2.1 DIVISION OF AGRONOMY AND HORTICULTURAL SCIENCE

The Division offers educational and research programs to study ecological, physiological characteristics of crops in harmony with environment, useful genetic variations and gene manipulation and also management of productive and sustainable arable ecosystems and quality control of agricultural products, focusing on establishment of the theory and technology for efficient and sustainable crop productions and improvement of crop quality. 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-one and forty-two graduate students, including twenty foreign graduate students, are enrolled in Master's and Doctor's Programs, respectively. One foreign visiting professor, one invited scholar, one research fellow and two research students have also worked in the Division in 2005.

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 : *Otaka, Toyoko*

Students and research fellows
Doctor's Program : *(5)*
Master's Program : *(7)*
Undergraduate : *(3)*
Guest scholar : *(1)*

A. Research Activities (2005.4-2006.3)

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 remains low and unstable as compared to the major cereal crops. This study aims at identification of 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, 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

Horie, T., Shiraiwa, T., Homma, K., Katsura, K., Maeda, Y., Yoshida, H. (2005) Can yields of lowland rice resumes the increases that they showed in the 1980s? Plant Prod. Sci. 8: 259-274.

Matui, T., K. Kobayashi, H. Kagata and T. Horie (2005) Correlation between viability of

pollination and length of basal dehiscence of the theca in rice under a hot-and-humid condition. Plant Prod. Sci. 8: 109-114.

Mochizuki, A., Shiraiwa, T., Nakagawa, H., Horie, T. (2005) The effect of temperature during the reproductive period on development of reproductive organs and the occurrence of delayed stem senescence in soybean. Jpn. J. Crop Sci. 74, 339-343.

Sato, J., Sakashita, M., Shiraiwa, T., Yoshida, R., Horie, T. (2005) The effect of soil water content on the cytokinin (trans zeatin riboside) level in xylem-sap and delayed leaf senescence of soybean. Kinki J. Crop Sci. Breed. 50, 41-44.

Takai, T., Y. Fukuta, T. Shiraiwa and T. Horie (2005) Time-related mapping of quantitative trait loci controlling grain filling in rice (Oryza sativa L.). J. Exp. Bot. 56: 2107-2118.

Reports

Horie, T., Yoshida, H., Kawatsu, S., Katsura, K., Homma, K., Shiraiwa, T. (2005) Effects of elevated atmospheric CO_2 concentration and increased temperature on rice: implications for Asian rice production. In: Toriyama, K., Heong, K. L., Hardy, B. (Eds.) Rice is Life: Scientific Perspectives for the 21st Century. Proceedings of the World Rice Research Conference held in Tokyo and Tsukuba, Japan, 4-7 November 2004, IRRI, Los Banos, and JIRCAS, Tsukuba, pp. 536-539.

Linquist, B., Saito, K., Keoboualapha, B., Phengchan, S., Songyikhangsuthor, K., Phanthaboon, K., Vongphoutone, B., Navongsai, V., Chindalak, S., Horie, T. (2005) Developing upland rice based cropping systems. In: Bouahom B, Glendinning A, Nilsson S and Victor M.(Eds) Poverty Reduction and Shifting Cultivation Stabilization in the Uplands of Lao PDR: Technologies, Approaches and Methods for Improving Upland Livelihoods. Proceedings of a work shop held in Luang Prabang, Lao PDR, 27 - 30 January 2004, National Agriculture and Forestry Research Institute. Vientiane, Lao PDR. pp. 299-313.

b) Conference and seminar papers presented

The 219th Ann. Meeting of Crop Sci. Soc. of Japan : 7 presentations

The 220th Ann. Meeting of Crop Sci. Soc. of Japan : 5 presentations

The 107th and 108 th Ann. Meeting of Jpn. Soc. Breeding: 1 presentation

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) Mechanisums for delayed stem senescence in

soybean: evaluation of gene by environmet interaction and identification of major genetic regions (Leader Shiraiwa, 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 (2005.4-2006.3)

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.
Lecturer *: Nakazaki, Tetsuya, Dr. Agric. Sci.*
Assistant Professor : Tsukiyama,Takuji, M. 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 (2005.4-2006.3)

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 there 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

Nakazaki, T., Y. Okumoto, A. Ohnishi and T. Tanisaka: Database search of *Ruba4* encoding RURM1-activating enzyme. Kinki Journal Crop Science and Breeding 50: 37-40, 2005

Fukuda, T., N. Maruyama, A. Kanazawa, J. Abe, Y. Shimamoto, M. Hiemori, H. Tsuji, T. Tanisaka,

and S. Utsumi: Molecular analysis and physicochemical properties of electrophoretic variants of wild soybean *Glycine soja* storage proteins. J. Agric. Food Chem. 53; 3658-3665, 2005

Reviews

Tanisaka, T.: Plant breeding for stable food supplies. Clinic All-raund 54; 62-67, 2005

b) Conference and seminar papers presented

Congress of Japanese Society of Breeding: 15 presentations

Congress of the Society of Crop Science and Breeding in Kinki: 1 presentations

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

Fifth International Rice Genetics Symposium and 3rd International Rice Functional Genomics Symposium: 4 presentation.

The 6th Kyoto University Symposium: 5 presentation.

A-3. Off-campus activities

Roles in academic societies

Tanisaka, T.: Japanese Society of Breeding (President of the Society), Association of Japanese Agricultural Scientific Societies (Council member), The Society for the Advancement of Breeding Researches in Asia Oceania (Board member), The Society of Crop Science and Breeding in Kinki (Council member)

Okumoto, Y.: Japanese Society of Breeding (Council member, editorial board), The Society of Crop Science and Breeding in Kinki (Council member)

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

Membership in Science Council of Japan, etc.

