岡山大学
OKAYAMA UNIVERSITY

Institute of Plant Science and Resources

OKAYAMA
UNIVERSITY

Global gate for learning

GUIDE BOOK 2016

Institute of Plant Science and Resources
Okayama University

Milestones in IPSR History

The institute was founded in 1914, the third year of the Taisho era according to the traditional Japanese calendar, by Magosaburo Ohara, leading entrepreneur and philanthropist of Kurashiki City, founder of the Ohara Museum of Art featuring the first collection of Western art permanently exhibited in Japan. The original Ohara Institute for Agricultural Research started as a private establishment devoted to improvement of the welfare of farmers and promotion of agriculture in Japan.

After World War II, because of the loss of its financial base due to implementation of post-war agrarian reforms in Japan, the institute was transferred to Okayama University in 1952. One year later, in 1953, the institute was renamed as the Institute for Agricultural Biology and it became officially affiliated with the Okayama University. The institute initially had five departments: Plant Pathology, Biochemistry, Applied Entomology, Plant Physiology, and Plant Genetics. The formation of the three additional departments of Micrometeorology (1960), Biological Water Quality Science (1966), Weed Science (1970), and the establishment of the Barley Germplasm Center in 1979 assured the continued expansion and growth of the institute in the following years.

In 1988, novel research technologies and changing demands of modern society prompted the additional reorganization and renaming of the institute to the Research Institute for Bioresources (RIB), Okayama University.

After National University reforms in 2004, the institute was officially approved by the Ministry of Education, Culture, Sports, Science and Technology in Japan as a “center-of-excellence” in the fields of plant genetic resources and plant stress science (2009). On April 1, 2010, the institute acquired its current name, the Institute of Plant Science and Resources (IPSR), while it has been recognized at the national level as the “Joint Usage/Research Center”. Currently, the IPSR is organized into five research units that include Atmospheric Stress, Soil Stress, Biotic Stress, Genetic Resources, and Applied Genomics. The institute quickly acquired status of a widely open and welcoming collaborative center for domestic and foreign researchers. Its current scientific mission is the development of new generation crops suited for a multitude of stress environments, and the promotion of agricultural production in stress-affected areas worldwide.

Institute of Plant Science and Resources

IPSR Branch Library

The library of the institute, established in 1921, is rated among the best agricultural and biological libraries in Japan, with an extensive selection of scientific periodicals as well as rare and valuable books such as Pfeffer’s collection, Ohara’s collection of Chinese books, and Japanese agricultural books.

Director’s message

The Institute of Plant Science and Resources (IPSR) is the only national university-affiliated institute with an emphasis on agriculture. Taking over the tradition of the Ohara Institute for Agricultural Research, founded by leading Kurashiki city entrepreneur Magosaburo Ohara in 1914, the institute is now commemorating its 100th anniversary of establishment.

To satisfy the increasing demands of society and the research community, the institute was promoted in 2009 by the Ministry of Education, Culture, Sports, Science and Technology in Japan to a “Joint usage/research center” for plant stress and genetic resources. The center joint research activities started in the following year. The mission of the center is to use the genetic resources of barley, rice, and wild plants developed and maintained at the institute to elucidate the mechanisms of plant disorders and tolerance to stressful conditions related to pests, pathogens, and harsh environments. From 2016, our Institute has started new stage of joint research for 6 years.

Currently, the institute has 14 research groups exploring various genetic and physiological aspects of plant life. Scientists, students, and supporting staff specifically examine the responses of plants to various abiotic and biotic stress conditions such as light, drought, water, minerals, pests, and pathogens. Through active research exchange with scientists in Japan and around the world, we aim making remarkable achievements in basic and applied plant science. Furthermore, we take an active part in graduate education programs at Okayama University’s Graduate School of Environmental and Life Science, including the training of foreign graduate students. We are strongly committed to the education of students for whom we provide an international research environment. We feel directly responsible for the next generations and their active role in the globalized world.

