Outline

NARO

HOKKAIDO AGRICULTURAL RESEARCH CENTER (HARC)

Hokkaido's Natural Conditions and Characteristics of Its Agriculture

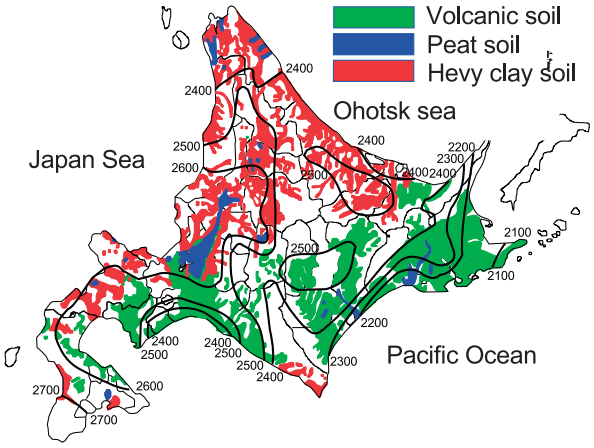
Against a backdrop of vast land resources, Hokkaido has cool summers with long days and long hours of sunlight, and large temperature differences between night and day. Farmers have taken advantage of this location as a place suited for agriculture to conduct large-scale production of rice and upland crops, and dairy farming unequaled 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
Anual mean temperature	8.9℃	6.8℃
Mean maximum temperature in August	26.4℃	25.2℃
Mean minimum temperature in January	-7.0℃	-13.7℃
Anual precipitation	1,117mm	888mm
Frosting season	Oct. 25～ Apr. 24	Oct. 9～ May.15
Snowy season	Oct. 28～ Apr. 19	Nov. 7～ Apr. 25

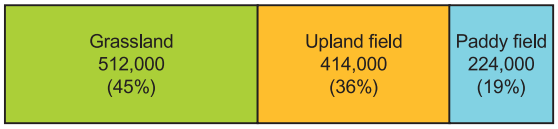
Japan Meteorological Agency (2011)

Distribution of soil type and accumulated temperatures in summer in Hokkaido



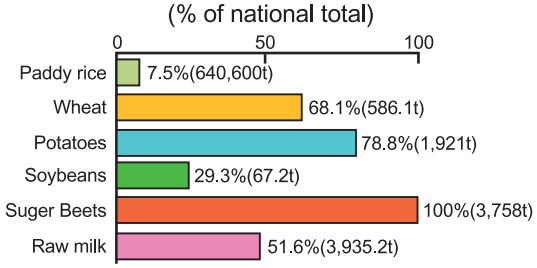
Hokkaido has 25% of Japan's cultivated land, and it is the nation's production leader in rice, wheat, soybeans, adzuki beans, kidney beans, buckwheat, potatoes, sugar beets, onions, sweet corn, pasture plants, raw milk, and beef. Each farming family cultivates 23 ha of farmland, which is about 15 times the national average, and 71% 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 (2013)



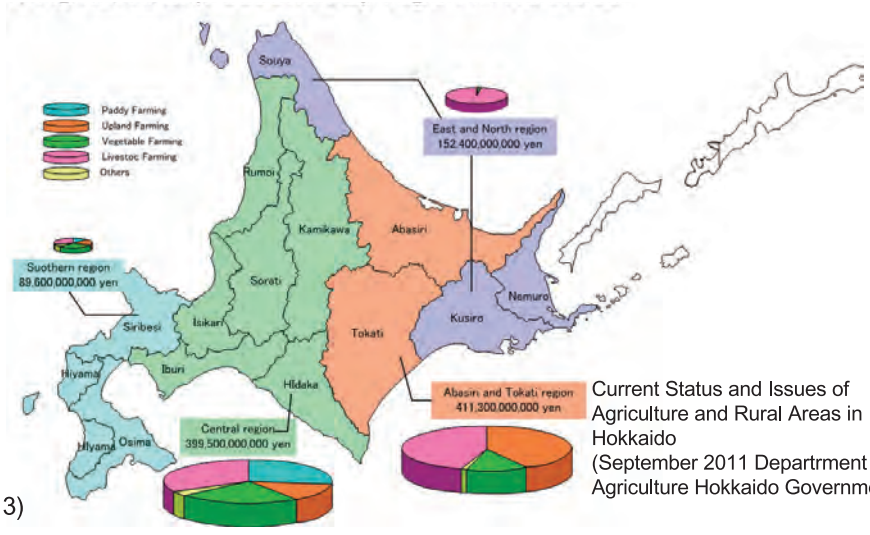
Total 1,158,000ha (25% of national total)

Production of farm and livestock



(Hokkaido annual statistical report on agriculture: 2013)

Agricultural production by region in Hokkaido



Current Status and Issues of Agriculture and Rural Areas in Hokkaido
(September 2011 Departrment of Agriculture Hokkaido Government)

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 upland crops are cultivated in the Tokachi and Abashiri areas of the eastern region, where farmers grow wheat, beans, 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, upland crops, 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.