Tanisaka, T.: Member of the Committee 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): Structural modification induced by the transposition *mPing*. (Tanisaka), Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research (B) (2): Genetic factors contributing to the mobilization of *mPing* in intact rice plants. (Okumoto), Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research (C): Analysis of an ubiquitin-like protein conjugation system relating to the rice RURM1 protein. (Nakazaki)

Independent Administrative Institute (National Institute of Agrobiological Sciences): Genetic and molecular dissection of quantitative traits in rice (Tanisaka)

Independent Administrative Institute (National Agricultural Research Organization): Development of efficient breeding system with DNA markers “Construction of tightly linking 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 (Tanisaka)

Momofuku International Co. Ltd.: Collaboration "Exploitation of high-yielding production techniques in soybean" (Tanisaka)

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

Kyoto University Research Grant for Young Researcher: Analysis of effect of abscisic acid-induced class II chitinase CHT11 on senescence and growth and development of rice (*oryza sativa* L.) (Tsukiyama)

A-4. International cooperations and overseas activities

International joint researches, oversea research surveys

Cloning of a erect panicle gene in rice and analysis of its function (China, Shenyang Agriculture 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)

Host member of the 6th Kyoto University International Symposium "Plant Sciences in Japan and China - from Genomics to Breeding"

B. Educational Activities (2005.4-2006.3)

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, Nakazaki), Introduction to Research (Tanisaka, Okumoto, Nakazaki, Tsukiyama), Food Safety II (Tanisaka)

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

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 (Fundamentals of Biological Experiments I, Fundamentals of Biological Experiments II)

B-3. Overseas teaching

Students and research fellow from abroad

Graduate course: 3 students (China 1, Nepal 1, Bhutan 1)

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

C. Other remarks

Tanisaka, T.: "The Ministry of Education, Science and Culture", Member of textbook authorization committee, 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 : (3) *Research student : (1)*
Master's Program : (9)
Undergraduate : (4)

A. Research Activities (2005.4-2006.3)

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) 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.

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) 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.

A-2. Publications and presentations

a) Publications

Books

Hayashi, T. 2005. Light and agriculture. p.466-467. In: Frontiers in Optical Science. Japan Intense Light Field Science Society, Tokyo.

Original papers

Kesmawati, E., T. Kimata, T. Uemachi, M. Hosokawa and S. Yazawa. 2006. Correlation of phytoplasma concentration in *Hydrangea macrophylla* with green-flowering stability. Sci. Hort. 108: 74-78.

Hosokawa, M., Y. Matsushita, H. Uchida and S. Yazawa. 2006. Direct RT-PCR method for detecting two chrysanthemum viroids using minimal amounts of plant tissue. J. Virol. Meth. 31: 28-33.

Haramizu, S., W. Mizunoya, Y. Masuda, K. Ohnuki, T. Watanabe, S. Yazawa and T. Fushiki. 2006. Capsiate, a nonpungent capsaicin analog, increases endurance swimming capacity of mice by stimulation of vanilloid receptors. Biosci. Biotechnol. Biochem. 70: 774-781.

Hosokawa, M., Y. Matsushita, K.Ohishi and S. Yazawa. 2005. Elimination of chrysanthemum chlorotic mottle viroid (CChMVd) recently detected in Japan by leaf-primordia free shoot apical meristem culture from infected cultivars. J. Japan. Soc. Hortic. Sci. 74: 386-391.

Reviews

Maeda, M., H. Yoneda, M. Hosokawa, T. Hayashi, T. Watanabe, S. Yazawa. 2006. Changes of novel capsaicinoid like substance, capsinoid content and morphological change of the placenta tissue during'CH-19 sweet'(*Capsicum annuum* L.) fruit development, and the influence of fruit storage condition on capsinoid content. Bulletin Exp. Farm, Kyoto University 15: 5-10.

b) Conference and seminar papers presented

2005 Spring Meeting of the Japanese Society for Horticultural Science (6 presentations)

2005 Autumn Meeting of the Japanese Society for Horticultural Science (6 presentations)

2005 Kinki-branch meeting of the Japanese Society for Horticultural Science (4 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: Scientific Research (B): Optical analysis of the color generation mechanism in petals and gene transformation for diverse flower color (Leader: Hayashi), Exploratory Research: Creation of useful potted ornamental plants with aromachological functions (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), Scientific Research (B): Viroid acting as a functional RNA in plants - Molecular biological elucidationof the flowering mechanism (Leader: Hosokawa)

The agriculture-and-forestry fishery research highly advanced enterprise commission utilized advanced technology: Development of the disease-free chrysanthemum transplants production system by a new culture method, shoot regeneration from a leaf primordia-free shoot apical meristem dome attached to a root tip (Leaders: Yazawa and Hosokawa), Establishment of a new production system for disease-free transplants and its practical use (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 (2005.4-2006.3)

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).

Hayashi, T.: External member of special committee to promote flower production in Kinki, Chugoku and Shikoku region (the Ministry of Agriculture, Forestry and Fishery).

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: (4)
Master's Program: (6)
Undergraduate : (5)

A. Research Activities (2005.4-2006.3)

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 both the pistil determinant (S-RNase gene) and the pollen determinant (S haplotype-specific F-box protein gene) of the self-incompatibility reaction. We are now on the way to elucidate the molecular basis of the self and nonself recoginition system in *Prunus*.

