国立大学法人 山口大学
Faculty of Agriculture, Yamaguchi University
農学部

Faculty of Agriculture
Yamaguchi University

Sciences for Food, Life, and Environment

January 2021

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Interaction of physiology, ecology, and cultivation technologies of crops for high yield and quality

High-yield and high-quality wheat production in eastern Japan
In the warm and rainy climate of western Japan, wheat is cultivated in fields that are temporarily converted from paddy fields for lowland rice production. Due to the poor drainage in these fields, wheat is often subjected to temporal waterlogging or overwetting of the soil. We investigate the physiological responses of wheat to overly wet soil and agronomical management to alleviate the loss of grain yield and quality.

High-quality rice in eastern Japan
During high-temperature years, the quantity of white immature grains increases. It is known that poor grain filling is responsible for white immature grains. Adding nitrogen is considered detrimental to rice crops as it reduces the white grains. We investigate nitrogen uptake and rice metabolism in reproductive stages.

Improving rice production in Tanzania
Water is a major factor restricting rice production in Africa. We aim to improve water use efficiency through increasing yield levels in irrigated areas. In rain-fed areas, we have performed trials to identify the most effective technology for obtaining a high yield. These trials were performed in cooperation with Japan International Cooperation Agency.

Investigating limiting factors for the high yield of rice in Tanzania

About researcher

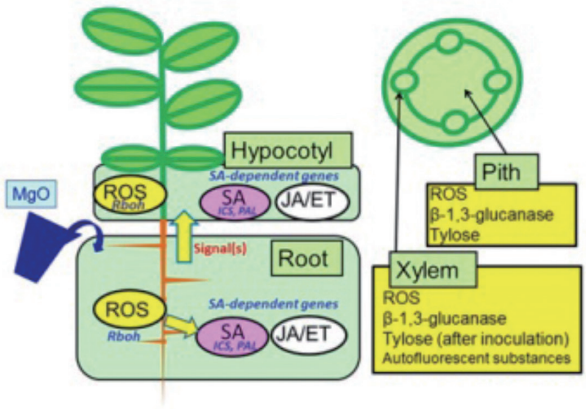
ARAKI, Hideki

Ph. D., 2002, Nagoya University

Induced resistance in host plants against soil-borne pathogens

Research in my laboratory focuses on both basic and applied research in molecular plant pathology. Basic research is focused on the genomics of soil-borne pathogens. Applied research is focused on two specific areas: the development of molecular methods to quantify soil-borne pathogens in plants and field soils and of novel methods to induce resistance in host plants against pathogens. My current research interests include the following:

- Signaling pathways underlying MgO-induced resistance to *Ralstonia solanacearum*
- Host-specificity determinants in *Plasmodiophora brassicae*
- *Trichoderma*-induced systemic disease resistance against clubroot



Factors involved in the MgO-induced suppression of bacterial wilt

About researcher

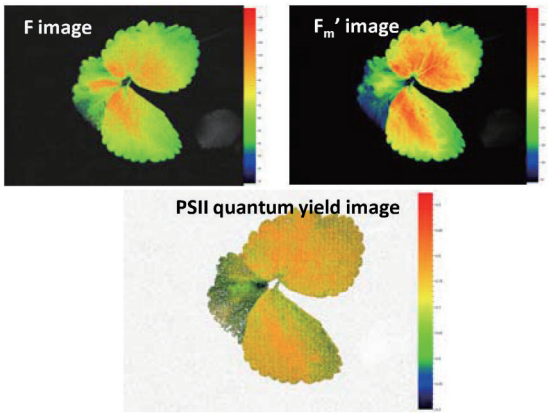
ITO, Shinichi

Ph. D., 1986, Yamaguchi University

Environmental control and plant monitoring in plant production

In Bio-Environmental Information Engineering laboratory, we perform research on the environmental control and use of information technology for plant production systems, including protected cultivation, plant factories, and plant tissue culture. We investigate the relationships among environmental factors, plant growth and development, and physiological state. Our aims are to develop systems to optimize the growth environment in plant production systems based on this knowledge.

We also attempt to develop methodologies to acquire information related to plant growth and development or physiological state. This information is then used to improve the efficiency of plant production (i.e., to improve the quality and quantity of products or to suppress plant diseases). Image analysis is a promising technique for the nondestructive acquisition of information on the plant physiological state. We not only use digital cameras but also use other types of cameras including hyperspectral cameras or thermal cameras. Fluorescence imaging from plant leaves is also used for the analysis of the plant physiological state.



Chlorophyll florescence imaging for analysis of photosynthesis

About researcher

IBARAKI, Yasuomi

Ph. D, 1996, The University of Tokyo

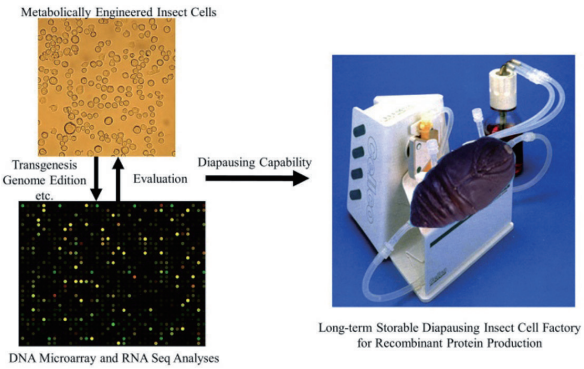
Innovation in Insect Biotechnology

Our research interests focus on the following two areas.

(1) Development of genome informatics-based technologies for the utilization and management of insects. Taking advantage of the enormous amounts of omics data accumulated because of the recent progress in genome projects on various insects that are important in both agriculture and human health, we are aiming to develop new technologies to utilize and control insects rationally with the aid of cutting-edge biotechnologies such as transgenesis, genome editing, RNA interference, and next-generation sequencing.

(2) Establishment of insect cell culture systems for valuable material production. There are many varieties of insects and insect-related organisms with excellent properties for producing special materials. Some of these properties and/or products have been already utilized by humans, while most of them, in spite of their potentially value, have not been well investigated and utilized yet. Therefore, we are exploring insect properties at molecular levels for material production in vitro by establishing novel insect cell lines. In addition, we are investigating genetic mechanisms of insect diapause control, by which insects can preserve themselves intact for a long time.

We are aiming to create a storable insect cell-based bioreactor for valuable material production by manipulating insect genes related to production and diapause.



