers published by the NIAES staff

Scientific Papers	English	117
	Japanese	42
	Others	7
Proceedings (incl. Abstracts)	English	223
	Japanese	452
Others	English	33
	Japanese	129
	Others	4

3. Research staff activities (English papers) NIAES staff's names are boldfaced.

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Amano T, Ushiyama K, Fujita G, Higuchi H	Predicting grazing damage by white-fronted geese under different regimes of agricultural management and the physiological consequences for the geese	Journal of Applied Ecology	44(3)	506-515	2007
Amano T, Yamaura Y	Ecological and life-history traits related to range contractions among breeding birds in Japan	Biological Conservation	137(2)	271-282	2007
Arakaki N, Nagayama A, Kobayashi A, Kishita M, Sadoyama Y, Mougi N, Kawamura F, Wakamura S, **Yamamura K**	Control of the sugarcane click beetle *Melanotus okinawensis* Ohira (Coleoptera: Elateridae) by mass trapping using synthetic sex pheromone on Ikei Island, Okinawa, Japan	Applied Entomology and Zoology	43(1)	37-47	2008
Asano M, Tamura K, **Maejima Y**, Matsuzaki H, Higashi T	14C variations of pedogenic carbonate in Mongolian steppe soils under a vegetation sequence	Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms	259(1)	403-407	2007
Baba K, Okamura T, Yamamoto H, Yamamoto T, Ueyama N	Zinc, Cadmium, and Mercury 1, 2-Benzenedithiolates with Intramolecular NH···S Hydrogen Bonds	Inorganic Chemistry	47(7)	2837-2848	2008

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Cheng W, **Yagi K**, **Akiyama H**, **Nishimura S**, **Sudo S**, **Fumoto T**, **Hasegawa T**, Hartley AE, Megonigal JP	An empirical model of soil chemical properties that regulate methane production in Japanese rice paddy soils	Journal of Environmental Quality	36(6)	1920-1925	2007
Chu H, Zhu J, Lin X, Yin R, Xie Z, Cao Z, **Fujii T**	Short-term decomposition of 14C-labelled glucose in a fluvo-aquic soil as affected by lanthanum amendment	Biology and Fertility of Soils	43(6)	811-814	2007
Chu H, Lin X, **Fujii T**, **Morimoto S**, **Yagi K**, Hu J, Zhang J	Soil microbial biomass, dehydrogenase activity, bacterial community structure in response to long-term fertilizer management	Soil Biology and Biochemistry	39(11)	2971-2976	2007
Dabrowska-Zielinska K, **Inoue Y**, Kowalik W, Gruszcynska M	Inferring the effect of plant and soil variables on C- and L-band SAR backscatter over agricultural fields, based on model analysis	Advances in Space Research	39(1)	139-148	2007
Ding W, Cai Y, Cai Z, **Yagi K**, Zheng X	Nitrous oxide emission from an intensively cultivated maize-wheat rotation soil in the North China Plain	Science of The Total Environment	373(2-3)	501-511	2007
Ding W, Cai Y, Cai Z, **Yagi K**, Zheng X	Soil respiration under maize crops: Effects of water, temperature, and nitrogen fertilization	Soil Science Society of America Journal	71(3)	944-951	2007
Ding W, **Yagi K**, **Akiyama H**, **Sudo S**, **Nishimura S**	Time-lagged induction of N_2O emission and its trade-off with NO emission from a nitrogen fertilized Andisol	Soil science and plant nutrition	53(4)	362-372	2007
Eguchi S, Hasegawa S	Determination and characterization of preferential water flow in unsaturated subsoil of andisol	Soil Science Society of America Journal	72(2)	320-330	2008
Enya J, **Koitabashi M**, Shinohara H, **Yoshida S**, Tsukiboshi T, Negishi H, Suyama K, **Tsushima S**	Phylogenetic diversities of dominant culturable *bacillus*, *pseudomonas* and *pantoea* species on tomato leaves and their possibility as biological control agents	Journal of Phytopathology	155(7-8)	446-453	2007
Enya J, Shinohara H, **Yoshida S**, Tsukiboshi T, Negishi H, Suyama K, **Tsushima S**	Culturable leaf-associated bacteria on tomato plants and their potential as biological control agents	Microbial Ecology	53(4)	524-536	2007
Faize M, **Faize L**, **Ishii H**	Characterization of a leucine-rich repeat receptor-like protein kinase (LRPK) gene from Japanese pear and its possible involvement in scab resistance	Journal of General Plant Pathology	73(2)	104-112	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Fudeyasu H, **Kuwagata T**, Ohashi Y, Suzuki S, Kiyohara Y, Hozumi Y	Numerical study of the local downslope wind "Hirodo-Kaze" in Japan	Monthly Weather Review	136(1)	27-40	2008
Fujiwara H, **Fukuyama T**, Shirato Y, Ohkuro T, **Taniyama I**, Zhang TH	Deposition of atmospheric ^{137}Cs in Japan associated with the Asian dust event of March 2002	Science of The Total Environment	384(1-3)	306-315	2007
Fumoto T, Kobayashi K, Li C, **Yagi K**, **Hasegawa T**	Revising a process-based biogeochemistry model (DNDC) to simulate methane emission from rice paddy fields under various residue management and fertilizer regimes	Global Change Biology	14(2)	382-402	2008
Funamoto R, Saito K, Oyaizu H, **Saito M**, Aono T	Simultaneous *in situ* detection of alkaline phosphatase activity and polyphosphate in arbuscules within arbuscular mycorrhizal roots	Functional Plant Biology	34(9)	803-810	2007
Golisz A, Lata B, Gawronski SW, **Fujii Y**	Specific and total activities of the allelochemicals identified in buckwheat	Weed Biology and Management	7(3)	164-171	2007
Goto S, **Kuwagata T**, Konghakote P, Polthanee A, **Ishigooka Y**, **Toritani H**, **Hasegawa T**	Characteristics of water balance in a rain-fed paddy field in Northeast Thailand	Paddy and water environment	6(1)	153-157	2008
Han GH, Yoshikoshi H, **Nagai H**, **Yamada T**, **Ono K**, **Mano M**, **Miyata A**	Isotopic disequilibrium between carbon assimilated and respired in a rice paddy as influenced by methanogenesis from CO_2	Journal of Geophysical Research G	112	G02016	2007
Hasegawa J, Guruge KS, **Seike N**, Shirai Y, Yamata T, Nakamura M, Handa H, Yamanaka N, Miyazaki S	Determination of PCDD/Fs and dioxin-like PCBs in fish oils for feed ingredients by congener-specific chemical analysis and CALUX bioassay	Chemosphere	69(8)	1188-1194	2007
Hasegawa T, **Sawano S**, **Goto S**, Konghakote P, Polthanee A, **Ishigooka Y**, **Kuwagata T**, **Toritani H**, Furuya J	A model driven by crop water use and nitrogen supply for simulating changes in the regional yield of rain-fed lowland rice in Northeast Thailand	Paddy and water environment	6(1)	73-82	2008

