



NARO

農研機構

独立行政法人 農業・食品産業技術総合研究機構

# NARO/TARC

National Agriculture and Food Research Organization  
Tohoku Agricultural Research Center

元気な東北の農業と農村を応援します

**NARO Tohoku Agricultural Research Center**

<http://tohoku.naro.affrc.go.jp/>

**The NARO Tohoku Agricultural Research Center (NARO/TARC) promotes “technological development for advancements in agriculture and the food industry by utilizing the abundant natural resources of the Tohoku region.”**  
**We aim to create four technological innovations.**

### **Establishing highly productive paddy field farming**

- ☐ Breeding of rice, wheat, and soybean cultivars
- ☐ Lowland crop rotation techniques utilizing subsurface irrigation-drainage facilities and direct seeding of well-drained paddy fields
- ☐ Low-input and high-efficiency rice cultivation by direct seeding
- ☐ Soil management and pest control for sustainable agriculture
- ☐ Combining our developed techniques with farm management

**Coordinating functions  
for the technological  
development of the  
agricultural and food  
industries**

# **FOUR INNOV**

### **Coping with and utilizing cold climate**

- ☐ Cultivation management support system utilizing meteorological information
- ☐ Agricultural production management techniques for coping with climate change
- ☐ Production technology of summer-autumn harvested vegetables for the food industry
- ☐ High-yield cultivation techniques for summer and autumn strawberries





### **Enforcing the circulatory functions of the agricultural and livestock industries**

- ☐ Production and processing technologies for forage soybean
- ☐ Breeding cold-region pasture grasses
- ☐ Production of lean beef by compensatory growth
- ☐ Environmentally friendly production system utilizing biological functions
- ☐ Resource recycle model for biomass material from paddy fields

**Promoting cooperation between industry, academia, and the public sector**

# **ATIONS**

### **Enhancing health functionality, and attaining safety and security**

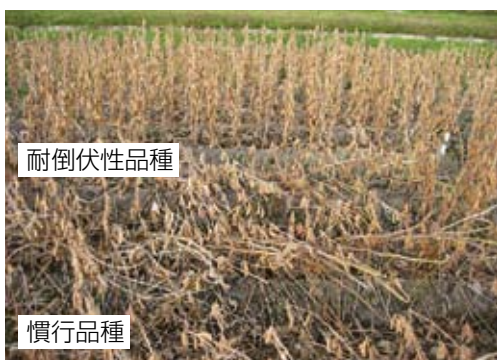
- ☐ Health functionality of local specialty products and breeding of cultivars
- ☐ Cadmium risk reduction techniques

# Establishing highly productive paddy field farming

- We are promoting the development of a lowland crop rotation system, through breeding rice, wheat and soybean cultivars, consolidating rice cultivation management with low-input and high-efficiency, developing soil management and pest control system for sustainable agriculture, utilizing forage rice through field and livestock farming, and developing system with high-quality, low-cost cultivation techniques.



Normal cv. "Akitakomachi" (left), and Lodging Resistant cv. "Moeminori" (right) in direct seeding



Resistant cv. "Satonohohoemi" (upper), and normal cv. "Enrei" (lower) in the experimental field, Daisen, Akita.

## Breeding of rice, wheat, and soybean cultivars

With the aim of breeding paddy rice cultivars that enable the inexpensive production of lowland rice, we develop good tasting cultivars for business use capable of direct seeding and with a high yield, and cultivars resistant to such problems as disease and pests, rice blast, cold weather, and high temperatures. We also breed cultivars with super-high yield and disease resistance to realize a stable supply of safe roughage. We breed high-quality wheat cultivars for bread, noodles and pastry that are resistant to cold and snow, yellow mosaic virus, and leaf rust. We also use DNA markers to breed barley cultivars with optimal processing characteristics and develop materials with resistance to a wide range of problems. We breed new soybean cultivars with high disease and pest resistance, lodging resistance, mechanization applicability such as resistance to pod bursting, and suitability for processing, while developing labor-saving high-yield systems through improving plant types and agronomic characteristics.

