Akdeniz University

FACTORS AFFECTING POSTHARVEST QUALITY OF HORTICULTURAL PRODUCES

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Outline of the presentation

- Definition of quality
- Maintaining quality
- Factors affecting postharvest quality
- Factors affecting quality during storage
- Storage types
- Advantages of CA storage

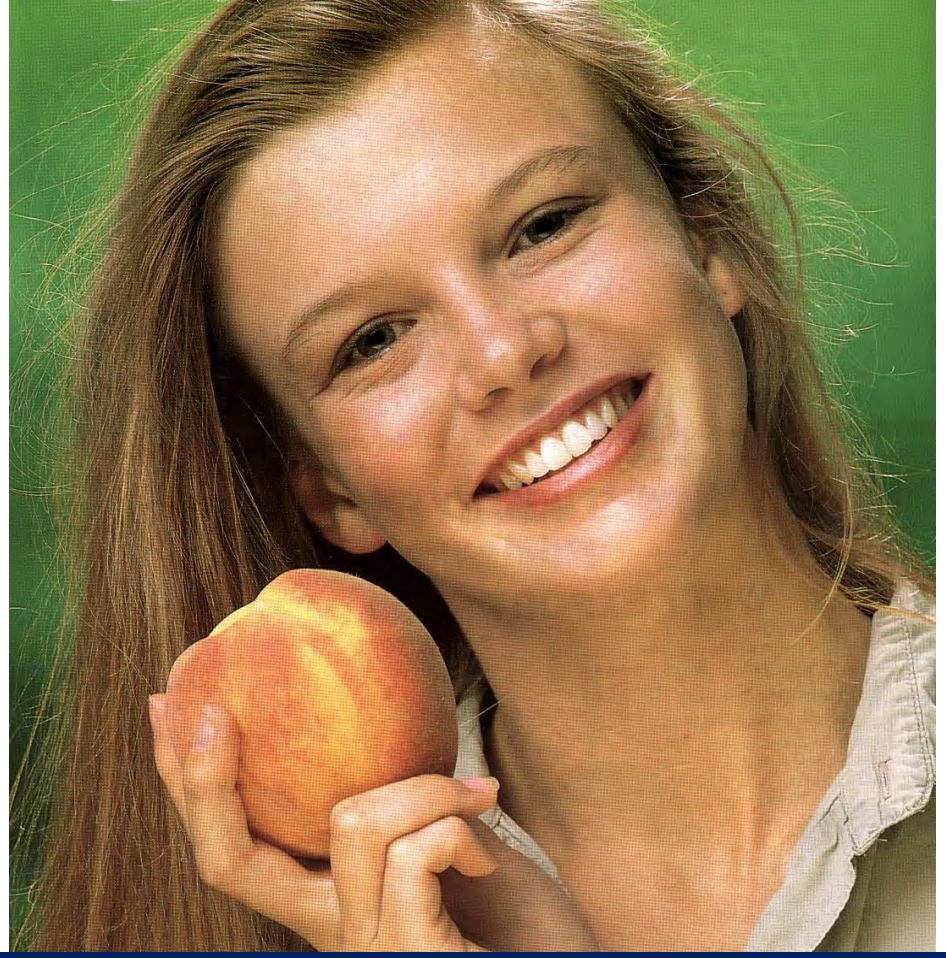
POWERTY AND FOOD SUPPLY

OVER PRODUCTION AND MARKET COMPETITON

PRODUCTION

CONSUMER PREFERENCE
PRODUCE DIVERSITY
FOOD SAFETY
QUALITY

What consumers tell us



- **Appeal to my senses and I will buy your produce**
  - **Taste is the most important factor**
  - **Price less an issue IF you consistently deliver on great taste**


Market Competition

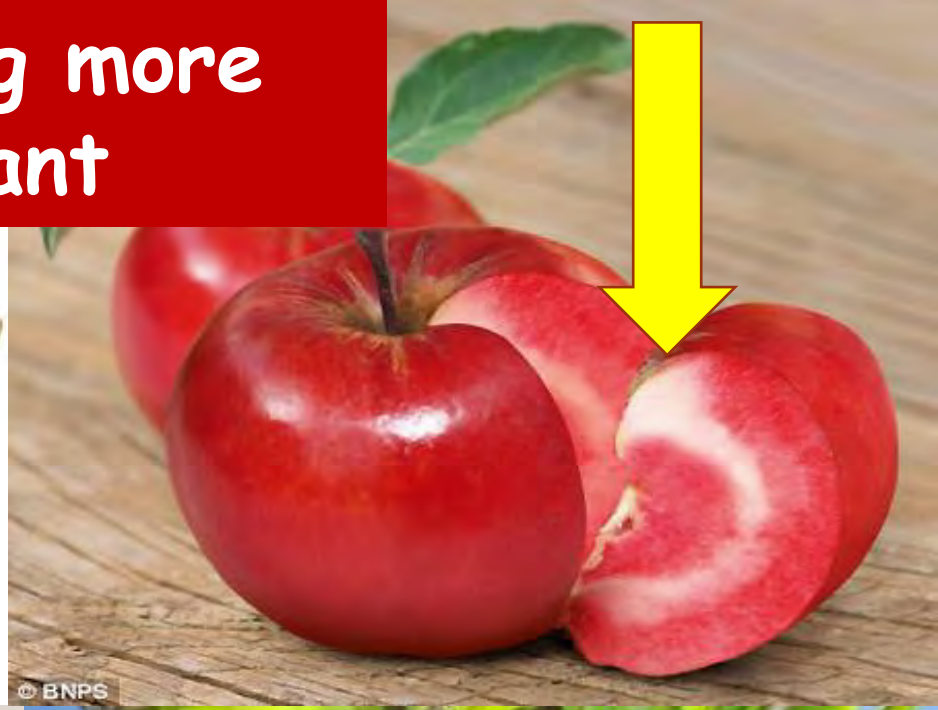
Market Competition

Fresh-cut products vs. Intact products

Introduction new tomato types

Introduction new cultivars

Fruits having more antioxidant



Product quality

To provide high quality fruits and vegetables throughout the year, it is required to start from high quality materials at harvest.

Product quality is only maintained after harvest. Not improved……

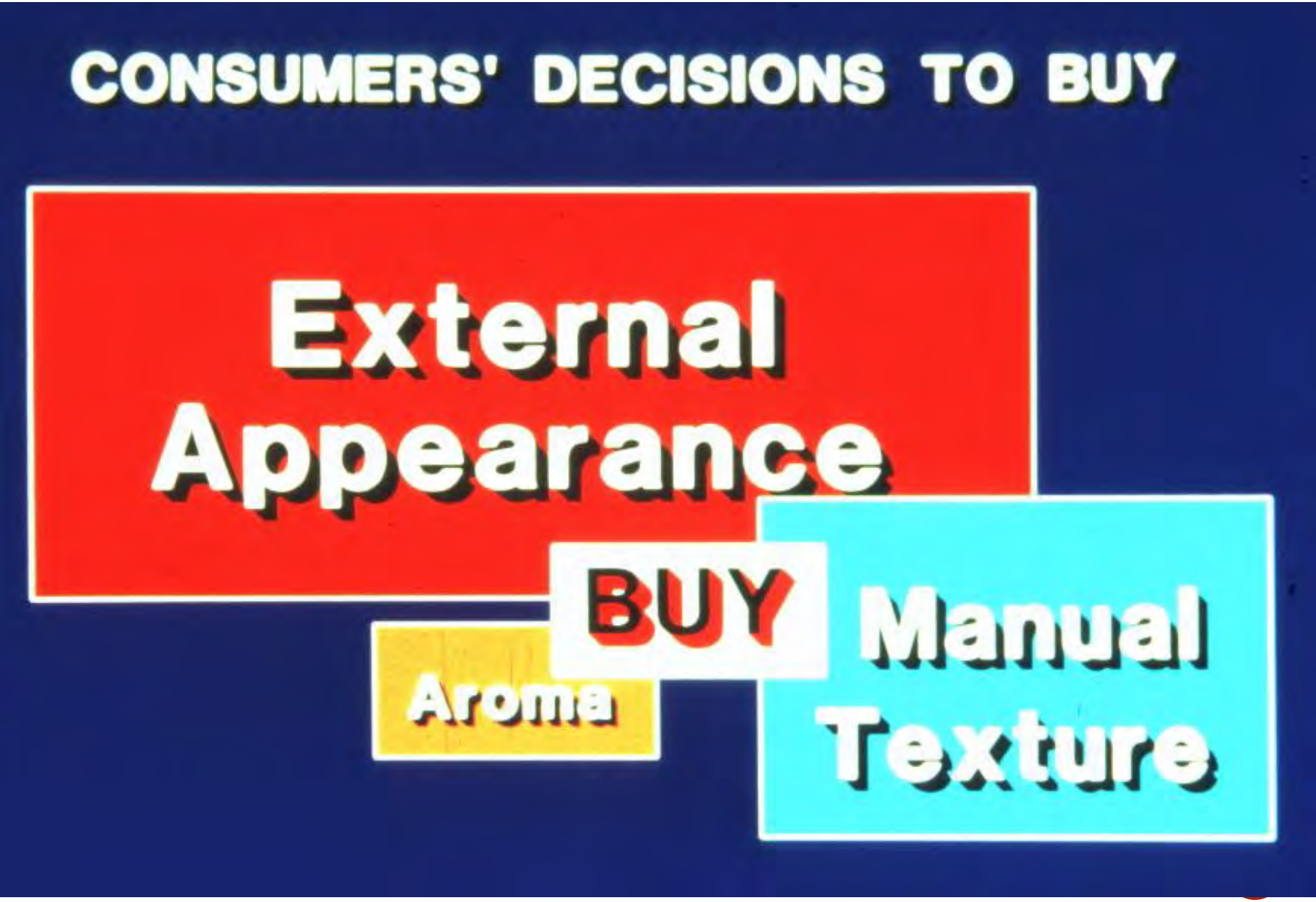
Pre-harvest and post-harvest factors maximize or minimize the quality of the fresh fruit and vegetables.







