2.1 DIVISION OF AGRONOMY AND HORTICULTURAL SCIENCE

The Division offers educational and research programs focusing on the theory and technology for efficient and sustainable crop productions and improvement of crop quality, particularly for ecological, physiological characteristics of crops in relation to environmental impacts, useful genetic variations and gene manipulation, as well as for management of productive and sustainable arable ecosystems and quality control of agricultural products. These programs are provided by nine laboratories; Crop Science, Plant Breeding, Vegetative and Ornamental Horticulture, Pomology, Weed Science, Plant Production Systems, Food Quality Design and Development, Quality Analysis and Assessment and Plant Production Control in cooperation with University Experimental Farm and Subtropical Plant Institute.

Seventy-three and thirty-four students, including eighteen foreign students, are enrolled in Master's and Doctor's Programs, respectively. One foreign visiting professor, two research fellows and three research students have also worked in the Division in 2004.

Chair of Crop Science

2.1.1 Laboratory of Crop Science

Staff *Professor* : *Horie, Takeshi, Dr. Agric. Sci.*
Associate professor : *Shiraiwa, Tatsuhiko, Dr. Agric. Sci.*
Assistant Professor : *Homma, Koki, Dr. Agric. Sci.*
Secretary : *Momoi, Chihiro*

Students and research fellows
Doctor's Program : *(4)*
Master's Program : *(8)*
Undergraduate : *(4)*
Guest scholar : *(1)*

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) A rice crop simulator to interface gene functions to field performances

This study aims at establishment of a rice crop model that simulates growth and yield of various genotypes grown under diverse environments, which enables quantitative evaluation of getnoype by envrironment interctive effects on yield formation processes and identification of desirable genetic traits to achieve high yield under a given environment. The processes of plant development, crop photosynthesis, respiration and biomass growth, spikelet production, ratio sterility caused by high and low temperature stresses, have so far been formulated as the respective sub-models and they have been synthesized into a comprehensive model. Formlization

of crop N accumulation and leaf area development processes are currently attempted based on a data set established by a multi-site experiment conducted under diverse environments in Asia.

b) Identification and genotypic evaluation of major traits determining yield potential of rice under field conditions

Stagnation of yield potential of rice cultivars has been recognized since the Green Revolution. The objectives of this study are to identify the processes that limit rice yield potential under field conditions and to evaluate genotypes in the processes. So far, we have demonstrated that a majority of yield variation among genotypes is related to difference in crop growth rate (CGR) during two weeks before heading and CGR in this period is closely limited by leaf photosynthetic ability (Pn) and stomatal conductance (gs). Analysis of genetic variability in Pn and associated factors revealed that some local varieties were promising for breeding, and that gs was significantly different among genotypic groups which were classified by DNA markers.

c) Improving productivity and sustainability of rain-fed rice culture in Asia

More than half of rice cropping lands in Asia is still under rain-fed condition. We have conducted the field surveys on constraints of rice production in rain-fed paddy culture in North-east Thailand and the upland culture in North Laos. It was demonstrated that inappropriate land and soil managements have caused serious degradation of soil fertility and decline of productivity. Field experiments as well as surveys are being conducted aiming at improvement of productivity and sustainability of rain-fed rice cultures. The effectiveness for improving rice productivity has been identified for introduction of legume manure crops during fallow seasons and returning clay-accumulated soil to the clay-eloded soil from the lower to the upper fields in the mini-watershed. In addition, monitoring soil respiration and biomass production of plant community of cropped and fallow plots have been started at a shifting agriculture area in North Laos in order to estimate CO_2 balance of the ecosystem.

d) Mechanisms for high productivity of soybean and its adaptability to changing environments

The yield potential of soybean is notably low and unstable compared to the major cereal crops. This study aims at clarifying major factors that limit yield potential of current genotypes and environmental factors that vary seed productivity in soybean. Field experiments demonstrated that a close and consistent correlation exists between seed yield and CGR during the initial seed filling stage across diverse genotypes. As a physiological basis for this correlation, a remarkable difference in leaf photosynthetic ability was observed between US and Japanese commercial cultivars. The phenomenon of “delayed stem maturation” has broadly been observed in the soybean farms and reduces seed quality and even yield. Based on field experiments and field survays, we found that the occurrence of delayed stem maturation may be promoted by unstable soil moisutre condition during plant growth and with high soil moisture during seed filling.

A-2. Publications and presentations

a) Publications

Original papers

Homma, K., T. Horie, T. Shiraiwa, S. Sripodok and N. Supapoj: Delay of heading date as an index of water stress in rainfed rice in mini-watersheds in Northeast Thailand. Field Crops Res. 88; 11-19, 2004

Shiraiwa, T., N. Ueno, S. Shimada and T. Horie: Correlation between yielding ability and dry matter productivity during initial seed filling stage in various soybean genotypes. Plant

Prod. Sci 7; 138-142, 2004

Kuwata, M., T. Horie: Susceptibilities to a toxic substance, phloxine, of silkworm larvae reared by mulberry leaves grown at different fertilizer application rates. J. Seric. Sci. Jpn. 73: 71-76.

Reviews

Shiraiwa, T.: Production ecology and environmental adaptability of C3 and C4 Poaceae plants. J. Jpn. Soc. Turfgrass Sci. 32; 114-116, 2004

Shiraiwa, T.: Rice productivity in Asia -Achievment and probability of further yield growth. ARDEC 29; 17-26, 2004

Reports

Horie, T., Shiraiwa, T., Homma, K., Katsura, K., Maeda, Y., Yoshida, H. (2004) Can yields of lowland rice resumes the increases that they showed in the 1980s? Proceedings of the 4th International Crop Science Congress. http:// www.cropscience.org.au/icsc2004/symposia/2/4/1869_horiet.htm#TopOfPage

Horie, T.: Evaluation and prediction of the effects of climate variation and global warming on rice production in Monsoon Asia. Report of Research Grant: Research (B)(2), 1-135.

Shiraiwa, T.: Identification of environmental and genetic factors causing "delayed stem senescence" in soybean. Report of Research Grant: Research (C)(2), 1-32.

b) Conference and seminar papers presented

World Rice Research Congress: 3 presentations

The 215th Ann. Meeting of Crop Sci. Soc. of Japan : 2 presentations

The 216th Ann. Meeting of Crop Sci. Soc. of Japan : 4 presentations

A-3. Off-campus activities

Membership in academic societies (roles)

Horie, T.: Crop Science Society of Japan (Board member, Awards committee member and Steering board member of English journal), The Society of Agricultural Meteorology of Japan (Board member and Awards committee member), The Society of Crop Science and Breeding in Kinki, Japan (Board member)

Shiraiwa, T.: Crop Science Society of Japan (Editorial board member, Over-sea exchange committee member), The Society of Crop Science and Breeding in Kinki, Japan (Editorial board member)

Homma, K.: The Society of Crop Science and Breeding in Kinki, Japan (Member of symposium organizing committee)

Membership in Science Council of Japan, etc.

Horie, T.: Committee member of IGBP/GAIM and IGBP/GCTE

Research grants

Monbusho Research Grant: Scientific Research (B) (2) A study for evaluating and predicting effects of climate variation and global warming on rice production in Monsoon Asia (Leader Horie, T., Collaborators Shiraiwa, T. and Homma, K.), Scientific Research (C)(2) Environmental and genetic factors to cause the "delayed stem maturation" in soybean (Leader Shiraiwa, T.).

National Institute of Agrobiological Sciences Grant: Development of gnome simulator (Collaborator Horie, T.).

The Ministry of the Environment Grant : Global Environmental Research - Development of the methods for impact assessment of global environmental change on biosphere and evaluation of its fragility (Collaborator Horie, T.)

The Ministry of the Environment Grant : Development of Greenhouse-gas Sink/Source Control Technologies through Conservation and Efficient Management of Terrestrial Ecosystems -Intermediate and long-term strategies for the stablilization of atomspheric GHG concentration (Collaborator Horie, T.)

A-4. International cooperations and overseas activities

International meetings (roles)

Horie, T.: West Africa Rice Development Association (WARDA) (Trustee)

Membership in international academic societies

Horie, T.: Agricultural Systems (Editorial board member), Climate Research (Editorial board member), Field Crops Research (Editorial board member)

International joint researches, overseas research surveys

Horie, T.: Working committee of Intergovernmental Panel on Climate Change (IPCC) (Member), IGBP-GCTE Rice Ecosystem Network Research (Steering committee member)

Horie, T., Shiraiwa, T. and Homma, K.: Genotype and environment interaction in rice in Asia (China, Thailand, Philippine), Sustainable rice production technology in rainfed culture regions in North-east Thailand (Thailand)

Horie, T., Shiraiwa, T.: Sustainable resource management for shifting rice culture in mountainous areas of northern Laos (Laos)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Biosphere Science - Life, Food and Environment - (Horie), Resource, Environment and Technology Factors and World Rice and Food Production (Horie), Outline of Bioresource Science I (Horie), Crop Science Ⅰ (Horie), Crop Science Ⅱ (Horie, Shiraiwa), Laboratory Course in Biological and Environmental Science Ⅰ, (Shiraiwa, Homma), Seminar in Crop Science (Horie)

Graduate level: Crop Environmental Physiology (Horie), Crop Production Ecology (Shiraiwa), Crop Science-Seminar (Horie), Special Laboratory Work in Crop Science (Shiraiwa)

B-2. Off-campus teaching, etc.

Part-time lecturer

Horie, T.: Kyoto Prefectural Univ. (Plant Function Advance Course)

Shiraiwa, T.: Kyoto Univ. Technology. (Crop Science)

B-3. Overseas teaching

Students and research fellows from abroad

Master's program: 1 (China)

C. Other remarks

Horie, T.: "The Ministry of Education, Science and Culture"- Expert member of ministry council, "The Ministry of Agriculture, Forestry and Fisheries"- Council of policy on food, agriculture and rural districts; Council of agricultural statistics, "Agriculture, Forestry and Fisheries Research Council"- Member of outsider's evaluation committee, "National Agricultural Research Organization"- Member of evaluation committee, "Fukui Prefecture"- Member of outsider's evaluation committee for agricultural research, "Kyoto University"- Vise chairperson of committee for entrance examination; Member of international exchange committee; Working board member of the field station, Expert member of Research Institute for Environmental Earth Science; Member of construction committee; Board member of university experimental farm.

2.1.2 Laboratory of Plant Breeding

Staff *Professor* *: Tanisaka, Takatoshi, Dr. Agric. Sci.*
Associate Professor: Okumoto, Yutaka, Dr. Agric. Sci.
Assistant Professor : Nakazaki, Tetsuya, Dr. Agric. Sci.
Secretary *: Furushima, Kimiko*

Students and research fellows
Doctor's Program : (9)
Research fellow : (2)
Master's Program : (11)
Undergraduate : (4)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) First discovery of an active transposon in rice

A mutant slender glume gene *slg* was induced with gamma-ray irradiation to seeds of the rice variety Gimbozu. But this slender glume gene occasionally reverts to its wild type allele slg^{+}. We considered that such mutability of *slg* results from precise excision by a transposon inserted in it. As a result of analyzing the molecular structure of *slg*, we could demonstrate that a transposon *mPing* (belonging to one of the non-autonomous transposon family called MITEs) was inserted in the fourth exson of *slg*, the same gene as $Rurm1^{m}$ *(Rice ubiquitin related modifier-1)*, and that reversion from $Rurm1^{m}$ to its wild type allele resulted from precise excision of the *mPing*. Thus we successfully identified an active rice transposon by analyzing the mutability of a slender mutation of glume. No active transposons have so far been reported in intact rice plants, and there have been no reports on active MITEs mobile both in intact higher plants and in animals. Mobile transposons used as gene tags in intact plants are powerful tools for function analysis because transposon insertions often inactivate genes. Therefore, this discovery is a milestone for function analysis of rice genes.

b) Genetic analysis of major agronomic characters in rice

A number of *japonica*- and *indica*-rice varieties and a large number of mutant lines induced and preserved in our laboratory were analyzed for genetic factors controlling important agronomic characters, such as heading time, plant height and resistance to blast. These genes were subjected to the RFLP or SSR analysis to determine their locations on chromosomes. Some of these genes were also examined for the effects on phenotypic expression including pleiotropy and gene-gene interaction, and evaluated for their agronomic values.

c) Molecular-genetic analysis of chitinase gene family in rice.

