Chair Biomaterials Function

2.2.10 Laboratory : Tree Cell Biology

Member :	Professor	Takabe, Keiji, Dr. Agric. Sci.
	Assistant Professor	Yoshinaga, Arata, Dr. Agric. Sci.
	Assistant Professor	Awano, Tatsuya, Dr. Agric. Sci.
	Doctor's program	4
	Master's Program	7
	Undergraduate	3
	Program-Specific Researcher	1

A. Research Activities (2010.4-2011.3)

A-1. Main Subjects

a) Formation process of plant cell walls

Many subjects on the formation and ultrastructure of wood cell walls were investigated as the basic studies on plant materials. Formation processes of cellulose microfibrils, hemicelluloses, and lignin were investigated using various microscopic techniques including light microscopy, confocal laser scanning microscopy, UV microscopy, FT-IR and Raman microscopy, and immunoelectron microscopy. Distribution and Formation process of hemicellulose in softwood and hardwood species was examined by immunoelectron microscopy with monoclonal antibodies. For lignification, transportation mechanism of monolignol was investigated using T-DNA insertion mutants of Arabidopsis thaliana and monoclonal antibodies against lignin substructures were developed and their specificity was examined.

b) Structural studies on the formation, physiology and functions of the cells in vascular bundles in plants.

Structures and behaviors of cell organelles, stored substances and walls in xylem and phloem cells are investigated in trees, bamboos and grass, lianas in relation to their development, physiological events and functions. Distribution of living wood fibers in some tree species, difference in anatomy and hemicellulose distribution between liana and trees, seasonal change in starch distribution in bamboo and their change during air drying were investigated.

c) Change in cell wall ultrastructure and cell wall components in enzyme saccharification of woody biomass.

Changes in cell wall ultrastructure and distribution of cell wall component (cellulose, hemicellulose, and lignin) were examined as fundamental studies on enzyme saccharification of woody biomass. Other pre-treatments, which were effective for enzyme saccharification of bark in softwood, were also investigated.

d) Improvement of carbon dioxide fixation in trees toward increase in biomass production.

Glutatione has been known to improve carbon dioxide fixation in crop plants. Toward increase in biomass production and improve carbon dioxide fixation in trees, the effect of glutatione treatment on woody biomass production was examined in Cryptomeria japonica and Chamaecyparis obtusa as softwoods, and Eucalyptus globulus and Populus spp. as hardwoods.

A-2.Publications and presentations

a) Publications

Books

- Kato, M., Noguchi, Y., Matsushita, Y., Yoshinaga, A., Awano, T., Takabe, K., Furujo, A., Asada, T., Kobayashi, T., Fukushima, K.: Pretreatment saccharification processes. 10. Feasibility of saccharification of eucalyptus bark combining fungus transcription factor engineering and a new pretreatment process. Serurosukei Baioetanoru Seizo Gijutsu, Kondo, A. and Ueda, M., eds., NTS Inc., pp189-197 (2010)

Original Papers(including book-reviews)

- Enomoto-Rogers, Y., Kamitakahara, H., Yoshinaga, A., Takano, T.: Radially oriented cellulose triacetate chains on gold nanoparticles. Cellulose; 17, 923-936 (2010)

- Kim, J.S., Awano,, T., Yoshinaga, A., Takabe, K.: Immunolocalization of beta-1-4-galactan and its relationship with lignin distribution in developing compression wood of Cryptomeria japonica. Planta; 232(1), 109-119 (2010)

- Kim, J.S., Awano, T., Yoshinaga, A., Takabe, K.: Temporal and spatial immunolocalization of glucomannans in differentiating earlywood tracheid cell walls of Cryptomeria japonica. Planta; 232(2), 545-554 (2010)

- Kim, J.S., Awano, T., Yoshinaga, A., Takabe, K..: Immunolocalization and structural variations of xylan in differentiating earlywood tracheid cell walls of Cryptomeria japonica. Planta; 232(4), 817-824 (2010)

