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 Kii-Oshima Research Station of Field Science Education and Research Center.

Sixty and forty graduate students, including twelve foreign graduate students, are enrolled in Master's and Doctor's Programs, respectively. Two research fellows and three research students have also worked in the Division in 2007.

Chair of Crop Science

2.1.1 Laboratory of Crop Science

Staff Professor : Shiraiwa, Tatsuhiko, Dr. Agric. Sci. Associate Professor : Katsube-Tanaka, Tomoyuki, Dr. Agric. Sci. Assistant Professor : Homma, Koki, Dr. Agric. Sci. Secretary : Otaka, Toyoko Students and research fellows Doctor's Program : (3) Master's Program : (6) Undergraduate : (2)

```
Guest scholar : (1)
Special Research Strudent : (1)
```

A. Research Activities (2007.4-2008.3)

A-1. Main subjects

a) Identification, genotypic evaluation and simulation-modelling 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 conducted field experiment using Rice Diversity Research Set of germplasm (RDRS) selected by NIAS and have reported several traits associated with yield potential. Analysis of genetic variability in leaf photosynthetic ability (Pn) and associated factors revealed that some local varieties were promising for breeding, and that stomatal conductance and leaf nitrogen concentration was significantly different among genotypic groups which were classified by DNA markers. We also developes a rice crop simulator to interface gene functions to field performances based on the results in a multi-site experiment conducted under diverse environments in Asia. The processes of spikelet production and leaf area development have been modeled.

b) Improving productivity and sustainability of rain-fed rice culture in the world

More than half of rice cropping lands in the world is still under rain-fed condition. We have conducted the field surveys on constraints of rice production in rain-fed paddy culture and upland culture in North-east Thailand, North Laos and Madagascar. The surveys in Thailand and Laos demonstrated that inappropriate land and soil managements have caused serious degradation of soil fertility and decline of productivity. In order to improve the productivity, introduction of legume manure crops during fallow seasons and return of clay-accumulated soil to the clay-eloded soil were the two major putative technologies. In North Laos, soil respiration and biomass production of plant community of cropped and fallow plots have been monitored at a shifting agriculture area to estimate CO₂ balance of the ecosystem. The survey in Madagascar revealed that application of organic materials with deep tillage is the key technology to improve rice productivity under unsufficient recource input condition.

c) 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. A remarkable difference in leaf photosynthetic ability was observed among cultivars and the mechanisms are being investigated. The phenomenon of "delayed stem senescence (DSS)" 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 especially during reproductive growth periods. The crop physiologal mechanism for DSS are being established.

d) Quality improvement of rice seeds and analysis of mechanisms for high-temperature injury

Rice grain is one of the most important cereals since around half of the world's population consumes rice as a staple food. Rice seed is, however, deficient in the essential amino acid, lysine. Therefore, nutritional improvement in the amino acid composition of rice protein is needed especially for developing countries. We have focused on compositional change of the most major seed protein, glutelin by genotype- and/or environment/management- oriented improvement techniques. So far we demonstrated the possibility that the lysine content is increased by ~10% using glutelin mutants which are deficient in a subunit with less amount of lysine and that the composition is altered by adjustment of plant nitrogen and/or sulfur nutrition. Screening and analysis of wild rice species is also carried out to isolate novel superior glutelin gene. On the other hand, analysis on the quality loss of rice seeds caused by global warming, etc. has shown that some plant hormones and transcription factors are involved in the high-temperature injury, by using unique experimental system of detached ear culture.

A-2. Publications and presentations

a) Publications

Original papers

- Asai, H., K. Saito, B. Samson, K. Vongmixay, Y. Kiyono, Y. Inoue, T. Shiraiwa, K. Homma and T. Horie[:] Quantification of soil organic carbon dynamics and assessment of upland rice productivity under the shifting cultivation systems in northern Laos. In: Proc. The 2nd International Conference on Rice for the Future. 5-9 November 2007, Bangkok, Thailand, p.9-13, 2007
- Homma, K., T. Horie, T. Shiraiwa and N. Supapoj: Evaluation of transplanting date and nitrogen fertilizer rate adapted by farmers to toposequential variation of environmental resources in a mini-watershed (Nong) in northeast Thailand. Plant Prod. Sci 10: 488-496, 2007
- Homma, K., T. Horie and T. Shiraiwa: Usefulness of the World Surface Data Arranged by Japan Meteorological Agency. Jpn. J. Crop Sci. 76: 464-467, 2007 (in Japanese)
- Inoue, Y., J. Qi, A. Olioso, Y. Kiyono, Y. Ochiai, T. Horie, H. Asai, K. Saito, T. Shiraiwa and L. Douangsavanh: Traceability of slash-and-burn land-use history using optical satellite sensor imagery: a basis for chrono-sequential assessment of ecosystem carbon stock in Laos. International Journal of Remote Sensing 28: 5641-5648, 2007
- Kanemura, T., K. Homma, A. Ohsumi, T. Shiraiwa and T. Horie: Evaluation of genotypic variation in leaf photosynthetic rate and its associated factors by using rice diversity research set of germplasm. Photosyn. Res. 94, 23-30, 2007
- Katsura, K., S. Maeda, T. Horie and T. Shiraiwa: Analysis of yield attributes and crop physiological traits of Liangyoupeijiu, a hybrid rice recently bred in China. Field Crops Res. 103, 170-177, 2007
- Kawatsu, S., K. Homma, T. Horie and T. Shiraiwa: Change of Weather Condition and its Effect on Rice Production during the past 40 Years in Japan. Jpn. J. Crop Sci. 76: 423-432, 2007 (in Japanese)
- Kiyono, Y., H. Asai, T. Shiraiwa, Y. Inoue and V. Kham: Trade-offs and synergy in slash-and-burn farming: A case study from northern Lao People's Democratic Republic. Proc. WS on Education on Forest Conservation in Tropics, p.100-105, 2007
- Kiyono, Y., Y. Ochiai, Y. Chiba, H. Asai, K. Saito, T. Shiraiwa, T. Horie, V. Songnoukhai, V. Navongxai and Y. Inoue: Predicting chronosequential changes in carbon stocks of pachymorph bamboo communities in slash-and-burn agricultural fallow, northern Lao People's Democratic Republic. J. For. Res. 12: 371-383, 2007
- Ohsumi, A., A. Hamasaki, H. Nakagawa, H. Yoshida, T. Shiraiwa and T. Horie: A model explaining genotypic and ontogenetic variation of leaf photosynthetic rate in rice (*Oryza* sativa L.) based on leaf nitrogen content and stomatal conductance. Annals of Botany. 99: 265-273, 2007
- Ohsumi, A., T. Kanemura, K. Homma, T. Horie and T. Shiraiwa: Genotypic variation of stomatal conductance in relation to stomatal density and length in rice (*Oryza sativa* L.). Plant Prod. Sci. 10: 322-328, 2007
- Saito, K., G.N. Atlin, B. Linquist, K. Phanthaboon, T. Shiraiwa and T. Horie: Performance of traditional and improved rice cultivars under nonfertilized and fertilized conditions in Northern Laos. Crop Sci. 47: 2473-2481, 2007
- Sato, J., T. Shiraiwa, M. Sakashita, Y. Tsujimoto and R. Yoshida: The occurrence of delayed stem

senescence in relation to trans-zeatin riboside level in the xylem exudate in soybeans grown under excess-wet and drought soil conditions. Plant Prod. Sci. 10: 460-467, 2007