Conceptual plan of a metabolically engineered insect cell bioreactor with excellent protein production properties and capability to diapause

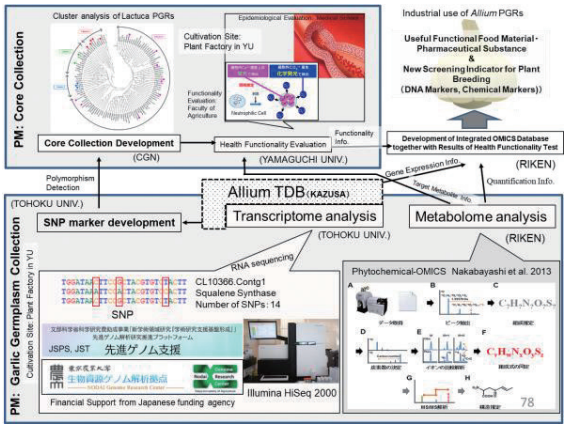
About researcher

KOBAYASHI, Jun

Ph.D., 1987, The University of Tokyo

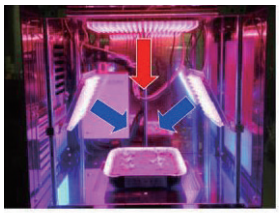
Genetics and Environmental Control in Vegetable Crops

In my laboratory, we conduct basic research on vegetable breeding and cultivation. We collect and maintain wild species and local varieties that are disappearing from the earth, and produce own genetic resources that provide a source of breeding materials with resistance to unknown diseases caused by global warming. Thus, we possess special resources not available at other research institutions, such as chromosome addition lines, nuclear-cytoplasmic substitution lines and doubled haploids. Using these lines, we are developing a novel omics-based technology for developing new varieties that can be used as a countermeasure against global warming. In addition, we have successfully developed a high-speed cultivation technique for leafy vegetables such as lettuce by conducting light irradiation tests using LEDs.

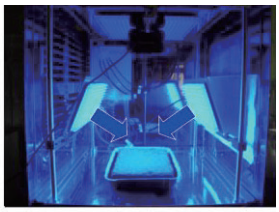


Allium omics concept

LED irradiation condition



RB (Simultaneous)
12h light / 12h dark



R/B (Alternating)
12h blue / 12h red

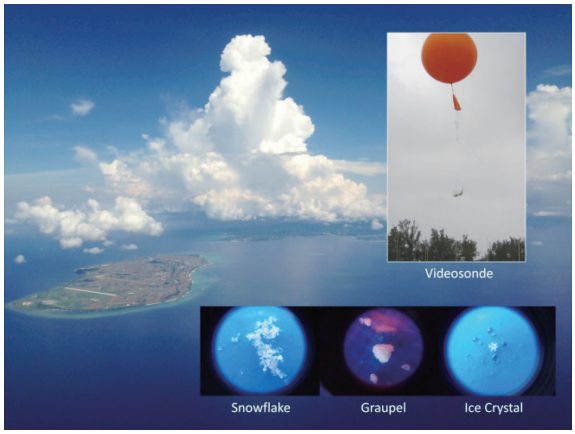
About researcher

SHIGYO, Masayoshi

Ph. D., 1997, Kagoshima University

In situ observation of microphysics in precipitating clouds

Global warming is one of the problems that must combat in the 21st century. The decrease in sea ice, delayed coloring of leaves, northward trend of the growth area of insects, and increase in heavy rains are all assumed to be influenced by global warming. Climate change brings about serious influences to ecosystems, agriculture, energy, water resources, and human health. For example, some scientists state that recent heavy snowfalls were influenced by the high sea surface temperatures caused by global warming. To predict climate change due to global warming, it is necessary to understand weather phenomenon. Of major concern is the rainfall mechanism, particularly the microscale phenomenon in clouds (cloud microphysics). My research consists of in situ observations using videosondes, ground-based particle images, and mass measurement systems (G-PIMMS) that directly measure precipitation particles. To investigate the vertical distribution of precipitation particles, it is important to improve our understanding of water concentration processes in clouds that bring torrential rain, which is sometimes called a "guerrilla rainstorm." I am also interested in the development of observation techniques and new equipment.



A launching videosonde and precipitation particle images

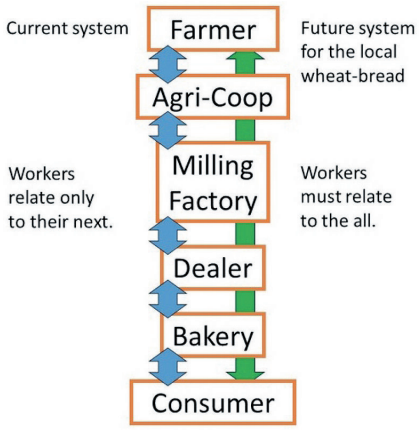
About researcher

SUZUKI, Kenji

Ph. D., 1997, Kyushu University

Crop Science Laboratory

The Takahashi Laboratory focuses on agronomy and crop science research for wheat crops. We have been examining not only how to improve the yield and quality of wheat products but also how to make the cultivation work easier and more comfortable. We aim to make the sowing period earlier than November, which is typical when cold rain prevents sowing. We use the west Japan ecotype for wheat production in Hokkaido where the climate is getting warmer, and rainy summers, like those in west Japan, have recently been occurring. This ecotype is tolerant to rainy conditions. The aim is for our local bread, which is made from the local wheat product in Yamaguchi, to go on the market. The local wheat-bread system is too difficult to develop, because there are many steps in its process. Each step, from growing wheat, milling flour, to baking bread is skillful work. These workers must relate to each other but are currently not even familiar to each other. In particular, consumers are not familiar with growing wheat or milling flour.



Process from wheat cultivation via milling flour to baking bread

About researcher

TAKAHASHI, Tadashi

Ph. D., 1993, Hokkaido University

Species and ecological diversity of termites (*Isoptera*) in Asia

Insects are the most prolific animals on earth and are closely related to the environment and humans. Our work focuses on one specific species of insects, the termite. We study its taxonomy, biodiversity, and ecology to obtain useful knowledge for the conservation of forests and to develop environmentally friendly termite control.

Our major research subjects are as follows:

(1) Taxonomy and biodiversity of termites in Asia

Termites play a crucial role in forest ecosystems as a decomposing agent, but termite diversity significantly varies according to its environment. We investigate the taxonomy, diversity, and molecular phylogeny of termites in Asian to clarify the relationship between the forest environment and termite diversity.

(2) Nestmate recognition of termites

Termites are social insects, and they have a unique recognition system to form and maintain colonies. We investigate the nestmate recognition of termites by comparing the cuticular hydrocarbon composition of respective species with their agonistic and trophallactic behaviors. The research results will be used to improve not only the taxonomy but also the control of termites.

Left: Species diversity survey in Borneo; Right: The open-foraging termite *Hospitalitermes lividiceps* in Borneo.

