

2.1.9 Laboratory : Plant Production Control

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	Master's Program	5
	Undergraduate	2
	Other	6

A. Research Activities (2009.4-2010.3)

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) Survey of novel flowering time genes using mutant lines

A flowering time is the most important trait that is responsible to the yield and its stability in rice. Although, recent molecular genetice analyses identified many genes involved in flowering time, the regulatory mechanism still remains unkown. Here, we identify novel flowering time genes from the investigation of flowering time mutant lines. Among them, we already have revealed some new genes and alleles.

d) Genetic analysis of agricultural trait in the population crossed between closely-related species, japonica varieties

DNA markers based on genetic polymorphism play important roles for genetic analyses and

selections on breeding. Most of these markers are difficult to use when we analyze closely-related species, because the genetic background is not so different from each other. Here, we developed new DNA marker, named mPing-SCAR marker. This marker is based on the polymorphism of insertion of transposable element 'mPing'. A japonica rice variety "Gimbozu" harbors more than 1000 mPing insertion through the genome wide, whereas other japonica rice varieties harbor less than 50. When we cross Gimbozu with other japonica varieties, the conventional DNA markers, such as RAPD, AFLP and SSR markers, are hard to use. On the other hand, over 1000 mPing SCAR markers are available. This marker can provide us a powerful method to perform genetic analyses of the agricultural traits, which are different among japonica varieties.

e) Breeding new lines of knock-out or gain-of-function using active transposable element mPing

An active transposable element mPing provides approximately 50 new insertions per plant per generation in rice variety Gimbozu. When a new insertion is appeared in a exon region of a gene, the gene will lose the function. On the other hand, when a mPing inserts in a promoter region, the gene might gain a new regulatory of the transcription, resulting in new functions. Here, we grew ten thousand of Gimbozu, which include more than 300 thousand unique mPing insertion. Now we survey mPing insertion in our target genes.

f) Investigation the relationship between transcriptional elements (cis-elements) created by transposable element and the co-expression network

A life phenomenon is regulated by not a gene expression but genes co-expression at a time. It is considered that the cis-elemental module (the combination of cis-elements) is involved in the co-expression. A lot of cis-elements exist in transposable elements. Therefore, it is possible that co-expression network might be developed, when the same transposable element inserts in the promoter regions of the different genes. Here, we are investigating the components of cis-regulatory elements of each gene in rice, and integrate with expression data using bio-informatical techniques.

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

We are collecting 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.

h) 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 under green house condition. In this year, the effects of thermal environment on embryo development in 'Mukaku Kishu' and the mechanisms of embryo development under

higher temperature condition were investigated.

i) Search of citrus seedless native cultivars in East Asia and their origin

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

j) 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.

k) An inducible mechanism for the parthenocarpy of grapes by gibberellic acid

An application of the gibberellic acid is a very important cultivation technique for the parthenocarpy of grapes but the mechanism of it remains unclear. We are now trying to elucidate how the gibberellic acid induces the parthenocarpy of grapes by molecular biological approach.

l) Role of gibberellin on tomato fruit development

We have revealed that the addition of gibberellic acid to 4-CPA solution, treated at anthesis for inducing fruit set and growth, can increase sugar contents per fruit of 'Mini-charol' and 'Louis 60' tomatoes.

m) Studies on seed formation of genetic parthenocarpic tomatoes

Genetic parthenocarpy of tomatoes has labor-saving advantages for fruit production even in seasons unsuitable for pollination. Fertile seeds can be obtained by pollination at the appropriate time; however, the number of true seeds obtained is quite small, complicating both seed production and breeding. In order to control the seed production of parthenocarpic tomato cultivars, we investigate the seasonal change of seed formation capability and the effect of gibberellin biosynthesis inhibitor with histological observations to reveal the source of the obstruction.

n) 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.

o) 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 investigated 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