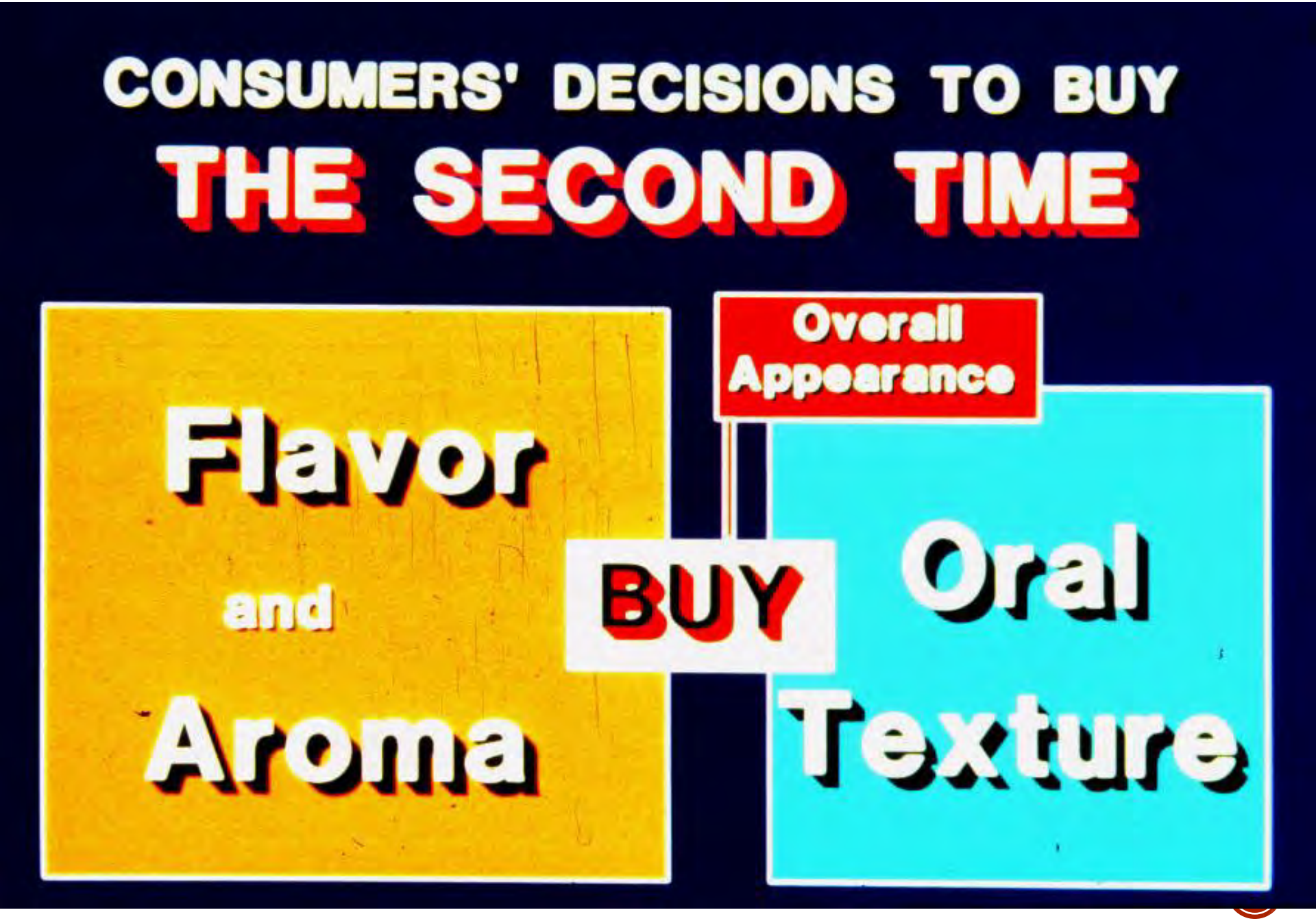
Quality is the most
important factor
for marketing and export