Director Masahiko Maekawa

Because global environmental changes are likely to affect the growth capacity of various crops, to provide a sufficient food supply in the future, stress research remains as an extremely important issue. We seek to work collaboratively, and believe that, through our research at the institute, we can contribute greatly to the production of durable, stress resistant crops in the near future.

Public Offering of Joint Research and Major Equipment

The Institute of Plant Science and Resources (IPSR) is serving as a nationwide “Joint Usage/Research Center” for plant genetic resources and stress science. It is focused on research of plant responses and adaptation to variable stress conditions, using a broad variety of plant genetic resources developed at the institute. Advanced research equipment and instruments are well-maintained by technical staff and made available for the “Joint Usage/Research Center” research projects that are annually recruited via public offerings. A new guesthouse was built to assist many valuable joint research projects that are proceeding successfully.

Guest House

Research Equipment

For more details about our research activities, please visit the IPSR website. ▶▶▶
http://www.rib.okayama-u.ac.jp/index.html

Research Core for Plant Stress Science

Atmospheric Stress Unit

Plant Light Acclimation Research Group

Professor Wataru Sakamoto
Associate Professor Ryo Matsushima
Assistant Professor Yusuke Kato

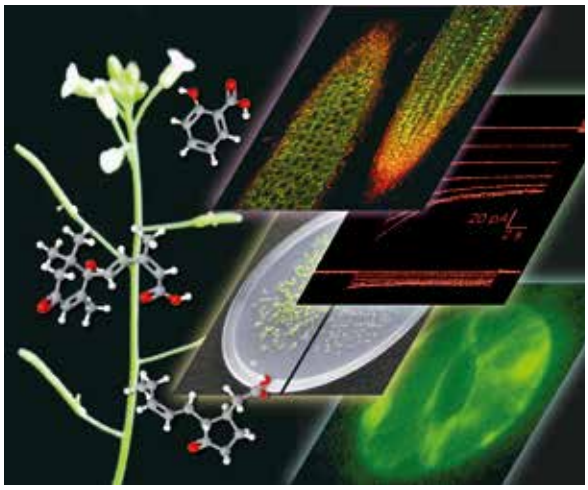
Photosynthesis and chloroplast biogenesis: Understanding to innovation

Our life on earth cannot continue without the atmospheric environment, which is maintained by oxygenic photosynthesis. Plants perform photosynthesis in chloroplasts, where light energy is converted into chemical energy by a series of electrochemical reactions. In contrast, sessile land plants are exposed incessantly to excess light energy or harsh atmospheric environments that engender 'photodamage'. How do plants cope with such photosynthetic inactivation? What are the key elements to maintaining or even maximizing chloroplast functions? Our group studies various aspects of chloroplast development and photosynthesis. Through understanding of the factors involved in photoprotection and chloroplast function, we aim at improving crop productivity against atmospheric stress over the long term.

Atmospheric Stress Unit

Group of Environmental Response Systems

Professor Takashi Hirayama
Associate Professor Izumi Mori
Assistant Professor Yoko Ikeda



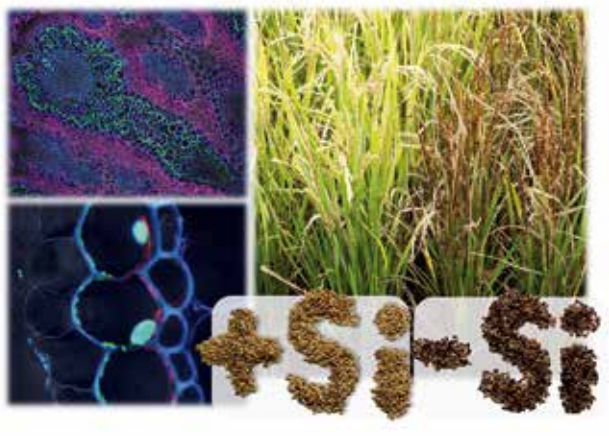
Uncovering secrets of plants: how plants 'know' their surroundings and 'think up' ways to cope with them

Being sessile, plants must adapt to all environmental changes or perish. Plants are already well-known to recognize environmental fluctuations and to respond promptly to such changes. Nevertheless, it remains unclear how plants dissect and integrate environmental signals and make a decision to render an optimal response even with no information-integration systems such as those of our central nervous system. To address this question, our group investigates environmental stress response systems of plants using physiological, molecular biological, and molecular genetic approaches. Among stress responses, we emphasize the study of stress-associated plant hormone signaling. Our ultimate goal is to take advantage of the research outcomes to create stress-tolerant crops.

