Agricultural Sciences for Human Sustainability

Meeting the Challenges of Food Safety and Stable Food Production

Graduate School of Agriculture, Hokkaido University

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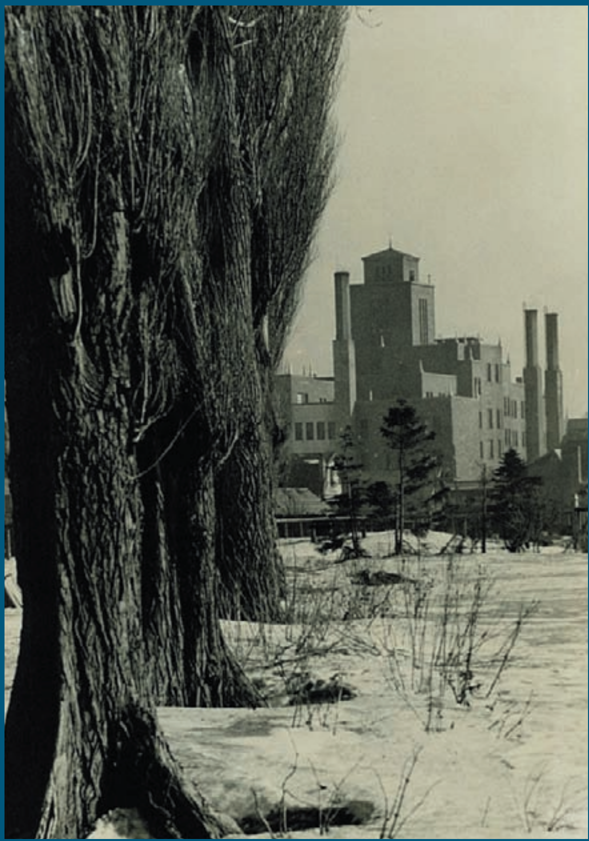

The main building of Faculty of Agriculture right after construction (February 21, 1935)

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To Students of the School of Agriculture and Graduate School of Agriculture at Hokkaido University

Hirokazu Matsui
Dean of School of Agriculture and
Graduate School of Agriculture,
Hokkaido University

A new path towards your future!

Advanced, hands-on study in the Hokkaido University School of Agriculture and Graduate School of Agriculture

A brief history of Hokkaido University from its beginning as Sapporo Agricultural College

Hokkaido University was established in 1876 as Sapporo Agricultural College and became the first educational institution in Japan to confer a Bachelors degree. Sapporo Agricultural College was based on the provisional school of the Development Commission established earlier in Zojo-ji Temple in Tokyo (1872), with the expectation that it would take the lead in the reclamation of Hokkaido. The Sapporo Clock Tower, a popular tourist attraction, was built in 1878 as part of a gymnasium for Sapporo Agricultural College. In 1907, Sapporo Agricultural College became Tohoku Imperial University Agricultural College. It was subsequently renamed as Hokkaido Imperial University in 1918 where the School of Agriculture was particularly helpful in the scientific development of agriculture, forestry and fisheries in East Asia. In 1947, the University became Hokkaido University and included the newly established School of Law and Literature.

During the College's early period, many of the teachers were from the USA and agricultural lectures placed emphasis on British and American-style large-scale farming and upland farming. One of the first graduates was Dr. Shosuke Sato, who later became a professor of the College and then president of Hokkaido Imperial University. Dr. Sato also spent time at Johns Hopkins University (USA) under the instruction of Professor R.T. Eley, where he developed an interest in the study of German agriculture and was influenced by the historical school of economics. As a result of Dr. Sato's guidance, the educational emphasis in the College shifted in the mid-1890s to small and medium-scale farming and rice farming. This led to the development of new land management techniques for transforming land into a manageable resource-producing system. It was the beginning of our tradition of practical scientific creativity and exemplifies the academic culture that strives to understand natural laws, topography and the environment for improving agricultural strategies.

The Clark Spirit

It has been said that the young Sapporo Agricultural College was the origin of the modern spirit of Japan. This claim is supported by the words of Dr. Tadao Yanaihara, who was a disciple of Professor Inazo Nitobe and who became the second president of the University of Tokyo after World War Two. He said that the college "undertook liberal education to nurture an entire human" in Sapporo, which at the time had a population of less than 2,000. To this background came Professor William Smith Clark who, despite only being at the College for eight months, had a profound influence that can still be felt today. The following words are from a brief history of the College, made public at the San Francisco World Exposition in 1915:

Prof. William S. Clark

Dr. Shosuke Sato

> "Boys, be ambitious!" It has become proverbial in the school. "Boys, be ambitious!" Be ambitious not for money or for selfish aggrandizement, nor for that evanescent thing which men call fame. Be ambitious for knowledge, for righteousness, and for the uplift of your people. Be ambitious for the attainment of all that a man ought to be. This was the message of Professor William Smith Clark (from Paul Rouland).

Furthermore, there was only one school regulation in Sapporo Agricultural College: Be gentlemen! You should know that your action involves responsibility. This is part of our heritage that we now refer to as the Clark Spirit. It is to seek for freedom, equality and philanthropy, to look at things from the viewpoint of the weak, with unconquerable spirit that insists on justice. This is the spirit of our campus.