- Takahashi, R., K. Homma, T. Kanemura, Narisu, T. Shiraiwa, T. Horie and T. Inamura: Genotypic diversity in vegetation development and radiation use efficiency in rice diversity research set of germplasm. Kinki J. Crop Sci. Breed. 52: 25-30, 2007 (in Japanese)
- Yoshida, H., T. Horie, K. Katsura and T. Shiraiwa: A model explaining genotypic and environmental variation in leaf area development of rice based on biomass grwoth and leaf N accumulation. Field Crops Res. 102, 228-238, 2007

Reports

Shiraiwa, T.: Soybean-an introduction of its eco-physiological characteristics and crop managementpractices-. Bulletin of Experimental Farm, Kyoto University 16: 61-67, 2007 (in Japanese)

b) Conference and seminar papers presented

The 223rd Ann. Meeting of Crop Sci. Soc. of Japan : 2 presentations

The 224th Ann. Meeting of Crop Sci. Soc. of Japan : 6 presentations

The 2007 Ann. Kinki Branch Meeting of The Society of Agricultural Meteorology of Japan: 1 presentation

BioAsia2007: 3 presentations

A-3. Off-campus activities

Membership in academic societies (roles)

Shiraiwa, T.: Crop Science Society of Japan (Councilor, Editorial board member, Chiar of reviewing committee), The Society of Crop Science and Breeding in Kinki, Japan (Councilor)

Katsube-Tanaka, T.: Crop Science Society of Japan (Reviewing committee member)

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

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). Scientific Research (C) Study on milky white rice kernel by long-term detached ear culture method (Leader; Katsube-Tanaka).
- 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; Shiraiwa)
- Agriculture, Forestory and Fisheries Research Council: Research Project for Utilizing Advanced Technologies for Agriculture, Forestory and Fisheries 'Production Technologies for Stable Production of "Black Soybean" in The Cropping System in Kinki Region.
- Nara City: The Effect of Irrigating The Treated Wastewater on Rice Growth (Leader; Shiraiwa).

A-4. International cooperations and overseas activities

Membership in international academic societies

Shiraiwa, T.: Plant Production (Editorial board member)

International joint researches, overseas research surveys

- Shiraiwa, T.: Contribution of environmental, genotypic and agronomic factors to increasing gap of soybean yield between Japan and USA (USA: University of Arkansas, University of Illinois)
- Tanaka, T.: Sustainable resource management for shifting rice culture in mountainous areas of northern Laos (Laos)
- Homma, K.: Study on the actual conditions and the high yielding factors of System of Rice Intensification (SRI) in Madagascar (Madagascar)

B. Educational Activities (2007.4-2008.3)

B-1. On-campus teaching

a) Courses given

- Undergraduate level: Outline of Bioresource Science I (Shiraiwa), Crop Science I (Shiraiwa), Crop Science II (Shiraiwa, Tanaka), Laboratory Course in Biological and Environmental Science I, (Tanaka, Homma), Seminar in Crop Science (Shiraiwa)
- Graduate level: Crop Environmental Physiology (Tanaka), Crop Science-Seminar (Shiraiwa, Tanaka), Special Laboratory Work in Crop Science (Shiraiwa, Tanaka)

B-2. Off-campus teaching, etc.

Part-time lecturer

Shiraiwa, T.: Fukui Prefectural University (Crop Science)

Doctral thesis examiner

Open seminar

Shiraiwa, T.: Crop Seminar, Shiga Agricultural Research and Extention Center (Lecturer) Tanaka, T.: Seminar, Shiga Agricultural Research and Extention Center (Lecturer)

B-3. Overseas teaching

Students and research fellows from abroad

Students from abroad: Special Research Strudent 1 (Pakistan)

C. Other remarks

Shiraiwa, T.: "Agriculture, Forestry and Fisheries Research Council" - Outsider's evaluation member for research grant, "Kyoto University"- 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. : Furushima, Kimiko Secretary Students and research fellows Doctor's Program : (10) Research fellow : (2) Master's Program : (9)

: (4)

A. Research Activities (2007.4-2008.3)

A-1. Main subjects

Undergraduate

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 W1locus) 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

Book

Nakazaki, T., K. Naito, Y. Okumoto and T. Tanisaka: Active transposons in rice. In Rice Biology in Genomics Era. H.-Y. Hirano et al. (eds.) Springer-Verlag Berlin Heidelbelg pp.69-79, 2008

Original papers

- Saito, H., Y. Okumoto, T. Teranishi, Y. Qingbo, T. Nakazaki, and T. Tanisaka: Heading time gene resposible for the regional adaptability of 'Tongil-type short-culmed rice cultivars' developed in Korea. Breed. Sci. 57; 135-143, 2007
- Oki, N., Y. Okumoto, T. Tsukiyama, K. Naito, T. Nakazaki and T. Tanisaka: A novel transposon Pyong in the japonica rice variety Gimbozu. Kinki J. Crop Sci. Breed. 52: 39-43
- Iwase, S., Y. Okumoto, T. Tsukiyama, T. Nakazaki, M. Morita and T. Tanisaka: Effects of y-irradiation on transposition activity of the mPing family transposons. Kinki J. Crop Sci. Breed. 52; 69-72, 2007
- b) Conference and seminar papers presented

Congress of Japanese Society of Breeding: 5 presentations

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

Workshop on Rice Genetics and Molecular Biology: 2 presentations

The 5th International Symposium of Rice Functional Genomics: 2 presentations

Frontier in Plant Proteome Reserch –Contribution of proteomics technology in creation of useful plants-: 1 presentation

Annual Meeting of JSBBA 2007: 1 presentation

Triticeae Workshop: 1 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, General affairs), The Society of Crop Science and Breeding in Kinki (Council member)

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

Tsukiyama, T.: The Society of Crop Science and Breeding in Kinki (Committee of the Symposium)

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* (Leader; 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 (Leader; 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 (Leader; 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): Construction of linkage-map, phisical-map and genome sequence dataset of soybean genome "Identification of soybean seed-flooding tolerance gene" (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)

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 (2007.4-2008.3)

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), Introduction to Foreign Literature in Bioresource Science I (Nakazaki), Seminar in Crop Science (Tanisaka), Laboratory in Bioresouce Science I (Tanisaka, Okumoto, Nakazaki, Tsukiyama), 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, etc.

Part-time lecturer

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 fellows from abroad

Graduate course: 1 student (Bangladesh) Doctor course: 6 students (Buhtan 1, Nepal 1, China 2, 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) Master's Program : (9) Undergraduate : (3)

A. Research Activities (2007.4-2008.3)

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) 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.

e) 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.