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) Dormancy in temperate fruit tree

Bud dormancy in deciduous fruit tree species is a complex process necessary for plant survival in the unfavorable environment. Once formed in summer, buds enter a endodormant state and require a certain amount of cold temperatures to resume growth in a favorable environment. Recent global warming potentially causes serious problem such as irregular or loss of flowering. We are trying to find the internal factors or external signals controlling endodormancy.

f) 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

Beppu, K., N. Komatsu, H. Yamane, H. Yaegaki, M. Yamaguchi, R. Tao, and I. Kataoka: S^e-haplotype confers self-compatibility in Japanse plum (Prunus salicina Lindl.). J. Hortic. Sci. and Biotech. 80; 760-764, 2005

Esumi, T., R. Tao, and K. Yonemori: Isolation of LEAFY and TERMINAL FLOWER 1 homologues from six fruit tree species in the subfamily Maloideae of the Rosaceae. Sex. Plant Reprod. 17; 277-287, 2005

Honsho, C., K. Nishiyama, W. Eiadthong, and K. Yonemori: Isolation and characterization of new microsatellite markers in mango (Mangifera indica). Molecular Ecological Notes 5;152-154, 2005

Iezzoni, A.F., R.L. Andersen, H. Schmidt, R. Tao, K.R. Tobutt, and P.A. Wiersma: Proceedings of the S-allele workshop at the 2001 International Cherry Symposium. Acta Hortic. 667; 25-35, 2005

Ikeda, K., K. Ushijima, H. Yamane, R. Tao, N.R. Hauck, A.M. Sebolt, and A.F.Iezzoni: Linkage and physical distances between the S-haplotype S-RNase and SFB genes in sweet cherry. Sex. Plant Reprod. 17; 289-296, 2005

Ikegami, A., A. Kitajima, and K. Yonemori: Inhibition of flavonoid biosynthetic gene expression coincides with loss of astringency in pollination-constant, non-astringent (PCNA)-type persimmon fruit. J. Hort. Sci. Biotech. 80; 225-228, 2005

Ikegami, A., A. Sato, M. Yamada, A. Kitajima, and K. Yonemori: Molecular size profiles of tannins in persimmon fruits of Japanese and Chinese pollination-constant non-astringent (PCNA)-type cultivars and their offspring revealed by size-exclusion chromatography. J. Japan. Soc. Hort. Sci. 74; 437-443, 2005

Ikegami, A., K. Yonemori, A. Kitajima, A. Sato, and M. Yamada: Expression of genes involved in proanthocyanidin biosynthesis during fruit development in a Chinese pollnation-constant, nonastringent (PCNA) persimmon, 'Luo Tian Tian Shi'. J. Amer. Soc. Hort. Sci. 130; 830-835, 2005

Yamane, H., S-J. Lee, B-D. Kim, R. Tao, and J.K.C. Rose: A coupled yeast signal sequence trap and transient plant expression strategy to identify genes encoding secreted proteins from peach pistils. J. Exp. Bot. 56; 2229-2238, 2005

Yamada, A., R. Tao and A. Sugiura: Influence of low temperature before flowering on the occurrence of p unreduced ollen in Japanese persimmon (Diospyros kaki Thunb.). HortScience 40; 24-28, 2005

Yonemori, K., A. Ikegami, A. Kitajima, A. Sato, M. Yamada, Z. Luo, Y. Yang, R. Wang, and S. Kanzaki: Existence of several pollination constant non-astringent type persimmons in China. Acta Hort. 685; 77-83, 2005

b) Conference and seminar papers presented

Spring meeting of the Japanese Society for Horticultural Science: 6 presentations

Autumn meeting of the Japanese Society for Horticultural Science: 6 presentations

5th International Cherry Symposium: 2 presentations

Interantional Symposium on Biotechnology of Temperate Fruit Crops and Tropical species: presentations

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) (2) Molecular basis 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.), Scientific Research (B) for Young Scientist. Seasonal expression of cell-cycle related genes related to dormancy status of winter buds of deciduous fruit trees. (Yamane, H.)

JSPS Japan-Spain Collaboration Research Project. Identification of the pollen component of gametophytic self-incompatibility in Prunus (Leader Tao, R.).

JSPS Japan-US Coperative Science Program: Molecular mechanism of self-compatibility in peach. (Leader Yamane, H.)

A-4. International cooperation and overseas activities

International meetings (roles)

Tao, R.: Interantional Symposium on Biotechnology of Temperate Fruit Crops and Tropical species (Scientific Committee)

Joint researches, overseas research surveys

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

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

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)

Yamane, H: Molecular mechanism of self-compatibility in peach (USA)

B. Educational Activities (2005.4-2006.3)

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), Pomology (Advanced Course) (Yonemori), Special Laboratory Work in Pomology (Yonemori, Tao)

B-2. Off-campus teaching, etc.

Part-time lecturer

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

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

Chair of Agricultural Ecology

2.1.5 Laboratory of Weed Science

Staff *Professor* : *Tominaga, Tohru, Dr. Agric. Sci.*
Lecturer : *Miura, Reiichi, Dr. Agric. Sci.*
Assistant Professor : *Wang, Guang-Xi, Dr. Agric. Sci.*

Students and research fellows

Research fellow:	*(1)*	*Doctor's program:*	*(5)*
Master's program:	*(4)*	*Undergraduate :*	*(2)*
Research student :	*(1)*		

A. Research Activities (2005.4-2006.3)

A-1. Main subjects

a) Molecular and ecological analyses of herbicide resistance of paddy weeds

Repeated field applications of acetolactate synthase (ALS)-inhibiting herbicides have resulted in selection of resistant biotypes within more than 90 weed species throughout the world. Objective of this research is to analyze mechanisms of the ALS resistance with molecular and ecological techniques by using three paddy species: *Monochoria korsakowii*, *M. vaginalis* and *Limnophila sessiliflora*. In this research, we found that (1) some strains originated from a preexisting and preadapted mutant *M. vaginalis* population with lower genetic variation, whereas some strains originated from multiple mutants which showed higher genetic variation in Japan; (2) the resistant biotypes had naturally mutated ALS genes resulting a substitution of Pro (in susceptible biotypes) for other amino acid (in resistant biotypes) in Domain A of ALS, and (3) the experiment on inheritance of ALS-inhibiting resistance is in progress.