A verse from the dormitory song *Miyakozo Yayoi*, which we are fond of singing, runs: “*Hito no yo no Kiyoki Kuni zo to Akogare nu* (We long for the northern place as a pure place in the human world.)” This reminds us of the ideals of the Clark Spirit.

Philosophy of the School of Agriculture and Graduate School of Agriculture

The attitude toward study taken at the School of Agriculture and Graduate School of Agriculture of Hokkaido University comes from the words of instructors who were in Sapporo with Prof. W.F. Clark in those early days.

Thomas Antisell once said that lectures at school and books are only knowledge about past inventions. He stated that “those who want to be scholars must make it fundamental to ask questions, study ways to solve them, invent, and make progress, and that they must not believe that lectures and books are perfect.”

William Wheeler preached the necessity of education in developing an understanding of theories and developing skill in applied practices. He said that “knowledge without thought goes nowhere, and that knowledge with thoughts can be a resource that never runs out.” He aimed to control and stabilize land in a catchment, summarizing his philosophy in the words “Learn from nature.”

William Penn Brooks said that “a person who can consider, from his knowledge and theories, what the cause of newly observed phenomenon is and clarify the causation, is a far more valuable and precious talent than those who are merely knowledgeable.”

One of the early graduates, Professor Inazo Nitobe, who studied agricultural economics and believed in pacifism, wrote, “With malice toward none, with charity for all”. He wrote the book “Bushido: The Soul of Japan” and introduced Japanese spirituality and identity to the wider world. He studied English, stating his motivation that “I wish to be a bridge across the pacific.”

Another early graduate, Kanzou Uchimura, concluded his book titled “The Greatest Relic for Posterity” with the words, “...what is the true greatest relic which can be left for however many people? It is a life of brave dignity.”

Prof. Inazo Nitobe. The portrait with his statement

Our goal

Let me remind you of the four basic philosophies of Hokkaido University: “The Frontier Spirit,” “Global Perspectives,” “Humanity Education” and “Practical Learning.” For more than 130 years now, we have advocated these words as our philosophy of education and study.

Today we face serious global resource issues, specifically “food problems,” “environmental problems” and “energy problems.” Each of us must act properly as a global citizen. Agricultural studies have developed by continuous scientific research into primary production in agriculture, forestry and fisheries. Today its domain has widened into the fields of environment and life sciences. In 2011 the world population exceeded 7 billion. On the other hand, the world’s total cultivated area was 1,400 million hectares and the total world food production was 2,200 million tons, values which have scarcely increased over the last 4 decades. This discrepancy will be a critical issue for humanity in the 21st century.

Having been involved in developing Hokkaido prefectural regulations regarding genetic modification since 2004 as chairperson of the relevant body, I am particularly interested in food safety and security. It derives from the stable maintenance and improvement of resource production systems based on primary production, and maintaining environmental conditions for human existence. Without adequate food there is no food safety or security.

The tasks that we should tackle now are these: preparation of the production environment and well-balanced development of areas including farming and mountain villages, forest and coastal areas; promotion of labor-saving technologies; development and establishment of new breeds that can be grown regardless of rapid changes in the production environment; development of pest preventive measures; creation of functional ingredients from animals and plants; further utilization of microbes; utilization and application of biomass; and scientific analysis and promotion of organic farming. Nature is still rich in Hokkaido. Let us cherish stirring dreams of this land, and promote sound, down-to-earth studies. We can make a contribution to the betterment of human life with our own hands.

Our mission

The mission of the School of Agriculture and the Graduate School of Agriculture of Hokkaido University is not limited to agriculture in Hokkaido. Hokkaido falls between the northerly latitudes of 42 and 45 degrees, a similar region to many other cities of advanced nations. This zone is where human activity has influenced nature over a long time. We have much in common with the world's agriculture research areas. Today, when the entire world has no choice but to coexist as a community bound together by a common fate, we must not forget that our predecessors have worked hard and made great contributions to the development of agricultural techniques and to environmental conservation in East Asia, in cold areas, and around the world. Also, as a graduate university that puts emphasis on research, we must keep our eyes on what happens abroad.

Our research is partly driven by curiosity. Of course, that is not the only purpose of those who study agriculture. The goal is to pursue human welfare and create a world in which everybody can live happily. To that end, we study the rich nature of Hokkaido, and make use of what natural resources we have acquired. We seek to bring about stable environmental conditions for human existence and stable resources of air, water, food and wood. We intend to address the fundamental issues in order to create a sustainable society. We shall not become over-enthused or despair at immediate matters. Instead, we shall imagine what we wish to be like in 5 or 10 years and endeavor to achieve that goal. Let us – the students and faculty member of the School of Agriculture, Graduate School of Agriculture, and the Research Faculty of Agriculture at Hokkaido University – work together to solve pressing problems for people in all parts of the world and for all future global citizens.

The symbolic building of Graduate School of Agriculture, Hokkaido University

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A Brief History of the Special Postgraduate Program in the Graduate School of Agriculture

Head of the Program, Prof. Dr. Atsushi Yokota

This chapter briefly reviews the history of the Special Postgraduate Program and describes the programs that have been conducted up to present.