Soil Stress Unit

Group of Plant Stress Physiology

Professor Jian Feng Ma
Associate Professor Naoki Yamaji
Assistant Professor Namiki Mitani
Assistant Professor Kengo Yokosho



Strategies of plants to overcome mineral stresses

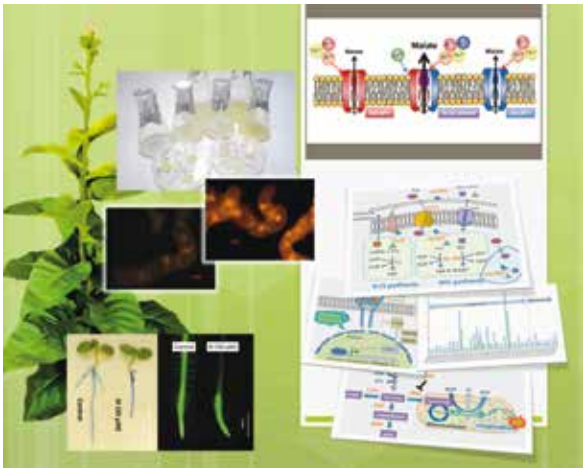
Plants rooting in soil must take up mineral nutrients as well as water for their growth. A deficiency or excess of a mineral element can cause growth inhibition. However, some plant species have developed strategies to overcome mineral stresses. Our group specifically examines the mechanisms of uptake, distribution, and accumulation of mineral elements including essential, beneficial and toxic elements from the intact plant level to the gene level. We aim at making a future contribution to sustainable and safe crop production.

Research Core for Plant Stress Science

Soil Stress Unit

Group of Plant Growth Regulation

Professor Yoko Yamamoto
Assistant Professor Takayuki Sasaki



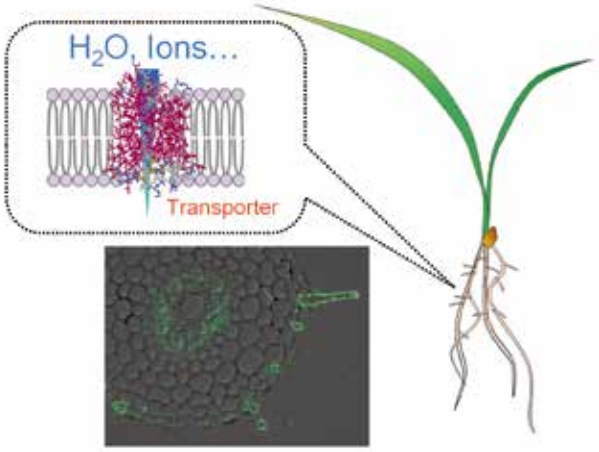
Study of plant growth regulation mechanisms under abiotic environmental stress

Our research is designed to ascertain the mechanisms of plant growth regulation under environmental stresses at the levels of cells, tissues, organs, and the whole individual. Our research has specifically examined aluminum ion, a major inhibitor of root growth in acidic soils, and has been analyzing the mechanisms of aluminum-induced cell elongation inhibition and cell death as well as tolerant mechanisms to overcome these toxic effects. During the study, we cloned the aluminum-tolerant wheat gene *ALMT1*, which is a highly promising gene to confer acid-soil tolerance on crops. The *ALMT1* gene belongs to the *ALMT* gene family, which has been found only in the plant kingdom. We expect to elucidate unique plant functions coded by individual *ALMT* genes.

