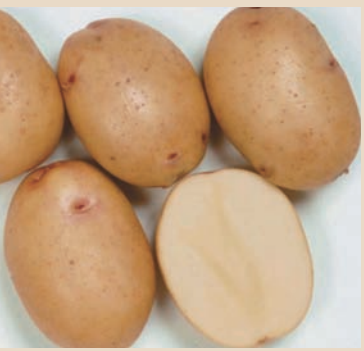


Outline



HOKKAIDO AGRICULTURAL RESEARCH CENTER (HARC)

NARO

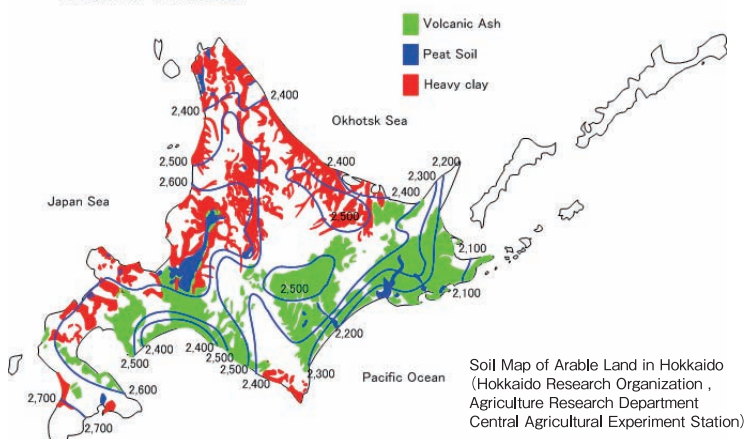
Hokkaido's Natural Conditions and Characteristics of Its Agriculture

Against a backdrop of vast land resources, Hokkaido has cool summers with long days and long hours of sunlight, and large temperature differences between night and day. Farmers have taken advantage of this location as a place suited for agriculture to conduct large-scale production of rice and dry field crops, and dairy farming unequalled in other regions of Japan. Hokkaido's agricultural products account for 22% of Japan's total on a calorie basis, making it Japan's premier food production region. But in some respects Hokkaido has disadvantages for agricultural production, such as cold injury or wet injury occurring once in four years, heavy snow and very low temperatures in winter, and peculiar soils such as peat soil and heavy clay. It is necessary to proceed with basic research that will overcome these land and climatic conditions and sustain the future of cold regions.

◆ Climate of Hokkaido

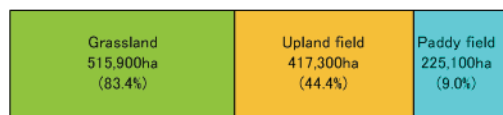
| | Sapporo | Obihiro |
|-------------------------------------|------------------------|------------------------|
| Annual mean temperature | 8.9°C | 6.8°C |
| Mean maximum temperature in August | 26.4°C | 25.2°C |
| Mean minimum temperature in January | -7.0°C | -13.7°C |
| Annual precipitation | 1,117mm | 888mm |
| Frosting period | October 25 to April 24 | October 9 to May 15 |
| Snowy period | October 28 to April 19 | November 7 to April 25 |

◆ Distribution of soil type and accumulated temperatures in summer in Hokkaido



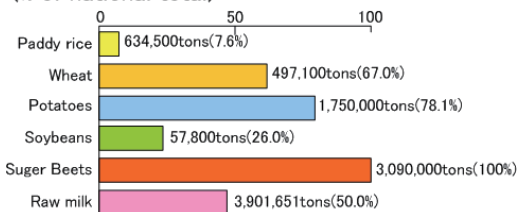
Hokkaido has 25% of Japan's cultivated land, and it is the nation's production leader in wheat, soybeans, adzuki beans, green beans, buckwheat, potatoes, sugar beets, onions, sweet corn, pasture plants, raw milk, and beef. Each farming family cultivates 20-ha of farmland, which is about 11 times the national average, and 74% of farming family are business farm household. Such facts characterize the high dependence of many farmers on agriculture to make their living. To further strengthen this large-scale agricultural foundation with its high percentage of business farm household, it is necessary to conduct research including that for developing cultivars and high-added-value processed items to create brands.

◆ Makeup of Hokkaido's cultivated area (2009).



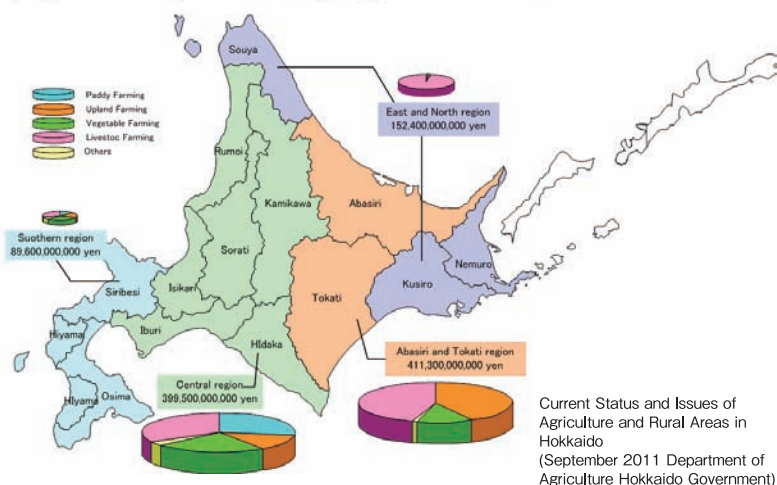
Total 1,158,000ha (25.1% of national total)

◆ Production of farm and livestock (% of national total)



(Hokkaido annual statistical report on agriculture, forestry and fisheries(2009-2010).)