CONSUMERS' DECISIONS TO BUY
External Appearance
BUY
Aroma
Manual Texture

EXTERNAL QUALITY

External color/quality relation

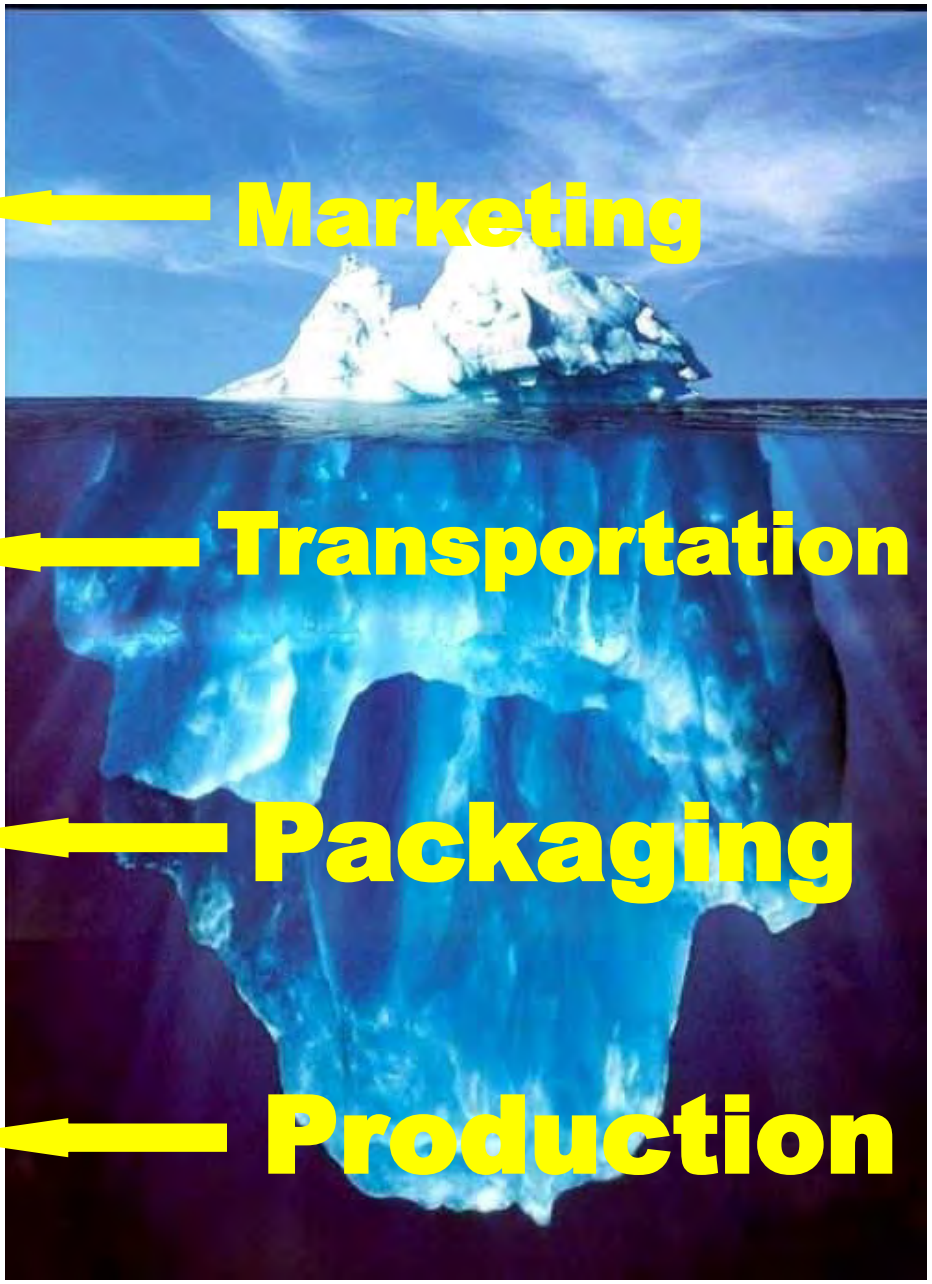
INTERNAL QUALITY

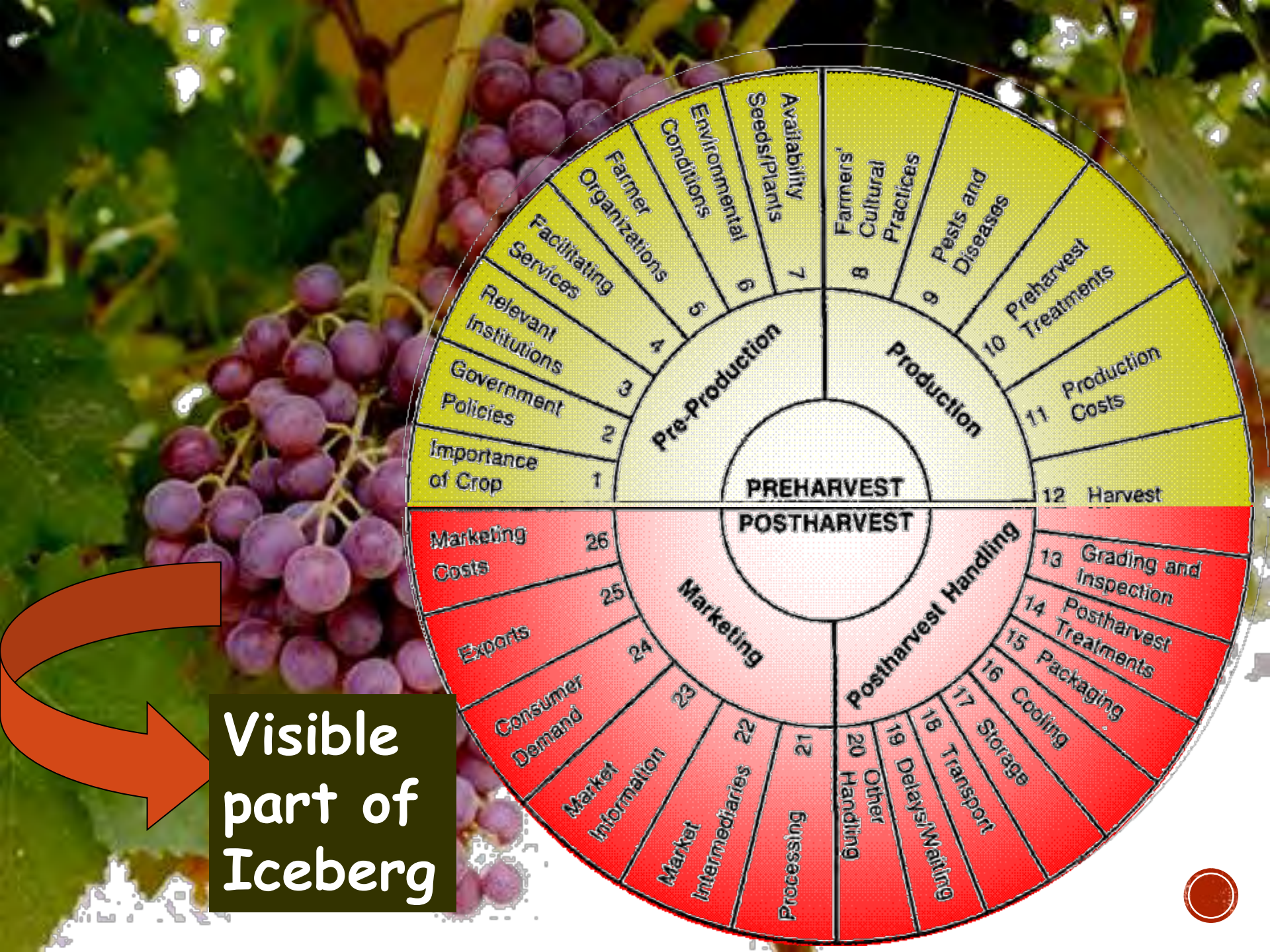

CONSUMERS' DECISIONS TO BUY
THE SECOND TIME
Overall Appearance
Flavor
and
Aroma
BUY
Oral
Texture

Quality

External Quality	Size and shape Skin color Physiological disorders
Internal Quality	Taste and aroma Vitamins Texture Flesh color Physiological disorders


SPANA FRUCHT


Marketing
Transportation
Packaging
Production


Visible part of Iceberg
PREHARVEST
POSTHARVEST
Pre-Production
Production
Marketing
Postharvest Handling
1 Importance of Crop
2 Government Policies
3 Relevant Institutions
4 Facilitating Services
5 Farmer Organizations
6 Environmental Conditions
7 Availability Seeds/Plants
8 Farmers' Cultural Practices
9 Pests and Diseases
10 Preharvest Treatments
11 Production Costs
12 Harvest
13 Grading and Inspection
14 Postharvest Treatments
15 Packaging
16 Cooling
17 Storage
18 Transport
19 Delays/Waiting
20 Other Handling
21 Processing
22 Market Intermediaries
23 Market Information
24 Consumer Demand
25 Exports
26 Marketing Costs

TOTAL QUALITY MANAGEMENT

1. Production quality
2. Harvest and handling quality
3. Storage quality
4. Packaging quality
5. Transportation quality
6. Marketing quality

Total quality

PRODUCTION QUALITY

PRODUCTION QUALITY

Harvest and handling quality

Storage quality

15 $

Packaging quality

13 $

Packaging quality

Packaging is the silent seller of the product

Smart Packaging

Environmentally Friendly Packaging

Transportation quality

Use of CA technology during transportation

Pallet Covers for Carbon Dioxide Treatment of Strawberries during Transport

USE OF MAP DURING TRANSPORTATION AND STORAGE FOR POMEGRANATES

USE OF MAP DURING TRANSPORTATION AND STORAGE FOR CHERRIES

Marketing quality


Pre-harvest factors
Care at harvest
Packging house operations
Storage conditions
Packaging
Disorders
Quality depends on

Fruits and vegetables are an important source of carbonhydrates, proteins, organic acids, vitamins and minerals for human nutrition.

However, fruits and vegetables are highly perishable products particularly once they have been harvested.

POSTHARVEST LOSSES : 10-50%

Grower

Harvest Transportation Storage Packaging Marketing

Main Loss

Consumer

POSTHARVEST LOSSES

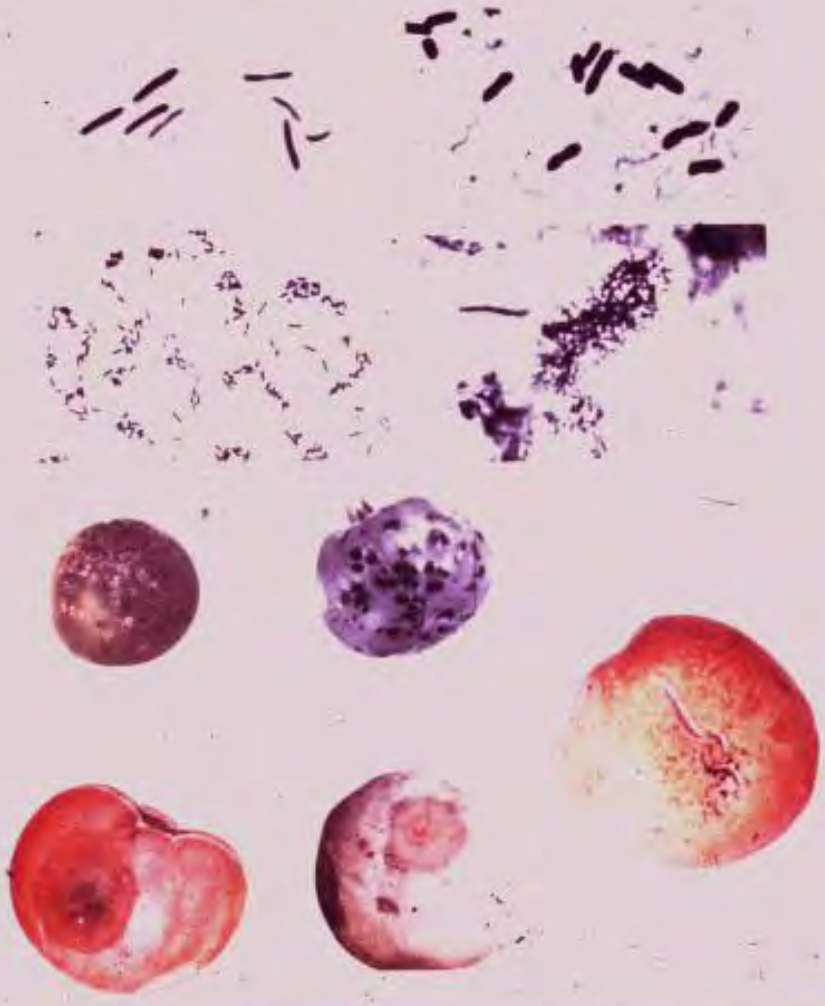
- **Quantity** (Water loss, decay, physiological disorders,
- **Quality** (texture, firmness, vitamins)

