Ⅱ. INTERNATIONAL ACTIVITIES

International Academic Exchange and Cooperation of the Faculty of Agriculture, Kyoto University

Collaboration with Foreign Guest Professors

Collaboration with foreign guest professors during April, 2004 and March, 2005 is shown in Table 1. The collaboration reports written by guest professors were attached at the end of this section.

International Cooperation and Overseas Activities

In recent years, international cooperation and overseas activities are actively carried out and many professors and students make research works abroad with many visiting foreign researchers. Please refer to “A-4. International cooperation and overseas activities” in each laboratory in “III. Research and educational activities” for the detail.

Study Tour

In 2004, we implemented an international student exchange program, “Human activities and environmental problems in temperate Asia”, supported by “ACCU (Asia Pacific Cultural Centre for UNESCO) Funds-in-Trust for the Promotion of International Co-operation and Mutual Understanding” programs. We accepted 8 Thai students, from Faculties of Agriculture, Forestry and Fishery, Kasetsart University. With 10 Japanese participants, they attended several English lectures and field trips, including UNESCO world heritages, Kumano Ancient Roads, Nara and Kyoto. This program provided very useful opportunities to students for international exchanging and mutual understanding.

Foreign Student Advisor’s Office and Its Activities

The Foreign Student Advisor’s Office was established in June 1985 as an office to handle wide-ranged issues related to foreign students and research fellows at the Faculty. Major tasks of the office are:

1. To improve the communications between the Faculty and foreign students and fellows,
2. To assist and guide foreign students in their schooling as well as in personal matters, and
3. To organize an introductory lecture series on the current topics of Japanese agriculture, agricultural sciences and bioscience in Japan.

Three academic staffs (two associate professors and one assistant professor) are responsible for fulfilling the tasks; Dr. Miki Akamatsu appointed in Dec., 1996, Dr. Ueru Tanaka appointed in Sep., 1999, and Ms. Katsuko Morita appointed in Jan. 2000.

The Office is located at one of the buildings of the Faculty. It has a saloon besides advisor’s offices. Foreign newspapers, journals and books as well as TV and video sets are equipped in the saloon for the use of foreign students.

There are 3 major activities of the Office besides its regular tasks:

1. Study tour: The tour is organized to give a chance to the foreign students to see Japanese culture, history, and rural life.
2. Publication of Newsletter of the Faculty: It is issued twice a year to enhance international academic exchange and understanding within the Faculty and to promote communications with the former students and fellows presently residing in their home country.

3. Orientation and welcome party: At the beginning of an academic year (April) an orientation session is organized for newcomers to familiarize themselves with the campus life. A welcome party is held thereafter to introduce the newcomers to other foreign students and the staffs of the Faculty.

These activities are partially supported by the fund raised by Supporters' Association for International Academic Exchange of the Faculty of Agriculture, which comprises both academic and administrative staffs of the Faculty. A part of purchase of foreign newspapers and journals for the saloon is also made by this fund.

Activities of the Foreign Student Advisor's Office in 2004

The number of foreign students by country in 2004 is shown in Table 2.

a) Orientation and welcome party:

On the 8th of April the orientation and acquaintance session was held for 35 newly enrolled foreign students. Associate Professor Nawata, a member of the University Committee for International Academic Exchange, administrative staff of the Faculty, and an executive of the Kyoto University Cooperative gave guidance to the new comers on various aspects of the campus life. A welcome party was held thereafter at the Main Council Room of the Faculty, in which about 120 students and staff participated.

b) Study tour and study bus trip:

The study tour was organized to visit Nagasaki Prefectures on July 29 - 31. In total 24 students and staffs participated in the tour. The sites which we visited were Unzen-jigoku, Fugendake, Isahaya Land Reclamation, Nagasaki Atom Bomb Museum and Peace Memorial Park.

The study bus trip was also organized using the school bus of Kyoto University. We visited Obata-cho Rice Farm (Kyoto, Ayabe-city), on May 22.

c) Newsletter:

Since 1988 the Office has been publishing the newsletter biannually. The 33rd and 34th issues were published in April and November. About 3,000 copies each were delivered to all the students and staffs of the Faculty, foreign alumni residing in different countries (see Table 3), the members of the Supporters' Association for International Academic Exchange of the Faculty of Agriculture, and various Faculties, institutes, centers and other offices in the campus.

d) Correspondence to inquiries:

The Office answered to a number of inquiries for admission from different countries.

e) Newspapers, periodicals and books purchased:

Three newspapers (one English, one Chinese and one Korean) and several periodicals (three in foreign language and 20 in Japanese) are subscribed, and a few books and several reference materials for learning Japanese have been purchased for the use of foreign students.

f) Japanese language class

The Japanese language class (beginner's, intermediate and advanced courses) was started in April, 1996. About 30 foreign students and researchers attended the class.

g) Membership of the Supporters' Association for International Academic Exchange:

The membership of the Association was renewed in July of this year. There are 123 individuals in the membership list at the end of December.

Table 1　Collaboration with Foreign Guest Professors

Name	Nationality	Affiliation	Research Title
Hans Jürgen Hellebrand	Germany	Institute of Agricultural Engineering Bornim	Studies on Substance Cycle and Technology Assessment for Establishment of Recycling Society
Tibor Tòth	Hungary	Hungarian Academy of Science	Characterization and Rehabilitation of Salt-affected Soils in Arid and Semi-arid Regions
Branka Javornik	Slovenia	University of Ljubljana	Comparative Food chemistry of Buckwheat Flour between Cultivated Buckwheat and Its Wild Ancestor
Martin John Lechowicz	Canada, U.S.A.	McGill University	Studies on Phenological Characteristics in Forest Trees
Claude Gaillard	Switzerland	University of Bern	Genetic Dissection of Complex Trains in Livestock Populations
Robert Neil Jones	U.K.	University of Wales, Aberystwyth	Restructuring of the Genome of Hexaploid Bread Wheat by Inducing Translocations between the Chromosomes of Wheat and the Supernumerary B Chromosomes (Bs) of Rye
Pictiaw Chen	U.S.A.	University of California, Davis	Studies on Physical Properties and Quality Sensing of Bio-Materials
Frederick George Gmitter,Jr.	U.S.A.	University of Florida	Genome Analysis on Fruit Trees

Table 2 Number of foreign students by country (2004)

Country	UG	MC	DC	OT	ST	Country	UG	MC	DC	OT	ST
Bangladesh		1	5		6	Malaysia		1	1		2
Brazil		1	3		4	Mexico			1		1
Cambodia			1		1	Nepal		1			1
China	8	14	15	7	44	New Zealand			1		1
Colombia			1		1	Nigeria				1	1
Ghana				1	1	Philippines			1		1
Honduras		1	1		2	Sudan			1		1
Indonesia			12		12	Taiwan		1	1	1	3
Iran			1		1	Thailand			4	1	5
Kenya				1	1	U.S.A.			1		1
Korea	2	2	12	2	18	Vietnam		1			1
Kyrgyzstan		1			1						
						Total	10	24	62	14	110

Note) UG:Undergraduate, MC:Master Course, DC:Doctor Course, OT:Others, ST:Sub-total

Table 3 Number of foreign alumni by country of residence

Argentine	1	Iran	2	Philippines	12
Australia	2	Japan	21	Poland	1
Bangladesh	14	Kenya	2	Spain	1
Belgium	1	Korea	59	Sri Lanka	6
Brazil	5	Laos	1	Switzerland	2
Bulgaria	3	Malaysia	3	Taiwan	18
Canada	1	Mexico	4	Tanzania	4
Chili	3	Myanmar	6	Thailand	55
China	37	Nepal	2	Turkey	3
Egypt	4	Netherlands	2	U.S.A.	15
France	2	New Zealand	1	Vietnam	2
Ghana	1	Pakistan	1	Yugoslavia	1
India	4	Paraguay	1	Zaire	1
Indonesia	50	Peru	1		
				Total	355

Report on research and teaching activities at Kyoto University

By : Hans Jürgen Hellebrand
(Institute of Agricultural Engineering Bornim, Potsdam, Germany)
Invited Period: 1-February, 2004 till 30-May, 2004
Div. of Environmental Science and technology, Lab. of Field Robotics
(Host professor: Prof. Mikio Umeda)

I thank especially Dr Ryu Chan-Seok for his great help in understanding Japanese life and culture and for supporting me in solving the difficulties with which one is confronted in daily life. Great thank to Professor Yoshio Ikeda for the fruitful discussions we had and for his guidance into Japanese agricultural practice and tradition. I am also grateful to Dr. Michihisa Iida for his support in all technical questions and for the useful interaction that we had. I thank Mrs. Katsuko Morita, Foreign Student Advisor's Office, for her smooth and friendly way of helping me in the administrative preparation of my journey and during my stay.

