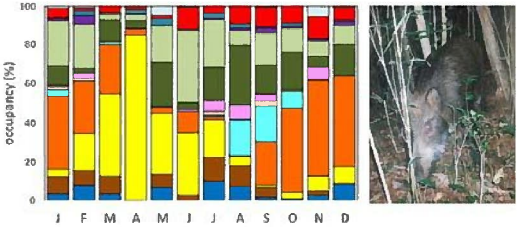
Animal Ecology and Wild Animal Damage Prevention, Genetic Diversity of Local Animal Populations

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

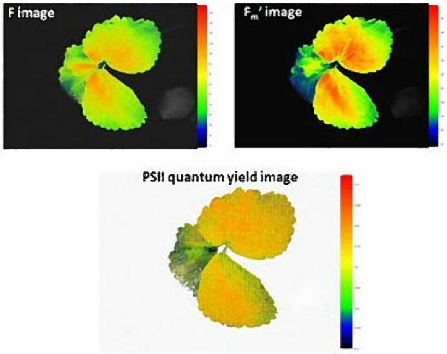
HOSOI Eiji, Ph.D.

Ph.D., 1992, Colorado State University

Environmental control and plant monitoring in plant production

In our 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/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 the development/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 fluorescence imaging

About Researcher

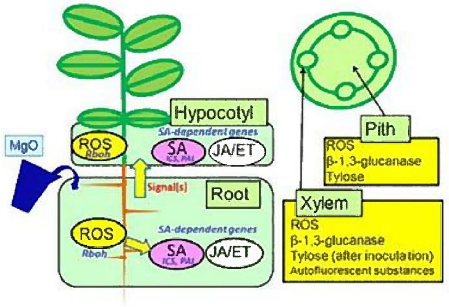
IBARAKI Yasuomi, Ph.D.

Ph.D., 1996, The University of Tokyo

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

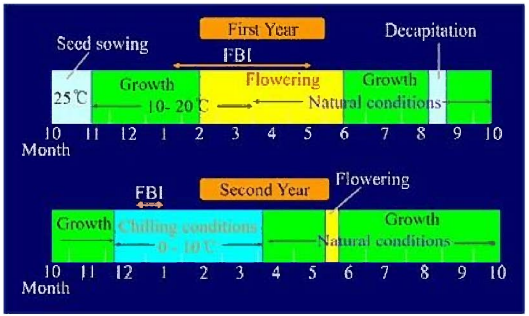
About Researcher

ITO Shinichi, Ph.D.

Ph. D., 1986, Yamaguchi 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

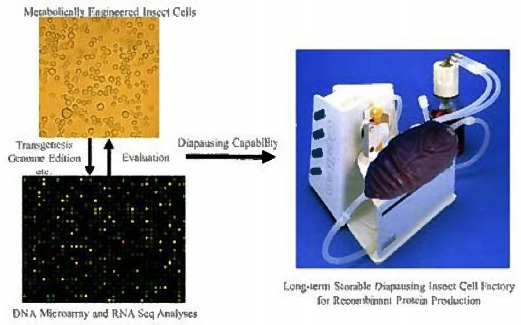
About Researcher

KIM Junghee,Ph.D.

Ph.D., 2011, Kyushu University

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.

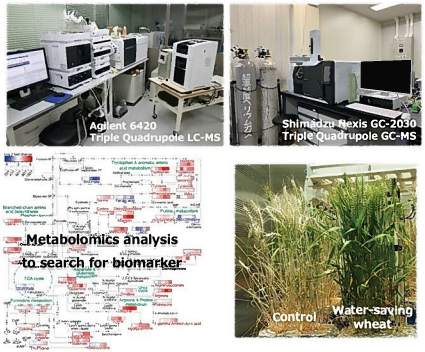
Ph.D., 1987 The University of Tokyo

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.

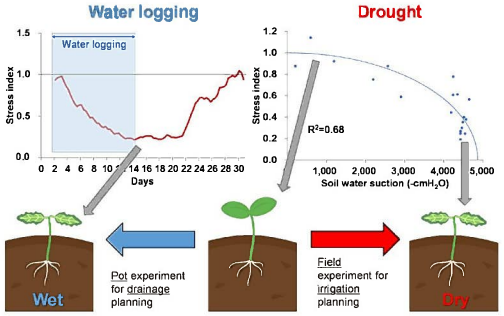
About Researcher

MEGA Ryosuke, Ph.D.

