

## Chair                      Crop Science

### 2.1.1                      Laboratory : Crop Science

Member:	Professor	Shiraiwa, Tatsuhiko, Dr. Agric. Sci.
	Associate Professor	Katsube-Tanaka, Tomoyuki, Dr. Agric. Sci.
	Assistant Professor	Homma, Koki, Dr. Agric. Sci.
	Doctor's program	5
	Master's Program	8
	Undergraduate	4
	Post-Doctoral fellow	1
	Program-Specific Resea	1
	Researcher	1

#### **A. Research Activities (2010.4-2011.3)**

##### **A-1. Main Subjects**

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

The yield 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 cause a large variation of soybean yield. 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 between Japanese and US cultivars and the underlying mechanisms and genetic factors 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 surveys, we found that the occurrence of DSS is promoted by unstable soil moisture condition especially during reproductive growth periods and we are analyzing crop physiological mechanism for DSS and genetic factors . We also are determining the effect of increased temperature on soybean growth and seed production with experiments conducted in the Temperature Gradient Chamber, TGC. In the soybean production area, a large field-to-field variability exists in the yield. We have investigated variations of soil moisture and fertility conditions and proposed major sources of yield variation, further we are developing methodology for evaluating field condition employing the remote sensing technique and the water budget model.

###### b) 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 ( $P_n$ ) 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 developed 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 dry matter and spikelet production, and leaf area development have been modeled.

#### c) 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.

#### d) 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 CO<sub>2</sub> balance of the ecosystem. The survey in Madagascar on the System of Rice Intensification (SRI) revealed importance of soil fertility amendment to achieve high yield under unsufficient resource input. We further investigated status of land use and rice productivity in a village where the lowland rice culture and the shifting agriculture are typically mixed up with strong land use pressure. For stabilizing rice production and consequently ameliorate deforestation, effectiveness of several management options, such as utilization of un-used crop residues as organic fertilizer, were examined.

## A-2.Publications and presentations

## a) Publications

### Original Papers(including book-reviews)

- Homma, K., Okai, H., Kurose, Y., Sudo, K., Ozaki, K., Shiraiwa, T., Katsube-Tanaka, T. (2010) Application of water budget equation model to farmer's fields of "Tambaguro" soybean. J. Crop Res. 55, 27-32.

- Inoue, Y., Kiyono, Y., Asai, H., Ochiai, Y., Qi, J., Oliosio, A., Shiraiwa, T., Horie, T., Saito, K., Dounagsavanh, L. (2010) Assessing land-use and carbon stock in slash-and-burn ecosystems in tropical mountain of Laos based on time-series satellite images. Int. J. Appl. Earth Obs. Geoinf. 12, 287-297.

- Katsube-Tanaka, T., Iida, S., Yamaguchi, T., Nakano, J. (2010) Capillary electrophoresis for analysis of microheterogeneous glutelin subunits in rice (*Oryza sativa* L.). Electrophoresis 31, 3566-3572.

- Saito, K., Phanthaboon, K., Shiraiwa, T., Horie, T., Futakuchi, K. (2010) Genotypic variation in ability to recover from weed competition at early vegetative stage in upland rice. Plant Prod. Sci. 13, 116-120.

- Tanaka, Y., Fujii, K., Shiraiwa, T. (2010) Variability of leaf morphology and stomatal conductance in soybean [*Glycine max* (L.) Merr.] cultivars. Crop Sci. 50, 2525-2532.

- Tsujimoto, Y., Homma, K., Shiraiwa, T. (2010) The effects of soil drying and rewetting on rice growth in lowland aquatic Ferralsols in the southeastern forest region of Madagascar. Plant Soil 333, 219-232.

### Reviews

- Katsube-Tanaka, T. (2010) Analysis and Improvement of Seed Storage Proteins. Jpn. J. Crop Sci. 79: 76-80.

### Reports,others

- Asanuma, S., Iseki, K., Suzuki, T., Sone, C., Tanaka, Y., Nishikawa, T., Hayashi, S., Hayashi, T., Matsuyama, H. (2010) Repoert of young crop scientist meeting (7). Jpn. J. Crop. Sci. 79, 372.

- Homma, K., (2010) Introduction The 39th Symposium of the society of crop science and breeding in Kinki, Japan. J. Crop Res. 55, 43.