→ Market Loss

PARASITIC DISEASES

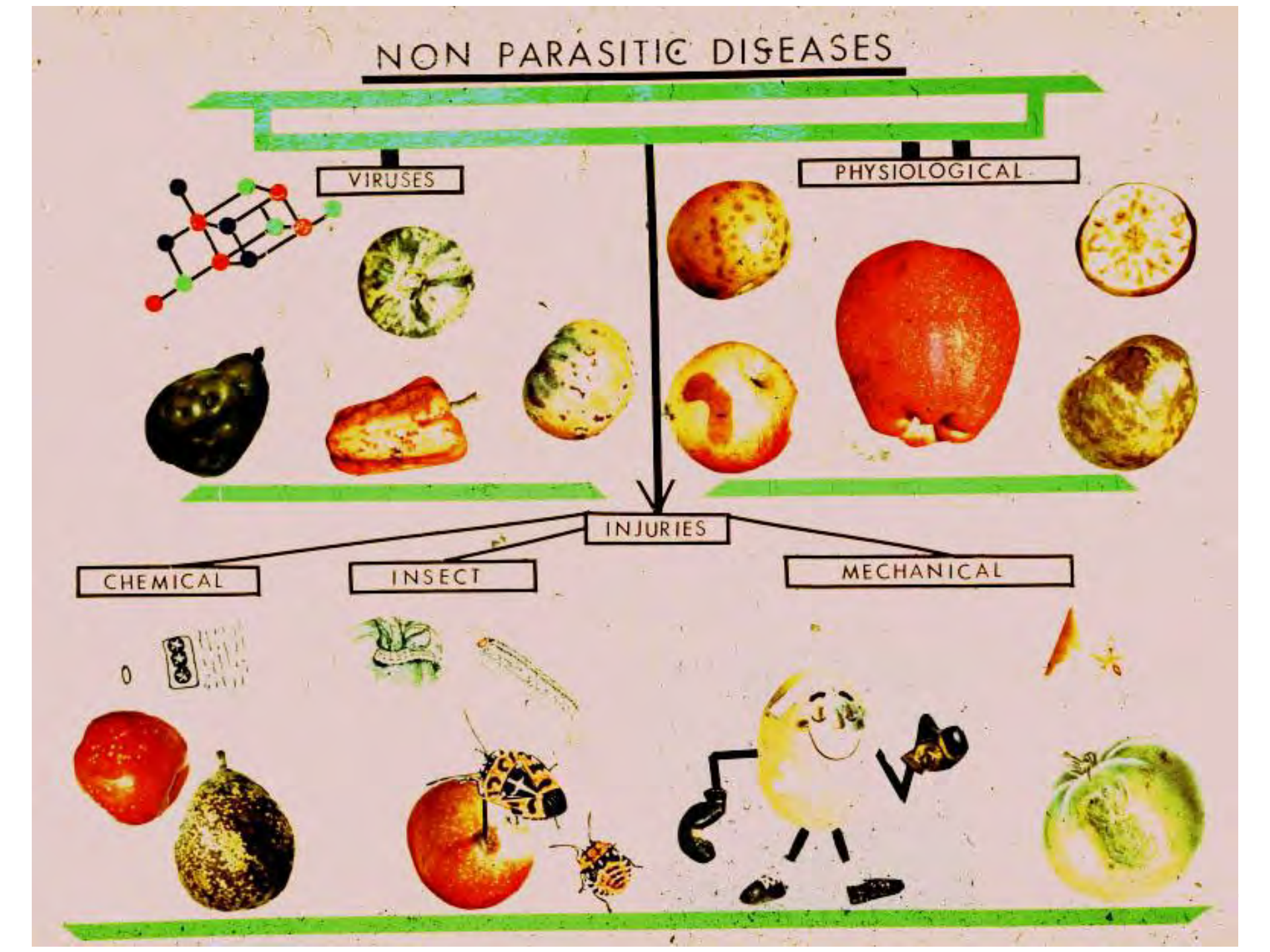
A PARASITE IS A LIVING ORGANISM WHICH OBTAINS FOOD AT THE EXPENSE OF ANOTHER LIVING ORGANISM (HOST)

CAUSED BY BACTERIA



CAUSED BY FUNGI

NON PARASITIC DISEASES



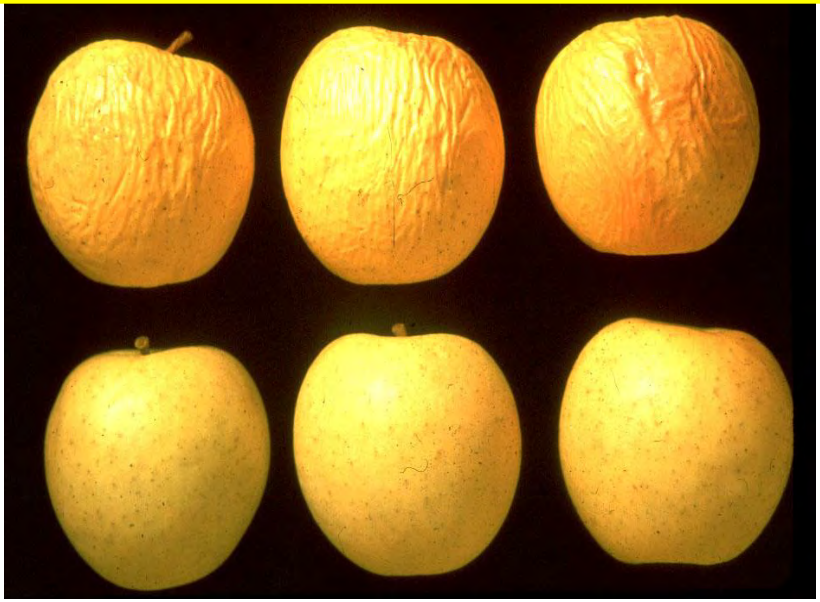
CARE AT HARVEST

USE OF TECHNOLOGY

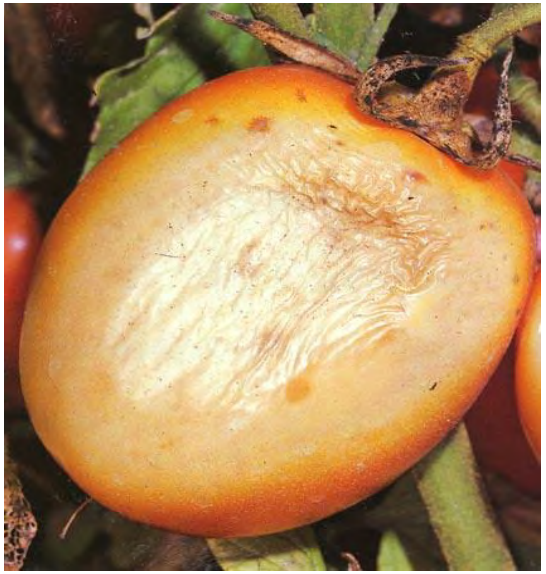
Superficial scald in ‘Granny Smith’ apples.