◆ Agricultural production by region in Hokkaido



Another of Hokkaido's major characteristics is the considerable differences in topography, soil, and weather conditions between regions, to which crop and livestock raising are adapted. Central Hokkaido has mainly rice farming which is mostly in the Ishikari River basin, and there is also much vegetable production owing to its proximity to the major city of Sapporo. The east and north regions are typical dairy farming regions, with just raw milk and dairy cattle in the Kushiro, Nemuro, and Soya areas accounting for much of the region's agricultural production in monetary terms. Many dry field are cultivated in the Tokachi and Abashiri areas of the eastern region, where farmers grow wheat and barley, pulses, sugar beets, potatoes, and other such crops, and vegetables such as onions. In the south there is much production of vegetables and fruit, and also rice, dry field, and livestock. While building on these diverse regional farming practices, it is necessary to proceed with research that helps innovate the system of production technologies and strengthen competitiveness.

About the Hokkaido Agricultural Research Center

Hokkaido Agricultural Research Center: Mission and Research Orientation

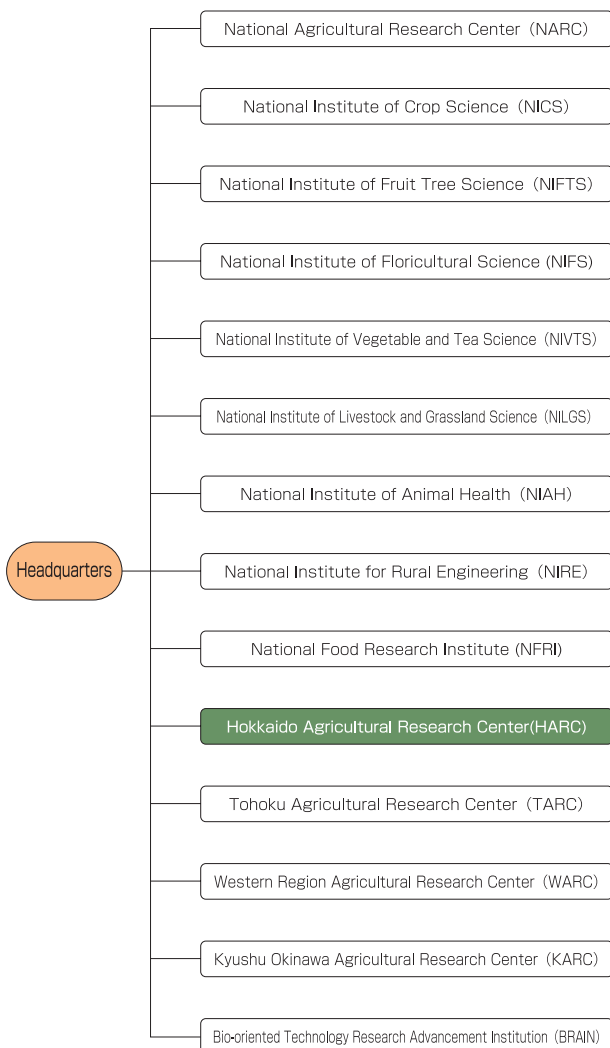
The Hokkaido Agricultural Research Center's mission is to develop new agricultural techniques in order to provide a stable supply of safe food to the citizens by means of further advances in cold-region agriculture. The Center is a member of the National Agriculture and Food Research Organization (NARO), Japan's largest agricultural research institution, and as such it makes the utmost use of the network of agricultural research institutes covering Japan to work on research from a long-term perspective including global warming, environmental conservation, biomass, and biotechnology. In collaboration with other research institutions in Hokkaido and other prefectures, including the Hokkaido Research Organization, the Center aims to establish techniques in farming operations and to conduct both leading edge research and basic research on areas including new cultivars, farm work, animal feeding, and foods.

Under its director-general, the Hokkaido Agricultural Research Center comprises a Department of Planning and General Administration, five research divisions, and a Research Support Center. Research is proceeding in accordance with mid-term plans.