About researcher

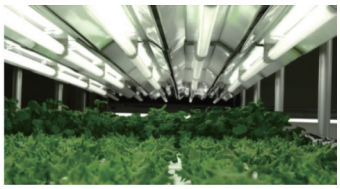
TAKEMATSU, Yoko

Doctor of Agriculture, 1997,
Kyushu University

Environmental Information Science

In our laboratory, we research environmental information science. The following are our major research themes:

1. understanding plant sensing, growth diagnosis, and control
2. developing road lighting to reduce the light pollution of agricultural crops
3. determining the costs and workability of plant factories
4. predicting disaster prevention for meteorological disasters
5. investigating global warming and agricultural production
6. constructing a Northeast Asia meteorological database



Environmental Information Laboratory

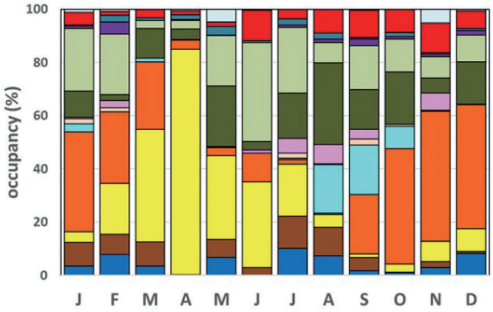
About researcher

YAMAMOTO, Haruhiko

Doctor of Agriculture, 1993,
Kyushu University

Animal ecology and wild animal damage prevention, Genetic diversity of local animal populations

Wildlife damage to crops has become more serious in our country over the past few decades. From a standpoint of wildlife management, not only culling pest animals, but also habitat management and damage prevention are indispensable. To prevent damage to crops, we must understand the ecology of the target species. In our laboratory, ecology, particularly food habits, of wild animals, such as deer, wild boars, raccoon dogs, bears and other species, have been investigated. We have elucidated that wild boars in Shimonoseki City mainly feed on bamboo shoots from mid-winter to early summer, and that they also feed on certain types of acorns from early fall to mid-winter. This suggests that the elimination of bamboo plants and acorn trees in and around villages removes a large part of the food resources of wild boars and that their range must shift to secluded places, which results in a peaceful coexistence of humans and wildlife. Such an application of scientific knowledge to wildlife management is our primary goal.
We also investigate the genetic diversity of local animal populations to detect the movement and/or expansion of a population to adjacent areas or the unauthorized introduction of animals.



Monthly food habit of wild boars in Shimonoseki City, Yamaguchi Prefecture, using the point frame method. We can see that bamboo (yellow) and acorn (orange) are important food items for wild boars (Photo by Hiroyuki Tado)

About researcher

HOSOI, Eiji

Ph. D., 1992, Colorado State University

Protected cultivation: Production technologies of vegetables in greenhouses and plant factories

Protected cultivation, such as in greenhouses and plant factories, allows for the stable production of vegetables with a high yield and high quality by controlling environmental conditions including temperature, humidity, light quality and intensity, and carbon dioxide concentration. The mission of our laboratory is to develop new technologies for environmental control to achieve vegetables with higher yields and higher quality in greenhouses and plant factories. Therefore, we determine relationships between plant physiology and environmental conditions using methods to measure plant physiological information and environmental conditions.
Research interests include the following:
• Responses of ion absorption by plant roots to environment conditions.
• Production of value-added vegetables by applying environmental stresses to roots in a soil-less culture.
• Improvement in plant productivity by preventing tipburn development on butterhead lettuce.
• Utilization of unused resources from other industries for crop production.

The actual condition of experiments in demonstration facilities for plant factories at the Yamaguchi University

About researcher

SAGO, Yuki

Ph. D., 2010, Kyushu University

A study on the use of fruit returnable containers

This study is one that saw the utility value and costs associated with returnable containers in persimmon distribution. Analysis points include i) soaring consumption of loss and cardboard materials costs, ii) returnable containers available due to impact of such farmers' income, particularly collection and shipping expenses, and iii) the utility value as seen from the holding and maintenance surface. Results to date have shown that among persimmon consumers, a price downturn is noted and related to unstable raw material prices. Returnable containers have been shown to reduce logistics and distribution expenses and contribute to the income increase of astringent persimmon growers. No corruption is found at the mass merchandiser stage and utility values are influenced from slowness of commodity deterioration in the quality conservation . In view of the above, using returnable containers both the fruit and material prices is unstable. However, they help to reduce logistics costs of the origin stage and are not conducive to improvement in the commercialization rate from a low of retailer's stages. Therefore it is possible to consider that there is value in utilization in production areas and among mass retailerse.

The returnable container use in fruit

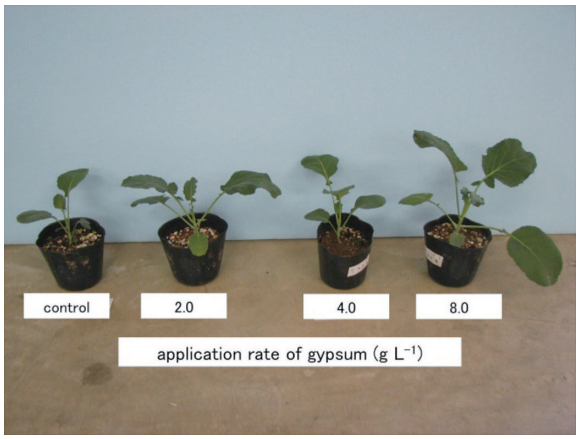
About researcher

TANEICHI, Yutaka

Ph. D., 2009, Tokyo University of Agriculture and Technology

Establishment of agricultural uses of by-product gypsum

In our Environmental Soil Sciences Laboratory, we study the relationships between soil and agricultural environments, specifically focusing on the improvement in nutrient supplies to crops and the amelioration of soil conditions for crop production and natural vegetation. One of our main research topics is the establishment of agricultural uses of by-product gypsum. Gypsum ($CaSO_4 \cdot 2H_2O$) has been used in agriculture for many years as a soil conditioner and ameliorant for sodic soils and as a nutrient source of Ca and S for plant growth. Recently, the utility of gypsum has been extended to acidic and infertile soils as an ameliorant for subsoil acidity. Two types of gypsum, mined gypsum and industrial by-product materials, are used. The production of by-product gypsum is increasing, although it is mostly limited to industrial uses such as wall boards and cement. These industrial uses are relatively unstable because of the economic situation. Therefore, establishing the agricultural uses of by-product gypsum is important. In our laboratory, we are currently researching the effects of by-product gypsum as a nutrient source of Ca and S for various crops on both crop yield and quality.