CRACKING INJURY

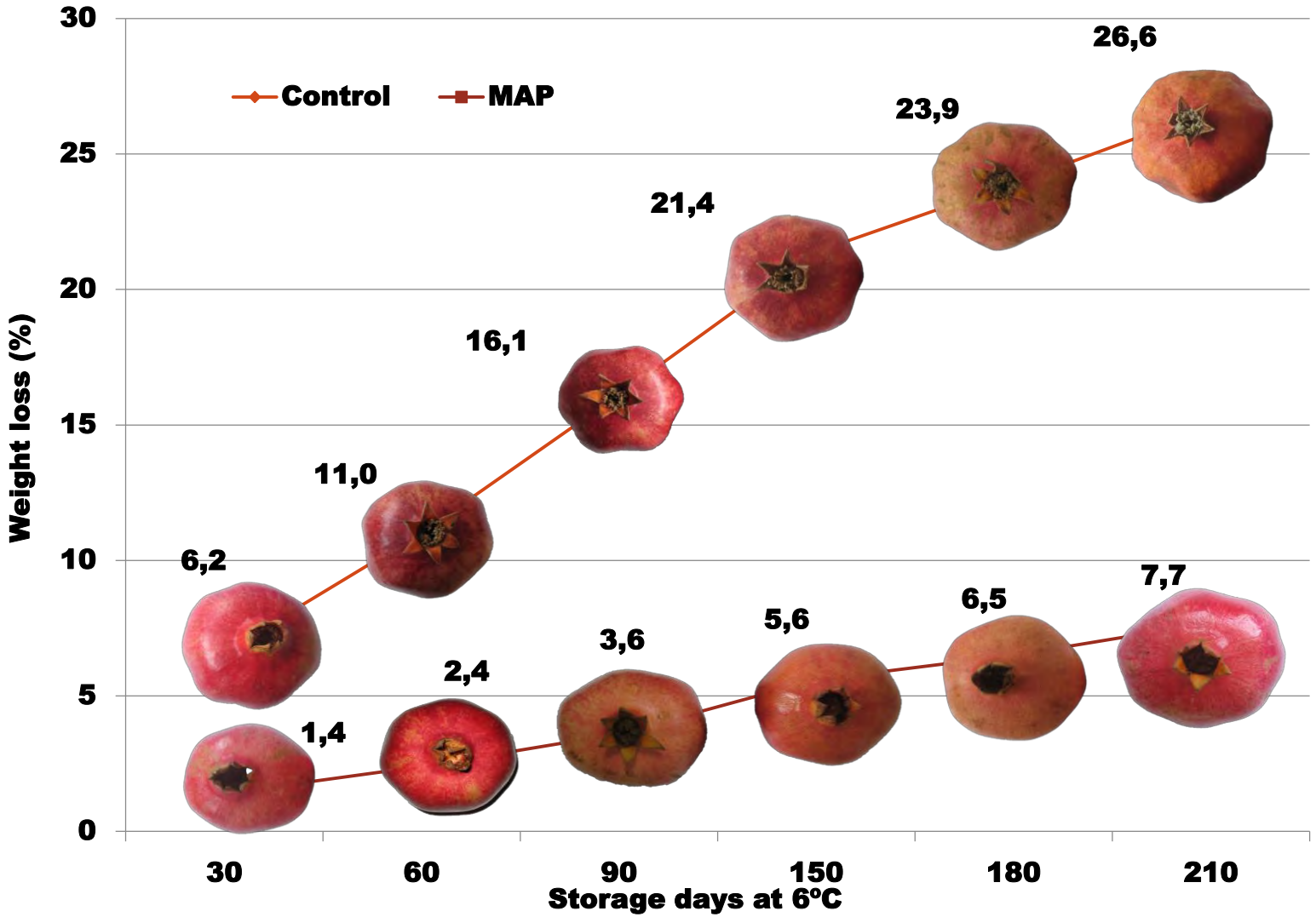
CHILLING INJURY



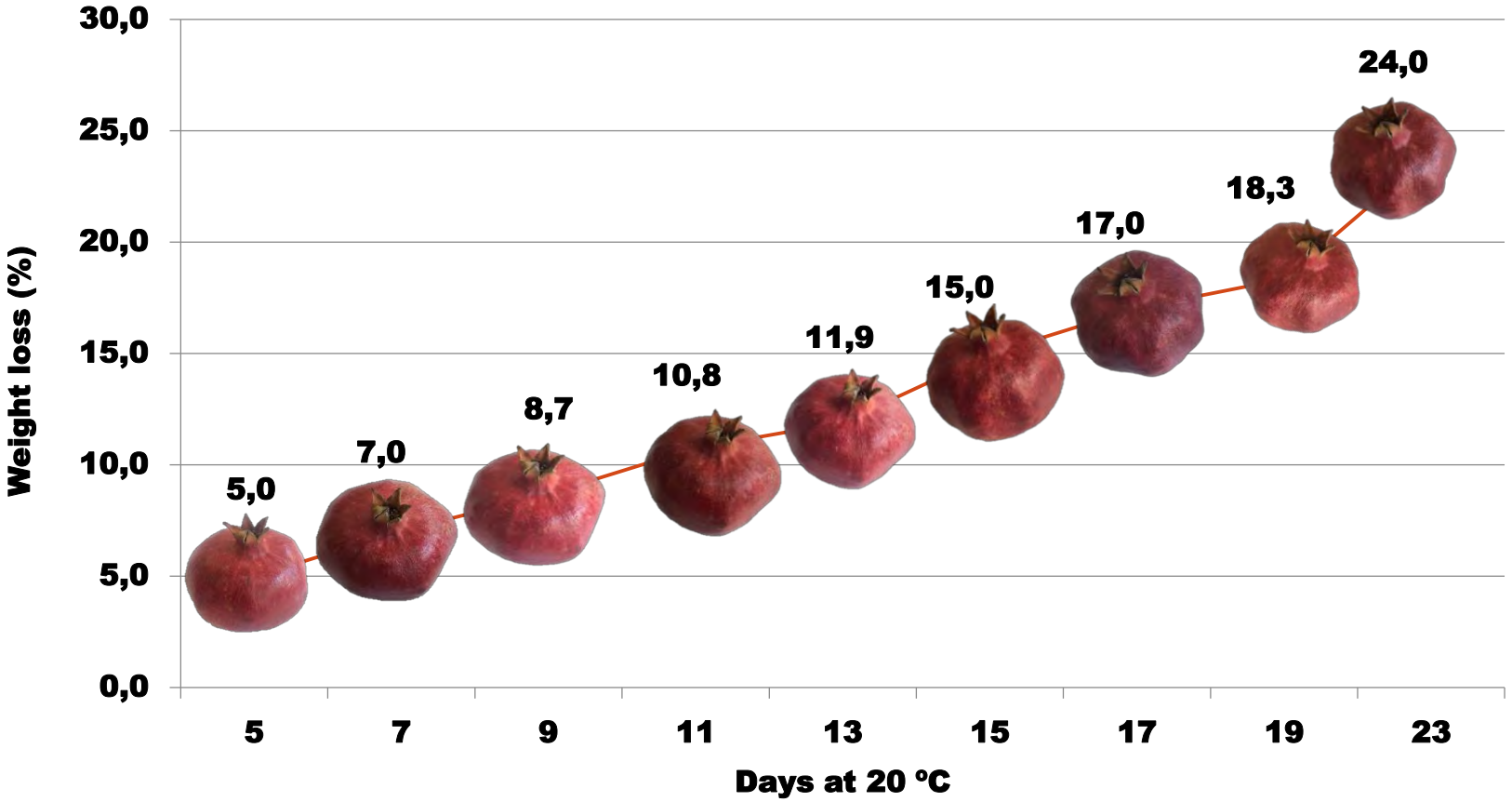
SUN BURN INJURY



Weight loss due to low RH



Weight loss due to low RH



Hicaznar pomegranates stored for 180 days at 6°C

Day - 8 Weight loss

Paper packaging

%5.2 %10.3 %13.9

MAP

%0.4 %1.5 %2.7

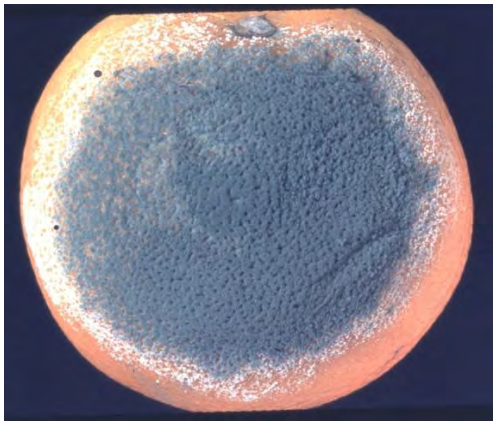
0.5°C 5°C 10°C


CHERRIES
CHERRIES
CHERRIES


복숭아
2008 8 22

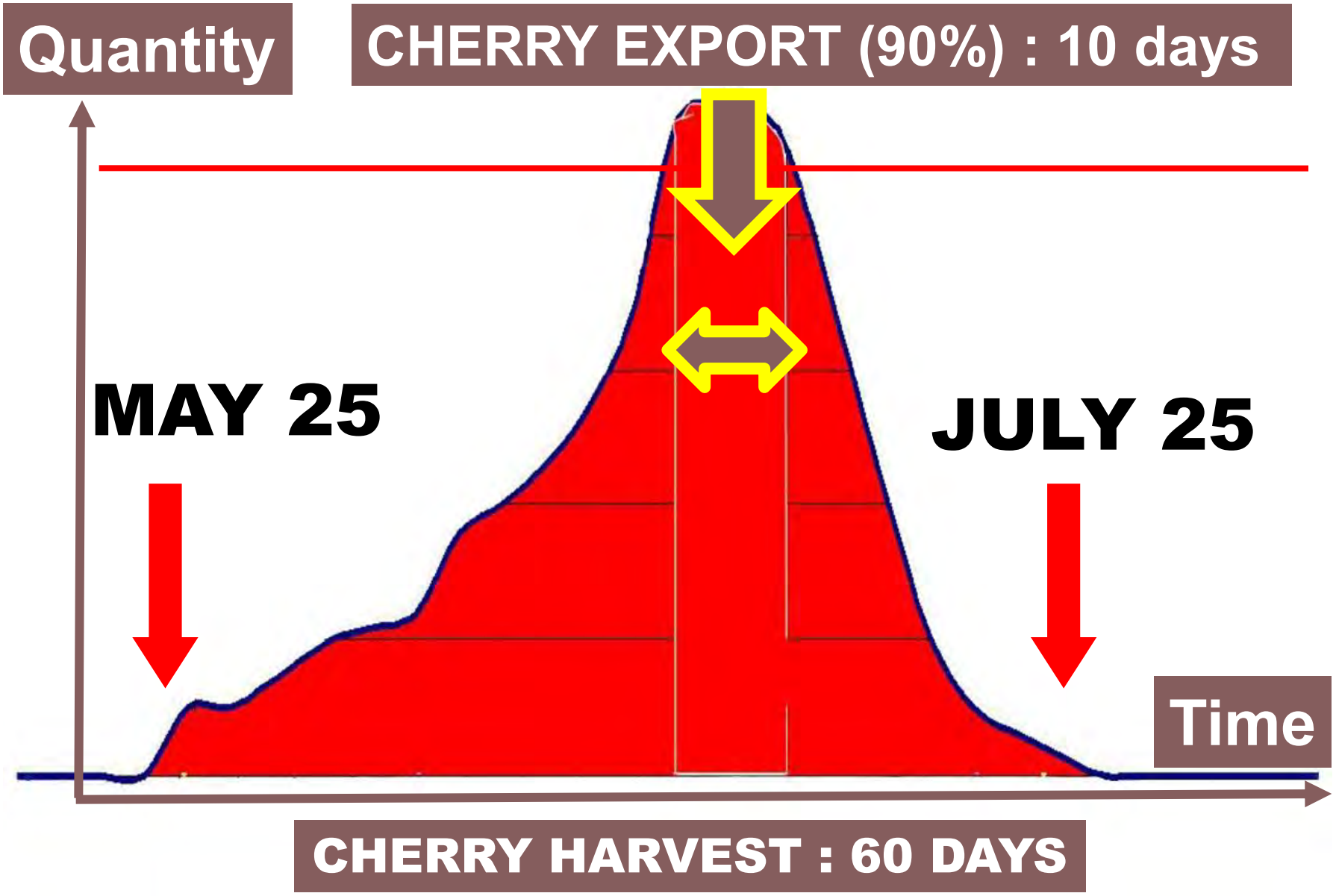
Primary factors of postharvest losses

- Poor pre-harvest techniques
- Improper handling
- Inadequate marketing system
- Inadequate transportation facilities
- Lack of information



