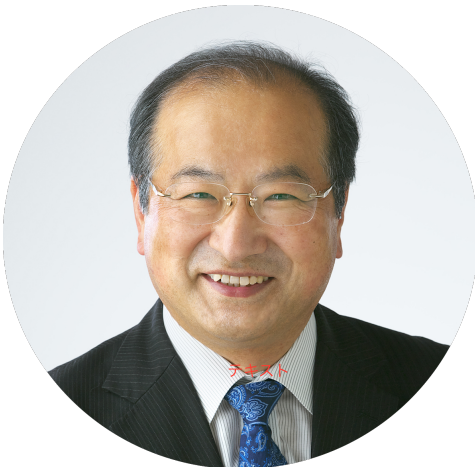


“Gene Editing Technology: Application in Agriculture and Regulations on Food Derived from Gene Editing Technology”

Introduction of Genome Edited High GABA Tomato into Japanese Market

Hiroshi Ezura, PhD

**Director, Tsukuba Plant Innovation Research Center,
Professor, Faculty of Life and Environmental Sciences,
University of Tsukuba**

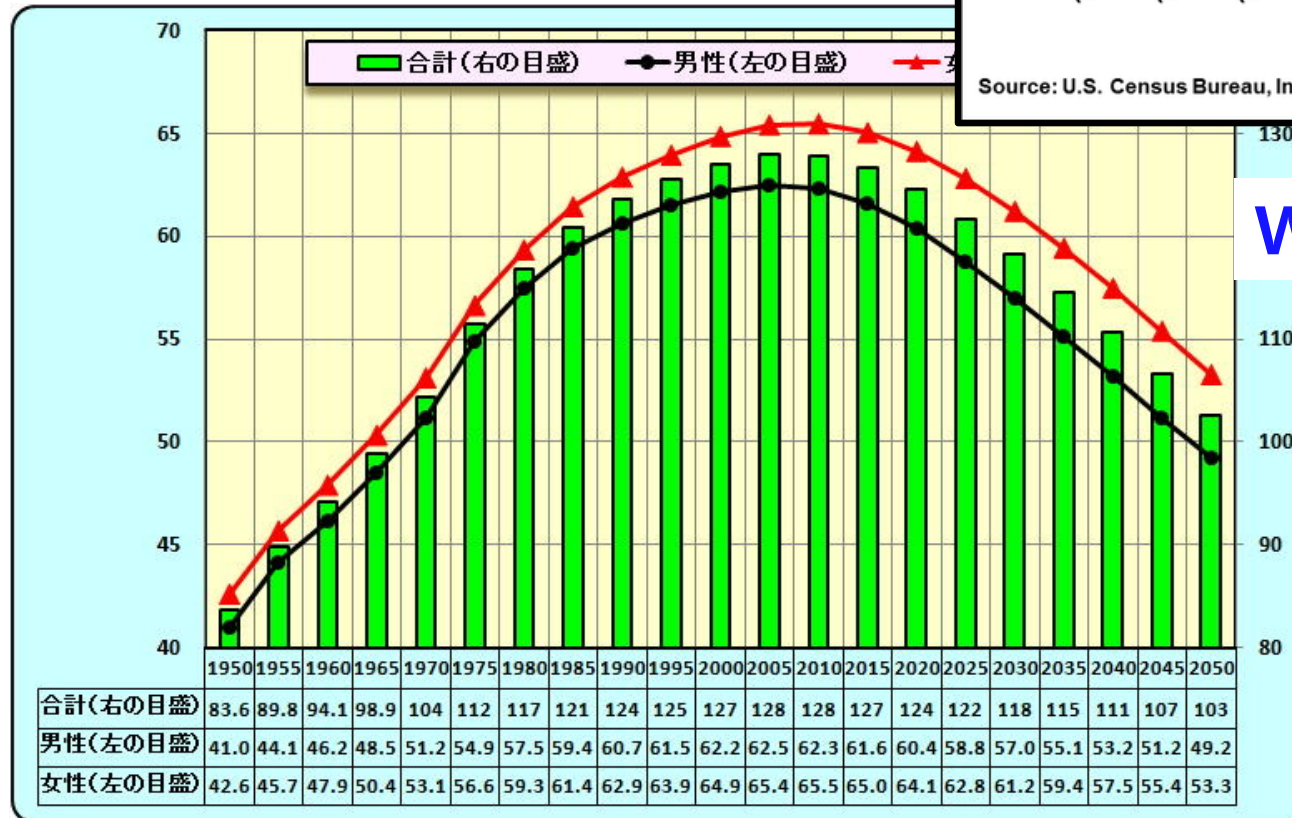
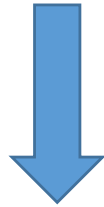


20211020@Bangkok

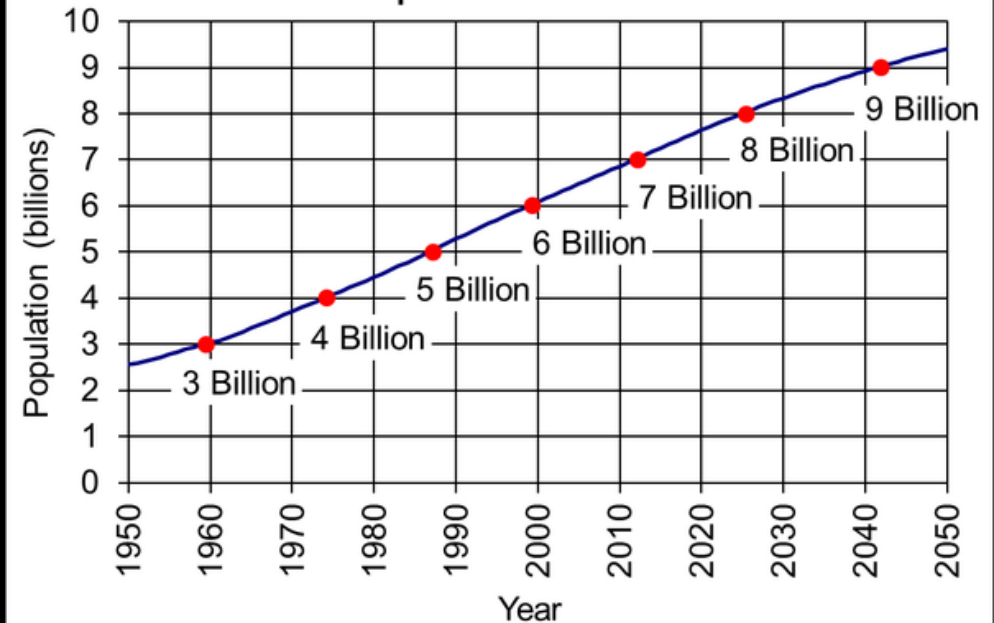


Aging and decreasing Japanese population has exposed problems in foods.