Teaching and Presentations

Lecture at the Department of Farm Mechanization and Engineering, National Agriculture and Bio-oriented Research Organization NARO, Tsukuba

February 26, 2004:

Sensors and information acquisition - actual development of precision agriculture in Europe

Lectures at the Graduate School of Agriculture, Kyoto University:

March 5, 2004:

Review on the application of thermal imaging in agriculture and horticulture

April 13, 2004:

Comparative agricultural studies - Energy and substance cycles: ***Basic principles of nitrogen cycle***

April 20, 2004:

Comparative agricultural studies - Energy and substance cycles: ***Basic principles of greenhouse effect and Global Warming Potentials, nitrogen sensing and fertilising***

April 27, 2004:

Comparative agricultural studies - Energy and substance cycles: ***Basic principles of carbon cycle and energetic use of biomass***

Research

My research work contributed to the Project

"**Utilisation of Digested Sludge as Fertilizer for Rice Paddies**".

Problem and goal

About 55 % of Japan's cultivated land (2.6 million ha) are paddy fields. Up to now, liquid manure is not used as fertilizer in the majority of cases but is treated and then poured away in rivers. As 72% of the concentrate feed and 22% of roughage are imported, Japan faces a nitrogen problem. The imported nitrogen flux in terms of cereals and forage is several times higher than the nitrogen amount taken up by the cereals produced in Japan. The nitrogen of livestock manure produced by Japanese agriculture gives on average 127 kg per ha cultivated land. Several goals must be tackled – storage and application for paddy and for upland soils. The best solution for storage is to store digested sludge, since the emission of the greenhouse gas methane can be avoided. For fertilisation, two solutions are necessary. Fertilisation of paddies can be combined with flooding of rice fields. Here digested sludge can be added to the water directly. For upland soils, spraying of digested liquids as well as distribution of pellets, produced from dried sludge, could be the solution. In this contribution, the German situation of manure digestion should be presented and a comparison between German and Japanese agriculture should be made.

Agricultural biomass digestion –
An additional pathway for reduction of anthropogenic greenhouse gas emissions and for improving environmental conditions by reduction of odour emissions

Basic principles of anaerobic digestion

Slurry produced by housed livestock causes considerable pollution risks (emission of the greenhouse gases nitrous oxide and methane; emission of ammonia) as well as odour problems

from the concentrated waste. One method of tackling the problem is with the technique of anaerobic digestion. The process is very simple: the waste is stored in a closed container and warmed so that anaerobic microorganisms can breakdown organic compounds. The resulting biogas, a mixture of carbon dioxide and methane, can be burned as fuel in boilers and generators to produce heat and/or electricity. High tech anaerobic digestion could be one of the most cost-effective options for reducing methane emissions from agriculture. The plant nutrients - potassium, phosphorus and nitrogen remain in the product, and can be used on farmland as a fertiliser. If small biogas plants were available on individual farms, then farmers could breakdown the waste they produce, and save money on mineral fertilisers.
Livestock manure is an important resource for agriculture, because it contains essential nutrients and organic matter (Table 1). The factors given in Table 1 were used for the estimation of nutrient fluxes from animal husbandry in Germany und Japan.

Tab. 1 Nutrient content of manure*,**

Animal	Dry matter 10^{-2}	N 10^{-3}	P_2O_5 10^{-3}	K_2O 10^{-3}	MgO 10^{-3}	CaO 10^{-3}
Solid manure						
Cattle	25	6.0	4.0	7.0	1.9	6.4
Hogs	25	7.6	8.5	5.4	2.6	8.0
Laying hens	80	34	35	20	6.2	65
Sheep	25	8.5	3.3	8.0	2.0	3.5
Horses	25	6.5	3.0	6.3	1.8	3.0
Liquid manure						
Cattle	7.5	4.9	2.0	6.0	1.9	2.0
Hogs	7.5	6.0	3.0	3.0	1.0	3.0
Hens	15	10	7.5	4.5	1.5	16.5

*The concentration of nutrients shows great variability and depends on local conditions. The values given here may be used for the estimation of nutrient fluxes, especially for countrywide evaluations.
**Data taken from: KTBL-Taschenbuch für die Landwirtschaft (KTBL pocketbook for agriculture), ed. Association for Technology and Structures in Agriculture (KTBL), Darmstadt 1998

Advantage 1 - Odour reduction

The in-barn manure handling system plays an important role in odour management. An effective manure handling system should promote quick separation of manure from animals to minimize odour generation. Properly designed slatted floor systems provide an effective way of separating manure from animals with minimum efforts. If manure is stored under the floors in the barn, well-designed ventilation systems are necessary to provide under-floor pit ventilation for minimizing odour problems, but outdoor odour and nitrogen losses (NH_3) increase. Solid manure systems usually result in less odour emission. They are more expensive and difficult to operate. Treating manure before or during storage may reduce odour emission from manure storage. Suitable technologies are solid-liquid separation, anaerobic digestion, and composting (for solid manure). Most odorous compounds are contained in small manure particles. Therefore, removal of fine particles is necessary for effective odour reduction when using solid-liquid separation. Anaerobic digestion is performed in closed digesters and it reduces odour emission by converting odorous intermediate products of anaerobic decomposition into odourless end products of carbon dioxide and methane.

Advantage 2 - Abatement of greenhouse gas emissions

The greenhouse gases (GHG) nitrous oxide and methane are products of microbial activity and set free from solid and liquid manure in all animal houses as well as during storage. The emission rates show a high variability and depend on several conditions, which will not be discussed here. The assumption that in average 5 % of the carbon content will be released as methane during a storage period is widely used in literature. This percentage can serve as a rough guideline for estimations of the emission potential of untreated liquid and solid manure.
Such a way, the GHG abatement due to anaerobic digestion gives a green credit of 2.3 kg CH_4 per

ton cattle or hog manure and 4.6 kg CH_4 per ton of poultry manure. With a global warming potential of 23 (time horizon of 100 years) these methane values correspond to a carbon oxide equivalent of 53 kg CO2 per ton of cattle and hog manure and 106 kg CO2 in case of poultry manure.

Digestion gives 20 m^3 biogas per ton of cattle or hog manure. In case of poultry manure, 40 m^3 biogas will be get. Each cubic metre of biogas has an energy content of 6 kWh. As 1 kWh electric energy gives an emission of 0.9 to 1.7 kg CO_2, if fossil fuels are the source, each kWh electricity produced via biogas will abate adequate CO_2 emission from fossil fuel. Assuming an efficiency of about 17% (1kWh per m^3 biogas) to generate electricity in a biogas plant, then an additional green credit of 20 kg CO2 (40 kg for poultry manure) will be achieved.

Advantage 3 - Green credits

In the near future, trading in "environmental credits" is expected to reduce emissions of greenhouse gases in line with the requirements of the Kyoto protocol of 1997. Green credits for combating greenhouse gases will be issued by governments or organisations based on qualified technologies, which guarantee abatements of greenhouse gases. Biogas plants may fall in these technologies. For the digestion of one ton of cattle or hog manure, a green credit of about 50 kg CO2 could be issued. In connection with electric power feeding, the credit could be 75 kg CO2. For poultry manure, the credits would be 100 kg CO2 and 150 kg CO2, respectively.

