

Innovative Technologies for the Sustainable Development of Food Production in the 21st Century

The Strategy in Japan

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The Agriculture, Forestry and Fisheries Research Council (AFFRC)

AFFRC is a special organization established in the Ministry of Agriculture, Forestry and Fisheries, Japan

Duties of AFFRC

1. Formulating the basic objectives and other fundamental matters for agricultural, forestry and fishery research activities in Japan
2. Liaison and coordinating between the research institutions and administrative sections

Sustainable Development of Agriculture in the 21st Century

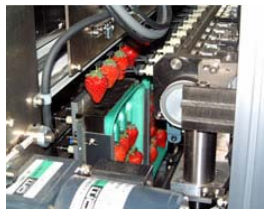
- © Aging Society
- © Global Warming



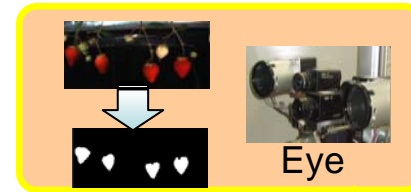
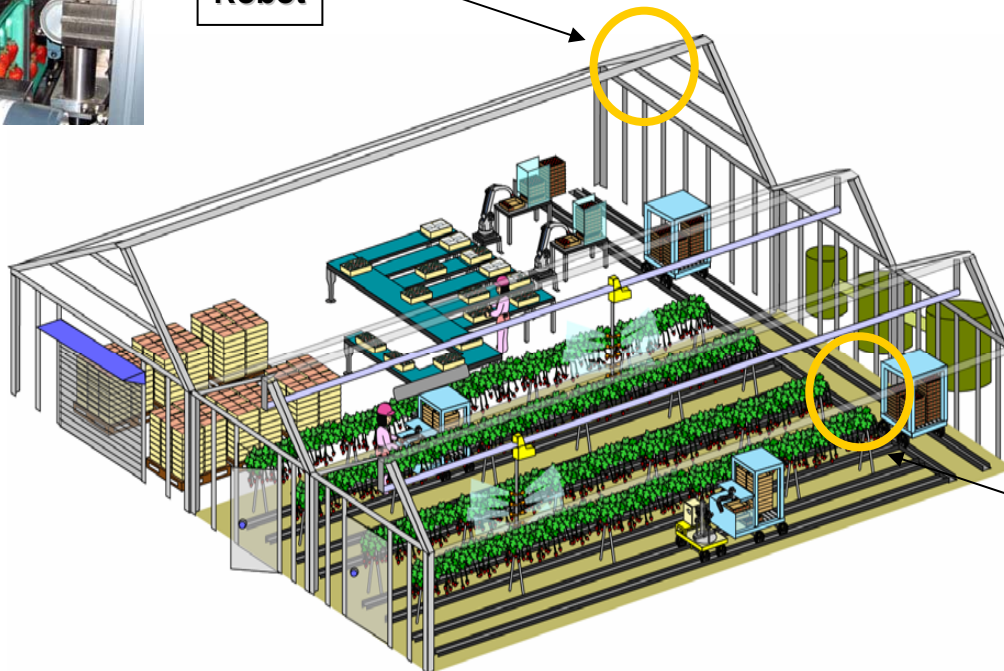
Labor-saving and Energy-saving
Agricultural Technologies

A new system created by fusing both agriculture and engineering technologies

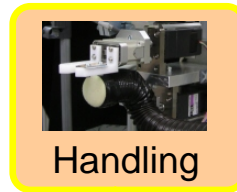
Use of robots for next-generation production system



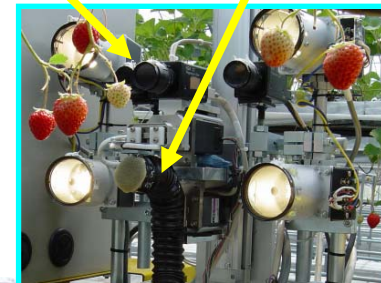
Sort
Robot



Eye



Handling



Harvest
Robot

Japan is good at robot technologies (Robo-Farm)