Japanese population



World Population: 1950-2050

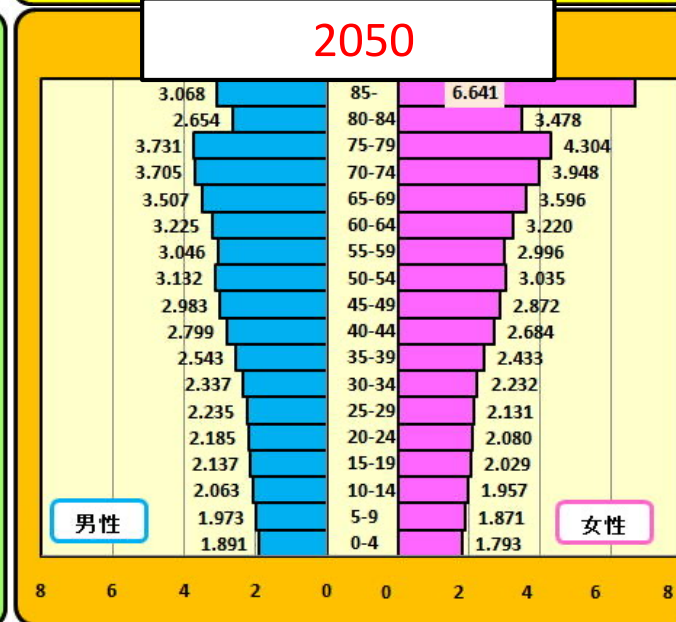
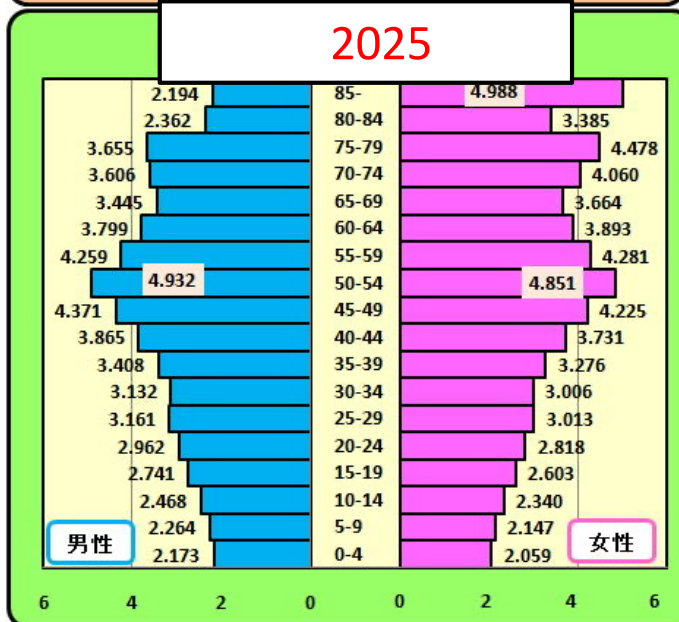
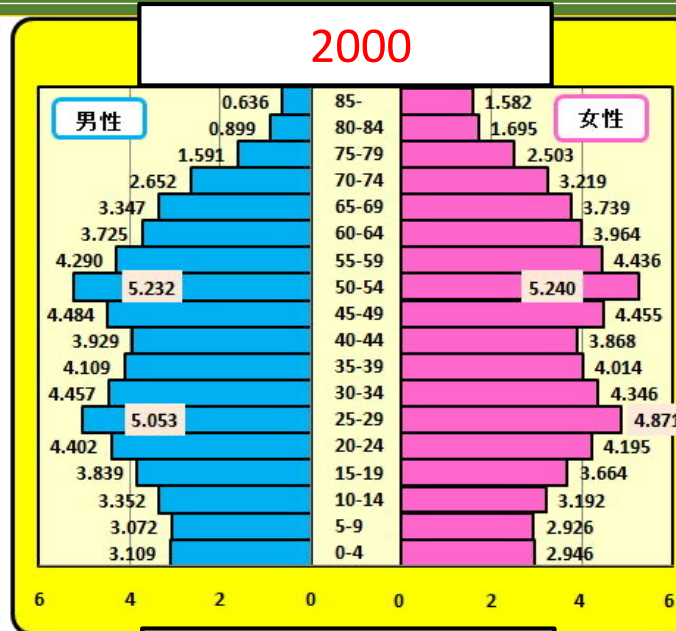
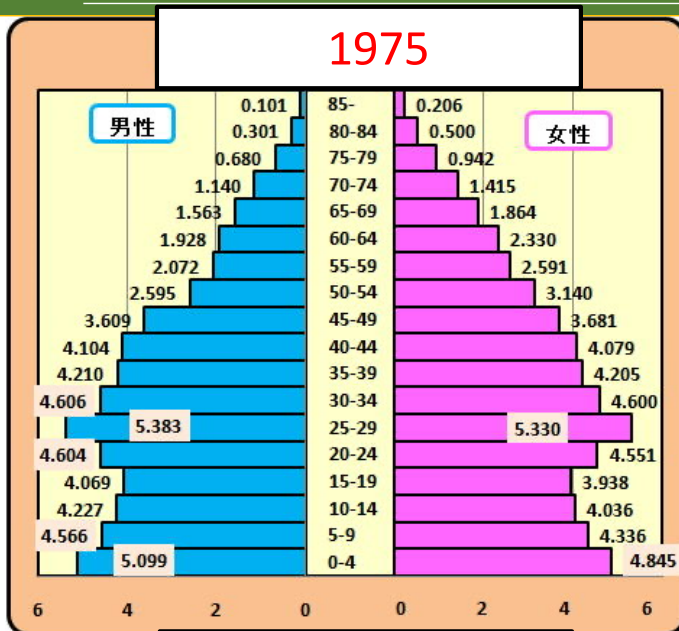


Source: U.S. Census Bureau, International Data Base, July 2015 Update.