We had identified that thtere are twelve independent loci of chitinase gene (*Cht1* to *Cht12*) in rice genome. These genes were analyzed for the primary structure and function of enzyme protein in relation to disease - resistance after isolation and purification using *E. coli* expression system.

d) Analysis of genetic variation in wheat seed storage protein, glutenin.

Asian hexaploid wheat (*Triticum aeastivum* L.) cultivars were investigated for the genotype of high molecular weight gulutenin subunits (HMGS). HMGS is the most important factor determining the bread-baking quality and noodle quality. We are investigating the genetic diversity of HMGS among East Asian wheat cultivar to identify the valuable genotypes for the improvement of wheat quality in Japanese varieties. Then, we found the new HMGS in one variety which showed a specific dough quality comparing to other varieties. It is important to disclose effects of this new HMGS on the characteristics of dought and bread-baking quality.

e) Genetic analysis of major agronomic characters in soybean

A number of varieties and 96 recombinant inbred lines (RILs) derived from the F_2 population of 'Peking' and 'Tama-homare' which was developed in our laboratory were analyzed for genetic factors controlling major agronomic characters such as filling duration, stress resistance, seed quality. The genetic map consisting 342 SSR markers loci, three phenotypic gene loci (*I* , *T* and *W1* locus) was constructed using above RILs. Based on this map, we found several QTLs (Quantitative Trait Loci) for pre-germination flood tolerance and isoflavone accumulation in seeds (cotyledon).

A-2. Publications and presentations

a) Publications

Original papers

Naito, K., M.Kusaba, N.Shikazono, T.Takano, T.Tanisaka, and M.Nishimura Transmissible and nontransmissible mutations induced by irradiating Arabidopsis thaliana pollen with gamma-ray and carbon ions. Genetics 169:881-889, 2005

Arzate-Fernandez, A.M. Mejia-Gouzalez, C.O., T.Nakazaki, Y.Okumoto, and T.Tanisaka Isozyme electorophoretic characterization of twenty-nine related cultivars of lily (Lilium spp.) . Plant Breeding 124:71-78, 2005

Sayama,K., H.Sasaki, T.Nakazaki, Y.Okumoto, and T.Tanisaka. Exploitation of the SSR markers related to the flooding tolerance of soybean seeds. Kinki Journal of Crop Science and Breeding. 49:29-32, 2004

Yamamoto, K., Y.Okumoto, T.Nakazaki, and T.Tanisaka. Responses of cool weather resisitance genes to the underground part cooling treatment in rice. Kinki Journal of Crop Science and Breeding 49:33-36, 2004

Nakayama, T., H.Nishida, Y.Okumoto, T.Nakazaki, and T.Tanisaka. Indentification of a

photoperiod sensitivity suppressor gene of the extremely early flowering mutant line, 'X61', in rice. Kinki Journal of Crop Science and Breeding 49:37-40, 2004.

b) Conference and seminar papers presented

Congress of Japanese Society of Breeding: 9 presentations

Congress of the Society of Crop Science and Breeding in Kinki: 3 presentations

Congress of Japan Society for Bioscience, Biotechnology, and Agrochemistry: 1 presentation

World Rice Research Conference 2004:4 presentation.

2nd International Symposium on Rice Functional Genomics:1 presentation

A-3. Off-campus activities

Roles in academic societies

Tanisaka, T.: Japanese Society of Breeding (Associate Chairman of the Society), The Society of Crop Science and Breeding in Kinki (Associate Chairman of the Society)

Okumoto, Y.: Japanese Society of Breeding (Council member, editorial board)

Nakazaki, T.: The Society of Crop Science and Breeding in Kinki (Chief Editor)

Membership in Science Council of Japan, etc.

Tanisaka, T.: Member of the Commitee of Gamma-Field-Symposia (Institute of Radiation Breeding, The Ministry of Agriculture, Forestry and Fisheries)

Research grants

Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research: Scientific Research (B) (2): Mechanism of transposition of an active transposon newly discovered in rice. (Tanisaka), Scientific Research (B) (2): Genetic factors contributing to the mobilization of *mPing* in intact rice plants. (Okumoto), Exloratory Research: Genetic and physiological process of cold tolerance in rice to the undergtound part cool treatment. (Okumoto)

Independent Administrative Institute, National Agricultural Research Organization. Development of efficient breeding system with DNA markers: Construction of DNA markers for pregermination flooding stress tolerance of soybean. (Tanisaka), The agriculture-and-forestry fishery research highly advanced enterprise commission utilized advanced technology: The elucidation of the flour quality suitable for Chinese-style noodles, and development of commercialization technology (Okumoto)

The Wakayama Prefecture Collaboration of Regional Entities for the Advancement of Technological Excellence: Development of the Technologies of Analyzing Gene Expression Information by Utilizing Genomic Information

Fujikko Co. Ltd.: Research Grant "Breeding of soybean varieties with high quality" (Tanisaka)

A-4. International cooperations and overseas activities

International joint researches, oversea research surveys

Identification of blast resistant genes in rice (China, South China Agricultural University) Studies on improvement of fatty acid composition in oil crops (Germany, Justus-Leibig University)

Exploitation of genetic factors contributing to the mobilization of *mPing* in rice (U.S.A., The University of Georgia)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Plant Breeding I, II (Tanisaka), Basic Bioresource Science II (Tanisaka), Outline of Bioresource Science I (Tanisaka), Biometrics (Okumoto), Seminar in Crop Science (Tanisaka), Laboratory in Bioresouce Science I (Tanisaka, Okumoto), Introduction to research (Tanisaka, Okumoto, Nakazaki), Food Safety II (Tanisaka)

Graduate level: Progress in Mutation Breeding (Tanisaka), Plant Breeding Seminar (Tanisaka), Special Laboratory Work in Plant Breeding (Tanisaka, Okumoto, Nakazaki)

B-2. Off-campus teaching

Part-time lecture

Tanisaka, T.: Graduate School of Natural Science, Kobe University (Mutation Breeding, Plant Production System), Takii College of Horticulture (Plant Breeding), Faculty of Agriculture, Hokkaido University (Plant Breeding II), Graduate School of Agriculture, Okayama University

Okumoto, Y.: School of Environmental Science, The University of Shiga Prefecture (Biometrics)

Nakazaki, T.: Faculty of Engineering, Kyoto Sangyo University (Foundamentals of Biological Experiments)

B-3. Overseas teaching

Students and research fellow from abroad

Research student: 1 student (China)

Graduate course: 4 students (China 2, Nepal 1, Butan 1)

Doctor course: 4 students (Korea 1, China 1, Bangradesh 1, Laos 1)

C. Other remarks

Tanisaka, T.: "The Ministry of Education, Science and Culture", Member of textbook authorization committee, "The Ministry of Agriculture, Forestry and Fisheries"- Member of fact-finding committee for each scientific field, Member of fact-finding committee for crop breeding.

Chair of Horticultural Science

2.1.3 Laboratory of Vegetable and Ornamental Horticulture

Staff *Professor : Yazawa, Susumu, Dr. Agric.Sci.*
Associate Professor: Hayashi, Takahiro, Dr. Agric.Sci.
Assistant Professor : Mizuta, Youichi, M. Agric.Sci.
Assistant Professor : Hosokawa, Munetaka, M. Agric.Sci.

Students and research fellows
Doctor's Program : (2) *Research student : (1)*
Master's Program : (10)
Undergraduate : (4)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Formation of novel capsaicinoid-like substances (CLSs) in chilli fruit

CLSs contained in a fruit of 'CH-19 Sweet' are identified as 4-hydroxy-3-metoxybenzyl (E)-8-methyl-6-nonenoate (capsiate) and 6,7-dihydro derivative of capsiate. These substances have no pungent for human. Now we conduct the experiment on formation of these substances in a fruit of 'CH-19 Sweet' and production of the fruit in grower's fields.

b) Isolation and transplant culture of undifferentiated shoot apical meristems by micro surgery

Tissue culture is a useful technique for producing virus-free plants. Viroid may be hardly removed by the ordinary tissue culture methods using shoot tips with one or two leaf primordia. Shoot apical meristem without leaf primordia is suitable for an explant to remove viroid which exist even in the young leaf primordia just after differentiation but difficult to be cultured without nurse culture. We are developing an exclusive device for picking up shoot apical meristems and the nurse culture system by transferring them to cultured roots.

c) Color appearance in flower petals

We are trying to clarify the mechanism generating diverse colors depended on the pigments and spectral characteristics of flower petals by spectrophotometry. By analyzing the spectral reflectance from a flower petal irradiated with a tungsten halogen lamp, it can be revealed how the petal color is determined by the pigments, the cell inclusions such as starch grains and structure of the petal which decide spectral characteristics. Informations about the relationship between the petal color and the petal structure e.g., the shape of epidermal cells will be useful for flower color breeding.

d) Development of new plant production system

(1)We developed new tissue culture method of the plant without using the sterility equipment by adding chlorine to the medium with sterile containers. And the enlargement method and the liquid culture method are being developed now. (2) We developed sucrose supplying method to plant by microbe-static conditions established by phosphate elimination using aluminum hydroxide and root split. By sucrose supply, potted plants had more flower and ornamental leaves while suppressing increaseing of the microorganism for about three months. (3) We facilitated the

transplant and the control of the rhizosphere by making rhizosphere plane. (4) We are developing the system that consistently does the tissue culture, the raising seedling, and the harvest by combining these three methods.

e) Clarification of anthocyanin biosynthesis mechanism regulated by phosphorus in petals

Phosphorus deficiency in fertilizer or nutrient solution causes the decrease of anthocyanin biosynthesis and consequently makes red petals turn white in some petunia cultivars. We are trying to clarify the mechanism how phosphorus regulates the anthocyanin biosynthesis in petunia.