IT Technology



Remote-controlled helicopter
Measuring the growth of crop



Auto-controlled spreader of
fertilizer



Harvester recording data of
quality and quantity of crop
automatically

Fused

Robot Technology



Automated farm tractor A



Automated farm tractor B



Automated rice planting
machine

Innovative technologies for improving a new variety

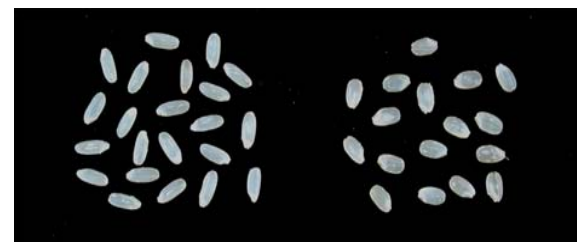
Development of new foods and/or new materials

Purple sweet potato



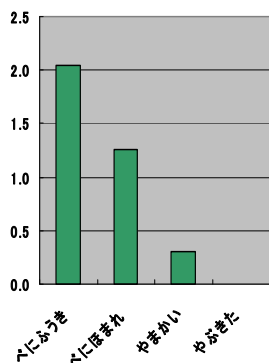
A new variety AYAMURASAKI containing a functional pigment, **Anthocyanin**

New rice variety for curry



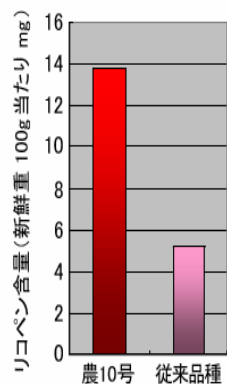
Left [華麗舞], rice for curry
Right: Koshikikari

Benifuuki, a new green tea



The new green tea contains an anti-allergic materials methyl-kakitene

High lycopene tomato



高リコペントマトの育成系統(中間母本農10号) 従来品種

A new tomato containing high lycopene with anti-oxidation effect

New materials for medical use

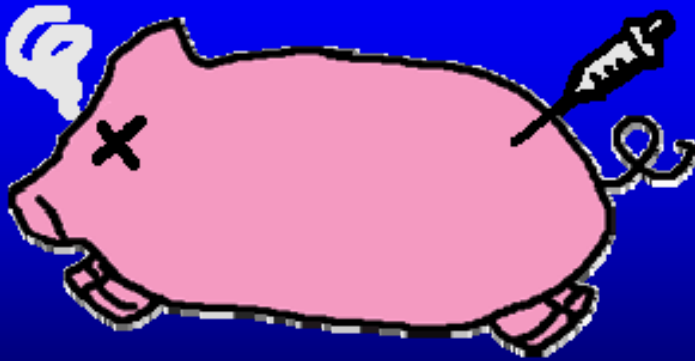


Silkworm producing a high protein containing silk for medical use

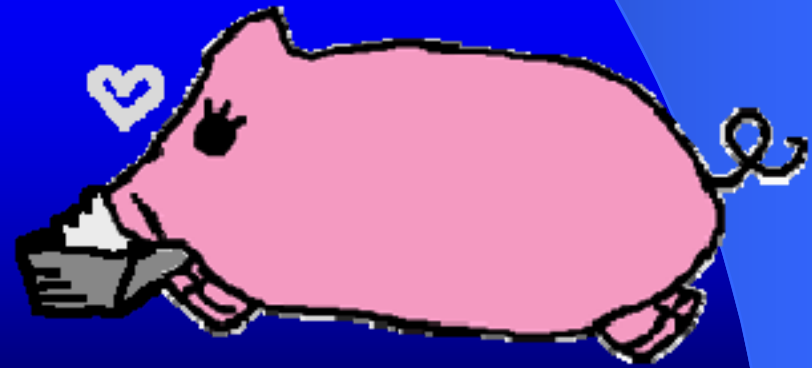
CROP-BASED EDIBLE VACCINES AS A PROMISING NEW AGRICULTURAL PRODUCT

Advantages of edible vaccine

- Avoidance of stress for animals
- Reduction of labor cost, transport and storage cost, purifying cost, and etc.
- Cheapness and easiness in edible vaccine production