World population



Health promotion via daily foods or diets becoming apparent in Japan



Low birth rate
and aging

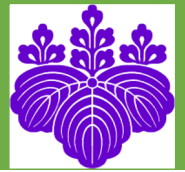


Increase of life-
style related
diseases



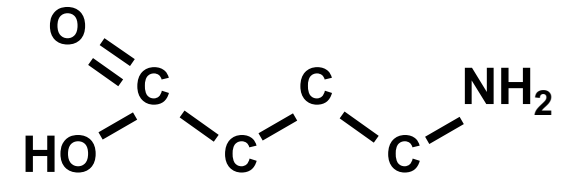
Health promotion
via daily food
(meal)

What is GABA?



Gamma-**a**mino **b**utyric **a**cid (GABA)

- Non-proteinogenic amino acid
- Found in animals, plants, and bacteria
- **Involved in biotic/abiotic responses**



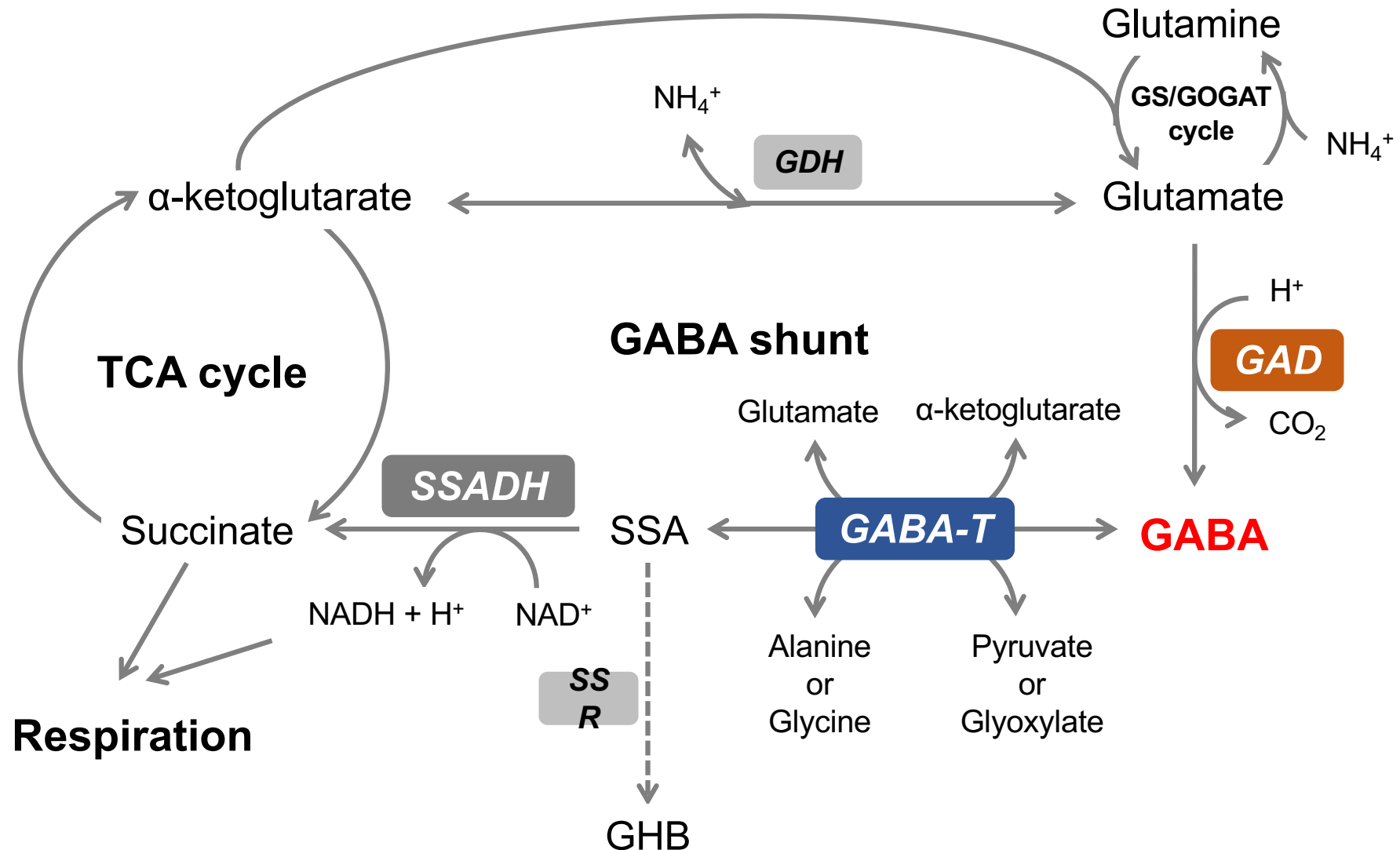
GABA in humans:

- Functions as a neurotransmitter
- **Reduces blood pressure**
- **Induces relaxation**

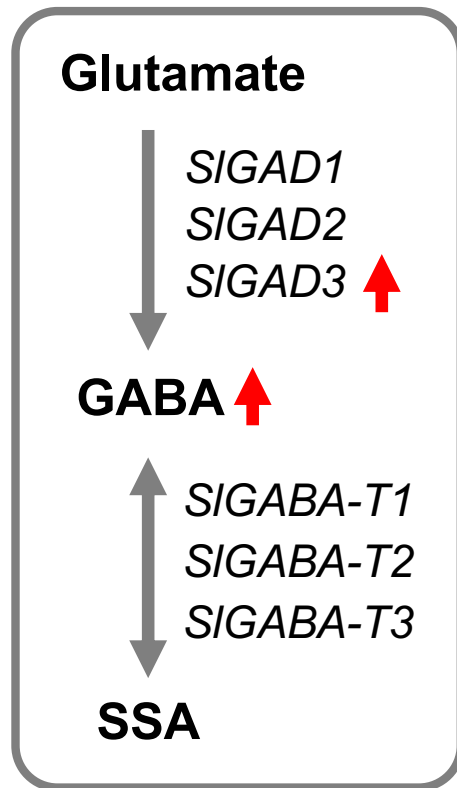
**Health-promoting
functional compound**



