

Producing Consistent High Quality Fruit in Japan

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Greenhouses in winter at Jinnai Farm Japan.
We grow mango, avocado, cherimoya,
passion fruit, star fruit in snow



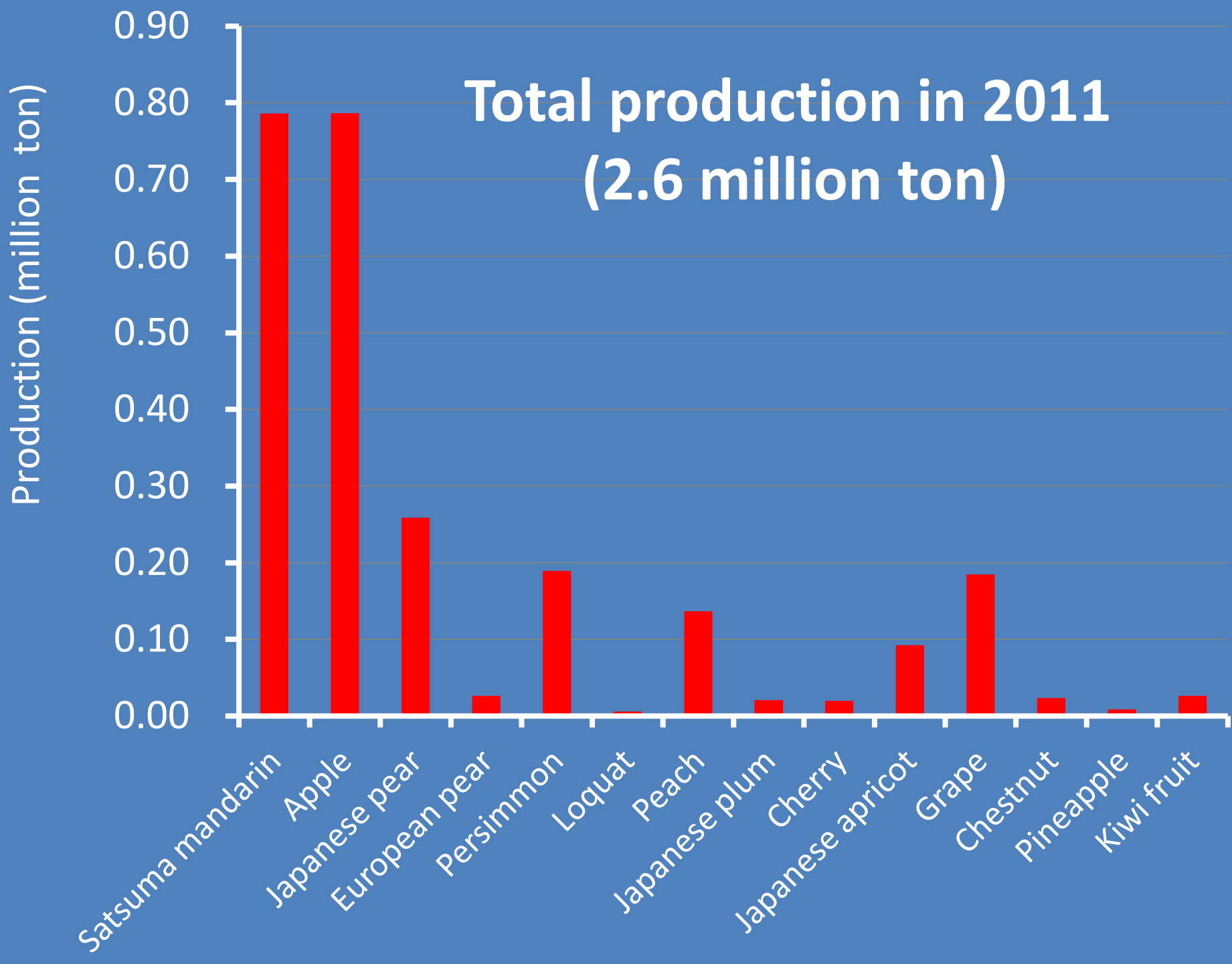
Today, I would like to talk about 4 points

- **First;** Situation of Japanese domestic fruit consumption and production.
- **2nd.;** How much fresh fruit we import into Japan.
- **3rd.; Why we must produce high quality fruit to obtain high price.**
- **4th.; How we produce high quality fruit, one example of mango production**

How much we consume fruits in Japan?

- We used to consumed more than 7 million ton that was 70kg per capita in a year.
- Now we consume less than 3 million ton, 20kg per capita.
- Two major fruit crops are Satsuma mandarin and apple.
- In 2011, total bearing acreage of fruit was (0.2 million ha), and production (2.6 million ton) .

Total production in 2011 (2.6 million ton)



How about imported fruit?

- We import **1.8 million tons** annually.
- The value of the imported fruit is **\$1.8 million**.
- However, **Banana** occupy **1 million tons**, followed by **grapefruit** (0.2million tons), **oranges** (0.1 million tons), and **lemon** (0.06 million tons).