b) Discovery of single-nucleotide mutaions in ALS genes by Ecotilling

Target site insensitivity is the most commonly reported mechanism of herbicide resistance. Target site resistance involving a single-nucleotide change and usually dominant genetics is easily selected. In addition, target site changes often provide high levels of resistance. A number of techniques for identifying single-nucleotide mutations have been developed but all have their limitations and are relatively expensive and laborious when applied to multiple loci in large numbers of individuals. In this research, we developed a new Ecotilling method for rapid detectioin of single-nucleotide mutations in ALS genes with the cooperation of Elizabeth Macarthur Agricultural Institute, Australia.

c) Ethnobotanical and genecological studies on the evolution of mimicry to wheat and barley in darnel

The agro-ecological field exploration was made in north-eastern parts of Greece The origin of darnel was analyzed by using field collections of this weed from eight countries. The inheritance mode of shattering and plant type was investigated by using the hybrids between darnel and *Lolium persicum*.

d) Ecological genetics of the crop-weed complex of pearl millet

Pearl millet fields of West Africa are almost invariably infested with a large population of

weedy pearl millet bearing shattering ears. Our genetic analysis revealed that these two types form a single breeding unit and in a state of balanced polymorphism, and that the "weed" type is actually a heterozygote arising from sown crop seed; which makes its eradication impractical.

A-2. Publications and presentations

a) Publications

Original papers

Senda, T., T. Ohsako and T. Tominaga: Genetic relationships and intra-specific variation of *Lolium temulentum* and *L. persicum*. Canadian Journal of Plant Science, 85 (4), 963-970, 2005

Senda, T., Y. Hiraoka and T. Tominaga: Plant type and seed dormancy in interspecific hybrids between *Lolium temulentum* and *L. persicum*. Journal of Weed Science and Technology 50 (4), 292-295, 2005 (in Japanese)

Miura, R. and R. Terauchi: Genetic control of weediness traits and the maintenance of sympatric crop-weed polymorphism in pearl millet (*Pennisetum glaucum*). Molecular Ecology 14, 1251-1261, 2005

Wang, G.-X., W. Li, X.-C. Wan and K. Itoh: Taxonomy of the genus *Monochoria* (Pontederiaceae) in Asia. In: Current Topics in Plant Biology (ed. by R. Richard). Research Trends, Trivandrum, pp. 39-52, 2005

Ito K., M. Ito, O. Huseyin, S. Tanaka, R. Miura and T. Anzai: Control of horsenettle regeneration from root fragments with Chlorpropham. Journal of Weed Science and Technology 50 (3), 176-183, 2005 (in Japanese)

Yuna, M. S., Y. Yogo, R. Miura, Y. Yamasue and A. J. Fischer: Cytochrome P-450 monooxygenase activity in herbicide-resistant and -susceptible late watergrass (*Echinochloa phyllopogon*). Pesticide Biochemistry and Physiology 83, 107-114, 2005

Others

Miura, R., S. Tobita *et al.*: Fakara Plants -A Photographic Guide to Common Plants of Sahel (Online). Japan International Research Center for Agricultural Sciences (http://ss.jircas.affrc.go.jp/ index.html), 2005

Miura, R.: Hoe weeding in the savanna zone of West Africa. Journal of Weed Science and Technology 50 (4), 327-328, 2005 (in Japanese)

Wang, G.-X.: Sleuthing weed resistance genes. Agriculture Today, Australia (NSW Department of Primary Industries research, advisory and management newspaper) July 28, 2005

b) Conference and seminar papers presented

The 44th Annual Meeting of the Weed Science Society of Japan: 5 presentations

The 20th Asian-Pacific Weed Science Society Conference: 1 presentation

The 2005 Annual Triticeae Meeting of Japan: 1 presentation

A-3. Off-campus activities

Membership in academic societies

Tominaga, T.: Weed Science Society of Japan (Councilor, Editorial Board member, Terminology Committee 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

JSPS Research Grant: Grant-in-Aid for Scientific Research (C) Ecological and genetic characteristics of sulfonylurea-resistant Monochoria vaginalis, a paddy weed (Leader: Tominaga, T.); Grant-in-Aid for Scientific Research (A) Genecological study on the relationships among man, crop and weed in agro-ecosystems (Collaborator: Tominaga, T.); Grant-in-Aid for Scientific Research (C) New approaches in field science (Collaborator: Tominaga, T.); Grant-in-Aid for Scientific Research (B) Structure and function of the "weediness supergene" responsible for the crop-weed balanced polymorphism in pearl millet (Leader: Miura, R.)

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)

Tominaga, T.: The 20th Asian-Pacific Weed Science Society Conference, Ho Chi Minh, Vietnam

International joint researches, overseas research surveys

Tominaga, T.: Genecological study on the relationships among man, crop and weed in agro-ecosystems (Thessaloniki University, Greece)

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 (2005.4-2006.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Weed Science I (Tominaga), Weed Science II (Tominaga, Miura), Laboratory Course for Bioresource Science (Tominaga, Miura, Wang), Seminar (Tominaga), Introduction to Research (Tominaga, Miura, Wang), Outline of Bioresource Science I (Tominaga)

Graduate level: Weed Science Advanced Course (Tominaga), Seminar (Tominaga, Miura), Special Laboratory Work in Weed Science (Tominaga, Miura), Thesis (Tominaga, Miura, Wang)

B-2. Off-campus teaching, etc.

Part-time lecturer

Tominaga, T.: Tottori University (Special Lecture on Plant Production Science I)

Tominaga, T.: Kinki University (Special Lecture on Weed Science)

Invited lecture

Tominaga, T.: The 9th Open Seminor of the Experimental Farm of Kyoto University

B-3. Overseas teaching

Students and research fellows from abroad

Graduate student: 1 (China)

C. Other remarks

Tominaga, T.: Research Institute for Humanity and Nature (Project member)

Miura, R.: National Museum of Ethnology (Project member); Research Institute for Humanity and Nature (Project member)

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

2.1.6 Laboratory of Plant Production Systems

Staff *Professor* *: Yamasue, Yuji, ph.D.*

Associate Professor: Inamura, Tatsuya, Dr. Agric. Sci.