1. Historical aspect

The Special Postgraduate Program for foreign students in the Graduate School of Agriculture has a fairly long history of 15 years. The first version of the program, “The Special Postgraduate Program in Agricultural Chemistry”, was started in October 1997 as the first special program at Hokkaido University. A total of 10 laboratories within the Division of Agricultural Chemistry participated in the program. The second phase of this special program followed from April 2002 until March 2007, during which time 5 more laboratories joined to bring the number of participating laboratories to 15. The current program, “The Special Postgraduate Program in Bio-systems Sustainability”, is the third-phase program, initially established for 5 years in April 2007 but extended 1 more year to 2012. These programs consisted of a master's course of study and a doctoral course with the special allocation of 5 research students receiving scholarships from the Japanese Government for each course (10 scholarship students in total) each year, together with a few personally funded students.

2. Concept

The current program provides a unique combination of classes from diverse fields, such as food production, health and environmental sciences, to educate students in areas urgently needed to advance to preserve and sustainably utilize our limited global resources to ensure our future quality of life. Toward this goal, we enroll students from Southeast Asian countries, China and Korea, train them in bioscience and environmental science, after which, they return to their countries as experts who serve in their countries' development. Due to the nature of the program, the language to be used in all educational and research activities is English.

3. Laboratories in this program

The following 16 laboratories are participating to educate students in 4 divisions of the Graduate School of Agriculture (Bio-systems Sustainability, Agrobiology, Applied Bioscience, Environmental Resources): Plant Nutrition (including Rhizosphere Control), Soil Science, Forest Chemistry, Pathogen-Plant Interactions, Applied Molecular Entomology, Molecular Biology, Molecular Enzymology, Natural Product Chemistry, Molecular Ecological Chemistry, Wood Chemistry and Chemical Biology, Biochemistry, Applied Microbiology, Microbial Physiology, Nutritional Biochemistry, Food Biochemistry, and Molecular Environmental Microbiology.

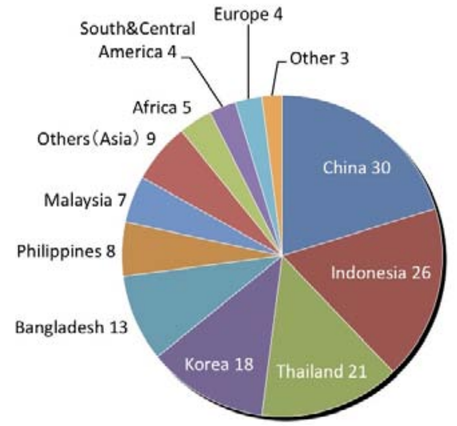

Fig. 1. Distribution of the home countries of the students enrolled into the special programs during 1997 to 2011.

4. Description of the programs

Enrollment

After full discussion with the host professor, each applicant submits a set of application documents, and these are evaluated at a meeting of the professors of the program. The final decision for admission is made at a faculty meeting of the Graduate School of Agriculture. In many cases, prescreening of the candidates is conducted using a network of alumni of this program, because many alumni are working as university staff members and researchers.

As of October 2011, a total of 148 students have been enrolled in the programs (1997–2011). The distribution of their home countries is shown in Fig. 1. The top 5 countries were China, Indonesia, Thailand, Korea and Bangladesh. Looking at the distribution of home countries within the current program (newly arrived 53 students, 2007–2011), Indonesia is most common and China is second

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Part I.

Agrochemical and Molecular Approach
— from globe to molecule —

1. Balancing Agricultural Load and Environmental Capacity

Ryusuke Hatano, Professor
(Laboratory of Soil Science)

Keywords: carbon cycle; environmental load; greenhouse gas; nitrogen cycle; water pollution

Introduction

Agriculture impacts material cycling in soil through tillage, fertilization and harvest. Tillage, which is conducted to improve soil structure, incorporates organic matter and oxygen into soil. Soil structure is stabilized due to the aggregation of soil particles by humus and is strengthened due to coating of the aggregates by humus. Macropores between soil aggregates enhance water drainage, supply oxygen to plant roots, and stimulate aerobic soil microbes, while fine capillary pores inside soil aggregates retain water, supply water to plant roots, and feed anaerobic soil microbes. Harvesting plants removes nutritional elements from fields, so fertilization by chemical fertilizers and manure is indispensable for sustained crop production. However, agricultural activities temporarily bare the ground and cause high nutrient concentrations in the soil. This may cause nutrient discharge to the aquasphere and greenhouse gas emissions to atmosphere. In the Soil Science Laboratory, studies of land use impact on environmental material load are conducted.

1. Controlling factors of nitrogen load from non-point sources

The pathway of water discharge in a watershed consists of groundwater flow, surface runoff and later, lateral flow through the soil, so it is difficult to specify the water discharge from a certain land area in the watershed. Therefore, nitrogen runoff in the watershed is studied as non-point source pollution. Rainfall events when the ground is bare due to tilling, fertilizing or harvesting causes a significant amount of nitrogen runoff to rivers and nitrate leaching to groundwater, resulting in eutrophication near seashores and drinking water pollution. Soils in upland fields are aerobic and produce NO_3^-, which is easily leached. On the other hand, soils in paddy fields and wetlands are anaerobic, with reduced amounts of NO_3^- so that the loss of N is in the form of N_2 and N_2O gases to the atmosphere. It is thought that N runoff to rivers from wetlands and riparian zones can be decreased by trapping and reducing the N compound runoff from upland fields. Therefore, N runoff to rivers in the watershed can be controlled by the N balance between N input and N output, the water flow pathway, and N transformation. This study aims to clarify how to manage these controlling factors to decrease N runoff to rivers.