The effect of by-product gypsum on broccoli seedlings

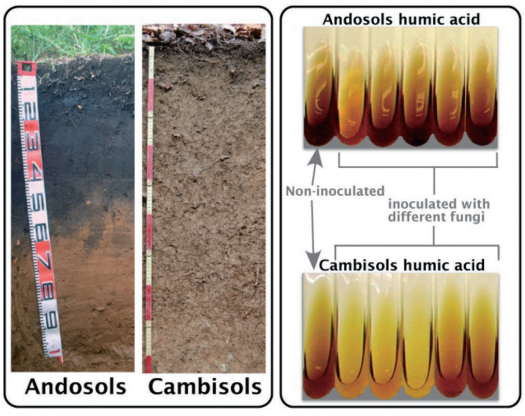
About researcher

TOMA, Mitsuru

Ph. D. (Agri.), 1996 ,
Tohoku University

Functions and dynamics of soil organic matter

Various types of soils are present on Earth. Soils have a variety of functions, such as plant production and environmental regulation, and support life. Soil organic matter is integral to soil function. Thus, understanding the fate and functions of soil organic matter is an extremely important issue from the point of view of sustainable agriculture and environmental conservation for the required harmony between modern society and the environment. In our laboratory, we
aim to clarify the detailed mechanisms of soil organic matter
function and interactions among soil organic matter, microorganisms, and plants. Specifically, we focus on the following subjects: (1) degradation of humic substances by ligninolytic fungi and enzymes and (2) interactions between humic substances and polycyclic aromatic hydrocarbons.
We are also interested in the pedogenesis of soils in the Yamaguchi Prefecture, such as the Akiyoshidai Plateau.



Soil profiles of Japanese Andosols and Cambisols (left) and degradation (decolorization) of their humic acids by ligninolytic fungi (right).

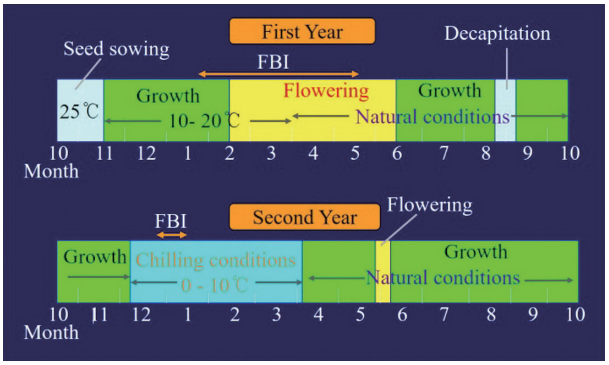
About researcher

YANAGI Yukiko

Doctor of Agriculture, 2002,
Kobe University

Fruit Tree Genetic Traits and their Application to Breeding

Our research studies important fruit tree genetic traits and their application to breeding. We focus on the following subjects: (1) genotype determination of self-incompatible Citrus cultivars by pollination with homozygous S1 seedlings, (2) segregation of self-incompatible hybrid seedlings in crosses with grapefruit and possible RAPD markers for the S
gene alleles, and (3) comparative analysis of expressed proteins in different stages of style development of the self-incompatibility reaction using monoembryonic Citrus species. DNA markers in major cultivars of sweet orange, Satsuma mandarin, Clementine mandarin, and grapefruit must be established as DNA markers are widely used for breeding.
The rapid development of the self-incompatibility gene and the polymerase chain reaction of molecular markers by utilizing precocious flowering seedlings enables the early selection of self-incompatibility and self-compatibility hybrid seedlings, which leads to an improvement in the efficiency of Citrus breeding.



Improved strategy for obtaining twice the high precocious flowering rates within one and half years after seed sowing in Japan

About researcher

KIM, Junghee

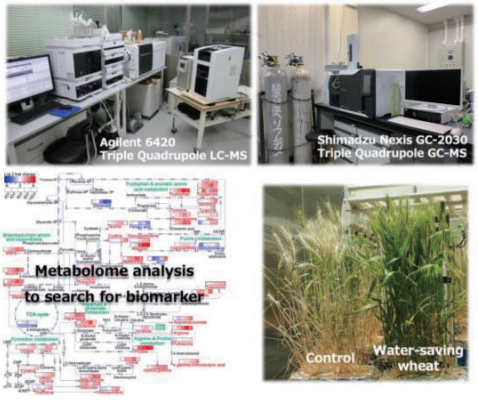
Ph.D., 2011, Kyushu University

Biomarker-based plant breeding science

In our plant breeding science laboratory, we focus on drought stress responsive or drought tolerance specific metabolites (**biomarkers**). We realized that transpiration fine-tuned wheat has water-saving type drought tolerance in previous research. Consequently, our laboratory is attempting to establish a biomarker-based method to screen out "**water-saving drought tolerant**" wheat from natural genetic resources using the water-saving wheat as a trait model.

1) To find candidate biomarkers by **metabolome** analysis using LC-MS and GC-MS.
2) To characterize the metabolite biosynthesis pathway and pick up the genes involved in the pathway from genomic information.
3) To identify biomarker-related genes by gene expression analysis.
4) To apply the identified genes to developing new breeding materials.

Our interest is in understanding plants' physiological responses to natural environments on the molecular level.



Water-saving wheat and metabolome analysis using LC-MS and GC-MS.

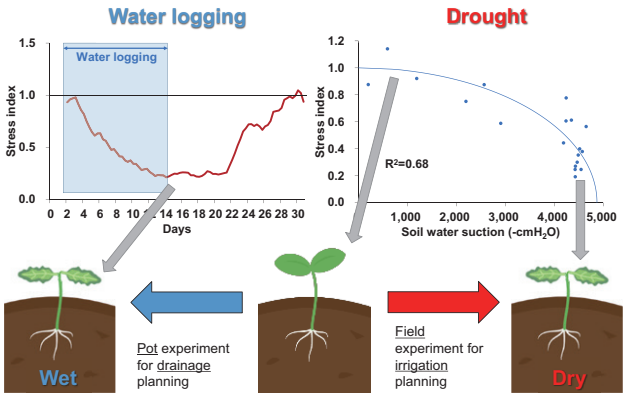
About researcher

MEGA, Ryosuke

Ph. D., 2010, Osaka University

Soil water management

We monitor soil water flux, crop water stress, soil loss and loads of phosphate and nitrate during monsoon periods and drought periods. Our goal is to develop the best field management practices for both crop production and environment. Using monitored data, we construct models to contribute planning of irrigation, drainage, soil amelioration and environmental load reduction. We specifically focus on the following subjects: (1) simulating the soil water flux using HYDRUS, (2) relationship between the suction of soil water and water stress of soybean, and (3) modeling the rainfall-runoff, soil loss and loads of phosphate and nitrate at a field scale.