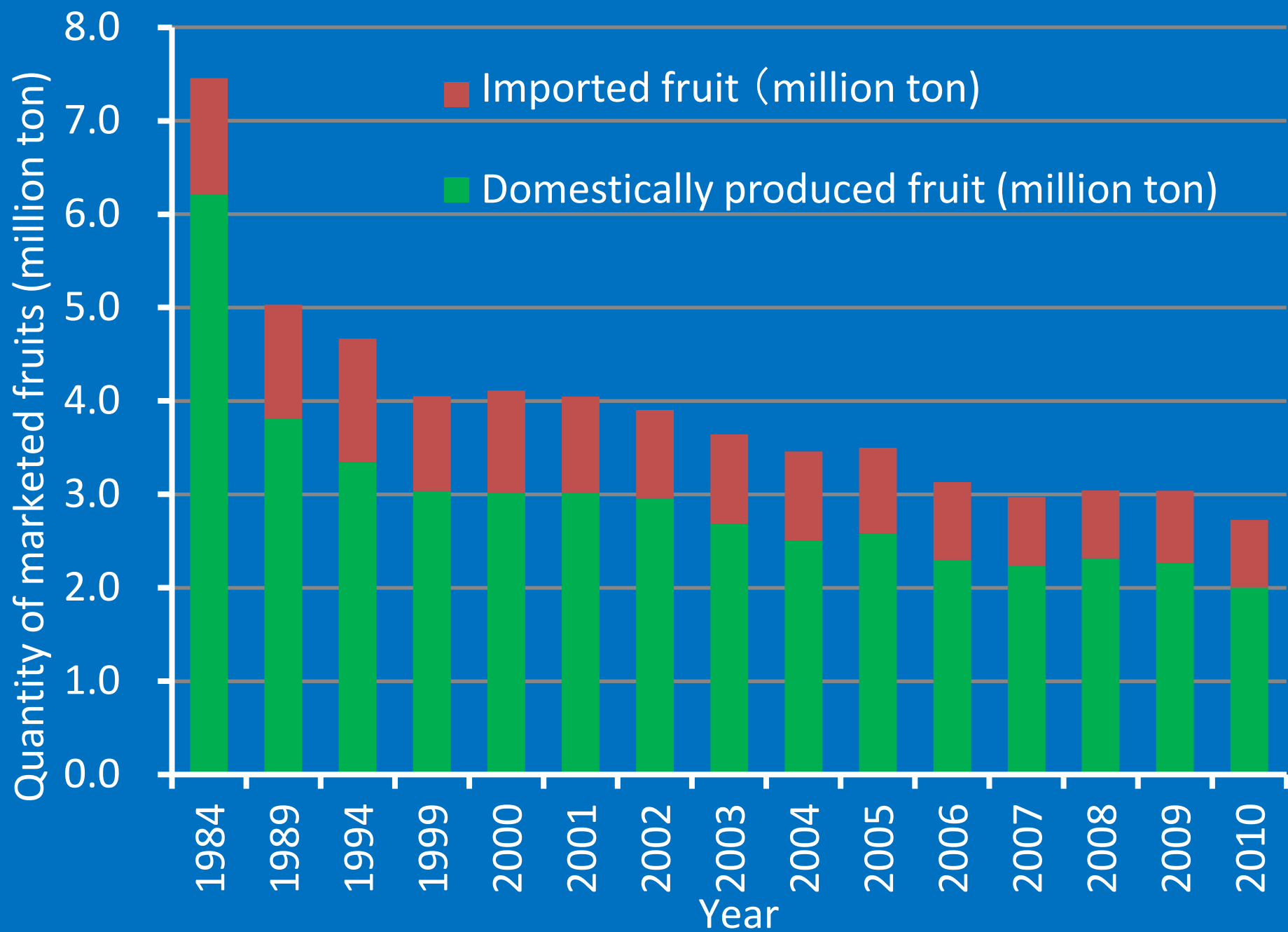


Fig. Quantity of marketed fruits in Japan

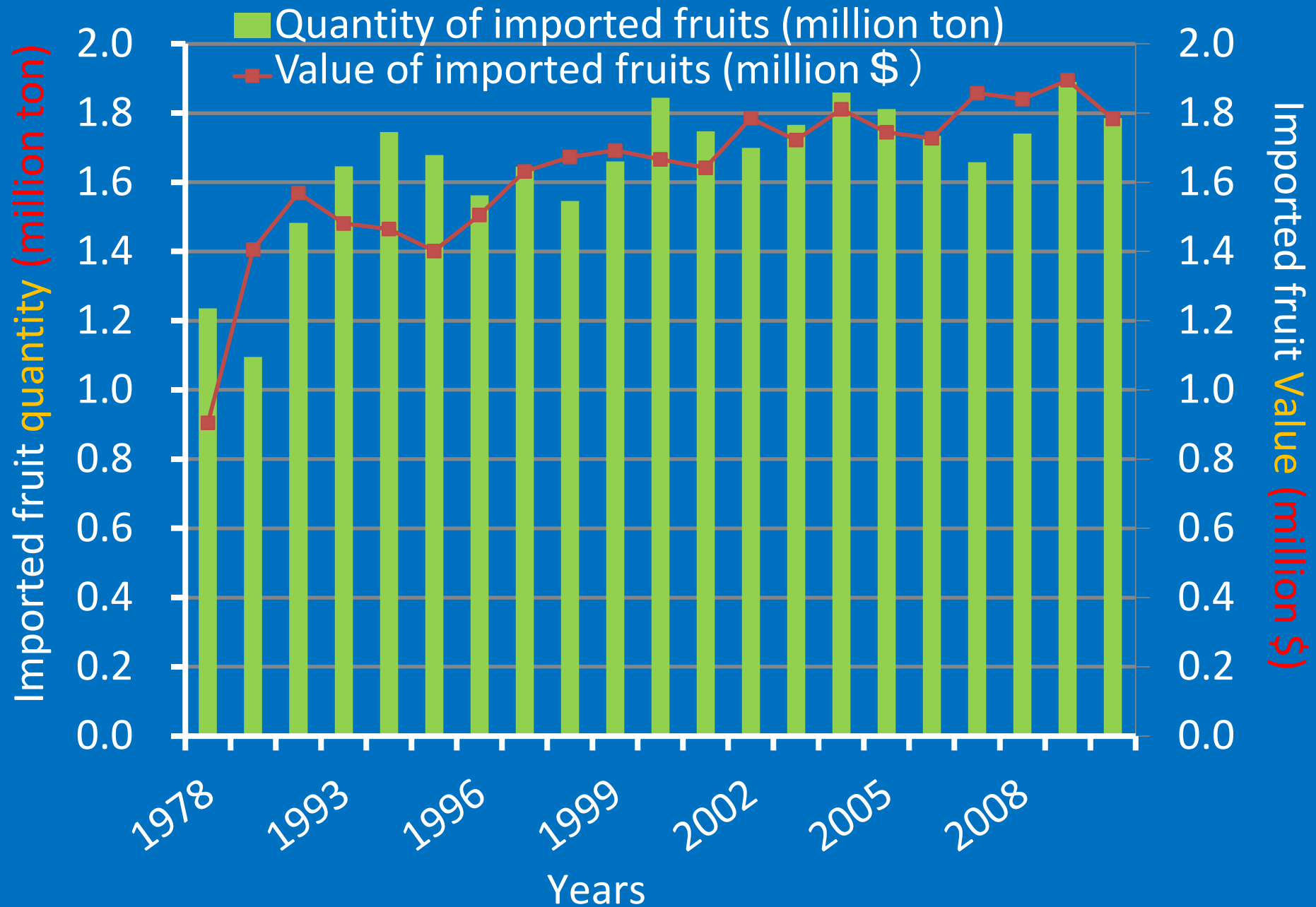


Fig. Quantity and Value of imported fruits into Japan

How about imported tropical fruits?

- Banana (1million ton) is No. 1
- Pineapple (0.14 million ton) is 2nd.
- Avocado (44000 ton)
- Mango (10000 ton)
- Papaya (2800 ton)
- Importation of avocado has been increased