*Lowland Farming Research Division*  
*Field Crop and Horticulture Research Division*



Bread baked with wheat variety "Yukichikara"

## Lowland crop rotation techniques utilizing subsurface irrigation-drainage facilities and direct seeding of well-drained paddy fields

While enhancing the performance of field moisture control such as drainage and irrigation functions by accurately adjusting groundwater levels, we develop soil management techniques that maintain soil fertility and achieve stable growth and yield of crops such as rice, soybeans and vegetables, combined with improved field workability. We are also reviewing conventional mechanized cultivation systems that employ rotary tilling, and have established a large-scale lowland crop rotation system that makes it possible to realize highly efficient and continuous rotation using high-speed machines such as chisel plows and grain drills.

*Agro-Production Technologies and Management Research Division*  
*Lowland Farming Research Division*



Simplified installation equipment for subsurface drain



Rice sowing work using vacuum planter

## Low-input and high-efficiency rice cultivation by direct seeding

We are working on sowing uncoated seeds while simultaneously puddling with the aim of reducing input and improving the efficiency of direct-seeding techniques in flooded paddy fields in cold region. We also propose efficient fertilizer application methods and effective techniques for preventing rice from germinating from shattered seeds to develop low-input high-yield direct-seeding cultivation techniques for forage rice.

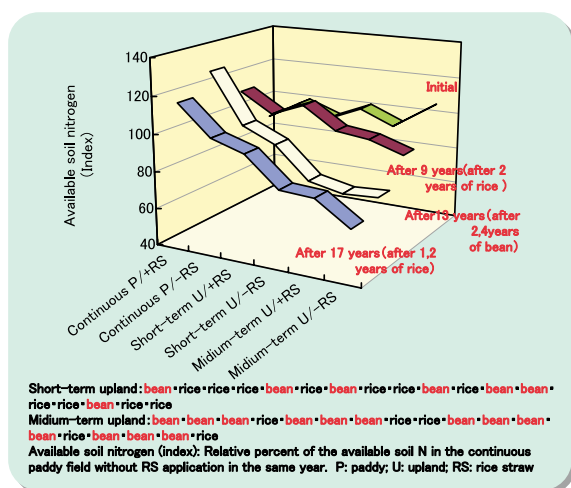
*Lowland Farming Research Division*



Overgrowth of volunteer rice derived from dropped seed of forage rice



Direct seeding of rice while puddling (wide-row seeding)



Influences of organic manure application and paddy-upland rotation system on the soil fertility

## Soil management and pest control for sustainable agriculture

We elucidate the nutrient dynamics of organic matter and develop high-yield cultivation techniques by utilizing organic materials to establish a sustainable soil management technique. We also evaluate the effects of cultural control in relation to developing pesticide-saving techniques against rice blast and phytophthora stem rot in soybeans. Furthermore, we analyze the biological reaction of weeds to cultural control as part of our development of comprehensive weed prevention and elimination techniques.

*Lowland Farming Research Division*



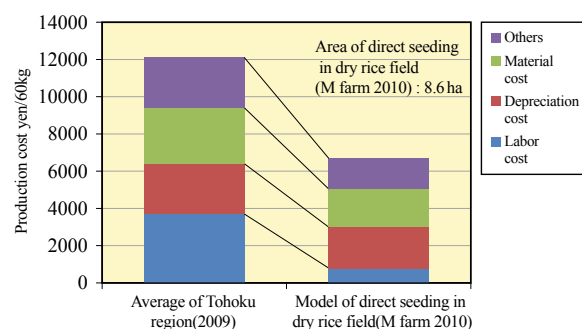
Diseased plants of rice infected with panicle blast

## Combining our developed techniques with farm management

Our goal is always to identify methods of improving the profitability and productivity of farming. We have been conducting a series of research projects on farm management in the Tohoku region, especially for large-scale farmers and community-based farming groups; this is our starting point for investigating new farming models and utilizing new developments at NARO/TARC and other NARO institutes as actual farming techniques. We set up new farm management models that integrate the latest developments at NARO and the integrated business models that combine farming management and farmers' new businesses for distribution of products and services from their farm. We present effective methods for revitalizing agriculture in the Tohoku region by introducing these new farming models based on market needs and evidence gathered in the field.