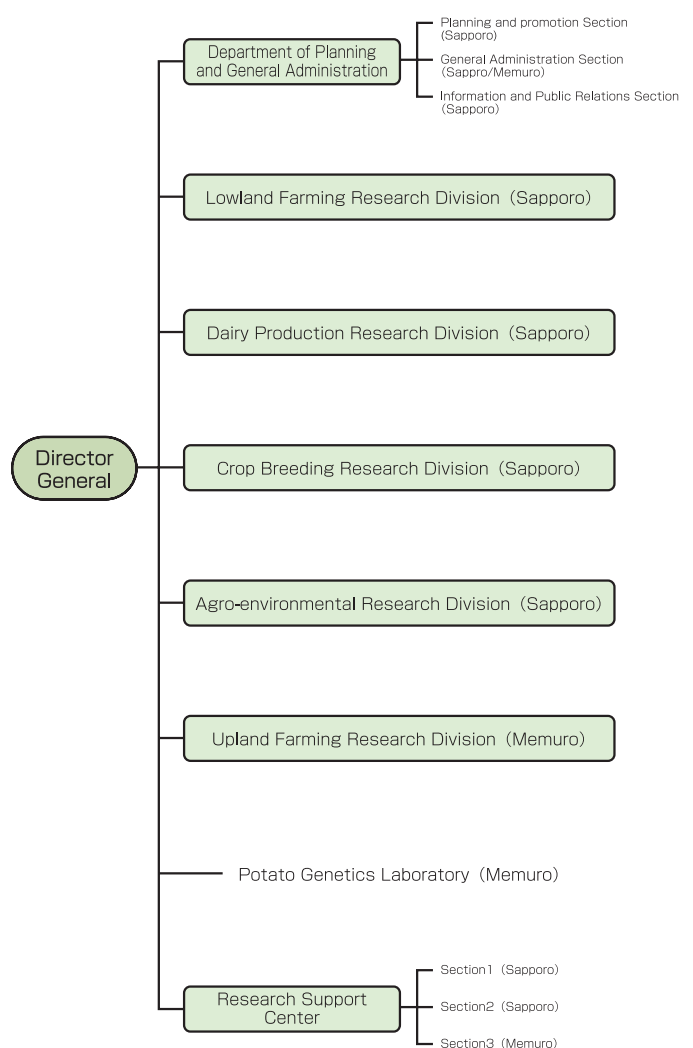
During the second mid-term targeted period (FY2006 to FY2010), our achievements included development of a revolutionary type of wheat for bread-making, a new potato cultivar with resistance to disease and insect pests, and a method of selective breeding for milking cows based on lactation persistency. Using these as a springboard, in the third mid-term targeted period (FY2011 to FY2015) we shall further our research and development in areas including basic research creating agricultural technology highly resistant to low temperatures and other environmental stresses, development of more cultivars adapted to cold regions, new ways of supplying domestically produced livestock feed, and IT technologies to large-scale agriculture.

Organization

National Agriculture and Food Research Organization(NARO)

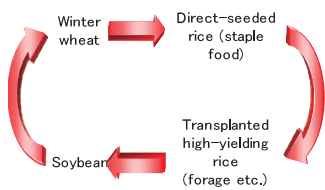


Organization of Hokkaido Agricultural Research Center(HARC)

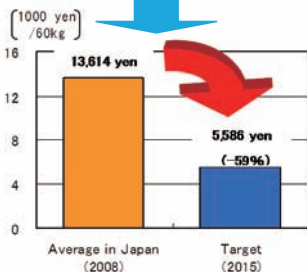


Main research targets

- Development of a crop rotation system in a large-scale paddy field using highly efficient agricultural machines for significant cost reduction.
- Development of leading varieties of open-field vegetables for increasing domestic production in industrial markets. Breeding of high-quality fruit trees and ornamental plants with new colors and shapes in cold regions.
- Economic evaluation of new agricultural technology and new varieties for their promotion. Development of business models in regional agriculture and human resource management methods for increasing the number of new farmers.



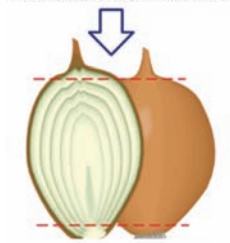
Assumed large-scale lowland crop rotation system (80 ha)



Target cost for rice production (for staple food)



There is a lot of waste in flat onions.

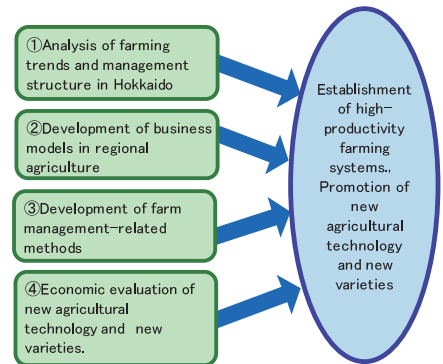


There is less waste in oval onions.

Development of onion varieties suitable for processing



Breeding of Alstroemeria with orange-red flowers



Main research results

- A low-cost direct seeding system for dry rice fields in Hokkaido was developed by a commonly used drill seeder for wheat.
- A new squash cultivar 'TC2A' with short internodes and high-quality fruit, a new early mature European pear cultivar 'Jade Sweet' with beautiful large fruit and high quality, and new blueberry cultivars 'Keraan Blue and Epiruka Blue'.
- Forecast of agricultural structure of Hokkaido in 2015. Conditions for employment in agricultural corporations.