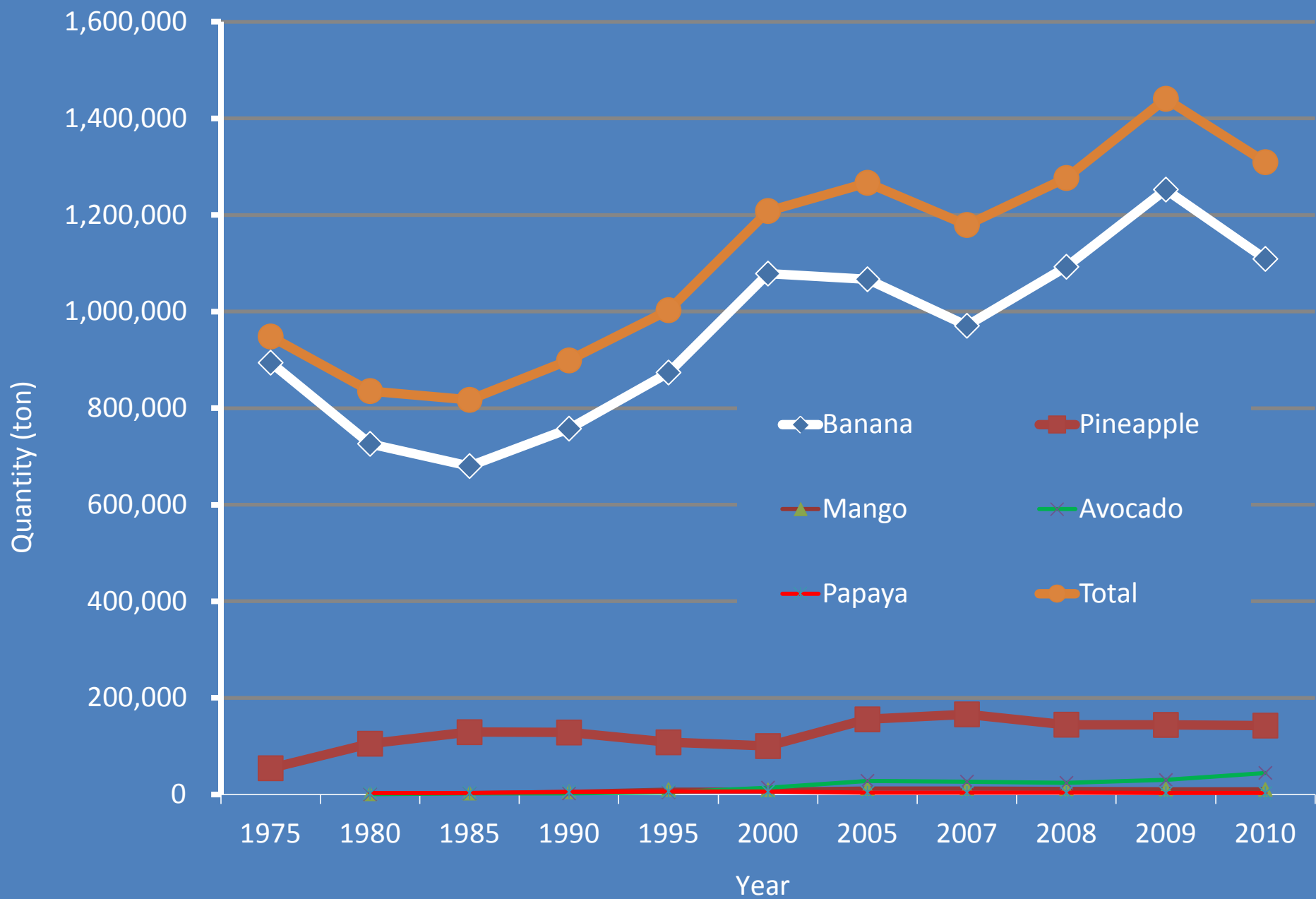


Fig. Imported Banana, Pineapple, Mango, Avocado and Papaya into Japan

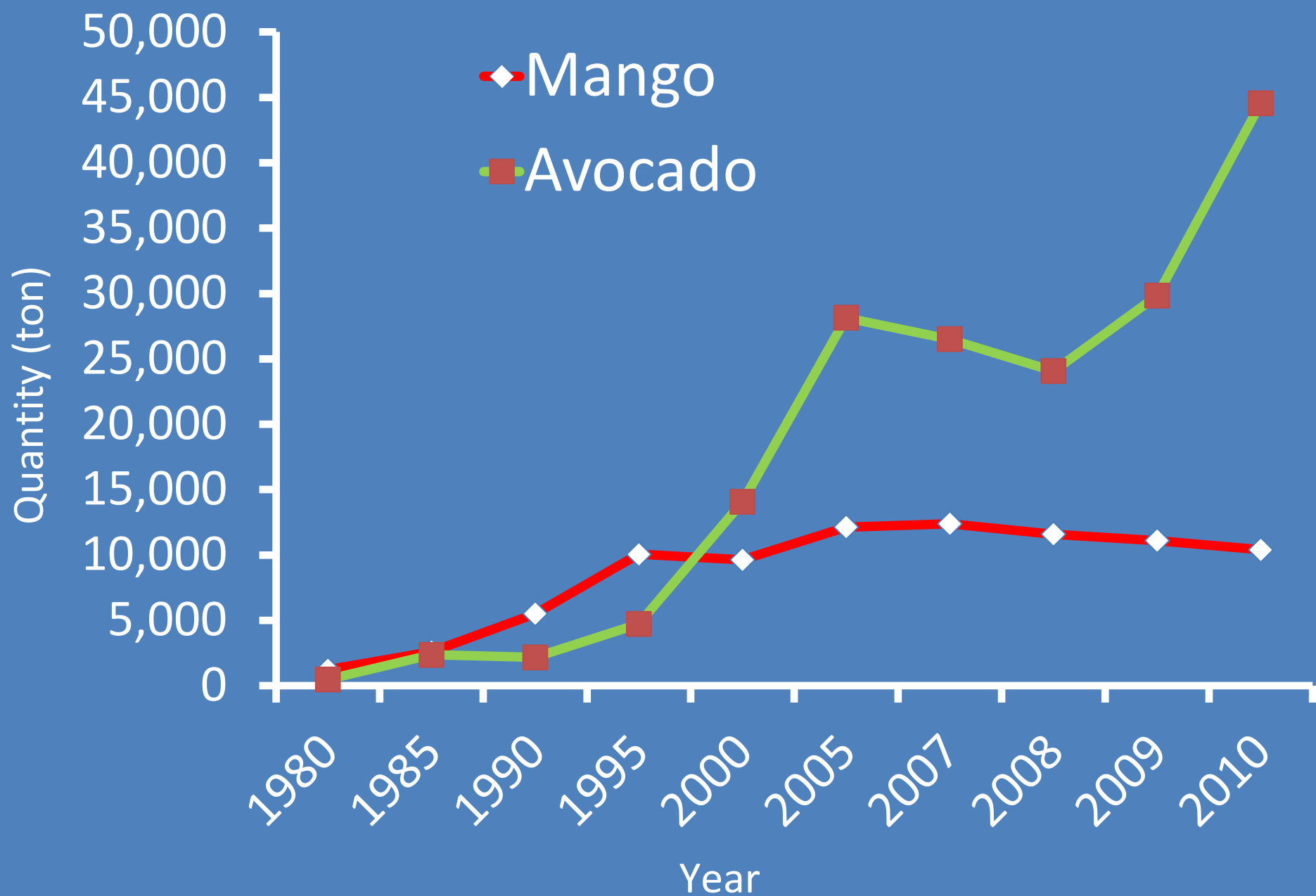
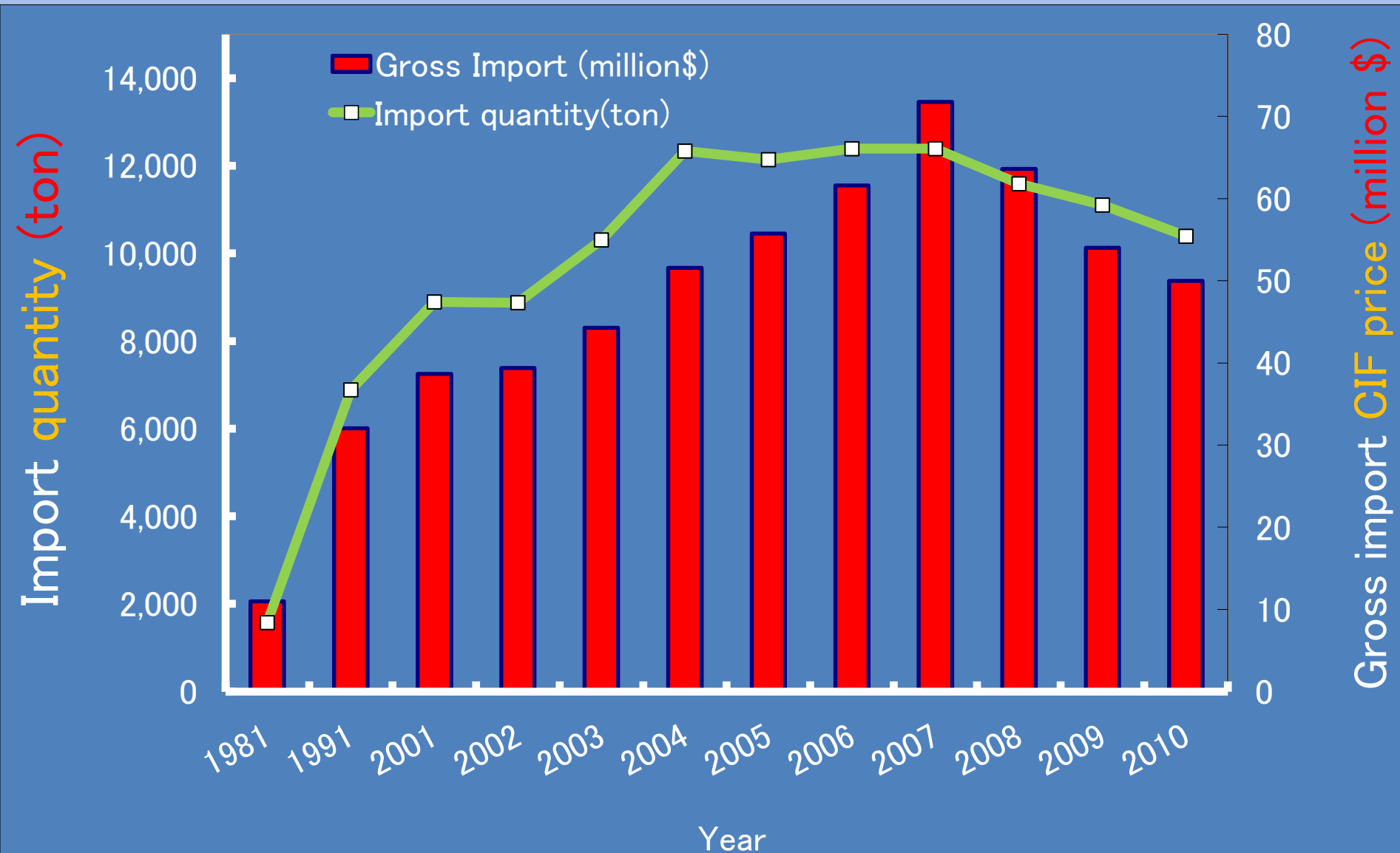


Fig. Imported quantity of mango and avocado

Tropical fruit consumption is increasing slowly

- Greenhouse Mango is the most expensive tropical fruit. The highest price at whole sale market was more than 10,000yen/kg (\$50/lb)
- We produce 3,000 ton of mango under greenhouse in Japan.
- We import 10,000 tons and the average price was 500yen/kg (\$2.5/lb).

Mango import into Japan (Exchange rate is 80 yen/US\$)