GABA metabolism in higher plants



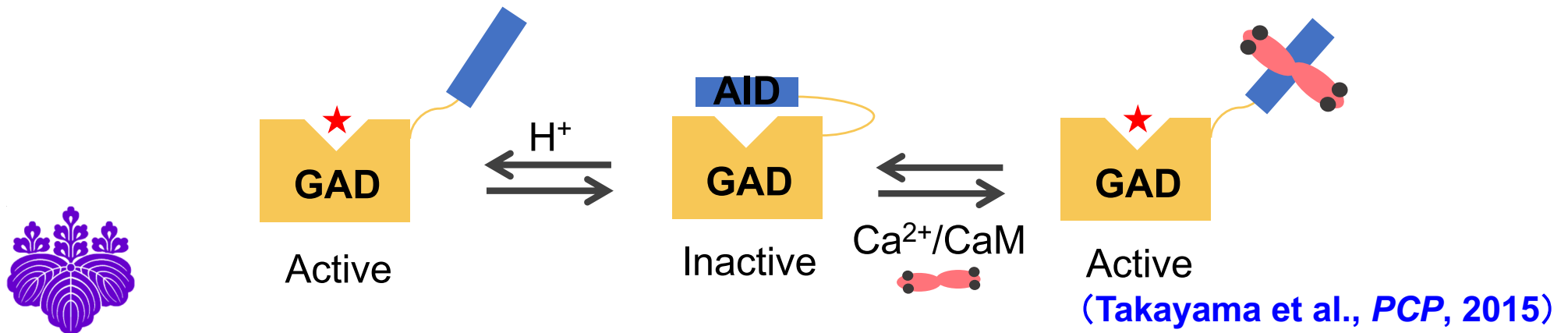
SIGAD3 is the limiting step in GABA contents in tomato fruits



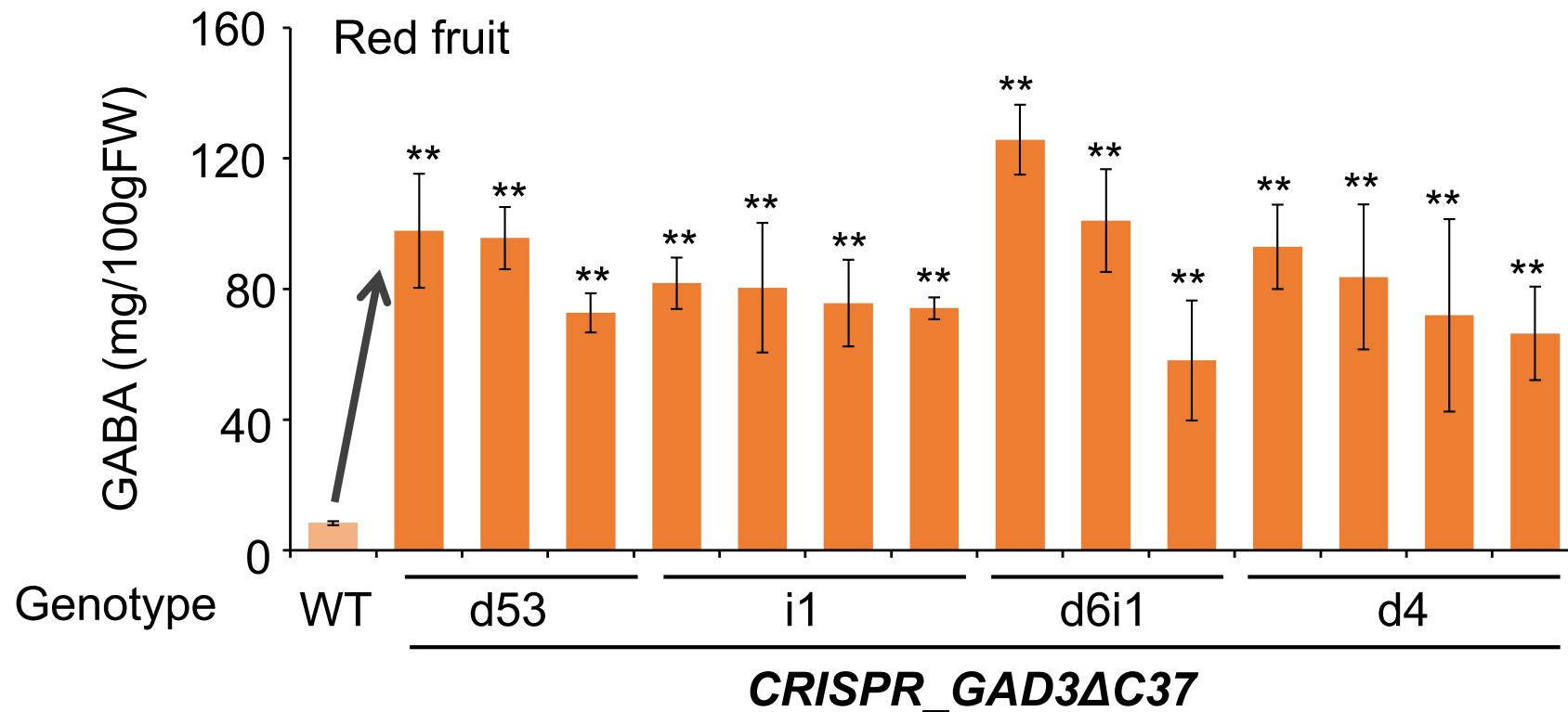
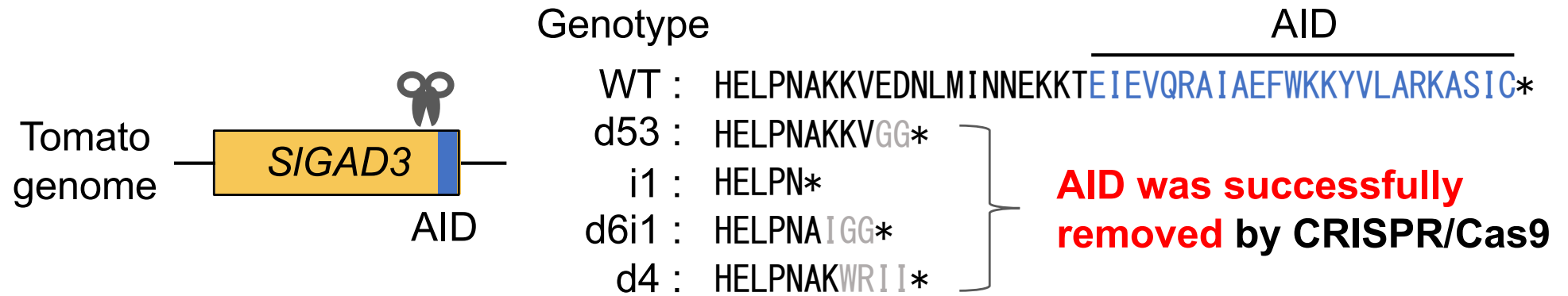
SIGAD3 has Putative **autoinhibitory domain (AID)**

When the **autoinhibitory domain (AID)** is removed, the enzyme should show higher activity, resulting in increasing GABA contents in tomato fruits.