A-2. Publications and presentations

a) Publications

Original papers

Ahmed, E.U., T. Hayashi, S. Yazawa: Leaf color stability during plant development as an index of leaf color variation among micropropagated Caladium. HortScience, 39; 328-332, 2004

Hosokawa, M., A. Otake, K. Ohishi, E. Ueda, T. Hayashi and S. Yazawa: Elimination of chrysanthemum stunt viroid from an infected chrysanthemum cultivar by shoot regeneration from a leaf primordia-free shoot apical meristem dome attached to a root tip. Plant Cell Reports 22; 859-863, 2004

Hosokawa, M., E. Ueda, K. Ohishi, A. Otake, S. Yazawa: Chrysanthemum stunt viroid disturbs the photoperiodic response for flowering of chrysanthemum plants. Planta 220; 64-70, 2004

Kataoka, K., H. Okita, A. Uemachi, S. Yazawa: A pseudoembryo highly stainable with toluidine blue O may induce fruit growth of parthenocarpic tomato. Acta Hort. 637:213-221, 2004

Hosokawa, M., S. Katsumura, T. Hayashi and S. Yazawa: Plant regeneration of stable parthenocarpic tomato cultivars from shoot apical meristems attached to root tips. Jpn. J. Taste Smell Res.11; 61-68, 2004

Reviews

Hosokawa, M. and S. Yazawa: Establishment of a vegetative propagation system for geneticaly parthenocarpic tomato cultivars. Nogyo oyobi Engei 79; 666-671, 2004

b) Conference and seminar papers presented

2004 Spring Meeting of the Japanese Society for Horticultural Science (5 presentations)

2004 Autumn Meeting of the Japanese Society for Horticultural Science (7 presentations)

2004 Kinki-branch meeting of the Japanese Society for Horticultural Science (3 presentations)

A-3. Off-campus activities

Membership in academic societies (roles)

Yazawa, S.: The Japanese Society for Horticultural Science (President)

Research grants

Monbusho Research Grant: Exploratory Research: Plant growth disorder occurred at around 25 ℃ and elucidation of its mechanism (Leader: Yazawa), Scientific Research (B): Optical analysis of the color generation mechanism in petals and gene transformation for diverse flower color (Leader: Hayashi), Scientific Research (C): Develpment of in vitro raising seedlings system by using of thin rhizosphere and phosphate absorption with aluminum under the ambient Condition (Leader: Mizuta), Encouragement of Young

Scientists (B): Growth characteristics of viroid-free chrysanthemum plants regenerated from leaf primordia-free shoot apical meristems (Leader: Hosokawa)

A-4. International cooperation and overseas activities

International joint researches,overseas research surveys

Yazawa, S.:Collection and evaluation of the local cultivars of pepper in Northeast Asia. Japan-Korea Scientific Tech. Coop. committee. Department of Horticulture, Kyungpook Univ. Prof. Emeritus Woo Sung Lee

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Ornamental Horticulture (Yazawa, Hayashi),Vegetable Science (Yazawa), Seminar in Horticultural Science (Yazawa), Laboratory in Bioresource Science I, II (Hayashi, Mizuta, Hosokawa)

Graduate level: Vegetable and Ornamental Horticulture (Advanced course) (Yazawa), Vegetable and Ornamental Horticulture-Seminar (Yazawa), Special Laboratory Work in Vegetable and Ornamental Horticulture (Yazawa, Hayashi), Environmental Control for Horticultural Production (Hayashi)

B-2. Off-campus teaching

Part-time lecturer

Hayashi, T.: Faculty of Bioresources, Mie University (Special lecture on floriculture)

B-3. Overseas teaching

Students and research fellows from abroad

Doctor's program: 2 students (Indonesia, China)

C. Other remarks

Yazawa, S.: Council member of National Research Institute of Vegetables, Ornamental Plants and Tea. Expert committee of the Ministry of Agriculture, Forestry and Fishery. Committee of the Science Council of Japan (Research Organization of Agriculture).

2.1.4 Laboratory of Pomology

Staff *Professor* : *Yonemori, Keizo, Dr. Agric. Sci.*
Associate Professor: Tao, Ryutaro, Dr. Agric. Sci..
Assistant Professor : Yamane, Hisayo, Dr. Agric. Sci.
Students and research fellows
Research fellow : (2)
Doctor's Program: (5)
Master's Program: (7)
Undergraduate : (4)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Molecular markers for selecting pollination-constant and non-astringent (PCNA) type persimmon in breeding populations

The PCNA-type fruit is the most desirable persimmon for fresh consumption. The breeding program is going on to obtain new promising PCNA cultivars. However, the trait of natural loss of astringency in PCNA-type is qualitatively inherited and the PCNA-type is recessive to the other three non-PCNA types (PVNA, PVA, and PCA). Thus, F_1 offspring of the PCNA- x non-PCNA-type must be backcrossed to the PCNA type to obtain diverse PCNA offspring. This backcross yields PCNA offspring at a low rate. We are now seeking the molecular makers for selecting PCNA offspring in the breeding populations at an early seedling stage using leaf DNA, in order to make greater efficiency for persimmon breeding program, and are examining two promising RFLP markers found from breeding populations.

b) Molecular basis of gametophytic self-incompatibility in *Prunus*

Many fruit tree species in *Prunus* exhibit the monofactorial gametophytic self-incompatibility. As they are unable to bear fruits parthenocarpically, fertilization is a very important factor in fruit production in self-incompatible fruit species in *Prunus*. We attempt to elucidate the physiological and molecular mechanisms of gametophytic self-incompatibility of four fruit tree species of *Prunus*: almond, Japanese apricot, Japanese plum, and sweet cherry. We have identified stylar S-RNases associated with self-incompatibility of these species and cloned cDNAs encoding the S-RNases. We are now on the way to develop molecular techniques for S-allele typing and to breed self-compatible cultivars through the antisense-expression of cDNAs encoding S-RNases.

c) Tissue culture for propagation and breeding of Japanese persimmon

Breeding of Japanese persimmon has been hindered by the long juvenile period, large plant size, and polyploidy. Furthermore, breeding of clonal rootstocks is virtually impossible because of rooting difficulties in this species. We attempt to overcome these problems by using tissue culture techniques. So far, efficient systems have been developed for plant regeneration from shoot tip, anther, endosperm, callus, and protoplast cultures. Further development of tissue culture systems for producing somatic hybrids and genetic transformation is now under way.

d) Phylogenetic and reproductive studies on the genus *Diospyros* and some tropical fruits

Persimmon is a member of the genus *Diospyros* which includes more than 400 species. Many

of them exist in tropical and subtropical regions, and a few of them, including persimmon (*Diospyros kaki*), are distributed in temperate regions. We are now attempting to survey and collect *Diospyros* species distributed in tropical regions with the cooperation of researchers in Thailand. Phylogenetic studies are going on by the analyses of a specific region of cpDNA and genomic hybridization of the chromosomes. Apomixis in the genus *Diospyros* is also investigated. In addition, the phylogenetic study is being done to the genus *Mangifera* and some tropical fruit genera, with the cooperation of researchers in Thailand, Malaysia, and Indonesia. The study on reproduction in tropical fruit is also planed under the cooperation of these researchers.

e) Miscellaneous

Sugar metabolisms in single cell of intact fruit by using micropipette method for collecting vacuolar saps. Molecular basis of flower bud initiation in fruit tree species in Maloideae in Rosaceae.

A-2. Publications and presentations

a) Publications

Original papers

Deguchi, M., Y. Koshita, M. Gao, R. Tao, T. Tetsumura, S. Yamaki, and Y. Kanayama: Engineered sorbitol accumulation induces dwarfism in Japanese persimmon. J. Plant Physiol. 161; 1177-1184, 2004

Honsho, C., K. Yonemori, S. Somsri, S. Subhadrabandhu, and A. Sugiura: Marked improvement of fruit set in Thai durian by artificial cross-pollination. Sci. Hort. 101; 399-406, 2004

Honsho, C., K. Yonemori, A. Sugiura, S. Somsri, and S. Subhadrabandhu: Durian floral differentiation and flowering habit. J. Amer. Soc. Hort. Sci. 129; 42-45, 2004

Ikeda, K., B. Igic, K. Ushijima, H. Yamane, N. R. Hauck, R. Nakano, H. Sassa, A. F. Iezzoni, J. R. Kohn, and R. Tao: Primary structural features of the S haplotype-specific F-box protein, SFB, in Prunus. Sex. Plant Reprod. 16; 235-243, 2004

Ikeda, K., A. Watari, K. Ushijima, H. Yamane, N. R. Hauck, A. F. Iezzoni, and R. Tao: Molecular markers for the self-compatible S4'-haplotype, a pollen-part mutant in sweet cherry (*Prunus avium* L.). J. Amer. Soc. Hort. Sci. 129; 724-728, 2004

Ikegami, A., K. Yonemori, A. Sugiura, A. Sato, and M. Yamada: Segregation of astringency in F1 progenies derived from crosses between pollination-constant, nonastringent persimmon cultivars. HortScience 39; 371-374, 2004

Lee, S.-J., R.S. Saravanan, C.M.B. Damasceno, H. Yamane, B.-D. Kim, J.K.C. Rose: Digging deeper into the plant cell wall preteome. Plant Physiology and Biochemistry 42; 979-988, 2004

Tamura, M., M. Gao, R. Tao, J. M. Labavitch, and A. M. Dandekar: Transformation of persimmon with a pear fruit polygalacturonase inhibiting protein (PGIP) gene. Sci. Hortic. 103; 19-30, 2004

Ushijima, K., H. Yamane, A. Watari, E. Kakehi, K. Ikeda, N. R. Hauck, A. M. Iezzoni, and R. Tao: The S haplotype-specific F-box protein gene, SFB, is defective in self-compatible haplotypes of *Prunus avium* and *P. mume*. Plant J. 39: 573-586, 2004

Yapwattanaphum, C., S. Subhadrabandhu, C. Honsho, and K. Yonemori: Phylogenetic relationship of mangosteen (*Garcinia mangostana*) and several wild relatives (Garcinia spp.) revealed by ITS sequence data. J. Amer. Soc. Hort. Sci. 129; 368-373, 2004

b) Conference and seminar papers presented

Spring meeting of the Japanese Society for Horticultural Science : 7 presentations

Autumn meeting of the Japanese Society for Horticultural Science : 5 presentations

Plant & Animal Genome XIII Conference: 1 presentation

XVIII International Congress on Sexual Plant Reproduction: 2 presentations

3rd International Symposium on Persimmon: 5 presentations

2nd International Rosaceae Genome Mapping conference: 1 presentation

2004 Gordon Research Conference on Plant Molecular Biology: 2 presentation

Frontiers in Sexual Plant Reproduction II: 1 presentation

A-3. Off-campus activities

Membership in academic societies (roles)

Tao, R: International Society for Horticultural Science (Board member)

Yonemori, K: Japanese Society for Horticultural Science (Board member)

Research grants

Monbusho Research Grant: Monbusho Research Grant: Scientific Research (B) (1) Molecular studies on perfect non-astringent type persimmons in China (Leader Yonemori, K.), Scientific Research (B)(2) Studies on the tannin accumulation and genetic differences of Japanese and Chinese PCNA type persimmon (Leader Yonemori, K.), Scientific Research (B) (1) Identification of pollen-determinant of self-incompatibility in Prunus (Leader Tao, R.), Exploratory Research Expression analysis of the genes involved in sugar metabolism in a single cell during fruit development (Leader Yonemori, K.), Exploratory Research Molecular basis of flower bud formation in fruit tree species in Rosaceae (Leader Tao, R.), JSPS Japan-US Coperative Science Program: Inhibition of metabolic genes in the shikimic acid pathway as an approach for limiting undesirable polyphenol formation in fruit (Leader Yonemori, K.), Japan Society for the Promotion of Science Japan-Spain collaboration research project. Identification of the pollen component of gametophytic self-incompatibility in Prunus (Leader Tao, R.).

A-4. International cooperation and overseas activities

International meetings (roles)

Tao, R.: XVIII International Congress on Sexual Plant Reproduction (Invited speaker)

Joint researches, overseas research surveys

Tao, R.: Improvement of fruit trees through genetic transformation (USA)

Tao, R.: Molecular basis of gametophytic self-incompatibility of *Prunus* species (USA, Thailand, Australia, Spain)

Yamane, H: Proteomics of the extracellular proteins of pistil (USA)

Yonemori, K.: Survey of tropical fruit germplasms and its phylogenetic classification (Thailand, Indonesia)

Yonemori, K.: Reproductive biology in tropical fruit trees (Thailand, Malaysia, Indonesia)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Pomology I (Yonemori), Pomology II (Yonemori, Tao), Seminar in Horticultural Science (Yonemori, Tao), Laboratory in Bioresource Science I, II (Yonemori, Tao), Introduction to Foreign Literature Bioresource Science I (Tao)

Graduate level: Pomology Seminar (Yonemori, Tao), Plant Propagation in Horticulture (Tao), Special Laboratory Work in Pomology (Yonemori, Tao)

B-2. Off-campus teaching, etc.

