2.8.1 Laboratory: Comparative Agricultural Science

Member:	Professor	Hirai, Nobuhiro, Ph. D.
	Associate Professor	Akamatsu, Miki, Ph. D.
	Associate Professor	Tanaka, Ueru, Ph. D.
	Associate Professor	Miyake, Takeshi, Ph. D.
	Master's Program	3
	Other	2

A. Research Activities (2009.4-2010.3)

A-1. Main Subjects

a) Molecular technology of a plant hormone, abscisic acid

Abscisic acid (ABA) is an important plant hormone that induces adaptative responses in plants upon water stress and low temperature. However, the effect of ABA does not last since ABA is quickly inactivated by the degradation enzyme, ABA 8'-hydroxylase. Inhibitors of the hydroxylase may delay the inactivation of ABA to increase resistance of plants to environmental stress. We have developed hydroxylase inhibitors with the researchers at Shizuoka University and Chiba University. Phaseic acid is a metabolite of ABA having a moderate activity, and its reductase completely inactivates phaseic acid by conversion to dihydrophaseic acid. Inhibitors of the reductase may also keep moderate activity of phaseic acid. We have started purification of the phaseic acid reductase for identification of its gene. (Hirai)

b) Chemical ecology of ectomycorrhiza

Some ectomycorrhiza form a fairy ring which shows the circular formation of fruit body. The inside of the fairy ring of Tricholoma is a whitish mycelium-soil aggregated zone, and called "shiro". The density of bacteria and fungi in the shiro is significantly lower than that of the outside of the shiro. The researchers of our University demonstrated in 1967 that the shiro had antimicrobial activity against bacteria. However, the antimicrobial compound(s) has been remained unclear. We have isolated several antimicrobial compounds from the extract roots of Pinus densiflora growing at the Kamigamo research field of Kyoto University, and identified as diterpenes including totarol. We have found another antimicrobial compound from P. densiflora roots growing at the Sakai research field of Kyoto Prefecture. This compound is not diterpene, and water-soluble. Purification of this compoud is under progress. (Hirai)

c) Mechanism of substrate recognition by cytochrome p450s (Enzymes involved in metabolism)

Human cytochrome p450s (CYPs) are primarily membrane-associated proteins, located either in the inner membrane of mitochondria or in the endoplasmic reticulum of cells. CYPs metabolise thousands of endogenous and exogenous compounds. Most CYPs can metabolize multiple substrates, and many can catalyze multiple reactions. To clarify the substrate recognition mechanism by CYPs, using a pesticide as a model compound, we isolated, purified and identified its metabolites by CYP3A4 ad CYP2C19. The metabolite structures by both CYPs were compared. (Akamatsu)

d) Mechanism of substrate recognition by P-glycoproteins (P-gp: ATP-dependent efflux pump)

P-gp is one of ABC transporters and acts as an efflux pump with broad substrate specificity. To clarify the substrate recognition mechanism by P-gp, screenig of various pesticides and derivatives as P-gp substrates was carried out. Then 3D-QSAR, CoMFA was performed for a pesticide and its derivatives. (Akamatsu)

e) Analysis of pesticide residues in environment around the agricultural fields near Bangkok (Thailand) and Hue (Vietnam)

The rapid economic growth of Thailand and Vietnam resulted in a rapid increase of the demand for agricultural production leading to the great use of pesticides and chemical fertilizers. The recent increase in pesticide application might cause environmental pollution problems in both countries. After 2003, we visited Bangkok area in Thailand. The river bottom and field soils around the area were sampled and pesticide residues in the samples were analyzed. Although a small amount of a few pesticides were detected in several samples, pesticide residues in the soils of the places were kept at the safety levels at present. In this year, we visited agricultural fields in Hue area in Vietnam and surveyed what kimd of pesticides are used. (Akamatsu, Tanaka)

f) Studies on soil management systems and socio-ecological resilience in Semi-arid Africa (Niger and Zambia)

Field studies were conducted in the Sahel region of Niger, West Africa, to elucidate the characteristics of ecosystems, soils, local husbandry systems which lead approaches to ecologically sound land use systems, prevention of desertification and restoration of degraded lands. This year, system of risk management inheritaed in the local husbandry systems was analyzed through the researches on peoples' action to mitigate the danmages caused by drought during the "years of crisis" in the past 20 years. In Zambia, southern Africa,

mechanisms of "resilliance" at household and landuse levels were studied. (Tanaka)

g) Studies on rural development, environmental conservation and disaster management at human scale (Viet Nam)