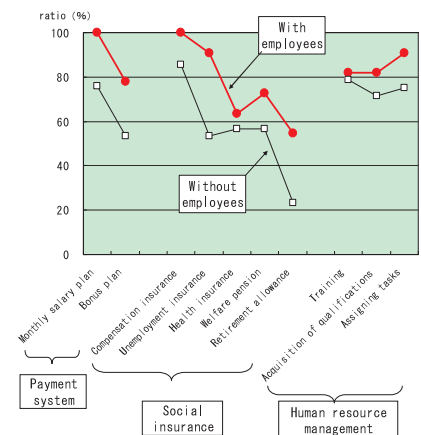
Low cost rice seeding system by grain drill and pack-roller



A new squash cultivar 'TC2A' with short internodes



A new early mature European pear cultivar 'Jade Sweet' with beautiful large fruit and high quality



Conditions for employment in agricultural corporations

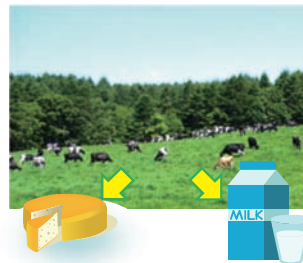
Main research targets

- The goal is development of techniques for dairy farmers to utilize a domestic concentrate feed produced at lower production cost and with less environmental impact in collaboration with upland crop farmers that utilizes organic matter such as an animal waste to allow nutrient circulation.
- We will establish a low-cost and high-quality dairy production system with full utilization of pastures by grazing or other methods.
- We aim for dairy farm management with healthy and robust cattle herds through improving their productive performance.
- We will develop new cultivars for silage corn, forage grass and legumes with improved agronomic characteristics, such as yield, forage quality, disease resistance, winter hardiness and persistency, that will increase the self-sufficiency rate of animal feed.
- We will develop a biomass production system from energy crops compatible with forage production and animal husbandry waste.

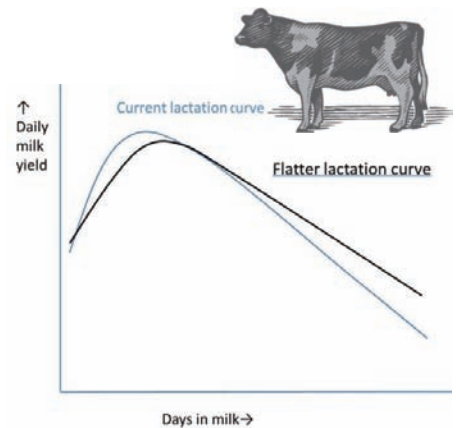


Development of new corn breeds and feeding as an ear corn*1 silage

Establishment of cost-saving pasture-based dairy production system



High-quality dairy products



levelling daily milk yield

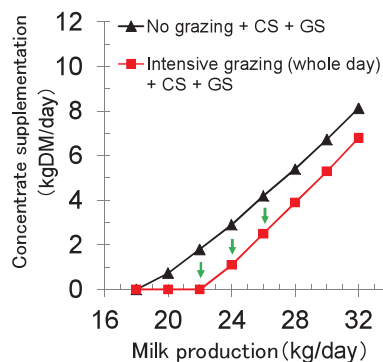
*1 An "ear" is a part of corn formed by kernels, a cob and protective leaves called a husk.

Main research results

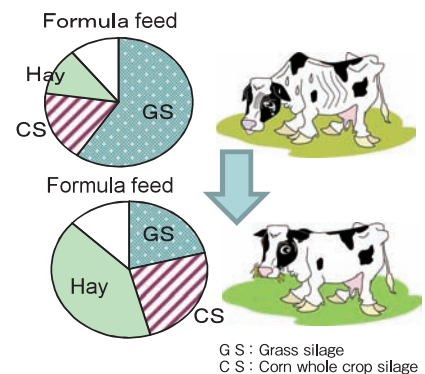
- We have developed forage crop cultivars suitable for growing in eastern Hokkaido: 'Tachipirika,' early maturity silage corn with high yield, lodging and northern leaf blight resistance; 'Makibasakae,' meadow fescue; and 'Korobokkuru,' very small-leaved white clover with good winter hardiness suitable for intensive grazing.
- We have established intensive grazing*2 techniques for supplying corn silage besides grass silage for saving costs of concentrate supplementation.
- We have developed a feeding technique for close-up dry cows, with a sufficient amount of hay and limited amount of grass silage, to decrease the risk of ketosis*3 after calving.



An early maturity silage corn cultivar, 'Tachipirika,' suitable for growing in grassland dairy farming areas of Hokkaido.



Reducing concentrate supplementation with intensive grazing




Feeding regimen to maintain health of cows after calving

*2 Intensive grazing: a system of grazing in which cows are regularly and systematically moved to fresh pasture with the intent to maximize the quality and quantity of forage growth.


*3 Ketosis is a metabolic disorder characterized by poor appetite and depression due to insufficient energy intake immediately before and after calving.

Main research targets


- Developing new rice cultivars including cultivars that can be used for producing rice flour for making bread cultivars that can be used in the food service industry.
- Developing rice flour processing technology by utilizing genetic diversity in starch.
- Developing new feed use rice cultivars.
- Developing novel breeding materials for rice by elucidating the chilling tolerance mechanism and for wheat and soybean by elucidating the mechanism of winter hardiness in wheat and the mechanism of chilling tolerance in soybean.




High-yielding rice cultivars resistant to biotic and abiotic stresses.



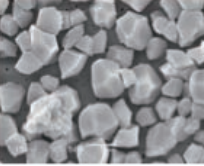
Feed using rice cultivars.



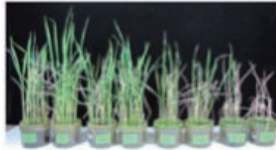
Cost-effective rice cultivars for food service industry use.