- Teraishi, M., Y. Ito, K. Yano, T. Nakazaki, T. Tsukiyama, Y. Okumoto, H. Saito, A. Kitajima and T. Tanisaka: In silico survey of transposable elements in soybean. *J. Crop res.* 54; 71-74, 2009
- Yu, Y., W. Wang, X. Yang, A. Yamasaki and A. Kitajima: PI/DAPI staining analysis of citrus chromosomes in mandarin cultivars. *Acta Horticulturae Science* 36; 1929, 2009
- Kataoka, K., Y. Yashiro, T. Habu, K. Sunamoto, A. Kitajima: The addition of gibberellic acid to auxin solutions increases sugar accumulation and sink strength in developing auxin-induced parthenocarpic tomato fruits. *Scientia Horticulturae* 123; 228-233, 2009
- Matsuda, M., T. Habu, F. Kishida, K. Kusumi, T. Konishi and A. Kitajima: Effect of different bearing shoot lengths on profitability of fruit production in Japanese persimmon (*Diospyros kaki* Thumb.) cv. Hiratanenashi. *Bull. Exp. Farm Kyoto Univ.* 18; 19-24, 2009
- Karki S., T. Tsukiyama, Y. Okumoto, G. Rizal, K. Naito, M. Teraishi, T. Nakazaki and T. Tanisaka: Analysis of distribution and proliferation of mPing family transposon in a wild rice (*Oryza rufipogon* Griff.) . *Breed. Sci.* 59; 297-307, 2009
- Wang, J., T. Nakazaki, S. Chen, W. Chen, H. Saito, T. Tsukiyama, Y. Okumoto, Z. Xu and T. Tanisaka: Characterization and identification of the erect-panicle gene EP conferring high grain yield in rice (*Oryza sativa* L.). *Theor. Appl. Genet.* 119; 85-91, 2009
- Sayama, S., T. Nakazaki, G. Ishikawa, K. Yagasaki, N. Yamada, N. Hirota, K. Hirata, M. Teraishi, T. Yoshikawa, H. Saito, M. Teraishi, Y. Okumoto, T. Tsukiyama and T. Tanisaka: QTL analysis of seed-flooding tolerance in soybean (*Glycine max* (L.) Merr.). *Plant Sci.* 176; 514-521, 2009
- Monden Y, K. Naito, Y. Okumoto, H. Saito, N. Oki, T. Tsukiyama, O. Ideta, T. Nakazaki, S. R. Wessler and T. Tanisaka: High potential of a transposon mPing as a

- marker system in japonica x japonica cross in rice. DNA Research 16; 131-140, 2009
- Hirata, K., T. Yoshikawa, M. Teraishi, K. Komatsu, M. Takahashi, N. Hirota, T. Nakazaki, T. Sayama, T. Tsukiyama, Y. Okumoto and T. Tanisaka: QTL analysis of seed-flooding tolerance of the yellow soybean variety 'Enrei'. J. Crop res. 54; 75-80, 2009
 - Inagaki, H., T. Tsukiyama, Y. Monden, S. Karki, Y. Okumoto, T. Nakazaki, M. Teraishi and T. Tanisaka: Identification of transcripts with sequence in rice. J. Crop res. 54; 99-102, 2009
 - Wakita, M., Y. Tanaka, K. Kataoka and S. Yazawa: Evaluation of low temperature tolerance in newly developed tolerant cultivar 'Super' (*Capsicum baccatum* var. pendulum) and other cultivars. Bull. Exp. Farm Kyoto Univ. 18; 11-17, 2009
 - Fudano, T. and T. Hayashi: Buds per inflorescence of progeny obtained from self-pollination of the many-buds type and cross-pollination of the many-buds type and normal type of sweet pea variety 'Early Lavender'. Bull. Exp. Farm Kyoto Univ. 18; 25-30, 2009
 - Fudano, T., T. Hayashi and S. Yazawa: Dynamic model of dry matter distribution and stabilization in the number of buds per inflorescence by overnight supplemental lighting in sweet pea (*Lathyrus odoratus* L.). J. Japan. Soc. Hort. Sci. 78; 344-349, 2009
 - Fudano, T., T. Hayashi and S. Yazawa: Factors influencing the number of buds per inflorescence in sweet pea (*Lathyrus odoratus* L.). J. Japan. Soc. Hort. Sci. 78; 463-468, 2009
 - Yamane, H., K. Fukuta, D. Matsumoto, T. Hanada, G. Mei, T. Esumi, T. Habu, Y. Fuyuhiko, S. Ogawa, H. Yaegaki, M. Yamaguchi and R. Tao: Characterization of a Novel Self-compatible S3' haplotype Leads to the Development of a Universal PCR Marker for Two Distinctly Originated Self-compatible S haplotypes in Japanese Apricot (*Prunus mume* Sieb. et Zucc.). J. Japan. Soc. Hort. Sci. 78; 40-48, 2009
 - Katsura, K., S. Maeda, T. Horie and T. Shiraiwa: Estimation of respiratory parameters for rice based on long-term and intermittent measurement of canopy CO₂ exchange rates in the field. Field Crops Res. 111; 85-91, 2009
 - Kato, Y., M. Okami and K. Katsura: Yield potential and water use efficiency of aerobic rice (*Oryza sativa* L.) in Japan. Field Crops Res. 113; 328-334, 2009
 - Katsura, K., T. Yoshihira, K. Homma, L.C. Purcell, T. Tanaka and T. Shiraiwa: Field studies on factors causing the widening gaps in soybean yield between Japan and USA. J. Crop. Res. 54, 149-154, 2009