A-2. Publications and presentations

a) Publications

Original papers

- Zhang, Y., T. Hayashi, M. Inoue, Y. Oyama, M. Hosokawa and S. Yazawa. Flower color diversity and its optical mechanism. Acta Hort. 766; 469-475, 2008
- Kobata, K., H. Tate, Y. Iwasaki, Y. Tanaka, K. Ohtsu, S. Yazawa and T. Watanabe. Isolation of coniferyl esters from Capsicum baccatum L., and their enzymatic preparation and agonist activity for TRPV1. Phytochemistry 69; 1179-1174, 2008
- Kesumawati E., S. Muko, T. Hayashi and S. Yazawa. Easy-maintenance long-lasting yield system (ELLYs) for cut Anthurium. Acta Horticulturae 755; 339-345, 2007
- Ahmed, E.U., T. Hayashi and S. Yazawa. Shading and reducing tuber provide young green leaf explants for the propagation of true-to-type Caladium bicolor Ait. plants. Acta Horticulturae 755; 87-91, 2007
- Irokawa, K., K. Tomi, Y. Hayashi, T. Hayashi, S. Yazawa, A. Morimura, H. Matsusaki, T. Fushiki and Y. Matsumura. Analysis of aroma compounds from fresh leaves of Mint and Lavender, and the effects of their compounds on autonomous nerve activity. Jpn. J. Taste Smell Res. 14; 523-526, 2007
- Fudano, T., T. Hayashi and S. Yazawa. Effect of plant density and variety on allometry of inflorescence architecture in *Gypsophila paniculata* L. J. Japan. Soc. Hort. Sci. 76; 327-332, 2007
- Hachiya, S., F. Kawabata, K. Ohnuki, N. Inoue, H. Yoneda, S. Yazawa and T. Fushiki. Effects of CH-19 Sweet, a non-pungent cultivar of red pepper, on sympathetic nervous activity, body temperature, heat rate, and blood pressure in human. Biosci. Biotechnol. Biochem. 7; 671-676, 2007
- b) Conference and seminar papers presented
- 2007 Spring Meeting of the Japanese Society for Horticultural Science (3 presentations)

2007 Autumn Meeting of the Japanese Society for Horticultural Science (5 presentations)

International Conference on Quality Management in Supply Chains of Ornamentals (3 presentations)

A-3. Off-campus activities

Membership in academic societies (roles)

- Yazawa, S.: The Japanese Society for Horticultural Science, International Society for Horticultural Science
- Hayashi, T.: The Japanese Society for Horticultural Science

Mizuta, Y.: The Japanese Society for Horticultural Science

Hosokawa, M.: The Japanese Society for Horticultural Science

Research grants

- Monbusho Research Grant: Scientific Research (B) Developing new functional vegetables for eating raw by using genetic variations of *Capsicum* plants (Leader; Yazawa), Exploratory Research Creation of useful potted ornamental plants with aromachological functions (Leader; Hayashi), Scientific Research (B) Viroid acting as a functional RNA in plants Molecular biological elucidation of the flowering mechanism (Leader; Hosokawa), Exploratory Research Microsurgery of a shoot apical meristem for micropropagation of difficult-to-propagate horticultural crops (Leader; Hosokawa)
- The agriculture-and-forestry fishery research highly advanced enterprise commission utilized advanced technology: Establishment of a new production system for disease-free transplants and its practical use (Leader; Hosokawa)

B. Educational Activities (2007.4-2008.3)

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: 1 students (China)

C. Other remarks

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

2.1.4 Laboratory of Pomology

Staff Professor : Yonemori, Keizo, Dr. Agric. Sci. Associate Professor: Tao, Ryutaro, Dr. Agric. Sci. Assistant Professor : Yamane, Hisayo, Dr. Agric. Sci.

Students and research fellows Research fellow : (2) Doctor's Program: (2) Master's Program: (10) Undergraduate : (3)

A. Research Activities (2007.4-2008.3)

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, F₁ 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 recognition 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. Recently, we have found a MADS-box transcription factor that is putatively related to endodormancy induction and endodormancy release. We are now conducting functional study to characterize the MADS-box transcription factor toward the ultimate goal to understand the internal genetic factors controlling endodormancy of deciduous fruit tree species.

A-2. Publications and presentations

a) Publications

Original papers

- Esumi, T., R. Tao, and K. Yonemori. Comparison of early Inflorescence development between Japanese pear (*Pyrus pyrifolia* Nakai) and quince (*Cydonia oblonga* Mill.). J. Japan. Soc. Hort. Sci. 76; 210-216, 2007
- Esumi, T., R. Tao, and K. Yonemori. Relationship between floral development and transcription levels of *LEAFY* and *TERMINALFLOWER1* homologs in Japaanese pear (*Pyrus pyrifolia* Nakai) and quince (*Cydonia oblonga* Mill.). J. Japan. Soc. Hort. Sci. 76; 294-304, 2007
- Gao, M. N. Matsuta, H. Murayama, T. Toyomasu, W. Mitsuhashi, A.M.Dandekar, R. Tao, and K. Nishimura. Gene expression and ethylene production in transgenic pear (*Pyrus communis* cv. 'La France') with sense or antisense cDNA encoding ACC Oxidase. Plant Science 173; 32-42, 2007
- Honsho, C. S. Somsri, T. Tetsumura, K. Yamashita, and K. Yonemori. Effective pollination period in durian (*Durio zibethinus* Murr.) and the factors regulating it. Scientia Hortic. 111; 193-196, 2007
- Honsho, C. S. Somsri, T. Tetsumura, K. Yamashita, C. Yapwattanaphun, and K. Yonemori. Characterization of male reproductive organs in durian; Anther dehiscence and pollen longevity. J. Japan. Soc. Hort. Sci. 76; 120-124, 2007
- Ikegami A, S. Eguchi, A. Kitajima, K. Inoue, and K. Yonemori. Identification of genes involved in proanthocyanidin biosynthesis of persimmn (*Diospyros kaki*) fruit. Plant Science 172; 1037-1047, 2007
- Tao, R., A. Watari, T. Hanada, T. Habu, H. Yaegaki, M. Yamaguchi, and H. Yamane. Self-compatible peach (*Prunus persica*) has mutant versions of the S haplotypes found in self-incompatible *Prunus* species. Plant Mol. Biol. 63;109-123, 2007
- Watari, A., T. Hanada, H.Yamane, T. Esumi, R. Tao, H. Yaegaki, M. Yamaguchi, K. Beppu, and I.

Kataoka. 2007. A low transcriptional level of Se-RNase in the S^e-haplotype confers self-compatibility in Japanese plum. J. Amer. Soc. Hort. Sci. 132; 396-406, 2007

Yamada, A. and R. Tao. Controlled pollination with sorted reduced and unreduced pollen grains reveals unreduced embryo sac formation in *Diospyros kaki* Thunb. 'Fujiwaragosho'. J. Japan. Soc. Hort. Sci. 76: 133-138, 2007

Reviews

- Tsukamoto, T., M. Gao, K. Negoro, H. Hanada, R. Tao, M. Kawabe, and K. Yonemori. Somatic embryogenesis and plant regeneration from immature cotyledons of *Prunus mume* 'Nanko'. Acta Hortic. 738; 409-414, 2007
- Yamada, A. and R. Tao. Sexual Polyploidization of Japanese Persimmon by Utilizing Unreduced Egg. Acta Hortic. 738; 607-701, 2007

Books

- Kanzaki, S., K. Yonemori (2007) Persimmon. p.353-358. In: Kole C (ed) Genome mapping and molecular breeding. Vol. 4. Fruits and Nuts. Springer, Heidelberg, Berlin, New York, Tokyo
- b) Conference and seminar papers presented
- 102th conference of Japanese Sciety for Tropicl Agriculture: 1 presentation
- $104^{\rm th}$ Annual conference of ASHS: 1 presentstion
- Spring meeting of the Japanese Society for Horticultural Science: 8 presentations
- Autumn meeting of the Japanese Society for Horticultural Science: 6 presentations