*Agro-Production Technologies and Management Research Division*

Community based market to revitalize agriculture and rural areas (Phot. Community based bakery)

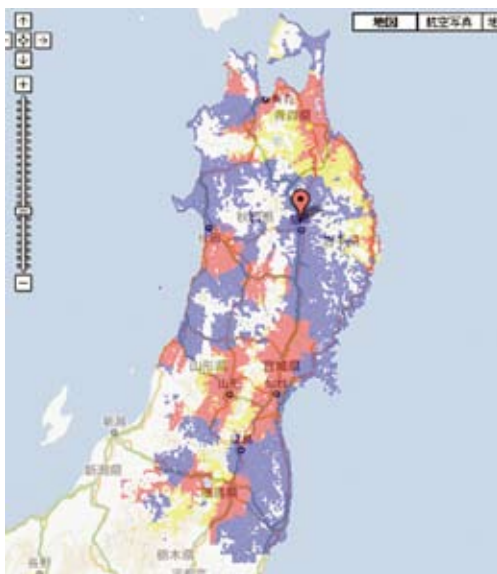


Cost reduction by direct seeding on dry paddy field



# Coping with and Utilizing Cold Climates

- We promote technical developments that utilize cool-climate resources that are characteristic of the Tohoku region during the summer, and develop stable production techniques that cope with and utilize the local cool easterly winds in the summer and the extremely cold weather in winter.
- We are developing techniques that reduce the risk of meteorological disasters caused by climate change.



Favorable conditions for rice leaf blast infection using the BLASTAM system.  
(Red: favorable conditions, Yellow: near-favorable conditions, Blue: no-favorable conditions.)

## Cultivation management support system utilizing meteorological information

We have developed a paddy rice cultivation information system using Google Maps as an early warning system that can forecast damage from cool weather or high temperatures and outbreaks of diseases and pests. We are expanding the utilization range of this system for cultivation management by integrating a model that forecasts the growth of main crops and a risk management procedure based on medium- to long-term weather forecasts.

The system provides an Internet-based warning system that reports on growing conditions for farmers in the Tohoku region. It also predicts damage from cool weather and high temperatures and the occurrence of diseases specific to each farmer's field location, cultivars, and planting dates. This system can be accessed via mobile phones, and automatically delivers warning e-mails.

*Agro-Environment Research Division*



Simulation results corresponding to the field point, variety, and planting date.

## Agricultural production management techniques for coping with climate change

To mitigate climate change by developing cultivation techniques suitable for the soil, weather and crops in Tohoku region, we are studying ways to reduce emissions of greenhouse gases and the use of farming techniques that sequester more carbon in the soil.

*Agro-Environment Research Division*



Measurements of methane emission from paddy soil



Determinate type tomato cultivar “Suzukoma”



Extremely late-bolting Chinese cabbage breeding line



Summer-to-autumn flowering -type chrysanthemums

## Production technology of summer-autumn harvested vegetables for the food industry

For onion, Chinese cabbage, asparagus, bunching onion, determinate tomato, and garlic, we are developing new cropping types and storage techniques that make it possible to cultivate them in what are currently off-crop seasons.

Soil moisture control using subsurface irrigation-drainage facilities is one of our most important targets for applying a paddy rotation system that includes vegetable cultivation.

In our research into chrysanthemums, we are aiming to control flowering to meet annual specific demand.