General situation of German agriculture

Germany has an intensive agriculture with adapted livestock density of about one animal unit per hectare. The animal waste is stored and manure is used not as dominating fertiliser except at locations with high animal concentrations, where manure is the main nitrogen fertiliser.

In Germany, there are 421 400 farms with a total area of 17 056 100 ha cultivated land. The average size is 40.5 ha per farm. Around 50% of the land is cultivated by farms with 100 ha or more. These are 28 500 farms or 6.7 % of all farms. The agricultural production has a level of self-sufficiency.

Arable crop land (in 2003): 17.1×10^6 ha

Number of farms (in 2003): 421×10^3 total, 388.7×10^3 commercial farms, 176.4×10^3 business farms; 212.4×10^3 semi-business farms; 28.5×10^3 farms > 100 ha

Average farm size (in 2003): 40.5 ha/farm

Tab. 2 Total production (1999; t is the abbreviation of metric ton – 1000 kg)

Type	Mass total	$N_{content}$	N_{mass}	$C_{product}$
Wheat	19.6×10^6 t	0.021	412×10^3 t	8.0×10^6 t
Barley	13.3×10^6 t	0.017	226×10^3 t	5.4×10^6 t
Rye	4.3×10^6 t	0.016	67×10^3 t	1.8×10^6 t
Triticale	2.4×10^6 t	0.020	50×10^3 t	1.0×10^6 t
Potatoes	11.6×10^6 t	0.0035	41×10^3 t	1.2×10^6 t
Sugar beets	27.6×10^6 t	0.0018	50×10^3 t	2.0×10^6 t
Cereals total	39.6×10^6 t	(0.019	755×10^3 t	16.2×10^6 t

Tab. 3 Consumption of Fertilizer (1999)

Nitrogenous Fertilizer (N)	Phosphate Fertilizer (P_2O_5)	Potash Fertilizer (K_2O)
1 903 000 t	407 000 t	629 000 t

Tab. 4 Number of animals (1999)

Animal	Number	Animal units	Animal units per ha
Cattle	14.9×10^6	13×10^6	0.75
Pigs	26.1×10^6	2.5×10^6	0.15
Poultry	108×10^6	0.7×10^6	0.05
Total		16.2×10^6	0.95

Tab. 5 Animals, manure and nutrient content, Germany (1999)

Animal	Animal units 10^6	Manure 10^6 t	Dry matter 10^6 t	Nitrogen 10^3 t	Phosphate 10^3 t	Potash 10^3 t
Cattle	13	195	14.6	955	390	1 170
Pigs	2.5	37.5	2.8	225	115	115
Poultry	0.7	6.5	1.0	65	50	30
	Total	239	18.4	1 245	555	1315

General situation of Japanese agriculture

Japan has an intensive agriculture with high livestock density of about 1.75 animal units per hectare, which is nearly twice as high as in Germany. Therefore, we find in Japan a surplus of manure production, which must be recycled in a suitable way to be used as fertilizer and energy source. The special problem is the nitrogen content, as it is imported as constituent of the imported fodder and forage for animal husbandry. The imported nitrogen flux is several times higher than the nitrogen amount taken up by the cereals produced in Japan. Therefore, nitrogen fertilization could be based principally on manure nitrogen only; no additional mineral fertilizer is needed in Japanese farms. In reality, question like storage of processed manure, maintenance of nitrogen content over the storage periods, as well as engineering solutions for distribution and sufficiently low cost of the application processed manure must be solved.

Arable crop land: 4.8×10^6 ha (with permanent crops), 4.5×10^6 ha (without permanent crops), 2.6×10^6 ha irrigated land

Number of farms (in 2002): 3 028×10^3 total, 2 249×10^3 commercial farms, 555×10^3 semi-business farms, 463×10^3 business farms

Average farm size: 1.58 ha/farm, business farms are > 2 ha in general

Tab. 6 Farm Households by Size of Land Holding 1990: 3 835 000

Less than 1 ha	1-2 ha	2-5 ha	5-10 ha	Over 10 ha
2 626 000	789 000	340 000	45 000	35 000

Tab. 7 Total production of cereals

Type	Mass total	$N_{content}$	N_{mass}	C_{grains}
Paddy rice	12.5×10^6 t	0.016	200×10^3 t	5.1×10^6 t
Wheat	0.57×10^6 t	0.021	12×10^3 t	0.2×10^6 t
Barley	0.19×10^6 t	0.017	3×10^3 t	0.1×10^6 t
Cereals total	13.3×10^6 t	(0.016)	215×10^3 t	5.4×10^6 t

Tab. 8 Consumption of Fertilizer

Nitrogenous Fertilizer (N)	Phosphate Fertilizer (P_2O_5)	Potash Fertilizer (K_2O)
487 000 t	584 000 t	383 000 t

Tab. 9 Import of cereals and forage

Type	Mass total	$N_{content}$	N_{mass}
Maize	16.2×10^6 t	0.015	243×10^3 t
Wheat	5.9×10^6 t	0.021	124×10^3 t
Soybeans	4.8×10^6 t	0.057	274×10^3 t
Forage	2.5×10^6 t	0.065	163×10^3 t
Total	29.4×10^6 t	0.027	804×10^3 t

Tab. 10 Export of cereals and other products

Type	Mass total	$N_{content}$	N_{mass}
Rice husked	0.5×10^6 t	0.016	8×10^3 t
Wheat flour	0.32×10^6 t	0.026	8×10^3 t

Tab. 11 Number of animals

Animal	Number	Animal	Animal units per ha
Cattle	4.56×10^6	4×10^6	1
Pigs	9.6×10^6	1×10^6	0.25
Poultry	306×10^6	2×10^6	0.5
Total		6×10^6	1.75

Tab. 12 Animals, manure and nutrient content, Japan

Animal	Animal units 10^6	Manure 10^6 t	Dry matter 10^6 t	Nitrogen 10^3 t	Phosphate 10^3 t	Potash 10^3 t
Cattle	4	60	4.5	295	120	360
Pigs	1	15	1.1	90	45	45
Poultry	2	18.5	2.8	185	140	85
	Total	93.5	8.1	570	305	490

The total amount of livestock manure produced by Japanese agriculture is near 95 million tons a year. The pure nitrogen content of this is estimated to be around 570 000 tons. This is twice the amount withdrawn by the total of cereals grown. If these animal wastes were to be recycled evenly over the 4.5×10^6 ha cropland (without permanent crops), the nitrogen would be 127 kg/ha, which is sufficient for all of the crops produced. However, the actual distribution of crop production and livestock husbandry is uneven. Therefore, the manure nitrogen in some regions (250 kg/ha or more) exceeds the real demand by crop production and in some other places there could be a shortage of manure nitrogen for fertilising the crop production.

Several problems must be solved. Manure must be stored and distributed. During storage, methane is naturally generated and ammonia is volatilised. Methane is a greenhouse gas and ammonia affects the environment. The best preparation for storage is methanisation (fermentation). Such a way the energetic potential of the manure is used, the danger of uncontrolled methane to be released into the atmosphere and the unpleasant odours are eliminated.

For storage, it is necessary to stabilise the ammonia content by reduction of pH-value and/or sulfatation (NH_4SO_4). The distribution of high viscous liquids like manure at agricultural fields is solved and machines are available. For long way transports, the water of the fermented sludge should be removed. But both processes are cost intensive, transportation and drying. A careful economic evaluation is necessary.

According Table 12, the manure from Japanese livestock husbandry gives a potential of about 2000 – 4000 million cubic metres biogas. In dependence on the methane content (Table 13), the energy per cubic metre is 15 to 30 MJ (4 – 8 kWh). Thus the energetic potential of the manure lies between 30 and 120 PJ.