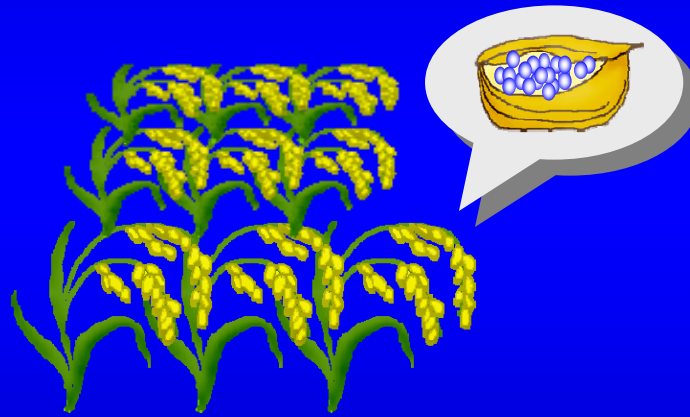


vaccine injection



edible vaccine feeding

Production of transgenic rice expressing CTB-As16 antigen for controlling roundworm in pig



Rice: *Oryza sativa* cv, kitaake (*japonica*)

Transformation of rice

Agrobacterium tumefaciens EH105

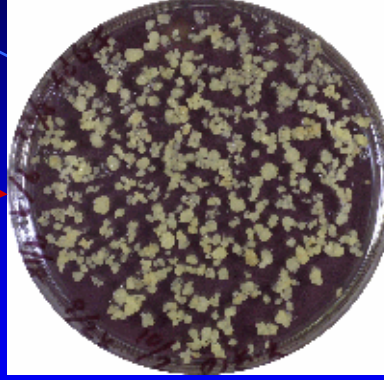
Co-cultivation



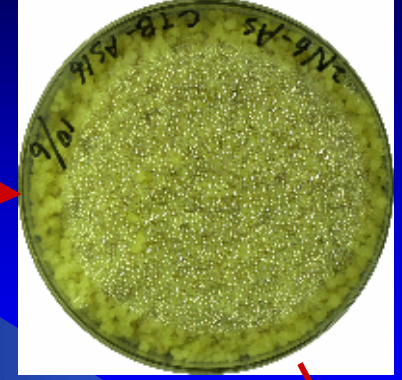
Callus induction d7



Callus induction d30



Pre-incubation



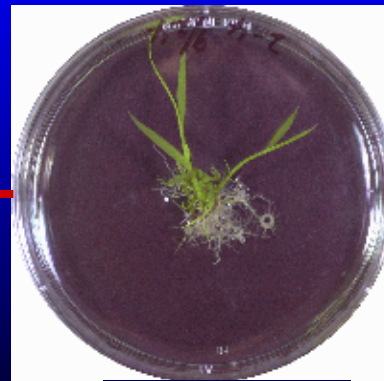
Sterilization
and selection
w/ hygromycine
1 week