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Hayano M, Horikawa N, **Kuwagata T**, Furuya J, **Ishigooka Y**, **Hasegawa T**, Taniguchi T, Shimizu A, **Toritani H**, Tada M, Masumoto T	Features of the AFFRC model for evaluating the relationship between the water cycle and rice production	Paddy and water environment	6(1)	15-23	2008
Hayashi K, **Nishimura S**, **Yagi K**	Ammonia volatilization from a paddy field following applications of urea: Rice plants are both an absorber and an emitter for atmospheric ammonia	Science of The Total Environment	390(2-3)	485-494	2008
Hayatsu M, **Tago K**, **Saito M**	Vrious players in the nitrogen cycle: Diversity and functions of the microorganisms involved in nitrification and denitrification	Soil science and plant nutrition	54(1)	33-45	2008
Hiradate S, Yonezawa T, Takesako H	Fine fractionation and purification of the fulvic acid fraction using adsorption and precipitation procedures	Soil science and plant nutrition	53(4)	413-419	2007
Honda K, Mizukami M, Ueda Y, Hamada N, **Seike N**	Residue level of polycyclic aromatic hydrocarbons in Japanese paddy soils from 1959 to 2002	Chemosphere	68(9)	1763-1771	2007
Iizumi T, Hayashi Y, Kimura F	Influence on rice production in Japan from cool and hot summers after global warming	Journal of agricultural meteorology	63(1)	11-23	2007
Iizumi T, **Nishimori M**, **Yokozawa M**	Combined equations for estimating global solar radiation: Projection of radiation field over Japan under global warming conditions by statistical downscaling	Journal of agricultural meteorology	64(1)	9-23	2008
Ikenaka Y, **Ishizaka M**, **Eun H**, Miyabara Y	Glucose-sulfate conjugates as a new phase II metabolite formed by aquatic crustaceans	Biochemical and Biophysical Research Communications	360(2)	490-495	2007
Inao K, Watanabe H, Karpouzas DG, Capri E	Simulation models of pesticide fate and transport in paddy environment for ecological risk assessment and management	JARQ-Japan Agricultural Research Quarterly	42(1)	13-21	2007
Inoue Y, Peñuelas J, **Miyata A**, **Mano M**	Normalized difference spectral indices for estimating photosynthetic efficiency and capacity at a canopy scale derived from hyperspectral and CO_2 flux measurements in rice	Remote Sensing of Environment	112(1)	156-172	2008
InoueY, Douangsavanh L, Qi J, Olioso A, Kiyono Y, Horie T, Asai H, Saito K, Ochiai Y, Shiraiwa T	Traceability of slash-and-burn land-use history using optical satellite sensor imagery: a basis for chronosequential assessment of ecosystem carbon stock in Laos	International Journal of Remote Sensing	28(24)	5641-5647	2007
Ishigooka Y, **Kuwagata T**, **Goto S**, **Toritani H**, **Ohno H**, Urano S	Modeling of continental-scale crop water requirement and available water resources	Paddy and water environment	6(1)	55-71	2008