Biogas plants in Germany – The development of anaerobic digestion

With the “Act on Feeding in Electricity” in 1991 and the “Renewable Energy Sources Act“ of the German Bundestag in April 2000, many farmers in Germany started with building of biogas plants (Fig. 1). Manure or slurry fermentation is the most frequently utilised process for biogas production. Whereas some years ago animal waste was the only basis for biogas production, farmers more and more try to recycle wastes from food processing industries and to get as additional input energy crops from set-aside land. The common treatment of animal waste with other organic wastes or energy crops is called co-fermentation and is now realised in many biogas plants in Germany.

Agricultural biogas plant with co-fermentation

The input for anaerobic digestion may vary considerably in composition, homogeneity, fluid dynamics and biodegradability in dependence on the different characteristics of animal manure und products added. The plant feedstock used for biogas production can consist of tubers, stems, leaves, fruits and seeds or even whole plants. Thus design and process conditions of a biogas plant are very much influenced by the input material composition.

Fig. 1 Number and total power of biogas plants in Germany (Wilfert et al. 2003; modified)

Typical components of an agricultural biogas plant with co-fermentation of energy crops are preparation of substrate, fermenter, gas storage and cleaning unit, and a gas utilisation station. In greater farms, the excrements are commonly collected as liquid manure (slurry) and pumped into the storage container and then from the storage into the fermenter. If necessary, plant biomass is pre-treated and stored (i.e. silage) for the subsequent utilisation as additional feedstock. A screw conveyer conducts chopping and transportation of the co-ferments in a fast and efficient way.

Tab. 13 Composition of biogas

Gas	Typical range, %
Methane	40-70
Carbon dioxide	25-55
Water vapour	0-10
Nitrogen	0-5
Oxygen	0-2
Hydrogen	0-1
Ammonia	0-1
Hydrogen sulphide	0-1

The biogas, which is generated in the anaerobic digester (fermenter), is composed of methane and carbon dioxide mainly. The amounts of hydrogen sulphide, ammonia and hydrogen are usually less than one percent (Table 13). Other trace (odorous) components are in the ppm-range. Methane is the component, which by oxidation (combustion) gives the energy for heating and generation of electric current. Thermal energy is needed to heat the fermenter. As usually more heat energy is available than consumed by the fermenter, the energy can be used for heating and warm water preparation in the farm buildings. Even a supply to the local heating network might be possible. The electricity may be used by the farmer or be fed into the public power supply system. The fermenter output must be stored up to several months before being spread as fertilizer in the field. Co-fermentation by plants added increases the biogas yield considerable compared to fermentation of pure manure (Table 14). The most suitable plant species for the production of biogas are those, which are rich in easily degradable carbohydrates, such as sugar and protein matter. Hemicelluloses and lignin have a low biodegradability and for the latter the breakdown is hardly noticeable under anaerobic conditions.

Tab. 14 Biogas yield of different agricultural materials compared to manure

Substrate	Biogas yield ($m^3\ t^{-1}$ substrate)
Corn-Cob-Mix	400-600
Straw chopped	280-300
Corn silage	180-290
Grass silage	170-200
Meadow grass	80-120
Manure	20-40

The profitability of biogas plants mainly depends on the costs of investments, level of running costs and on the returns for purified gas (used as fuel for engines) or for processed gas (heat and electricity). A typical cost situation for German biogas plants in agricultural areas with medium and poor soil quality (sandy loam and loamy sands) are given in Fig. 2 and 3.
The profitability of biogas plants in Germany is ensured by the returns from feeding the electricity net on the one hand. On the other hand, the farmer tries to reduce the investment costs by flexible measures and, additionally, he is optimising his plant by locally available sources of organic substances, which may be used for co-fermentation.

Fig. 2 Costs of biogas plants (Grundmann et al. 2004; modified)
Fig. 3 Costs of electricity produced by biogas plants (Grundmann et al. 2004; modified)

Conclusions

The total amount of livestock manure produced by Japanese agriculture contains with about 570 000 tons more nitrogen than necessary for fertilizing of all cultivated land. This nitrogen content is sufficient for all of the crops produced. Solutions for nutrient conservation, storage, and distribution must be developed.

Digestion of manure uses the energetic potential. This reduces the danger of uncontrolled methane emissions to be released into the atmosphere and the unpleasant odours are eliminated.
For storage, it is necessary to stabilise the ammonia content. Storage and distribution of digested sludge can be decentralised after digestion. The distribution and storage network must be optimised according to the local structure. For long way transports and use as upland fertilizer, the water of the fermented sludge should be removed. The fertiliser may be handled then as granules or pellets. But both processes, transportation and drying, are cost and energy intensive. A careful economic analysis is necessary.
The manure from Japanese livestock husbandry gives a potential of about 2000 – 4000 million cubic metres biogas. The energy per cubic metre is 15 to 30 MJ (4 – 8 kWh). Thus the energetic potential of the manure lies between 30 and 120 PJ.

References

GRUNDMANN, P.; HEIERMANN, M.; HELLEBRAND, H.J.; JACOBS, H.; LUCKHAUS, CH.: Studie zur Errichtung einer Pilotanlage zur Trockenvergärung oder Thermolyse landwirtschaftlicher, forstwirtschaftlicher und gewerblicher Biomasse zur Energiegewinnung als Beispielsobjekt für die Landkreise Barnim und Uckermark. Forschungsberichte des ATB 2003/1, Kurzfassung http://www.atb-potsdam.de/hauptseite-deutsch/Institut/Abteilungen/Abt2/Mitarbeiter/jhellebrand/jhellebrand/Publikat/Studie.pdf

HEIERMANN M.; PLÖCHL M.; LINKE, B.; SCHELLE, H. (2002): Preliminary evaluation of some cereals as energy crops for biogas production. In: Proceedings of the World Renewable Energy Congress VII, 29.06.-05.07.2002, Köln, Germany, ISBN 0080440797

Linke, B.; Kolisch, G.: Common treatment of sewage sludge and animal slurries in covered digesters; Biotechnologies For Pollution Control And Energy. In: Proceedings of the Third Working Group on Biogas Production Technologies CNREE Network on Biomass Production and Conversion for Energy, Braunschweig, Germany, 5 – 7 May 1992

Wilfert, R.; Scheuermann, A.; Dilger, M.; Kaltschmitt, M.: Biogasgewinnung und –nutzung - Tendenzen und Entwicklungen infolge des EEG - http://www.carmen-ev.de/dt/portrait/sonstiges/kaltschmidt.pdf

Professor Umeda's laboratory discuss the new fertilization project with digested sludge as liquid fertilizer for paddy

Biogas plant Yagi town – the source of digested sludge for the project

Comparative food chemistry of buckwheat flour – Comparison of usage between Slovenia and Japan

By: Dr. Branka Javornik
(University of Ljubljana, Biotechnology Faculty)
Invited Period: 1-April, 2004 till 30-June, 2004
Div. of Applied Biosciences, Lab. of Crop Evolution
(Host professor: Prof. Ohmi Ohnishi)

Buckwheat was grown in Slovenia since the 15. Century and was one of the most important crop until the end of the 19.century. Because of this relatively high production, buckwheat was very common in the diet of than mainly Slovene peasants and nowadays it is considered as one of the typical Slovene folk's food. Buckwheat as a plant and as an important source of nutrition is also included in some in poems, folk songs and proverbs.

Different kinds of foods were made from buckwheat flour or groats (kasha). Most common were zganci, bread, struklji and kasha. Nowadays, buckwheat has regained some of its past use but not as a poor people's plant. It is more considered as a special, »health food« and recent scientific research provided data on health-beneficial components in buckwheat (rutin, chiro-inositol) which make buckwheat even more desirable in our nutrition.

In the past, most common foods were žganci (see receipt) in which buckwheat flour is mixed with water into a dry paste until small flakes are formed. Than it was bread made from buckwheat flour mixed with oats, barley, potato, millet or even beans; nowadays buckwheat bread is made with a high addition of wheat flour. Buckwheat groats was also widely used as addition to milk or soup and for a filling of blood sausages and its similar use is also present today. Some of the buckwheat foods were made only on special occasions or for holidays ("potica" – sweet bread rolled up with walnut filling, "pisani kruh" – baked layers of wheat, corn and buckwheat four, struklji (see receipt) and others).