* In many cases, the autoinhibitory function is regulated by $\text{Ca}^{2+}/\text{CaM}$ or pH

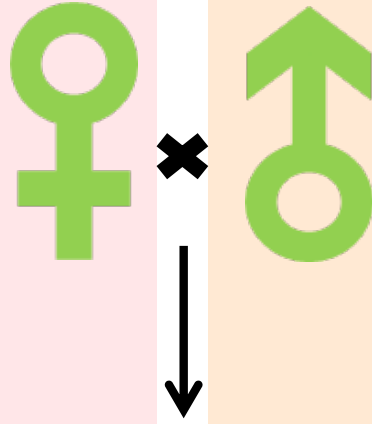


Regulation of GABA contents in tomato fruits by CRISPR

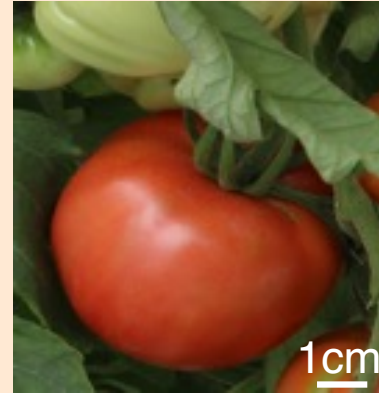


Utilization of gene edited line for hybrid breeding in tomato

'Micro-Tom'
SIGAD3 Δ C



Pure line cultivar
WT

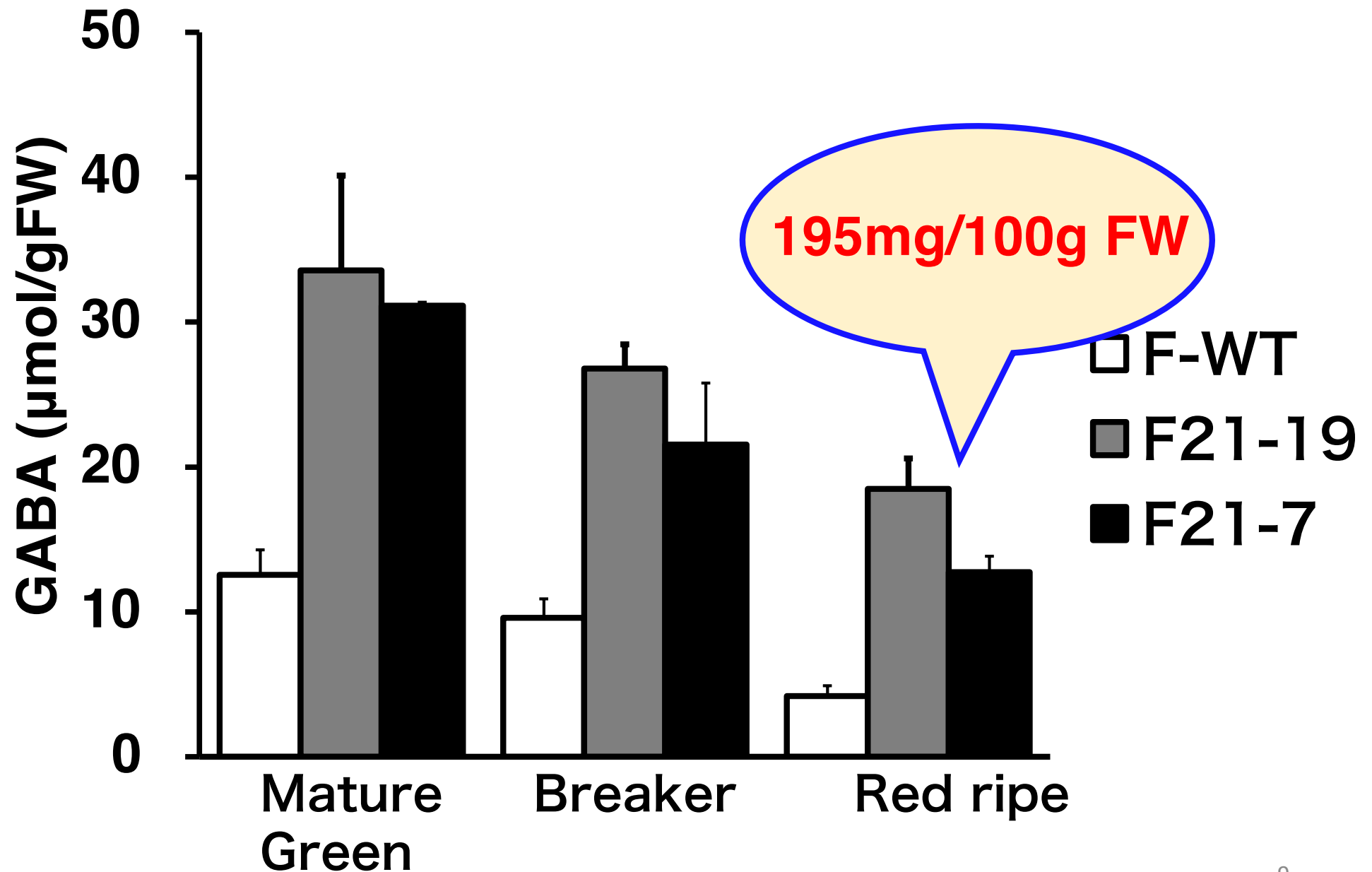


Genotype:
Homozygous
Null segregant
of CRISPR/Cas9



F₁ SIGAD3 Δ C
Genotype:
Heterozygous

GABA content in fruit (F₁ generation)