There has been a significant correlation between the proportion of upland field and stream NO_3^- concentration in each agricultural watershed investigated. The regression slopes were then defined as an impact factor (IF), as these appeared to be an index of impact on stream water quality. The IF significantly correlated with the cropland surplus N. However, two watersheds of grassland-based dairy cattle farmlands with similar cropland surplus N showed significantly different IF, with the IF higher in the watershed with a lower wetland proportion (Fig. 1). Denitrification activity was higher in the wetland and riparian zones than in managed grassland. Wetlands in the watershed might contribute to reduced NO_3^- runoff. [1] Annual stream N runoff measured in five sub-watersheds of the Shibetsu River watershed was significantly correlated to net N input (NNI) in the sub-watersheds. The regression slope showed that the stream N runoff accounted for 27% of NNI. Plots of published data collected in the US and EU coincided with this correlation. Nitrogen not discharged to streams might be denitrified. The peak stream NO_3^- runoff was narrower than the peak of

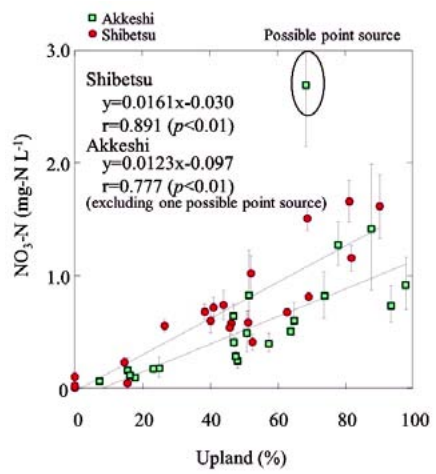

Fig. 1. Relationship between the proportion of uplands in drainage basins and NO_3-N concentration in stream water in the Akkeshi and Shibetsu catchments. Error bars represent standard deviation over 4 seasons.

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enzymatic and GC-MS methods.

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Column: *Magnaporthe oryzae*, the Fungal Pathogen Responsible for Rice Blast

Magnaporthe oryzae, an ascomycetous fungus, is the causal agent of rice blast that accounts for app. 10 % of the total loss of the rice crop, and recognized as the most devastating disease of rice. Infection of the fungus is started by the attachment of conidia onto the rice leaf in a dewdrop. Germination of conidia is followed by the differentiation of appressorium, a specified cell for the penetration (Fig. 1a). Using an enormous turgor pressure up to 8MPa, fungal cell penetrates into the rice cell, followed by the generation of new conidia on the surface of the infected rice cell for the next infection. Infected cells cause necrosis and forms lesion, which is a typical symptom of the disease (Fig. 1b). Infection at leaf of young rice plant is often followed by infection of panicle and cause serious loss of the rice crop.

In order to control the disease, fungicides and resistant cultivars have been developed, but their longevity was prevented by frequent mutation of the pathogen. The breakdown of the resistant cultivar has been recorded many times, typically several years after the release of the new cultivar. *Magnaporthe* genes involved in the resistant cultivar breakdown are avirulence (AVR) genes, which participate with corresponding resistance (R) genes in Gene-for-Gene theory. A pathogen that carries an AVR gene cannot invade the host plant with the corresponding R gene. Mutaions which cause the loss of function of AVR genes are responsible for the breakdown of resistance and important research subject for the sutainable use of resistant rice cultivars.

Several AVR genes have been cloned from the fungus and spontaneous mutations of them are revealed as deletion, insertion of transposons, in addition to point mutations. Interestingly, during infection, DNA of the fungus suffers double strand break, which causes recombination for the repair (Fig. 1c). Control of DNA recombination and transposon activity will be a novel strategy for the disease control.

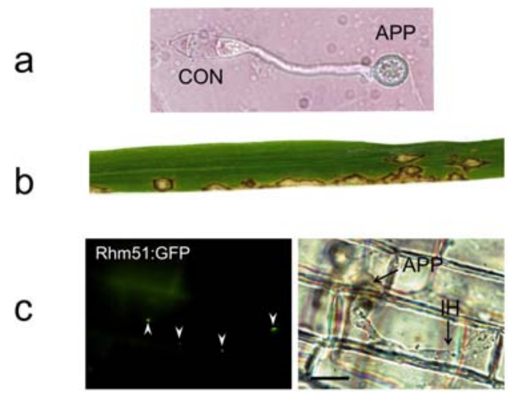

Fig. 1. Rice blast fungus, *Magnaporthe oryzae.*
a) A Conidium and an appressorium formed on plastic surface. CON = conidium, APP = Appressorium. b) Lesions on rice leaf. c) DNA breaks detected during the infection using Rhm51:GFP foci (arrows), which appear at the DNA double strand break. Right panel shows the infective hyphae formed in the rice leaf sheath cells, and left panel shows GFP fluorescence of the same field. APP = Appressorium, HI = infective hyphae. Scale bar = 10 μm.

Teruo Sone, Associate Professor
(Laboratory of Applied Microbiology)

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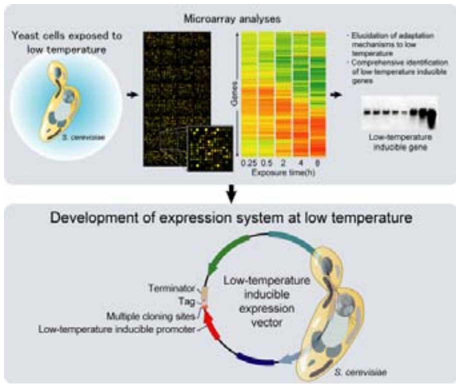
Questions
1. Describe the advantages and disadvantages in the production of recombinant mammalian proteins in insect cells.
2. What are the major differences between chemical pesticides and microbial pesticides?