Observed water stress of soybean under drought and water logging condition

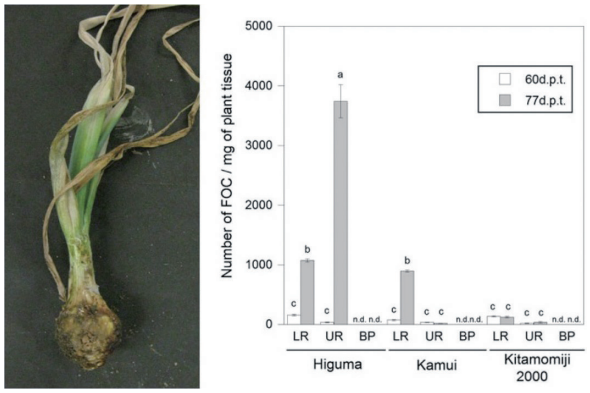
About researcher

SAKAGUCHI, Atsushi

Ph. D., 2014, Tokyo University of Agriculture and Technology

Effector proteins of plant pathogenic fungi

Our research is on the infection mechanisms of the plant pathogenic fungus *Fusarium oxysporum* f. sp. *cepae* (FOC). FOC causes basal rot on bulb and Japanese bunching onions. Plant pathogenic fungi can secrete pathogenicity proteins, such as effector proteins, into plant cells to suppress plant defense and facilitate fungal colonization. Some effector proteins are recognized by resistance genes of the host plant, and they function as avirulence factors. However, the detailed function of effector proteins involved in FOC infection has never been reported. We aim to clarify the infection mechanism of FOC using molecular biology tools such as next-generation sequencing, transcriptome and proteome analyses, and genetic transformation. In addition, we are developing detection techniques of plant pathogenic fungi from soil and host plants to establish a novel disease control system.



Symptom of basal rot on onions (left) and quantification of *Fusarium oxysporum* f. sp. *cepae* in onion cultivars with different disease resistances (right).

About researcher

SASAKI, Kazunori

Ph. D., 2015, Tottori University

Investigation and synthesis of functional aroma compounds Pharmaceutical applications of physiologically active compounds

Research interests range widely among a variety of physiologically active compounds in nature. In particular, analysis and synthesis are my main tools for the demonstration of the chemical ecology. We are currently investigating pheromones and allelochemicals in marine organisms.
Citrus fruits and herbs are found worldwide, and the essential oils are widely utilized in foods and beverages and as fragrances in cosmetics. The essential oils can have relaxing or stimulating effects on humans. Our odor descriptions and physiological analyses reveal the relationships between odor and the human brain.

Research interests
1) Investigation and synthesis of pheromones and allelochemials in marine organisms
2) Flavor chemistry of citrus fruits, herbs, and flowers
3) Elucidation of mechanistic pathways for the biogeneration of volatile aroma compounds
4) Relaxation effects of aroma on humans
5) Isolation and synthesis of physiologically active compounds
6) Development of functional foods and cosmetics

Diversity of naturally occurring compounds

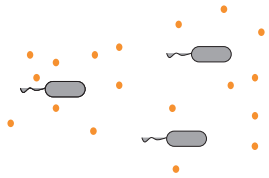
About researcher

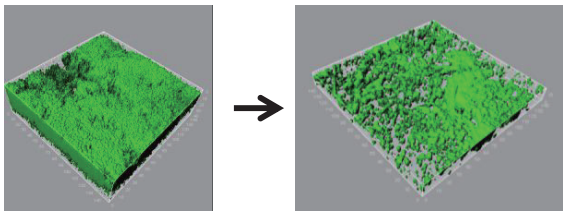
AKAKABE, Yoshihiko

Ph. D., 1994, Okayama University of Science

Pathogenic bacterial adhesion and colonization of host cells

When pathogenic bacteria infect animal and plant hosts, they must adhere to host surfaces. These bacteria have various adhesion factors against host defense mechanisms. Additionally, most of these bacteria communicate each other within biofilm community. Employing biochemistry and molecular biology techniques, we aim to uncover the mechanisms governing pathogenic bacterial communication and colonization. Particularly, we aim to investigate the mechanism of bacterial adhesion and colonization of animal and plant host cells and screen for inhibitors of biofilm formation. Dissecting the mechanism of bacterial communication will provide insights into managing and even preventing biofilm formation, which is necessary to prevent diseases and maintain quality in various industrial fields.


Bacteria communicate each other using signal molecules.


Inhibition of bacterial communication affects biofilm formation

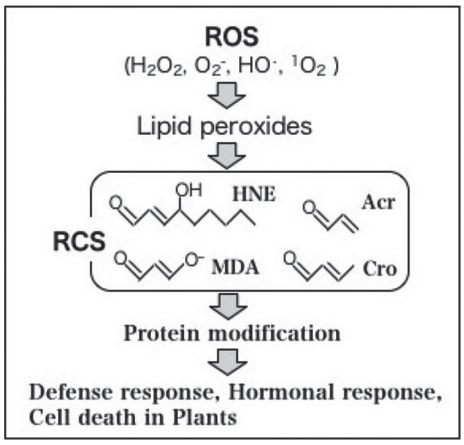
About researcher

AZAKAMI, Hiroyuki

Ph. D., 1994, Hiroshima University

Investigation of the mechanisms of plant responses to and defense against environmental stress

Investigating basic plant biology provides insights into applications to improve human health. Plants are affected by environmental changes, which induce oxidative stress due to increased levels of reactive oxygen species. We recently revealed that reactive carbonyl species (RCS), products of lipid peroxides, are mainly responsible for 'oxidative injury' in plant cells. RCS are a group of compounds commonly found in living organisms, and their biological functions are as versatile and important as those of reactive oxygen species. Our current aims are: (1) to elucidate RCS regulation in plants, (2) to define the physiological functions of RCS in plants, and (3) to discover compounds to scavenge RCS in plants. Detailed understanding of RCS functions will give us insights into the critical importance of these compounds in plant cells. In addition, if we identify RCS scavenging compounds, they may be viable nutritional supplements for human consumption.



Reactive carbonyl species are critical compounds in plant cells

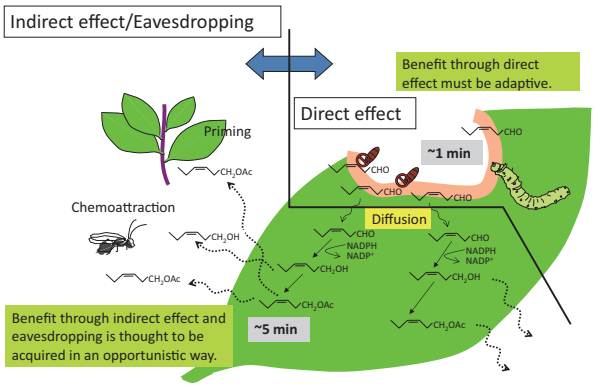
About researcher

MANO, Junichi

Ph. D., 1991, Kyoto University

Volatile compounds as tools for plants to communicate with animals, other plants, and microbes

Almost all living organisms produce volatile compounds that elicit odor. In our laboratory, we are particularly investigating why plants emit volatile compounds and the dynamics of such volatile compound emissions upon various stimuli, such as other plants, animals, and microbes. Using molecular biological techniques and ecological experiments, we aim to holistically dissect the landscape of the volatile compounds emitted by plants.