Part-time lecturer

Tao, R.: Kinki Univ. (Special lecture for graduate students)

Yonemori, K.: Shimane Univ. (Special lecture for graduate students)

Yonemori, K.: Miyazaki Univ. (Special lecture for graduate students)

Yonemori, K.: Fukui Prefectural Univ. (Special lecture for undergraduate students)

Yonemori, K.: Shizuoka Univ. (Special lecture for graduate students)

Chair of Agricultural Ecology

2.1.5 Laboratory of Weed Science

Staff *Professor* *: Ito, Misako, Dr. Agric. Sci.*

Associate Professor: Yamasue, Yuji, ph. D.

Assistant Professor : Miura, Reiichi, Dr. Agric. Sci.

Assistant Professor : Wang, Guang-Xi, Dr. Agric. Sci.

Students and research fellows

Doctor's program:(5) *Research fellow:(1)*

Master's program:(9)

Undergraduate :(1)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Ecology and control of creeping perennial weeds

Architecture and function of the subterranean system of creeping perennials, as well as their roles in the propagation patterns, have been clarified in Convolvulaceae species, *Solanum carolinense*, *etc.* in relation to the life history and variation.

b) Mulching materials for weed suppression and soil conservation

Weed control technology in establishment of ornamental green cover using mulching sheets has been developed. Performances of various unutilized resources as m

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Pomology I (Yonemori), Pomology II (Yonemori, Tao), Seminar in Horticultural Science (Yonemori, Tao), Laboratory in Bioresource Science I, II (Yonemori, Tao), Introduction to Foreign Literature Bioresource Science I (Tao)

Graduate level: Pomology Seminar (Yonemori, Tao), Plant Propagation in Horticulture (Tao), Special Laboratory Work in Pomology (Yonemori, Tao)

B-2. Off-campus teaching, etc.

Part-time lecturer

Tao, R.: Kinki Univ. (Special lecture for graduate students)

Yonemori, K.: Shimane Univ. (Special lecture for graduate students)

Yonemori, K.: Miyazaki Univ. (Special lecture for graduate students)

Yonemori, K.: Fukui Prefectural Univ. (Special lecture for undergraduate students)

Yonemori, K.: Shizuoka Univ. (Special lecture for graduate students)

Chair of Agricultural Ecology

2.1.5 Laboratory of Weed Science

Staff *Professor* *: Ito, Misako, Dr. Agric. Sci.*

Associate Professor: Yamasue, Yuji, ph. D.

Assistant Professor : Miura, Reiichi, Dr. Agric. Sci.

Assistant Professor : Wang, Guang-Xi, Dr. Agric. Sci.

Students and research fellows

Doctor's program:(5) *Research fellow:(1)*

Master's program:(9)

Undergraduate :(1)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Ecology and control of creeping perennial weeds

Architecture and function of the subterranean system of creeping perennials, as well as their roles in the propagation patterns, have been clarified in Convolvulaceae species, *Solanum carolinense*, *etc*. in relation to the life history and variation.

b) Mulching materials for weed suppression and soil conservation

Weed control technology in establishment of ornamental green cover using mulching sheets has been developed. Performances of various unutilized resources as mulching materials are compared.

c) Physiological and molecular analyses of germination ecology in *Echinochloa*

E. crus-galli has extremely large variation in submergence tolerance at seed germination and distributes as a common weed in rice fields with various water regimes. Objective of this research project is to analyze mechanism of the submergence tolerance with physiological and molecular techniques by using two varieties of the species. In 2004, we found that seeds of the variety tolerant to submergence largely proceeded alcohol fermentation under anaerobic imbibition and a part of acetaldehyde produced appeared to be converted to acetate by acetaldehyde dehydrogenase and then to tricarboxylic acids. But seeds of the counterpart variety susceptible to submergence increased alcohol dehydrogenase activity, but little proceeded the fermentation under anaerobic imbibition.

d) Herbicide resistance of paddy weeds

Reports on the occurrence of herbicide resistant paddy weeds are rapidly increasing. The mechanism of resistance, reproductive biology and the history of expansion were investigated in sulfonylurea-resistant *Lindernia* spp. and *Monochoria korsakowii*.

e) Crop-weed complex in pearl millet in Africa

Experiments were carried out to reveal the genetic system underlining the sympatric crop- and weed-type polymorphism of pearl millet, a peculiar but common phenomenon in tropical Africa.

A-2. Publications and presentations

a) Publications

Books

Ito, M.: Principles of Weed Science (Revised version). Yokendo, Tokyo, 354pp., 2004 (in Japanese)

Tominaga, T. and Y. Yamasue: Crop-associated Weeds. Weed Ecology and Management (ed by S. Inderjit). pp. 47-63, Kluwer Acad. Pub., Netherlands, 2004

Yamasue, Y.: Soil-buried seed bank and seed dormancy of weeds. Encyclopedia for Environmentally Conservative Agriculture (ed. by Ishii, R.), pp. 453-457, Maruzen, Tokyo, 2004

Wang, G.-X. Rice production and paddy weeds in Japan. In: Recent Research Developments in Crop Science I (ed. by S. G. Pandalai). Research Signpost, Trivandrum, pp. 27-43, 2004

Original papers

Konishi, M., M. Ito and T. Tominaga: Comparison of growth characteristics between clones of *Imperata cylindrica* (L.) Beauv. for a revegetation plant on the face of slopes. J. Jpn. Soc. Reveget. Tech. 30; 421-427, 2004 (in Japanese)

Goto, S. and M. Ito: Effects of turf-cutting regimes and gap size on the growth of *Killinga brevifolia* Rottb. var. *leiolepis* (Franch. et Savat.) Hara. J. Weed Sci. Tech. 49; 98-106, 2004 (in Japanese)

Miyazaki, K. and M. Ito: Root system structure and shoot arrangement of 1-year-old *Solanum carolinence* L. Weed Biology and Management 4(2); 122-125, 2004

Fukao, T., A. H. Paterson, M. A. Hussey, Y. Yamasue, R. A. Kennedy and M. E. Rumpho: Construction of a comparative RELP map of *Echinochloa crus-galli* using buffelgrass and other grass probes and quantitative trait loci analysis of flooding tolerance and other common traits in *Echinochloa crus-galli.* Theor. Appl. Genet.108; 993-1001, 2004

Wang, G.-X., Y. Lin, W. Li, M. Ito and K. Itoh: A mutation confers *Monochoria vaginalis* resistance

to sulfonylureas that target acetolactate synthase. Pesticide Biochemistry and Physiology 80; 43-46, 2004

Lin, Y., G.-X. Wang, W. Li and M. Ito: Secondary structure prediction of acetolactate synthase protein in sulfonylurea herbicide resistant *Limnophila sessiliflora*. Journal of Pesticide Science 29; 1-5, 2004

Wan, X.-C., G.-X. Wang and I. Washitani: Seed germination responses of *Monochoria korsakowii* Regel et Maack, a threatened paddy weed, to temperature and soil moisture. Plant Species Biology 19; 203-207, 2004

Li, W., L.-Q. Xia, J.-Q. Li & G.-X. Wang: Genetic diversity of *Potamogeton maackianus* in the Yangtze River. Aquatic Botany 80; 227-240, 2004

b) Conference and seminar papers presented

43rd Annual Conference of the Weed Science Society of Japan: 9 presentations

2004 Spring Meeting of Japanese Society of Turfgrass Science: 2 presentations

4th International Weed Science Congress: 2 presentations

The 2004 Annual Conference of Weed Science Society of America: 1 presentation

A-3. Off-campus activities

Membership in academic societies

Ito, M.: Weed Science Society of Japan (Councilor, Award Nomination Committee Member), Japanese Society for Turfgrass Science (Councilor)

Yamasue, Y.: Weed Science Society of Japan (Councilor, Editorial Board member)

Miura, R.: Weed Science Society of Japan (Editorial Board Member)

Wang, G.-X.: The Weed Science Society of Japan (Editorial Board Member, Terminology Committee Member)

Research grants

Monbusho Research Grant: Grant-in-Aid for Scientific Research (C)(2) Physiological and molecular analyses of seed germination ecology in *Echinochoa crus-galli* Beauv. (Leader Yamasue, Y.)

Grains Research and Development Corporation Award (Australia): Identification of mutations in ALS genes in resistant populations of wild oats and ryegrass (Leader Wang, G.-X.)

A-4. International cooperations and overseas activities

International meetings (roles)

Ito, M: 2004 Sixth Term of Chinese Grassland Society and International Grassland Workshop, Huhuhaote, China

International joint researches, overseas research surveys

Ito, M.: Weed problems and weed management in artificial grasslands in Inner Mongolia (Inner Mongolia Agricultural University, China)

Yamasue, Y. : Ecological genetics on multi-herbicide resistance of *Echinochloa oryzicola* Vasing. (University of California at Davis, USA)

Miura, R.: Development of soil fertility management technologies in semi-arid tropical Africa (JIRCAS/ICRISAT, Niger)

Wang, G.-X.: Ecological studies on aquatic plants and the management (Wuhan Institute of Botany, The Chinese Academy of Sciences, China).

Wang, G.-X.: Identification of mutations in ALS genes in resistant populations of wild oats and ryegrass（Elizabeth Macarthur Agricultural Institute, NSW agriculture, Australia）

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Weed Science I (Ito,), Weed Science II (Ito, Yamasue), Laboratory Course for Bioresource Science (Yamasue, Miura, Wang), Seminar (Ito), Introduction to Research (Ito, Yamasue, Miura, Wang), Outline of Bioresource Science I (Ito), Experimental Practice in Biology (Miura)

Graduate level: Weed Science Advanced Course (Yamasue), Seminar (Ito), Laboratory Course in Weed Science (Yamasue), Weed Management (Yamasue), Thesis (Ito, Yamasue, Miura, Wang)

B-2. Off-campus teaching, etc.

Part-time lecturer

Ito, M.: Gifu University (Weed Science)

Invited lecture

Ito, M.: The Shunju Lecture, Kyoto University

Wang, G.-X.: Workshop for the conservation of *Monochoria korsakowii*, Kurashiki City

B-3. Overseas teaching

Students and research fellows from abroad

Graduate student: 1 (China)

Research fellow: 1 (Turkey)

C. Other remarks

Ito, M.: Lake Biwa Research Institute (Council); Kyoto Prefecture (Member of Council for an Appraisal of Environmental Influence). Jury Member of JSPS Grant-in-Aid Committee

Wang, G.-X.: Guest Professor of Wuhan Institute of Botany, Chinese Academy of Science

2.1.6 Laboratory of Plant Production Systems

Staff *Professor* : *Yamasue, Yuji, ph.D. (2004.10–)*
Associate Professor: Inamura, Tatsuya, Dr. Agric. Sci.
Assistant Professor : Inoue, Hiromo, M. Agric. Sci

Students and research fellows
Doctors program : *(2)*
Masters program : *(7)*
Undergraduate : *(4)*
Research student : *(1)*

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Physiological and molecular analyses of seed germination ecology in *Echinochoa crus-galli* Beauv.,

E. crus-galli has extremely large variation in submergence tolerance at seed germination and distributes as a common weed in rice fields with various water regimes. Objective of this research project is to analyze mechanism of the submergence tolerance with physiological and molecular techniques by using two varieties of the species. In 2004, we found that seeds of the variety tolerant to submergence largely proceeded alcohol fermentation under anaerobic imbibition and a part of acetaldehyde produced appeared to be converted to acetate by acetaldehyde dehydrogenase and then to tricarboxylic acids. But seeds of the counterpart variety susceptible to submergence increased alcohol dehydrogenase activity, but little proceeded the fermentation under anaerobic imbibition.

b) Evaluation of the land productivity for the clarification of the optimal land utilization and cropping systems.