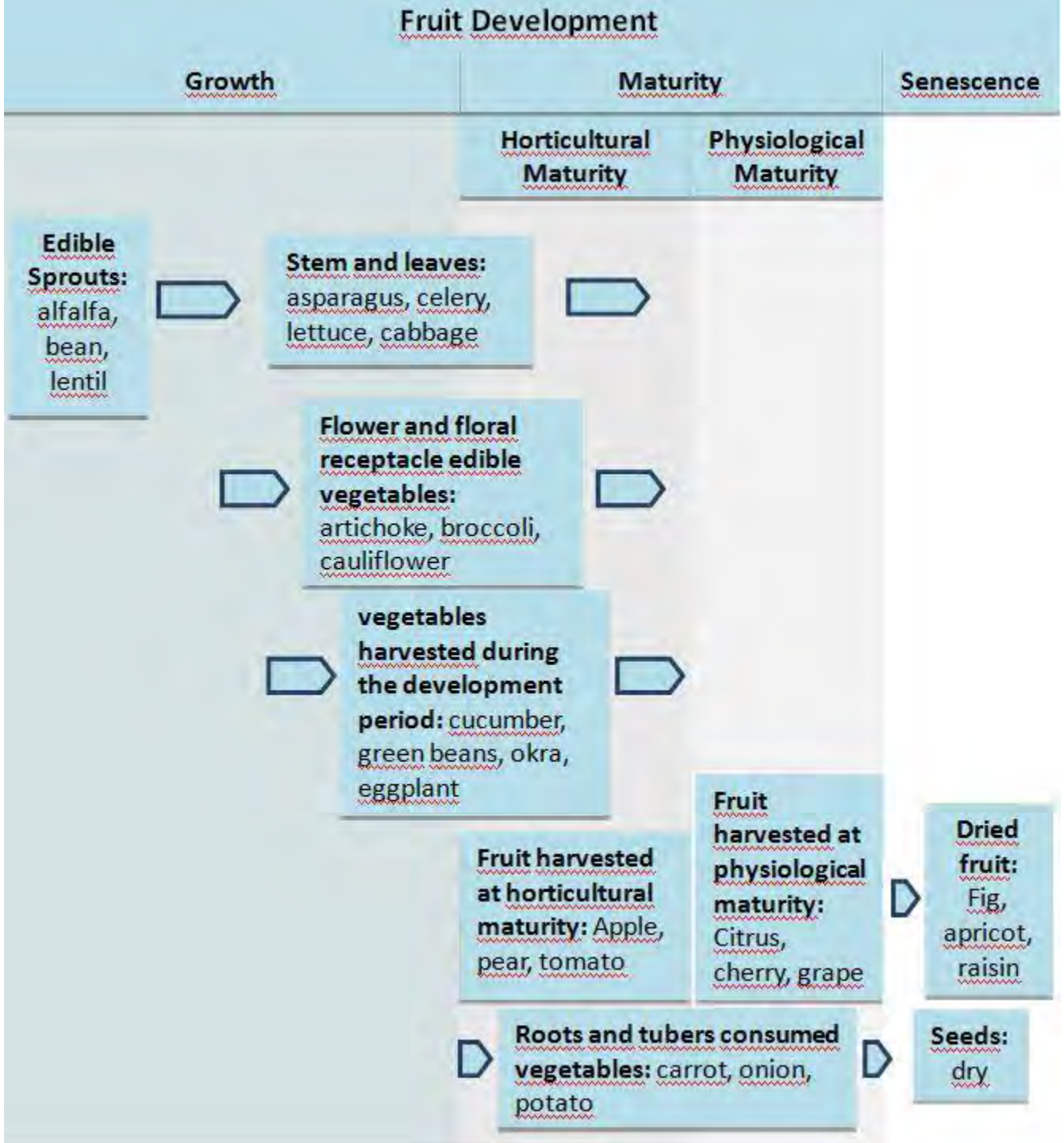
Importance of maturity and storage

- To obtain maximum sensory and nutritional quality fruit for customer perception,
- To obtain prolonged storage and shelf life capacity,
- To facilitate scheduling of harvest window and packing house operations,
- To manage shipping and marketing.


Quantity
CHERRY EXPORT (90%) : 10 days
MAY 25
JULY 25
Time
CHERRY HARVEST : 60 DAYS

Determination of Harvest Maturity

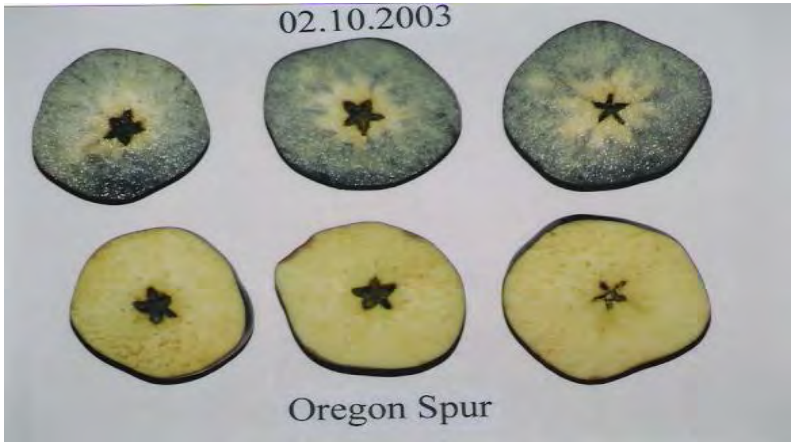
Cell Expansion	Horticultural Maturity	Commercial Maturity
Cucumber, squash	Apple, Banana	Cherry, Pomegranate


Fruit Development
Growth
Maturity
Senescence
Horticultural Maturity
Physiological Maturity
Edible Sprouts: alfalfa, bean, lentil
Stem and leaves: asparagus, celery, lettuce, cabbage
Flower and floral receptacle edible vegetables: artichoke, broccoli, cauliflower
vegetables harvested during the development period: cucumber, green beans, okra, eggplant
Fruit harvested at horticultural maturity: Apple, pear, tomato
Fruit harvested at physiological maturity: Citrus, cherry, grape
Dried fruit: Fig, apricot, raisin
Roots and tubers consumed vegetables: carrot, onion, potato
Seeds: dry

Harvesting and Postharvest handling Systems for various Commodity Groups

Maturity indices:

- size and shape
- Skin and flesh color
- Starch index
- Firmness
- Soluble solids
- Titratable acidity
- Respiration rate
- Ethylene production



Disadvantages of early harvest

- Early harvested fruits and vegetables have not reached their final size, shape and weight due to uncompleted fruit development that results in low yield,

- In early harvested fruits, carbohydrates and primarily sugar accumulation, loss of acid and astringent substances, cell wall degradation and the formation of aroma substances are not enough.

- Fruits harvested early cannot develop the desired skin color.

- Cuticular and lenticular development is not completed in early harvested fruits, so weight losses due to water loss is high and these fruits wrinkles quickly,

- Early harvested fruits are prone to some physiological disorders such as superficial scald.

Disadvantages of late harvest

- The storage duration of late harvested fruit is relatively shorter than those of optimal harvested crops,
- These fruits are prone to fungal decay since they are over-matured,
- The fruit taste is inferior due to the reduction in acidity,
- They are susceptible to some physiological disorders such as senescence breakdown, internal browning, Jonathan spot etc.,
- Late harvest increases pre-harvest fruit drop and ends up with a reduced marketable yield.