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Ishii H, Yano K, Date H, Furuta A, Sagehashi Y, Yamaguchi T, **Sugiyama T**, **Nishimura K**, **Hasama W**	Molecular characterization and diagnosis of QoI resistance in cucumber and eggplant Fungal Pathogens	Phytopathology	97(11)	1458-1466	2007
Islam MA, Yamamoto M, Sugie M, Naka H, **Tabata J**, Arita Y, Ando T	Synthesis and characterization of 2,13- and 3,13- Octadecadienals for the identification of the sex pheromone secreted by a clearwing moth	Journal of Chemical Ecology	33(9)	1763-1773	2007
Itahashi S, Seo MC, Takeuchi M	Estimation and comparison of nitrogen loads in agricultural catchments of Japan and Korea	Water Science and Technology	56(1)	105-113	2008
Ito A, Inatomi M, **Mo W**, Lee M, Koizumi H, Saigusa N, Murayama S, Syamamoto S	Examination of model-estimated ecosystem respiration using flux measurements from a cool-temperate deciduous broad-leaved forest in central Japan	Tellus. Series B, Chemical and physical meteorology	59(3)	616-624	2007
Jayakumar J, Bhaskaran R, **Tsushima S**	Potential of plant extracts in combination with bacterial antagonist treatment as biocontrol agent of red rot of sugarcane	Canadian Journal of Microbiology	53(2)	196-206	2007
Jiang S, Park P, **Ishii H**	Ultrastructural study on scab resistance expressed in epidermal pectin layers of pear leaves	Journal of General Plant Pathology	73(5)	314-323	2007
Jomura M, Kominami Y, Dannoura M, Kanazawa Y	Spatial variation in respiration from coarse woody debris in a temperate secondary broad-leaved forest in Japan	Forest Ecology and Management	255(1)	149-155	2008
Kamo T, Endo M, Sato M, Kasahara R, **Yamaya H**, **Hiradate S**, **Fujii Y**, Hirai N, Hirota M	Limited distribution of natural cyanamide in higher plants: Occurrence in *Vicia villosa* subsp. *varia*, *V. cracca*, and *Robinia pseudo-acacia*	Phytochemistry	69(5)	1166-1172	2008
Katase T, Okuda K, **Kim Y**, **Eun H**, Takada H, Uchiyama T, Saito H, Makino M, Fujimoto Y	Estrogen equivalent concentration of 13 branched *para*-nonylphenols in three technical mixtures by isomer-specific determination using their synthetic standards in SIM mode with GC-MS and two new diasteromeric isomers	Chemosphere	70(11)	1961-1972	2008
Kawabe M, Katsube K, **Yoshida T**, Arie T, **Tsuchiya K**	Genetic diversity of *Fusarium oxysporum* f. sp. *spinaciae* in Japan based on phylogenetic analyses of rDNA-IGS and *MAT1* sequences	Journal of General Plant Pathology	73(5)	353-359	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Kawakami T, Takezawa A, Nishi I, **Watanabe E**, **Ishizaka M**, **Eun H**, Onodera S	Monitoring of cholinesterase-inhibiting activity in water from the Tone canal, Japan, as a biomarker of ecotoxicity	Ecotoxicology	17(4)	221-228	2008
Kiyono Y, Ochiai Y, Chiba Y, Asai H, Saito K, Shiraiwa T, Horie T, Songnoukhai V, Navongxai V, **Inoue Y**	Predicting chronosequential changes in carbon stocks of pachymorph bamboo communities in slash-and-burn agricultural fallow, northern Lao People	Journal of Forest Research	12(5)	371-383	2007
Kou T, Zhu J, Xie Z, **Hasegawa T**, Heiduk K	Effect of elevated atmospheric CO_2 concentration on soil and root respiration in winter wheat by using a respiration partitioning chamber	Plant and Soil	299(1-2)	237-249	2007
Kuga Y, Saito K, Nayuki K, Peterson RL, **Saito M**	Ultrastructure of rapidly frozen and freeze-substituted germ tubes of an arbuscular mycorrhizal fungus and localization of polyphosphate	New Phytologist	178(1)	189-200	2008
Luo XY, **Ikeda H**	Effects of four rice herbicides on the growth of an aquatic fern, *Marsilea quadrifolia* L.	Weed Biology and Management	7(4)	237-241	2007
Ma J, Li KL, Xu H, Han Y, Cai ZC, **Yagi K**	Effects of nitrogen fertilizer and wheat straw application on CH_4 and N_2O emission from a paddy rice field	Australian Journal of Soil Research	45(5)	359-367	2007
Makino T, Kamiya T, Takano H, Itou T, Sekiya N, Sasaki K, **Maejima Y**, Sugahara K	Remediation of cadmium-contaminated paddy soils by washing with calcium chloride: Verification of on-site washing	Environmental Pollution	147(1)	112-119	2007
Makino T, Takano H, Kamiya T, Itou T, Sekiya N, Inahara M, **Sakurai Y**	Restoration of cadmium-contaminated paddy soils by washing with ferric chloride: Cd extraction mechanism and bench-scale verification	Chemosphere	70(6)	1035-1043	2008
Masumoto T, **Toritani H**, Tada M, Shimizu A	Assessment of changes in water cycles on food production and alternative policy scenarios	Paddy and water environment	6(1)	5-14	2008
Matsuzaki H, Nakano C, Tsuchiya YS, Kato K, **Maejima Y**, Miyairi Y, Wakasa S, Aze T	Multi-unclide AMS performances at MALT	Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms	259(1)	36-40	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Mimida N, **Kitamoto H**, Osakabe K, Nakashima M, Ito Y, Heyer WD, Toki S, Ichikawa H	Two alternatively spliced transcripts generated from *OsMUS81*, a rice homolog of yeast *MUS81*, are Up-Regulated by DNA-Damaging treatments	Plant and Cell Physiology	48(4)	648-654	2007
Mishima S, **Taniguchi S**, **Kohyama K**, **Komada M**	Relationship between nitrogen and phosphate surplus from agricultural production and river water quality in two types of production structure	Soil science and plant nutrition	53(3)	318-327	2007
Mochizuki A, Naka H, Mitsunaga T, Haruyama N, Nomura M	Is the introduction of the biological control agent, Chrysoperla carnea (Stephens, 1836), risky or beneficial?	Annali del Museo civico di Storia naturale di Ferrara	8	197-202	2007
Mori K, Tashiro T, Yoshimura T, Takita M, **Tabata J**, **Hiradate S**, Sugie H	Determination of the absolute configuration of the male aggregation pheromone, 2-methyl-6-(40methylenebicyclo[3.1.0]-hexyl)hept-2-en-1-ol, of the stink bug *Erysarcoris lewisi* (Distant) as 2*Z*, 6*R*, 1'*S*, 5'*S* by its synthesis	Tetrahedron Letters	49(2)	354-357	2008
Morita A, Yanagisawa O, Takatsu S, Maeda S, **Hiradate S**	Mechanism for the detoxification of aluminum in roots of tea plant (*Camellia sinensis* (L.) Kuntze)	Phytochemistry	69(1)	147-153	2008
Murano H, **Otani T**, **Furubayashi A**, **Yamamura K**, Kobayashi K, Hiradate S	Adsorption of herbicidally active degradate 2-(2,4-Dichloro-3-methylphenoxy) propanoic acid on and andosol	Journal of agricultural and food chemistry	56(4)	1350-1357	2008
Nagai T, **Imai A**, **Matsushige K**, Fukushima T	Growth characteristics and growth modeling of *Microcystic* aeruginosa and *Planktothrix agardhii* under iron limitation	Limnology	8(3)	261-270	2007
Naito Y, Kanzaki M, Numata S, Obayashi K, **Konuma A**, Nishimura S, Ohta S, Tsumura Y, Okuda T, Lee SL, Muhammad N	Size-related flowering and fecundity in the tropical canopy tree species, *Shorea acuminata* (Dipterocarpaceae) during two consecutive general flowerings	Journal of Plant Research	121(1)	33-42	2008
Nakayama T, **Horita M**, Shimanuki T	*Spongospora subterranea* soil contamination and its relationship to severity of powdery scab on potatoes	Journal of General Plant Pathology	73(4)	229-234	2007
Niwa S, Kaneko N, **Okada H**, Sakamoto K	Effects of fine-scale simulation of deer browsing on soil micro-foodweb structure and N mineralization rate in a temperate forest	Soil Biology and Biochemistry	40(3)	699-708	2008
Noguchi MT, Yasuda N, Fujita Y	Fitness characters in parasexual recombinants of the rice blast fungus, *Pyricularia oryzae*	JARQ-Japan Agricultural Research Quarterly	41(2)	123-131	2007
Noguchi MT, Yasuda N, Fujita Y	Parasexual cycle provides genetic segregants equivalent to sexual progeny in the rice blast fungus *Magnaporthe oryzae*	JARQ-Japan Agricultural Research Quarterly	41(3)	207-210	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Obata T, **Kitamoto HK**, Nakamura A, Fukuda A, Tanaka Y	Rice shaker potassium channel OsKAT1 confers tolerance to salinity stress on yeast and rice cells[1[OA]]	Plant Physiology	144(4)	1978-1985	2007
Ohno T, Fernandez IJ, **Hiradate S**, Sherman JF	Effects of soil acidfication and forest type on water soluble soil organic matter properties	Geoderma	140(1-2)	176-187	2007
Ohtsuka T, **Mo W**, Satomura T, Inatomi M, Koizumi H	Biometric based carbon flux measurements and net ecosystem production (NEP) in a temperate deciduous broad-leaved forest beneath a flux tower	Ecosystems	10(2)	324-334	2007
Okuda H, Noda K, **Sawamoto T**, **Tsuruta H**, Hirabayashi T, Yonemoto JY, **Yagi K**	Emission of N_2O and CO_2 and uptake of CH_4 in soil from a Satsuma mandarin orchard under mulching cultivation in Central Japan	Journal of the Japanese Society for Horticultural Science	76(4)	279-287	2007
Ono K, **Miyata A**, **Yamada T**	Apparent downward CO_2 flux observed with open-path eddy covariance over a non-vegetated surface	Theoretical and Applied Climatology	92(3-4)	195-208	2007
Otani T, **Seike N**	Rootstock contorol of fruit dieldrin concentration in grafted cucumber (*Cucumis sativus*)	Journal of Pesticide Science	32(3)	235-242	2007
Saito A, Shinya T, Miyamoto K, **Yokoyama T**, Kaku H, Minami E, Shibuya N, Tsujibo H, Nagata Y, Ando A, **Fujii T**, **Miyashita K**	The dasABC Gene Cluster, Adjacent to *dasR*, Encodes a Novel ABC Transporter for the Uptake of *N,N'*-Diacetylchitobiose in *Streptomyces coelicolor* A3(2)	Applied and Environmental Microbiology	73(9)	3000-3008	2007
Saito M, Asanuma J, **Miyata A**	Dual-scale transport of sensible heat and water vapor over a short canopy under unstable conditions	Water Resources Research	43(5)	W05413	2007
Sakai Y, **Ogata N**, **Fujii T**, **Sugahara K**, **Miyashita K**, **Hasebe A**	2,4-Dichrolophenoxyacetic acid-degrading genes from bacteria isolated from soil in Japan: Spread of *Burkholderia cepacia* RASC-type degrading genes harbored on large plasmids	Microbes and Environments	22(2)	145-156	2007
Sakamoto T, Nguyen NV, **Kotera A**, **Ohno H**, **Ishitsuka N**, **Yokozawa M**	Detecting temporal changes in the extent of annual flooding within the Cambodia and the Vietnamese Mekong Delta from MODIS time-series imagery	Remote Sensing of Environment	109(3)	295-313	2007
Sakurai Y, Murayama S, **Makino T**, **Maejima Y**, **Sugahara K**	Chemical form of soluble cadmium and copper in arable soils and its implication to their mobility	JARQ-Japan Agricultural Research Quarterly	41(2)	139-145	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Sawa Y, Tanimoto H, **Yonemura S**, Matsueda M, Mukai H, Wada A, Taguchi S, Hayasaka T, Tsuruta H, Tohjima Y, Mukai H, Kikuchi N, Katagiri S, Tsuboi K	Widespread pollution events of carbon monoxide observed over the western North Pacific during the East Asian Regional Experiment (EAREX) 2005 campaign	Journal of Geophysical Research D	112	D22S26	2007
Sawano S, **Hasegawa T**, **Goto S**, Konghakote P, Polthanee A, **Ishigooka Y**, **Kuwagata T**, **Toritani H**	Modeling the dependence of the crop calendar for rain-fed rice on precipitation in Northeast Thailand	Paddy and water environment	6(1)	83-90	2008
Seike N, Kashiwagi N, **Otani T**	PCDD/F contamination over time in Japanese paddy soils	Environmental Science & technology	41(7)	2210-2215	2007
Sekiguchi H, Hasegawa H, **Okada H**, Kushida A, Takenaka S	Comparative analysis of environmental variability and fungal community structure in soils between organic and conventional commercial farms of cherry tomato in Japan	Microbes and Environments	23(1)	57-65	2008
Sekine T, Sugano M, Majid A, Fujii Y	Antifungal effects of volatile compounds from black Zira (*Bunium persicum*) and other spices and herbs	Journal of Chemical Ecology	33(11)	2123-2132	2007
Shibayama M, **Kanda K**, **Sugahara K**	Water turbidity estimation using a handheld spectropolarimeter to determine surface reflection polarization in visible, near and short-wave infrared bands	International Journal of Remote Sensing	28(16)	3747-3755	2007
Shibayama M, Watanabe Y	Estimating the mean leaf inclination angle of wheat canopies using reflected polarized light	Plant Production Science	10(3)	329-342	2007
Shimono H, **Hasegawa T**, Iwama K	Modeling the effects of water temperature on rice growth and yield under a cool climate: I. Model development	Agronomy Journal	99(5)	1327-1337	2007
Shimono H, **Hasegawa T**, **Kuwagata T**, Iwama K	Modeling the effects of water temperature on rice growth and yield under a cool climate: II. Model application	Agronomy Journal	99(5)	1338-1344	2007
Shimono H, Okada M, Yamakawa Y, Nakamura H, Kobayashi K, **Hasegawa T**	Rice yield enhancement by elevated CO_2 is reduced in cool weather	Global Change Biology	14(2)	276-284	2007
Shimono Y, **Konuma A**	Effects of human-mediated processes on weed species composition in internationally traded grain commodities	Weed Research	48(1)	10-18	2008
Someya N, Tsuchiya K, **Yoshida T**, **Noguchi MT**, Akutsu K, Sawada H	Fungal cell wall degrading enzyme-producing bacterium enhances the biocontrol efficacy of antibiotic-producing bacterium against cabbage yellows	Journal of Plant Diseases and Protection	114(3)	108-112	2007