Sanatech seed

UTsukuba-Ventuer

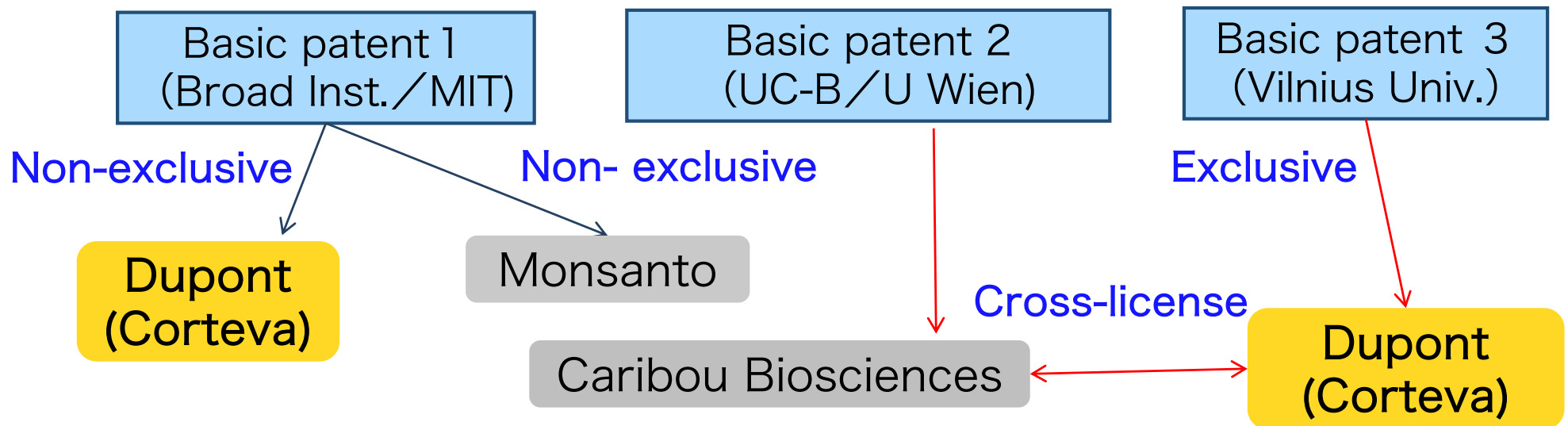
We are breeding company to create new cultivars using
gene editing technologies.



Chairman	Tatsuo Takeshita
Address	Landic Toranomom Bldg. 7F, 3-7-10 Toranomom, Minato-ku, Tokyo 105-0001 Japan
Shareholder	Pioneer EcoScience Co., Ltd. 92%
Composition	Officer/Employee 8%
Executives	COO: Shimpei Takeshita CTO: Hiroshi Ezura
Associated Company	Pioneer EcoScience Co., Ltd.

Handling patents in CRISPR/Cas9

Current status of basic patents for gene editing



Academic use: Free available

Industrial use: Need Licence

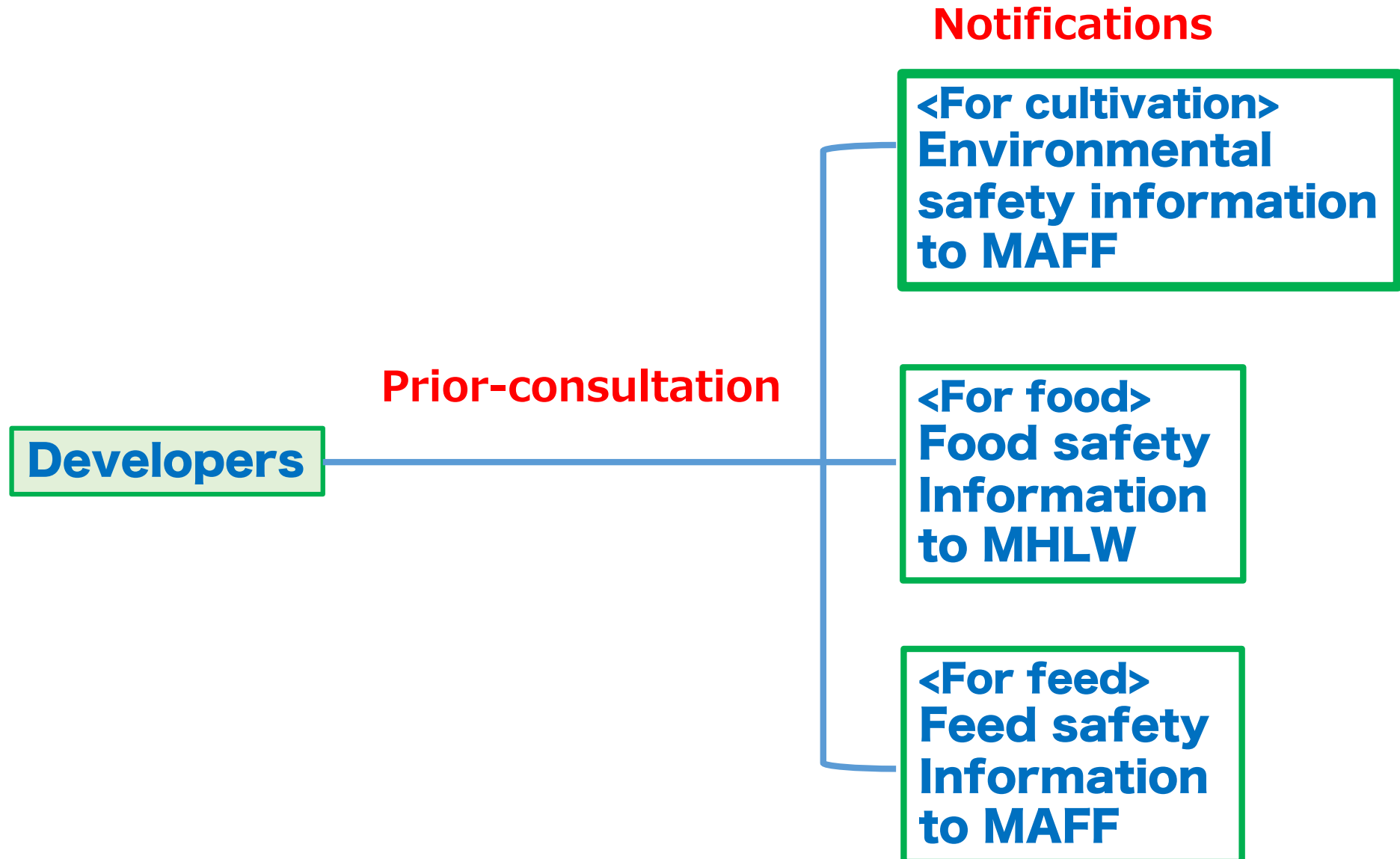


Sana Tech Seeds, Co. Ltd
Start-up company

**A commercial cultivar using CRISPR/Cas9 technology
has been developed and has started
commercialization on May 12, 2021 in Japan**

***Sicilian Rouge High GABA !
The 1st gene-edited crops in Japan***

Commercial use of gene edited crops in Japan



Notification to MAFF and MHLW

Notification has completed on December 11, 2020

Environmental safety information (To MAFF)