Plant volatiles to communicate friends and foes

About researcher

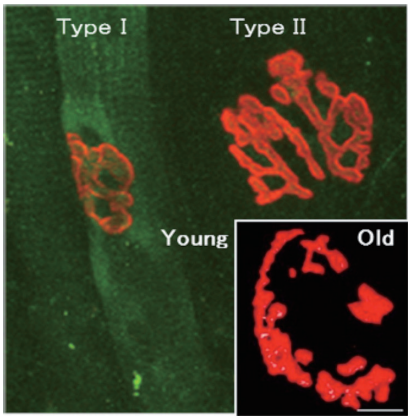
MATSUI, Kenji

Ph.D., 1991, Kyoto University

Muscle and motoneuron plasticity

Our research interests encompass several areas of motoneuron and muscle plasticity, including 1) accommodation of skeletal muscle and motoneuron functions during altered use; 2) neurophysiology of locomotion and respiratory motor system during development and aging; and 3) optimal training stimulation for muscle adaptation in mammals. We conduct research employing histochemical, biochemical, and basic electrophysiological techniques.

Several ongoing research projects in the laboratory include 1) morphological changes in the endplate of aged rat diaphragms; 2) training and detraining effects on satellite cell responses after exhaustive exercise in thoroughbred horses; 3) muscle fiber properties in mammals, including humans; and 4) effect of eccentric muscle contraction on satellite cell activation in human anti-gravity muscles. We are embarking on collaborative research efforts within Yamaguchi University, the Japanese Racing Horse Society, and the Mayo Clinic (USA).



One of our research projects is assessing the aging of the 3D endplate in aged rats

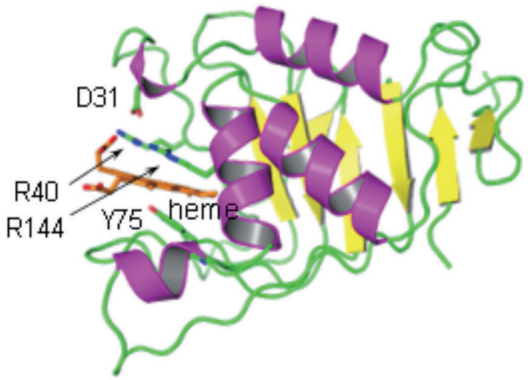
About researcher

MIYATA, Hirofumi

Ph.D., 1992, Osaka University

Structure and function of metalloproteins

Iron is an essential metal element in most living organisms, including bacteria. Pathogenic bacteria have developed diverse mechanisms to survive under iron-limited conditions. For example, gram-negative bacteria produce siderophores, which have high affinity for Fe(III). Siderophores chelate iron and transport it into the bacteria. However, iron atoms in host cells are tightly bound to proteins such as transferrin or ferritin. Very low concentrations of free iron pose severe challenges to pathogenic bacteria. Under such circumstances, heme could be a major iron source and some bacterial pathogens use hemophores for iron uptake from heme. Heme acquisition system A (HasA) is known as a hemophore in several gram-negative pathogens including *Pseudomonas aeruginosa, Serratia marcescens,* and *Yersinia pseudotuberculosis*. Using spectroscopic, crystallographic, and kinetic techniques, we have shown that iron–tyrosine coordination is critical for prompt heme capture by HasA from *Y. pseudotuberculosis*. We have also shown that interactions of the guanidinium group of the distal arginine with propionates and the heme plane contribute to the retention of heme in this hemophore.



The Structure of Heme Acquisition System A from *Y. pseudotuberculosis*

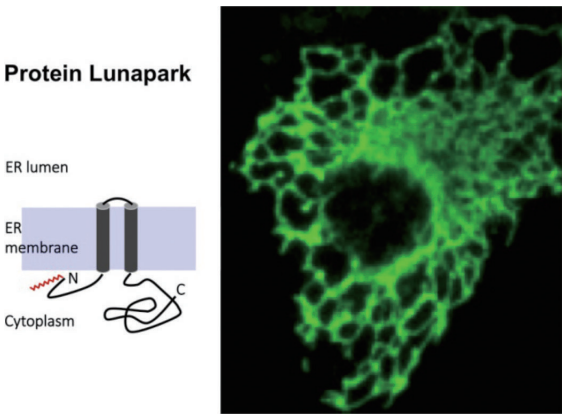
About researcher

OZAKI, Shin-ichi

Ph.D., 1992, Texas A&M University

Analysis of post-translational modifications of proteins and its application for genetic and protein engineering

Post-translational modifications of proteins play critical roles in the structure and function of proteins. In our laboratory, we are investigating lipid modifications of proteins. Lipid modification involves the covalent attachment of lipids, such as fatty acids, isoprenoids, or phospholipids, to a protein. Wide ranges of proteins, including many proteins involved in human diseases, are modified by lipids. Therefore, identification and characterization of lipid-modified proteins will be useful for the discovery of disease marker proteins, disease associated proteins or therapeutic target proteins. For the identification of novel human lipid-modified proteins, we have established a systematic strategy by using metabolic labeling of proteins. In this strategy, using cDNA as starting material, the susceptibility of the protein to lipid modification was evaluated by metabolic labeling in a cell-free protein synthesis system or in transfected mammalian cells. Using this strategy, we have succeeded in discovering more than 100 novel human lipid-modified proteins. We are currently studying the specific role of lipid modification on the function of disease-associated proteins.



Discovery of an N-myristoylated transmembrane protein that induces endoplasmic reticulum (ER) morphological change

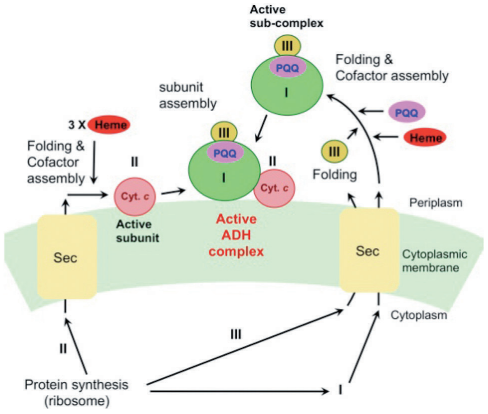
About researcher

UTSUMI, Toshihiko

Ph.D., 1988, Kyushu University

Biochemical function, physiological role, and molecular architecture of membrane proteins in bacteria

We are interested in the fermentation process orchestrated by bacteria, such as acetic acid bacteria. Particularly, we are assessing the molecular architecture of membrane-bound bacterial enzymes involved in fermentation (such as alcohol dehydrogenase), via genetic engineering, molecular biology, biochemistry, and structural biology. Understanding the basic properties of these enzymes in fermentation may provide insights into the development of enzyme-based technologies, such as biosensors and fuel cells, and may improve fermentation processes.