PRE-HARVEST DROP IN APPLES

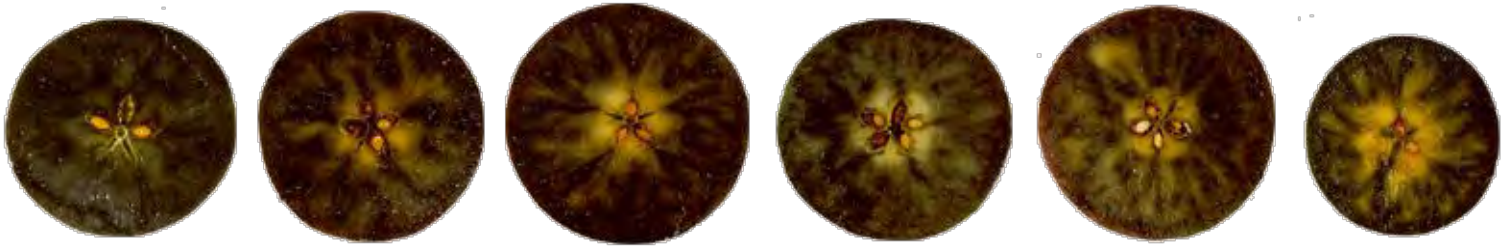
The main maturity indices in EU and the USA for Citrus*

Citrus Types	TSS (%)	TA (%)	TSS/TA ratio	Juice (%)
Oranges	8	0.4-0.7	8–10	>33
Navel oranges			8-8.5	>33
Blood oranges			7	>30
Others				>35
Mandarins	>8-8.5	0.3-0.5	6.5-7.5	
Satsumas			6.5	>33
Clementines			7	>40
Hybrids/other			7.5	
Lemons				>20
Grapefruits	6-7		5.5-7	>35

Days after full bloom to harvest in some temperate-zone climate fruits

Species	Variety	Days full bloom to harvest	Species	Variety	Days full bloom to harvest
Apple	Starking Delicious	155-160	Plum	Formasa	120-130
	Golden Delicious	150-155		Santarosa	120-130
	Amasya	160-170		Black Beauty	125-135
	Granny Smith	180-190		Angeleno	175-185
	Red Chief	140-150		Papaz	80-90
	Jersey Mac	100-110		Stanley	125-135
Sweet Cherry	Bing Spur	40-45		Grand Prise	120-130
	Stella	55-60		Gaint	145-155
	Van	55-65	Peach	Spring Time	90-100
	Jubile	55-65		Spring Lady	100-110
	0900 Ziraat	60-70		July Elberta	125-135
	Morten Late	65-75		Elegant Lady	130-140
Pear	Akça	75-85		Alyanak Hale	165-175
	Santa Maria	115-125		Monreo	170-180
	Williams	135-145		Early Sun Grad	90-100
	Abba Fetel	140-150	Nectarine	Spring Red	95-105
	Ankara	150-160		Sun Red	100-110
	Deveci	150-160		June Berta	105-115
	Kieffer	140-150			

Maturity is Judged by Starch



Immature

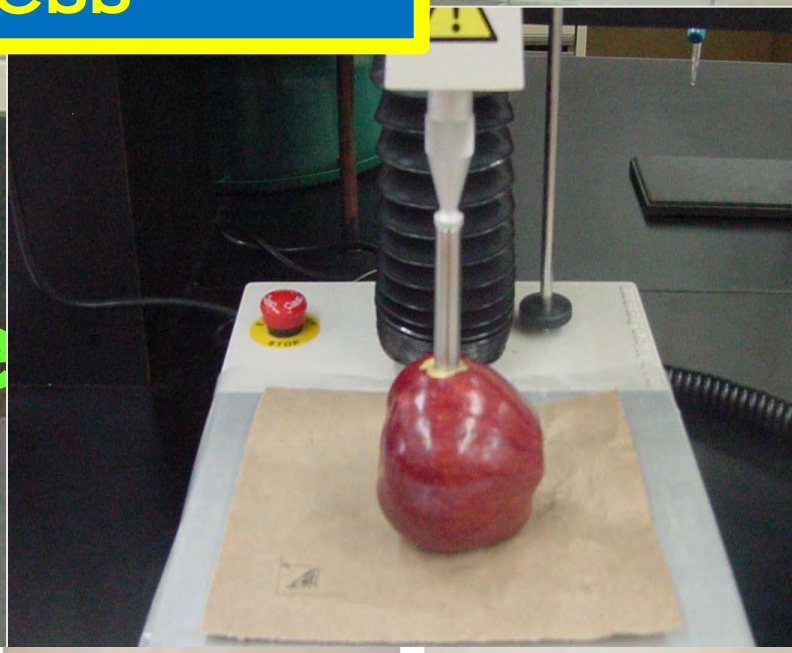
Mature

Skin Color

TOTAL SOLUBLE SOLIDS

Fruit firmness

Texture



Respiration rate and ethylene production

Summary of maturity indices for different horticultural crops

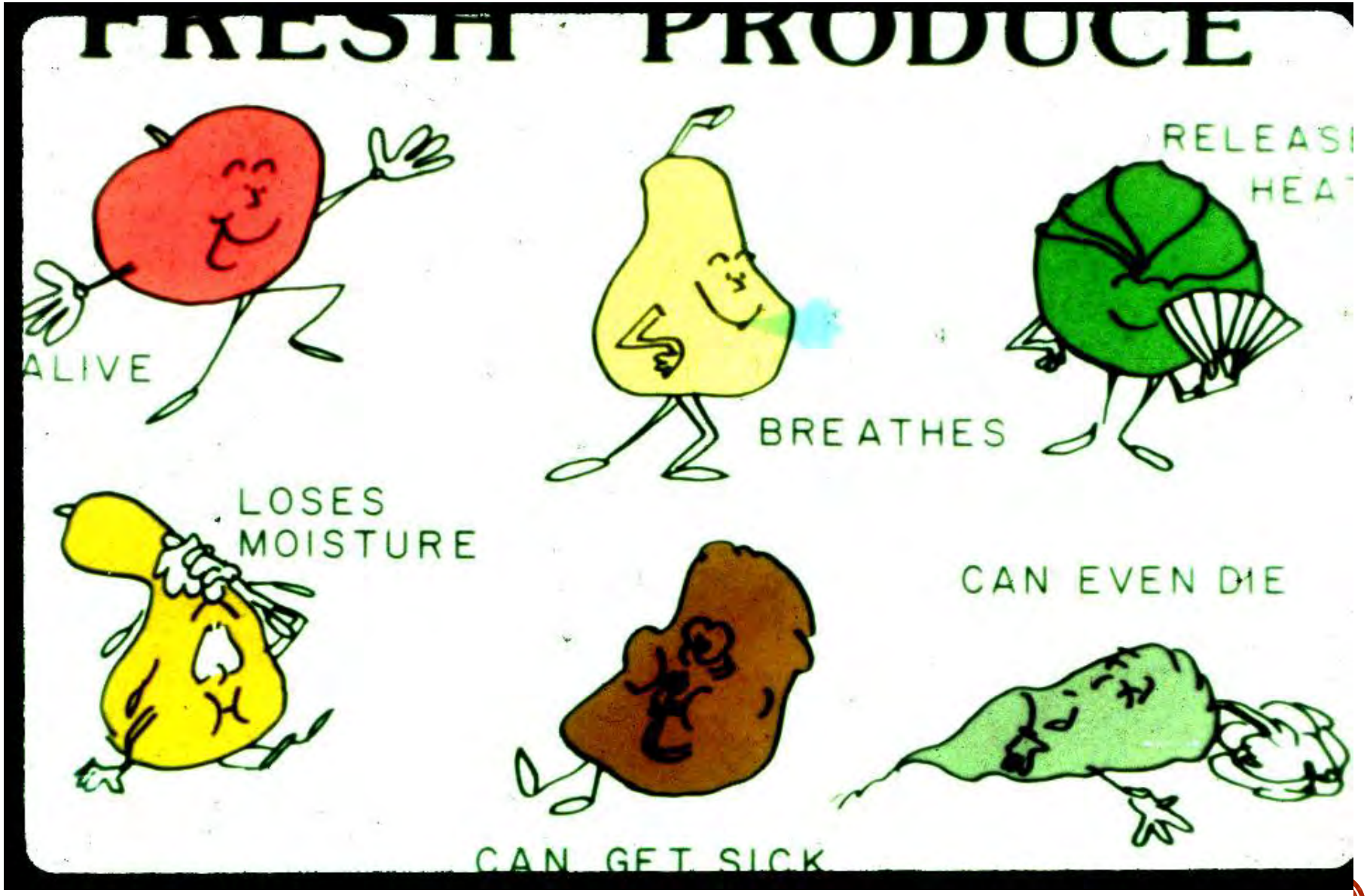
Species - Maturity indices	Days after anthesis	Days after planting	Skin color	Flesh (seed/aril)	Flesh firmness	Juice content	Soluble solids content (SSC)	Titratable acidity (TA)	Ripening index (TSS /	Starch - iodine test	Oil content	Internal ethylene	Respiration climacteric	Absicion layer	Hull splitting	Size and shape	Aroma production	Firm head/Compact
Apple	+		+		+		+			+		+	+	+		+	+	
Pear	+		+		+		+			+		+	+	+		+		
Peach			+	+	+		+		+			+	+			+		
Sweet Cherry			+	+	+		+	+	+					+		+		
Mandarin-Orange-Grapefruit						+	+	+	+							+		
Grape			+		+		+	+	+							+		
Banana	+									+			+			+		
Kiwi							+						+			+		
Avocado											+		+			+		
Tomato			+	+			+	+	+				+			+		
Pepper			+													+		
Melon				+			+	+					+	+		+	+	
Watermelon				+			+									+		
Lettuce																		+
Broccoli																		+

The main objectives of applying postharvest technology to harvested fruits and vegetables are

- to maintain quality
- to protect food safety
- to reduces fungal and physiological losses between harvest and consumption.

STORAGE SUCCSESS DEPENDS ON

- Species,
- Cultivars,
- O_2 and CO_2 levels in the storage room,
- Storage temperature,
- Stage of maturity of produce at harvest,
- Growing conditions before harvest,
- Presence of ethylene in the storage room
- Use of ethylene antagonist (1-MCP and etc.)