Rice cultivars suitable for rice flour bread.



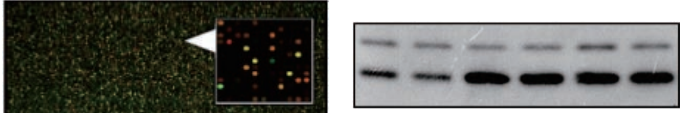
Starch technology
(Photo: figure of starch granule by electron microscopy analysis)




Genetic diversity in chilling tolerance in rice.



Genetic diversity in winter hardiness in wheat.



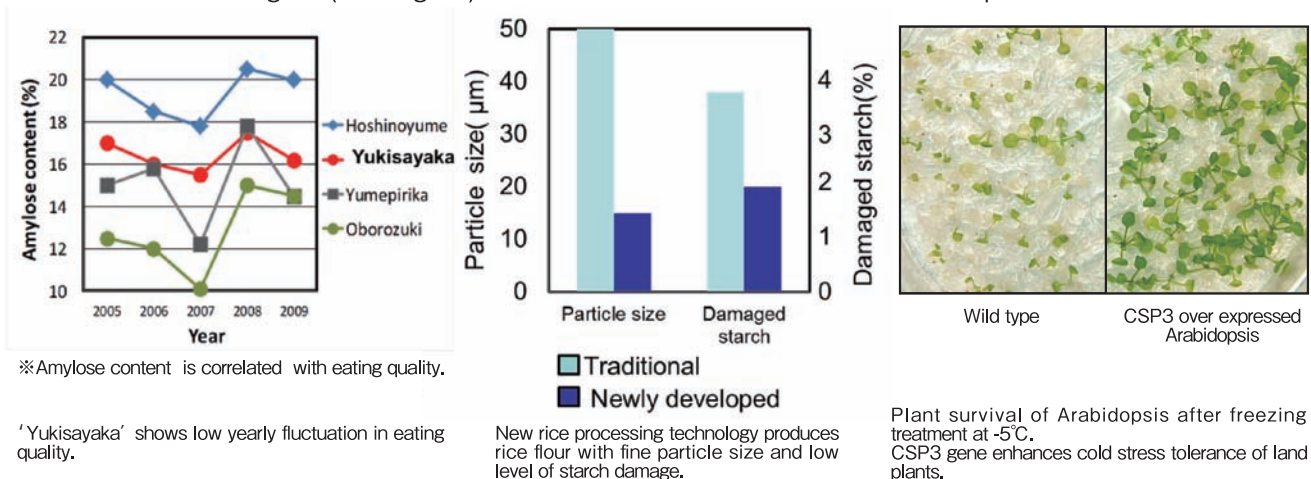
Analysis of gene expression for chilling tolerance and winter hardiness.



Development of breeding materials by utilizing molecular markers and transgenic.

Main research results

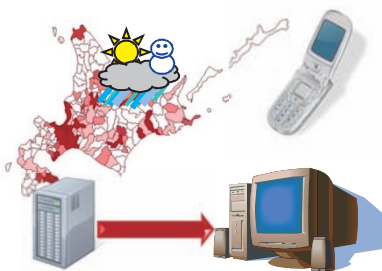
- Development of a new rice cultivar 'Yukisayaka' in which the qAC9.3 gene confers both of high rating and low yearly fluctuation in eating quality.
- Development of rice grain processing technology that enables the production of high-quality rice flour with fine particle size index and low level of starch damage at a lower cost.
- Identification of the gene (CSP3 gene) that enhances cold stress tolerance in land plants.



Main research targets

- Development of an early prediction and warning system of weather conditions.
- Development of adaptation and mitigation technologies for climate change in agriculture.
- Development of sound material-cycle agriculture with the help of rhizosphere microorganisms.
- Establishment of year-round supply of potatoes for domestic processing by development of new potato varieties and development of long-term storage technology.
- Development of a vegetation management method to conserve natural enemies of arthropod pests in crop fields.

Agriculture Meteorological Alert Transmission and Expert Regional Assistant System



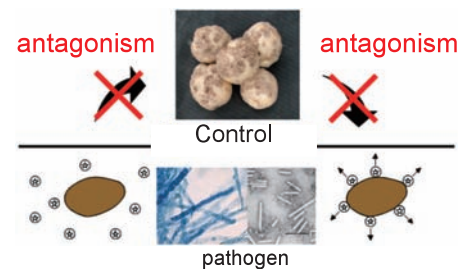
An early warning system which is based on meteorological observation and forecast data, and provides agricultural warning information for farmers.

Material-cycle agriculture



Regulation of plant root and rhizosphere soil microorganism function for development of suitable nutrient cycling.