Field studies were conducted in some villages of Central Viet Nam, where natural disaster frequently hits. Agro-ecological characteristics and local husbandry systems were described in order to design research/development project for participatory rural development, environmental conservation and disaster management. The study particularly focuses on how to involve vulnerable peoplu such as ethinic mainority and economically poor househplu into the rural development assistance (Tanaka)

h) Genetic diversity and utilization of genetic resources of farm animals

A new association analysis method for multiple genetic markers was developed based on Bayesian estimation, which can handle two or more genes and the interactions between genes in the model. The analytical computing program was also developed. Based on genetic analysis for the competing ability of racing pigeons, the heritability was estimated. A single mathematical function for the racehorse's growth curve was estimated considering the compensation growth and the training load in Thoroughbred racehorses. (Miyake)

A-2.Publications and presentations

a) Publications

Original Papers

- Kajikawa, M., Hirai, H. and Hashimoto, T: A PIP-family reductase is required for biosynthesis of tobacco alkaloids. Plant Mol. Biol. 69; 287-298, 2009

- Todoroki, Y., Kobayashi, K., Shirakura, M., Aoyama, H., Takatori, K., Nimitkeatkai, H., Jin, M.-H., Hiramatsu, S., Ueno, H., Kodo, S., Mizutani M. and Hirai, N.:

Abscinazole-F-1, a conformationally restricted analogue for the plant growth retardant uniconazole and an inhibitor of ABA 8'-hydroxylase CYP707A with no

growth-retardant effect. Bioorg. Med. Chem. 17; 6620-6630, 2009

- Todoroki, Y., Aoyama, H., Hiramatsu, S., Shirakuram, M., Nimitkeatkai, H., Kondo, S., Ueno, K., Mizutani, M. and Hirai, N.: Enlarged analogues of uniconazole, new azole containing inhibitors of ABA 8'-hydroxylase CYP707A. Bioorg. Med. Chem. Lett. 19; 5782-5786, 2009

- Toshima, K., Kanaoka, S., Yamada, A., Tarumoto, K., Akamatsu, M., Sattelle, D.B., and Matsuda, K.: F Combined roles of loops C and D in the interactions of a neonicotinoid insecticide imidacloprid with the a4b2 nicotinic acetylcholine receptor. Neuropharmacol. 56, 264-272 (2009) - Fujikawa, M., Nakao, K., Shimizu, R., and Akamatsu, M.: The usefulness of an artificial membrane accumulation index for estimation of the bioconcentration factor of organophosphorus pesticides. Chemosphere, 74, 751-757 (2009)

- Nakao, K., Fujikawa, M., Shimizu, R., and Akamatsu, M.: QSAR application for the prediction of compound permeability with in silico descriptors in practical use. J. Comput. Aided Mol Des., 23, 309-319 (2009)

- Sattelle, D. B., Buckingham, S. D., Akamatsu, M., Matsuda, K., Pienaar, I., Jones, A. K., Sattelle, B. M., Almond, A., and Blundell, C. D.: Comparative pharmacology and computational modelling yield insights into allosteric modulation of human α 7 nicotinic acetylcholine receptors. Biochem. Pharmacol., 78, 836-843 (2009)

- Matsuda, K., Kanaoka, S., Akamatsu, M., and Sattelle, D. B.: Diverse actions and target-site selectivity of neonicotinoids: structural insights. Mol. Pharmacol., 76, 1-10 (2009)

- Ikazaki, K., Shinjo, H., Tanaka, U., Tobita, S. and Kosaki, T.: Sediment catcher to trap coarse organic matter and soil particles transported by wind. Transactions of the ASABE, 52(2), 487-492 (2009)

Yamada, T., Sasaki, S., Sukegawa, S., Yoshioka, S., Takahagi, Y, Morita, M.,
Murakami, H., Morimatsu, F., Fujita, T., Miyake, T., Sasaki, Y.: Association of a single nucleotide polymorphism in titin gene with marbling in Japanese Black beef cattle.
BMC Res. Notes, 2, 78 (2009)