Soil Stress Unit

Group of Molecular and Functional Plant Biology

Associate Professor Maki Katsuhara
Assistant Professor Mineo Shibasaka



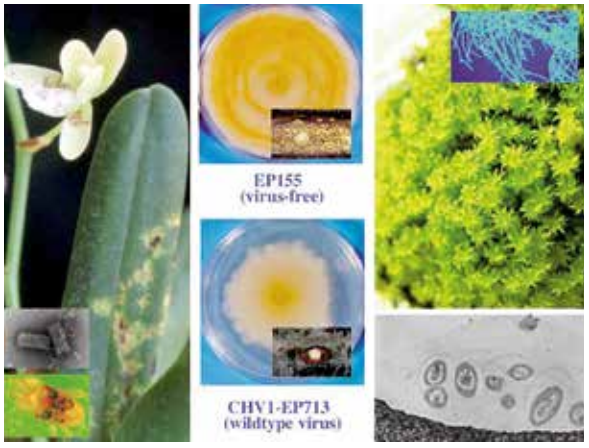
Physiological and molecular analysis of plant membrane transporters

We study the molecular functions of plant cells and biomembranes in response to drought and salt stress environments, especially water channels (aquaporins) and cation channels. In addition to water transport, we are investigating another aquaporin function transporting low molecular-weight compounds including CO_2. Electrophysiological measurements are also conducted to analyze sodium and potassium transporters in a salt stress condition.

Biotic Stress Unit

Group of Plant-Microbe Interactions

Professor Nobuhiro Suzuki
Associate Professor Akio Tani
Associate Professor Hideki Kondo Assistant Professor Kiwamu Hyodo



Ascertaining the interplay between plants and beneficial and harmful viruses or microorganisms

Plant growth is influenced by interactions between plants and various microorganisms. Viruses, bacteria and fungi pathogenic are threats to plants. By contrast, some viruses infect phytopathogenic fungi and reduce their virulence, thereby having potential as biocontrol agents. Beneficial bacteria and fungi enhance plant growth and confer stress tolerance. This group studies various bipartite (plant - virus, plant - symbiotic bacteria) or tripartite (plant - pathogenic fungus - mycovirus) interplays with specific examination of the multifaceted nature of microbes. Our ultimate goal is to contribute to the promotion of healthy growth of crops and other plants.

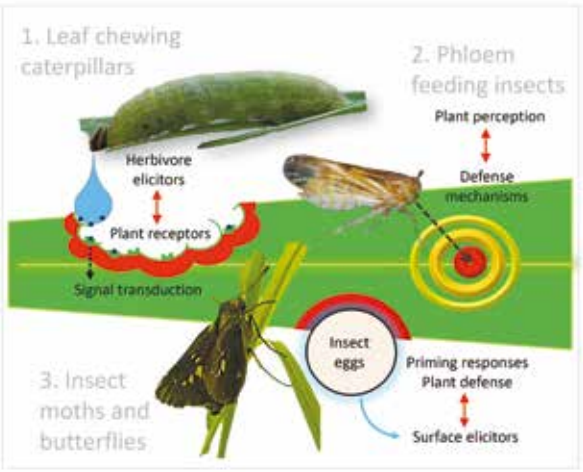
Biotic Stress Unit

Group of Plant-Insect Interactions

Professor Ivan Galis
Assistant Professor Tomonori Shinya

Elucidation of plant-insect interactions at the molecular level

Establishment of effective plant defense systems against herbivores in natural history reflects the existence of extremely variable interactions between plants and insects, also known as co-evolution process. Our group strives to understand, at a molecular level, the mechanisms of activation, signal transduction and metabolic basics of plant defenses triggered after the recognition of insect attack. Furthermore, we target sustainable pest control by the use of natural enemies and their attraction to herbivore-infested plants by the emissions of various volatile organic compounds (VOCs) from plants.