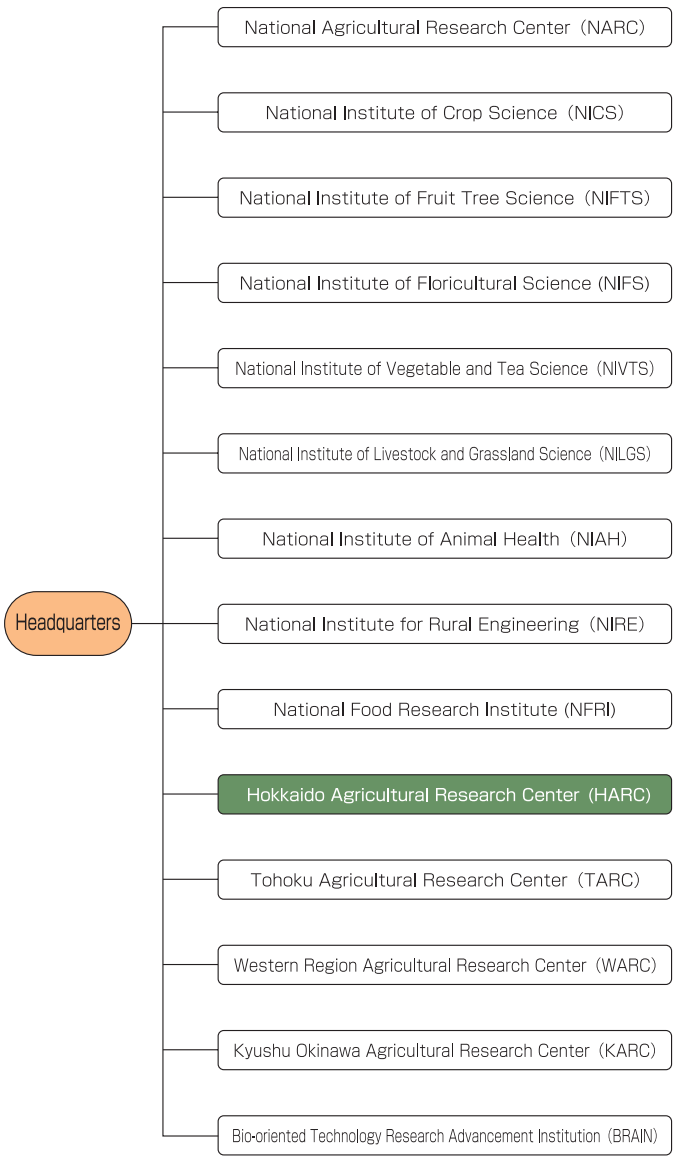
About the Hokkaido Agricultural Research Center

Hokkaido Agricultural Research Center: Mission and Research Orientation

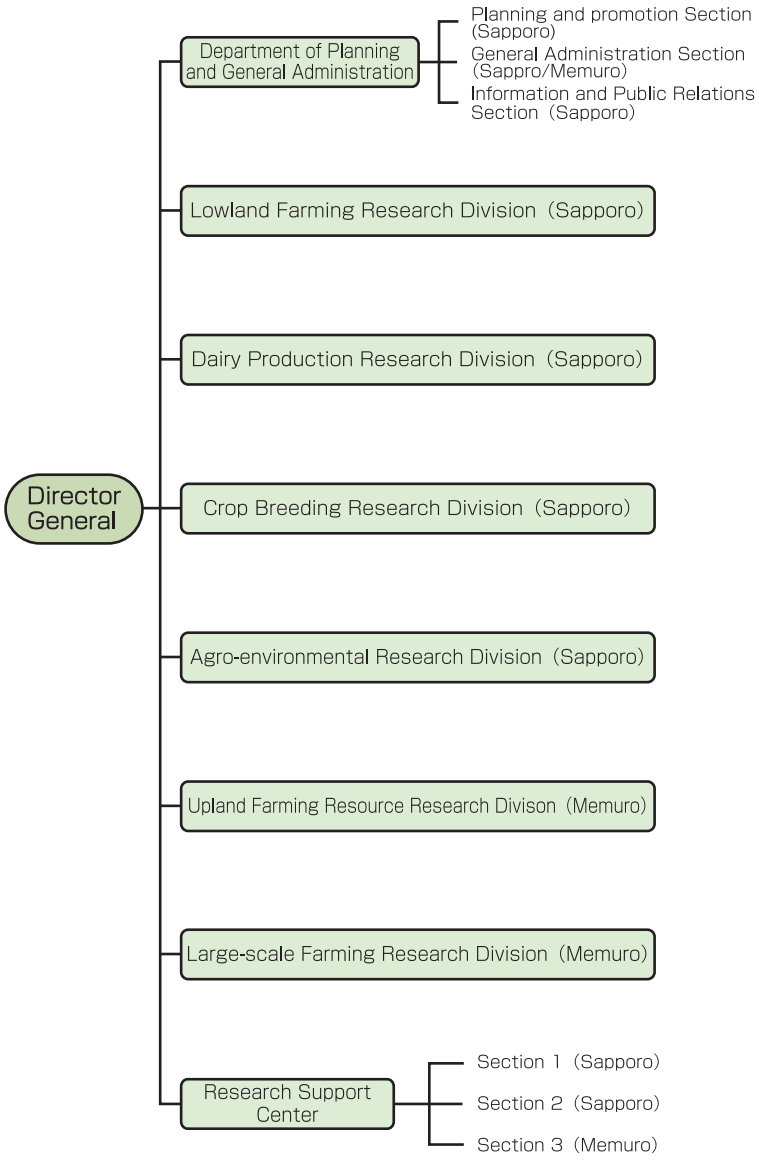
The Hokkaido Agricultural Research Center's mission is to develop new agricultural techniques in order to provide a stable supply of safe food to the citizens by means of further advances in cold-region agriculture. The Center is a member of the National Agriculture and Food Research Organization (NARO), 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, six 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 selecting 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 products 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 ICT (Information Communication Technology) to large-scale agriculture.