Assistant Professor : Inoue, Hiromo, M. Agric. Sci

Students and research fellows

Doctors program : (3)

Masters program : (9)

Undergraduate : (4)

A. Research Activities (2005.4-2006.3)

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.

We investigated effect of the change of agricultural systems with socialist market economy on the physicochemical property of paddy field in the southwestern inland region of China. There was a trend that in villages nearby market, cash crops such as vegetables and fruits were increasingly planted for the farmers to increase their gross income. This trend has brought quality of paddy soil management less than before and increased arable land utilization and land use as upland fields for the cash crops. As this result, the paddy soils become to deteriorate in physicochemical properties, and it is therefore required to avoid the soil deterioration by adopting a rational soil management. Cash crops such as vegetables, fruits and tobacco have been also introduced to villages far from market, but do not well spread yet.

It is partially due to insufficient cultivation techniques and to difficulty in finding the market. They secure gross income by temporary works outside villages. It is concluded that road network construction for expanding the market as well as improvement of the cultivation techniques are help farmers to plant cash crops in villages far from the market.

2) Possibility of the Variable Rate Management.

Sources of the variation of wheat yield in paddy-upland rotational fields (rice-wheat-soybean) were clarified to evaluate the variable rate management that implements the site-specific input of agricultural materials, e.g. fertilizer and seed, in proportion to the variation of these sources in the field for maximum yield. The number of panicles was the largest source of variation contributing to wheat yield among the three yield components (number of panicles, thousand-grain weight and number of ripened grain per panicle). This result proposed the number of panicles as a criterion of variable rate management for maximizing yield. The number of panicles was controlled by the seeding rate through the effects of the number of establishment, the amount of nitrogen accumulated in aboveground biomass at spikelet initiation stage and the number of tillers, and in addition, it was seemed to be controlled by the soil moisture percentage at seeding through the effects of the pulverization ratio and the emergence depth. Therefore, it is suggested that a possibility of proper management of variable rate seeding in proportion to the soil moisture percentage on dried soil basis at seeding in the field brings the adequate number of panicles in the field for the maximizing the yield. This variable rate management may control the 40.8% of the controllable proportion to total variation of wheat yield in the field.

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

1) Reduction of cadmium contamination in brown rice by methane-fermented manure liquid.

Reduction of low-level Cadmium contamination in brown rice was examined under three nitrogen fertilization conditions: application of methane-fermented manure liquid (MF), application of ammonium sulfate fertilizer (CF) and no nitrogen fertilization (NF). Rice was grown in the pots with gray lowland soil and andosol amended with cadmium (Cd) at the concentration of 2 and 5 ppm, respectively, and fertilized as above. Several parameters including soil redox potential (Eh), amount of Cd absorbed by rice plants and its partition to brown rice, were periodically determined during the growth. In both gray lowland soil and andosol, soil Eh was significantly lower in MF than in CF and NF during the growth period from panicle initiation to heading, and Cd absorption by rice plants and Cd allocation to brown rice were also lower in MF than in CF and NF. Split application of MF resulted in a lower Cd concentration in brown rice than basal application without reducing brown rice weight. These results suggested that applying MF, in both kinds of soils, reduces the low-level Cd contamination in brown rice.

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

1) Factors for wide regional adaptability for cultivation in rice variety “Hinohikari”.

Rice cultivar “Hinohikari” is one of the most popular varieties cultivated in the southwest warm region in Japan. Genetical analysis for heading time gene locus, *Se1*, in Hinohikari was carried out and the process in performance test for recommendable varieties about Hinohikari at the southwest warm region in Japan was investigated. It was revealed that Hinohikari harbors the same early-heading allele on the *Se1* locus as Nipponbare, one of the most popular varieties in the southwest warm region in Japan. As the market price of Hinohikari

and the ratio of area under cultivation on Hinohikari were investigated, it was revealed that the ratio of area under cultivation changed with the fluctuation of the market price of Hinohikari and that at present the ratio of area under cultivation did not increase because of the fall tendency of the market price. From the above fact, not only genetic region adaptability but also the fluctuation of the market price must be considered for making to spread in the paddy rice.

A-2. Publications and presentations

a) Publications

Books and reviews

Inamura, T.: Plant production systems. p.1-195, Asakura, Japan, 2005

Original papers

Hirai, G., H. Nishioka, N. Yamamoto, T. Okumoto, S. Ogura, K. Ashida and T. Inamura: Differences between Nipponbare and IR24 rice in the response of stomatal density to atomospheric saturation deficiency and day length. Kinki Journal of Crop Science and Breeding, 50, 75-77, 2005.

Hirai, G., N. Yamamoto, H. Nishioka, T. Okumoto and T. Inamura: Growth of Japonica-type rice Nipponbare and Indica-type rice IR24 under various atomospheric saturation deficiency condition. Kinki Journal of Crop Science and Breeding, 50, 49-53, 2005.