*Agro-Production Technologies and Management Research Division*  
*Field Crop and Horticulture Research Division*

## High-yield cultivation techniques for summer and autumn strawberries

The Tohoku region has a meteorological advantage (cool weather) that allows strawberry production during the summer and autumn. To realize a stable high yield in the summer and autumn, by using everbearing strawberry cultivars such as “Natsuakari”, developed at NARO/TARC, we are developing effective flowering control methods using the photoperiodic response, as well as nutrition management techniques.

We are working to develop stable high-yielding techniques by identifying the temperature and photoperiod conditions that induce flower buds, and by finding an optimum plant growth management method.

We will also develop fertilizer application techniques based on the nutrient absorption characteristics of summer and autumn strawberries.

*Field Crop and Horticulture Research Division*



Everbearing cultivar “Natsuakari” adaptable to summer and autumn harvesting culture



Photoperiodic control of flowering, using LED lamp



# Enforcing the Circulatory Functions of the Agricultural and Livestock Industries

- We are re-examining the use of natural cyclical functions for agriculture and developing techniques for environmentally-friendly agriculture and organic farming.
- We are developing techniques for forage production, utilizing public grasslands and abandoned farmland, while at the same time working to develop organic livestock techniques that boost these resources' circulatory functions.
- We are contributing to the development of techniques for biomass utilization and to the structuring of the regional system in the Tohoku region.

## Production and processing technologies for forage soybean

High-protein forage, on which Japanese milk and beef production relies, is almost entirely imported. To overcome this problem, we are establishing techniques to produce and utilize forage soybean at low cost as foliage, whole crop, and soft-grain silage, with our eventual goal being domestic self-sufficiency. We are developing 1) a living mulch system, namely a method that fills the furrows and spaces between plants with cover crops to allow the cultivation of forage soybean, on which no agrochemicals can legally be used, without herbicides but in a labor-saving manner; 2) an explanation of the effects of ensiling on nutritional values and biologically active substances such as isoflavones; and 3) a technique for efficiently supplying livestock with soybean in the form of fermented total mixed ration.

*Livestock and Forage Research Division*



No-herbicide soybean using living mulch system



“Tohoku 1” (the second row from the left), a festulolium cultivar developed at NARO/TARC. “Tohoku 1” exhibits high dry matter yield and tolerance to waterlogging.

## Breeding cold-region pasture grasses

To promote the livestock industry in the Tohoku region with forage production as its base, we grow high-quality and high-yield pasture grass cultivars. It is essential to employ a variety of grass species and cultivars to respond to the various needs that arise from management policies, and to take advantage of geographical and climatic conditions to produce forage efficiently. We improve breeding in relation to 1) adaptability to hostile environments and durability of disease resistance in perennial grasses such as orchard grass and festulolium; 2) the wintering ability of Italian ryegrass as an annual grass; and 3) the adaptability to hostile environments of perennial ryegrass for grazing.

*Livestock and Forage Research Division*

## Production of lean beef by compensatory growth

In recent years, beef production and quality have diversified, and marbling is not the sole priority. We are working to produce beef through grazing with the aim of improving self-sufficiency in forage production and the effective utilization of regional resources. Weight gain in cattle during the grazing period has stagnated; however, we have seen excellent weight gain (compensatory growth) following the grazing period. We have used this effect to develop a beef production technique focused mainly on producing lean meat that is popular with consumers.