As compared with various Slovenian buckwheat foods, buckwheat noodles are the only major food of buckwheat flour in Japan. By cooking buckwheat noodles (boiling noodles) a great amount of nutritional components of buckwheat flour is lost. However, Japanese cooking has good tradition to use the boiling water used for noodle making as »soba-yu«. It is served after buckwheat noodles. By drinking »soba-yu« people can recover nutrition of buckwheat flour.

We still do not know how buckwheat flour was cooked at the beginning of buckwheat cultivation. It must be like as buckwheat dough and paste. People utilize buckwheat nutrition effectively as just Japanese people do now. We have to study food chemistry of primitive buckwheat including the wild ancestor of buckwheat and modern cultivars of buckwheat.

Appendix:

»Zganci«

Ingredients for žganci: 1.5 lb buckwheat flour, 3/4 l salted boiling water, a few tablespoons of lard with cracklings (garnish)

Roast the buckwheat flour (according to the Koroska style) in an ungreased iron pan until the aroma appears, stirring constantly. Pour the salted boiling water over the flour and continue stirring until small *zganci* begin to form. Cover the pan and place over very light heat for ten minutes so that flour swells. Brown cracklings in lard and use to garnish *zganci*.

Another way to prepare *zganci* is the following: Pour buckwheat flour into salted boiling water, and after boiling five to ten minutes, make a hole in the pile of flour with the handle of a wooden spoon so that the pile cooks from the inside as well. Continue boiling for another 15 minutes. Pour off half the liquid and save. If you wish small *zganci*, stir with two-pronged fork and garnish in the pot. For softer *zganci* (in the Styrian (Stajerska) style), add some of the saved liquid and stir with a long wooden spoon until smooth. Scrape *zganci* from spoon with a fork into a bowl and garnish to taste.

»Struklji« are a "multi-purpose" dish: they can be served as a side-dish with game or any dark meat with a heavy sauce, as an independent course (usually with a salad) or as a dessert (with a sweetened cream sauce or just dusted with sugar). General principle for making struklji is the same - the dough is made either of "soft" white flour or - more popular in Slovenia, with buckwheat flour. The spread dough is filled with different filling and than cooked wrapped up in cloth in boiling water.

Ingredients for buckwheat dough: 1 litre buckwheat flour; 0.1 kg wheat ("white") flour; 1 litre boiling water, slightly salted.

Scald the buckwheat flour with boiling water, mixing with a wooden spoon; allow to cool just enough that you can knead the dough with your hands. Knead in the wheat flour and roll out the dough about 2-3 mm thick immediately; cut off any thicker or crooked edges and spread the filling. For filling are most commonly used pre-prepared walnuts, honey, cottage cheese or tarragon. After spreading the filling on the dough, roll the dough tightly, making sure that there are no air pockets in the roll. Uncooked buckwheat roll should be about 5 cm thick, wheat up to 10 cm. Moisten a thin linen cloth, wringing out excess water; spread the cloth on a flat surface and dust lightly with dry bread-crumbs. Wrap the struklji tightly with the cloth and tie both ends - the cloth should cover the struklji roll at least twice. Bring 1 litre salted water to boil; drop the roll into boiling water and cook for 1/2 hour. Remove immediately, unwrap and cut into serving pieces. Brown some bread-crumbs on butter and pour over struklji; serve hot. If served as a dessert with cream sauce, serve the sauce separately, sugar can be added to the taste.

Buckwheat groats, whole: These are the raw kernels with their inedible black shells removed. Whole groats are either white (unroasted) or brown (roasted). The white groats have a fairly mild flavour and can be substituted in dishes that call for white or brown rice. Roasted, hulled buckwheat kernels--usually cracked into coarse, medium, or fine granules-are also known as *kasha*. Kasha, whole buckwheat, and buckwheat grits can be simmered or baked. Use water or a more flavourful liquid, such as chicken or vegetable broth, as a cooking medium. Approximate cooking times: unroasted whole buckwheat groats, 15 minutes; roasted whole groats, 13 minutes; cracked groats seven to 10 minutes. Simply cook the grain as you would rice. These can be used as an accompaniment to meat or as the basis for a grain-and-vegetable.

Reconciling scale-dependent differences in determinants of forest productivity

By : Martin J. Lechowicz
(McGill University, Canada)
Invited Period: 1-April, 2004 till 31-July, 2004
Div. of Forest and Material Science, Lab. of Forest Biology
(Host Professor:Prof. Kihachiro Kikuzawa)

Forest productivity arises in the aggregate productivity of different, co-occurring tree species. Because tree species differ substantially in form and function, it is challenging to model the mechanistic basis of productivity from the scale of individual trees to the forest community as a whole. While there is a large literature on the timing of spring budbreak in different tree species (Menzel et al 2003) and an equally large literature on the spring greening of the landscape (Tucker et al 2001), connecting events at the two scales is difficult (White et al 1997). In a given forest, there will often be a 4-6 week span during which spring budbreak occurs in different tree species, yet as little as 1-2 weeks difference in the seasonal duration of the forest canopy can decide the difference between positive or negative production in a year. There is a disjunction between: a) our knowledge of the comparative ecology of trees and their contributions to the composition and dynamics of forest communities and b) our knowledge of the productivity of diverse forest types and the environmental factors associated with their geographic. Very few inquiries exist into the possible connections between these bodies of literature (Enquist 2002). Here we show that exclusion of times during the year when conditions are unsuitable for productivity processes combined with an estimation of the time during the favorable period when leaves can function near full capacity yields a unified connection between leaf-level and canopy-level components of forest productivity.

Canopy duration, the time from leaf emergence to leaf fall, is set by the emergence and senescence of leaves on the trees in a forest. Forests are typically classified by the leaf habit of the species that comprise them as deciduous (summergreen, drought deciduous) or evergreen (wintergreen, tropical broadleaf evergreen), although mixed forests of both deciduous and evergreen species also occur. Leaf life span (leaf longevity), which in deciduous trees can be less than canopy duration, in turn is linked to a set of foliar traits including photosynthetic capacity that influence productivity (Wright et al). A theory of leaf life span exists that predicts leaf habit or forest canopy duration as a function of the lifetime carbon gain by leaves (Kikuzawa1991). Leaf life span is usually measured simply as the calendar duration of individual leaves, but in evergreen forests some part of the year, such as a cold or dry season, may be unfavorable for photosynthesis. We argue that in considering the lifetime carbon gain by a leaf, the length of this unfavorable period should be discounted from the leaf's life span. Consideration of this functional leaf longevity (l_f) yields the surprising result that the leaves of all tree species have essentially the same lifetime carbon gain. Thus gross primary production in the diverse forests of the world can be approximated simply by the duration of the favorable period for photosynthesis.

Within the seasonally favorable period for photosynthesis, productivity is also limited by four factors: 1) the period of darkness, 2) the shading effects of clouds during daylight, 3) the shading effects of adjacent vegetation and 4) the effect of midday photosynthetic depression (Kikuzawa et al, 2004). Interspecific differences in response to these factors arise in differing adaptation to the environmental regime in a locality. These differences can be characterized by the mean labor time (m) of leaves, the average daily duration of full foliar function (Kikuzawa et al, 2004). Considering both functional leaf longevity and mean labor time, we can express gross photosynthetic production of a plant community by the product of the following three terms: leaf production rate, life time carbon gain of a leaf and the duration of the seasonal favorable period for photosynthesis. If the first two factors are essentially constant, gross primary production can solely be approximated by the duration of the favorable period.

The leaf biomass in forest increases with stand age, reaching a stable value that is maintained for a relatively long period. Mean leaf longevity during this stable period can be expressed by the ratio of leaf biomass in the forest canopy (g m^{-2}) and annual leaf fall of the stand (g m^{-2} yr^{-1}). Both parameters are available for a wide variety of forests . Plotting leaf biomass (B) against leaf longevity (L), yields a positive relationship that differs in seasonal versus aseasonal climates .