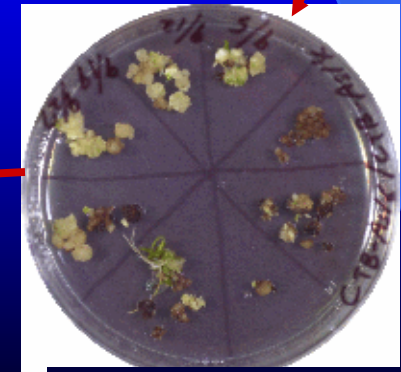
Blooming rice



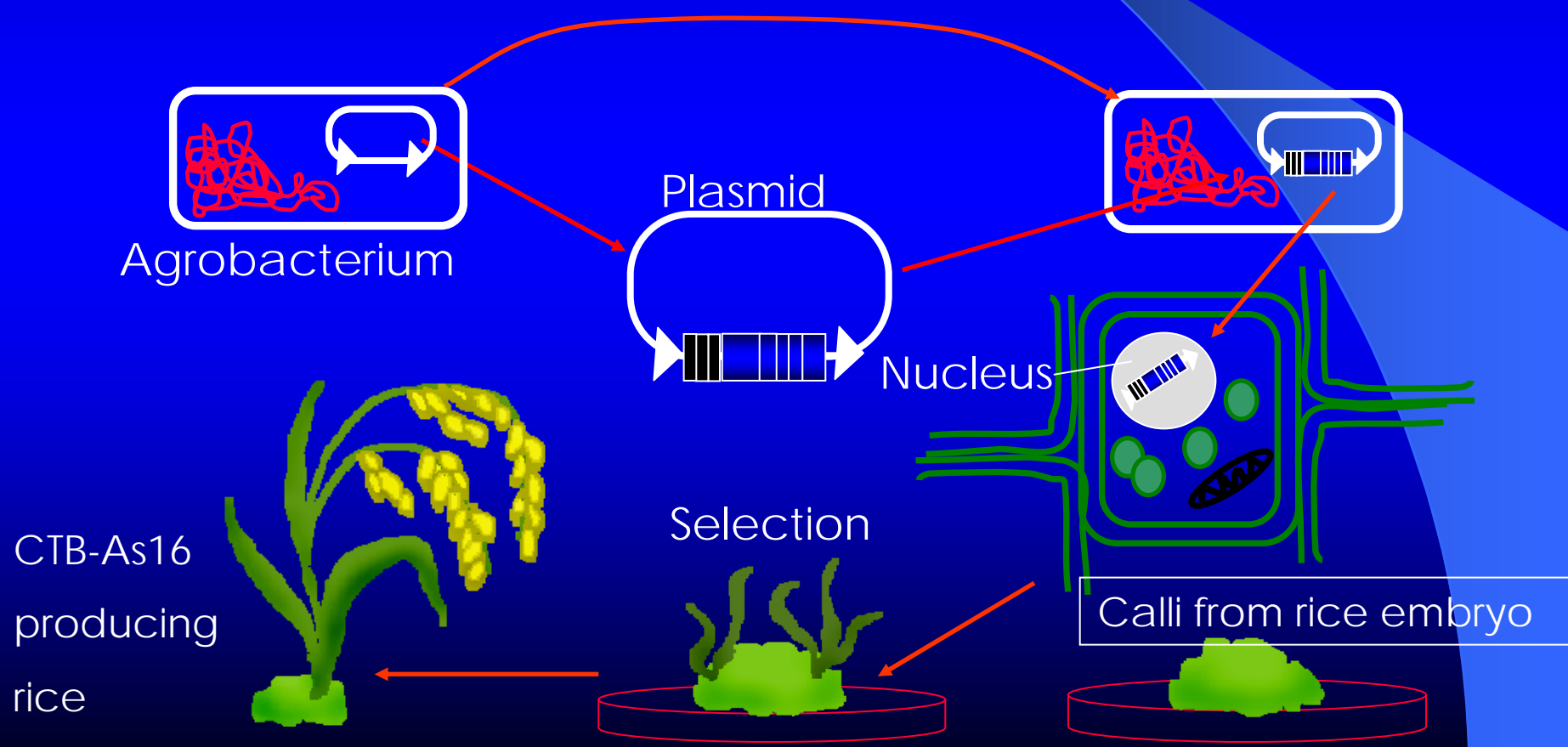
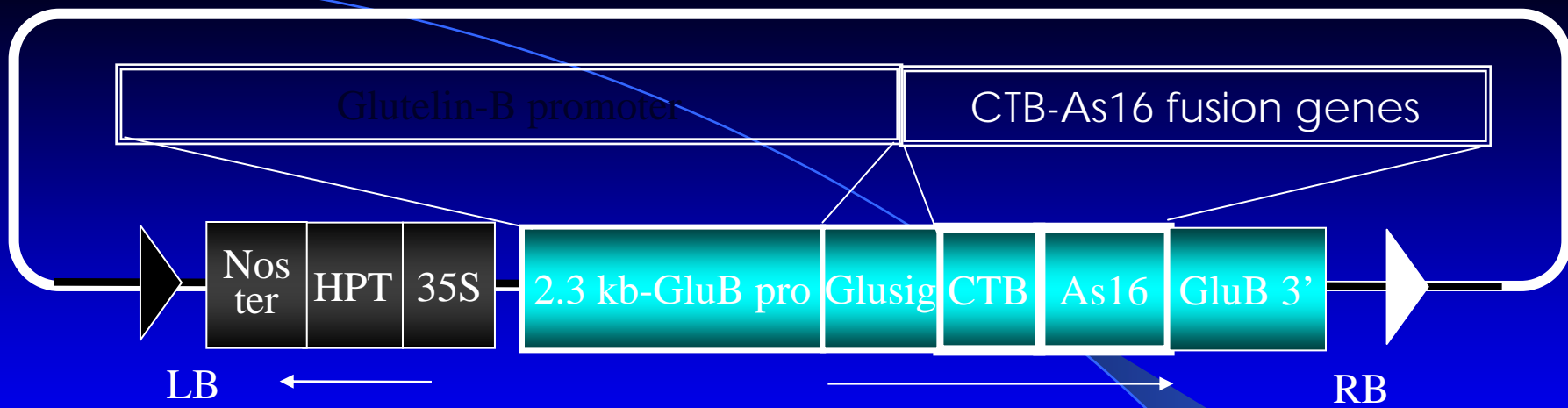
Potted rice 1 week