Biological control of diseases and pests

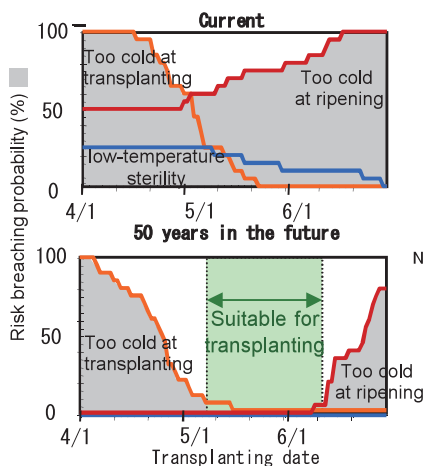


Control of soil-borne diseases and pests by antagonistic microorganisms and green manure crops

Main research results

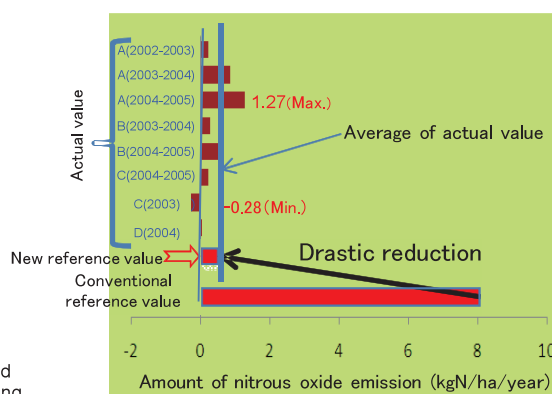
- Suitable cultivars and suitable transplanting date of paddy rice in Hokkaido in the future under global warming conditions were predicted.
- Precise measurement of greenhouse gas emission led to a new reference value for the amount of N₂O emission from peat soil.
- We developed a useful method for detection and estimation of viable potato cyst nematodes (PCN) in soil.

Estimation of the effect of global warming



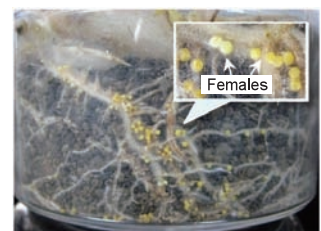
Akitakomachi, the present Tohoku paddy rice cultivars and it can not be grown at Hokkaido, appear to be as suitable for cultivation at Sorachi area in Hokkaido at 50 years in the future, at when the air temperatures rise by 2.5° C from present.

Amount of greenhouse gas emission



Amount of N₂O emission from cultivated peat land paddy soil of Hokkaido has been determined and used for a new reference value.

Detection of pathogens



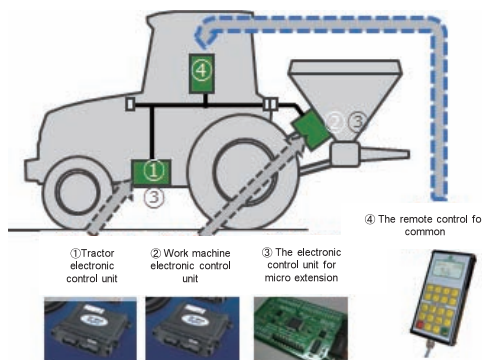
Population densities of viable PCN in soil can be distinguished visually, by using this closed plastic container system.

Main research targets

- Establishment of large-scale field crop rotation systematized techniques for a 50-ha scale by introduction of vegetables for processing.
- Development of environment-friendly pest/disease control technologies for upland farming using biological functions and upland field management technology against global warming.
- Development of practically useful information technology for optimal cultivation management and improvement of working efficiency in the large-scale farming zone.
- Establishment of year-round supply of potatoes for domestic processing by development of new potato varieties and development of long-term storage technology.
- Development of hard winter wheat varieties with favorable bread-making quality, sugar beet F1 varieties with high sugar productivity and resistance to various diseases, and buckwheat varieties with high rutin content and preferable noodle quality.



Introduction of onions for processing to large-scale upland farming.



Information such as location and fertilization acquired simply for management.



Development of new potato varieties for potato chips and early harvest

Main research results

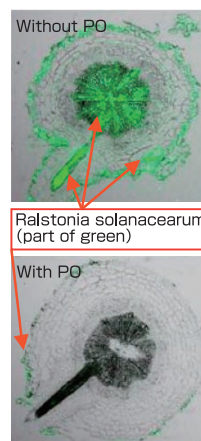
- We bred Yumechikara, an extra-strong winter wheat variety in Hokkaido. Very delicious bread can be made by blending with medium-strength flour.
- We bred Haruka, a potato variety that can be used for various foods such as salad and croquettes.
- We showed the effectiveness of using a living control microbe (*Pythium oligandrum*: PO) for control of tomato bacterial wilt disease, and we developed PO tablets.
- Future prediction of the amount of soil carbon storage in Tokachi region was performed by using the soil carbon dynamic model. For reducing the amount of storage of soil carbon and not increasing discharge of CO₂ from the soil, it was found that appropriate use of harvest residue or green manure cultivation is important.



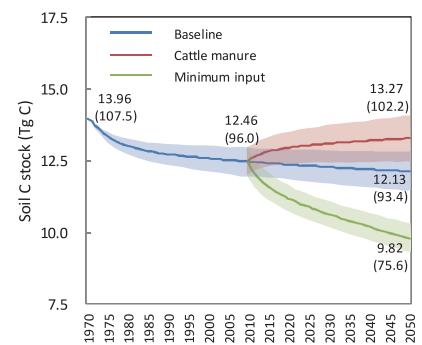
'Yumechikara', extra-strong winter wheat.



'Haruka' can be used for various foods.