- Sasaki, S., Yamada, T., Sukegawa, S., Miyake, T., Fujita, T., Morita, M., Ohta, T., Takahagi, Y., Murakami, H., Morimatsu, F., Sasaki, Y.: Association of a single nucleotide polymorphism in akirin 2 gene with marbling in Japanese Black beef cattle. BMC Res. Notes, 2, 131 (2009)

- Yamada. T., Sasaki, S., Sukegawa, S., Miyake, T., Fujita, T., Kose, H., Morita, M., Takahagi, Y., Murakami, H., Morimatsu, F., Sasaki, Y.: Novel SNP in 5'flanking region of EDG1 associated with marbling in Japanese Black beef cattle. Anim. Sci. J., 80, 486-489 (2009)

- Yamada. T., Sasaki, S., Sukegawa, S., Miyake, T., Fujita, T., Kose, H., Morita, M., Takahagi, Y., Murakami, H., Morimatsu, F., Sasaki, Y.: Association of a single nucleotide polymorphism in ribosomal protein L27a gene with marbling in Japanese Black beef cattle. Anim. Sci. J., 80, 631-635 (2009)

Reviews

- Akamatsu, M., Fujikawa, M., Nakao, K., and Shimizu, R.: In silico prediction of human oral absorption based on QSAR analyses of PAMPA permeability. Chemistry and Biodiversity, 6, 1845-1866 (2009)

Reports

Hirai, N.: Development of drugs protecting plants from environmental stress in semi-arid land. Report for Monbu-kagakusho Research Grant [Scientific Research (B)]
Ikazaki, K., Shinjo, H., Tanaka, U., Tobita, T. and Kosaki, T. : "Fallow band system" as new practical technique to improve crop yield and to prevent wind erosion in the Sahel, West aAfrica. JIRCAS Report, 16, (Web edition) (2009)
Ikazaki, K., Shinjo, H., Tanaka, U., Tobita, S., Funakawa, S. and Kosaki, T.: Field Verification of Performance of Aeolian Material Sampler in Determining Amount of

Coarse Organic Matter Transported during Wind Erosion Events in Sahel Region of West Africa. Proceedings of 9th International Conference of the East and Southeast Asia Federation of Soil Science Societies, 524-525 (2009)

- Ikazaki, K., Shinjo, H., Tanaka, U., Tobita, S., Funakawa, S. and Kosaki, T.: Field estimation of soil and nutrient flux by wind erosion in the Sahel region of West Africa. Proceedings of 5th Conference of the Africa Soil Science Society, 22-28 November, Yaounde, Cameroon (2009)

- Miyake, T., The Japan Bloodhorse Breeders' association and Kyoto University joint research: Estimation and the use of standard growth curve equations of Japanese bloodhorses. Research Report (2009)

b) Conference and seminar papers presented

- The 2010 Annual Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry: 3 Presentations

- The 4th Annual Meeting of The Chemical Biology: 1 presentation

- The 44th Annual Meeting of The Japanse Society for Chemical Regulation of Plants (Sendai): 3 presentation

- The 37th Symposium on Structure-Activity Relationships: 1 presentation

- The 2009 Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition: 2 presentations

- The 2009 (March) Meeting of the Japanese Society of Trop@ical Agriculture and Development: 2 presntations

- The 2009 (Novembere) Meeting of the Japanese Society of Agricultural Systems: 2 presentations

The 10th Annual Meedting of the Japanese Society of Animal Breeding and Genetics:
1 presentation

A-3.Off-campus activities

Membership in academic societies

- Hirai, Nobuhiro, Ph. D. : Japan Society for Bioscience, Biotechnology, and Agrochemistry (councilor of the Kansai Branch, and editor of the English journal), Japanese Society for Chemical Regulation of Plants (head of general secretary)

- Akamatsu, Miki, Ph. D. : Pesticide Science Society of Japan (Board member), Division of Structure-Activity Studies, the Pharmaceutical Society of Japan (Board member)

- Tanaka, Ueru, Ph. D. : Japanese Society of International Rural Development (Editorial board member)

- Miyake, Takeshi, Ph. D. : Japanese Society of Animal Science, Japanese Society of Animal Breeding and Genetics (Member of organizing committee of new animal breeding seminar), Society of Beef Cattle Science (Secretary)