Regenerates

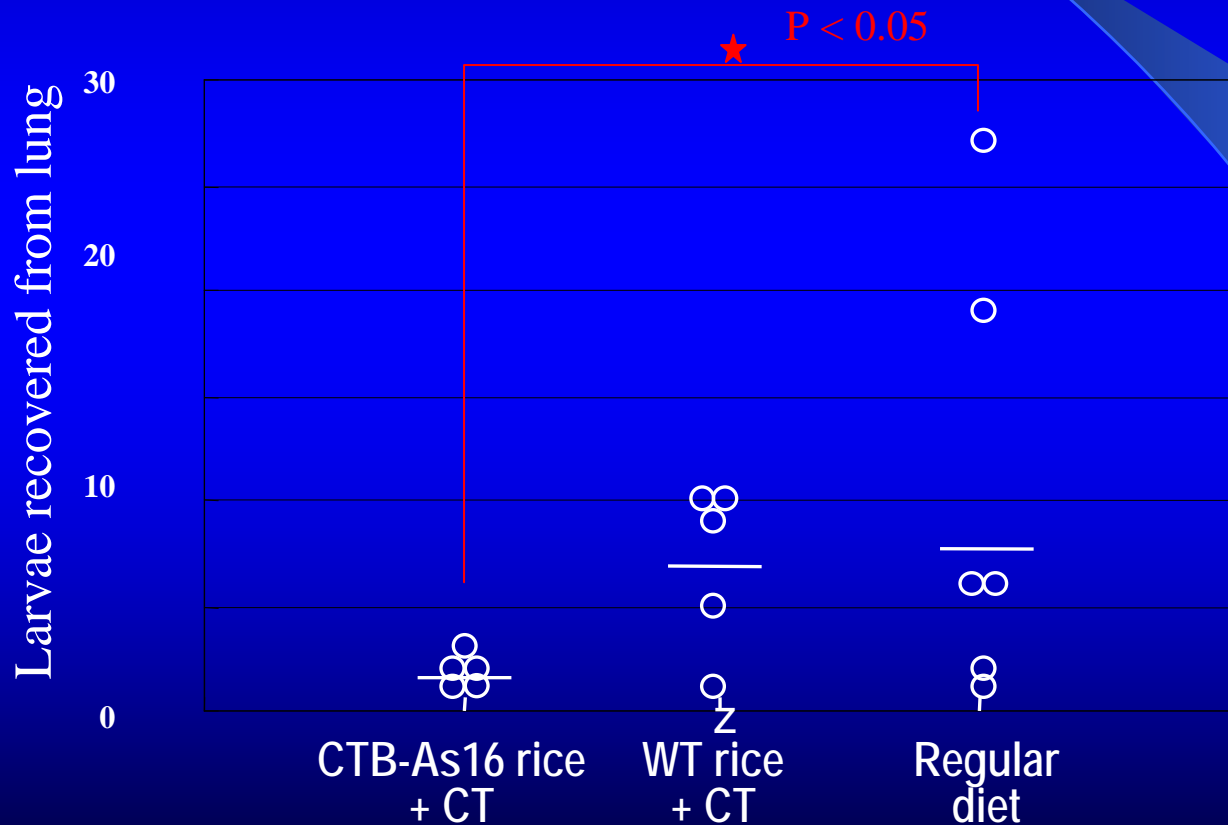


Regeneration 3 wk



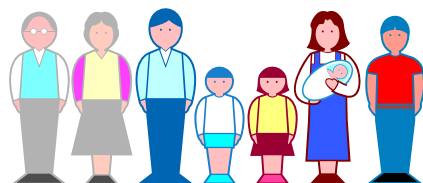
Identified *A. suum* 3rd stage larval antigen, As16, is a hopeful mucosal vaccine candidate

Reduction of 3rd stage larvae by CTB-As 16 antigen



Development of tailor-made foods using by nutrigenomics

All-inclusive analyses of gene expression contribute to evaluate the safety and function of food components and to offer the menu for individual constitution and physical condition