We produce 3000 tons from 400 ha
greenhouses

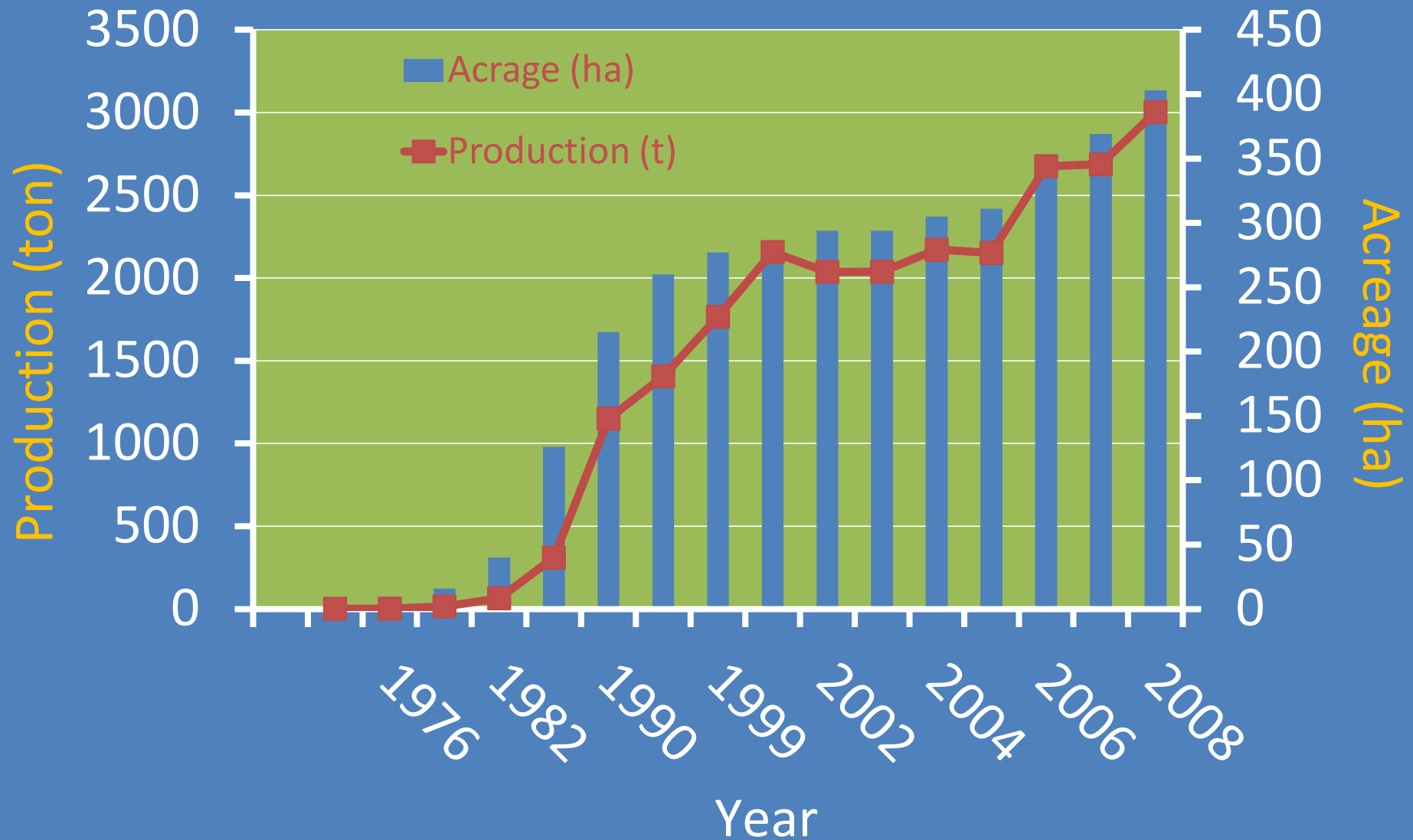


Fig. Mango production and acreage in Japan

Price recovers in July for Gift Exchange

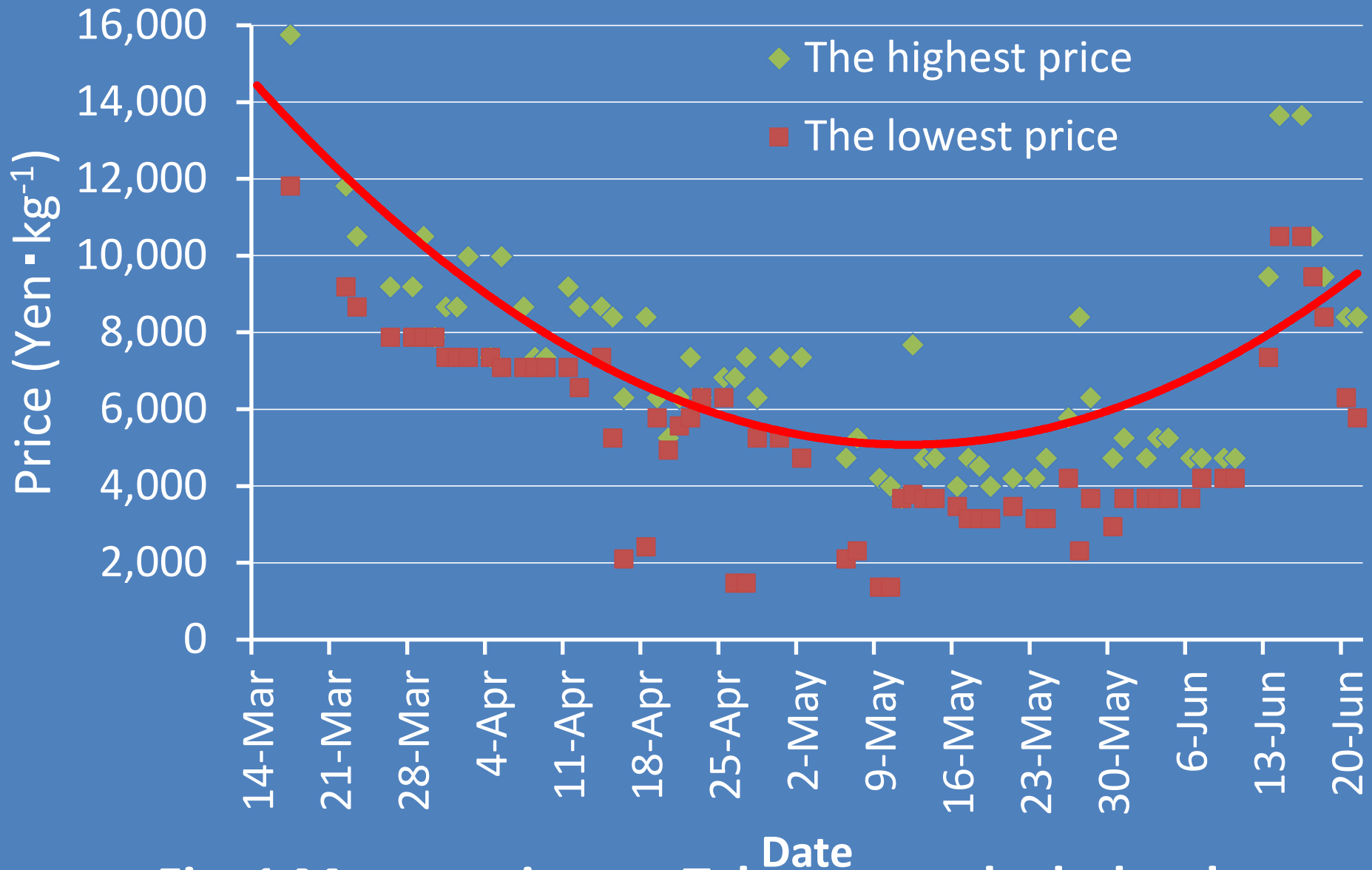


Fig. 1 Mango prices at Tokyo central wholesale

Why is the a high quality fruit price so different from an ordinary fruit ?

- We use the high quality **fruits as a gift.**
- The higher the price, the larger the **pleasure** and **satisfaction** of customers are.
- However, the **gift fruit must be perfect;**
-

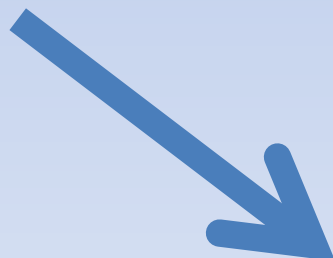
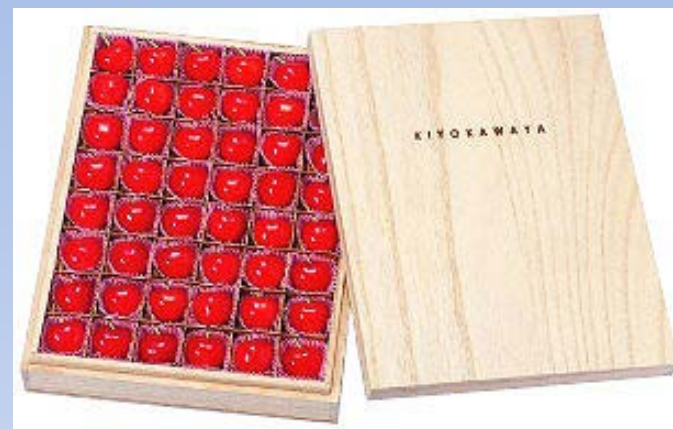
What means '**quality**' in Japan

- 1. **Taste** (High sugar content, Full maturity).
- 2. **External appearance** (Perfect color development, Free from any injury).
- 3. **Safety** (free from chemical contamination).
- 4. **Traceability**.

Fruit Items for Gift

- 1. **Muskmelon** from Shizuoka used to be the most valuable fruit gift.
- 2. **Cherry** ('Satohnishiki') and **Mango** ('Irwin') have replaced the Muskmelon now.
- Strawberry can be a valuable gift.
- Whatever a fruit is perfect, it can be a valuable gift.

Muskmelon, Cherry and Mango



Strawberry price was
10500yen/box(\$125/box)



2012, March, Miyazaki mango price
was 15750yen/2fruits(\$95/fruit)



Nakamura Co.,Ltd.
宮崎産
完熟マンゴー (太陽のタマゴ)
¥15,750
本体価格 ¥15,000

At the same store, Mango from Mexico was 2100yen/fruit(\$25/fruit)



At a super market, mango from Philippines was 395 yen/pack (\$1.2/fruit)



Now you know a difference
between domestic gift fruit and
imported one or domestic
common fruit

Japanese growers must produce
high quality fruit to obtain high
price, even though the production
cost is very high.

Let me explain how we produce perfect mango for example.

- **Hokkaido mango**; the most heavily equipped, high cost production.
- **Miyazaki mango**; the highest price mango production with heating facility.
- **Okinawa mango**; the lowest cost production with non-heating facility.

Domestic mango 'Irwin' production in greenhouse



Hokkaido: High cost production (Potted culture)



Okinawa: Non-heating low cost production (planted into a soil)

**Fruit with green color remaining is
the second grade**



Scars caused by Thrips also 2nd grade



This is a high quality 'Irwin'



Brand name 'Egg of the Sun'

- Sugar contents is more than **15° Brix**.
- **Perfect color development.**
- **No scars** from disease and insect on the fruit surface.
- Fruit must be **harvested at full maturity** when it drops in a net or paper sac.
- However, **only 1%** of the total production is approved as 'Egg of the Sun'

Fruit is catch by a net in Miyazaki



Fruit is catch by a paper bag in Okinawa



All mango tree in Japan must be grown under plastic houses.

- 1. Protection from rain (Anthracnose disease, and from cold temperature.
2. Pollination by honeybee or fly)
- There are two types of greenhouses;
- **A: Strong structure plastic house** or **B: Simple pipe structure vinyl film house.**

Strong structure plastic house (\$380,000/1000m²)

Double plastic covering with compressed air between the two layers for better insulation.



Inside of the strong structure house

Fan is for mixing air in the greenhouse



Curtain and supplemental lighting

Thermal screen

Sodium (Na) Lamp



Heating device is necessary to grow mango in Japan except Okinawa



Power of heater:

116 kW

Fuel consumption:

12.7ℓ/h

Electricity:

AC 200V

Netting on greenhouse for protecting insects and strong wind



Let me talk about **simple structure** green house in **Okinawa**

1. **Height of greenhouse** is short because of typhoon.
2. Vinyl film should be **removed quickly** when typhoon comes
3. However, **net cover** on the greenhouse must be practiced for wind break and for insect prevention.
4. There is **no heating equipment**. **No heating fuel** is the most advantage or disadvantage for Okinawa growers.

Simple structure green house in Okinawa (\$38,000/1000m²)



Flowering at Ishigaki Island Okinawa.

Visitors are from Oman



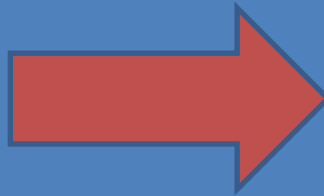


**At full bloom: mulching with
sugarcane leaves**

Temperature should be 20~25°C at this stage

**A lot of sugarcane leaves are used for mulching
on the ground to develop feeder roots**

High quality fruit is produced on **good**
root system (many fibrous roots)



Before bagging

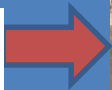


White paper bagging for catching fruit and protection from insects or sunburn

Shading



Netting



Pipes are used for training branches

50% shading screen for protecting fruit from sunburn



Cost of Heating Oil

Consumption of heating oil per 1000m² (1/4 acre)

	Kerosene (liter)	Yen	US\$
Miyazaki Forcing culture	25,000	2,000,000	25,000
Miyazaki heating culture	20,000	1,600,000	20,000
Hokkaido heating culture	60,000	4,800,000	60,000
Okinawa non-heating culture	0	0	0

\$25/kg and 2tons of yield per ¼ acre is the lowest price and yield for farmers

If we can harvest 2000kg of fruit per 1000m²,

Prices per kg		Gross income	
Yen	US\$	Yen	US\$
1,000	12.5	2,000,000	25,000
2,000	25.0	4,000,000	50,000
3,000	37.5	6,000,000	75,000
4,000	50.0	8,000,000	100,000
5,000	62.5	10,000,000	125,000