Barley and Wild Plant Resource Center

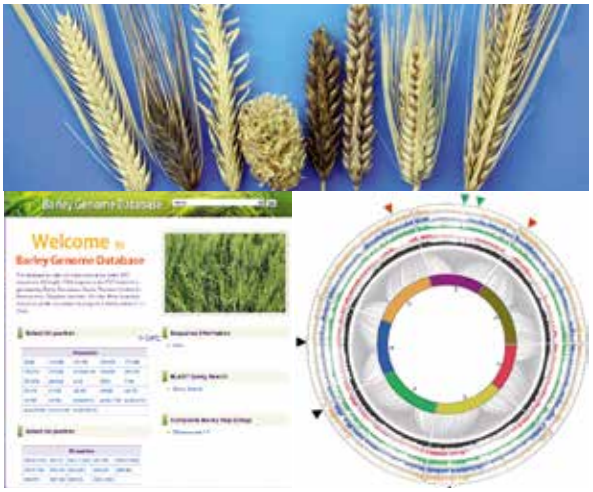
Genetic Resources Unit

Group of Genome Diversity

Professor Kazuhiro Sato
Assistant Professor Daisuke Saisho
Assistant Professor Hiroshi Hisano

Analysis and application of genome diversity in barley genetic resources

Our group conducts research on the analysis and application of genome diversity using ca. 15,000 accessions of barleys with special reference to East Asian landraces including experimental lines and wild relatives. The subjects of our research are (1) Evaluation of barley genetic resources and genome diversity, (2) Generation and application of information and resources on the barley genome, (3) Analysis of industrially important traits in barley. In addition to seed samples of accessions, cDNA and BAC clones (including individual clones, pooled BAC DNA for screening, high-density replica membranes and complete clone set of barley) were distributed worldwide with the support of the National BioResource Project.



Genetic Resources Unit

Group of Genetic Resources and Functions

Professor Shin Taketa

Molecular genetics of barley: morphology, seed quality, and disease resistance

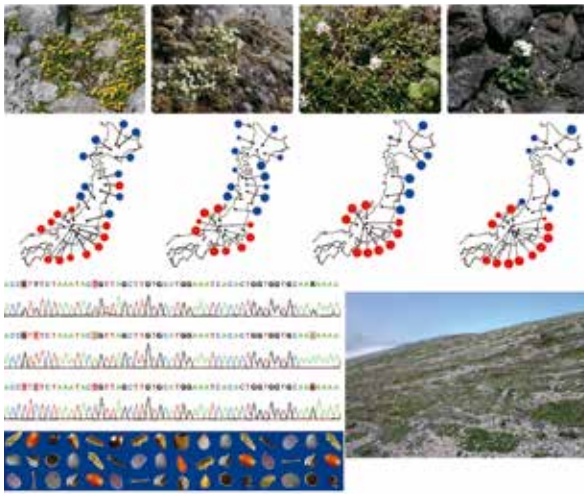
Barley, regarded as the fourth most important cereal in the world, is used for food, brewing of beer, and animal feed. Different uses require particular quality standards. Our current research specifically examines molecular characterization of barley genes controlling plant morphology, healthy seed constituents, and viral disease resistance. Such basic research is expected to facilitate the breeding of new cultivars. Despite its huge genome size (5 Gbp) with limited genome sequence information, we are identifying many key genes of barley. Our interests also extend to the transfer of outcomes from barley to hexaploid wheat.

Barley and Wild Plant Resource Center

Genetic Resources Unit

Group of Wild Plant Science

Professor Kazuhiro Sato (adjunctive)
Assistant Professor Jun Yamashita
Assistant Professor Hajime Ikeda



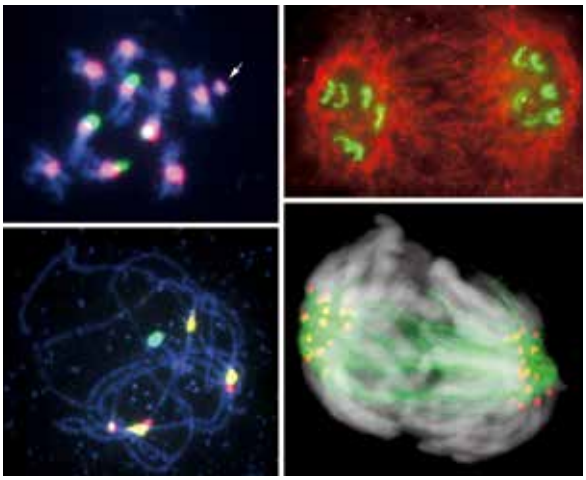
Natural variation and evolution of plants

Earth is home to over 270,000 known species of plants. This diversity of plants has been shaped mainly through adaptive evolution to various environments, including abiotic as well as biotic ones. We are interested in understanding the global plants' diversity. We specifically examine mechanisms of adaptive evolution that proceed in natural populations of plants. In addition to such basic research on natural history, we preserve and distribute wild plant seed resources.