Author(s)	Title	Journal Title	Vol.(No.)	Pages	Year
Someya N, Tsuchiya K, **Yoshida T**, **Noguchi MT**, Sawada H	Encapsulation of cabbage seeds in alginate polymer containing the biocontorol bacterium *Pseudomonas fluorescens* strain LRB3W1 for the control of cabbage soilborne diseases	Seed Science and Technology	35(2)	371-379	2007
Sugiyama M, Ae N, **Arao T**	Role of roots in differences in seed cadmium concentration among soybean cultivars-proof by grafting experiment	Plant and Soil	295(1-2)	1-11	2007
Tabata J, **Noguchi H**, Kainoh Y, Mochizuki F, **Sugie H**	Behavioral response to sex pheromone-component blends in the mating disruption-resistant strain of the smaller tea tortrix, *Adoxophyes honmai* Yasuda (Lepidoptera: Tortricidae), and its mode of inheritance	Applied Entomology and Zoology	42(4)	675-683	2007
Takahashi T, Nanzyo M, **Hiradate S**	Aluminum status of synthetic Al-humic substance complexes and their influence on plant root growth	Soil science and plant nutrition	53(2)	115-124	2007
Takita M, Sugie H, **Tabata J**, Ishii S, **Hiradate S**	Isolation and estimation of the aggregation pheromone from *Eysarcoris lewisi* (Distant)(Heteroptera:Pentatomidae)	Applied Entomology and Zoology	43(1)	11-17	2008
Tanimoto H, Mukai H, Sawa Y, Matsueda H, **Yonemura S**, Wang T, Poon S, Wong A, Lee G, Jung JY, Kim KR, Lee MH, Lin NH, Wang JL, Ou-Yang CF, Wu CF, Akimoto H, Pochanart P, Tsuboi K, Doi H, Zellweger C, Klausen J	Direct assessment of international consistency of standards for ground-level ozone: strategy and implementation toward metrological traceability network in Asia	Journal of Environmental Monitoring	9(11)	1183-1193	2007
Tanimoto H, Sawa Y, Matsueda H, **Yonemura S**, Wada A, Mukai H, Wang T, Poon S, Wong A, Lee G, Jung JY, Kim KR, Lee M, Lin NH, Wang JL, Ou-Yang CF, Wu CF	Evaluation of standards and methods for continuous measurements of carbon monoxide at ground-based sites in Asia	Papers in Meteorology and Geophysics	58	85-93	2007