- Katsura, K., M. Okami, H. Mizunuma and Y. Kato: Radiation-use efficiency, N accumulation and biomass production of high-yielding rice in aerobic culture. *Field Crops Res.* 117; 81-89, 2010
- Kato, Y. and K. Katsura: Panicle architecture and grain number in irrigated rice grown under different water management regimes. *Field Crops Res.* 117; 237-244, 2010
- Asami, T., Y. Okumoto, H. Saito, Q. Yuan, Y. Monden, M. Teraishi, T. Tsukiyama and T. Tanisaka:
Physical mapping of two novel photoperiod sensitivity genes, *se14* and *se15* using mPing SCAR markers. *J. Crop Res.* 54; 85-89, 2009
- Yuan Q., H. Saito, Y. Okumoto, H. Inoue, H. Nishida, T. Tsukiyama, M. Teraishi and T. Tanisaka: Identification of a novel gene *ef7* conferring an extremely long basic vegetative growth phase in rice. *Theor. Appl. Genet* 119; 675-684, 2009
- Naito K., F. Zhang, T. Tsukiyama, H. Saito, C. N. Hancock, A. O. Richardoson, Y. Okumoto, T. Tanisaka and S. R. Wessler: Unexpected consequences of a sudden and massive transposon amplification on rice gene expression. *Nature* 461; 1130-1134, 2009
- Saito H., Q. Yuan, Y. Okumoto, K. Doi, A. Yoshimura, H. Inoue, M. Teraishi, T. Tsukiyama and T. Tanisaka:
Multiple alleles at Early flowering 1 locus making variation in the basic vegetative growth period in rice (*Oryza sativa* L.). *Theor Appl Genet* 119; 315-323, 2009

Reviews

- Katsura, K.: Future perspective of studies on high yielding rice. *Bull. Exp. Farm Kyoto Univ.* 18; 1-4, 2009

Reports

- Habu, T., F. Kishida, T. Konishi, K. Kusumi, M. Matsuda and A. Kitajima:
Improvement of grape fruit coloration by application of liquid fertilizer contains natural abscisic acid. II. *Bull. Exp. Farm Kyoto Univ.* 18; 41-44, 2009
- Sakakibara, T., S. Kurosawa, K. Nishikawa, K. Kusumi and K. Kataoka: Changes of the yeild in green asparagus semi-forcing cultivation for fi ve years after planting. *Bull. Exp. Farm Kyoto Univ.* 18; 49-52; 2009
- Nishikawa, K., T. Sakakibara, S. Kirosawa and K. Kataoka: Improvement of a spray program for crop protection in tomato forcing culture. *Bull. Exp. Farm Kyoto Univ.* 18; 53-54, 2009
- Nishikawa, K., T. Sakakibara, S. Kurosawa, T. Fudano and K. Kataoka: Challenges for the establishment of winter tomato fruit production system using a parthenicarpic cultiva‘r, Kyo-temari’, without heating. II. effect of planting time on yield and quality.

Bull. Exp. Farm Kyoto Univ. 18; 57-60, 2009

- Tao, R., T. Habu, K. Fukuta, D. Matsumoto, and H. Yamane: Self-(in)compatibility in Japanese apricot (*Prunus mume*). *Acta Hort.* 814; 375-380 2009.

- Nara, N., K. Nonaka and T. Fudano: Effects of 5-aminolevulinic acid blended mixed fertilizer on cutting propagation of blue daze. *Bull. Exp. Farm Kyoto Univ.* 18; 45-48, 2009

- Nonaka, K., N. Nara and T. Fudano: Effects of soil application of 5-aminolevulinic acid blended mixed fertilizer on growth of cyclamen. *Bull. Exp. Farm Kyoto Univ.* 18; 55-56, 2009

- Naito, M., H. Kagata, H. Wakahara and K. Katsura: Challenges for the establishment of low agrichemical rice cultivation system focused on weed-growth-inhibiting effect of rice bran. *Bull. Exp. Farm Kyoto Univ.* 18; 37-40, 2009

b) Conference and seminar papers presented

- 2009 Spring Meeting of the Japanese Society for Horticultural Science : 4 presentations

- The 227th annual meeting of Japanese Society for Crop Science: 1 presentation

- The 115th Congress of Japanese Society of Breeding : 1 presentation

- The 48th meeting of Okinawa Agriculture Research Society: 1 presentation

- 2009 Meeting of Kinki branch of the Japanese Society for Horticultural Science : 1 presentation

- The 116th Congress of Japanese Society of Breeding : 5 presentation

- The 228th annual meeting of Japanese Society for Crop Science : 1 presentation

- 2009 Autumn Meeting of the Japanese Society for Horticultural Science : 5 presentations

- The 3rd International Conference on Integrated Approaches to Improve Crop Production Under Drought-Prone Environments (Interdourght-III) : 2 presentations