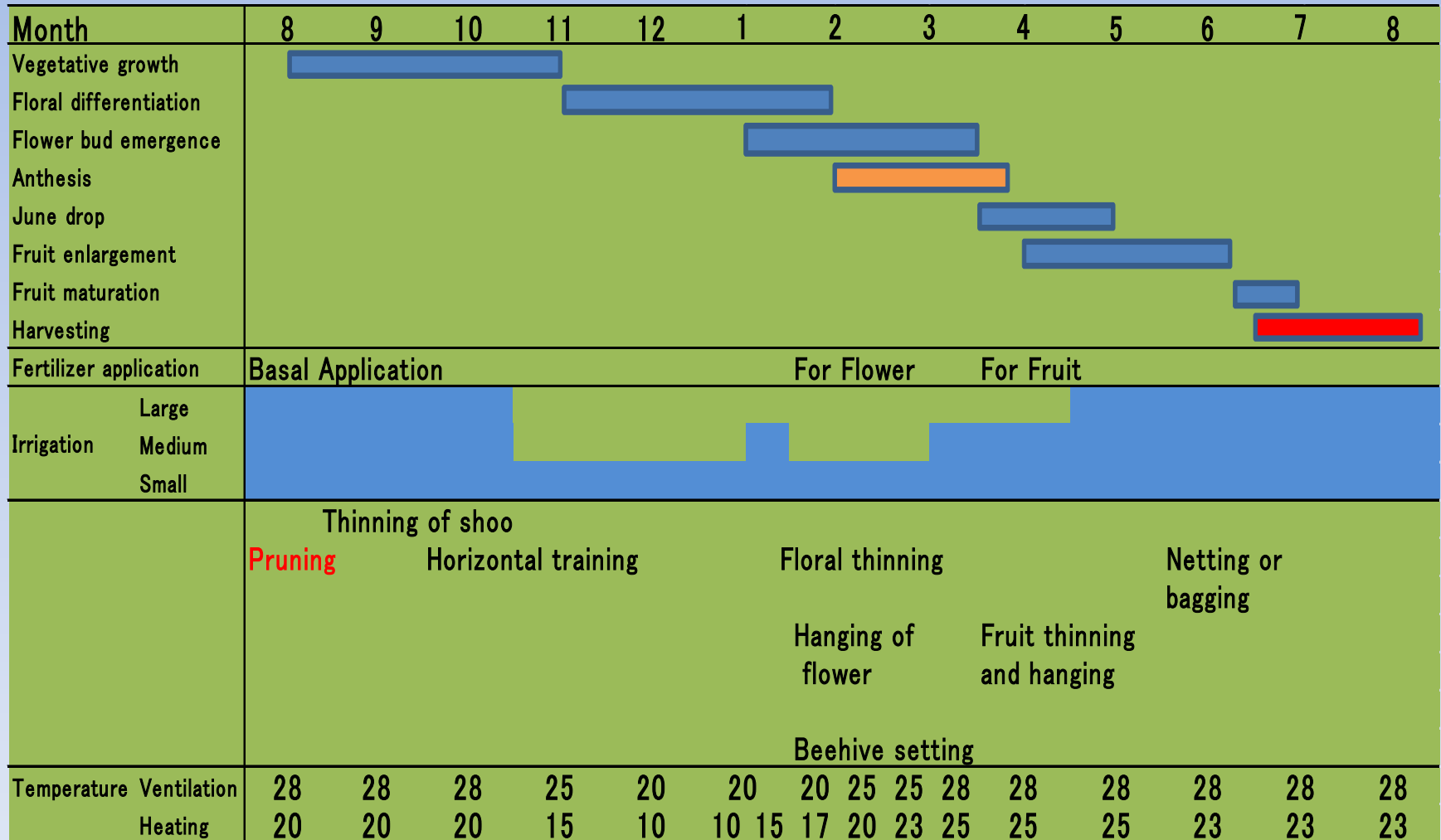
Let me talk little about our **cultural practices**

- Pruning
- Flower peduncle hanging
- Flower peduncle thinning
- Fruit thinning and hanging
- Netting and reflector setting
- Harvesting

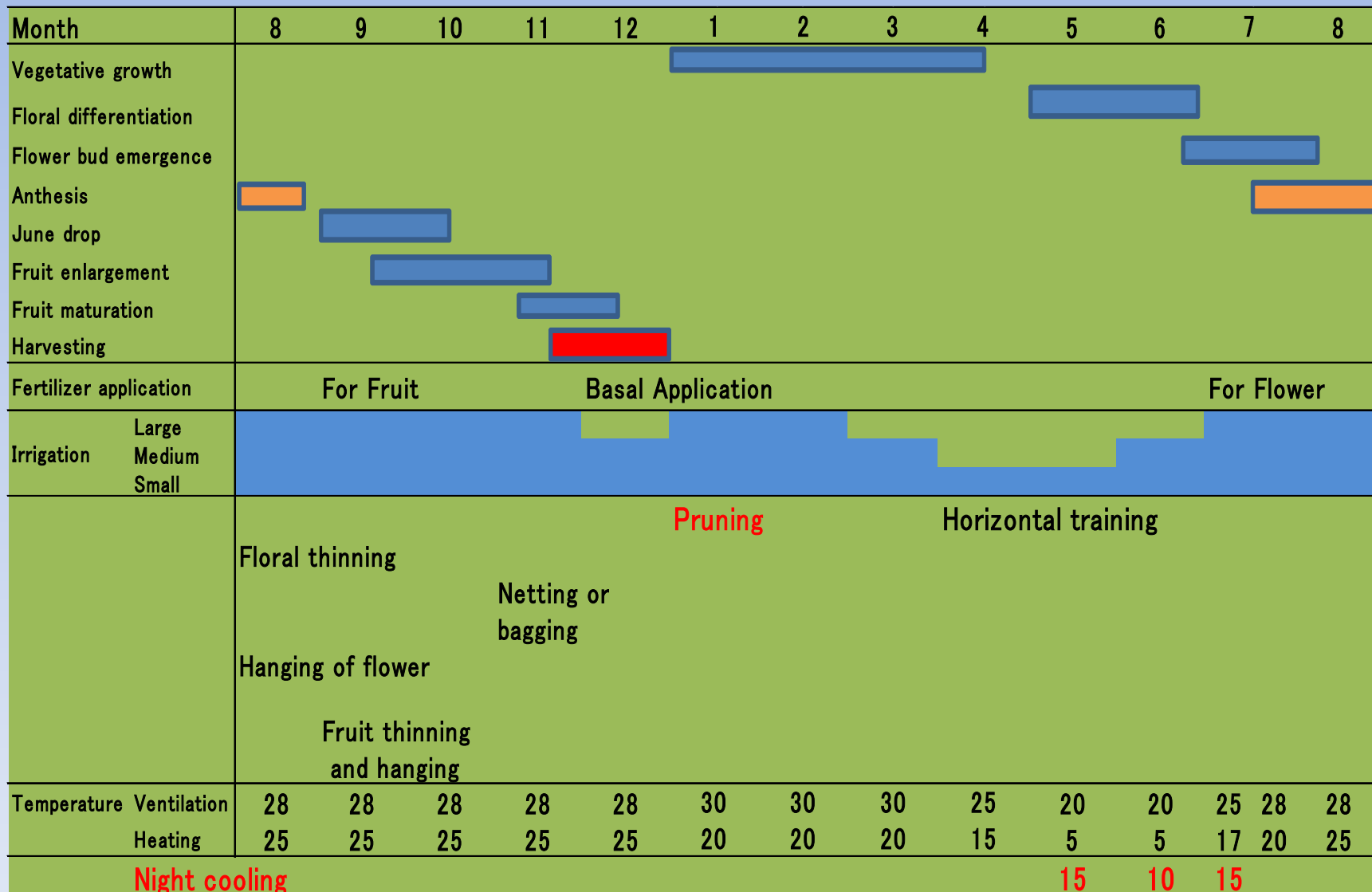
Let me explain about **calendar of cultural practice**

- **1. Calendar for harvesting in Summer** (Floral initiation can be done during cold winter, but need heating for raising temperature up to **25°C for best fruit setting**.)
- **2. Calendar for harvesting in winter** (Floral initiation must be done during hot summer.
- Must lower the night temperature down to **15°C to initiate flower**. Since Plant growth regulator is not permitted in Japan.

Cultural practices for summer harvesting mango



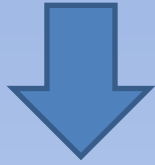
Cultural practices for winter harvesting



Now I will show our practices for
producing high quality fruit



Before and



after pruning



Main branches are trained horizontally at the height of waist

Every flower peduncle is hanged upward to get better sunlight



Basal floral peduncle is cut off to set fruit far from leaves for better color development and for protection from rubbed injury by leaf



For winter harvesting culture



One third of the basal portion is removed during flower cluster development for fruit production much farther away from leaves to get better sun light.