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

Scientific Research (B) : Kondo, Satoru (Collaborator;Hirai) : Development of a method increasing water-stress resistance in fruit trees by regulation of abscisic acid hydroxylase
Scientific Research (B) : Tanaka, Ueru : Approaches of horizontal technology transfer for preventing desertification in the Sahel, West Africa

- Scientific Research (B) : Kobayashi, Masami(Collaborator;Tanaka) : Chronic hazards and community resilience in the disaster prone Indochina region

2. Other Research Grants

- Research Fund for Incubation Study (RINH): Tanaka, Ueru: Approaches to vrevent desertification in the Sahel, West Africa

A-4.International cooperation and overseas activities

Membership in academic societies

- Hirai, Nobuhiro, Ph. D.: International Plant Growth Substances Association, International Allelopathy Society

- Akamatsu, Miki, Ph. D.: American Chemical Society
- Tanaka, Ueru, Ph. D.: International Society of Soil Science
- Miyake, Takeshi, Ph. D.: American Society of Animal Science

International joint research, overseas research surveys

- Pesticide residue analysis in environment around the suburban agricultural fields of Bangkok, Akamatsu, Miki, (Thailand)

- Pesticide residue analysis in environment around the suburban agricultural fields of Hue, Akamatsu, Miki, (Vietnam)

- Socioecological resilience in the villages of Southern Zambia, Tanaka U., Zambia

- Soil fertility improvement in the Sahel, West Africa, Tanaka U., Niger

- Approaches to supprot volunerabl people in natural disaster prone Central Vietnam, Tanaka U., Vietnam

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level:	Scientific English (Agriculture) (Akamatsu, Tanaka), Discovery and	
	Development of New Drugs (Department of Pharmaceutical	
	Sciences (share, Akamatsu), Information Processing Basics	
	(Agriculture) (Miyake), Biometrics Practice (Miyake), Nature and	
	Culture (shared, Tanaka), Introduction of Global Environmental	
	Studies (shared, Tanaka), Environmental Agriculture (shared,	
	Tanaka), International Exchange Study "Livelihood, Environment	
	and Peace - Learning from Vietnam"(shared, Tanaka)	
- Graduate level:	Comparative Study of Resources and Environment (Akamatsu,	
	Miyake), Comparative Agricultural Science (Hirai, Tanaka),	
	Agriculture and Environment in Japan (Hirai, Akamatsu, Tanaka,	
	Miyake), Terrestrial Ecosystems Management (GSGES, Tanaka),	
	Technique for Agr-environmental Management (GSGES, English,	
	Tanaka), Emvironmental Management Leaders A (shared, GSGES,	
	English, Tanaka)	

B-2.Off-campus teaching etc.

Part-time lecturer

- Akamatsu, Miki : Doshisha Women's U College of Liberal Arts (Life Sciences)

Open lectures, etc.

- Tanaka, Ueru: The 4th Kyoto Univ. Global Environment Forum on "Green Industry and Livelihood" (July 4, 2009)

- Tanaka, Ueru: The 2009 Training Course for Rural and Agricultural Development based on

Livestock mManagement (Nov. 18, 2009)

- Tanaka, Ueru: The 3rd Seminar on Participatory Agricultural and Technical Development, JICA (Dec. 7, 2009)

- Tanaka, Ueru: The 6th Kyoto Univ. Global Environment Forum on "Learning from the field in Africa - Food, Livelihood and Global Environment" (Jan. 30, 2010)

B-3.Overseas teaching

International students

- International students : Research Students 2 (China)

C.Other Remarks

- Hirai, Nobuhiro, Ph. D.: Japan Society for the Promotion of Science, member of Committee on Grants-in-Aid for Scientific Research

Akamatsu, Miki, Ph. D.: The Ministry of Agriculture, Forestry, and Fisheries of Japan, tentative member of Councils of agricultural materials, pesticide division, The Ministry of Economy, Trade and Industry, tentative member of Councils of Chemicals, National Institute of Technology and Evaluation, member of Structure-Activity Relationship Committee
Miyake, Takeshi, Ph. D.: Research Evaluation Committee of the General Horseracing Institute of Japan Racing Association