3rd International Rosaceae Genomics Conference: 2 presentations

EUCARPIA fruit section: 2 presentations

Plant and Animal Genome Conference XVI: 5 presentations

A-3. Off-campus activities

Membership in academic societies (roles)

- Yonemori, K: Japanese Society for Horticultural Science (Vice President, Board member), International Society for Horticultural Science (Board member)
- Tao, R: International Society for Horticultural Science (Board member), Japanese Society for Horticultural Science (Editor)

Research grants

- Monbusho Research Grant: Scientific Research (B) Exploring the genes linked to tannin accumulation in persimmon and its utilization for analysis of genome composition and breeding (Leader; Yonemori), Exploratory Research Studies on the apomictic seed formation in mangosteen (Leader; Yonemori), Grant-in-Aid for JSPS Fellows Studies on the reproductive process of mangosteen (Leader; Yonemori) Scientific Research (B) (2) Molecular basis of self-incompatibility in *Prunus* (Leader; Tao), Exploratory Research Studies on the development of the early evaluation methods for reproductive characters in fruit trees (Leader; Tao), Scientific Research (B) for Young Scientist Identification and characterization of chilling-responsive transcription factor related to winter bud endodormancy of deciduous fruit tree species (Leader; Yamane)
- JSPS Japan-US C Survey of the genes linked to the inhibition of tannin biosynthesis in fruits and the use of these genes for breeding of new fruits with high functional components (Leader; Yonemori).

A-4. International cooperation and overseas activities

International joint researches, overseas research surveys

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

Yonemori, K: Studies on the origin and developent of European persimmon cultivars (Italy)

Yoenmori, K.: Studies on a PCNA cultivar of Chinese origin (China)

Yonemori, K.: Studies on persimmon tannins (USA)

- Tao, R.: Improvement of fruit trees through genetic transformation (USA)
- Tao, R.: Molecular basis of gametophytic self-incompatibility of *Prunus* species (USA, Thailand, Spain)

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

Yamane, H: Survey of low-chill deciduous fruit tree species adapted to subtropical regions (Thailand)

B. Educational Activities (2007.4-2008.3)

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)

Chair of Agricultural Ecology

2.1.5 Laboratory of Weed Science

Staff	Professor	:	Tominaga, T	Tohru, Dr. Agric. Sci.		
	Lecturer	:	Miura, Reiic	hi, Dr. Agric. Sci.		
	Assistant Professor : Wang, Guang–Xi, Dr. Agric. Sci.					
Students	s and research fellow	NS				
	Research fellow	:	(1)	Doctor's program :	(6)	
	Master's program	:	(3)	Undergraduate :	(4)	
	Research student	:	(1)			

A. Research Activities (2007.4-2008.3)

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) in Japan, some strains originated from a preexisting and preadapted mutant *M. vaginalis* population with lower genetic variation, whereas some strains showed higher genetic variation, and the resistance gene can be dispersed by outcrossing; (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 Self-EcoTILLING

Target site insensitivity is the most commonly reported mechanism of herbicide resistance. Target site resistance involving a single-nucleotide change and usually dominant gene 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 method named Self-EcoTILLING for rapid detection of single-nucleotide mutations in ALS genes with the cooperation of Iwate Agricultural Research Center.

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

Pearl millet fields of West Africa are almost invariably infested with a large number of weedy pearl millet plants that have shattering ears. We have revealed that the crop and weed types are actually in a state of balanced genetic polymorphism, and that the "weed" type is a heterozygote arising from sown crop seed. We have been trying to isolate the responsible gene(s) by the chromosome-walking technique.

d) Vulnerability and resilience of a slash-and-burn based economy in Zambia

We have set out an experimental plot simulating a traditional slash-and-burn system in a

miombo-woodland of Zambia and have been monitoring the microclimate, soil conditions, vegetation, and the productivity of maize. This is a joint research program with the Laboratory of Soils of Kyoto University, Research Institute for Humanity and Nature (Japan) and Zambia Agriculture Research Institute.

e) Role of weeds in the urban landscape

To evaluate the positive and negative roles of weeds in the urban landscape, we carried out vegetation survey and analysis in Kyoto City focusing on two landscape elements: 1) lawns in city parks, 2) unpaved alleys in the Old Town.

A-2. Publications and presentations

a) Publications

Book

Tominaga, T.: The survival strategy of weeds, Plant Protection, pp. 243-278, Kyoto University Press, Kyoto, 2008 (in Japanese).

Original papers

- Wang, G.-X., M.-K. Tan, S. Rakshit, H. Saitoh, R. Terauchi, T. Imaizumi, T. Ohsako and T. Tominaga. 2007. Discovery of single-nucleotide mutations in acetolactate synthase genes by Ecotilling. Pesticide Biochemistry and Physiology 87: 143-148.
- Ohsako T. and T. Tominaga. 2007. Nucleotide substitutions in the acetolactate synthase genes of sulfonylurea-resistant biotypes of *Monochoria vaginalis* (Pontederiaceae). Genes and Genetic Systems 82 (3): 207-215.
- Inagaki, H., T. Imaizumi, G.-X. Wang, T. Tominaga, K. Kato, H. Iyozumi and H. Nukui. 2007. Spontaneous ultraweak photon emission from rice (*Oryza sativa* L.) and paddy weeds treated with a sulfonylurea herbicide. Pesticide Biochemistry and Physiology 89 (2): 158-162.
- Yoshino, N., G.-X. Wang and T. Tominaga. 2007. Irrigation time affects duration of emergence and flowering of paddy weeds, *Lindernia procumbens* and *L. dubia* subsp. *dubia*, but not *L. antipoda*. Tohoku Weed Journal 7: 21-26 (in Japanese).
- Tanaka, S., R. Miura and T. Tominaga. 2007. Soil physicochemical property in public lawn in Kyoto City. Journal of Japanese Society of Turfgrass Science 36: 26-33 (in Japanese).
- Miura, R., M. Hosotani and M. Ito. 2007. A bristleless variant of *Bidens tripartite*. Journal of Weed Science and Technology 52: 130-136 (in Japanese).
- Imaizumi, T., G.-X. Wang, T. Ohsako and T. Tominaga. 2008. Genetic diversity of sulfonylurea -resistant and -susceptible *Monochoria vaginalis* populations in Japan. Weed Research 48 (2): 187-196.
- Niwa, K., H. Suzuki, T. Tominaga, S. Nasim, R. Anwar, M. Ogawa and Y. Furuta. 2008. Evaluation of genetic variation in high molecular weight glutenin subunits of seed storage protein using landraces of common wheat from Pakistan. Cereal Research Communications 36: 327-332.
- Tan, M.-K., C. Preston and G.-X. Wang. 2007. Molecular basis of multiple resistance to ACCase-inhibiting and ALS-inhibiting herbicides in *Lolium rigidum*. Weed Research 47: 534-541.

Others

Tominaga, T. 2007. Weed Monograph 5. Imperata cylindrica (L.) Beauv., Journal of Weed Science

and Technology. 52 (1): 17-27 (in Japanese).