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Tao F, Hayashi Y, Zhao Z, **Sakamoto T**, **Yokozawa M**	Global warming, rice production, and water use in China: Developing a probabilistic assessment	Agricultural and Forest Meteorology	148(1)	94-110	2008
Tian SF, Inoue M, **Du M**	Influence of dust storm frequency in Northern China on fluctuations of Asian dust frequency observed in Japan	SOLA	3	121-124	2007
Toda M, **Yokozawa M**, Sumida A, Watanabe T, Hara T	Simulating the carbon balance of a temperate larch forest under various meteorological conditions	Carbon Balance and Management	2(6)	doi:10.1186/1750-0680-2-6	2007
Umemoto S, Nagashima K, **Yoshida S**, **Tsushima S**	Sclerotinia rot of blueberry caused by Sclerotinia sclerotiorum	Journal of General Plant Pathology	73(4)	290-292	2007
Wang Y, Shimodaira J, **Miyasaka T**, **Morimoto S**, Oomori T, Ogawa N, Fukuda M, Fujii T	Detection of *bphAa* gene expression of *Rhodococcus sp*. Strain RHA1 in soil using a new method of RNA preparation from soil	Bioscience, Biotechnology, and Biochemistry	72(3)	694-701	2008
Watanabe M, Inoue Y, Sakagami N, Bolormaa O, Kawasaki K, **Hiradate S**, Fujitake N, Ohta H	Characterization of major and trace elements in sclerotium grains	European Journal of Soil Science	58(3)	786-793	2007
Watanabe M, Sato H, Matsuzaki H, Kobayashi T, Sakagami N, **Maejima Y**, Ohta H, Fujitake N, **Hiradate S**	^{14}C ages and $\delta^{13}C$ of sclerotium grains found in forest soils	Soil science and plant nutrition	53(2)	125-131	2007
Wuyunna, **Okamoto K**, Kawashima H	Analysis of vegetative biomass changes in steppes of inner Mongolia, China, using multitemporal landsat, climatic, and socioeconomic data	International Journal of Ecodynamics	2(2)	97-107	2007
Xie Z, Zhu J, Liu G, Cadisch G, **Hasegawa T**, Chen C, Tang H, Zeng Q	Soil organic carbon stocks in China and changes from 1980s to 2000s	Global Change Biology	13(9)	1989-2007	2007
Xiong ZQ, Freney JR, Mosier AR, Zhu ZL, Lee Y, **Yagi K**	Impacts of population growth, changing food preferences and agricultural practices on the nitrogen cycle in East Asia	Nutrient Cycling in Agroecosystems	80(2)	189-198	2007
Yamamura K, Hino A	Estimation of the proportion of defective units by using group testing under the existence of a threshold of detection	Communications in Statistics - Simulation and Computation	36(5)	949-957	2007