Applied Genomics Unit

Group of Nuclear Genomics

Professor Minoru Murata
Associate Professor Kiyotaka Nagaki



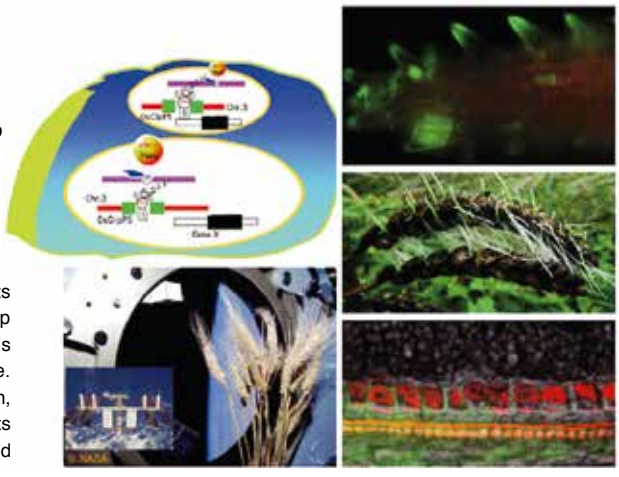
Design and synthesis of 'chromosomes' carrying new genome information

Nuclei that have very complex structures and various functions are the most important organelles in eukaryotic cells. Nuclear DNA are divided and packed into chromosomes, enabling the accurate transmission of genetic information to daughter cells. Our research group is studying the molecular structures and functions of nuclei and chromosomes, mainly in plants. Our most recent goal is the development of plant artificial chromosomes to elucidate chromosome functional elements: centromeres, telomeres, and replication origins. We are also interested in the relation between chromatin modifications and gene expression.

Applied Genomics Unit

Group of Genome Regulation

Professor Masahiko Maekawa
Associate Professor Bunichi Ezaki
Associate Professor Manabu Sugimoto
Assistant Professor Kazuhide Rikiishi
Assistant Professor Shigeko Utsugi



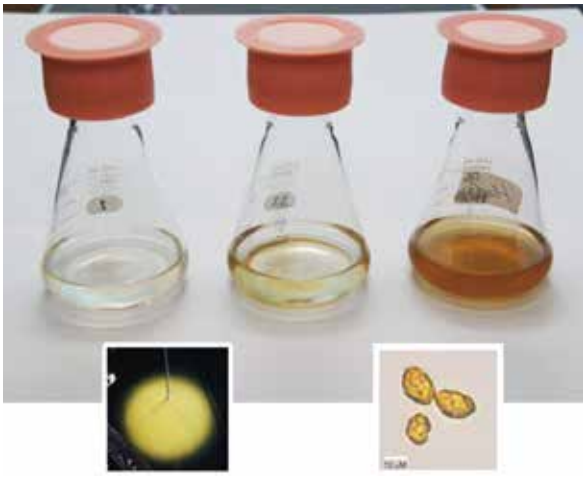
Analysis of genetic and physiological regulation mechanisms for food production

Sustainable agriculture and securing a sufficient supply of food are very important subjects for people living harmoniously in natural environments in the 21st century. This group conducts analyses of genetic factors for greater production efficiency using endogenous transposon and gene introduction or genome rearrangement from wild species in rice. Important seed dormancy in wheat is analyzed genetically and physiologically. In addition, the isolation of genes for tolerance of metal stresses or oxidation stresses in wild plants and their expression analysis are conducted. Furthermore, plants are being developed that can grow in space and in inferior environments on Earth.