*Livestock and Forage Research Division*



Grazing experiment for beef cattle

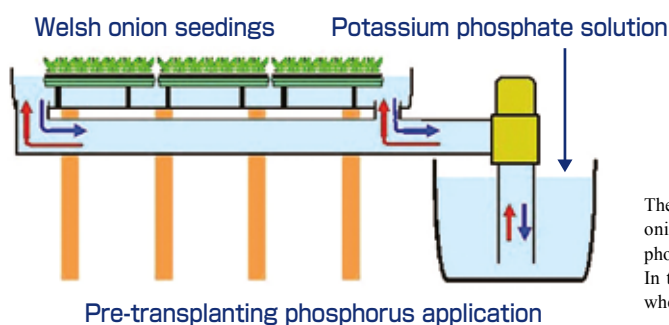




## Environmentally friendly production system utilizing biological functions

At NARO/TARC, we have been developing techniques that are useful for reducing the amount of herbicides and chemical fertilizers needed, such as by the use of cover crops, living mulch, and phosphate feeding before planting. Based on our research, the Ministry of Agriculture, Forestry, and Fisheries(MAFF) has established a structure that directly supports farmers who adopt environmentally-friendly production techniques that achieve a reduction of more than 50% in chemical input. By using these techniques as the basis for new production systems, we are developing field crops and vegetable systems that realize a 50% reduction in chemical usage, while at the same time demonstrating their environment-conserving effects by calculating the volume of greenhouse gas emissions and fossil energy usage.

*Environmentally Sound Agriculture Research Division*



The amount of phosphatic fertilizers necessary for Welsh onion culture can be reduced by applying potassium phosphate solution to the seedlings before transplanting. In this way, the yield of Welsh onion is the same as that when using the conventional fertilizer system.

## Resource recycle model for biomass material from paddy fields

We have been conducting a series of research projects to convert agricultural waste into industrial materials and biofuels by applying engineering, environmental evaluation and economic analysis. For instance, we have developed a method of extracting valuable chemical materials from rice bran, and have clarified a lignin-decomposing process to enrich the nutritive value of rice straw feedstuff. We are also developing engineering methods to use rice straw and husks as a briquette fuel for drying crops and heating, and inedible rapeseed oil from substandard seeds as fuel for farming machines and generators. These developments provide farming villages with new fuel resources. We are evaluating the greenhouse gas emissions of this fuel utilization system and are combining all our research with an economic analysis of farming conditions in the Tohoku region to provide a resource-recycling and fuel self-sufficient farming model.

*Agro-Production Technologies and Management Research Division*  
*Environmentally Sound Agriculture Research Division*



Harvested rapeseed.

Straight vegetable oil (SVO) expelled from rapeseed.

Rape oil cake (to be used as organic fertilizer or briquette fuel).

Rapeseed harvesting by SVO engine-mounted combine.

Cascading of rapeseed in rural area.

# Enhancing Health Functionality, and Attaining Safety and Security

- We promote the creation of regional industries by discovering specialty products and unused resources in the Tohoku region by focusing on the health functions of foods and by attempting to commercialize these new products.
- We also develop techniques for limiting exposure to harmful substances such as cadmium, and contribute to safety and security.

## Health functionality of local specialty products and breeding of cultivars

We aim to create rapeseed cultivars with zero erucic acid or double-low properties for oil resources. We also develop new rapeseed cultivars for oil-source that contain no erucic acid and have early ripening habit for use in mild-climate regions. With Job's Tears (*Coix lacryma-jobi*), we work to popularize cv. "Hatokirara", which offers early maturity, short height, and high suitability for machine processing. We aim to make a new variety "Nijiyutaka", which has excellent lodging resistance and flour quality, more widely adopted. We are also attempting to apply new breeding methods to improve the characteristics of buckwheat. We aim to create top-quality varieties of these industrial crops to support processing and the creation of products with additional value.

We are further elucidating the inhibitory action of metabolic syndrome, caused by the functional ingredients contained in regional specialty crops such as Job's Tears and Japanese barnyard millet, and we are developing a cultivation technique for spinach that increases the content of lutein, which has antioxidant activity.