Ralstonia solanacearum Cannot invade a tomato stalk with PO bacillus.



Predictions of soil C stock under different management scenarios.

Background

This laboratory was founded on April 1, 2010, with a financial support from Calbee Foods Co., Ltd. Germplasm enhancement using wild and primitive potato species and the underlying genetic problems are focused on as the research themes. Output is integrated into the existing potato breeding programs. This is the first endowed laboratory in NARO.

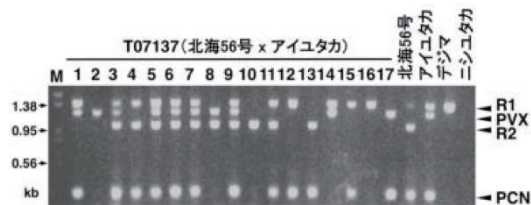
Main research targets

- Elucidating the mechanism of heterosis in potato.
- Elucidating the hybrid seed formation mechanism.
- Molecular evaluation of genetic diversity in potato.
- Technology development to breed varieties with multiple disease and pest resistances.



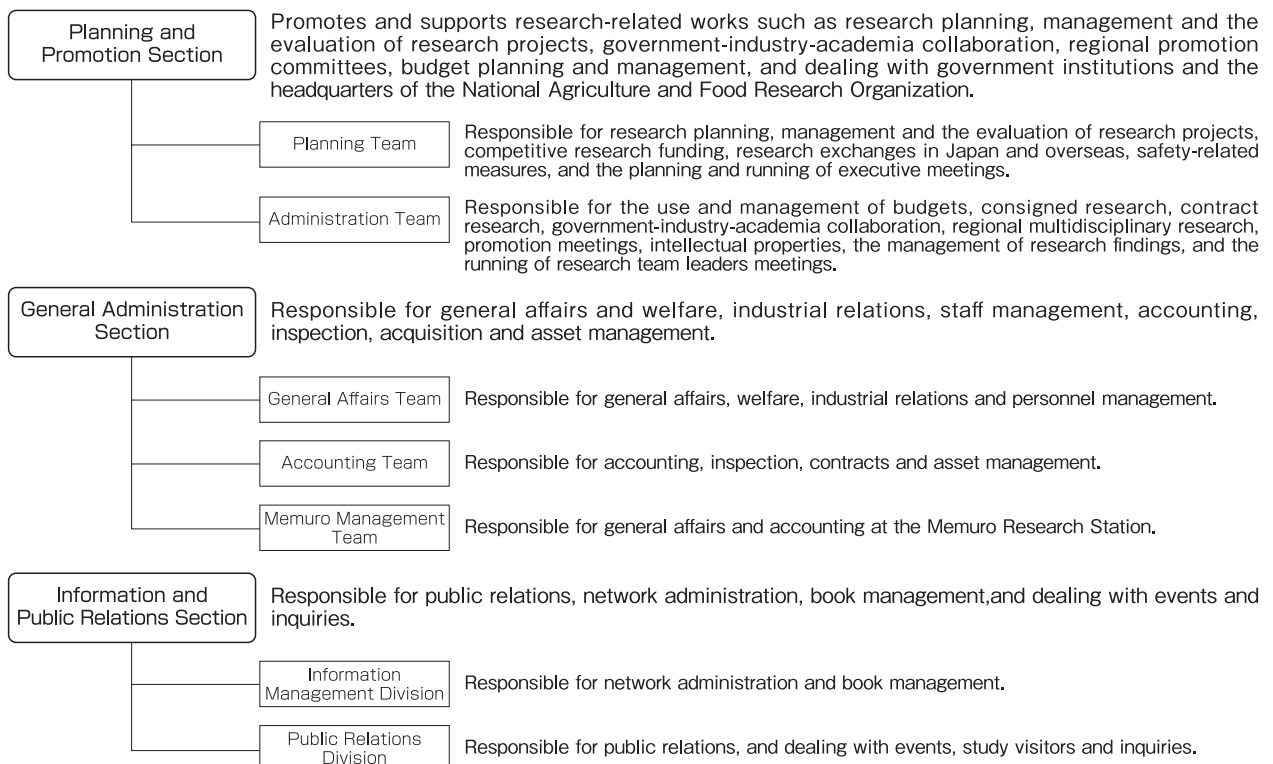
A (♀) × (♂) B B (♀) × (♂) A

Different seed size or germinability altered by the male and female gametes competition.



Development of rapid and reliable DNA marker technologies for breeding.

Department of Planning and General Administration



Research Support Center

Missions

1. Activities in agricultural experimental design involved in
 - (1) Crop cultivation and livestock culture for research programs
 - (2) Technological operations for research outcomes
2. Field trials regarding
 - (1) New variety cultivation of crops created in research programs
 - (2) Crop production for proving the usefulness of the developed technologies

The 1st Support Section (Sapporo)

We are working with researchers in dairy science for the development of a labor-saving management system in dairy herds based on a flatter shape of the lactation curve, pasture-based dairy production system, and ear corn production together with utilization systems.

Feed trial using dairy herds



The 2nd Support Section (Sapporo)

We are working with researchers involved in breeding of crops such as suitable cultivars for rice flour and forage and onion cultivars for high net yield, control of nutrient dynamics in rhizosphere soil, biological control of plant disease, and development of an early prediction and warning system of weather conditions.