Research Core for Future Crops

Innovative Research Group

Professor Masahiko Maekawa (adjunctive)
Assistant Professor Shoko Ueki



Molecular biology of bloom forming algae, *Heterosigma akashio*

We specifically study of *Heterosigma akashio*, a species causing harmful algal blooms often observed in the Seto Inland Sea. *Heterosigma akashio*, unicellular algae with flagella, are usually just one part of the plankton population in seawater. However, with some unknown environmental cues, it propagates dramatically, and forms blooms that negatively impact other living species in the area. We are particularly interested in its behavior in the environment, and in scrutinizing it using various molecular biology approaches.

International Collaboration Group

Professor Wataru Sakamoto (adjunctive)
Professor Masahiko Maekawa (adjunctive)
Professor Nobuhiro Suzuki (adjunctive)
Associate Professor Akio Tani (adjunctive)
Professor Yasutaka Kubo (adjunctive)
(Graduate School of Environmental and Life Science)

For innovative and leading plant research in East Africa

Understanding how plants respond and acclimate themselves to various biotic and abiotic stress conditions is useful to generate future crops endowed with 'stress resistance'. However, the application of stress-resistant crops must be conducted from a global standpoint, which necessitates international collaboration in a timely and strategic manner. Currently, this group aims to develop a research network in east Africa, in collaboration with Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kenya. Through this research network, our institute accepts graduate students and researchers, who conduct various projects in disciplines related to plant stress science. The group also organizes international meetings, both domestically and abroad, to accelerate networking.

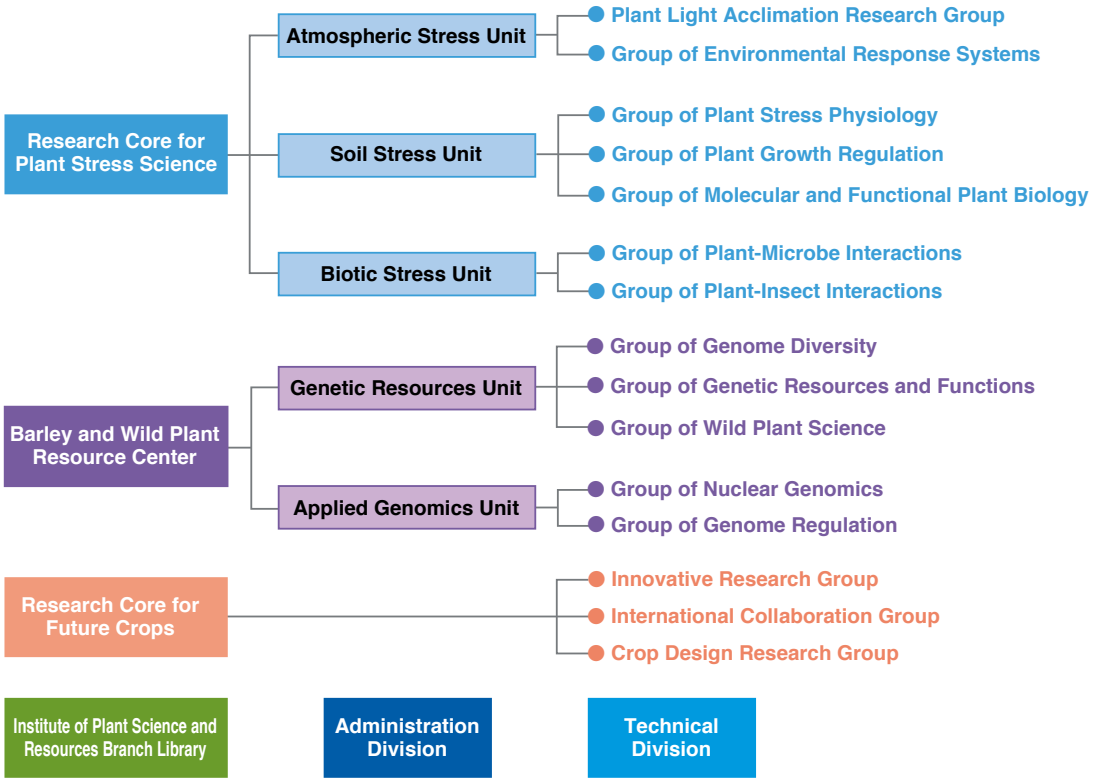
Crop Design Research Group

Specially Appointed Professor Keiichi Mochida
Professor Takashi Hirayama (adjunctive)