- Tominaga, T. 2007. Germination characteristics of ALS inhibiting herbicides-resistant biotypes of weed. Journal of Weed Science and Technology. 52 (1): 36-40 (in Japanese).
- Tominaga, T. 2007. Hybridization between wheat and jointed goatgrass (*Aegilops cylindrica*) under field conditions. J. Weed. Sci. Tech. 52 (4): 203-204 (in Japanese).
- b) Conference and seminar papers presented
- The Annual Meeting of the Weed Science Society of Japan: 5 presentations

The Annual Meeting of the Turf Grass Science Society of Japan: 1 presentation

The 78th Annual Meeting of the Genetics Society of Japan: 1 presentation (workshop)

The Annual Meeting of the Weed Science Society of America: 1 presentation

The Annual Meeting of the Japanese Society of Breeding: 1 presentation

A-3. Off-campus activities

Membership in academic societies

- Tominaga, T.: Weed Science Society of Japan (Councilor, Editor-in-Chief of WEED BIOLOGY and MANAGEMENT)
- Miura, R.: Weed Science Society of Japan (Editorial Board Member, International Exchange Committee member)
- Wang, G.-X.: Weed Science Society of Japan (Editorial Board Member, Terminology Committee Member)

Research grants

- JSPS Research Grant: Grant-in-Aid for Scientific Research (C) Evolution, diversification and maintenance of the weediness supergene in pearl millet (Miura)
- Shizuoka Prefectural Research Institute of Agriculture and Forestry: Estimation of genetic diversity of plants in paddy fields, abandoned paddy fields and cover plants on paddy-levees (Tominaga and Wang)
- The Sumitomo Foundation: Studies on the distribution expansion by hybridization between alien weeds of *Lolium*, Poaceae (Tominaga)

A-4. International cooperations and overseas activities

International joint researches, overseas research surveys

- Tominaga, T.: Genecological study on the relationships among man, crop and weed in agro-ecosystems (National Plant Gene Bank, Iran and Cukuroba University, Turkey)
- Miura, R.: Vulnerability and Resilience of Social-Ecological Systems (RIHN, Japan / Zambia Agriculture Research Institute, Zambia), Environmental Change and the Indus Civilization (RIHN, Japan / Institute of Rajasthan Studies, India)
- Wang, G.-X.: Ecological studies on aquatic plants and the management (Wuhan Institute of Botany, the Chinese Academy of Sciences, China).

B. Educational Activities (2007.4-2008.3)

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, Miura,

Wang), Introduction to Research (Tominaga, Miura, Wang), Outline of Bioresource Science I (Tominaga), Nature and Culture (Miura)

- Graduate level: Seminar (Tominaga, Miura, Wang), Special Laboratory Work in Weed Science (Tominaga, Miura, Wang), Thesis (Tominaga, Miura, Wang), Weed Science (Advanced Course) (Tominaga)
- General education: An international exchange subject: Sustainable Agriculture in Yunnan Provice, China (Wang)

B-2. Off-campus teaching, etc.

Part-time lecturer

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

Invited lecture

- Wang, G.-X.: Kunming University of Science and Technology (Ecology and Management of Paddy Weeds and Studies on Herbicide-Resistant Genes)
- Wang, G.-X.: The Weed Science Society of Kyushu (Use of Ecotilling to Survey Genetic Variation of Herbicide-Resistant Genes)

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.: 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

Doctor's program : (3) Masters program : (7) Undergraduate : (4)

A. Research Activities (2007.4-2008.3)

A-1. Main subjects

a) Physiological and genetical studies on multiple herbicide-resitance of *Echinochloa phyllopogon* Multiple herbicide-resistant biotypes of a paddy weed, *Echinochloa phyllopogon* (Stapf)

Kossenko (= E. oryzicola Vasing.) was found in 1997 in many rice fields scattered throughout the

Sacramento Valley of California (Fischer et al. 2000). They were resistant to four herbicides from different families, namely molinate and thiobencarb (thiocarbamates), fenoxaprop (aryloxyphenoxy propionate), and bispyribac-Na (pyrimidinyloxybenzoate). Our preceding experiments showed that (1) there are large similarities in spikelet (seed) morphological traits and AFLP fingerprints among the biotypes collected in various rice fields, suggesting a common ancestry of the resistant biotypes(Tsuji et al., 2003), (2) a resistant biotype increases cytochrome P450 activity when treated with herbicides (Yun et al., 2005), (3) the resistance to each of the four hebicides is controlled by a pair of alles, and (4) a resistant biotype has smaller fitness in term of the number of progenies (Machida et al., 2005). At present we are studying mechanism(s) of this multiple herbicide-resitance of E phyllopogon focuing to invlvement of P450.

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

Sources of the variation of wheat yield in paddy-upland rotational fields (rice-wheat-soybean) were examined during the wheat seasons from 2002 through 2004 to evaluate the possibility of 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 the criterion of variable rate management for maximizing the yield. The number of panicles was effected by the seeding rate via the number of establishment, the amount of nitrogen accumulated in aboveground biomass at spikelet-initiation stage and the number of stems, and in addition, it seemed to be effected by the soil moisture percentage at seeding via the emergence depth. Therefore, the proper management of variable rate seeding in proportion to the soil moisture percentage on dried soil basis at seeding in the field may be able to control the number of panicles in the field to bring the adequate average yield. This variable rate management may control 42.7% of the controllable proportion to total variation of wheat yield in the field.

- c) Development of the environment-friendly technology for sustainable land utilization.
 - Effect of Consecutive Fermented Manure Liquid Application on Growth of Paddy Rice, and Soil Total N and C, and mineralized N of Soil

Fermented manure liquid (MF) derived from anaerobic digestion of cattle excreta contains N, P and K as plant nutriment. We carried out a field experiment over 4 years to evaluate efficiency of MF application (10gN/m²) as an alternative of chemical fertilizer (CF), especially focused on growth and yield of rice, soil total N, C and mineralized N of soil in paddy field under yearly application of fermented manure liquid. In MF plots, brown rice yield was not significantly different compared with CF plots over 4 years. The amounts of N mineralized from soil as well as soil total N and C in the MF plots were approximately equal to that of CF plots over 4 years. These results showed that standard MF application (10gN/m²) could achieve equivalent level of rice yield compared with CF application, and consecutive MF application over 4 years did not have significant effect on mineral N release from the soil.

2) Evaluation of acetylene reduction activity in rice rhizosphere

The nitrogen fixing activity in rice rhizosphere was evaluated by measuring the acetylene reduction activity. Two rice varieties, Kinuhikari and Taichung 65, were cultivated in 1/5000 a wagner pots with paddy soil and Masa soil, and the acetylene reduction activity was measured in

each pot at the various rice growth stages. In non-planted pots of both with paddy and Masa soil, no acetylene reduction activities were measured in all rice growth stages. In rice planted pots with paddy soil, significantly high acetylene reduction activities were measured at rice heading-time stage both in Kinuhikari and Taichung 65 with nitrogen non-applied condition. On the other hand, in the rice planted pots with Masa soil, significantly high acetylene reduction activities were measured at rice heading-time stage both in Kinuhikari and Taichung 65 only with nitrogen applied condition (8g/m²). In addition, in Masa soil the supply of inorganic nitrogen seemed to be almost 0 throughout rice growth period, because mineralized nitrogen expression level changed in almost 0 throughout rice growth period in Masa soil. From the above results, the significantly high acetylene reduction activity appears in rice heading-time stage and it was supposed that the high acetylene reduction activities are regulated with not only the supply of inorganic nitrogen in soils but also the rice biomass in heading-time stage.