- The 6th International Rice Genetics Symposium: 1 presentation

- The 229th annual meeting of Japanese Society for Crop Science: 1 presentation

- The 117th Congress of Japanese Society of Breeding: 1 presentation

- 2010 Spring Meeting of the Japanese Society for Horticultural Science : 3 presentations

A-3.Off-campus activities

Membership in academic societies

- Kitajima, Akira, Dr.Agric.Sci. : The Japanese Society for Horticultural Science (Editorial board), International Society of Citriculture, Japan Branch (Board)
- Nakazaki, Tetsuya, Dr.Agric.Sci. : The Society of Crop Science and Breeding in Kinki (Editorial board)
- Katsura, Keisuke, Dr.Agric.Sci. : The Society of Crop Science and Breeding in Kinki, Japan (General secretary, Symposium organizing committee)

Research grants

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

- Scientific Research (B) : A. Kitajima : Mechanisms of citrus seedlessness derived from ‘Mukaku Kishu’ and development of seedless citrus breeding system
- Scientific Research (B) : A. Kitajima : Search for seedless native cultivars and their origin in citrus
- Young Scientists (B) : T. Habu : An inducible mechanism for the parthenocarpy of grapes by gibberellic acid
- Scientific Research (A) : R. Tao (Collaborator; T. Habu) : Molecular basis of the S-RNase-based gametophytic self-incompatibility system in Prunus
- Young Scientists (B) : H. Saito : Investigation of the regulatory system of flowering in rice using multiple mutation lines

2. Other Research Grants

- Sponsored Research Funds (Independent Administrative Institute (National Institute of Agrobiological Sciences)) : T. Tanisaka (Collaborator; H. Saito) : Genetic and molecular dissection of quantitative traits in rice "Identification and functional analysis of heading time genes controlling the basic vegetative growth."
- Sponsored Research funds (Fujikko Co. Ltd.) : T. Tanisaka (Collaborator; H. Saito) : Breeding of soybean varieties with high quality

A-4. International cooperation and overseas activities

International joint research, overseas research surveys

- Study on origin and survey of seedless citrus, Kitajima, A, China: Citrus Research Institute of Chinese Academy of Agricultural Science
- Cloning of a erect panicle gene in rice and analysis of its function, Prof. Z. Xu (Collaborator; T. Nakazaki), China: Shenyang Agriculture University
- Contribution of environmental, genotypic and agronomic factors to increasing gap of soybean yield between Japan and USA, T. Shiraiwa (Collaborator; K. Katsura), USA:

University of Arkansas, University of Illinois

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level: Plant Cultivation Technology and Farm Practice (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito), Agricultural Technology and Farm Practice (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito), Seminar on Plant Production Control Science (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito), Lecture on Outline of Bioresource Science I (Kitajima), Introduction to Research (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito), Laboratory Course in Bioresource Science I • II (Nakazaki)
- Graduate level: Seminar on Plant Production Control Science (Kitajima), Plant Production Control Science Seminar (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito), Special Laboratory Work in Plant Production Control Science (Kitajima, Nakazaki, Kataoka, Fudano, Habu, Katsura, Saito)

B-2.Off-campus teaching etc.

Part-time lecturer

- Kitajima, Akira, Dr.Agric.Sci. : Kyoto University of Education
- Kitajima, Akira, Dr.Agric.Sci. , Habu,Tsuyoshi, Dr.Agric.Sci.: Kyoto Study Center of The Open University of Japan(Current situation of promoting education and research in pomology)
- Nakazaki, Tetsuya, Dr.Agric.Sci. : Faculty of Engineering, Kyoto Sangyo University (Fundamentals of Biological Experiment I, Fundamentals of Biological Experiment II)
- Keiko, Kataoka, Dr.Agric.Sci. : Faculty of Agriculture, Shinshu University (Ornamental Horticulture)

Open lectures, etc.

- Nakazaki, Tetsuya, Dr.Agric.Sci. : The 13th Open Seminar of Experimental Farm, Kyoto University

- Katsura, Keisuke, Dr. Agric. Sci.: Training course by region "Technologies for the selection of upland rice varieties in Africa" (Japan International Cooperation Agency: (JICA))

B-3. Overseas teaching

International students

- International students : Research Students 1 (China)

Lectures and seminars

- Kitajima, Akira, Dr. Agric. Sci.

Japanese native citrus (Lecturer) : Yunnan Agriculture University; Yunnan province (China)

Trends of citrus breeding in Japan (Lecturer) : Institute of Chinese Academic of Tropical Agricultural Science; Hainan province (China)

C. Other Remarks

- Kitajima, Akira, Dr. Agric. Sci. : The Public Corporation of Tree-Planting and Forest of Takatsuki-shi (Director)

- Nakazaki, Tetsuya, Dr. Agric. Sci. : The Safety Control Committee for Recombinant DNA of Reserch Institute for Humanity and Nature (Committee)