Column: Molecular and Biological Technology

We have been constructing a unique and powerful protein expression system based on the budding yeast, *S. cerevisiae* at low temperatures. The expression of proteins at a low temperature is highly beneficial owing to its inhibitory effects on protein degradation and insolubilization. We are now improving our protein expression system based on the budding yeast and constructing a novel protein expression system using microoraganisms suitable for pharmaceutical and industrial applications.

A bioassay using a reporter protein and bioimaging are important technologies for visualizing gene expression and molecular dynamics in living cells quantitatively and in real time, respectively. We have developed a novel yeast reporter assay suitable for high-throughput assay with a novel secretory luciferase. Furthermore, we are developing luminescent probes with luciferase that can be used to monitor the metabolism and stress response in cells.



Construction of high-level protein expression system in microorganisms using genomic information.

Naoki Morita, Associate Professor
(Laboratory of Molecular Environmental Microbiology)

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Part II.

Sustainable Crop Production and Land Use
— from global to local —

Section 1. Agricultural and Resource Economics

1. Economic Analysis of Agricultureal and Environmental Policy

Yasutaka Yamamoto, Professor
Tomoaki Nakatani, Assistant Professor
(Laboratory of Agricultural and Environmental Policy)

Keywords: agricultural policy; environmenal policy; agricultural trade; quantitative analysis

Introduction

Economic analysis of agriculture, trade and the environment is a major discipline in modern agricultural economic research. Its topics cover a wide range of agricultural and environmental issues, ranging from policy evaluation and measuring the recreational value of agriculture on one hand, to international trade analysis and nitrate pollution studies on the other. Therefore, our laboratory's research area, agricultural and environmental policy, includes a variety of subjects. Most of our discussions are built upon quantitative analysis.

In what follows, we present five research themes from our laboratory, referring to abstracts of representative papers by our members and collaborators. The subjects are agricultural trade and the environment, analysis of nitrate pollution in Europe, econometric analysis of agricultural policy, modeling demand for rural recreation, and consumers' attitudes toward organic milk. We also list several further research topics.

1. Agricultural trade and the environment

Yamamoto, Sawauchi and Masuda[1)] contributed to the debate over agricultural trade and the environment by asking "Would a Japan-Korea Free Trade Agreement (JKFTA) increase nitrogen pollution from agriculture?" In order to find some answers, they measured the potential impact of nitrogen pollution from agriculture caused by agricultural trade liberalization under the JKFTA using the Global Trade Analysis Project (GTAP) model and the OECD Nitrogen Balance Database (Fig. 1). The scenario they model assumes the complete removal of all import tariffs between Japan and Korea, not only in the agricultural sector but in non-agricultural sectors as well. Their results show that the JKFTA is likely to lead to an overall increase in the total nitrogen surplus for Japan and Korea, suggesting that a JKFTA would likely increase nitrogen pollution from agriculture.

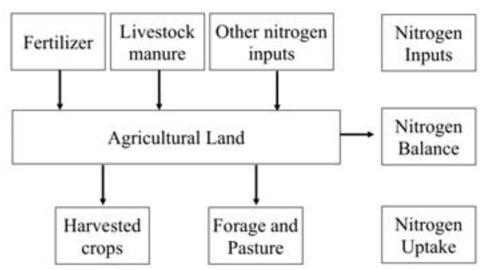

Fig. 1. Summary of the OECD nitrogen balance mechanism. Source: Yamamoto, Sawauchi and Masuda.[1)] Note: Fertilizer means inorganic fertilizer; livestock manure means net livestock manure; other nitrogen inputs include biological nitrogen fixation, atmospheric deposition, and seeds and planting materials.

2. Analysis of nitrate pollution in Europe

In the European Union during the 1980s, the nitrate debate gained public significance and political relevance. The spread of nitrate pollution is responsible for its growing political importance. However, the definitive factor making political action necessary was the enactment of the EC Drinking Water Directive in 1980. This Directive introduced a stringent new definition of nitrate pollution. Drinking water that would have previously been deemed "safe" was redefined as "polluted". As a result, nitrate pollution control and regulation became part of northern European countries' policy agendas in the latter half of the 1980s. Finally, in 1991, member states unanimously adopted the Nitrates Directive, aimed at reducing and preventing water pollution caused by nitrate runoff from agricultural sources.

Izcara Palacios, Demura and Yamamoto[2)] analyzed the issue of nitrate pollution in Europe, examined nitrate pollution policies, and reviewed shortcomings in the implementation of the 1991 Nitrates Directive.