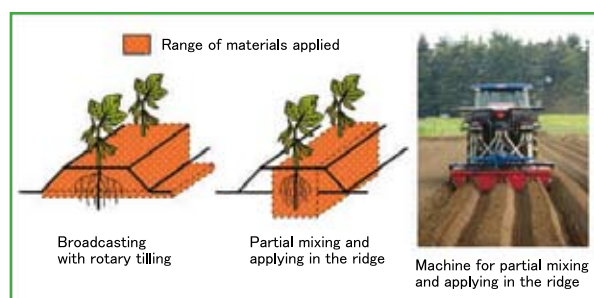
*Agro-Production Technologies and Management Research Division*  
*Field Crop and Horticulture Research Division*



Lodging resistant buckwheat "Nijiyutaka"



Job's tears "Hatokirara"(left), "Hatojirou"(right)



By employing the partial mixing and applying technique of liming materials in the ridge, the soil pH of the rooting zone is efficiently raised and thus cadmium absorption can be controlled. The machines for partial mixing and applying in two or three ridges are marketed.

## Cadmium risk reduction techniques

- Development of techniques for controlling cadmium absorption through material applications
- Establishment of a comprehensive technical system to reduce exposure to cadmium

MAFF has specified certain food-borne chemical substances and microorganisms as hazardous. At NARO we are developing analytical and sampling methods, elucidating the factors that influence their contamination, and developing technologies of reducing them that are needed for risk management. At NARO/TARC, with the aim of reducing cadmium levels in the edible part of crops by controlling cadmium absorption during the production process, we are selecting materials that effectively limit cadmium absorption and are developing application methods that improve their effects. We are also establishing a technical system for cutting the cadmium concentration in the edible part of crops by 30% or more by combining the use of low-cadmium-absorbing cultivars with these absorption control techniques.

*Agro-Environment Research Division*



# Promoting cooperation among industry, academia, and the public sector

- We are committed to contributing to society by promoting cooperation with farmers, corporations, universities, and national and public organizations.  
Please contact us if you would like to use the following facilities.

## Open laboratories



### Functionality evaluation laboratory

At our functionality evaluation laboratory we conduct research related to the biological regulation functions (functionality) of agricultural and livestock products. The laboratory is equipped with analytical instruments for studying functional ingredients and quality-related ingredients in agricultural and livestock products and for elucidating the *in vivo* functions of these substances. It can also be used for conducting tests on small animals. There are also instruments with which to conduct quality evaluations of food products, such as physical property measurements, and facilities for taste evaluations. NARO/TARC offers support to external bodies for the functionality elucidation testing of food products and crops using our facility.



### The Gradiotron

A temperature gradient laboratory called the Gradiotron has facilities for analyzing the damage caused by cold weather or elevated temperatures, the effects of global warming, and differences between crop responses on flat land and in mountainous areas that have different temperature ranges. One of the world's largest temperature gradient chambers, it enables us to set a continuous temperature range in a 30-meter-long greenhouse, allowing us to rapidly analyze the temperature response of crops. In our artificial weather control room, where we can control temperature and humidity very precisely, we can grow samples suitable for physiological and biochemical analysis.

## Support Center for Industry-Academia-Government Cooperation

To utilize NARO/TARC's research results for the benefit of society at large, we undertake the matching of needs and seeds by facilitating two-way communication between us and agricultural production sites or between us and private businesses. We exhibit at various trade shows to create new agribusinesses, give technological guidance at production sites to promote the spread of knowledge gained through research, and hold seminars to exchange information. We also support the planning and proposal stages of collaborative research with private businesses.

To promote the spread of knowledge gained from research and of practical applications, we support Tohoku-based regional research efforts undertaken by institutions performing related research and administrative organizations in the Tohoku jurisdiction and liaison conferences for popularization sponsored by the Tohoku Regional Agricultural Administration Office.

## Cooperation with Universities

### Cooperative graduate schools

NARO is further strengthening its cooperation with universities by utilizing a graduate school linking system.

NARO/TARC signed a cooperative graduate school agreement with Iwate University in April 2006, and has been dispatching three to five visiting faculty members to provide professional guidance and advice in necessary fields.