A-2. Publications and presentations

a) Publications

Book

- Yamasue, Y.: Agriculture in the 21st century, the 1st volume "the future of crop production" (edited by Yamasue), pp.252, Kyoto University press, Kyoto, 2007 (in Japanese)
- Inamura, T.: Remote sensing and agricultural production. Agriculture in the 21st century, the 1st volume "the future of crop production" (edited by Yamasue), pp.221-248, Kyoto University press, Kyoto, 2007 (in Japanese)

Original papers

- Inamura, T., A. Yoshikawa, K. Matsumoto, S. Ikenaga, H. Inoue and Y. Yamasue: Analysis of the sources of variations of wheat yield in the field, and possibility of the variable rate management. Japan Journal of crop sci. 76; 189-197, 2007
- Ikenaga, S., K. Goto, M. Suguri, M. Umeda, T. Inamura: Geostatistical analysis of spatial variability of paddy rice nitrogen in paddy-upland rotational fields for extension of precision agriculture. Journal of the Japanese society of agricultural machinery 69; 69-78, 2007
- Takahashi, R., K. Homma, T. Kanemura, Narisu, T. Shiraiwa, T. Horie, T. Inamura: Genotypic diversity in vegetation development and radiation use efficiency in rice diversity research set of germplasm. Kinki J. Crop Sci. Breed. 52; 25-30, 2007 (in Japanese)
- Nishikawa, T., F. Chen, H. Inoue, M. Umeda, Y. Yamasue, T. Inamura: Effect of Consecutive Fermented Manure Liquid Application on Growth and Yield of Paddy Rice, Soil Total N and C, and mineralized N of Soil. Kinki J. Crop Sci. Breed. 52; 53-58, 2007 (in Japanese)
- b) Conference and seminar papers presented
- The 224th Ann Meet. of Crop Sci. Soc. of Japan (3 presentation), The 225th Ann Meet. of Crop Sci. Soc. of Japan (3 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 (Councilor, Editorial board member of Plant

Production Science)

Research grants

Research Grant of Japanese Sciece Promotion Society (JSPS): Grant-in-Aid for Scientific Research (B) "Mechanism and its genetics of multiple herbicide-resistance of Echinochloa phyllopogon (Leader; Yamasue, Collaborators; Inoue), Grant-in-Aid for Scientific Research (B) (2) "Analysis of the sources of variations of quality of wheat and soybean in the field, and variable rate management" (Leader; Inamura), 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)

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: International joint research about the improvement of the water pollution in the agricultural irrigation system in southwest China (Cooperation with Kunming University of Science and Technology, Kunming, Yunnan Province of China).

B. Educational activities (2007.4-2008.3) 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: Agricultural Production Ecology (Inamura), Plant Production Systems-Seminar (Yamasue and Inamura), Special Laboratory Work in Plant Production Systems (Yamasue and Inamura).

B-2. Off campus teaching, etc.

Part-time lecturer

Inamura, T.: Kyoto University of Education (Agriculture and Environment), Shizuoka University (Ecology)

C. Other remarks

Yamasue, Y.: Experimental Farm (Member of council) Inamura, T.: Experimental Farm (Member of council)

Chair of Food Quality Science

2.1.7 Laboratory of Food Quality Design and Development

Professor : Utsumi, Shigeru, Dr. Agric. Sci. Associate Professor: Maruyama, Nobuyuki, Dr. Agric. Sci. Assistant Professor : Masuda, Taro, Dr. Agric. Sci.

Students and research fellows

Staff

Doctor's Program : (1	1) Foi	reign Visiting Researcher	: (2)
Master's Program : (9	9) Po	stdoctoral fellow	: (1)
Undergraduate : (4	4) As:	sistant	: (2)
Research student : (1	1)		

A. Research Activities (2007.4-2008.3)

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 and glycinin have been elucidated at subunit level, and molecular level analysis 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. Crystallization, crystallography and protein engineering of adzuki bean, French bean, pumpkin, pea, and mung bean proteins have been going, and general relationships between their structures and functions at molecular levels have been elucidated.

b) 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 of β -conglycinin contain C-termiral and sequence specific type sorting signals and glycinin contains C-terminal, sequence specific and structural type signals. In addition, identification of receptor species for each signal and elucidation of recognition mechanism are in progress.

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). Soybean proteins having improved nutritional values and physicochemical and heath-promoting 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) Structural factors determing allegenicity of legume seed proteins

Peanut induces a critical condition of an allergy patient, but pea and field bean do not induce and soybean induces mild symptom, although these plants contain similiar proteins to each other. Eight allergens are identified so far from peanut. We are now preparing the recombinant proteins for their crystallography and characterization. In future, we will compare these points of soybean, pea and field bean proteins with those of peanut proteins to elucidate structural factors determing critical allergenicity of peanut.

A-2. Publications and presentations

a) Publications

Original papers

- Nishizawa, K., M. Teraishi, S. Utsumi and M. Ishimoto: Assessment of the importance of alpha-amylase inhibitor-2 in bruchid resistance of wild common bean. Theor. Appl. Genet., 114, 755-764, (2007)
- Fukuda, T., K. Prak, M. Fujioka, N. Maruyama and S. Utsumi: Physicochemical properties of native adzuki bean (*Vigna angularis*) 7S globulin and the molecular cloning of its cDNA isoforms. J. Agric. Food Chem. 55, 3667-3674, (2007)
- Fuji, K., T. Shimada, H. Takahashi, K. Tamura, Y. Koumoto, S. Utsumi, K. Nishizawa, N. Maruyama and I. Hara-Nishimura: Arabidopsis vacuolar sorting mutants (green fluorescent seed) can be identified efficiently by secretion of vacuole-targeted green fluorescent protein in their seeds. Plant Cell, 18, 1253-1273 (2007)
- Prak, K., K. Nakatani, N. Maruyama and S. Utsumi: C-Terminus engineering of soybean proglycinin: improvement of emulsifying properties. Protein Engineering, Design and Selection, 20, 433-442, (2007)
- Masuda, T., F. Goto, T. Yoshihara and S. Utsumi: Construction of homo- and heteropolymers of plant ferritin subunits using an in vitro protein expression system. Protein Exp. Purif. 56, 237-246, (2007)

Reports

Utsumi, S. and N. Maruyama: Molecular and food scientific study on bambara bean 11S globulin. Annual Report of Stuly for Food. The Skylark Food Science Institute. 20, 19-25, 2007.

b) Conference and seminar papers presented

- The Annual Meeting (2008) of Japan Society for Bioscience, Biotechnology, and Agrochemistry (3 papers)
- The 61th Annual Meeting of Japanese Society of Nutrition and Food Science: 1 paper

Joint Meeting of JOCS-AOCS-ISF in 2007: 2 papers

Plant Biology and Botany Joint Congress: 1 paper

The 46th Ganma Field symposia: 1 paper The Annual Meeting of the Skylark Food Science Institute: 1 paper

A-3. Off-campus activities

Membership in academic societies (roles)

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

Research grants

- Monbukagakusho Research Grant: Research (B) Molecular mechanism of vacuolar sorting and accumulation of seed storage proteins (Leader; Utsumi), Research (Encourage) Investigation of Signal recognition mechanism of seed storage protein vacuolar sorting receptor (Leader; Maruyama)
- Ministry of Agriculture, Forestry and Fisheries: Development of efficient breeding techniques based on genomic breeding (Collaborator; Utsumi)

Research Foundation: The Asahi Glass Foundation (Leader; Utsumi)

A-4. International cooperations and overseas activities

International meetings (roles)

Utsumi, S.: Joint Meeting of JOCS-AOCS-ISF in 2007: 1 symposium, 1 poster

Maruyama, N.: Plant Biology and Botany Joint Congress: 1 paper

Oversea joint research surveys

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

B. Educational Activities (2007.4-2008.3)

B-1. On-campus teaching

a) Courses given

- Undergraduate Level: Basic Bioresource Science (Utsumi), Cell Biology I (Utsumi), Outline of Bioresource Science I (Utsumi), Quality Design and Development (Utsumi, Maruyama), Quality Science (Utsumi, Maruyama)
- Graduate Level: Food Quality Design and Development, Advanced Course (Utsumi, Mikami, Maruyama)

B-2. Off-campus teaching, etc.