3. Econometric analysis of agricultural policy

A direct payment measure for hilly and mountainous areas (HMAs) was introduced in

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Section 2. Gene Engineering of Crop and Animal Production

1. Plant Breeding

Yuji Kishima, Professor
Itsuro Takamure, Lecturer
(Laboratory of Plant Breeding)

Keywords: plant breeding; rice, genetic study; transposon; phenotypic variation; *Antirrhinum*

Introduction

The Laboratory of Plant Breeding was founded in 1915. Since then, it has trained a large number of plant breeders and researchers. This laboratory's research aims to contribute to genetic improvement of plants, especially rice. Recent themes in this laboratory are: rice genetics underlying genome dynamism and phenotypic change, and genetic control of transposition of transposons in snapdragon. Most experimental materials are obtained from artificial mating between plants every summer in the greenhouse (Fig. 1). Molecular techniques also have become powerful tools for the analyses in this laboratory described below.

Fig. 1. Rice cross works in a greenhouse. The students carried out artificial mating between different rice plants in a greenhouse.

1. Insensitive response to low temperature in rice

One of the major problems for rice cultivation in Hokkaido is low summer temperature. Rice is very sensitive to low temperature in summer, when the florets at the boot stage develop pollen in the anthers. Based on the idea that an insensitive response to low temperature may confer tolerance, this laboratory is studying cold tolerance in rice.

2. Endogenous *Rice tungro bacilliform virus* in the rice genome

A number of segments of endogenous Rice tungro bacilliform virus (RTBV)-like sequence (ERTBV) are in the rice genome. A possible relationship between tungro disease and ERTBV is being investigated, as is the mechanism by which the viruses were inserted into the genome.

3. Genetics of hybrids of rice species

Hybrids show high potential abilities superior to the parents' performances known as heterosis. Different projects are examining phenotypic variation in traits of hybrids between rice species. This laboratory's projects based on rice hybrids are concerned with heterosis, doubled haploids through anther culture, and stress tolerance.

4. Genetic constitution of a rice variety, the Koshihikari population

This laboratory collected more than 80 populations of a popular japonica rice variety, Koshihikari, from 15 prefectures in Japan and investigated their genetic variation. In plants, insertion sites of transposable elements are often good indicators of genetic polymorphisms among different strains in the same species. These materials allow study of the genetic diversity occurring in a single rice variety.

5. Low-temperature-dependent transposition of a transposon in *Antirrhinum*

One strain of snapdragon (*Antirrhinum majus*) shows petal variegation when grown at low temperature. The variegation is attributable to transposon Tam3, which transposes from a gene associated with petal pigmentation. This laboratory analyzed low-temperature-dependent transposition of Tam3 and found that the mechanisms underlying the transposition are associated with non-epigenetic relationships between host and transposon.[1]

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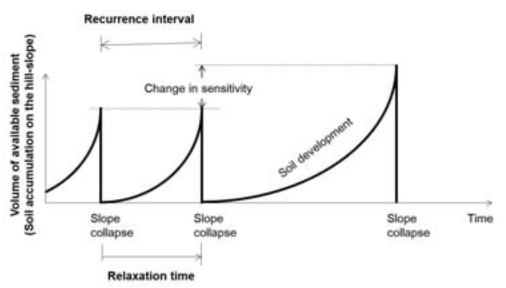

Fig. 2. Recurrence interval of new soil development where slope had collapsed.

2. Sensitivity and connectivity

"Sensitivity" and "connectivity" are concepts to consider in designing land use and management systems, and to help minimize human impacts on an existing catchment system. We know that heavy rainfall or large earthquakes can cause significant sediment loss from the land, but how "sensitively" does each slope component/stream reach react to these events? As mentioned above, deforestation increases slope sensitivity to yield more sediment in these events. However, once a slope collapses, little soil may remain on the hill-slope, making the area stable until such time as new soil develops and accumulates there (Fig. 2). Changes to sensitivity in streams can also occur following land use change. An increase in sediment stored in a stream results in more sediment being released from the bed in a flood event, than in the past. Connectivity is a concept which describes how well these geomorphic units, which may have various temporal and spatial sensitivities, connect to each other, to propagate sediment downstream. Each unit will have its own sediment transport capacity, controlled by water discharge and slope (steep or gentle), which is considered simultaneously when appraising connectivity.

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2) International Tropical Timber Organization. (2011) Status of Tropical Forest Management 2011. 418 pp. International Tropical Timber Organization, Yokohama.

Question

What kind of human activities can impact the sensitivity of sediment production on an entire catchment scale?

Column: Green Manure and its Nutrient Availability

It is useful for economical sustainable crop production to reduce chemicals and energy for crop managements. For low input cropping systems, some legume cover crops are often used as green manure and companion crops. The current work is focused on understanding of the relationship between ecological characteristics of crops and spatio-temporal dynamics of available resources, such as nutrients, water and light, due to low-input crop production systems. Some corps, such as wheat, rape, onion, clovers and hairy vetch, are used for the evaluation of crop managements.

Toshiyuki Hirata, Assistant Professor
(Agro-Ecosystem Course)

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Postface

The English program has contributed not only to fostering foreign agricultural researchers but also has given ample opportunities for domestic (Japanese) students to study with foreign students. This is a very important aspect in today's higher education system in Japan. The current globalization of society requires domestic students to be more adaptable to international society. For example, Japanese global companies seek internationally competitive university graduates and they are not necessarily Japanese.

Because of social demands, Hokkaido University has been encouraging graduate schools and faculty to increase the number of foreign students to promote internationalization of educational programs. The Special Postgraduate Program in Bio-systems Sustainability is a pioneering and successful program and continues to contribute significantly to internationalization.

In order for all students to understand what globalization means, I hope all agricultural fields will be involved in the program. The program is expected to keep playing a key role in the educational program of the Graduate School of Agriculture.