Organization

National Agriculture and Food Research Organization (NARO)

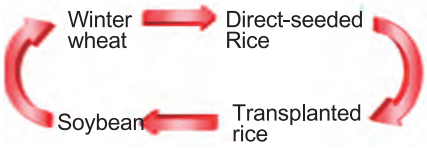


Organization of Hokkaido Agricultural Research Center (HARC)

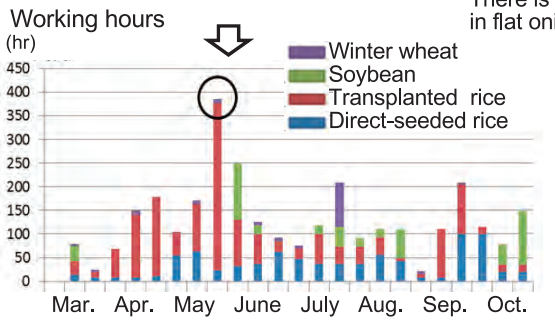


Main research targets

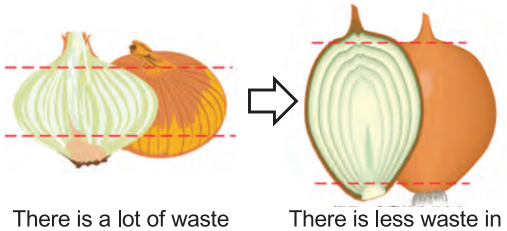
- Development of a crop rotation system in a large-scale paddy field that enables labor saving and steady production in a cold region, focusing on unloading of springtime work, for significant cost reduction.
- Development of leading varieties of open-field vegetables for increasing domestic production 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 the promotion of them. Development of business models in regional agriculture and human resource management methods for increasing new farmers.



Assumed large scale lowland crop rotation system (70 ha).



Using new technologies, working hours within 400 hr during the last ten days in May.
(Conventional rice transplanting needs over 900 hr)



There is a lot of waste in flat onions.

There is less waste in oval onions.

Development of onion varieties for processing.

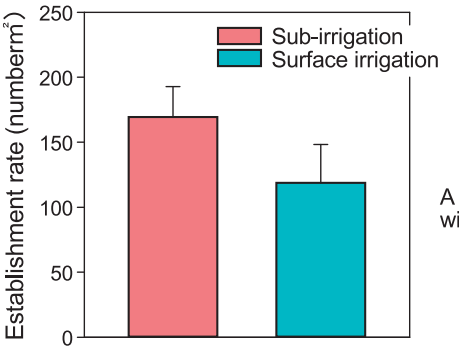
Breeding of Alstroemeria with orange-red flowers.

Establishment of high-productivity farming systems
Promotion of new agricultural technology and new varieties

- ①Analysis of farming trends and management structure in Hokkaido
- ②Development of business models in regional agriculture
- ③Development of farm management-related methods
- ④Economic evaluation of new agricultural technology and new varieties

Main research results

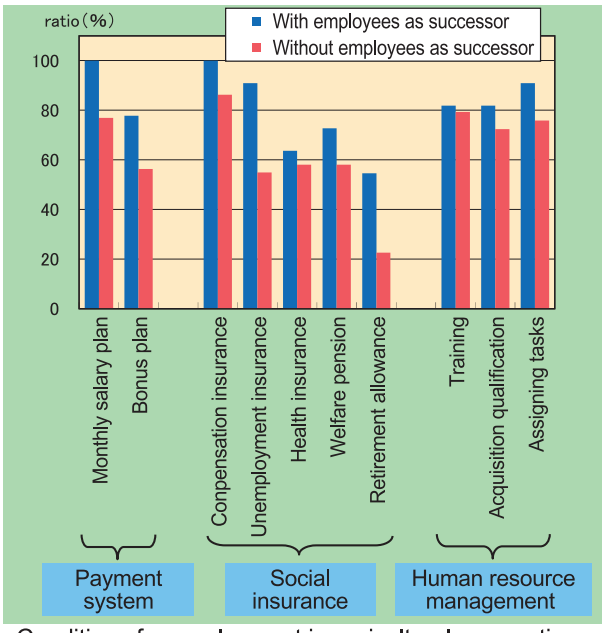
- Sub-irrigation (e.g., FOEAS, Hokkaido style FOEAS) usage for a high rate of establishment of direct-seeding for a dried rice field in Hokkaido.
- A new onion cultivar 'KaroeOne' with adaptability for food processing, a new squash cultivar 'JeJeJ' with short internodes and high fruit quality after storage, and a new early mature European pear cultivar 'Jade Sweet' with large fruit and high quality.
- Forecast of agricultural structure of Hokkaido in 2020. Conditions for employment in agricultural corporations.