- Matsushita, Y., Yamauchi, K., Takabe, K., Awano, T., Yoshinaga, A., Kato, M., Kobayashi, T., Asada, T., Furujyo, A., Fukushima, K. : Enzymatic sacchari˚cation of Eucalyptus bark using hydrothermal pre-treatment with carbon dioxide. Bioresource Technology; 101(13), 4936-4939 (2010)

- Takeuchi, Miyuki; Takabe, Keiji; Mineyuki, Yoshinobu. Immunoelectron microscopy of cryofixed and freeze-substituted plant tissues. Methods in Molecular Biology (Totowa, NJ, United States) , 657, 155-165 (2010).

b) Conference and seminar papers presented

- The 61th Annual Meeting of the Japan Wood Research Society: 13 papers

- The 12th Cell Wall Meeting: 5 papers

- The 55th Lignin Symposium: 1 paper

A-3.Off-campus activities 1

Membership in academic societies

- Takabe, Keiji : The Japan Wood Research Society (Councilor), The Japanese Society of Microscopy (Councilor)

- Yoshinaga, Arata : The Japan Wood Research Society (Editorial board member of the journal)

A-3.Off-campus activities 2

Research grants

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

- Fundamental Research (B) : Takabe, Keiji : Proteins relating to transportation and polymerization of monolignols

- Fundamental Research (C): : Kamitakahara, Hiroshi : Fine synthesis of cellulosic block co-polymers and their functionalization based on supermolecular structures

- Fundamental Research (C): : Yoshinaga, Arata : Distribution of lignin precursors in tree cells.

2.Other Research Grants

- NEDO, Accelerated Technology Development for Biofuel : Sugiyama, Junji (Study Group of Material Structure) : Basic R&D on Enzymatic Saccharification of Cellulosic Biomass and Biofuel Production.

- CREST, Creation of Innovative Technologies to Control Carbon Dioxide Emissions : Ogawa, Kenichi : Innovation and Development of New CO2-Fixation-Promoting Technology for Increasing Bio-Material Production

A-4.International cooperation and overseas activities 1

Membership in academic societies

- Takabe, Keiji: International Academy of Wood Science (Fellow)

A-4.International cooperation and overseas activities 2

Visiting Research Scholars

- Professor 1（Sweden）

- DC student 1（Sweden）

B.Educational Activities(2010.4-2011.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level : Basic Forest and Biomaterials Science I (Takabe), Structural and Physiological Biology of Woody Plant Cells (Takabe), Formation of Plant Cell Walls (Takabe), Mushroom Science (Awano), Information Technology in Forest and Biomaterials Science (Awano), Reading of Foreign Literature II (Yoshinaga, Awano), Laboratory Course in Forest and Biomaterials Science I (Takabe, Yoshinaga, Awano), Laboratory Course in Forest and Biomaterials Biology (Takabe, Yoshinaga, Awano), Laboratory Course in Ultrastructural Observation of Wood (Takabe, Yoshinaga, Awano), Seminar in Forest and Biomaterials Science (Takabe)

- Graduate level : Seminor on Tree Cell Biology (Takabe), Laboratory Course in Tree Cell Biology (Takabe)

B-2.Off-campus teaching etc.

Part-time lecturer

- Takabe, Keiji: Tokyo University of Agriculture and Technology, Environmental and Natural Resource Science, Special Lecture I

Open lectures, etc.

- Takabe, Keiji: Open Seminar in Forest Science, "From trees to plant materials", Research Institute for Sustainable Humanoshere and Division of Forest and Biomaterials Science, Kyoto University, Lecturer

- Awano, Tatsuya: Open Seminar in Forest Science, "From trees to plant materials", Research Institute for Sustainable Humanoshere and Division of Forest and Biomaterials Science, Kyoto University, Lecturer

B-3.Overseas teaching 1

International students

- International students : Doctral 1 (South Korea)