- Kuwada, M. (2010) Crop can adapt no-fertilizer condition! -from the experience of a omparison study of Mulberry production. Gendai Nogyo August 84-87.

b) Conference and seminar papers presented

- The 231st Ann. Meeting of Crop Sci. Soc. of Japan : 5 presentations
- The 170th Ann. Meeting of the Society of Crop Science and Breeding in Kinki, Japan: 2 presentation
- The 2010 Ann. Meeting of the Kinki, Chugoku, and Shikoku Promotion Council: Agrometeorology Research Group : 1 presentation
- Symposium on Controlling Soybean Delayed Senescence : 1 presentation
- The 230th Ann. Meeting of Crop Sci. Soc. of Japan : 5 presentations
- The 169th Ann. Meeting of the Society of Crop Science and Breeding in Kinki, Japan: 2 presentation

**A-3.Off-campus activities 1**

Membership in academic societies

- Shiraiwa, T. : Crop Science Society of Japan (Councilor, Editorial board member of English journal, Member of the symposium committee, Member of the society award committee), Crop Science Society of Japan, Kinki branch (Representative), The Society of Crop Science and Breeding in Kinki, Japan (President)
- Katsube-Tanaka, T. : Crop Science Society of Japan (Editorial board member of Japanese journal), The Society of Crop Science and Breeding in Kinki, Japan (Secretary)
- Homma, K. : Crop Science Society of Japan (Chair person of strategy committee for young members, Member of strategy committee for men and women cooperative, Editorial board member of Japanese journal, Member of promotion of international relationship ), The Society of Crop Science and Breeding in Kinki, Japan (Editorial board member)

**A-3.Off-campus activities 2**

Research grants

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

- Scientific Research (B) : Shiraiwa, T. : Contribution of environmental, genotypic and agronomic factors to increasing gap of soybean yield between Japan and USA
- Scientific Research (B) : Shiraiwa, T. : Development of soybean crop model for stable production under drained paddy fields through adapting to and controlling the varying moisture environment
- Scientific Research (A) : Saito, K. (representative), Shiraiwa, T. (collaborator) : Strategy development for increasing yield potential of soybean in the Monsoon Asia

- Scientific Research(C) : Katsube-Tanaka, T. : Analysis of seed storage protein variation to reduce allergen in buckwheat.

- Grant-in-Aid for Young Scientists (B) : Homma, K. : Evaluation of selection method based on a cross tolerance for drought and oxidative stresses in rice

- Scientific Research (B) Co-investigator : (Yamagishi, J., The University of Tokyo) Co-investigator: Homma, K. : Evaluation of drought resistance in rice on the basis of relationship between nutrient uptake and nutrient dynamics in soil in Northeast Thailand

## 2. Other Research Grants

- Research Project by Ministry of Agriculture, Forestry and Fisheries : Taniyama, Ichiro : Impact assessment of global warming on agriculture, forestry and fisheries and development of technology for amelioration and adaptation (Impact assessment of global warming on soybean production)

### A-4. International cooperation and overseas activities 1

#### Membership in academic societies

- Shiraiwa, T.: International Journal of Plant Production (Editorial board member)

#### International joint research, 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)

### A-4. International cooperation and overseas activities 2

#### Visiting Research Scholars

- Postdoctoral Fellow 1 (Pakistan)

## B. Educational Activities(2010.4-2011.3)

### 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), Exercises in biostatistics (Homma), New Strategy of Agriculture (Shiraiwa), Outline of Agriculture II (Shiraiwa)

- Graduate level : Crop Science-Seminar (Shiraiwa, Tanaka), Special Laboratory Work in Crop Science (Shiraiwa, Tanaka), Crop production Ecology (Shiraiwa), Special Lecture of Agnomomy (Shiraiwa)

## **B-2.Off-campus teaching etc.**

### Part-time lecturer

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

## **B-3.Overseas teaching 1**

### International students

- International students : Master 1 (Nepal) Doctral 1 (Mozambique) Research Students 1 (Bangladesh)

## **C.Other Remarks**

- Shiraiwa, T. : Member of Professor Meeting ofr the Special Course of Agriculture , Kyoto University- Board member of university experimental farm, Member of advisory committee for Agriculture, Forestry and Fishery in Shiga Prefecture for coping with climate change, Member of advisory committee for application of satellite remote-sensing to assesement of rice planted area
- Homma, K. : Member of study of satellite-based remotesensing for food security in 2010, JAXA