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Yamamura K, Wada T, Urano S	Random median sampling to enhance the precision of population estimates	Population Ecology	49(4)	357-363	2007
Yao F, Xu Y, Lin E, **Yokozawa M**, Zhang J	Assessing the impacts of climate change on rice yields in the main rice areas of China	Climatic Change	80(3-4)	395-409	2007
Yara K, Sasawaki T, Kunimi Y	Displacement of *Torymus beneficus* (Hymenoptera: Torymidae by *T. sinensis*, an indigenous and introduced parasitoid of the chestnut gall wasp, *Dryocosmus kuriphilus* (Hymenoptera: Cynipidae), in Japanese chestnut fields: Possible involvement in hybridization	Biological Control	42(2)	148-154	2007
Yonemura S, **Kawashima S**, Matsueda H, Sawa Y, **Inoue S**, Tanimoto H	Temporal variations in ozone concentrations derived from principal component analysis	Theoretical and Applied Climatology	92(1-2)	47-58	2008
Yoshida S, Tsukiboshi T, Shinohara H, **Koitabashi M**, **Tsushima S**	Occurrence and development of *Collectotrichum acutatum* on symptomless blueberry bushes	Plant Pathology	56(5)	871-877	2007
Yoshioka Y, Ohashi K, **Konuma A**, Iwata H, Ohsawa R, Ninomiya S	Ability of bumblebees to discriminate differences in the shape of artificial flowers of *Primula sieboldii* (Primulaceae)	Annals of Botany	99(6)	1175-1182	2007
Yun MS, Chen W, Deng F, **Yogo Y**	Propanil and swep inhibit 4-coumarate: CoA ligase activity *in vitro*	Pest Management Science	63(8)	815-820	2007

4. Patents

1) System to Prevent Rice Agrochemical Outflow with Charcoal Made by Rice Husk
Patent number: 4014988
Date of application: September 26, 2002
Date of registration: September 21, 2007
Inventors: Kazuhiro Takagi and Seizaburo Takanashi

2) Case and Disperse Medium for Microorganism Preservation
Patent number: 3937019
Date of application: December 12, 2003
Date of registration: April 6, 2007
Inventors: Koji Nishiyama and Hirosuke Shinohara

5. Collaborative Research

Collaborative Research	Number
Private Enterprise	18
University	3
Other Independent Administrative Institution	6
Prefectural Research Institution	5

Advisory Coucil

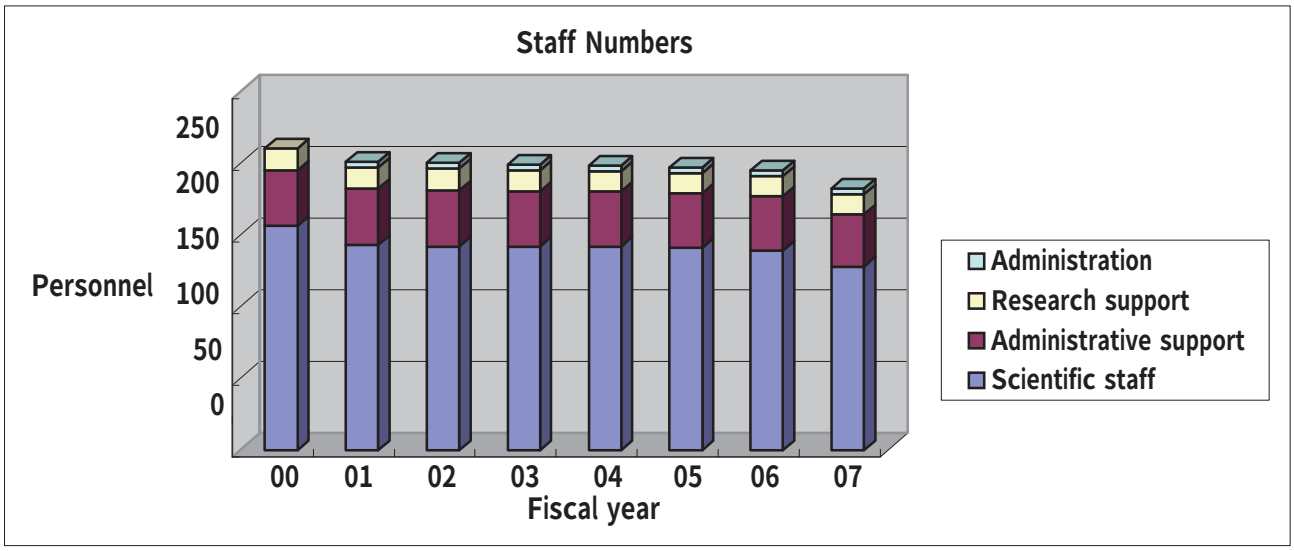
NIAES Advisory Council (2007)