## Meetings for promoting agricultural testing and research in the Tohoku region

As an agricultural research organization in the Tohoku region, we hold promotion meetings. There are five sections dealing with specialized fields: crops, fundamental technology, vegetables and floriculture, orchards, and livestock, each with their own specialized divisions. We hold on-site study meetings in the summer, and promotion meetings for each section in the winter, in addition to plenary meetings and evaluation-planning meetings involving all

## Cooperation with farmers

We test the effectiveness of the agricultural techniques and research outcomes that NARO/TARC achieves with the cooperation of farmers, and provide on-site guidance to meet requests from farmers for instructions regarding the implementation of new techniques. We also hold regional matching forums to enable farmers, researchers, specialists, and administrative officers to exchange opinions and information directly. We have also established a research support personnel system to obtain assistance with research at NARO/TARC.

## Research exchanges

### Invited research fellow program

We welcome employees commissioned by the national government, local public bodies, universities, private firms, and corporations involved in agricultural research, and guide them in the relevant experiments and research.

### Technical training system

NARO/TARC uses this system to provide employees at research and development institutions, farmers, and people in the food industry with technical training in research and development.

### Inviting and hosting foreign researchers

We welcome foreign researchers who wish to undergo training or to conduct research at NARO/TARC through requests received via the Japan International Cooperation Agency (JICA) or from domestic or overseas research and development institutions. We also invite overseas researchers to NARO/TARC to promote collaboration and cooperation with overseas research institutions.

## Organization

### Director-General



## Location and Access

### ●NARO Tohoku Agricultural Research Center (Headquarters)

4 Akahira, Shimo-kuriyagawa, Morioka, Iwate 020-0198, Japan Tel. +81-(0)19-643-3433  
(8 minutes' walk from IGR Kuriyagawa Station or 20 minutes' ride on a bus bound for Sugo Depot from JR Morioka Station. Get off at the Nogyo Kenkyu Sent-mae bus stop.)

#### Vegetable and Floricultural Research Group

92 Nabeyashiki, Shimo-kuriyagawa, Morioka, Iwate 020-0123, Japan Tel. +81-(0)19-643-3433  
(25 minutes' ride on a bus bound for Sugo Depot from JR Morioka Station. Get off at the Kaju Kenkyusho-mae bus stop and walk for 3 minutes.)

### ●Daisen Research Station

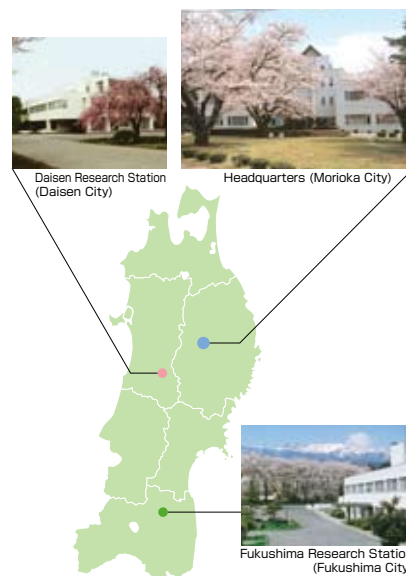
3 Shimo-furumichi, Yotsuya, Daisen, Akita 014-0102, Japan Tel. +81-(0)187-66-1221  
(3 minutes' walk from Kitaomagari Station, JR Tazawako Line)

#### Soybean Breeding Research Group

297 Uenodai, Kariwano, Daisen, Akita 019-2112, Japan Tel. +81-(0)187-75-1084  
(5 minutes' walk from Kariwano Station, JR Ohu Line)

### ●Fukushima Research Station

50 Harajukuminami, Arai, Fukushima, Fukushima 960-2156, Japan Tel. +81(0)24-593-5151  
(30 minutes' ride on a bus bound for Arai from the East Entrance of JR Fukushima Station. Get off at the Jieitai-mae bus stop (the terminal) and walk for 3 minutes.)



## Contact Us

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