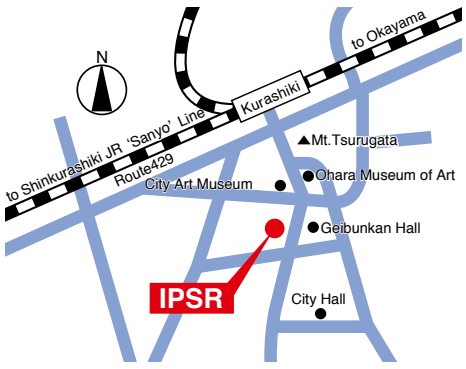
Technology development to design crops driven by filed data

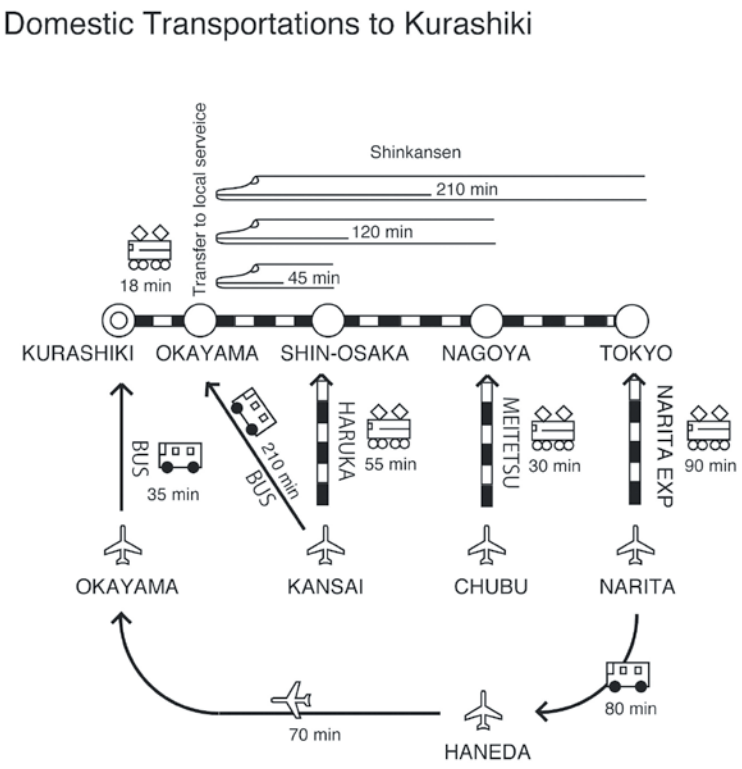
Our group was launched in November 2015 based on an agreement for a cross-appointment between Okayama University and RIKEN. Taking advantage of genetic resources in IPSR and integrating a broad range of data and knowledge related to the physiological responses of the plant, our group aims to accelerate discovery of genes that contribute to higher crop productivity. It is essential to understand interactions of genes and environmental changes in plants under field conditions. Our group has been promoting the research to elucidate physiological states transitions of crops throughout their life cycle in field conditions by integration of various comprehensive analytical techniques. We also has been promoting the development of analytical methodologies to computationally predict agronomic traits of crops by using field data.

Organization



Access & Routes





OKAYAMA UNIVERSITY
INSTITUTE OF PLANT SCIENCE AND RESOURCES
2-20-1 Chuo, Kurashiki 710-0046, Japan
Tel:+81-86-424-1661 Fax:+81-86-434-1249
E-mail:SEE1201@adm.okayama-u.ac.jp

http://www.rib.okayama-u.ac.jp/index-j.html IPSR, OKAYAMA UNIVERSITY Search

University Mark