1) The effect of land utilization on crop productivity in China.

In the village near to market, the planting of cash crops (vegetables and fruits) was increased, and the increase of agriculture income by sales of the cash crops was pushing up farm income. The increases of vegetable planting promoted the arable land utilization and the utilization of paddy fields as upland fields. As the result, the physicochemical properties of soil in those paddy fields deteriorated. It seemed to be necessary to develop and extend the rational land use that can avoid the deterioration of soil physicochemical properties.

2) Evaluation of land use by using geo-statistic method.

We analyzed the spatial variability of Npf (nitrogen accumulated in the aboveground biomass of paddy rice at the panicle formation stage) in an area of about 8.6 ha cropped in paddy-upland rotation and an area of about 1.6 ha cropped in non-paddy-upland rotation in Sakurai, Nara Japan. Npf data was obtained from 860 and 160 sites by aerial photography at near-infrared (835-885 nm) and green (535-585 nm) wavelengths. The variation of Npf had a strong spatial dependence with range distance of 40-55 m in paddy-upland rotation and 10-30 m in non-paddy-upland rotation. The uniformity of the land use and cultivation techniques among fields influenced these spatial dependences. Results indicate that the site-specific application of variable rates of fertilizer is applicable in both land use systems.

c) Development of the environment-friendly technology for sustainable land utilization.

1) Effect of fermentation manure liquid on rice.

The oxidation-reduction potential of soil in methane fermented manure liquid (MF) was lower than that of chemical fertilizer (CF) and non-nitrogen (NF), and absorption and distribution to brown rice of the cadmium were more suppressed in MF, and then, the cadmium accumulation in brown rice was lowered in MF than in CF and NF. In addition, the paddy rice efficiently absorbed the nitrogen of MF by split application, and the brown rice weight in MF was not lower than CF and NF. So the cadmium concentration in brown rice was lower in MF than in CF and NF.

d) Research for cultivative adaptability in rice from the viewpoint of heading trait.

1) Genetical analysis for heading trait in American rice cultivars.

Six American rice cultivars (S201, M202, L201, Lemont, Calrose76 and BlueBell) were subjected to gene analysis for heading time locus, *Se1*. Photoperiod response of six American rice cultivars were also investigated by the cultivation in five different day-length condition. All the six cultivars had extremely large basic vegetative glowth, but photoperiod sensitivity was different among each cultivar. In genetical analysis of *Se1* locus, it was suggested that S201, M202, L201, Lemont and BlueBell harbors an early heading allele in the *Se1*, respectively, and that Calrose76 harbors a middle heading allele at the *Se1*.

2) Factors for wide regional adaptability for cultivation in rice cultivar "Hinohikari".

Rice cultivar "Hinohikari" is one of the most popular cultivars cultivated in the southwest warm region in Japan. Photoperiod response of Hinohikari was investigated to clarify the factor for wide regional adaptability in the southwest warm region. Hinohikari showed extremely strong photoperiod sensitivity compared with another popular cultivars, i.e. Nipponbare, Kinuhikari, and so on. Potoperiod sensitivity which Hinohikari showed appeared in day length which exceeded 14 hours.

A-2. Publications and presentations

a) Publications

Books and reviews

Tominaga, T. and Y. Yamasue: Crop-associated Weeds. Weed Ecology and Management (ed by S. Inderjit). p.47-63, Kluwer Acad. Pub., Netherlands, 2004

Yamasue, Y. : Soil-buried seed bank and seed dormancy of weeds. Encyclopedia for Environmentally Conservative Agriculture (ed. by Ishii, R.), p.453-457, Maruzen, Tokyo, 2004

Original papers

Fukao, T., A. H. Paterson, M. A. Hussey, Y. Yamasue, R. A. Kennedy and M. E. Rumpho: Construction of a comparative RELP map of *Echinochloa crus-galli* using buffelgrass and other grass probes and quantitative trait loci analysis of flooding tolerance and other common traits in *Echinpchloa crus-galli*, Theor. Appl. Genet.108;993-1001, 2004

Inamura, T., K. Goto, M. Iida, K. Nonami, H. Inoue and M. Umeda: Geostatistical analysis of yield, soil properties and crop management practices in paddy rice fields. Plant Prod. Sci. 7(2):230-239, 2004

Kobata, T., N. Uemuki, T. Inamura and H. Kagata: Shortage of assimilate supply to grain increases the proportion of milky white rice kernels under high temperatures.

Jpn.J.Crop Sci. 73(3),315-322, 2004

Ryu, C., M. Iida, M. Suguri, M. Umeda, T. Inamura, H. Inoue, H. Shinjo, N. Moritsuka: Effect of variable rate fertilizer application aimed at reducing the spatial variablity of grain yield on rice taste. Journal of the JSAM, 66(5), 49-62, 2004

Ryu C., M. Suguri, M. Umeda and T. Inamura: Estimation of nitrogen content of rice plant using remote sensing technology. Journal of the JSAM, 66(2), 85-96, 2004

b) Conference and seminar papers presented

The 2004 Annual Conference of Weed Science Society of America (1 presentation)

The 218th Ann Meet. of Crop Sci. Soc. of Japan (3 presentations)

The 219th Ann Meet. of Crop Sci. Soc. of Japan (1 presentation)

A-3. Off-campus activities

Membership in academic societies (roles)

Yamasue, Y.: Weed Science Society of Japan (Councilor, Editorial Board member of Weed Biology and Management)

Inamura, T.: The Crop Science Society of Japan (Editorial board member)

Inoue, H.: The Society of Crop Science and Breeding in Kinki, Japan (Chair of symposium committee).

Research grants

Monbusho Research Grant: Grant-in-Aid for Scientific Research (C)(2) Physiological and molecular analyses of seed germination ecology in Echinochoa crus-galli Beauv. (Leader Yamasue, Y.), Grant-in-Aid for Scientific Research (A)(2) Development of Sensing technology for Grain Yield Variability and Variable Rate Application System in Crop Rotation Field (collaborator Inamura, T.), Grant-in-Aid for Scientific Research (B)(2) Development of the method for cultivative control in response to the spatial variability of among soil, crop growth and crop yield in the villege farming system (Leader Inamura, T., collaborator Inoue, H.)

Norin-suisansho Research Grant: General studies of development in basic technologies for construction of low-working agricultural technologies in the future (collaborator Inamura, T.).

A-4. International cooperations and overseas activities

International meetings (roles)

International joint researches, overseas research surveys

Yamasue, Y. : Ecological genetics on multi-herbicide resistance of Echinochloa oryzicola Vasing. (University of California at Davis, USA)

Inamura, T. and H. Inoue : Investigation on land productivity, land use and cropping system in mountain and hill area in southwest China (Cooperation with Science and Technology Committee of Panzhihua City, Szuchuan Province of China).

B. Educational activities (2004.4-2005.3)

B-1. On campus teaching

a) Courses given

Undergraduate level: Seminar on experience of farm work (2) (Yamasue, Inamura and Inoue), Crop Production Techniques and Farm Practice (Yamasue, Inamura and Inoue), Plant Production Systems I (Yamasue), Plant Production Systems II (Inamura), Laboratory Work in Bioresource Science I, II (Inamura and Inoue), Seminar in Agricultural Ecology (Yamasue, Inamura and Inoue), Introduction to Research (Yamasue, Inamura, Inoue).

Graduate level: Plant Production Systems (Advanced Course) (Yamasue), Agricultural Production Ecology (Advanced Course) (Inamura), Plant Production Systems-Seminar (Yamasue), Special Laboratory Work in Plant Production Systems (Inamura).

B-2. Off campus teaching, etc.

Part-time lecture

Inamura, T.: Kyoto University of Education (Part-time lecture)

C. Other remarks

Inamura, T.: Board member of University Experimental Farm. "The Ministry of Agriculture, Forestry and Fisheries" – Member of fact-finding committee for each scientific field.

Chair of Food Quality Science

2.1.7 Laboratory of Food Quality Design and Development

Staff *Professor : Utsumi, Shigeru, Dr. Agric. Sci.*
Associate Professor: Mikami, Bunzo, Dr. Agric. Sci.
Assistant Professor : Maruyama, Nobuyuki, Dr. Agric. Sci.

Students and research fellows
Doctor's Program : (6)
Master's Program : (7)
Research student : (1)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Protein engineering and X-ray crystallography of food proteins

Three dimensional structure, mechanism of food functional properties and structure-function relationships of food proteins are studied at molecular level by means of protein engineering and X-ray crystallography. The main targets are soybean storage proteins, glycinin and β-conglycinin. The structure-physicochemical function relationship of β-conglycinin has been elucidated at subunit level and that of glycinin is in progress. Elucidation of the three dimensional structures

B. Educational activities (2004.4-2005.3)

B-1. On campus teaching

a) Courses given

Undergraduate level: Seminar on experience of farm work (2) (Yamasue, Inamura and Inoue), Crop Production Techniques and Farm Practice (Yamasue, Inamura and Inoue), Plant Production Systems I (Yamasue), Plant Production Systems II (Inamura), Laboratory Work in Bioresource Science I, II (Inamura and Inoue), Seminar in Agricultural Ecology (Yamasue, Inamura and Inoue), Introduction to Research (Yamasue, Inamura, Inoue).

Graduate level: Plant Production Systems (Advanced Course) (Yamasue), Agricultural Production Ecology (Advanced Course) (Inamura), Plant Production Systems-Seminar (Yamasue), Special Laboratory Work in Plant Production Systems (Inamura).

B-2. Off campus teaching, etc.

Part-time lecture

Inamura, T.: Kyoto University of Education (Part-time lecture)

C. Other remarks

Inamura, T.: Board member of University Experimental Farm. "The Ministry of Agriculture, Forestry and Fisheries" – Member of fact-finding committee for each scientific field.

Chair of Food Quality Science

2.1.7 Laboratory of Food Quality Design and Development

Staff *Professor : Utsumi, Shigeru, Dr. Agric. Sci.*
Associate Professor: Mikami, Bunzo, Dr. Agric. Sci.
Assistant Professor : Maruyama, Nobuyuki, Dr. Agric. Sci.