Makoto Kimura	Professor, Graduate School of Bioagricultural Sciences, Nagoya University
Toyoki Kozai	President, Chiba University
Toru Nagata	Former Professor, School of Agriculture, Ibaraki University
Shunrokuro Fujiwara	Deputy Director General, Kanagawa Agricultural Technology Center
Waki Matsunaga	Science Writer
Yoko Yamazaki	President, Inakano Heroine Wakuwaku Network
Ryutaro Ohtsuka	President, National Institute for Environmental Studies
Takeshi Horie	President, National Agriculture and Food Research Organization
Kazuo Suzuki	President, Forestry and Forest Products Research Institute
Toshio Akiyama	President, National Research Institute of Fisheries and Environment of Inland Sea, Fisheries Research Agency
Masamichi Saigo	Head of Environment and Biomass Policy Division, Minister's Secretariat, MAFF

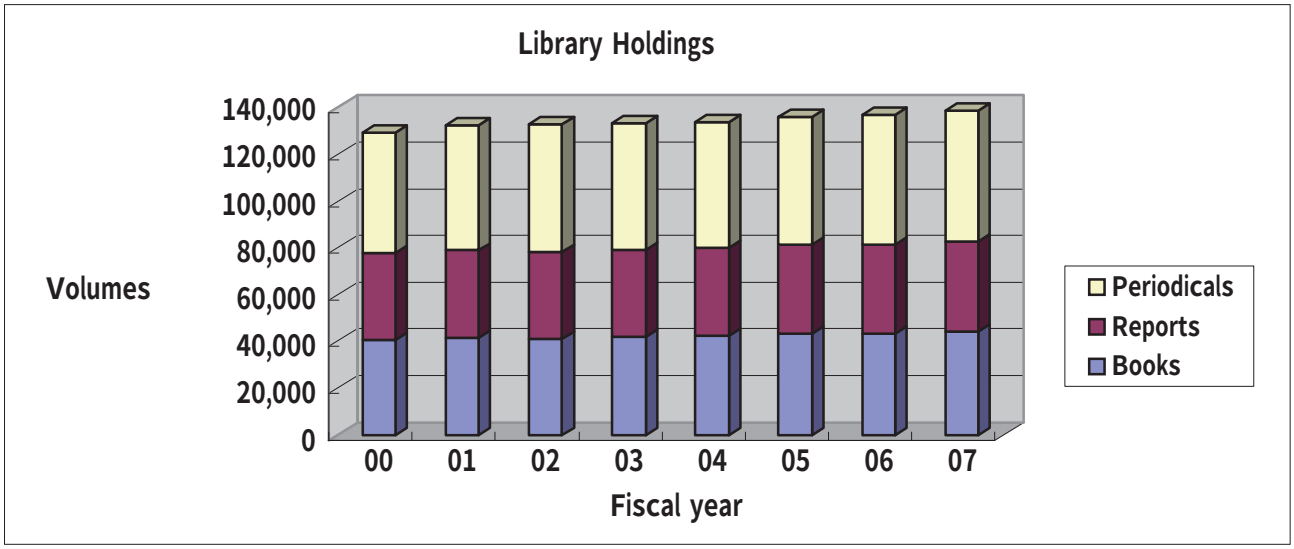
Budget in the FY 2007 (Million yen)

Operational Budget	3, 142
Facilities Maintenance Subsidy	97
Project Research Budget	1,601
Miscellaneous Income	1
Incidental Income	-
Total	4, 841