Part-time lecturer

Utsumi, S.: Faculty of Health and Welfare Science, Okayama Prefectural University (Food Biotechnology, Advanced Course)

B-3. Overseas teaching

Students and research fellows from abroad

Student: Master Course (1, Malaysia) Visiting researcher: (2, Malaysia, China)

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 : (4) Master's program : (9) Undergraduate : (3)

A. Research Activities (2007.4-2008.3)

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 is 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 foodstuffs 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 *Caenorhabditis elegans* have been performed. We have found that oxidized fatty acid induces short life span in *C.elegans*. As this may impose certain aspects in quality control of food, the molecular mechanism of this phenomena is being studied. At the same time, role of fatty acid transporter has been studied using the nematode.

A-2. Publications and presentations

a) Publications

Original papers

- T. Ukai, Y. Matsumura and R. Urade: Disaggregation and reaggregation of gluten proteins by sodium chloride. J. Agric. Food Chem., 56, 1122-1130 (2008)
- E. Yamazaki, T. Fujiwara, O. Kurita, J. Ikeda and Y. Matsumura: Comparison of pectins from the alcohol-insoluble residue of Japanese pepper (*Zanthoxylum piperitum* DC.) fruit, a major by-product of antioxidant. *Food Sci. Technol.* Res., 14(1), 18-24 (2008)
- E. Yamazaki, O. Kurita and Y. Matsumura : Hydrocolloid from leaves of *Corchorus olitorius* and its synergistic effect on κ-carageenan gel strength. Food Hydrocoll., 22, 819-825 (2008)
- Irokawa, K., K. Tomi, Y. Hayashi, T. Hayashi, S. Yazawa, A. Morimura, : H. Matsusaki, T. Fushiki and Y. Matsumura. Japanese J. Taste and Smell Res. 14 ; 523-526, 2007 (in Japanese)
- Taniguchi, T., M. Narukawa, W.-J. Hwang, Y. Yoshimura and Y. Hayashi: Effect of dietary phytate to bitter sensitivity in C57BL/6J mice. Japanese J. Taste and Smell Res. 14; 353-356, 2007 (in Japanese)
- Morita, K., M. Narukawa, and Y. Hayashi: Effect of Amiloride on umami recognition I human. Japanese J. Taste and Smell Res. 14; 349-352, 2007 (in Japanese)

Reports

Shinya Matsumoto: Participating the 5th Forum for Creating High Value Food. J. Jpn Soc Food Engineering. v 28 No1 pp.40-43.

- b) Conference and seminar papers presented
- The Annual Meeting of Japan Society for Bioscience, Biotechnology and Agro chemistry 2007: 2 subjects

The 41th JASTS Annual Meeting: 3subjects

The Annual Meeting of Japanese Society for Food Science and Technology 2007:2 subjects

The Annual Meeting of Japan Society of Cookery Science 2007: 1 subjects

98th AOCS Annual Meeting (Canada): 3 subjects

The 69th Annual Meeting of Japanese Society of Nutrition and Food Science: 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), Japan Society of Food Engineering (Counselor + Editorial Committee)

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

Research grants

<u>Monbusho Reseach Grant</u>: Scientific Research (C) Effects of trans acids on physical properties and acceptability of foods and searching for the displacer of trans acids. (Leader Matsumura, Y.)

<u>Ministry of Agriculture, Forestry and Fisheries</u>: Development of techniques on nano-scale processing and evaluation of food materials. (Leader Matsumura, Y.)

Research Foundation: Fuji Foundation for Protein Research (Leader Matsumura, Y.)

A-4. International cooperations and overseas activities

International meetings (roles)

Matsumura, Y: 98th AOCS Annual Meeting (Canada): Invited speaker

B. Educational Activities (2007.4-2008.3)

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.), Outline of Bioresource Science I (Matsumura, Y.), Laboratory Course in Bioresource Science I, II (Matsumura, Y., Hayashi, Y., Matsumoto, S.), Scientific English I (Yukako Hayashi)

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

B-2. Off-campus teaching, etc.

Part-time lecturer

Hayashi, Y: Doshisha Women's College of Liberal Arts (Basic Experiment for biochemistry) 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: 2 (China1, Brazil1)

C. Other remarks

Matsumura, Y.: Kyoto City- Outsider's evaluation member for venture business

Chair of Plant Production Science (Experimental Farm)

2.1.9 Laboratory of Plant Production Control

StaffProfessor: Yamada, Toshiaki , Dr.Agric.Sci.(~2008.3)Associate Professor: Kitajima, Akira, Dr.Agric.Sci.Assistant Professor : Kataoka, Keiko, Dr.Agric.Sci.Assistant Professor : Teraishi, Masayoshi, Dr.Agric.Sci.Assistant Professor : Fudano, Takashi, M.Agric.Sci.Assistant Professor : Habu, Tsuyoshi, Dr.Agric.Sci.Assistant Professor : Katsura, Keisuke, Dr.Agric.Sci.

Students and research fellows

Doctor's Program : (2) Master's Program : (3) Undergraduate : (1)

A. Research Activities (2007.4-2008.3)

A-1. Main subjects

a) 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.

b) 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.

c) Relationships of grain characters and agronomical characters in brewer's rice

Yamadanishiki, the most famous japanese brewer's rice, was proved to have a dwarf gene inspite of its long culm length. We find the relationships between grain characters and agronomical characters as well as revealing genetic linkage relationships of the dwarf gene.

d) Studies on high productivity in rice under upland conditions.

We are collectiong the data about crop physiological traits of upland rice in order to determine the potential productivity of rice under upland condition and seek the way for further increase in rice yield under upland conditions.

e) Studies on seedlessness in citrus

We have been cleared that no seed development in seedless cultivar 'Mukaku Kishu' is resulted from embryo arrest at zygote or proembryo stage and the seed development is induced unede green house condition. In this year, the effects of thermal environment on embryo development in 'Mukaku Kishu' and the mechanisms of embryo development under highter temperature condition were investigated.

f) Search of citrus seedless native cultivers in East Asia and their origin

We went to China, Thailand and Vietnam to invstigate native citrus cultivars. Most of mandarin cultivars were poly-embryony but a few were mono-embryony similar to Japanese cultivars of *Citru kinokuni*. We found Chines native citrus cultivar that is mandarin type and almost seedless with mono-embryony seeds.

g) 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*.

h) 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 gibberellic acid added to 4-CPA solution, treated at anthesis for inducing fruit set and growth, on sugar accumulation, invertase activity, and cell proliferation with maturing.

i) Promoted growth of Phalaenopsis in embedded culture.