Using sub-irrigation, the rate of establishment of direct seeding for a dried rice field was enhanced by 13 points.
(In HARC from 2010 to 2013)

A new onion cultivar 'KaroeOne' with adaptability for food processing.

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



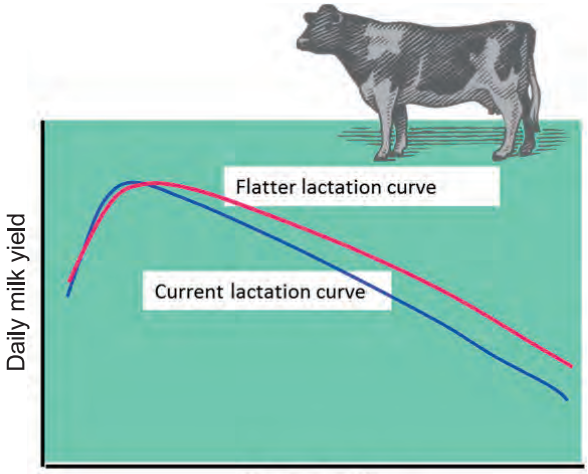
Conditions for employment in agricultural corporations.

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 cutting.
- 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 cultivars for silage corn, grass and legumes.

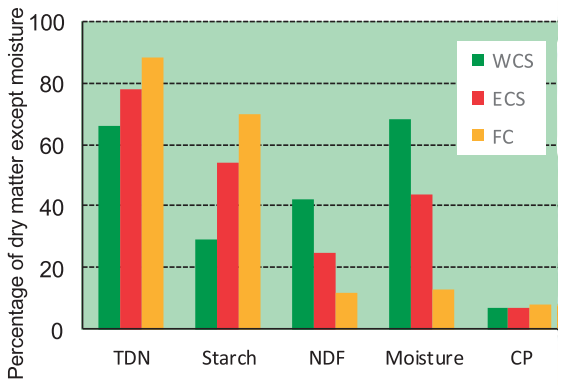
Establishment of a low-cost dairy production system based on domestic feed or pasture.



Levelling daily milk yield.

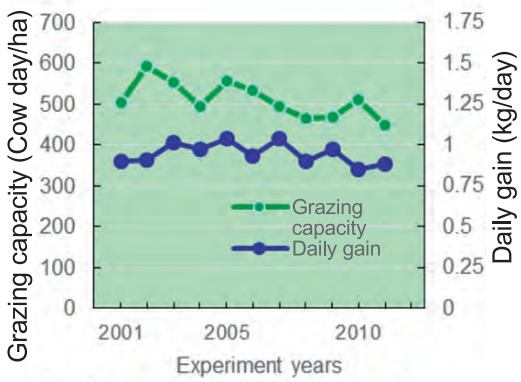
Main research results

- 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 labor-saving grazing management techniques for raising cattle by Kentucky bluegrass swards.
- We have developed a feeding technique for milking cows to utilize ear-corn* silage.



Feed composition of ear-corn silage

WCS: Whole-crop silage, ECS: Ear-corn silage, FC: Flaked corn, TDN: Total digestible nutrients, NDF: Neutral detergent fiber, CP: Crude protein.



Grazing capacity and daily gain of Kentucky bluegrass pasture for labor-saving grazing management.

A good winter hardiness meadow fescue cultivar, "Makibasakae", suitable for intensive grazing.

*Ear is a part of corn formed by kernels, a cob and protective leaves called husk.

Main research targets

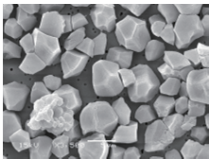
- Developing new rice cultivars including cultivars that can be used for producing rice flour for making bread cultivars that can be used in the food service industry.
- Developing rice flour processing technology by utilizing genetic diversity in starch.
- Developing new feed use rice cultivars.
- Developing 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.

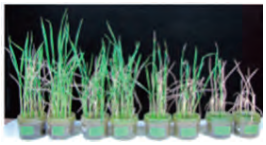
Soft grain silage of feed-use rice.

Cost-effective rice cultivars for food service industry use.

Rice cultivars suitable for rice flour bread.

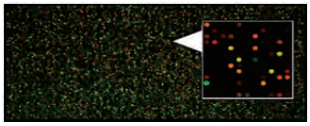


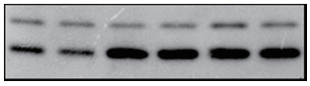
Starch technology (Photo:figure of starch granule by electron microscopy analysis).



Genetic diversity in chilling tolerance in rice.

Genetic diversity in winter hardiness in wheat.