Executive and Vice President
Professor Dr. Ichiro Uyeda

Acknowledgments

First of all, we would like to express our sincere thanks to the Ministry of Education, Culture, Sports, Science and Technology for providing us with this framework - namely, the Special Postgraduate Programs in English - for the past fifteen years, from its first to its third phase. Thanks are especially due to Mr. Hitoshi Nara, Deputy Director-General of the Ministry's Higher Education Bureau, as well as to those who devoted themselves to making these programs run in an effective manner.

We are grateful to Hokkaido University's Division of International Services (formerly the International Student Center), to its Graduate School of Agriculture's Student Affairs, section, and also to the Secretariat of this program, Ms. Kazuko Harada, who helped us welcome foreign students smoothly to Hokkaido University and then to each laboratory.

Dr. Fusao Tomita, Emeritus Professor (formerly Vice President of Hokkaido University), proposed the program's first phase, the Special Postgraduate Program in Agricultural Chemistry, and served as program head for six years. We very much appreciate his perspective.

Thanks are also due to the former deans of our institute, Prof. Dr. Akira Ogoshi, Prof. Dr. Takaaki Ohtahara, Prof. Dr. Masaaki Suwa, Prof. Dr. Akihito Hattori, Prof. Dr. Ichiro Uyeda, and the present dean, Prof. Dr. Hirokazu Matsui for encouraging us to run these programs as the innovative systems in our institute.

The sustainability of our programs for the past fifteen years can undoubtedly be attributed not only to the enthusiasm for education demonstrated by professors and staff members but also to the enthusiasm displayed by students in their coursework.

The time period allowed for manuscript preparation was extremely short (and came during Decemeber and January, the busiest time of the academic year.) In spite of this, all authors made important contributions, and we are most grateful for their efforts.

Financial support from the Sapporo Alumni Association was highly appreciated, for it enabled this memorable book to be published.

Last but not least, we wish to express our heartfelt thanks to two professors of our institute: Dr. Yasuyuki Hashidoko (Laboratory of Molecular and Ecological Chemistry) and Dr. Takayoshi Koike (Laboratory of Forest Ecophysiology). Dr. Hashidoko carried out all kinds of practical work from the soliciting of the various manuscripts to their final editing. It was Dr. Koike who suggested launching this project in order to commemorate the the Special Program's fifteen-year mark. These acknowledgments would not be complete without drawing attention to the strong willpower and dedication of the two individuals.

Finally, all of the editorial members would like to thank Mr. Hisashi Miyauchi, president of Kaiseisha Press (Otsu, Shiga, Japan), for kindly agreeing to take on our project. Dr. Derek Goto (Creative Research Institution, Hokkaido University) whose assistance in checking the manuscript is highly appreciated. We also wish to acknowledge the efforts of Mr. Shintaro Hara, a graduate student in the Laboratory of Molecular and Ecological Chemistry who spent a great deal of time formatting the book.

March 10, 2012

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このプレビューでは表示されない頁があります。

学院長からのメッセージ (Message from Dean)

北大農学部・農学院で学ぶ学生諸君

札幌農学校から北大へ

札幌農学校は日本初の学士授与教育機関であり、北海道大学の母体である。札幌農学校は、1872 年に設置された東京・増上寺の開拓使 (the Development Commission) 仮学校(provisional school)を基礎に、北海道の開拓を担うために 1876 年に設置された。観光名所でもある札幌市時計台は、この札幌農学校の演武場として 1878 年に建てられた。1907 年に東北帝国大学農科大学、1918 年に北海道帝国大学として、特に農学部は東アジアの開拓に寄与した。そして 1947 年に法文学部を設置して北海道大学へと発展した。

開校初期にはアメリカ出身の教師が多かったこともあり、イギリス・アメリカ風の大規模農業経営・畑作に重点をおく農学が講義された。しかし、第 1 期生の佐藤昌介が米国のジョンズ・ホプキンス大学（Hopkins Johns University）でイリー（R. T. Eley : 保護貿易論者、ドイツ農学を研究した）のもとで学んだことから、ドイツ農学や歴史学派経済学の影響を受け、1890 年代半から中小農経営と米作に重点をおく農学へ展開した。必然的に、それは大地を切り拓き、人間のための資源生産システムへと作り変える技術（land management）の開発へと帰結していった。すなわち、自然の摂理や地形･気象を理解し、これをうまく利用する学風、いうなれば実学的創造へ続く伝統の端緒である。

クラーク精神

初期の札幌農学校は「日本の近代精神の源流を築いた」とされる。それは人口僅か 2000 人足らずの札幌において､｢人間を造るというリベラルな教育を行った。」という新渡戸稲造門下の矢内原忠雄（戦後二代目の東大総長）の言葉に裏付けられる。この背景には、僅か 8 ヶ月の滞在ではあったが、クラーク博士の足跡がある。1915 年のサンフランシスコ万博で紹介された北大略史には、以下の言葉が綴られている。

“Boys, be ambitious!” It has become proverbial in the school. “Boys, be ambitious!” Be ambitious not for money or for selfish aggrandizement, nor for that evanescent thing which men call fame. Be ambitious for knowledge, for righteousnness, and for the uplift of your people. Be ambitious for the attainment of all that a man ought to be. This was the message of Professor William Smith Clark (from Paul Rouland).