Molecular architecture of membrane-bound alcohol dehydrogenase in acetic acid bacteria

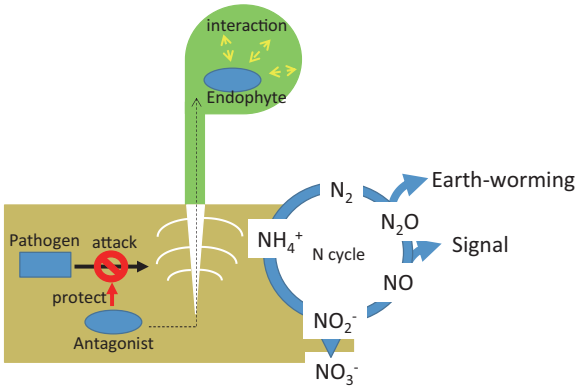
About researcher

YAKUSHI, Toshiharu

Ph.D., 1998, University of Tokyo

Investigating soil microbial ecology to advance crop production and protect the environment

I study the following aspects of soil microbial ecology: Microorganisms in soil are essential for the cycling of plant nutrients.. Particularly, nitrogen is a major plant nutrient. Various soil microorganisms mediate nitrogen transformation. Additionally, both nitrification and denitrification contribute to the dynamics of nitrous oxide (N_2O), which degrades ozone and acts as an earth-warming gas. To mitigate N_2O emission, we are assessing the properties and regulation of nitrification and denitrification in agricultural soil.
Microorganisms in soil interact with each other for either being detrimental or beneficial to the soil ecosystem.
Studying the means to enhance crop protection from soil-borne microbial diseases will identify ways to control the growth of antagonistic microorganisms.
Some soil microorganisms invade plants and promote growth without disease symptoms. These microorganisms, called endophytes, affect plant growth in various manners. Notably, some endophytes induce environmental stress resistance in the host plant. This aspect of endophytes is currently being studied.



Schematic image of soil microbial ecology for crop production

About researcher

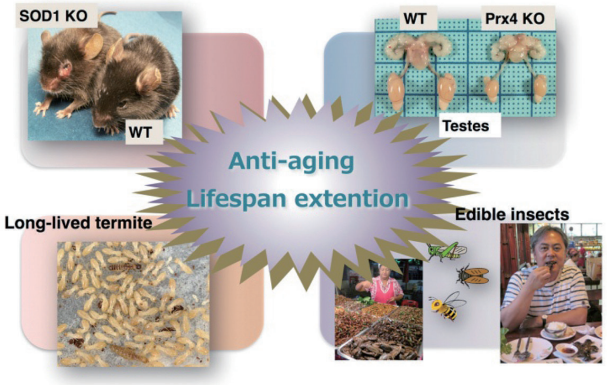
YOKOYAMA, Kazuhira

Ph. D., 1989, Kyushu University

Anti-aging and life span extension

Our main subject of research is the understanding of the aging process and the development of effective methods for anti-aging and life span extension. Because we have a limited understanding of the aging mechanism, we investigate it in terms of oxidative stress. With regard to the aging process, we emphasize on reactive oxygen species (ROS) generated inside the body and the antioxidant systems protecting against ROS-mediated oxidative stress. We study the benefits as well as the damages of ROS. In addition to these research themes, we attempt to reveal the anti-aging strategy of long-lived termites.
Ongoing research projects in our laboratory are

1. Understanding the ROS-induced aging process using superoxide dismutase-deficient mice.
2. Identifying functional food components for anti-aging and life span extension.
3. Analysis of the long-lived termite from the standpoint of the antioxidant system.
4. Edible insects as a functional food for health.



About researcher

IUCHI, Yoshihito

Ph. D., 1995, Hiroshima University

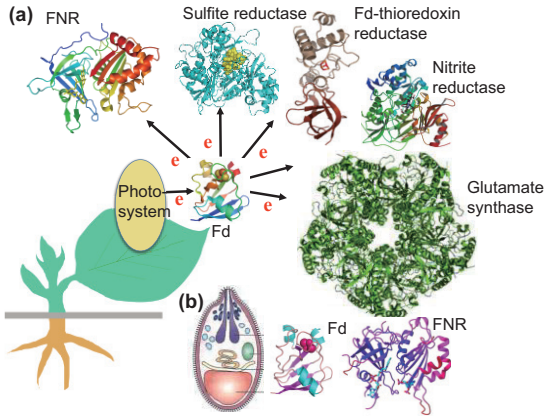
Molecular mechanism for the reducing power supply system in the plastids of plants and malaria parasites

We are interested in the way plants utilize light energy to synthesize various biomolecules which nourish life on earth. We have been focused on the mechanism by which high-energy electrons (reducing power), provided from photosystems, are properly distributed into various biosynthetic metabolisms depending on the environmental and physiological demands (Figure). A small stromal electron carrier protein, ferredoxin (Fd), which receives electron from photosystem I, plays a key regulatory role. On this front, we are currently working on identifying;

1) molecular mechanism for the distribution of reducing power in the plant plastids, in terms of protein-protein interactions and electron transfer between ferredoxin and its dependent metabolic enzymes. Recently, malaria parasites were found to possess a system for supplying reducing power, of which protein components (ferredoxin and its dependent NADP$^+$ oxidoreductase) are homologous to those of plants. Therefore, we are also working on;

2) characterization of the system for reducing power supply in the plastids (apicoplasts) of malaria parasites.

We are studying these molecular mechanisms using biochemical and physicochemical methods, for the purpose to regulate the energy flow into their plastids, and also, from the viewpoints of their physiological significances and evolutional development of plastids in the parasitic organisms.