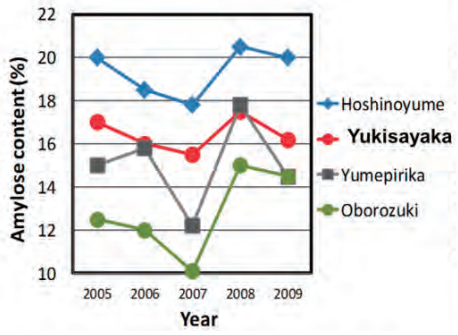


Analysis of gene expression for chilling tolerance and winter hardiness.

Development of breeding materials by utilizing molecular markers and transgenics.

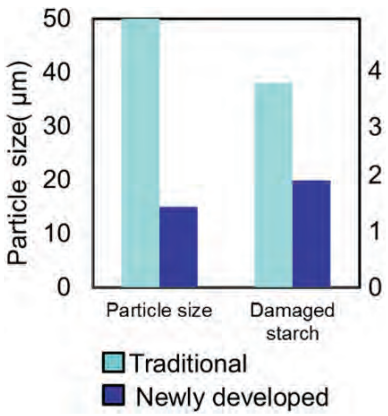
Main research results

- Development of a new rice cultivar “Yukisayaka” in which the *qAC9.3* gene confers both of high rating and low yearly fluctuation in the 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 lost.
- Identification of the gene (*CSP3* gene) that enhances cold stress tolerance in land plants.

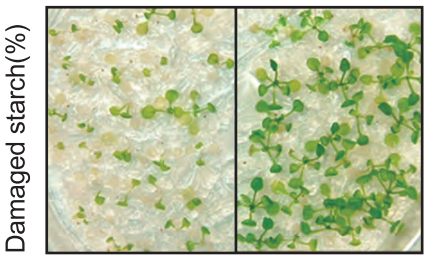


※Amylose content is correlated with eating quality.

“Yukisayaka” shows low yearly fluctuation in eating quality.



New rice processing technology produces rice flour with fine particle size and low level of starch damage.



Wild type

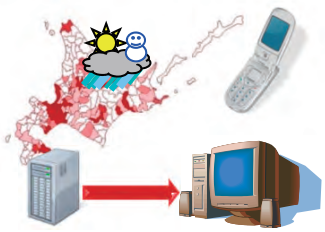
CSP3 over expressed *Arabidopsis*

Plant survival of *Arabidopsis* after freezing treatment at -5℃。
CPS3 gene enhances cold stress tolerance of land plants.

Main research targets

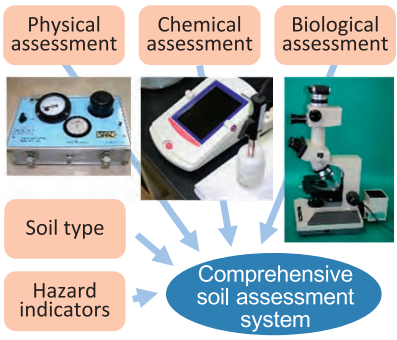
- Development of an early prediction and warning system of weather conditions.
- Development of adaptation and mitigation technologies for climate change in agriculture.
- Development of new soil management methods by use of soil microbes to reduce dependence on chemical fertilizers.
- Development of a comprehensive soil assessment system to measure and improve soil productivity.
- Development of a system for control of plant damage caused by microorganisms and nematodes in soil.
- Development of vegetation management method to conserve natural enemies of arthropod pests in crop fields.

Agriculture meteorological alert transmission and expert regional assistant system



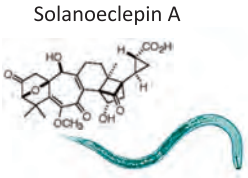
An early warning system which is based on meteorological observation and forecast data, and provides agricultural warning information for farmers.

Improvement of soil productivity



We show plans to improve soil productivity using a comprehensive soil assessment system.

Biological control of diseases and pests



Development of natural pest control materials.

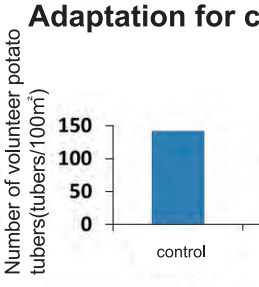
Trap crops

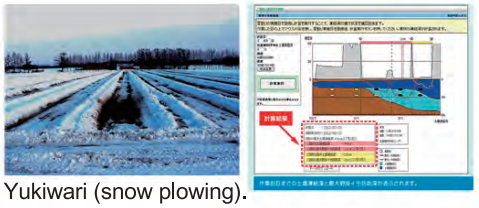
Control of soil-borne diseases and pests by resistant cultivars, antagonistic microorganisms and green manure crops.

Main research results

- Establishment of killing volunteer potato tubers by soil frost control.
- We revealed that practical application of indigenous arbuscular mycorrhizal fungi (AMF) could reduce the use of phosphorus fertilizer in soybean fields.
- We developed a useful method for detection and estimation of viable potato cyst nematodes (PCN) in soil.