さらに、札幌農学校の校則はただ 1 つ、Be gentleman ! であった。自らの行動には、責任が伴うことをわきまえることが求められている。これは後にクラーク精神（Clark Spirit）として、「自由・平等・博愛の精神」を求め、「弱者の側に立つ視点」、そして「正義を主張する不屈の精神」を源流とし、今に伝わる。我が学舎の精神は、ここにある。我々の愛唱する寮歌「都ぞ弥生」の一節、「人の世の　清き国ぞとあこがれぬ (Hito no Yo no Kiyoki Kuni zo to Akogare nu)」は、クラーク精神の理想を謳っているという。

農学部・農学研究院の哲学

クラーク博士ゆかりの当時の教員達の言葉に、北大農学部・農学院で学ぶ基礎がある。すなわち、「学校の講義や書物は過去の発明に関する知識に過ぎない。学者であろうとする者は、疑問をおこし、解決の道を研究し、発明進歩することを基本にすべし。講義や書物を完全と信じてはいけない。」(Thomas Antisell)

「思考なき知識はそれ以上どこへも行かない。思想力の伴った知識は尽きることのない資源たり得る。」(＝理論の理解とその応用実践の能力を養う教育が必要である)。そして「自然に学べ」という一言で看破しているが、山地から河川を通じて平野へと至る流域システムの確立を目指した。(William Wheeler)

「新たに観察された事象が､どのような原因によるものか、知識と理論から考察し、因果関係を明らかにする能力のあるものは、単に博識であるものより、遙かに得がたく貴重な人材である。」(William Penn Brooks)

さらに、2 期生、新渡戸稲造は農業経済を学び、平和

主義を貫き、「With malice toward none, with charity for all」と記した。さらに、“Bushido: The Soul of Japan” を著して日本の精神性とアイデンティティーを紹介した。英語を学ぶ動機として「I wish to be a bridge across the Pacific.」を述べ、実践した。同じく 2 期生の内村鑑三は、その著書「後世への最大の遺物」のなかで、「…何人にも遺すことのできる本当の最大の遺物とは、何であるか。それは勇ましい高尚 (dignity) なる生涯である。」と結んでいる。

我々の目指すもの

ここで、我々が抱く四つの言葉を想い起こしてもらいたい。“フロンティア精神”、“国際性の涵養”、“全人教育”、“実学の重視”である。本学は、130 数年の歴史のなかで、これらの言葉を教育研究の理念として掲げてきた。

今、私達は地球規模の大きな問題、すなわち「食糧問題」「環境問題」「エネルギー問題」などに直面している。一人ひとりが地球市民として正しく行動せねばならない。農学は農林水産の持続的一次生産の科学を行うことを主目的に発展してきた。さらに今日では環境や生命科学へも、その領域が広がっている。折しも 2011 年には世界人口は 70 億を超えた。一方で、世界の農耕面積は 14 億 ha、食糧の生産量は 22 億トンと、この 40 年間ではほとんど増えていない。

私自身は、2004 年以来、北海道の遺伝子組換え条例策定に座長として関わっており、食の安全・安心に人一倍関心がある。しかし、その基本は一次生産を基礎にした資源生産システムと人類生存基盤の安定的維持と向上である。そして、食料が満ち足りてこその、食の安全・安心である。

当面、取り組むべき課題を個別に見ると、農山村から沿岸域の生産環境の整備と調和のとれた開発、省力化の推進、生産環境の激変にあっても生育できる新品種の開発と利用法の確立、生物の病害虫からの防御法の開発、動植物の機能性成分の作出、微生物のさらなる利用、バイオマスの利活用、有機農業の科学的分析とその促進、などが挙げられる。北海道には豊かな自然がまだ残されており、この大地において壮大な夢を持ちつつ､地に足の付いた正当な研究を推進しながら、我々の力で人類に大きな貢献をしよう。

我々の使命

北海道大学農学部と北海道大学大学院農学院の使命は、北海道の農林水産業だけに目を向けるものではない。北海道は北緯 42～45 度に位置するが、この緯度周辺は世界の多くの先進国の首都が位置する場所である。そこは古くから人間活動が自然を改変してきた場所でもある。従って、我々は必然的に世界の農学研究分野と時空を共有している。然るに、世界全体が否応にも運命共同体と共存していかねばならない現在においてこそ、先達が東アジアや、寒冷地に限らず世界の途上国で農業技術の発達と環境保全に尽力し、貢献を成してきたことを私達は認識すべきである。視野を海外に向けること、これは、研究重点化大学院大学としての責務でもある。

私達の研究は、当然、好奇心によって突き進む。しかし、我々農学を学ぶ者の目的は、単に好奇心だけではなく、人類の福祉を追求し、便利で楽しく幸せな人生を皆が送ることのできる世界を創ることにある。そのためには、北海道の豊かな自然から学び、それを活かすことである。大気・水資源、食料資源、木質資源と人間の生存基盤を確固たるものとし、持続的な循環社会の形成の根本問題を私達が解決するのである。目前の事柄に一喜一憂するのではなく、5 年先、10 年先の自分を描いて、それに向かうのである。

伝統の灯火（農学部本館玄関ホールのシャンデリア）

北海道大学農学部・農学院・農学研究院を中核として、世界の皆さんと地球市民の将来のためにも、大きな問題を解決するために、共に取り組もう。

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