様式第3（第3の1の（2）の①関係）

ゲノム編集技術の利用により得られた生物の使用等に関する情報提供
(情報提供書の提出)

令和2年 12月 11日

農林水産省消費・安全局農産安全管理課長 宛

法人名 サナテックシード株式会社
(法人番号: 4010401137642)
代表取締役 竹下 達夫 印
提出者 代表者氏名
住 所 〒105-0001
東京都港区虎ノ門三丁目7番10号
ランディック虎ノ門ビル
電 話 番 号 03-6432-4051

ゲノム編集技術の利用により得られた生物の使用等をするため、「農林水産分野におけるゲノム編集技術の利用により得られた生物の生物多様性影響に関する情報提供等の具体的な手続について」（令和元年10月9日付け元消費第2743号農林水産省消費・安全局長通知）第3の1の（2）の①の規定に基づき、当該生物の使用等に関する情報提供書を提出します。

For cultivation

Food safety information (To MHLW)

別紙3-1（届出様式：食品）

令和2年12月11日

厚生労働省医薬・生活衛生局
食品基準審査課新開発食品保健対策室 御中

届出者 住所 〒105-001 東京都港区虎ノ門三丁目
7番10号ランディック虎ノ門ビル

氏名 サナテックシード株式会社
(法人番号: 4010401137642)
代表取締役 竹下 達夫

「ゲノム編集技術応用食品及び添加物の食品衛生上の取扱要領」（令和元年9月19日生活衛生・食品安全審議官決定）に基づき、下記のゲノム編集技術応用食品について営業上の使用に先立ち届出をします。

記

名 称
グルタミン酸脱炭酸酵素遺伝子の一部を改変しGABA含有量を高めたトマト

開発者等（法人にあっては、その名称及び代表者の氏名）
サナテックシード株式会社 代表取締役 竹下 達夫

備考

For food

Feed safety information (To MAFF)

令和2年12月11日

農林水産省消費・安全局
畜産安全管理課 御中

届出者 住所 〒105-001 東京都港区虎ノ門三丁目
7番10号ランディック虎ノ門ビル

氏名 サナテックシード株式会社
(法人番号: 4010401137642)
代表取締役 竹下 達夫

「ゲノム編集飼料及び飼料添加物の飼料安全上の取扱要領」（令和2年2月7日付け元消費第4605号農林水産省消費・安全局長通知）に基づき、下記のゲノム編集技術について営業上の使用に先立ち届出をします。

記

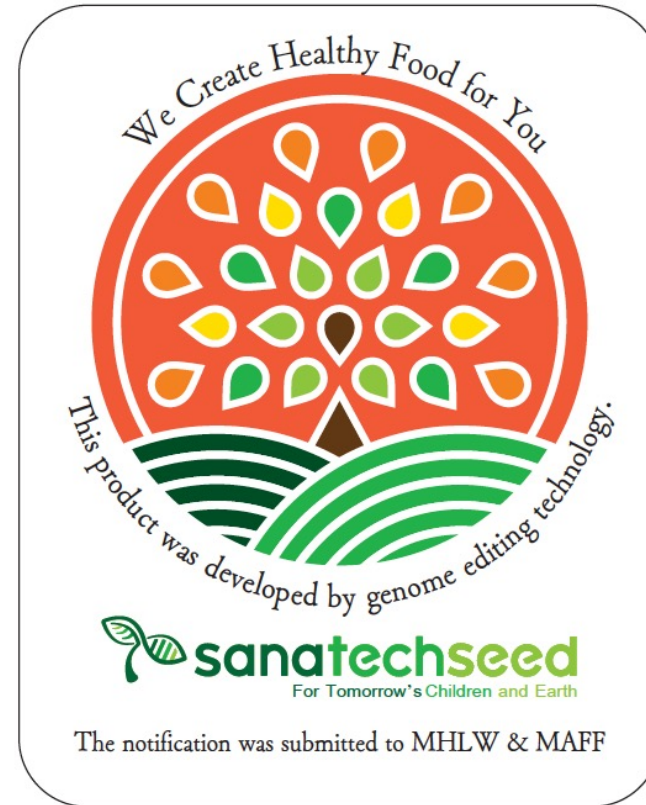
名 称
グルタミン酸脱炭酸酵素遺伝子の一部を改変しGABA含有量を高めたトマト
(GABA高蓄積トマト（≒S7-17系統）)

開発者等（法人にあっては、その名称及び代表者の氏名）
サナテックシード株式会社 代表取締役 竹下 達夫

備考

For feed

Labelling of the gene edited tomato

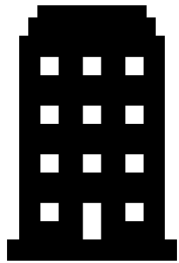


- This tomato has been improved by gene editing technology
- Notifications to MAFF and MHLW have been completed

From Seed to Consumer

Traditional Value (Supply) Chain

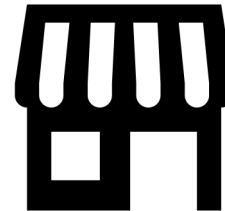
A systematic, conservative approach from Seed to Plate.