Students and research fellows
Doctor's Program : (6)
Master's Program : (7)
Research student : (1)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Protein engineering and X-ray crystallography of food proteins

Three dimensional structure, mechanism of food functional properties and structure-function relationships of food proteins are studied at molecular level by means of protein engineering and X-ray crystallography. The main targets are soybean storage proteins, glycinin and β-conglycinin. The structure-physicochemical function relationship of β-conglycinin has been elucidated at subunit level and that of glycinin is in progress. Elucidation of the three dimensional structures

of glycinin and β-conglycinin has been achieved by X-ray crystallography at 1.9-2.8 Å resolutions. Enrichiments of health-promotiong and physicochemical functions of soybean proteins based on their three dimensional structures have been attempted, and we have achived some successes. High resolution analyses of soybean ferritin, mushroom lectin and egg white ovotransferrin are also in progress. Crystallization and protein engineering of adzuki bean, pumpkin, pea and mung bean proteins have been started.

b) X-ray structural analyses and protein engineering of food-related enzymes

High resolution 3-D studies of β-amylase complexed with substrate analogs are in progress using soybean, barley and bacterial enzymes. Expression system of these β-amylase has been constructed using *Escherichia coli* and X-ray crystallography of mutant β-amylase is in progress to elucidate structure-function relationship. The 3-D structure of a fungal lipase has been determined at 2.2 Åresolution. Crystallographic data of microbial α-amylase, alginate lyase, pullulanase, racemase and amino acid lyase have been determined to elucidate their 3-D structures.

c) Development of transgenic crops producing food proteins and/or enzymes with improved/altered functions

A major effort is being made to develop transgenic crops producing food proteins with improved food functions (nutritional value and physiological and physicochemical functions) and/or enzymes with altered functions (substrate specificity, specific activity and etc.). Soybean proteins having improved nutritional value and physicochemical functions have been successfully expressed in transgenic rice seeds and potato tubers. Development of transgenic rice accumulating modified soybean proteins at a high level is in progress. So far, we have attained the accumulation level of 20% of total proteins.

d) Mechamism of protein sorting and accumulation in legume seeds

Storage proteins of legume seeds are synthesized during maturation at a high level. Such a spatial-, temporal- and quantity-specific expression is controlled by a gene. Proteins synthesized on the rough ER are transported from the ER to protein storage vacuoles and accumulate to form protein bodies. Such a process of intracellular transport and accumulation is defined by the property and structure of the storage proteins. However, essential structural factors are unknown. Studies on sorting signals and receptors of glycinin and β-conglycinin are in progress based on their three dimensional structures. We have found that the C-terminal 10 amino acid residues contain sorting signal of β-conglycinin from the ER to the vacuole.

A-2. Publications and presentations

a) Publications

Original papers

Bernardo, A.E.N., R.N. Garcia, M. Adachi, J.G.C. Angeles, A. Kaga, M. Ishimoto, S. Utsumi and E.M. Tecson-Mendoza: 8S globulin of mungbean [*Vigna radiata* (L.) Wilczek]: Cloning and characterization of its cDNA isoforms, expression in *Escherichia coli,* purification, and crystallization of the major recombinant 8S isoform. J. Agiric. Food Chem. 52; 2552-2560, 2004

Katsube-Tanaka, T., J.B.A. Duldulao, Y. Kimura, S. Iida, T. Yamaguchi, J. Nakano and S. Utsumi : The two subfamilies of rice glutelin differ in both primary and higher-order structures. Biochim. Biophys. Acta 1699; 95-102, 2004

Mohamad Ramlan, M.S., N. Maruyama, K. Takahashi, K. Yagasaki, T. Higasa, Y. Matsumura and S. Utsumi: Gelling properties of soybean ß-conglycinin having different subunit compositions. Biosci. Biotechnol. Biochem. 68; 1091-1096, 2004

Kang, Y.N., M. Adachi, S. Utsumi and B. Mikami: The roles of Glu186 and Glu380 in the catalytic reaction of soybean ß-amylase. J. Mol. Biol. 339; 1129-1140, 2004

Nishizawa, K., N. Maruyama, R. Satoh, T. Higasa and S. Utsumi: A vacuolar sorting determinant of soybean ß-conglycinin ß subunit resides in a C-terminal sequence. Plant Sci. 167; 937-947, 2004

Adachi, M., C. Ho and S. Utsumi: The effects of designed sulfhydryl groups and disulfide bonds into soybean proglycinin on its structural stability and heat-induced gelation. J. Agric. Food Chem. 52; 5717-5723, 2004

Mori, T., N. Maruyama, K. Nishizawa, T. Higasa, K. Yagasaki, M. Ishimoto and S. Utsumi: The composition of newly synthesized proteins in the endoplasmic reticulum determines the transport pathways of soybean seed storage proteins. Plant J. 40; 238-249, 2004

Choi, S.K., M. Adachi and S. Utsumi: Improved bile acid-binding ability of soybean glycinin A1a polypeptide by the introduction of a bile acid-binding peptide (VAWWMY). Biosci. Biotechnol. Biochem. 68; 1980-1983, 2004

Choi, S.K., M. Adachi, M. Yoshikawa, N. Maruyama and S. Utsumi: Soybean glycinin A1aB1b subunit has a molecular chaperone-like function to assist the folding of the other subunit having low folding ability. Biosci. Biotechnol. Biochem. 68; 1991-1994, 2004

Hirata, A., M. Adachi, S. Utsumi and B. Mikami: Engineering of the pH Optimum of *Bacillus cereus* ß-amylase: Conversion of the pH Optimum from a Bacterial Type to a Higher-Plant Type. Biochemistry 43; 12523-12531, 2004

Tandang, M.R.G., M. Adachi, N. Inui, N. Maruyama and S. Utsumi: The effects of protein engineering of rapeseed procruciferin on its physicochemical and functional properties. J. Agric. Food Chem. 52; 6810-6817, 2004

Hiemori, M., H. Ito, M. Kimoto, H. Yamashita, K. Nishizawa, N. Maruyama, S. Utsumi and H. Tsuji: Identification of the 23-kDa peptide derived from the precursor of Gly m Bd 28K, a major soybean allergen, as a new allergen. Biochim. Biophys. Acta 1675; 174-183, 2004

El-Shemy, H. A., M. Teraishi, M.M. Khalafalla, T. Katsube-Tanaka, S. Utsumi and M. Ishimoto: Isolation of soybean plants with stable transgene expression by visual selection based on green fluorescent protein. Mol. Breed. 14; 227-238, 2004

Maruyama, N., K. Prak, S. Motoyama, S.K. Choi, K. Yagasaki, M. Ishimoto and S. Utsumi: Structure-physicochemical function relationships of soybean glycinin at subunit level assessed by using mutant lines. J. Agric. Food Chem. 52; 8197-8201, 2004

Yokochi N., Y. Yoshikane, T. Yagi, M. Yamasaki, and B. Mikami: Crystallization and preliminary X-ray analysis of pyridoxal 4-dehydrogenase, the second enzyme in degradation pathway I of pyridoxine. Acta Cryst. D 60; 2061-2062, 2004

Yoon H.-J., H.-L. Kim, S.-K. Lee, H.-W. Kim, H.-W. Kim, J.-Y. Lee, B. Mikami, and S.-W.Suh: Crystal structure of peptide deformylase from *Staphylococcus aureus* in complex with actinonin, a naturally occurring antibacterial agent. Proteins 15; 639-642, 2004

Mukai T, S. Kawai, S. Mori, B. Mikami, and K. Murata: Crystal structure of bacterial inorganic polyphosphate/ATP-glucomannokinase. Insights into kinase evolution. J. Biol. Chem. 279: 50591-50600, 2004

Sano S., Y.-N. Kang, H. Shigemizu, N. Morishita, H.-J. Yoon, K. Saito, K. Asada, and B. Mikami: Crystallization and preliminary crystallographic analysis of monodehydroascorbate radical reductase from cucumber. Acta Cryst. D 60; 1498-1499, 2004

Itoh, T., S. Akao, W. Hashimoto, B. Mikami, and K. Murata: Crystal structure of unsaturated glucuronyl hydrolase, responsible for the degradation of glycosaminoglycan, from *Bacillus* sp. GL1 at 1.8 A resolution. J. Biol. Chem. 279; 31804-31812, 2004

Yamasaki, M., S. Moriwaki, O. Miyake, W. Hashimoto, K. Murata, and B. Mikami: Structure and function of a hypothetical *Pseudomonas aeruginosa* protein PA1167 classified into family PL-7: a novel alginate lyase with a β-sandwich fold. J. Biol. Chem. 279; 31863-31872, 2004

Kim H.-L., H.-J. Yoon, J.-Y. Ha, B.-I. Lee, H.-H. Lee, B. Mikami, and S.-W. Suh: Crystallization and preliminary X-ray crystallographic analysis of nicotinic acid mononucleotide adenylyltransferase from Pseudomonas aeruginosa. Acta Cryst. D 60; 948-949, 2004

Kurokawa, H., D.-S. Lee, M. Watanabe, I. Sagami, B. Mikami, C.-S. Raman, and T. Shimizu: A redox-controlled molecular switch revealed by the crystal structure of a bacterial heme PAS sensor. J. Biol. Chem. 279; 20186-20193, 2004

Miyake, O., E. Kobayashi, H. Nanka, W. Hashimoto, B. Mikami, and K. Murata: Posttranslational processing of polysaccharide lyase: maturation route for gellan lyase in *Bacillus* sp. GL1. Arch. Biochem. Biophys. 422;211-220, 2004

Kim, H.-W, H.-J. Yoon, H.-W. Kim, B. Mikami and S.-W. Suh: Crystallization and preliminary X-ray crystallographic analysis of peptide deformylase from Staphylococcus aureus. Korean J. Cryst. 15; 40-43 2004

Pang, Z. Y.-N. Kang, M. Ban, M. Oda, R. Kobayashi, M. Ohnishi and B. Mikami : Crystallization and preliminary crystallographic analysis of endo-1,3-β-glucanase from *Arthrobacter* sp. Acta Cryst. F 61; 68-70 2005

Yamasaki, M., K, Ogura, S. Moriwaki, W. Hashimoto, K. Murata and B. Mikami: Crystallization and preliminary X-ray analysis of alginate lyases A1-II and A1-II' from *Sphingomonas* sp. A1. Acta Cryst. F 61; 288-290 2005

Reports

Maruyama, N., T. Fukuda, Y. Shimamoto, A. Kanazawa and S. Utsumi:Characterization of seed storage proteins of wild soybean for application of breeding. Soy Protein Res., 6; 20-25, 2004

Kang, Y.-N, A. Hirata, M. Yamasaki, T. Itoh, S. Mori, S. Utsumi and B. Mikami: X-Ray crystallographic analysis of mutant β-amylase/maltose complex. SPring-8 User Experiment Report, No.13 (2004A) p. 176, 2004

Yamasaki, M., S. Moriwaki, K.Mizutani, T. Itoh, A. Hirata, Y.-N. Kang, M. Ban, W. Hashimoto, B. Mikami and K. Murata: Insight into the catalytic mechanism of family PL-7 alginate lyase PA1167 from Pseudomonas aeruginosa. SPring-8 User Experiment Report, No.13 (2004A) p. 199, 2004

Kang, Y.-N., A. Hirata, M. Yamasaki, T. Itoh, Y. Maruyama, K. Mizutani, S. Utsumi and B. Mikami: X-Ray crystallographic analysis of K295A β-amylase/maltose complex. SPring-8 User Experiment Report, No.14 (2004B) p. 172, 2005

Maruyama, Y., Yamasaki, T. Itoh, A. Ochiai, K. Ogura, B. Mikami, W. Hashimoto, and K. Murata:Polysaccharide lyase: Crystal structure of Bacillus sp. GL-1 Xanthan lyase

complexed with substrate. SPring-8 User Experiment Report, No.14 (2004B) p. 173, 2005

Maruyama, Y., B. Mikami, W. Hashimoto, and K. Murata:Polysaccharide lyase: Crystal structure of Bacillus sp. GL-1 Xanthan lyase complexed with pyrvate mannose. SPring-8 User Experiment Report, No.14 (2004B) p. 295, 2005

b) Conference and seminar papers presented

The Annual Meeting (2005) of Japan Society for Bioscience, Biotechnology, and Agrochemistry (16 papers)

9th International Symposium on Plant Seeds: Seeds in the –omics Era: 3 papers

World Rice Research Conference 2004: 1 paper

25th Annual Meeting of Seed Physiology and Biochemistry: 3 papers

Reseach Meeting of National Institute of Genetics: 1 paper

7th Annual Meeting of the Soy Protein Committee: 1 paper

The 434th Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai District, 2004 (1 paper)

The Annual Meeting of the Society for Biotechnology Japan, 2004 (2 papers)

The branch meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai District, 2004 (2 papers)

The Annual Meeting of the Japanese Biochemical Society (5 papers)

The Annual Meeting of Japanese Society of Applied Glycoscience, 2004 (2 papers)

A-3. Off-campus activities

Membership in academic societies (roles)

Utsumi, Shigeru: Japanese Biochemical Society (Councilor), The Japanese Society for Food Science and Technology (Editorial Board)

Mikami, Bunzo: The Japanese Society of Applied Glycoscience (Councilor)

Research grants

Monbukagakusho Research Grant: Research (B) Structure-quality relationships at molecular level of soybean major storage proteins (Leader Utsumi, S., Collaborator N. Maruyama)

Ministry of Education, Culture, Sports, Science and Technology: Protein 3000 project (Leader Mikami, B., Collaborator S. Utsumi)

Ministry of Agriculture, Forestry and Fisheries: Molecular design of food proteins with physiologically functional peptide (Leader Utsumi, S.), Rice genome project (Leader Mikami, B., Collaborator S. Utsumi)

Program for Promotion of Basic Research Activities for Innovative Biosciences: Structural biology of bacterial “Super-channel” and molecular breeding of “Super bacteria” for remediation (Collaborator Mikami, B.)