Adaptation for climate change

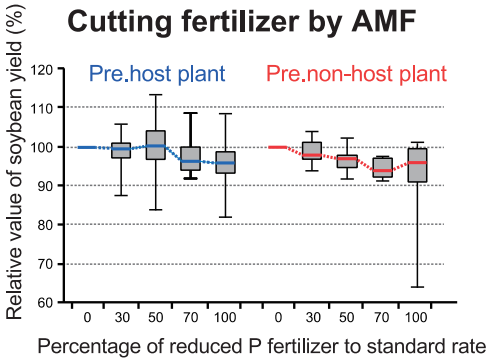




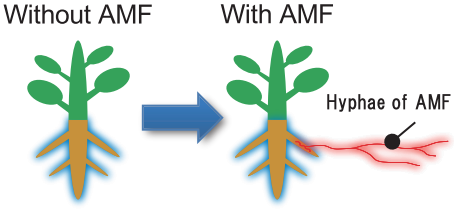
Yukiwari (snow plowing).

Earlier onset of thick snowcover in recent years has reduced the penetration depth of soil frost, resulting in over-winter survival of unharvested small potato tubers that emerge as weeds (volunteer potatoes) in the summer in rotation crop fields. To eliminate them, a method was developed to manipulate soil-frost depths by artificially controlling snowcover thickness, guided by a simple numerical model.

Cutting fertilizer by AMF



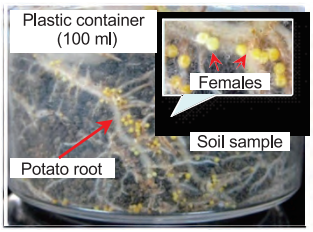
Soybean plants in a field previously cropped with AMF host plants absorbed much phosphorus, so that the yields were maintained until P application rate was reduced by 50%.



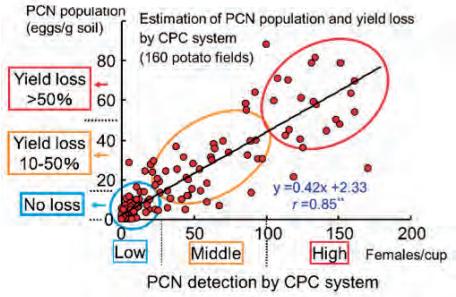
Plants without AMF absorb nutrients only around roots.

Plants with AMF absorb nutrients beyond the root area.

Detection of pathogens



Viable PCN in soil can be distinguished visually by breeding females, using this closed plastic container (CPC) system.

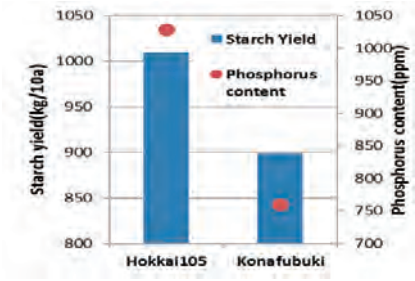


Yield loss of potatoes by PCN can be estimated by using the CPC system.

Main research targets

- Development of winter wheat varieties favorable for bread, Chinese noodles and cakes.
- Development of potato varieties for novel use and food processing such as potato chips.
- Development of sugar beet varieties contribute to stable supply of sugar production against global warming.
- Development of buckwheat varieties with high yield and quality supporting the 6th industry.
- Development of storage and processing techniques for agricultural products and evaluation technique for functional substances.

High yield and wheat yellow mosaic virus-resistant wheat cultivars for bread.

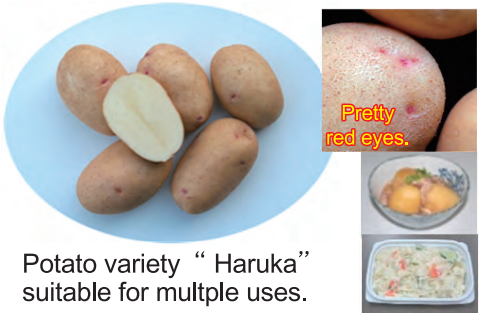


Hokkai 105 has a higher starch yield than that of Konafubuki. The starch with high phosphorus content can be used for development of functional foods and innovative products.

Multi-conbined disease resistant variety "Hokkai 101 and/or Hokkai-Mitsuboshi".

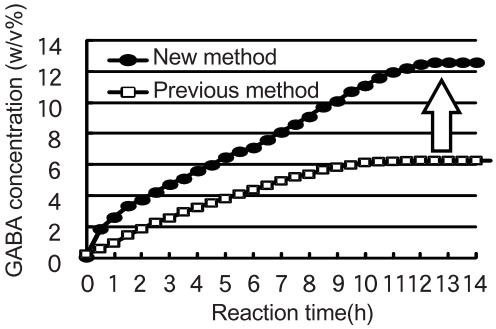
Main research results

- We bred an extra strong winter wheat variety "Yumechikara". By adding "Yumechikara" flour to medium-strength flour, it shows high quality for bread making.
- We bred a multiple-use potato variety "Haruka" and a high yield buckwheat variety "Reranokaori".
- We established methods for the production of γ-aminobutyric acid (GABA) using wheat bran and for the storage of potatoes using ethylene.



Potato variety "Haruka" suitable for multple uses.

Common buckwheat variety "Reranokaori".