We succeeded in promoted growth of cultured plant embedded in solid medium. Therefore it is 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.

j) Avoidance of the microorganism contamination in vitro shoot apex culture of Paphiopedilum.

In many cases, microorganism contamination occur in vitro shoot apex culture of Paphiopedilum. Therefore the microorganism is identified, and it is investivated how to avoid the microorganism contamination. Until now, some microorganism was identified, and it could improve the avoidance rate of microorganism contamination.

A-2. Publications and presentations

a) Publications

Original papers

- Tozawa, Y., M. Teraishi, T. Sasaki, K. Sonoike, Y. Nishiyama, M. Itaya, A. Miyao and H. Hirochika: The plastid sigma factor SIG1 maintains photosystem I activity via regulated expression of the *psaA* operon in rice chloroplasts. Plant J. 52; 124-132, 2007
- Teraishi, M., K. Nishitsuji, D. Ogata, T. Sayama, Y. Okumoto, T. Tanisaka and T. Yamada: Exploitation of SSR markers related to saponin contents in soybean seeds. Kinki J. of Crop Sci. and Breed. 52; 49-52, 2007
- Katsura, K., S. Maeda, T. Horie, and T. Shiraiwa: Analysis of yield attributes and crop physiological traits of Liangyoupeijiu, a hybrid rice recently bred in China. Field Crops

Res. 103; 170-177, 2007

- Yoshida, H., T. Horie, K. Katsura, and T. Shiraiwa: A model explaining genotypic and environmental variation in leaf area development of rice based on biomass growth and leaf N accumulation. Field Crops Res. 102; 228-238, 2007
- Yonemori, K., C. Honsho, A. Kitajima, M. Aradhya, E. Giordani, E. Bellini, and D. E. Parfitt: Relationship of European persimmon (*Diospyros kaki* Thunb.) cultivars to Asian cultivars, characterized using AFLPs. Genet Resour. Crop Evol. DOI 10.1007/s10722-007-9216-7, 2007
- Yonemori, K., C. Honsho, S. Kanzaki, H. Ino, A. Ikegami, A. Kitajima, A. Sugiura, and D. E. Parfitt: Sequence analyses of the ITS regions and the *mat*K gene for determining phylogenetic relationship of *Diospyros kaki* (persimmon) with other wild *Diospyros* (Ebenaceae) species. Tree Genetics Genomes DOI 10.1007/s11295-007-0096-y, 2007
- Hamada, K., K. Hasegawa, A. Kitajima and T. Ogata: Effect of one year or 2-year-successive strapping of lateral branchs on fruit development of Japanese persimmon 'Hiratanenashi' and 'Otanenashi'. J. Japan. Soc. Agr. Technol. Manage. 14; 43-48, 2007
- Kitajima, A., B. Preedasuttijit, A. Yamasaki, T. Habu, and K. Hasegawa: Chromosome identification and karyotyping of satsuma mandarin by genomic in situ hybridization. J. Amer. Soc. Hort. Sci. 132; 836-841, 2007
- Yamasaki, A., A. Kitajima, N. Ohara, M. Tanaka, K. Hasegawa: Histological study of expression of seedlessness in *Citrus kinokuni* 'Mukaku Kishu' and its progenies. J. Amer. Soc. Hort. Sci. 132; 869-875, 2007
- Preedasuttijit, B., A. Yamasaki, A. Kitajima, T. Ogata and K. Hasegawa: Chromosome identification and characterization in trifoliate orange (*Poncirus trifoliata* (L.) Raf.) by CMA and PI/DAPI staining and GISH. J. Japan. Soc. Hort. Sci. 76; 197-204, 2007
- Kanzaki, S., A. Sato, M. Yamada, N. Utsunomiya, A. Kitajima, A. Ikegami, and K. Yonemori: RFLP markers for the selection of pollination-constant and non-astringent (PCNA)-type persimmon and examination of the inheritance mode of the markers. J. Japan. Soc. Hort. Sci. 77; 28-32, 2008
- Vieira, J., N. A. Fonseca, R. A. M. Santos, T. Habu, R. Tao and C. P. Vieira. 2008. The number, age, sharing and relatedness of S-locus specificities in *Prunus*. Gent. Res., Camb. 90: 17-26.
- Fudano, T., T. Hayashi and S. Yazawa: Effect of plant density and variety on allometry of inflorescence architecture in *Gypsophila paniculata* L. J. Japan. Soc. Hort. Sci. 76; 327-332, 2007.
- b) Conference and seminar papers presented

The 224th meeting of Japanese Society for Crop Science : 1 presentations

2007 Autumn Meeting of the Japanese Society for Horticultural Science : 1 presentation

2008 Spring Meeting of the Japanese Society for Horticultural Science : 2 presentations

2007 Meeting of Kinki branch of the Japanese Society for Horticultural Science : 3 presentations Plant & Animal Genome XVI : 1 presentation

International Symposium on Conservation and Use of Tropical and Sub-Tropical Fruit : 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 (Accounts managers)

Katsura, K.: Crop Science Society of Japan (Secretary member)

Katsura, K.: The Society of Crop Science and Breeding in Kinki, Japan (General secretary)

Kataoka, K.: The Japanese Society for Horticultural Science (Editorial board, Ad hoc committee)

Research grants

Monbusho Research Grant: Research for Young Scientist (B) Exhaustive exploration of transposable elements in soybean for depelopment of reverse-genetical mutant ligbrary (Leader; Teraishi), Scientific Research (B) Structual genomic variation induced by *mping* transposable element in rice (Collaborator; Teraishi), Scientific Research (B) Mechanisms of citrus seedlessness derived from 'Mukaku Kishu' and development of seedless citrus breeding system (Leader; Kitajima), Scientific Research (B) Search for seedless native cultivars and their origin in citrus (Leader; Kitajima), Scientific Research (B) Investigation of origin species in Diospyros kaki and development process in PCNA type kaki lines (Collaborator; Kitajima), 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), Research for Young Scientist (B) Identification of pollen determinant of gametophytic self-incompatibility in *Maloideae* (Leader; Habu),

A-4. International cooperations and overseas activities

International joint researches, oversea research surveys

Kitajima, A.: Surveys of native citrus cultivers in East Asia (China, Thailand, Vietnam), Surveys of wild and PCNA types *D. kaki* (China)

B. Educational Activities (2007.4-2008.3)

B-1. On-campus teaching

a) Courses given

- Undergraduate level: Plant Cultivation Technology and Farm Practice (Yamada, Kitajima, Kataoka, Teraishi, Fudano, Habu, Katsura), Agricultural Technology and Farm Practice (Yamada, Kitajima, Kataoka, Teraishi, Fudano, Habu, Katsura), 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, Teraishi, Fudano, Habu, Katsura)
- Graduate level: Seminar on Plant Production Control Science (Yamada), Special Laboratory Work on Plant Production Control Science (Yamada, Kitajima, Kataoka, 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 11th open seminar of Experimental Farm, Kyoto University (Lecture)

B-3. Overseas teaching

Overseas lectures and Open lectures

Kitajima, A.: Cnina National Citrus Research Institute Special Lecture (China)

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.
- Kataoka, K.: Cooperative Expart of the Committee to Investigate the Advanced Technology and Information about Plant Variety Right in the Agriculture, Forestry and Fisheries Technical Information Society.