Research Foundation: Fuji Foundation for Protein Research (Leader Maruyama, N.)

A-4. International cooperations and overseas activities

International meetings (roles)

Utsumi, Shigeru: 9th International Symposium on Plant Seeds: Seeds in the-omics Era, Meisdorf, Germany (Invited Speaker)

Mikami, Bunzo: The 22nd European Crystallographic meeting (1 regular paper)

International joint research, overseas research surveys

Utsumi,S.: Processing of soybean glycinin (Germany, IPK), Molecular evolution of seed storage proteins (Moldova, University of Moldova), Functional properties of mung bean globulins (Philippines,UPLB), Allergenicity of soybean glycinin and β-conglycinin (Germany, PEI)

Mikami, B.: Tertiary structure of bacterial enzymes (Korea, Seoul University)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate Level: Basic Bioresource Science I (Utsumi), Outline of Bioresource Science I (Utsumi), Molecular Biology (Utsumi), Quality Design and Development (Utsumi, Mikami), Quality Science (Utsumi, Mikami)

Graduate Level: Food Quality Design and Development, Advanced Course (Utsumi, Mikami)

B-2. Off-campus teaching, etc.

Part-time lecturer

Utsumi, S.: Graduate School of Science and Technology, Kobe University (Food Functionality). Faculty of Health and Welfare Science, Okayama Prefectural University (Food Biotechnology, Advanced Course), Graduate School of Bioresources, Mie University (Special Lecture of Biosphere Life Science)

Mikami, B.: Department of Agricultural Sciences; Kobe University, Faculty of Agriculture

Open seminars

Utsumi, S.: Basic course of biotechnology (lecturer)

B-3. Off-campus activities

Students and research fellows from abroad

Student: Doctor Course (3, Philippine, Cambodia, Indonesia), Master Course (1, Malaysia)

C. Other remarks

Utsumi, S.: Andou Momohuku Award

2.1.8 Laboratory of Quality Analysis and Assessment

Staff *Professor* : *Matsumura, Yasuki, Dr. Agric. Sci.*
Lecturer : *Hayashi, Yukako, Dr. Agric. Sci.,*
Assistant Professor : *Matsumoto, Shinya, Dr. Agric. Sci.*
Students and research fellows
Doctor's program : *(7)*
Master's program : *(7)*
Undergraduate : *(3)*

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Evaluation and improvement of quality as food stuffs for soybean and wheat.

A great variety of foods are produced from various crops, for instance, soybean curd (*tofu*) and bread are prepared from soybean and wheat, respectively. The quality of final product changes according to cultivars of crops, weather, district, and conditions of storage and transportation, etc. It is not practical and economical to evaluate the suitability of crops to final products in a large scale. This situation needs us to develop the new methods to evaluate the quality of crops as food stuffs efficiently and accurately using only a small sample. We are testing validity of various analytical methods, in order to establish the appropriate evaluation methods in a small scale for soybean and wheat. Another goal of this research is to understand the factors determining the quality of the crops. If we get a plenty information on such factors, we will be able to give a good index to breeding scientists when improving the properties of crops.

b) Quality control of food products containing lipids.

Lipids coexist with water, proteins and other components in many foods such as mayonnaise, milk, ice cream, soybean curd, etc. In these emulsion type foods, lipids are dispersed in water as fine particles. The stability of lipid particles against flocculation and coalescence is crucial for the acceptability and shelf-life of the emulsions. Chemical aspects, such as oxidation degree of lipids, also affect deeply flavor, safety, nutritional and physiological quality of emulsion foods. The objective of our research is to improve the quality of emulsion foods by controlling the physical and chemical stability of lipids. Recently, the interaction of lipids with proteins and polysaccharides in low water activity system such as pasts and powders became our target of research.

c) Control of interaction of food macromolecules.

Main food macromolecules consist of proteins and polysaccharides. Our group has been studying the effects of plant polysaccharides on the dispersion behavior and gelling properties of milk and soybean proteins. Our goal of this project is to understand the mode of macromolecules' interaction such as network formation of mixed polymers, phase separation, and coacervation, etc and to develop the new useful texture of food macromolecules. Our group is also trying to improve the physical properties of food macromolecules using the new type enzyme, for instance, protein-deamidase.

d) Analyses of perceptional mechanism of umami taste by physiological and biochemical methods.

Scientific interest in how food taste affect the functioning of the human body, for example, appetite, digestive enzymes, metabolism, etc., is growing. Five primary taste stimuli-acids, salts, sugars, amino acids and bitter substances-have been used as standard stimuli. Amino acids are one of the most important nutrients and are potent attractant for many living organisms ranging from bacteria to higher vertebrates. Umami is defined as the taste of monosodium glutamate in human being. The taste reception to amino acids, sugar and some bitter substance are known to be initiated by the adsorption of the chemical stimuli to the receptors on the taste cell membranes. In this laboratory, the perceptional mechanisms of umami and bitter are focused and studied by the electrophysiological and biochemical techniques.

e) Molecular and genetic analysis of function and recognition of lipophilic substances

The analysis of biological and physiological functions of lipophilic substances including fat, fatty acids and steroids had been partly hampered due to their insolubility to water. Recent finding that some fatty acid ethanolamines function as endogenous hormones that regulate appetite shed new light on physiological functions of lipophilic substances. To study the physiological function of fat and fatty acid and to overcome the experimental difficulty associated with the lipophilic substances due to their insolubility to water, genetic and in vivo analyses using nematode C.elegans have been performed. We have found that oxidized fatty acid induces short life span in C.elegans. As this may impose certain aspects in quality control of food, the molecular mechanism of this phenomena is being studied. At the same time, role of fatty acid transporter expressed in tongue taste buds epithelium has been studied using rat and worm expecting to clarify its biological function in taste buds.

A-2. Publications and presentations

a) Publications

Books

Aji-no-Nandemo-Shojiten, BlueBacks Series B1439. (The Japanese Association for the Study of Taste and Smell ed.) Matsumura Y., Hayashi Y. and Matsumoto S., Kodan-Sha. Tokyo (2004): Matsumura 3 subjects, Hayashi 3subjects, Matsumoto 2 subjects

Original papers

Seguchi, M., Y. Mizutani, C. Nakamura and Y. Matsumura: Effects of secondary structure of heated egg white protein on the binding between prime starch and tailing fractions in fresh wheat flour. Cereal Chem., 81, 633-636 (2004).

Mizutani, Y., Y. Matsumura, H. Murakami and T. Mori: Effects of heating on the interaction of lipid and zein in a dry powder system. J. Agric. Food Chem., 52, 3570-3576 (2004).

Salle, M. R. B. M., N. Maruyama, K. Takahashi, K. Yagasaki, T. Higasa, Y. Matsumura and S. Utsumi: Gelling properties of soybean β-conglycinin having different subunit compositions. Biosci. Biotechnol. Biochem., 68, 1091-1096 (2004).

Yong, H., S. Yamaguchi, Y-S. Gu, T. Mori and Y. Matsumura: Effects of enzymatic deamidation by protein-glutaminase on structure and functional properties of α-zein. J. Agric. Food Chem., 52, 7094-7100 (2004).

Park, E-Y., H. Murakami, T. Mori and Y. Matsumura: Effeccts of protein and peptide addition on lipid oxidation in powder model system. J. Agric. Food Chem., 53, 137-144

(2005).

Reviews

Adachi, S. and Y. Matsumura: Suppression of lipid oxidation by its interaction with a food polymer. Nippon Shokuhin Kogaku Kaishi, 51, 221-228 (2004).

Matsumura, Y. and Y. Mizutani: Interaction of lipid and biopolymers in powdery system. Kagaku to Seibutsu, 42, 373-379 (2004).

Matsumura, Y.: Effects of crystallization on physical properties and stability of emulsion. Oleoscience, 5, 13-19 (2005).

b) Conference and seminar papers presented

The Annual Meeting of Japan Society for Bioscience, Biotechnology and Agrochemistry 2004: 6 subjects

The Annual Meeting of Japanese Society for Food Science and Technology: 1 subject

The Annual Meeting of Japanese Society for Food Engineering: 1 subject

The 14th International Symposium on Olfaction and Taste/ The 38th JASTS Annual Meeting: 4 subjects

International Conference on "Food Structure and Quality" organized by American Oil Chemists' Society (European Branch) : 2 subject

The XVIth conference of the European Chemoreception Research Organisation: 2 subjects

East Asia C. elegans Meeting: 2 subjects

A-3. Off-campus activities

Membership in academic societies (roles)

Matsumura, Y.: Symposium on Physical Properties of Foods and Food Materials (Member of the Steering Committee), Kansai Branch of Japanese Society for Food Science and Technology (Counselor), Rheology Society of Japan, Division of Dispersion and Interfacial Science (Member of the steering committee), Japan Society for Food Engineering (Counselor + Editorial Committee)

Hayashi, Y.: Japanese Society for the Study of Taste & Smell (Editorial Committee)

Research grants

Monbusho Reseach Grant:

Scientific Research (C)(2) Contribution of D-aspartic acid to formation of non-digestive aggregates from proteins (Leader Matsumura, Y.), Scientific Research (B)(1) Effects of natural antioxidant and surface active compounds on Food Processing and Cooking (Collaborator Matsumura, Y), Scientific Research (B)(2) Modeling of taste transduction mechanisms from multi-angle approaches (Leader Hayashi, Y.)

A-4. International cooperations and overseas activities

International meetings (roles)

Matsumura, Y.: The 95th Annual Meeting of American Oil Chemists' Society (Cincinnati, USA, invited speaker)

Matsumura, Y.: International Conference on "Food Structure and Quality" organized by American Oil Chemists' Society (European Branch) (Cork, Ireland, invited speaker)

Hayashi, Y.: The 14th International Symposium on Olfaction and Taste(Kyoto, Sub-execution chairperson, Program committee, chairperson)

Hayashi, Y.: The XVIth conference of the European Chemoreception Research Organisation (Dijon, France, speaker)

Matsumoto, S.: East Asia C. elegans Meeting (Awajishima, Japan, speaker)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Food Quality Science (Matsumura, Y.), Quality Analysis and Assessment (Matsumura, Y., Hayashi, Y.), Introduction to Foreign Literature in Bioresource Science I (Hayashi, Y.)