Field trial on onion breeding



The 3rd Support Section (Memuro)

We are working with researchers in breeding wheat, potato, sugar beet and buckwheat. We are also working for the development of upland crop rotation systems with vegetables such as onions and IT farming systems for large-scale agricultural production.

Potato harvest in a field trial



History

- 1901 The Hokkaido Farming Experiment Station was established in the Second Farm of the Sapporo Agricultural College.
- 1925 Construction of the new office building of the Hokkaido Agricultural Experiment Station was completed in Koton, Sapporo.
- 1942 The Hokkaido Farming Experiment Station, the Breeding Station of the Hokkaido Government, and the Sheep Breeding Station of the Hokkaido Government were consolidated into the Hokkaido Agricultural Experiment Station.
- 1950 The Hokkaido Agricultural Experiment Station was divided into the Hokkaido National Agricultural Experiment Station and the Hokkaido Prefectural Agricultural Experiment Station.
- 1966 The Hokkaido National Agricultural Experiment Station was moved to its current location (Hitsujigaoka, Sapporo).
- 2001 Reorganized as the National Agricultural Research Center for Hokkaido Region.
- 2003 Reorganized as the National Agricultural Research Center for Hokkaido Region under the Bio-oriented Technology Research Advancement Institution.
- 2006 Reorganized as the National Agricultural Research Center for Hokkaido Region under the National Agriculture and Food Research Organization.

Premises Unit: ha

| Location | Buildings | Upland field | Paddy field | Grazing land | Mountain, forest, etc | Total |
|--|-----------|--------------|-------------|--------------|-----------------------|-------|
| Hitsujigaoka (Sapporo) | 34.4 | 190.7 | 6.5 | 150.7 | 440.7 | 823.0 |
| Memuro Upland Farming Research Station | 10.1 | 89.5 | — | — | 3.1 | 102.7 |
| Bibai Research Station | 0.9 | 2.3 | 1.7 | — | 50.1 | 55.0 |

Livestock

| | |
|--------------|----|
| Dairy cattle | 85 |
| Beef cattle | 29 |
| Sheep | 65 |

Staff

| | |
|----------------------|------------|
| Designated staff | 1 |
| Administrative staff | 46 |
| Technical staff | 72 |
| Research staff | 144 |
| Total | 263 |

(Premises, livestock, staff: As of March 2012)

Hitsujigaoka



1, Hitsujigaoka, Toyohira-ku, Sapporo, 062-8555 JAPAN
Tel : 011-851-9141

- ★ Sapporo Station $\xrightarrow[\text{13 min.}]{\text{Subway Toho Line}}$ Fukuzumi Station $\xrightarrow[\text{4 min.}]{\text{Chuo Bus}}$
- Tsukisamu-Higashi 1-jo 19-chome $\xrightarrow[\text{15 min.}]{\text{Walk}}$ → HARC
- ★ New Chitose Airport $\xrightarrow[\text{48 min.}]{\text{Chuo Bus/Hokuto Kotsu Bus}}$ →
- Tsukisamu-Higashi 1-jo 19-chome $\xrightarrow[\text{15 min.}]{\text{Walk}}$ → HARC

Memuro Upland Farming Research Station



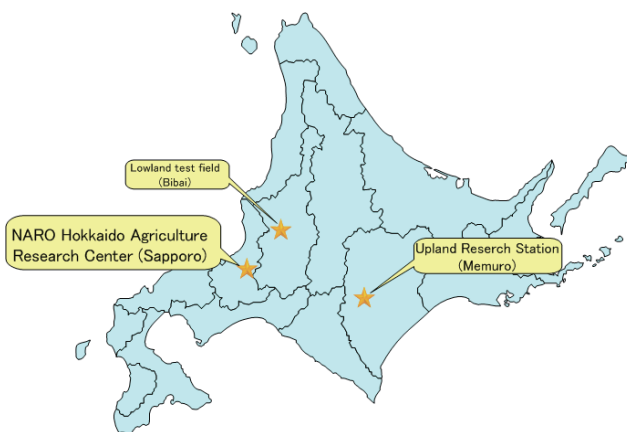
9-4, Shinsei-minami, Memuro-cho, Kasai-gun, 082-0081
JAPAN Tel : 0155-62-2721

- ★ Tokachi-Obihiro Airport $\xrightarrow[\text{40 min.}]{\text{Tokachi Bus (25 km)}}$
- JR Obihiro Station $\xrightarrow[\text{20 min.}]{\text{JR (13.6 km)}}$ → JR Memuro Station $\xrightarrow[\text{10 min.}]{\text{Car (4.5 km)}}$
- Memuro Upland Farming Research Station

Bibai Research Station

Kaihatsu-cho-minami, Bibai, 072-0045 JAPAN
Tel : 0126-63-3005

- ★ JR Bibai Station $\xrightarrow[\text{10 min.}]{\text{Car (4.5 km)}}$ → Bibai Research Station



Contact

Information and Public Relations Section,
Department of Planning and General Administration

TEL (011) 857-9260
<http://cryo.naro.affrc.go.jp>

おいしさ、
深化。
by 北農研