**At Full Bloom :pollinated by honey
bee (\$270/beehive) or fly (\$0)**



Before fruit thinning



After fruit thinning (One or two fruit per peduncle is left)



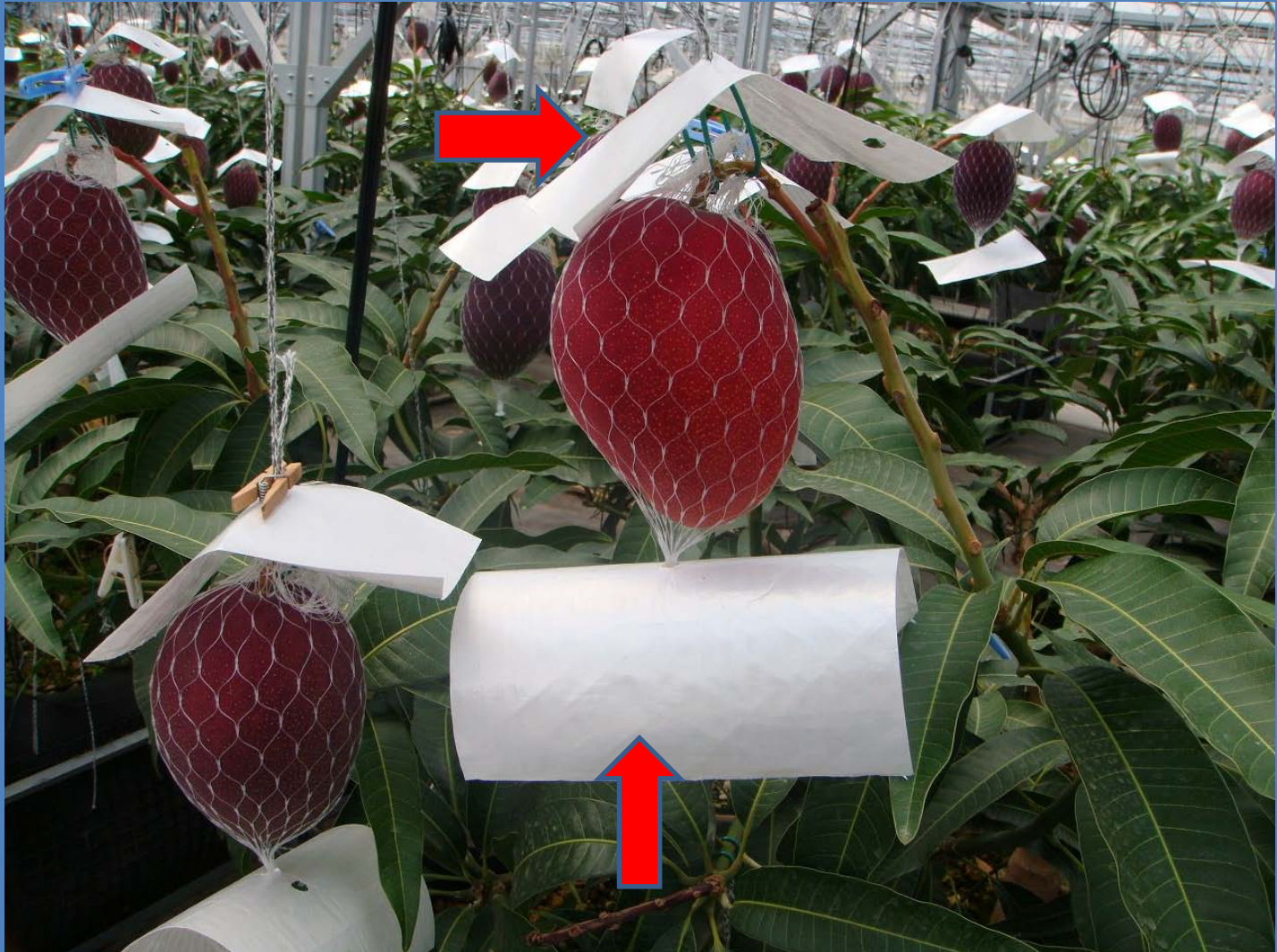
**Leaf and fruit ratio; 70~80 leaves per
fruit as a standard**



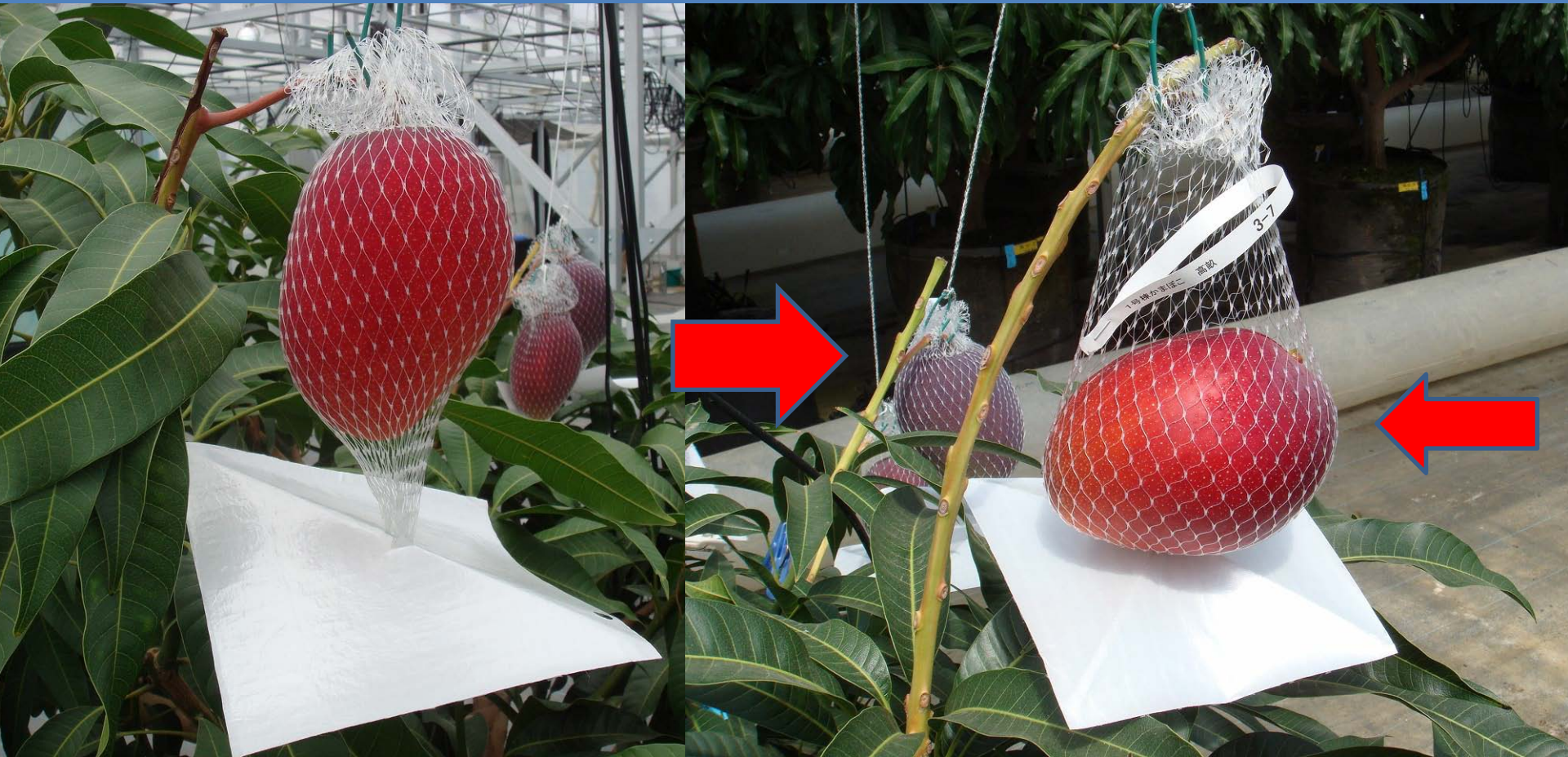
Netting for catching fruit and reflector under a fruit for better color development at fruit apex



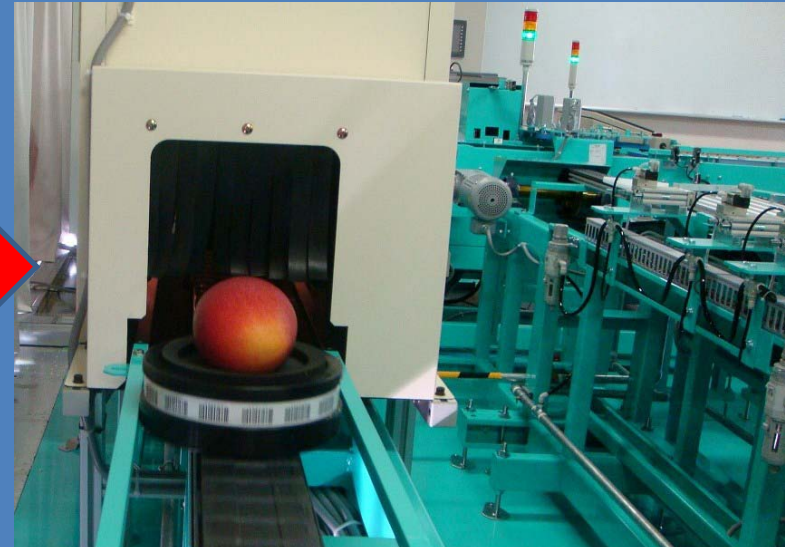
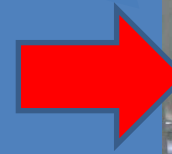
Sunshade and reflector



Only a **fallen fruit** is harvested



NIR fruits sorting



Setting fruit on a tray

Fruits are sorted by
sugar content
(Brix°)

Each fruit is **printed number** which **detects**
where the fruit come from



Let me explain little about **Winter-**
harvesting of Irwin mango

Problems for **Harvesting in December** for gift

- 1. Must **initiate flower bud** in Summer
- 2. Must **develop a red color** under short and weak daylight in fall and winter.
- 3. Must **force photosynthesis** under short and weak daylight in fall and winter.
- 3. Must consume a lot of **heating Fuel**.