Seed Company



Farmer



Supermarket

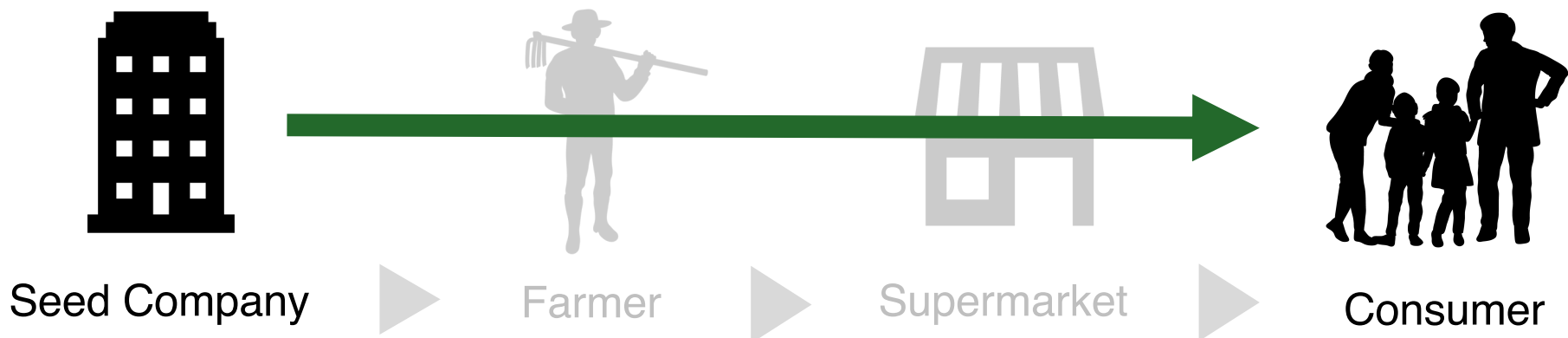


Consumer

Bypass the Gatekeepers

Trying a New Approach

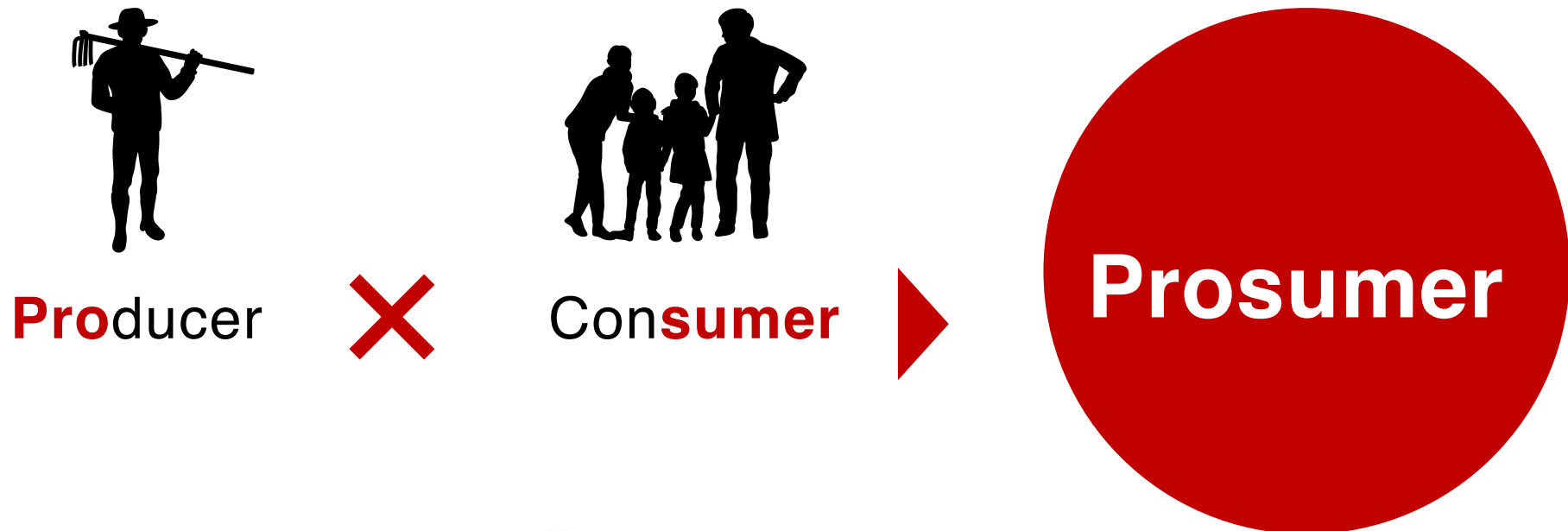
- Directly deliver product to consumer & bypass the gatekeepers.
- Have a bidirectional connection & communication with customers
- Make it easier for customers to access our products



Directly Contact Home Gardeners

Monitoring Program

- Approach "Prosumers" (Farmers & Consumers) – invested in the process from growing to consumption



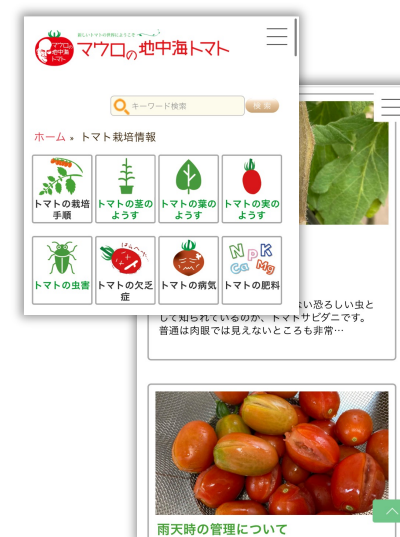
Provide Samples to “Prosumers”

- Share **free samples to home gardeners** throughout Japan
- Have these individuals grow plants from seedling to fruit
- **Receive their unfiltered and authentic feedback directly** via Social channels



4,200 Samples Sent Across Japan

Free sample growing kits distributed to 4,200 Homegardeners throughout Japan for monitoring



Each Sample Contained:

- 4 Seedlings
- Fertilizers and Biological products (minerals and bacterial)



PIONEER ECOSCIENCE CO., LTD.

Consultation via “LINE”

- Most popular messenger app in Japan



sanatechseed
For Tomorrow's Children and Earth

Growing Guidebook

- On/offline instructions for how to grow
- Prescription, recipe (photo/video)

D2C Marketing (BtoC)

Grow all our tomatoes **only with contracted farmers** and **purchase all the produce**

Produce not **only fresh tomatoes** but also **processed products** (puree/powder/etc) through our website.

Sell directly to consumers, especially those who are concerned **about high blood pressure and lack of sleep**



Advantage of D2C

1

Consumers can access our website **to buy Sicilian Rough High Gaba tomatoes directly anytime, anywhere.**
(Supermarkets cannot do this)

2

Engage in **bidirectional communication** with consumer even after initial sale
> We can learn how we can develop further our products by GE by engaging with customer and understanding their wants/needs

3

We can consistently **show the traceability** of our products from seed to product all through the value chain.
(GE labeling/growers data-soil/sap/etc.)

High GABA Tomato History

-Information of target gene is a key-

2005: Start fundamental research on GABA in tomato

2008: Release high GABA tomato by conventional breeding program

2015: Start high GABA tomato project by genome editing

2017: POC in a model tomato cultivar, and start development in commercial cultivars

2018: Establishment of Sanatech Seed Co., Ltd.

2019: Developed SRHG, and start prior-consultation for notification to MHLW and MAFF

2020: Notifications completed to MHLW and MAFF

2021: Start delivering SRHG seedlings (May 15) to home gardeners and SRHG fresh fruits (Sep 15) in Japan

2022: What next?





**New era of rapid and precise
breeding via gene editing**



**GE allow us an order-made breeding
for sustainable and nutritional food
production**

Thank for your attention