This suggests that the difference in leaf biomass among forests in a given region is explained mainly by differences in leaf longevity or differences in the turnover rate of leaves. Greater leaf biomass suggests slow turnover and longer leaf longevity.

It has also long been known that there is a negative correlation between potential maximum photosynthetic rate of a single leaf (A_{max}) and leaf longevity (L) among different plant species. Plant species that allocate resources to higher photosynthetic capacity cannot allocate resources at the same time to sustain individual leaves over a long period of time.

If natural selection acts on A_{max} and L, it should favor the lifetime carbon gain, or the product of A_{max} and L. The scaling factor between the two, however, was not –1 on a double log scale but only –0.65 (Reich 1992). Lifetime carbon gain therefore is not constant among different species.

Only for the data set whose leaf longevity is less than 365 days (where leaf longevity is equal to functional leaf longevity), the scaling was still –0.65. Therefore, we cannot obtain a scaling factor of –1 even after converting leaf longevity to functional leaf longevity. If, however, natural selection favors high lifetime carbon gain, not $A_{max} \cdot L$ but $A_{mean} \cdot L \cdot f \cdot m$ should be maximized. Where, A_{mean} is average A_{max} throughout the leaf lifetime and *m* is the mean labor time.

Here, we will show that carbon gain by a forest (gross primary production, P in g m^{-2} yr^{-1}) can be expressed as the product of leaf biomass, mean A_{max} (A_{mean}) and the effective period for production (d; days yr^{-1}).

$$P = B \cdot A_{mean} \cdot d \qquad (1)$$

Th effective period for production, d, is the product of mean labor time (*m*, hour day^{-1}) and the length of favorable period (l_f, days).

$$d = m \cdot l_f \qquad (2)$$

The mean labor time is a parameter that shows how many hours, on average, a leaf works at full capacity within a day (Kikuzawa2004). A_{mean} is the average value of A_{max} among leaves throughout the favorable period of a year. In the case of evergreen trees in temperate forests where different leaf cohorts (different aged leaves) overlap, A_{mean} can be approximated by the average A_{max} throughout a leaf's life span under the following assumptions: 1) different cohorts can be considered equivalent to different aged leaves of a single cohort and 2) a cohort of leaves is assumed to be shed only at the end of leaf's life span. Then the average A_{max} through leaf's life, in turn, is 1/2 of A_{max} under the following assumptions: 1) A_{max} declines with time linearly and 2) becomes zero at the end of the leaf's life. Even relaxing these assumptions, A_{mean} can at least be assumed proportional to A_{max}.

Report of the research activity during the visit of Dr. Claude Gaillard at the Lab for Animal Breeding and Genetics (May till September 2004) with Drs. Yoshiyuki Sasaki and Takeshi Miyake

By: Dr. Claude Gaillard
(University of Bern, Animal Breeding and Genetics)
Invited Period: 1-May, 2004 till 30-September, 2004
Div. of Applied Bioscience, Lab. of Animal Btreeding & Genetics
(Host professor: Prof. Yoshiyuki Sasaki)

One of the central challenges in animal genetics is to unravel the genetic basis of animal diseases and other phenotypes of interest. Apart from the inherent interest in understanding the biological determinants of phenotypic variation, it is hoped that this work will lead to important medical and economical advances. Most notably, determination of the genetic variants involved in a particular disease should provide more insight into the disease etiology and could lead to genetic screening to identify individuals at increased risk. This knowledge can then be used as a selection criterion in animal breeding programs. Animal geneticists were successful in finding genes that are responsible for Mendelian or monogenic diseases most often with the help of the comparative genomics with human or mice genomes. In contrast, the search for complex disease genes has been less successful. Disease genes often produce weak and sometimes inconsistent signals in complex disease studies. Unlike Mendelian traits, which are controlled by genes of large effect and show simple patterns of inheritance within families, the transmission of complex phenotypes is governed by multiple factors, and familial patterns of inheritance are complicated. Phenotypic outcomes may be determined by a mixture of genetic factors plus environmental and stochastic factors. A defining feature of complex phenotypes is that no single locus contains alleles that are sufficient explaining for the disease.

Before genetic studies of complex traits on a molecular level are onducted, it is recommended to obtain indications about the overall magnitude of genetic effects. One possibility is performing segregation analyses that provide information about the allele frequency of a bi-allelic major single gene, the mode of inheritance at that locus and the magnitude of the allelic effect. In addition the importance of polygenic effects is measured with the heritability. A model that includes a single major gene and a polygenic effect is called mixed inheritance model. Many complex diseases in humans, animals and plants are expressed in a binary form *e.g.* as “affected” or “not-affected”. Segregation analyses with this kind of phenotypes are statistically more demanding. Many studies of segregation analyses of quantitative traits have been reported but the ones of binary or categorical traits are still very limited. One of the rare programs that is able to perform segregation analyses of binary traits based on mixed inheritance model is the Pedigree Analysis Package (PAP: http://hasstedt.genetics.utah.edu/). This program package uses a Maximum Likelihood (ML) approach to estimate parameters. Unfortunately this program is not able to handle large pedigrees with inbreeding and mating loops, which are common in livestock populations. In order to obtain solutions these loops has to be cut what leads to a loss of information. A Bayesian approach with Gibbs sampling, however, could allow a useful solution for handling complex pedigrees.

The objective of our research project was to develop a segregation analysis for binary traits based on a mixed inheritance model using a Bayesian approach with Gibbs sampling. The property of the developed method as well as the efficiency obtaining correct results were investigated by using simulated half-sib populations with two or four generations. The results were compared with the ones obtained by the Maximum Likelihood approach using the PAP program.

Our approach of binary trait analysis followed the liability concept of Wright. The disease was analyzed assuming an underlying continuous liability, where a threshold determines the health status. The disorder occurs when the liability of an individual exceeds the threshold. An assumed continuously distributed underlying liability allows very flexible modeling of its distribution according to various genetic and non-genetic factors. If a mixed inheritance model is used, however, the liability distribution is no more normal. The liability distribution with mixed inheritance model is the mixture of normal distributions of the three genotypes of the bi-allelic single major gene. In order to obtain valuable solutions with a mixed inheritance model it is required setting constraints on parameters. This parameter setting was very tricky. The parameters were estimated by Gibbs sampling, while using the suggested conditional distribution functions for parameters and genotypes of Janss and Sorensen respectively.

The comparison between the Bayesian and the ML approach were carried out with simulated half-sib populations counting 2050 animals. Ten different parameter settings were produced and for each of them 50 replicates were performed. The evaluation of both approaches consisted in comparing the power of each method and the unbiasedness of the estimated parameters.

When a polygenic model was simulated *i.e.* no major gene was segregating in the population, all parameters were always correctly estimated with the Bayesian approach. With the ML method unbiased estimates of heritabilities were found too but false positive detections of a major gene were made, especially when the heritability was high.

The obtained power when a single recessive major gene exclusively controls the binary trait was much smaller with the Bayesian approach than with ML one particularly when the effect of the major gene was low. The magnitude of the major gene as well as the mode of inheritance was most often biased upwards with the ML but not with the Bayesian method.

The power of detection of the major gene for populations simulated under the mixed inheritance models improved as larger the effect of the major gene and as deeper pedigrees was. When a major gene was detected, the parameters related to it were almost correctly estimated with the Bayesian approach but generally overestimated with ML. It seems difficult obtaining correct estimates of the heritability of the polygenic effects with both methods.

Our preliminary conclusions are: 1) The power was better with the ML approach. 2) Unbiasedness was rather better with our Bayesian approach. 3) With the Bayesian method, complex pedigree could be handled more easily. 4) Both methods have their own merits. The Bayesian approach can confirm and complement the results of the ML method.