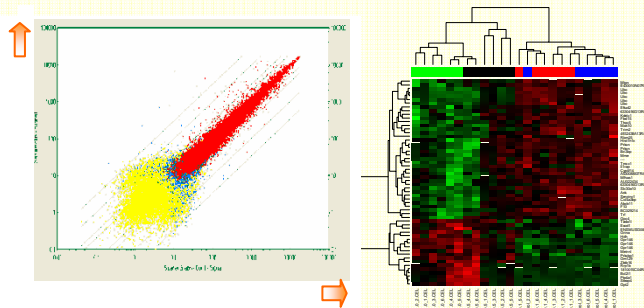
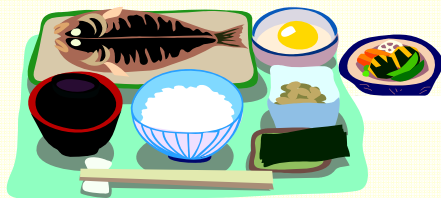
Individual characterization



Integrated data base system

1. Polymorphism
2. Functional components

Tailor-made foods for each person



Measurement of the gene expression using DNA microarray, after feeding the samples to experimental animals

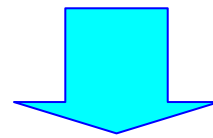


Characteristics of tailor-made foods

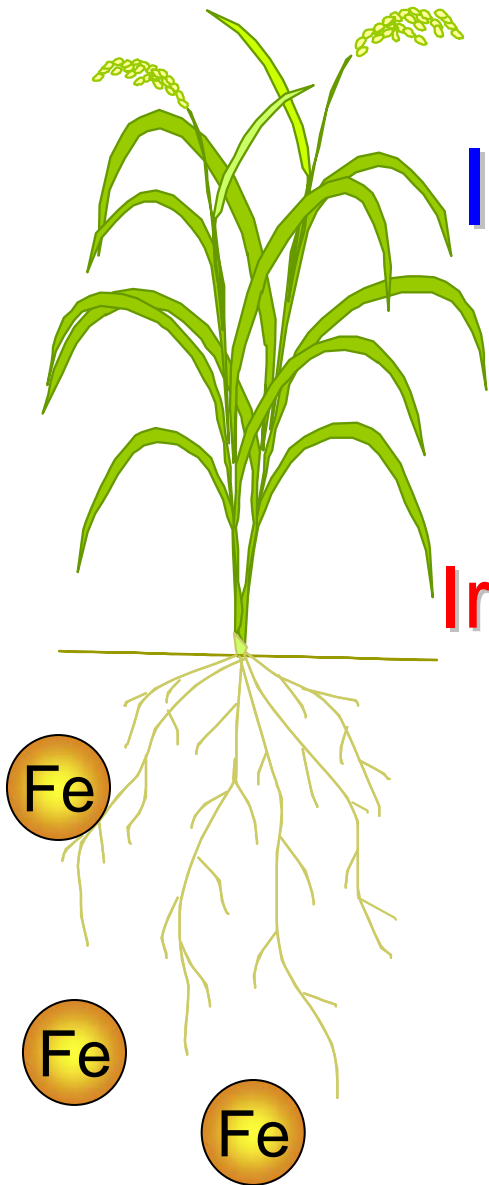
- Able to choose the foods containing effective components according to individual gene information
- Able to predict the safety and effectiveness of foods
- Able to offer the menu for well balanced and functional meals