Ikenaga, S., N. Matsumoto, H. Inoue and T. Inamura: Yearly and field variations of paddy-upland rotation fields in nitrogen mineralization and nitrogen absorption by rice in paddy-upland rotational fields. Japan Journal of crop sci., 74(3), 291-297, 2005

Maruyama, A., T. Inamura, G. Li, X. Bu, D. Qin, Y. Xiang, H. Inoue, J. Shen, J. Wan and T.Amano: Effect of the change of agricultural systems with socialist market economy on the physicochemical property of paddy field －A case study at Renho district in Panzhihua, Sichuan in southwestern region of China. Kinki Journal of Crop Science and Breeding, 50, 27-30, 2005

Min-Soo Yun, Y. Yogo, R. Miura, Y. Yamasue and A. J. Fischer: Cytochrome P450 monooxygenase activity in herbicide-resistant and -susceptible late watergrass (*Echinochloa phyllopogon*), Pesticide Biochemistry and Physiology 83: 107-114, 2005

Tabata, Y., M. Kitagawa, T. Inamura, J. Ishida and H. Hirooka: Farm level nitrogen utilization and cycling in the mixed farming system of beef fattering and rice production. Animal Science Journal. 76(3), 321-330, 2005

b) Conference and seminar papers presented

The 221th Ann Meet. of Crop Sci. Soc. of Japan (4 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

Research Grant of Japanese Sciece Promotion Society (JSPS): 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 (B) (2) "Development of the variable rate management in proportion to the specific variation of soil and crop growth properties and yield on village farm" (Leader Inamura, T., collaborator Inoue, H.), Grant-in-Aid for Scientific Research (B) (2) "The research on systematization of conservational animal industry for cooperating crop farming with animal industry, and it's evaluation" (collaborator Inamura, T.)

Research from National Agricultural Research Organization: "Variable rate applicator for wheat seeding and fertilizing in crop rotation fields" (collaborator Inamura, T.)

Research from Ministry of Agriculture, Forestry and Fisheries: "Evaluation of effect of methane-fermentation digester application as liquid fertilizer" (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 (2005.4-2006.3)

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.: Experimental Farm (Member of council)

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 : (8)
Undergraduate : (4) *Research student : (1)*

A. Research Activities (2005.4-2006.3)

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, banbara bean 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 for transpotation from the ER to the vacuole are in progress based on their three dimensional structures. We have found that the C-terminal 10 amino acid residues contain C-termiral and sequence specific type sorting signals and glycinin contains C-terminal and structural type signals.

A-2. Publications and presentations

a) Publications

Original papers

Kang, Y., A. Tanabe, M. Adachi, S. Utsumi, and B. Mikami: Structural analysis of threonine 342 mutants of soybean-amylase: Role of a conformational change of the inner loop in the catalytic mechanism. Biochemistry 44; 5106-5116, 2005

Prak, K., K. Nakatani, T. Katsube-Tanaka, M. Adachi, N. Maruyama, and S. Utsumi: Structure-function relationship of soybean proglycinins at subunit level. J. Agric. Food Chem. 53; 3650-3657, 2005

Fukuda, T., N. Maruyama, A. Kanazawa, J. Abe, Y. Shimamoto, M. Hiemori, H. Tsuji, T. Tanisaka, and S. Utsumi: Molecular analysis and physicochemical properties of electrophoretic variants of wild soybean Glycine soja storage proteins. J. Agric. Food Chem. 53; 3658-3665, 2005

Demirkan, S. E., B. Mikami, M. Adachi, T. Higasa, and S. Utsumi: α-Amylase from *B. amyloliquefaciens*: purification, characterization, raw starch degradation and expression in E. coli. Process Biochemistry. 40; 2629-2636, 2005

Ban, M., H.-J. Yoon, E. Dermirkan, S. Utsumi, B. Mikami, and F. Yagi: Structural basis of a fungal galectin from Agrocybe cylindracea for recognizing sialoconjugate. J. Mol. Biol. 351; 695-706, 2005

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Yoon, H.-Y., M.-J. Ku, H. Juu, B.-I. Lee, B. Mikami and W. Suh: Crystallization and preliminary X-ray crystallographic analysis of UDP-N-acetylglucosamine enolpyruvyl transferase from Haemophilus influenzae in complex with UDP-N-acetylglucosamine and fosfomycin. Mol. Cells., 19; 398-401, 2005

Mori, S., M. Yamasaki, Y. Maruyama, K. Momma, S. Kawai, W. Hashimoto, B. Mikami and K. Murata: NAD-binding mode and the significance of intersubunit contact revealed by the crystal structure of Mycobacterium tuberculosis NAD kinase-NAD complex. Biochem.

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Yamasaki, M., K. Ogura, W. Hashimoto, B. Mikami and K. Murata: A structural basis for depolymerization of alginate by polysaccharide lyase family-7. J. Mol. Biol. 352; 11-21, 2005

Mizutani, K., B. Mikami, S. Aibara and M. Hirose: Structure of aluminium-bound ovotransferrin at 2.15 Angstroms resolution. Acta Crystallogr. D 61; 1636-1642, 2005

Suzuki, M., Y. Tanaka, S. Korematsu, B. Mikami and N. Minato: Crystal structure and some properties of a major house dust mite allergen, Derf 2. Biochem. Biophys. Res. Commun. 339; 679-686, 2006

Aso, Y., Y. Miyamoto, K.-M. Harada, K. Momma, S. Kawai, W. Hashimoto, B. Mikami and K. Murata: Engineered membrane superchannel improves bioremediation potential of dioxin-degrading bacteria. Nature Biotech. 24; 188-189, 2006

Reports

Fukuda, T., A. Kimura, N. Maruyama and S. Utsumi: Structure-function relationships of legume seed strage proteins. FFI Journal 210; 1039-1047, 2005

Maruyama, N., A. Oita, K. Nishizawa and S. Utsumi: Structure of vacuolar sorting determinant of soybean β-conglycinin. Soy Protein Res. 8; 19-23, 2005

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. 14; 2004B, 172, 2005

Maruyama, Y., 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. 14; 2004B, 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. 14; 2004B, 295, 2005

b) Conference and seminar papers presented

The Annual Meeting (2006) of Japan Society for Bioscience, Biotechnology, and Agrochemistry (20 papres)

The 6th Kyoto University International Symposium: Plant Sciences in Japan and China-from Genomics to Breeding: 2 papers

The 69th Annual Meeting of the Botanical Society of Japan: 1 paper

26th Annual Meeting of Seed Physiology and Biochemistry: 1 paper

The 21st Century COE Program Symposium (Nagoya University): 1 paper

8th Annual Meeting of the Soy Protein Committee: 1 paper

The 439th Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai District (1 paper)

The 443th Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai District (1 paper)

The Annual Meeting of the Society for Biotechnology Japan, 2005 (2 papers)

The Joint Meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai, Chu-Shikoku and Nishi-Nippon Districts, 2005 (2 papers)

The Annual Meeting of the Japanese Biochemical Society (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: Development of efficient breeding techniques based on genomic breeding (Collaborator Utsumi, S.)