Record of activities in Kyoto University Faculty of Agriculture, as Visiting Professor
Aug. 1 –Oct. 31 2004

By Professor Robert.Neil Jones
(The University of Wales Aberystwyth, Institute of Biological Sciences, United Kingdom).
Invited Period: 1-August, 2004 – 31-October, 200
Div. of Applied Biosciences, Lab. of Plant Genetics
(Host professor: Prof. **Takashi Endo**)

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Friday July 30: Travel from Aberystwyth to London Heathrow, and on to Kansai airport.

Sat. July 31: I was met by Dr. Endo Tagashi and stayed in his house on the first night.

Sun. Aug. 1: Occupied my hotel residence, and was introduced to the campus and the facilities in the Faculty of Agriculture and the Laboratory of Plant Genetics.

Mon. Aug. 2: Registered in University, and was give details of travel expenses and the key to my office S250. I had a meeting and some discussions with the Dean of the Faculty, Dr. Tsuyoshi Takahashi. Establish e-mail communication facilities.

WEEK 1. Completed work on submission of a manuscript to the *New Phytologist* journal and began work on two-year Royal Society Joint Research Project application with Dr TR Endo.

WEEK 2: Continued work on completing the Joint Research Project application. Visited research labs and glasshouses of the Laboratory of Plant Genetics. Started to collect and to read the literature on 'gametocidal' chromosomes, and to make the bibliography. This is the subject of the research application.

WEEK 3: Reading the literature on gametocidal chromosomes. Completed work on the research project application, and submitted it to the Royal Society. Dealt with some work from Aberystwyth: PhD student thesis, travel grant application for the Plant and Animal Genome conference in San Diego in January 2005 (to make two workshop presentations).

WEEK 4: Preparing lecture for meeting of the Kyoto Faculty of Agriculture on Sept 4.

WEEK 5: Completed preparations for lecture on Sept 4th. Presented a 1 hr lecture on "Chromosomes without genes". At the reception in the evening, after the meeting, I was presented with a framed certificate by the Dean, to commemorate my lecture as a visiting Professor in the Faculty, and also with a clock and paperweight of the Kyoto Foundation. I met a number of Japanese scientists who are familiar with my work, including: Dr. Hisahi Tsujimoto – Tottori University; Dr Tetsuo Sasakuma, Kihara Institute of Yokohama City University and Dr. Keiichi Mochida – Nagahama Institute of Bio-Science and Technology. Dr Sasakuma invited me to present a lecture in Tokyo, and discussions took place with Dr. Hisahi Tsujimoto about collaborations on B chromosome research.

WEEK 6: Editing a document for Dr Endo, and working on a seminar on centromeres.

WEEKS 7,8,9 Researching the literature for a seminar "What is a centromere". Visited Osaka

29/09/04 for Genetical Society of Japan Conference, and met Dr. Kiichi Fukui from Osaka University.

WEEK 10 Seminar to Laboratory of Genetics – 'mysteries of the centromere'. Preparing seminar for Yokohama Kihara Institute on Oct 15

WEEK 11 Seminar to the Laboratory of Plant Genetics on 'McClintock's controlling elements'. Meeting with Dr Noguchi, Department of Botany, Institute of Plant Sciences, to discuss possible collaborative work on the meiosis. Friday Oct. 15: seminar on 'Chromosomes without genes', Kihara Institute of Yokohama City University, by invitation of Professor Tetsuo Sasakuma. Also visited the laboratories and met with staff and research students, followed by dinner in China Town. Saturday 16 met with Professor Tadao Matsuda, formerly visiting me in Aberystwyth in 1987, and spent a day in Tokyo.

WEEK 12 Sunday 17: attended the 5th International Conference on Chromosome Research at the Nano Level, Shiran Kaikan, Kyoto University. Presented a seminar to the Laboratory of Plant Genetics on "Genetically Modified Crops".

WEEK 13 Prepared a seminar which I gave in the University of Osaka Department of Biotechnology on Thursday Oct 28th. Completed preparations for leaving from Kansai airport on Sunday October 31 at 120.00 pm.

In addition to the chronological sequence listed above, I held regular (2-3 times / week) discussion meetings with Dr Endo Takashi to discuss matters of science and of teaching and administration in our respective universities. I also carried on my regular reading of journals, dealt with manuscript preparation and proof reading, and kept contact with various other labs around the world with which I have collaborative research.

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Report of Activities during My Visit at Kyoto University

By: Pictiaw Chen
(University of California, U.S.A.)
Invited Period: 1-October, 2004 till 31-December, 2004
Div. of Environmental Science and Technology, Lab of Agricultural. Process Engineering
(Host Professor: Prof. Yoshio Ikeda)

I left Davis, California, on September 28 and flew from Sacramento to San Francisco, and on to Kansai airport. I arrived at Kansai airport on September 29 and was met by Professor Yoshio Ikeda's assistant, Dr. Hyeon-Tae Kim, who took me to the Kyoto University International House. In the morning of the following day, I came to the campus with Dr. Kim and was introduced to the campus and the facilities in the Faculty of Agriculture and the Laboratory of Agricultural Process Technology. On October 1, Professor Ikeda introduced me to the Dean of the Faculty of Agriculture, Dr. Tsuyoshi Takahashi, and officers from the Foreign Student Advisor's Office. After signing the formal contract, I was given details of travel expenses and the key to my office S250. I attended the faculty meeting on October 14 and was formally introduced to faculty members of the Faculty of Agriculture by Dean Takahashi. I gave my main lecture entitled "Nondestructive Techniques for Sensing Quality of Agricultural Products" on November 26. At the end of my presentation, I was presented with a framed certificate and other gifts to commemorate my lecture as a visiting Professor in the Faculty.

During the three months of my visit, my main activities included the following: preparing and giving seminars, participating in discussion meetings with researchers and students, conducting joint research, reviewing manuscripts, and visiting other institutes.

This visit provided me with a golden opportunity to share my research on physical properties of biological materials and nondestructive techniques for quality evaluation of agricultural products with faculty members and students in Professor Ikeda's Laboratory. I brought with me an impact sensor for sensing fruit firmness and used it here with Dr. Takahisa Nishizu in a joint research project to monitor firmness of kiwi fruit during storage and ripening. An undergraduate student was also working on this project. I spent some time with the student in the lab to show her how to use the impact sensor properly and to give her advice when needed. I had a few meetings with Dr. Nishizu to discuss the research and future collaboration. A collaborative research proposal was prepared and submitted. The impact sensor will be left here for future cooperative research.

I met with Professor Ikeda's doctorate student, Mr. Somchai Limsiroratana, and had some discussions with him about his research projects. I found Mr. Somchai's work on "Detection of Fruits in Natural Background" very interesting and enlightening for me, since I am not so familiar with various problems in machine-vision and image processing. I gave Mr. Somchai some advice and assistance in preparing two manuscripts for publication.

I had very productive discussion meetings with Dr. Koro Kato and Dr. Takahisa Nishizu. I was particularly impressed with their unique high-precision, high-speed, on-line volume measurement techniques—one based on the electrical capacitance measurement (by Dr. Kato) and the other based on the Helmholtz acoustic resonant frequency measurement (by Dr. Nishizu). Various applications of these principles to nondestructive techniques for quality evaluation of agricultural products were discussed.

Several students in Professor Ikeda's group came to see me in my office, and on several occasions, invited me to the monthly Friday luncheons and also to dinner parties. I reciprocated by inviting them to dinner and visiting them in their laboratories to observe and talk about their research. I noticed that the students here are quite serious about their research and work very hard on their projects. I also edited two papers for a doctorate student in the Laboratory of Forest Ecology (next door to my office).

During my three-month visit here, Professor Ikeda also made arrangements for me to visit Hokkaido University, Tottori University, Mie University, and a number of universities in Korea. I was very happy to have opportunity to reacquaint with many of my colleagues and to talk about our current research and exchange new ideas.