Electron distribution in chloroplasts (a) and the homologous system of ferredoxin (Fd) and Fd-NADP+reductase (FNR) in malaria parasites (b)

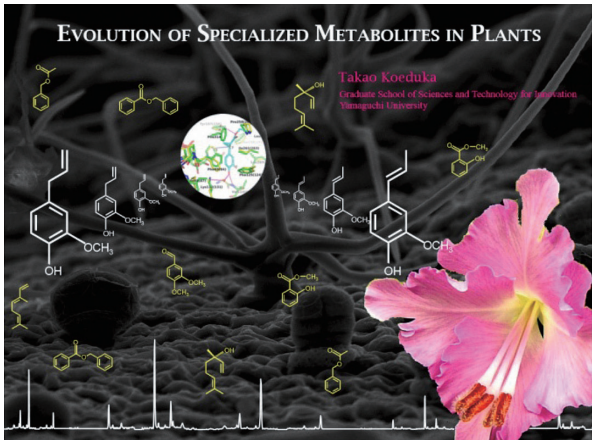
About researcher

KIMATA, Yoko

Ph.D., 1993,
North Carolina State University

Functional analyses of biosynthetic enzymes involved in plant specialized metabolites

Plants biosynthesize many specialized metabolites (secondary metabolites) including volatile compounds that serve as attractants for pollinators or for defense against herbivores and bacterial pathogen for adaptation to their ecological niches. Since antiquity, humans have used plant metabolites as commercial resources, such as medicinal, food flavoring agents, and perfumes. However, the biosynthetic pathways leading to these metabolites and their regulatory mechanisms are largely unknown. My goal is to investigate the biosynthetic pathways involved in the production of specialized plant metabolites and the enzymes that catalyze them. Genetic engineering of plant production systems with such enzymes could offer high potential for the introduction of new scents and flavors into various plant species.



Research overview

About researcher

KOEDUKA, Takao

Ph.D., 2005, Tottori University

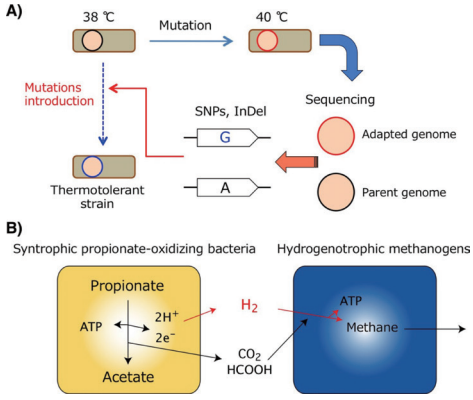
Application of genomics to physiological analysis of microorganisms

It has become increasingly important to learn the procedures of extracting information from genomic sequence and exploiting this information for a better understanding of biological phenomena. Although bioinformatics using genomic information can expand the understanding of metabolic mechanisms of microorganisms, it is dependent on biological studies for most of this information. Thus, our researches provide to the increasing need for the systematic merger of genetic and genomic information with physiological analysis.

We presently focus on studying several microbiological aspects of fermentative microbes, especially thermotolerant and syntrophic microorganisms.

A) For thermotolerant microorganisms, we have investigated several ethanol-producing bacteria, of which relatively thermotolerant strains have been analyzed to elucidate the thermotolerance mechanisms based on their genetic differences with mesophilic microorganisms. In addition, we attempt to identify the differences in these mechanisms by observing the effects of genetic and genomic modification.

B) For syntrophic microorganisms, we have investigated methane fermentation, in particular propionate oxidation performed by syntrophic propionate-oxidizing bacteria and hydrogenotrophic methanogens. These microorganisms inhabit anaerobic environments, and their genetic modification is difficult. Genomic, physiological, and biochemical analyses are performed to identify the mechanisms and procedures that are important for achieving syntrophic association under these energy-limited conditions.



A) Research of thermotolerant microorganisms
B) Schematic diagram of syntrophic propionate oxidation in methane fermentation

About researcher

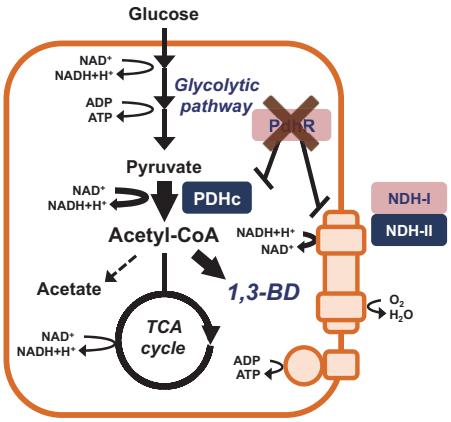
KOSAKA, Tomoyuki

Ph.D., 2003, Kyushu University

The role of microbial physiology and metabolic engineering in fermentation

Our laboratory mainly focuses on the "fermentation physiology" and "metabolic engineering" of microbes. Acetic acid bacteria, such as *Gluconobacter* spp. and *Acetobacter* spp., and amino acid-producing bacteria, such as *Corynebacterium* spp., are industrially important microbes used for the fermentative production of vitamin C, acetic acid, amino acids and so on. These microbes produce various chemical compounds through their respective metabolic processes. We are studying the dynamics of this "fermentative physiology" to molecularly understand these metabolic process.

Due to increased concerns about the depletion of fossil resources and ensuing environmental problems, biological production of platform chemicals from renewable sources has attracted much attention as a viable alternative to petroleum-based manufacturing. "Metabolic engineering" is one of the most promising means to respond to this demand. In this field, metabolically and genetically well-studied microbes, such as *Escherichia coli* and *Corynebacterium glutamicum,* are engineered to produce the desired products, i.e., platform chemicals. Thus, we aim to produce valuable chemical compounds via "metabolic engineering" approaches, such as constructing the synthetic pathways to generate platform chemicals on a large scale.



Metabolic engineering strategies to enhance 1,3-butanediol (1,3-BD) production

About researcher

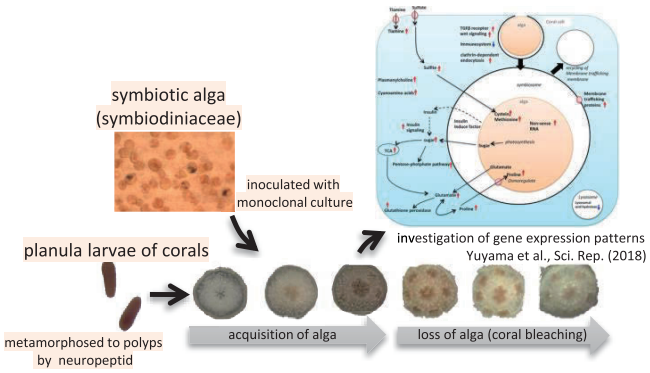
KATAOKA, Naoya

Ph. D., 2013, Hiroshima University

Functional analysis of symbiotic microorganisms

Research in my laboratory focuses on the characterization of environmental microorganisms and symbiotic microorganisms. So far, we have used scleractinian corals to clarify the role of symbiotic microorganisms. In this study, we are conducting incubation experiments, transcriptome analysis, immunohistological analysis, and physiological analysis. My current research interests include the following:

- Effects of bacterial communities on stress tolerance of corals.
- Identification of genes involved in the establishment of symbiotic relationship, and genes related to the stress response.
- Establishment of new monoclonal culture collections of coral symbiotic microorganisms.



Experimental system for investigating symbiotic relationships between coral and algae

About researcher

YUYAMA, Ikuko

Ph. D. 2009, The University of Tokyo

Keyword Index