Horizontal training of bearing shoot



Facilities used for floral initiation

Electric cooler



Outside



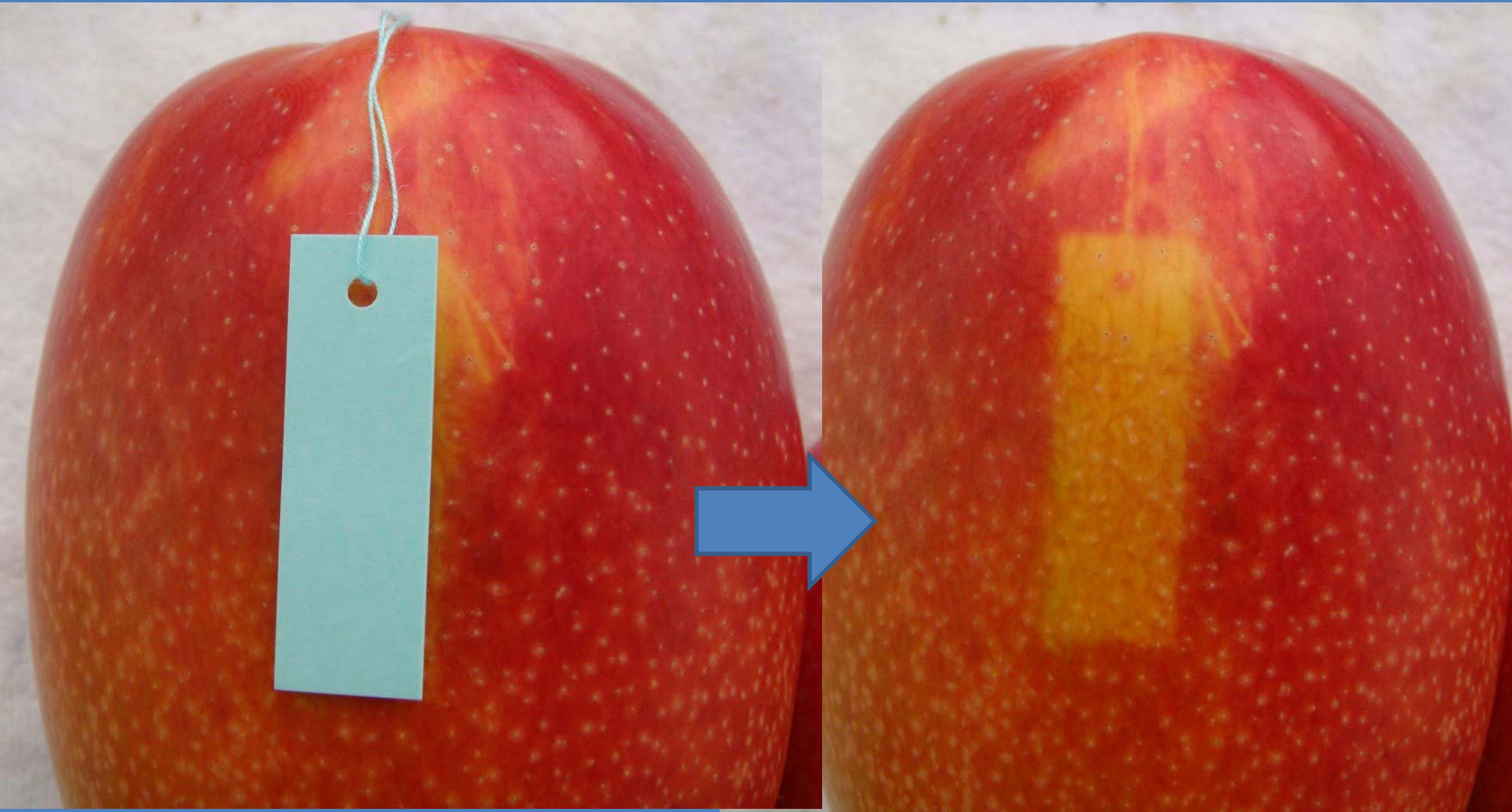
Inside

Ice meltwater conversion into cold air



Ice is produced in a pool under ground during winter, ice meltwater comes in green house and converted into cold air by these equipment and the cold air is supplied into greenhouse.