Graduate level: Quality Analysis and Assessment（Matsumura, Y.）

B-2. Off-campus teaching, etc.

Part-time lecturer

Matsumura, Y.: Kyoto Prefectural University, Faculty Agriculture (Food Functionality). Hiroshima University, Faculty of Applied Biological Science (Macromolecular Chemistry).

Open Seminar

Matsumura, Y.: The 8th open seminar of Experimental Farm, Kyoto University (Lecture)

B-3. Overseas teaching

Students and research fellows from abroad

Doctor's program: 6 (China3, Korea, Malaysia)

Master's program:1(Brazil)

C. Other remarks

Matsumura, Y., Hayashi, Y., and Matsumoto, S: Archer Daniels Midland Award (for best paper in protein and co-product division of American Oil Chemists' Society)

Chair of Plant Production Science (Experimental Farm)

2.1.9 Laboratory of Plant Production Control

Staff *Professor* : *Yamada, Toshiaki , Dr.Agric.Sci.*
Associate Professor: Kitajima, Akira(2004.4.1～), Dr.Agric.Sci.
Assistant Professor : Kataoka, Keiko, Dr.Agric.Sci.
Assistant Professor : Matsui, Tsutomu, Dr.Agric.Sci.
Assistant Professor : Teraishi, Masayoshi, Dr.Agric.Sci.
Assistant Professor : Fudano,Takashi, M.Agric.Sci.
Assistant Professor : Habu,Tsuyoshi, M.Agric.Sci.

Students and research fellows
Master's Program : (6)
Undergraduate : (1)

A. Research Activities (2004.4-2005.3)

A-1. Main subjects

a) Studies on seedlessness in citrus

Seedless fruit is the most desirable character in citrus. The world wise breeding program in citrus is going on to obtain seedless cultivars. We focus on the seedless types caused by the disorder of female gamete or zygote and try to clear the mechanisms of their disorders. We also seek the molecular markers for selecting seedless offspring in the breeding populations at an early seedling stage using leaf DNA, in order to make greater efficiency for citrus breeding program.

b) Studies on chromosomes in fruit trees

Since fruit trees chromosomes are small in size, the identification of each chromosome in the set is very difficult. We are developing the methods for chromosome identification to make cytological map from linkage map. Now, we try to identify the chromosomes and chromosome construction in *Prunus* plants of peach, apricot, Japanese apricot, plum and cherry.

c) Studies of self-compatibility in *Prunus*

Peach and some cultivars in Japanese apricot or apricot exhibit self-compatibility though many other species or cultivars in *Prunus* exhibit gametophytic self-incompatibility. In this study, we investigate the *S*-locus of such self-compatible cultivars or species to elucidate the mechanism of gametophytic self-incompatibility in *Prunus*. In this year, we attempted to identify the *S*-genotypes of twenty apricot cultivars.

d) Identification of proteins relate to dormancy of deciduous fruit trees

When autumn comes, deciduous fruit trees such as pear or peach must enter a state of dormancy to survive winter. This dormancy is broken by sufficient exposure to low temperatures but insufficient exposure to low temperatures can't break dormancy with the result that bud break and flowering don't occur even if the environmental conditions become suitable for their growth. In recent years, the global warming by greenhouse gas is a big problem and this dormancy in deciduous fruit trees is considered to be seriously influenced by the warming. Thus,

we attempt to elucidate the mechanism of dormancy in deciduous fruit trees for the breeding new cultivars which are able to avoid the influence of warming. In this year, we analyzed the proteins expressed during dormancy in order to identify the proteins related to the transition of dormancy states.

e) Characteristics of floral organs responsible for stable self-pollination in rice (*Oryza sativa* L.)

The length of basal pores on the thecae just after anthesis was highly correlated both with the percentage of the sufficiently pollinated florets, and with the number of pollen grains deposited on the stigmata and its variation (coefficient of variation) in many rice varieties. The size of the basal pores was, therefore, considered to be an important factor for the stable self-pollination in rice.

f) High temperature-induced floral sterility in japonica rice

Anticipated future global warming may increase the instability of rice yield even in temperate regions, mainly trough the increased probability of high temperature-induced floret sterility. The purpose of this study is to clarify the mechanism of high temperature-induced floret sterility in rice and of the high temperature tolerance. It has been clarified that there exist 3 C cultivar difference in the high temperature tolerance among major japonica cultivars and that tolerant cultivars have well dehiscent anthers.

g) Genetic studies of isoflavone contents in soybean seeds

Isoflavone is spotlighted as one of functional substances in soybean seeds. We plant recombinant inbred lines of soybean at some locations different in temperature, to decide temperature-sensitive or -insensitive quantitative trait loci involved in isoflavone contents, and then try to create soybean varieties with high content of isoflavone even in warm climate.

h) Screening of tanbaguro mutant

Tanbaguro is a japanese traditional soybean variety, characterized by the big black seeds. We are screening tanbaguro mutants with interesting agronomic traits from γ - ray irradiated population.

i) Suppression of tomato fruit production under high temperature conditions

In the summer production of tomato fruit, high temperature often reduces fruit sets, fruit growth, and sugar accumulation; furthermore, it increases the occurrence of blossom-end rot. We investigate the effects of the existence of seeds on high temperature restriction on fruit growth and sugar accumulation using a parthenocarpic cultivar 'Kyotemari', which is a progeny of 'Severianin'. 'Severianin' is a genetic parthenocarpic tomato cultivar, whose fruit setting is reported to be stable under high temperature conditions. This year, we attempted to create methods for enzyme activity assay and to induce seeded fruit.

j) Promoted growth of Phalaenopsis in embedded culture.

We succeeded in promoted growth of cultured plant embedded in solid medium. Therefore we named this method the embedded culture, and investigated that the embedded culture is useful for horticultural production. It is revealed that growth of axillary bud of flower-stalk and seedling are promoted in embedded culture.

A-2. Publications and presentations

a) Publications

Original papers

Kitajima, A., A. Yamasaki and K. Hasegawa: Seedless fruit production in 'Tosa Buntan' pummelo. J. Japan. Soc. Hort. Sci. 73; 469-475, 2004 (in Japanese with English summary)

Kawano, T., A. Kitajima, A. Yamasaki, Y. Tanaka, H. Ohata and K. Hasegawa: The fruit characteristics prediction of 'Tosa Buntan' and the search for cultivating conditions of a target fruit. Journal of Society of High Technology in Agriculture 16; 107-114, 2004 (in Japanese with English summary)

Kasai, K., M. Kawagishi-Kobayashi, M. Teraishi, Y. Ito, K. Ochi, K.Wakasa and Y. Tozawa: Differential expression of three plastidial sigma factors, OsSIG1, OsSIG2A, and OsSIG2B, during leaf development in rice. Biosci Biotechnol Biochem 68; 973-977, 2004

El-Shemy, H.A., M. Teraishi, M.M. Khalafalla, T. Katsube-Tanaka, S. Utsumi and M. Ishimoto: Isolation of soybean plants with stable transgene expression by visual selection based on green fluorescent protein. Molecular Breeding 14; 227-238, 2004

Kataoka, K., H. Okita, A. Uemachi, S. Yazawa: A pseudoembryo highly stainable with toluidine blue O may induce fruit growth of parthenocarpic tomato. Acta Horticulturae 637; 213-221, 2004

Morita, T., M. Nishinoiri, K. Kataoka, T. Fudano and K. Kawase: The effects of inoculation of fusarium on periderm formation in taro(Colocasia esculenta Schott). Hort. Res. 3; 97-100, 2004

Reviews

Yamada, T.: New activity of Experimental Farm, Kyoto University. Journal of Agricultural Science 59(12); 561-565

Yamada, T.: Present status and the future perspectives of agriculture and food in Japan. Bulletin of Experimental Farm, Kyoto University 14; 66-67

Kitajima, A.: From history to future breeding of citrus. Bulletin of Experimental Farm, Kyoto University 14, 46-58

b) Conference and seminar papers presented

The 105th meeting of Japanese Society for Breeding Science (2 presentations)

The 106th meeting of Japanese Society for Breeding Science (1 presentation)

2004 Spring Meeting of the Japanese Society for Horticultural Science (1 presentation)

2004 Autumn Meeting of the Japanese Society for Horticultural Science (5 presentations)

2004 Meeting of Kinki branch of the Japanese Society for Hoticultural Science (1 presentation)

3rd International Symposium on Persimmon (4 presentations)

3rd International Symposium on Tropical and Subtropical Fruit (1 presentation)

4th International crop science congress (1 presentation)

World Rice Research Conference 2004 (2 presentations)

The 6th International Symposium on Plant Response to Air pollutionand Global Changes (1 presentation)

A-3. Off-campus activities

Membership in academic societies (roles)

Yamada, T.: Japanese Society of Breeding (Secretary member)

Yamada, T.: The Society of Crop Science and Breeding in Kinki, Japan (Secretary member)

Kitajima, A.: International Society of Citriculture, Japan Branch (Board)

Teraishi, M.: The Society of Crop Science and Breeding in Kinki, Japan (Symposium committee)

Fudano, T.:Kinki branch of Japanese Society for Horticultural Science (Accounts managers)

Research grants

Monbusho Research Grant: Scientific Research (C) (2) Histological and cytological studies on female sterility in pummelo originated from 'Mukaku Kishu' (leader: Kitajima), Scientific Research (B) (1) Investigation of origin species in Diospyros kaki and development process in PCNA type kaki lines (collaborator: Kitajima), Research for Young Scientist (B) Identification of gametophytic self-incompatibility related modifier genes in *Prunus* (leader: Habu), Research for Young Scientist (B) Morphological traits of anther controlling the stability of pollination (leader: Matsui), JSPS Japan-US Cooperative Science Program: Inhibition of metabolic genes in the shikimic acid pathway as an approach for limiting undesirable polyphenol formation in fruit (collaborator: Kitajima)

A-4. International cooperations and overseas activities

International meetings (roles)

Kitajima, A.: 3rd International Symposium on Persimmon (Korea)

Joint researches, oversea research surveys

Kitajima, A.: Surveys of wild and PCNA types *D. kaki* (China, Thailand)

B. Educational Activities (2004.4-2005.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Agricultural Technology and Farm Practice (Yamada, Kitajima, Kataoka, Matsui, Teraishi, Fudano, Habu), Lecture on Plant Production Control Science (Yamada), Seminar on Plant Production Control Science (Yamada), Lecture on Outline of Bioresource Science I (Yamada), Lecture on Outline of Agricultural Science II, Introduction to Research (Yamada, Kitajima, Kataoka, Matsui, Teraishi, Fudano, Habu)

Graduate level: Plant Production Control Science (Advanced course) (Yamada), Plant Production Techniqe (Advanced course) (Kitajima), Seminar on Plant Production Control Science (Yamada), Special Laboratory Work on Plant Production Control Science (Yamada, Kitajima, Kataoka, Matsui, Teraishi, Fudano, Habu)

B-2. Off-campus teaching, etc.

Part-time lecturer

Yamada, T.: Center of Lifelong Study in Takatsuki City (Special Lecture)

Open seminar

Yamada, T.: The 8th open seminar of Experimental Farm, Kyoto University (Lecture)

Kitajima, A.: The 8th open seminar of Experimental Farm, Kyoto University (Lecture)

C. Other remarks

Yamada, T.: A member of the Evaluation Committee for the Designated Breeding Program in the Ministry of Agriculture, Forestry and Fisheries of Japan, Board member of University Experimental Farm, Member of construction committee.

Kitajima, A.: Member of the Evaluation Committee for the General Research of Local Agriculture Development in the National Agricultural Research Organization, Board member of University Experimental Farm.