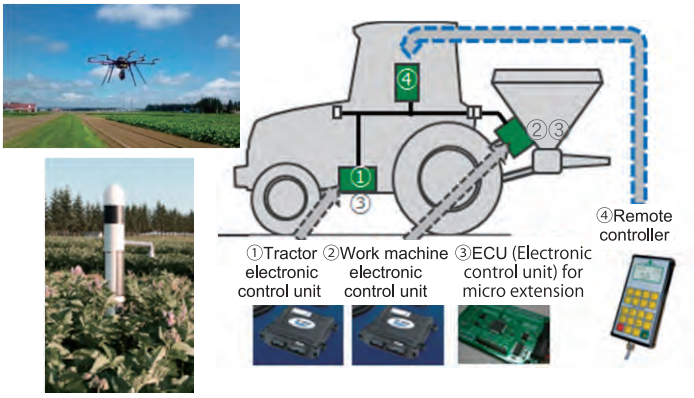
GABA production using wheat bran.

Ethylene treatment enabled long-term potato storage for 7 months from late October.

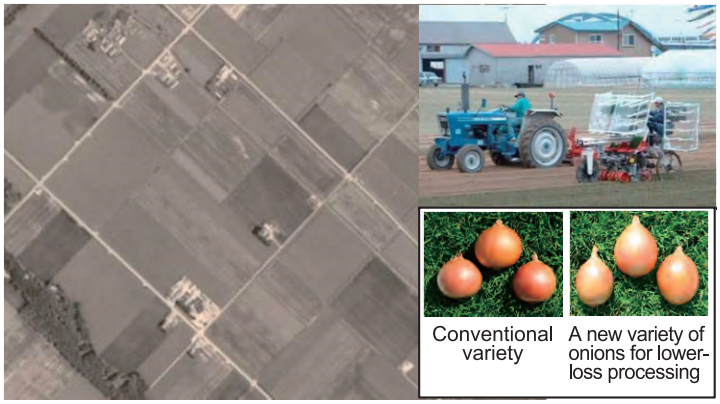
By adding "Yumechikara" flour to medium-strength flour made from "Kitahonami", Half and half mixing may show better quality for bread making.

Main research targets

- Applications and fundamental technologies based on ICT (Information Communication Technology) for farm work and/or crop management in large-scale farms.
- Environment-friendly pest and/or disease control technologies using biological functions and management technology against global warming.
- Large-scale field crop rotation system for 50 ha scale by introduction of vegetables such as onions for processing.



Collection of various data and management of farm work and/or cropping by ICT.

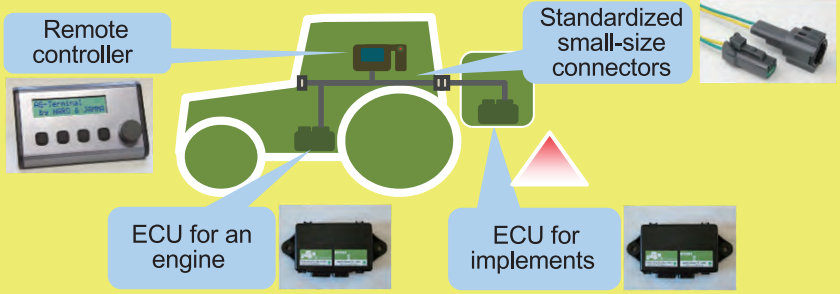


Large-scale upland farming with introduction of vegetables such as onions for processing.

Main research results

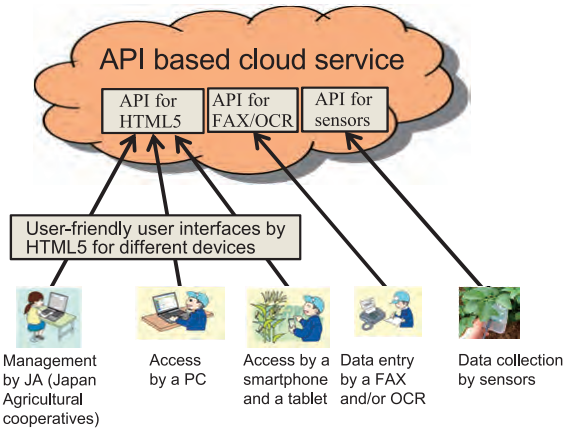
- Mechanized weed control technique in narrow ridges for soybeans was proposed.
- Standardized Standardized communication and/or control technologies technologies for agricultural machinery were developed in cooperation with agricultural machinery companies in Japan.
- A cloud service, apras, for agricultural production process management was developed.

Standardized communication and/or control technologies



Mechanized weed control technique in soybeans narrow ridges

Production management cloud service (apras)



apras (agricultural production assistance system) supports the production process management of agricultural products.
Users can use apras by a PC, a smartphone, or a tablet.

Department of Planning and General Administration

Planning and Promotion Section
Promotes and supports research-related works such as research planning, management and the evaluation of research projects, government-industry-academia collaboration, regional promotion committees, budget planning and management, and dealing with government institutions and the headquarters of the National Agriculture and Food Research Organization.

- Planning Team — Responsible for research planning, management and the evaluation of research projects, competitive research funding, research exchanges in Japan and overseas, safety-related measures, and the planning and running of executive meetings.
- Administration Team — Responsible for the use and management of budgets, consigned research, contract research, government-industry-academia collaboration, regional multidisciplinary research, promotion meetings, intellectual properties, the management of research findings, and the running of research team leaders meetings.