Better color development; A piece of paper retards anthocyanin

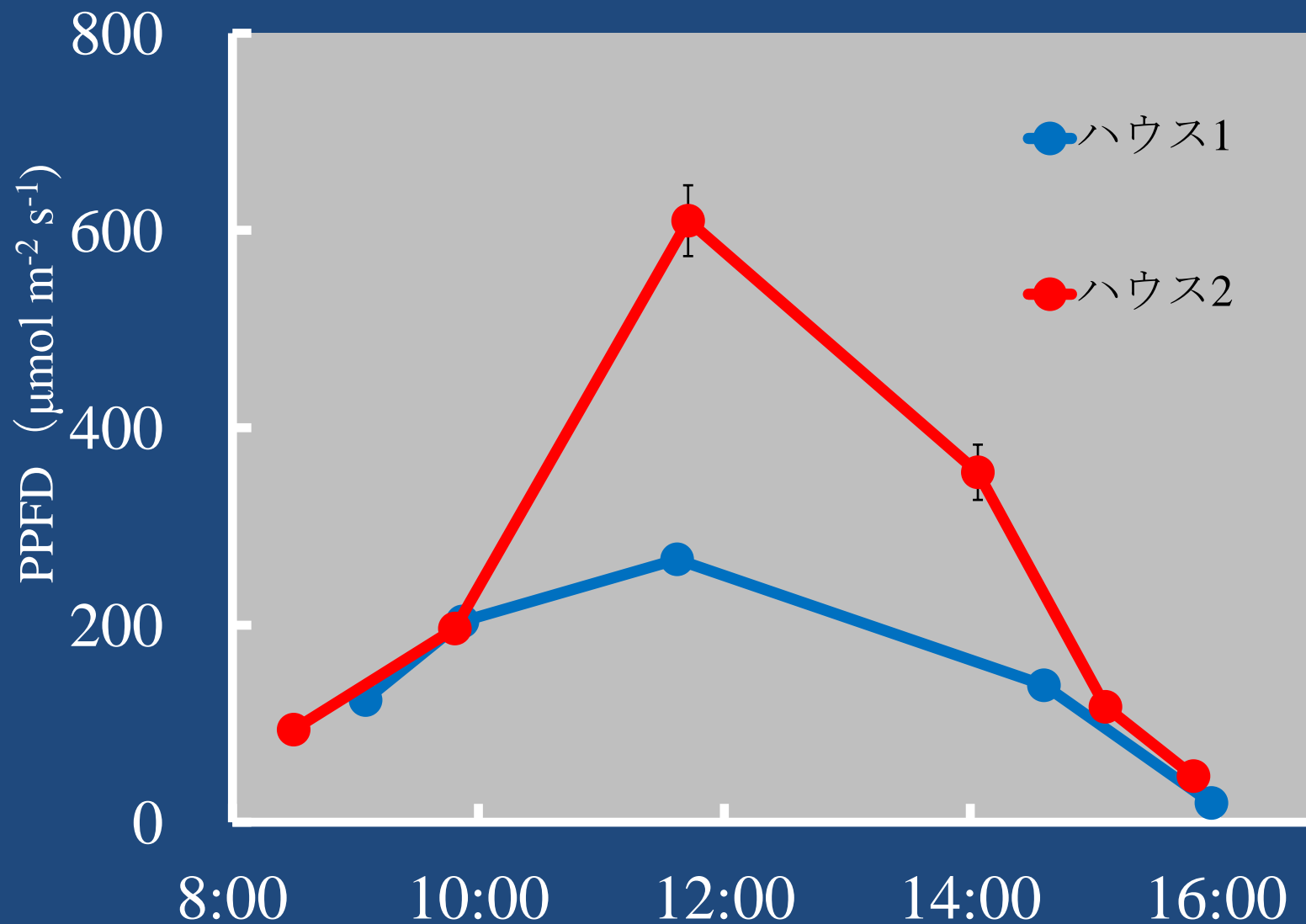


LED light and UV ray promote red color

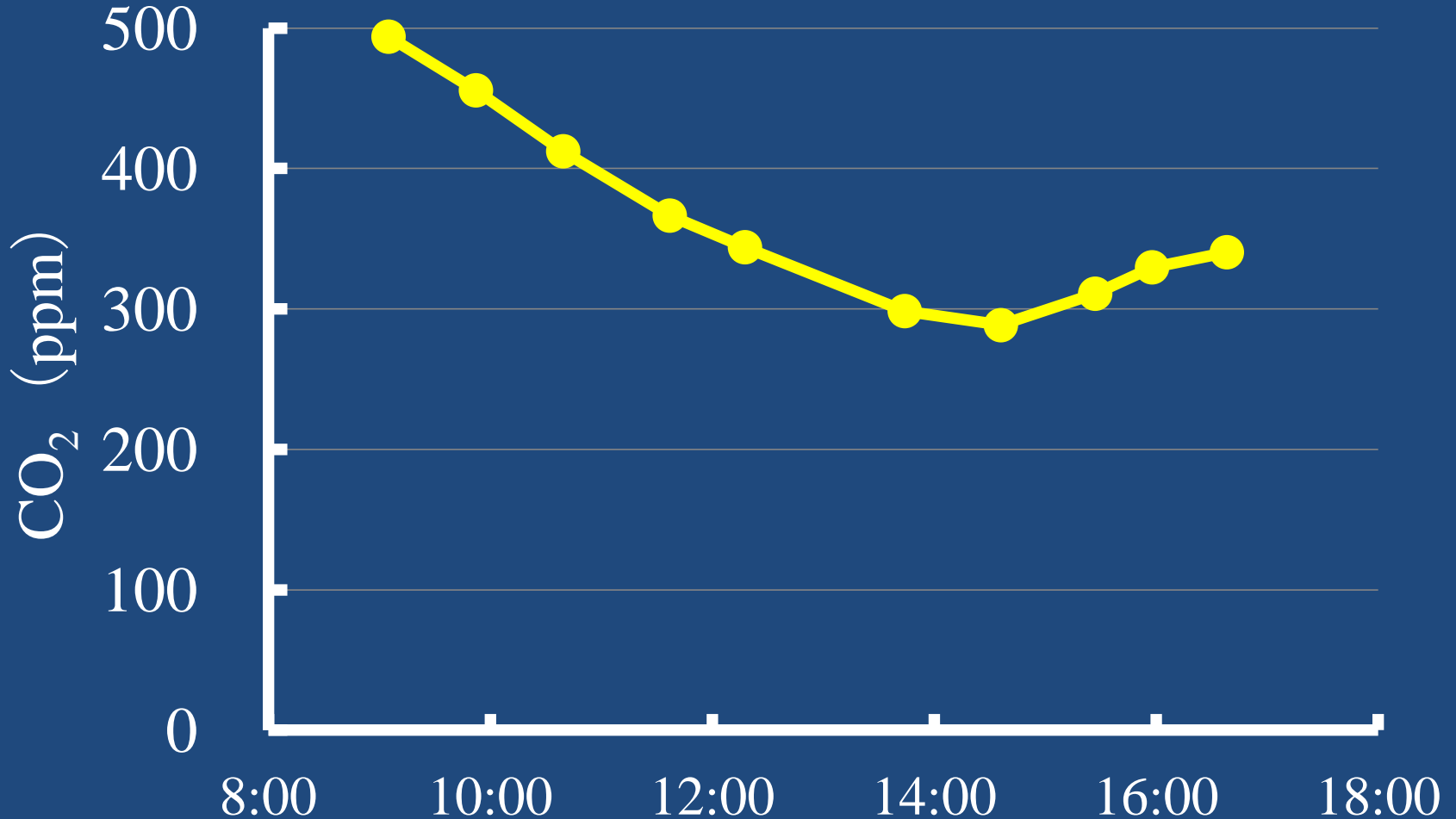


UV250nm: $80\mu\text{w}/\text{cm}^2$

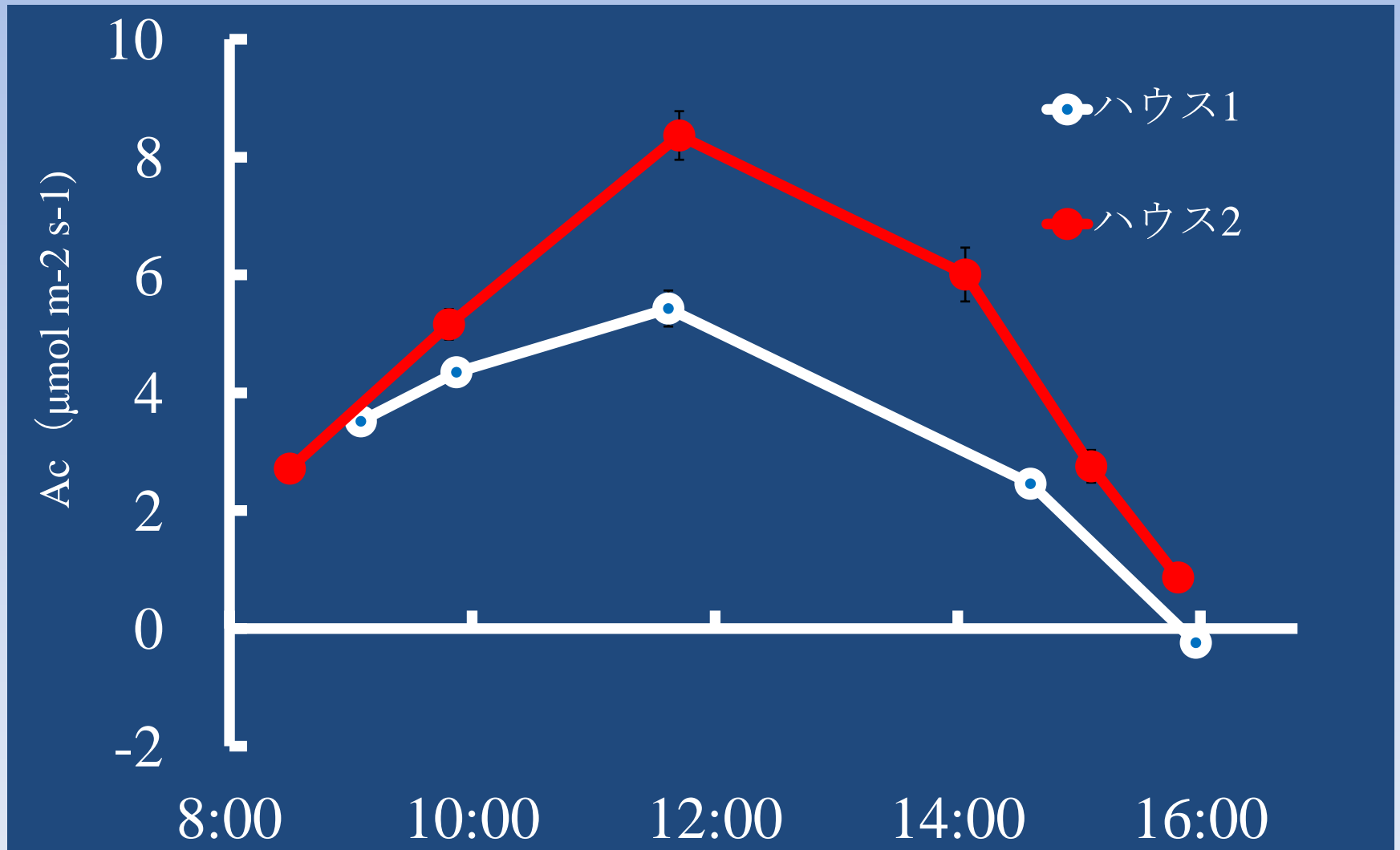
Diurnal change of PPFD under greenhouse in winter in Hokkaido



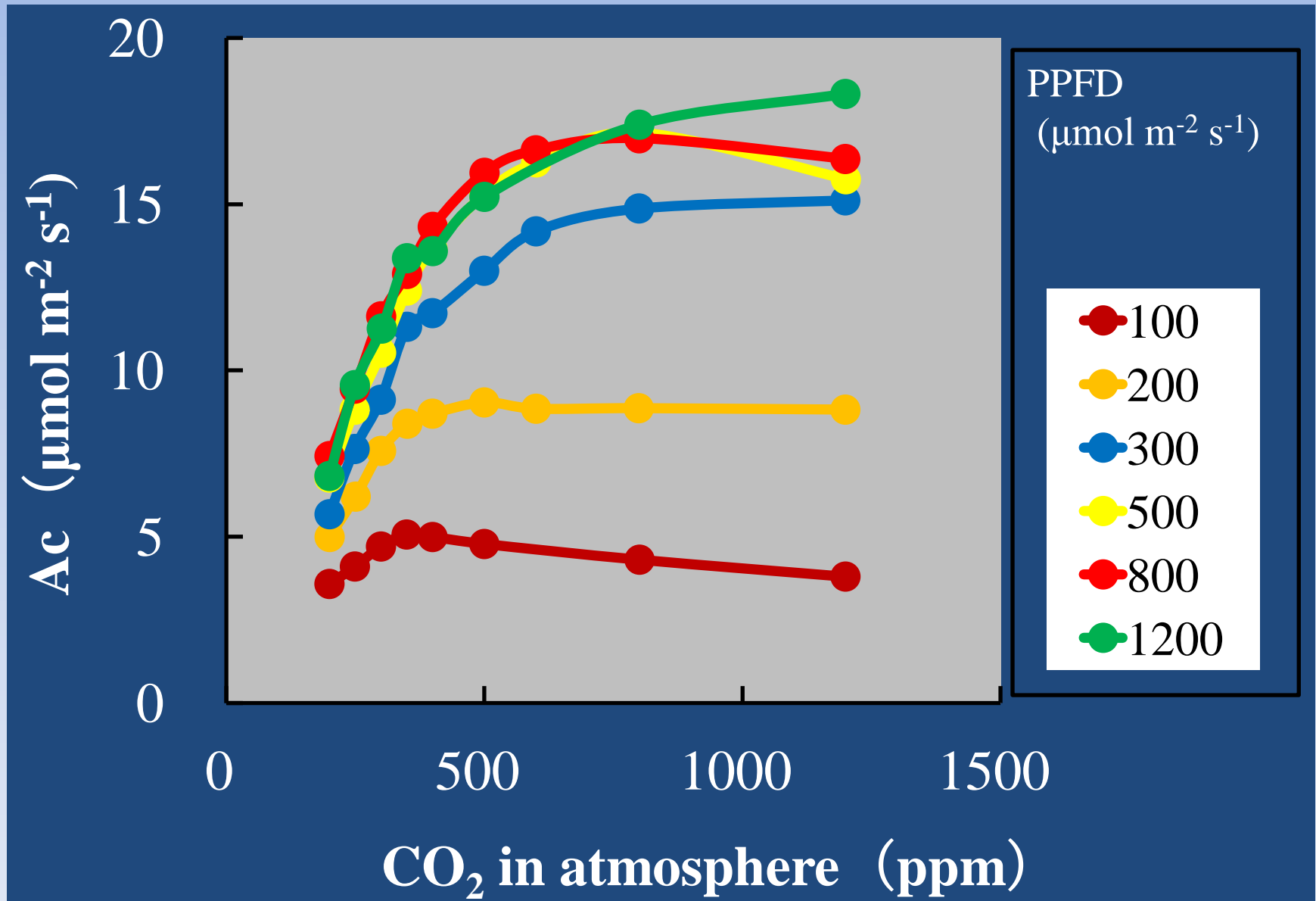
Diurnal change of CO₂ level under greenhouse in winter in Hokkaido



Diurnal change of AC under greenhouse in winter in Hokkaido



Relationship between PPFD and CO₂ on *Ac*



We use CO_2 producer

CO_2 gas moves into air duct



Conclusion:

About mango

- There are \$65million import market and \$75 million domestic market in Japan for mango.
- Japanese consumers do not know real taste of other mango cultivar. They are beginners who are satisfied with a cultivar 'Irwin' .
- If the Japanese know other mango taste, We must supply many kinds of mango cultivars.
- However, High quality requirement is remained.

About avocado

Japanese consumer want domestic avocado

- Hass is the only avocado imported from Mexico. 37,000tons (\$131million) were imported in 2011.
- Domestic production is almost nothing.
- Price of domestically produced avocado is \$4/fruit.
- We should try to grow avocado in Japan.

I'm trying to grow avocado in greenhouse



Japanese love to eat **high oil** content avocado.
We must develop such cultivars with high **cold temperature tolerance.**



Locally produced fruit has its own value which has much higher quality than imported ones. We must make an effort to bring out the quality for our local consumers and for our income .

Tank you very much for your kind attention