During the period of October 18 to 23, I was invited by Dr. Shuso Kawamura to visit Hokkaido University and to go on field trips to see postharvest operation systems for rice and other crops. I gave a seminar on "Brief Introduction to University of California, Davis (UC Davis) & Nuclear Magnetic Resonance (NMR) Techniques for Quality Evaluation of Agricultural Products". I met with researchers in the Graduate School of Agriculture and talked about their ongoing research projects. I had very interesting discussion with Dr. Kawamura about new techniques for rice storage using winter cold air, and quality evaluation of milled rice using near-infrared technique. Dr. Kawamura also showed me his innovative research on "On-line Near-Infrared Spectroscopic Sensing Techniques for Assessing Milk Quality in Automatic Milking Systems".

In early November, Professor Ikeda took me and my wife to visit Professor Masami Iwasaki in Tottori. We went to see Baker's garlic production in sand dunes. I gave a seminar on "Some Information on Education, Research, and Management at University of California, Davis" at Tottori University. On the way back, we visited Satake Corporation in Hiroshima and saw newly developed rice milling equipment and many other quality evaluation machines for rice.

From November 15 to 22, I went to Korea with Professor Ikeda and Dr. Kim. We visited several universities and attended an agricultural machinery show. We had interesting technical discussions with Korean scientists about new techniques for high-speed sorting of agricultural products. I gave a seminar on "Non-Destructive Techniques for Sensing Quality of Agricultural Products" to students at Sungkyunkwan University.

In the morning of December 21, I travelled with Professor Gmitter and Professor Ikeda to Mie University in Professor Ikeda's car. We visited Lab. of Environmental Control in Biology and discussed with graduate students their research projects. I gave two presentations—"Physical Properties and Quality Sensing of Agricultural Products" and "University System at University of California, Davis"—at the International Symposium on International Education Program on Global Tetralemma, organized by Professor Nobutaka Ito, Academic & International Affairs Committee, Faculty of Bio-resources.

On December 27, Professor Ikeda and I went to Dean Takahashi's office to say good bye and thank him for my wonderful visit here at Kyoto University. After three months of en joyable, enlightening, and fulfilling visit, I returned to Davis with a very pleasant memory.

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Report of Research Cooperation between Kyoto University and University of Florida-Citrus Research and Education Center (CREC)

By: Frederick George Gmitter Jr.
(University of Florida, Institute of Food and Agricultural Science, U.S.A.)
Invited Period: 13-October-2004-12-January-2005
Div. of Agronomy & Horticultural Science, Lab of Pomology
(Host Professor: Prof. Keizo Yonemori)

Professor Fred G. Gmitter Jr. of the University of Florida's Citrus Research and Education Center visited the Laboratory of Pomology, Graduate School of Agriculture at Kyoto University, hosted by Professor Keizo Yonemori during the time indicated above. There has been a relationship established between these two research programs for several years, on the basis of a common interest in pomology and the utilization of genomic science tools for understanding fundamental biological processes, leading to cultivar improvement. Associate Professor Akira Kitajima of Kyoto University (Experimental Farm in Takatsuki-City) has been involved in the collaboration over the past several years. Kitajima first visited Gmitter's lab during 1996, and has worked in the area of citrus cytogenetics. In recent years, there has been collaboration between Kitajima and Gmitter using genomic tools developed by Gmitter, specifically BAC library clones, for distinguishing citrus chromosomes in Kitajima's program. During this visit, numerous discussions took place between Yonemori, Kitajima, and Gmitter. Yonemori also has an interest in participating in global citrus genomics efforts, and many fruitful discussions took place regarding the plans for collaboration in the future. Another link between the two laboratories is Dr. Young A Choi, who received her Ph.D. degree from the Laboratory of Pomology of Kyoto University, and is currently employed as a Post-Doctoral Research Associate in Gmitter's lab at the CREC, working on a genome mapping and differential gene expression project related to citrus canker resistance.

Gmitter's research program has a broad base in several specific research areas, all focused toward an end product of new and genetically improved citrus cultivars for the industry. Various approaches are utilized for achievement of the goal, ranging from traditional breeding approaches, through utilization of in vitro techniques to overcome certain citrus-specific breeding barriers and particular industry requirements, to development and application of contemporary genomic tools and methods for very specific objectives. It is in the latter area of genomics where the greatest degree of congruence between Gmitter's and Yonemori's programs can be found. For example, Gmitter's lab has been developing molecular marker-based systems for marker-assisted selection in tree fruit breeding programs. Because both labs are focused on woody perennial species, there are many commonalities of biological impediments and breeding program needs. Additionally, Gmitter's lab has been engaged in a long-term research effort to utilize the principles of positional, or map-based, cloning of a gene for virus resistance. The virus for which the resistance gene is being developed is the most economically significant viral pathogen of citrus worldwide, and as such, the benefit of success in this area justifies the research expenditures. Likewise for Yonemori's laboratory, there is a long-term interest in cloning the gene for astringency in the fruit of Japanese persimmon cultivars. This gene, like the virus resistance gene in citrus, is a very important gene to be manipulated for persimmon cultivar improvement in order to produce new non-astringent-type, and the methods and techniques utilized for citrus can be adapted for the persimmon objective. Also of significance in the case of the astringency gene is its relevance and critical role in understanding the unique aspects of the flavonoid biosynthetic pathway within persimmon. Not only are there economic considerations for the persimmon gene in terms of improved fruit quality and consumer preferences for non-astringent fruit, but also the critical roles that flavonoids may play in the betterment of human health indicate a particular importance for this research objective. During the visit to Kyoto, Gmitter and Yonemori discussed in depth the specific problems faced in the persimmon project from the biological, genetic, and genomic perspectives. Discussions were based on the presentation of research results from Yonemori and associated former and current graduate students. These results included efforts toward identifying and isolating several key genes involved in the biosynthetic pathway by subtractive hybridization (a technique being utilized in both laboratories for in-depth dissection and understanding of complex metabolic pathways), as well as reports on developing and screening large-insert genomic libraries to identify clones harboring potential candidate genes of interest, and the subsequent sequencing of these clones. Additional collaborative plans to share Gmitter's experience using DNA sequence analysis software programs, to search for putative genes and transposable elements in the region, have been made and will be pursued in the immediate future.

An important aspect of Gmitter's visit to Kyoto University was the interaction with the graduate students in the Laboratory of Pomology, as well as other Laboratories involved in plant genetics and breeding. One form of this interaction was a series of lectures titled "Genetic Improvement of Citrus: Challenges Facing the Industry and Genetic Solutions". In these lectures, Gmitter first presented information about the nature of the Florida citrus industry, as a background for understanding the challenges faced and the critical need for genetic improvement. This was followed by an overview of the University of Florida Citrus Genetic Improvement Program, which is a team-based program aimed at covering all aspects in the genetic improvement process, from fundamental genetics to field trials leading to the release of new commercial cultivars. Subsequent lectures went into greater depth on specific techniques being employed, and their application to the cultivar improvement objectives outlined earlier, based on the critical industry needs. Some of the techniques covered in detail included tissue culture methods such as somatic hybridization to develop new rootstocks and polyploid breeding parents, and embryo rescue following interploid hybridization to develop seedless fresh citrus fruit cultivars; similar work is underway in the Laboratory of Pomology to develop seedless persimmon cultivars. Methods and applications of genetic transformation, for basic genetic studies and cultivar improvement, were also described and discussed in detail. Finally, information on genomic projects similar to those being conducted in Yonemori's laboratory was presented, including development of marker-assisted selection techniques, use of genomic tools to identify the genes involved with plant disease resistance, and gene cloning for specific targeted traits. Through this series of lectures, the graduate students were presented with an opportunity to learn about a comprehensive program for genetic improvement of a major tree fruit crop, as well as the application of different disciplines and related research techniques. The lectures also served as a framework for discussions between Yonemori and Gmitter on improving the research outcomes for both laboratories in Kyoto and Florida. Gmitter's activities in Kyoto were very fruitful for future collaborative works with Yonemori, which will open a new window for genomic research on fruit crops.