General Administration Section
Responsible for general affairs and welfare, industrial relations, staff management, accounting, inspection, acquisition and asset management.

- General Affairs Team — Responsible for general affairs, welfare, industrial relations and personnel management.
- Accounting Team — Responsible for accounting, inspection, contracts and asset management.
- Memuro Management Team — Responsible for general affairs and accounting at the Memuro Research Station.

Information and Public Relations Section
Responsible for public relations, network administration, book management, and dealing with events and inquiries.

- Information Management Unit — Responsible for network administration and book management.
- Public Relations Unit — Responsible for public relations, and dealing with events, study visitors and inquiries.

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

Section 1 (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.

Periodic body measurement of dairy cattle

Section 2 (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, the biological control of plant disease, and development of an early prediction and warning system of weather conditions.

Rice harvest in a direct seeding test on a well-drained paddy field

Section 3 (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 ICT farming systems for large-scale agricultural production.

Large-scale farm mechanization for an upland crop rotation field

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 Kotoni, 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 Hokkaido Agricultural Research Center (HARC) under the National Agriculture and Food Research Organization.

Number of Staff

Designated staff	1
Administrative staff	42
Technical staff	60
Research staff	131
Total	234

Number of Livestock

Dairy cattle	80
Sheep	69

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 Lowland Test Field	0.9	2.3	1.7	—	50.1	55.0

(Premises, livestock, staff: As of Feb. 2015)

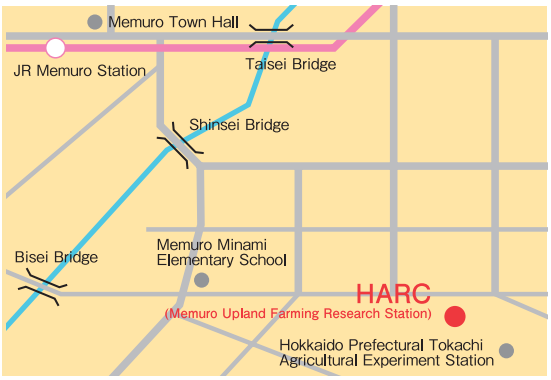
Sapporo

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

★ Sapporo Station — Subway Toho Line, 13 min. → Fukuzumi Station — Chuo Bus, 4 min.
→ Tsukisamu-Higashi 1-jo 19-chome — Walk, 15 min. → HARC

★ New Chitose Airport — Chuo Bus/Hokuto Kotsu Bus, 48 min. →
→ Tsukisamu-Higashi 1-jo 19-chome — Walk, 15 min. → HARC

Memuro Upland Farming Research Station



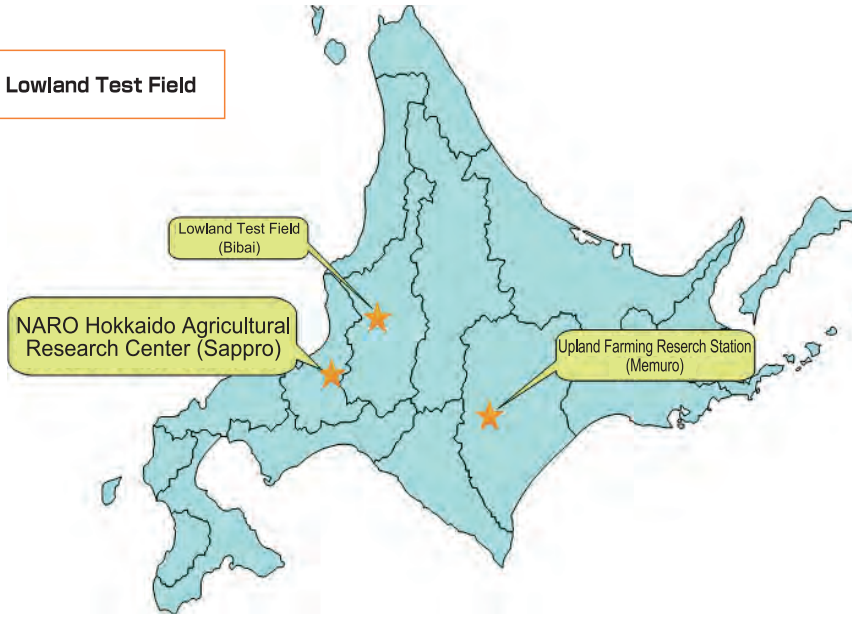
9-4, Shinsei-minami, Memuro-cho, Kasai-gun, 082-0081, JAPAN Tel : 0155-62-2721

★ Tokachi-Obihiro Airport — Tokachi Bus (25 km), 40 min.
→ JR Obihiro Station — JR (13.6 km), 20 min. → JR Memuro Station — Car (4.5 km), 10 min.
→ Memuro Upland Farming Research Station

Bibai Lowland Test Field

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

★ JR Bibai Station — Car (4.5 km), 10 min. → **Bibai Lowland Test Field**



Contact

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

TEL (011) 857-9260

http://cryo.naro.affrc.go.jp

Feb. 2015 Cover: Sapporo (Upper), Memuro (Lower)