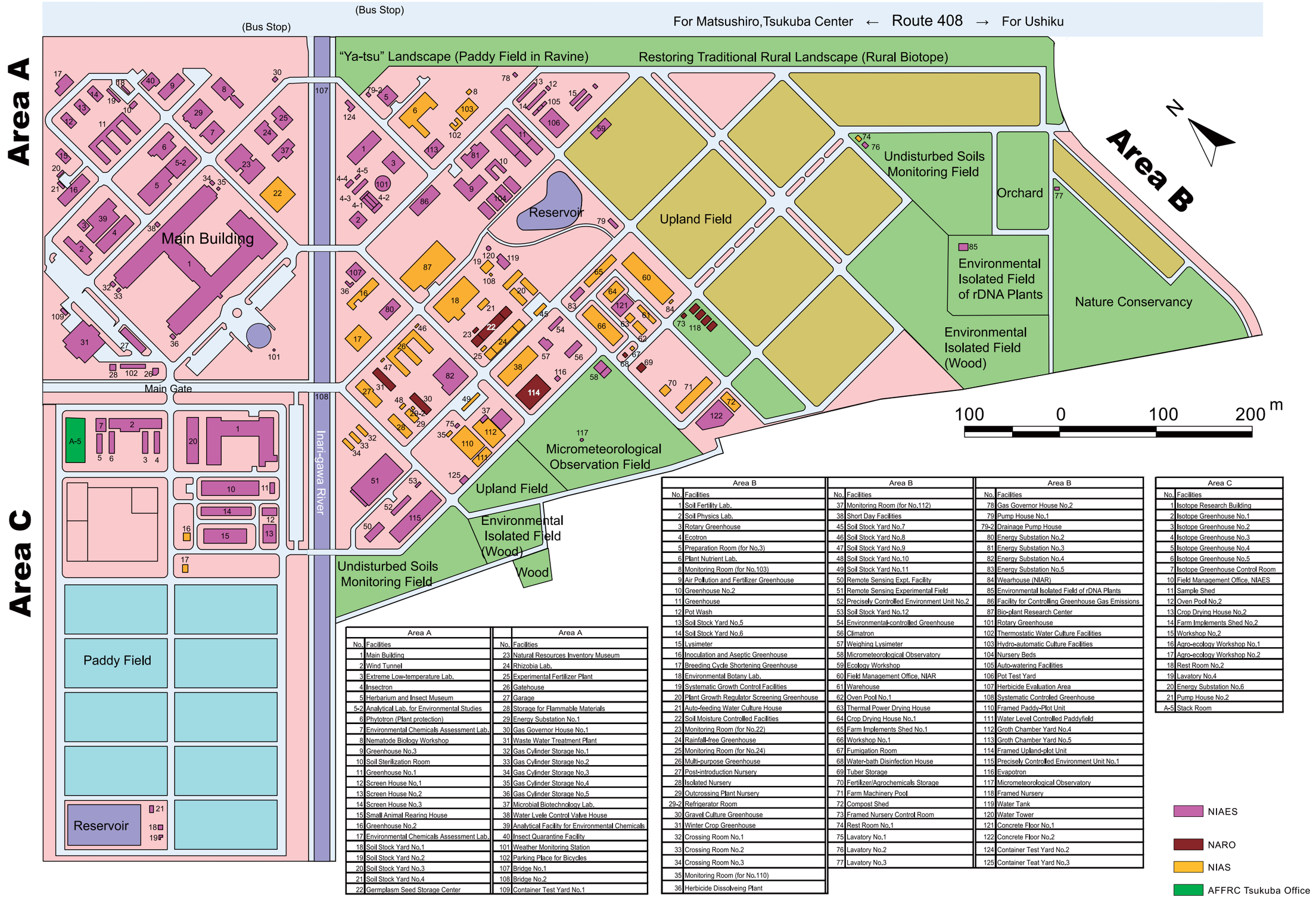
Staff Numbers



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
5-2	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	Natural Resources Inventory Museum
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 Lvele Control Valve House
39	Analytical Facility for Environmental Chemicals
40	Insect Quarantine Facility
101	Weather Monitoring Station
102	Parking Place for Bicycles
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
NARO
NIAS
AFFRC Tsukuba Office

Internet Web Site of NIAES

NIAES has an official Internet web site in English (http://www.niaes.affrc.go.jp/index_e.html). This site provides relevant information on the international affiliation and research works of NIAES, including the Monsoon Asia Agro-Environmental Research Consortium (MARCO), Asian-Pacific Alien Species Database (APASD), the Ecosystem Database, the microForce: Microorganisms Database, and the Type Specimens in the NIAES Insect Museum.

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

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  - Asian-Pacific Alien Species Database (APASD)
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  - microForce: the Microorganisms Data house
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  - An Illustrated Key to Japanese Species of the Tribe Pilophorini (Heteroptera, Miridae)
  - A Checklist of Japanese Cinara Curtis (Homoptera: Aphididae), with Keys to the Species
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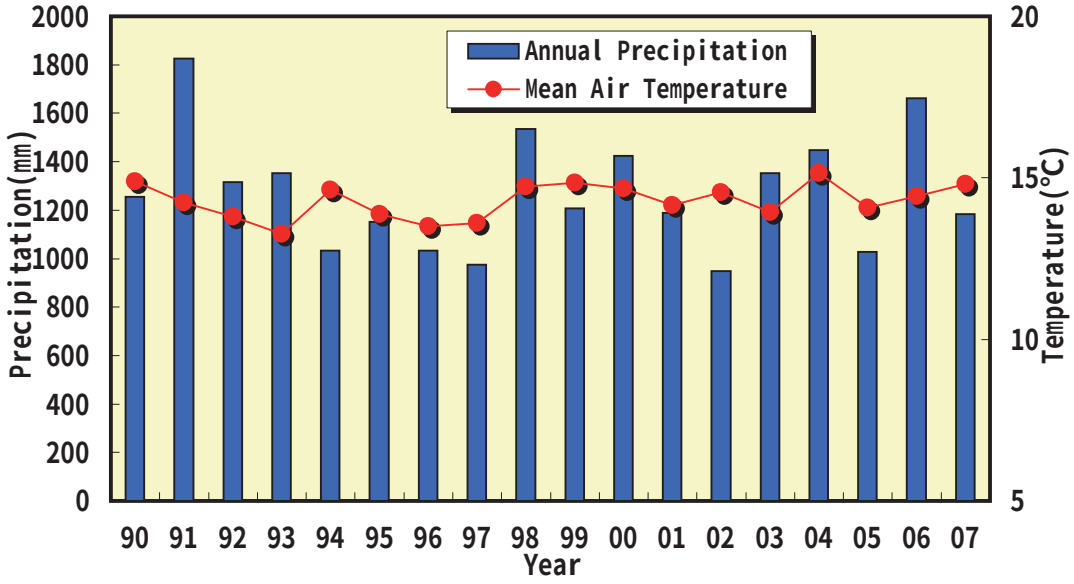
Meteorological Information



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