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: The Salt Science Research Foundation (Leader Utsumi, S.), The Japan Food Chemical Research Foundation (Leader Utsumi, S.), Takano Life Science Research Foundation (Leader Utsumi, S.), Fuji Foundation for Protein Research (Leader

Maruyama, N.)

A-4. International cooperations and overseas activities

International meetings (roles)

Utsumi, Shigeru: The 6th Kyoto University International Symposium: Plant Sciences in Japan and China-from Genomics to Breeding, Beijin (1 paper)

Mikami, Bunzo: The 20th International Crystallographic Meeting (1 regular paper)

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 (2005.4-2006.3)

B-1. On-campus teaching

a) Courses given

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

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

B-2. Off-campus teaching, etc.

Part-time lecturer

Utsumi, S.: 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), Faculty of Life and Environmental Science, Shimane University (Food Biochemistry)

Mikami, B.: Department of Agricultural Sciences; Kobe University, Faculty of Agriculture, Department of Agricultural Sciences; Nagoya University, Faculty of Agriculture, Department of Agricultural Sciences; Kyoto Prefectural 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, Cambodia, Indonesia, Malaysia)

2.1.8 Laboratory of Quality Analysis and Assessment

Staff *Professor* *: Matsumura, Yasuki, Dr. Agric. Sci.*
Associate Professor: Hayashi, Yukako, Dr. Agric. Sci.,
Assistant Professor : Matsumoto, Shinya, Dr. Agric. Sci.
Students and research fellows
Doctor's program : (6)
Master's program : (8)
Undergraduate : (3)

A. Research Activities (2005.4-2006.3)

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. 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 taste perceptional mechanisms are focused and studied by the electrophysiological (taste cell patchclamp and nerve recordings) and biochemical techniques (optical calcium imaging and immunoassaying methods) using mice and humans.

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 Caenorhabditiselegans 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 has been studied using worm.

A-2. Publications and presentations

a) Publications

Original papers

Minamisawa, E., Sawano, S., Hayashi, Y: Bitter taste recognition after transaction of taste nerves in C57BL/6J mice. Japanese J. Taste and Smell Res. **12**; 369-372 (2005)

Narukawa, M., Miyamoto, N., Hayashi, Y: Perception of Giα family I umami transduction. Japanese J. Taste and Smell Res. **12**; 319-320 (2005)

Sawano, S., E. Seto, T. Mori and Y. Hayashi: G-protein-dependent and -independent mechanisms in denatonium signal transduction. Biosci, Biotechnol. Biochem., 69, 1643-1651 (2005)

Park, E-Y., H. Murakami and Y. Matsumura: Effects of the addition of amino acids and peptides on lipid oxidation in a powdery model system. J. Agric. Food Chem., 53 (21); 8334-8341 (2005)

Reports

Hayashi, Y.: Approach to elucidate the factors for fat taste perception. Urakami Foundation memories "20nenn no ayumi", 103 (2005)

b) Conference and seminar papers presented

The Annual Meeting of Japan Society for Bioscience, Biotechnology and Agrochemistry 2005: 6 subjects

The Annual Meeting of Japanese Society for Food Science and Technology: 3 subject

The 39th JASTS Annual Meeting: 4 subjects

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

15th International Worm Meeting: 1 subject

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), Japan Society for Bioscience, Biotechnology and Agrochemistry (Editorials Committee)

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

Research grants

Monbusho Reseach Grant:

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)

Hayashi, Y: The 3rd International Symposium on Molecular and Neural Mechanisms of Taste and Olfactory Perception & YR Umami Forum 2005 (Fukuoka, Japan, discussant)

Matsumoto, S.: 15th International Worm Meeting (Los Angeles, USA, speaker)

B. Educational Activities (2005.4-2006.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Food Quality Science (Matsumura, Y.), Quality Analysis and Assessment (Matsumura, Y., Hayashi, Y.), Basic Bioresource Science I (Hayashi, Y.), Laboratory Course in Bioresource Science I, II (Matsumura, Y., Hayashi, Y., Matsumoto, S.)

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

Matsumoto, S: Mukogawa Women's University The Junior College Division (Basic Nutrition)

B-3. Overseas teaching

Students and research fellows from abroad

Doctor's program: 3 (China2, Malaysia1,)

Master's program: 1 (Brazil1)

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, Dr.Agric.Sci.
Assistant Professor : Kataoka, Keiko, Dr.Agric.Sci.
Assistant Professor : Matsui, Tsutomu(～2005.9.30), Dr.Agric.Sci.
Assistant Professor : Teraishi, Masayoshi, Dr.Agric.Sci.
Assistant Professor : Fudano,Takashi, M.Agric.Sci.
Assistant Professor : Habu,Tsuyoshi, M.Agric.Sci.
Assistant Professor : Katsura,Keisuke(2005.11.1～), M.Agric.Sci.