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

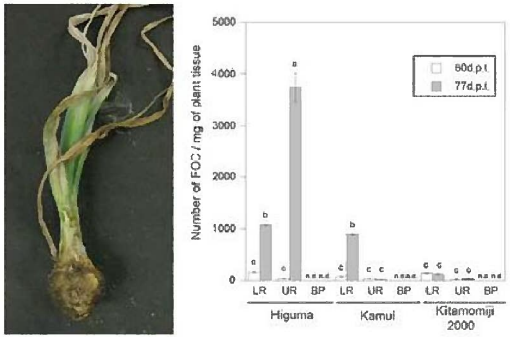
About Researcher

SAKAGUCHI Atsushi, Ph.D.

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)

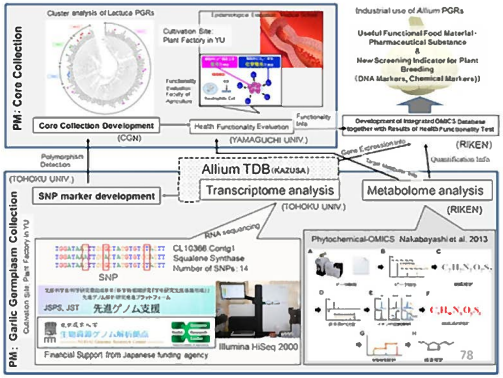
About Researcher

SASAKI Kazunori,Ph.D.

Ph.D., 2015, Tottori University

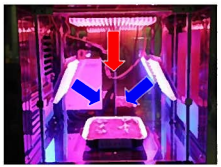
Genetics and Environmental Control in Vegetable Crops

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.

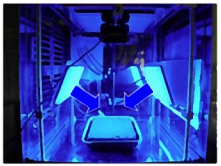


Allium omics concept

LED irradiation condition



RB（Simultaneous）
12h light / 12h dark



R/B（Alternating）
12h blue / 12h red

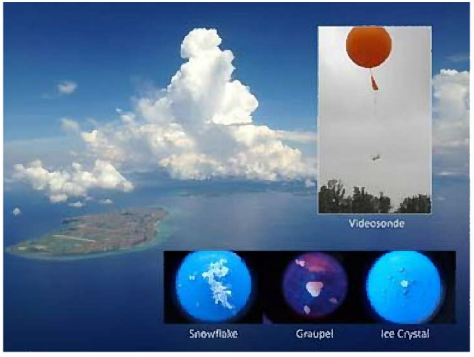
About Researcher

SHIGYO Masayoshi, Ph.D.

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

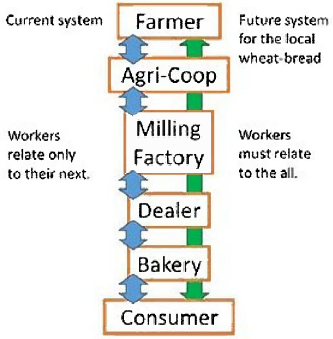
About Researcher

SUZUKI Kenji, Ph.D.

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.

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 termites. We study their 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, and termite diversity significantly varies according to its environment. We investigate the taxonomy, diversity, and molecular phylogeny of termites in Asia 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 with the 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, Ph.D.

Doctor of Agriculture, 1997, 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 retailers.

The returnable container use in fruit

About Researcher

TANEICHI Yutaka,Ph.D.

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

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

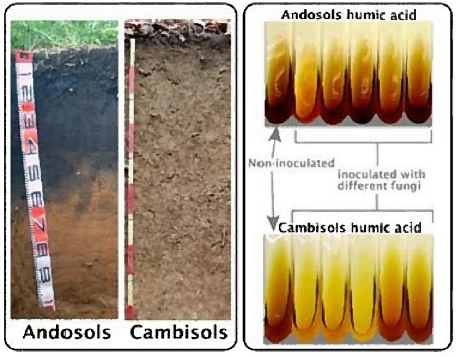
About Researcher

YAMAMOTO Haruhiko,Ph.D.

Doctor of Agriculture, 1993, Kyushu 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 Andosols (left), Cambisols (mid.), and Podzols (right)

About Researcher

YANAGI Yukiko, Ph.D.

Doctor of Agriculture, 2002, Kobe University