Iron is the essential element
for plant growth

Iron is not available in alkaline soils



Plants die in alkaline soils
due to iron deficiency



Transgenic rice tolerant to alkaline soils

Success 1

Success 2

WT

Transgenic

Transgenic

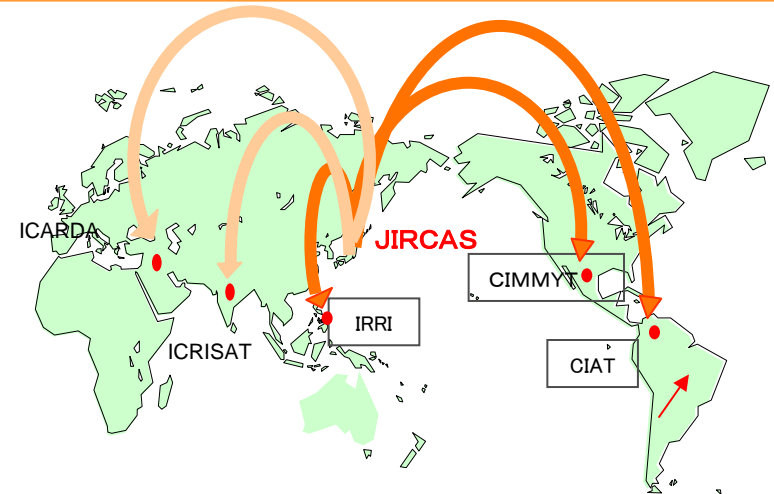
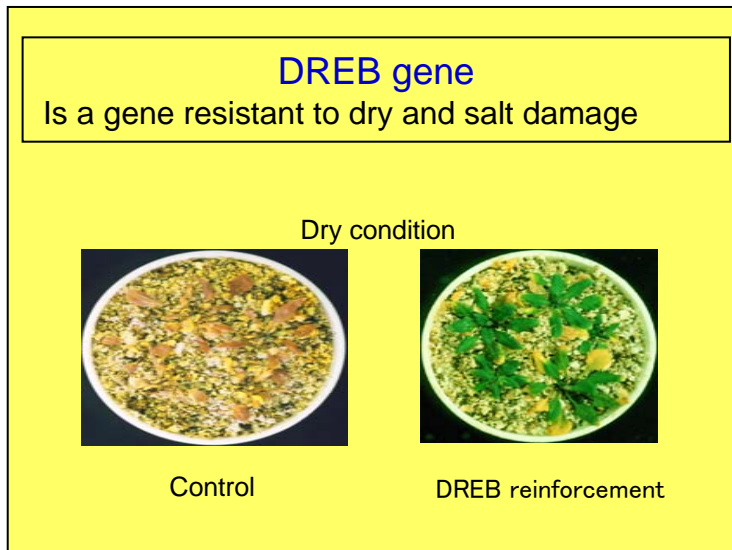
WT

Takahashi et al,
Nature Biotechnol 2001

Ishimaru et al,
Proc Natl Acad Sci USA 2007

JIRCAS, a national agricultural institute, has found DREB gene resistant to dry and salt damage by the collaboration with international research institutions

Collaboration with international organization



Development of crop resistant to dry and salt damage

Increased production

Afforestation

Bioenergy

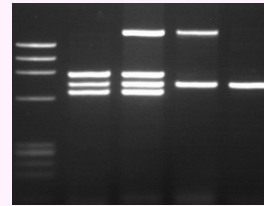


Control wheat

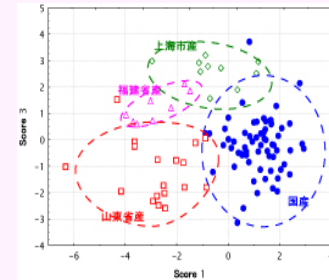
DREB reinforcement

Distinction of variety and locality

Discrimination method using by DNA technology



コシヒカリ
ひとめぼれ
あきたこまち
ササニシキ



Principal component analysis

Role in the food chain

Production



Processing



Distribution



Consumer

輸入品

Elimination of camouflage food

Rapid and reliable methods for food label

Food safety and intellectual property

Adaptive agricultural technologies for global warming

New technologies for surmounting high temperature circumstance



図 15 同一出穂期の「ニコまる」と「ヒノヒカリ」の品質比較

100粒中の整粒、白未熟粒、その他の数。「ニコまる」は整粒が多い。
(2005年(高温年) 長崎県総合農林試験場)

Rice resistant to high temperature



図 6 高温、水不足によるみかんの「日焼け果」

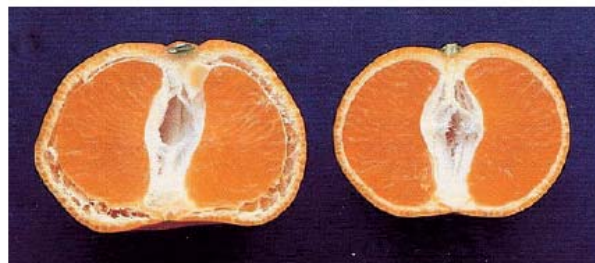


図 5 高温、多雨によるみかんの「浮皮症」(左)
果皮と果肉が分離するもので、品質、貯蔵性の低下につながる。

Orange resistant to high temperature