Students and research fellows
Doctor's Program : *(2)*
Master's Program : *(7)*
Undergraduate : *(2)*

A. Research Activities (2005.4-2006.3)

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, although 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 determined the *S*-genotypes of fifteen 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) Identification of the scab resistant gene

Pear scab caused by *Venturia nashicola* Tanaka et Yamamoto is one of the most serious diseases in Japanese pear, because all commercial cultivars of Japanese pear are susceptible. Thus, an application of fungicides has been required to control pear scab. On the other hand, Japanese pear cultivar 'Kinchaku', some Chinese pear cultivars as 'Hong-li' and some European pear cultivars as 'La France' are highly resistant to *V. nashicola*. The previous studies demonstrated that the scab resistance of 'Kinchaku' and Chinese pear cultivars is controlled by a single dominant gene and that the scab resistant gene of European pear is located on different locus from that of Asian pears. However, both of the scab resistant genes have not been identified. Thus, we attempt to identify the scab resistant gene of Asian pears. In this year, we carried out the micropropagation of F1 seedlings of 'Hong-li' (highly resistant cultivar) x 'Kikusui' (susceptible cultivars) and 'Hong-li' x 'Osa-nijusseiki' (susceptible cultivar), and the isolation of *V. nashicola*.

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) Transposable elements in soybean genome.

We are identifying some transposable elements in soybean genome. We try to find elements potential to transpose and reveal composition and variation among soybean varieties.

j) 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 high temperature on fruit growth and sugar accumulation. In this year, we evaluated the effect of gibberellin added to 4-CPA solution, treated at anthesis for inducing fruit set and growth, on sugar accumulation with maturing.

k) 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

Ikegami, A., A. Kitajima and K. Yonemori: Inhibition of flavonoid biosynthetic gene expression coincides with loss of astringency in pollination-constant, non-astringent (PCNA)-type persimmon fruit. J. Hort. Sci. Biotech. 80; 225-228, 2005

Ikegami, A., A. Sato, M. Yamada, A. Kitajima and K. Yonemori: Molecular size profiles of tannins in persimmon fruits of Japanese and Chinese pollination-constant non-astringent (PCNA)-type cultivars and their offspring revealed by size-exclusion chromatography. J. Japan. Soc. Hort. Sci. 74; 437-443, 2005

Ikegami, A., K. Yonemori, A. Kitajima, A. Sato and M. Yamada: Expression of genes involved in proanthocyanidin biosynthesis during fruit development in a Chinese pollnation-constant, nonastringent (PCNA) persimmon, 'Luo Tian Tian Shi'. J. Amer. Soc. Hort. Sci. 130; 830-835, 2005

Horie, T., T. Shiraiwa, K. Homma, K. Katsura, S. Maeda and H. Yoshida: Can yields of lowland rice resumes the increases that they showed in the 1980s? Plant Prod. Sci. 8; 259-274, 2005

Horie, T., H. Yoshida, S. Kawatsu, K. Katsura, K. Homma, and T. Shiraiwa: Effects of elevated atmospheric CO_2 concentration and increased temperature on rice; Implications for Asian rice production. Proc. World Rice Research Conference, Tsukuba, November 2004, IRRI. 536-539, 2005

Matsui, T., K. Kobayashi, H. Kagata and T. Horie: Correlation between viability of pollination and length of basal dehiscence of the theca in rice under a hot-and-humid condition. Plant Prod. Sci. 8; 109-114, 2005

Nishikawa, K., K. Kusumi, T. Sakakibara, K. Kataoka: Effects of rooting zone restriction on yield and fruit quality in parthenocarpic tomato cultivars: 'Kyotemari' and 'Kyoakane'. Bulletin Exp. Farm, Kyoto University 14; 1-5, 2005

Kusumi, K., K. Nishikawa, T. Sakakibara, K. Kataoka: The effect of plant growth regulators on a propagated *Dioscorea alata* cutting. Bulletin Exp. Farm, Kyoto University 15; 1-4, 2006

Reviews

Yamada, T.: Present status and the future perspectives of agriculture and food in Japan. Kinki Journal of Crop Science and Breeding 50; 5-14, 2005

Report

Kishida, F., A. Yamasaki, T. Habu, T. Konishi, M. Morikita, M. Matsuda and A. Kitajima: Study of seedless cultivation in short pruning grapevine 'Kyoho'. Bulletin of Experimental Farm, Kyoto University 15; 11-14, 2006

Nonaka, K., N. Nara, K. Ohtsu and T. Fudano: The effects of uniconazole-P treatments on growth and fruiting in potted *Capsicum baccatum* var. *pendulum* 'UFO'. Bulletin of

Experimental Farm, Kyoto University 15, 17-19. 2006

Nara, N., K. Nonaka and T. Fudano: The effects of 5-aminolevulinic acid on growth of *Phalaenopsis*. Bulletin of Experimental Farm, Kyoto University 15, 20-22. 2006

b) Conference and seminar papers presented

The 107&108th meeting of Japanese Society for Breeding Science : 2 presentations

The 219th meeting of Japanese Society for Crop Science : 2 presentations

The 220th meeting of Japanese Society for Crop Science : 2 presentations

2005 Spring Meeting of the Japanese Society for Horticultural Science : 2 presentations

2005 Autumn Meeting of the Japanese Society for Horticultural Science : 5 presentations

2005 Meeting of Kinki branch of the Japanese Society for Hoticultural Science : 5 presentations

Plant and Animal Genome XIII : 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) 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 pollen determinant of gametophytic self-incompatibility in *Maloideae* (leader: Habu), Scientific Research (C) Clarification of the mechanism of high temperature-induced floret sterility in rice(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

Joint researches, oversea research surveys

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

B. Educational Activities (2005.4-2006.3)

B-1. On-campus teaching

a) Courses given

Undergraduate level: Agricultural Technology and Farm Practice (Yamada, Kitajima, Kataoka, Matsui, Teraishi, Fudano, Habu, Katsura), 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 (Yamada), Introduction to Research (Yamada, Kitajima, Kataoka, Matsui, Teraishi, Fudano, Habu, Katsura)

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, Katsura)

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 9th 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.