FRESH PRODUCE
ALIVE
BREATHES
RELEASE
HEAT
LOSES
MOISTURE
CAN EVEN DIE
CAN GET SICK

COLD CHAIN MANEGEMENT

Pre-cooling

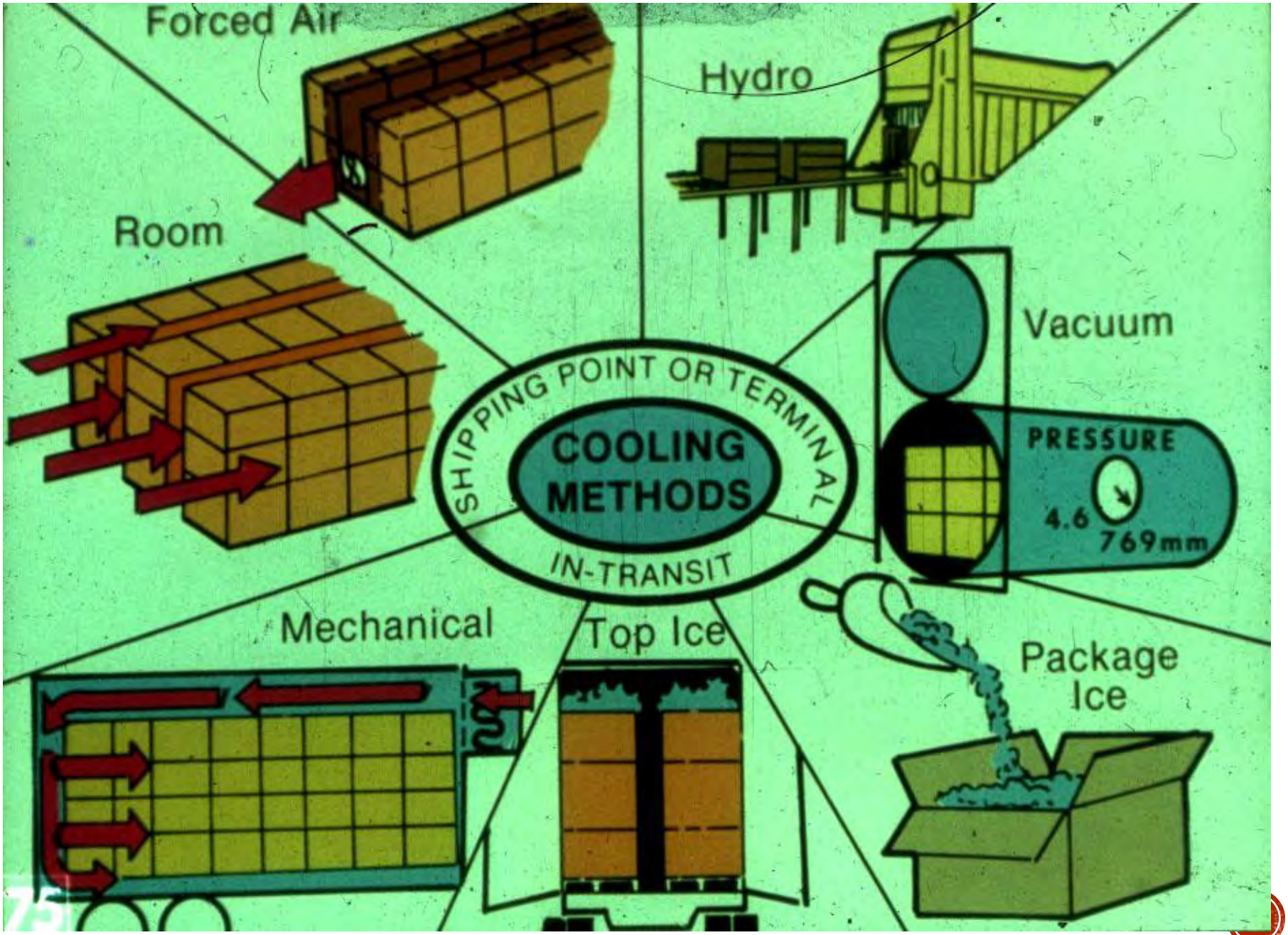
Packaging

Consumer

Harvest

Storage

Transportation


Forced Air
Hydro
Room
Vacuum
SHIPPING POINT OR TERMINAL
COOLING METHODS
IN-TRANSIT
PRESSURE
4.6
769mm
Mechanical
Top Ice
Package Ice


FORCED-
AIR
COOLING

HYDROCOOLING FOR CHERRİES


TOP ICING FOR VEGETABLES

STORAGE TEMPERATURES FOR FRUITS

Fruits	Temperature (°C)	Relative humidity (%)
Orange	4-6	85-90
Mandarin	3	85-90
Lemon	10	85-90
Grapefruit	8-10	85-90
Apple	0-4	90-92
Pomegranate	6	90-92
Pear	0	90-92
Plum	0-1	90-92
Cherry	0	90-92
Peach	0	90-92
Banana	13	80-85

STORAGE TEMPERATURES FOR VEGETABLES

Vegetables	Temperature (°C)	Relative humidity (%)
Tomato (ripe)	7-8	90-95
Domates (breaker)	9-11	90-95
Domates (green)	11-14	90-95
Pepper	7-12	90-95
Eggplant	8-12	90-95
Cucumber	9-11	95
Squash	9-11	50-70
Carrot	0	95-98
Melon	5-7	70-80
Cabbage	0	95

SYMPTOMS OF CHILLING INJURY

- PITTING
- DISCOLORATION
- INTERNAL BREAKDOWN
- FAILURE TO RIPEN
- DECAY

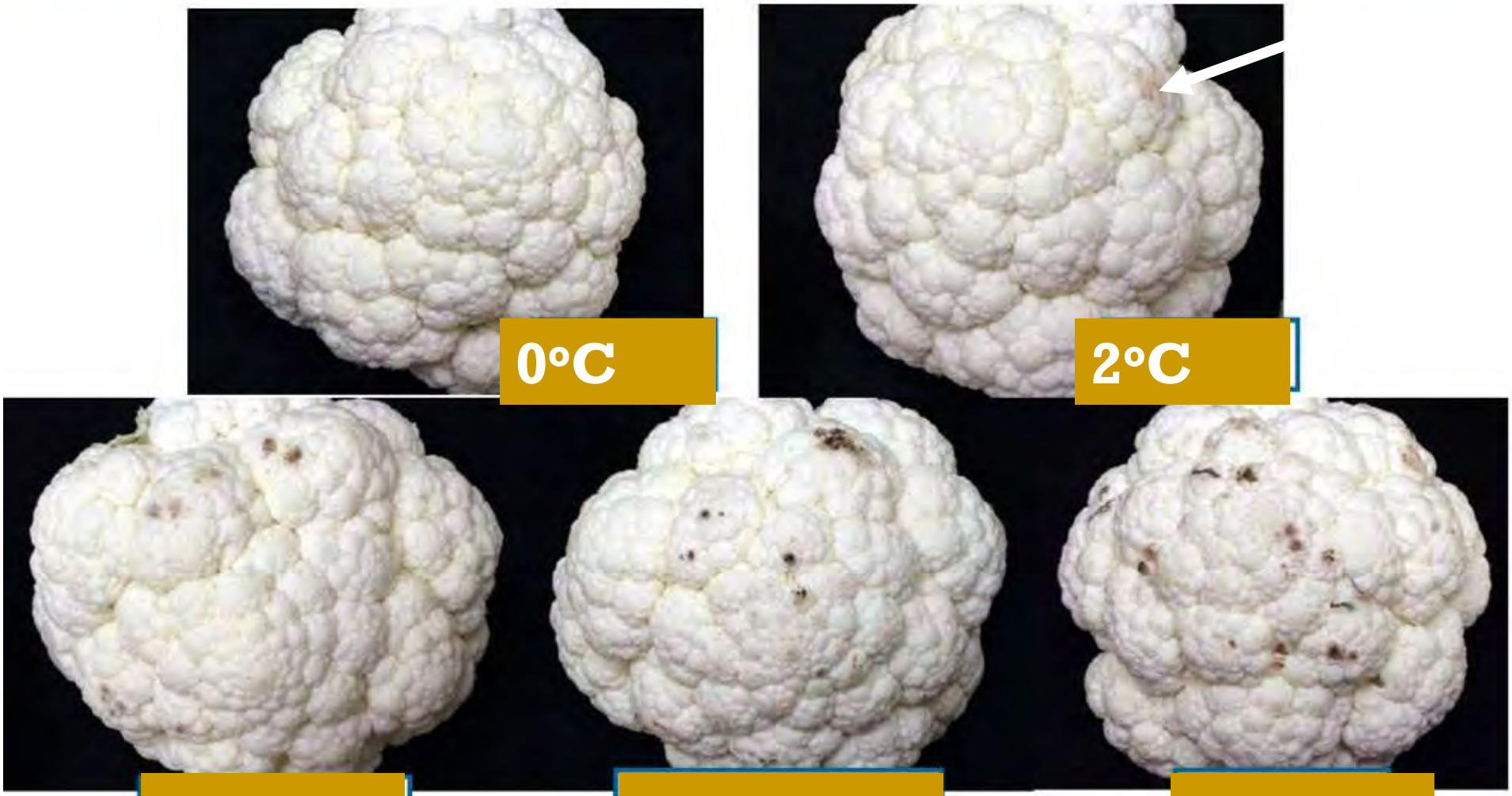
Controlling fruit temperature

Temperature effect

Salads

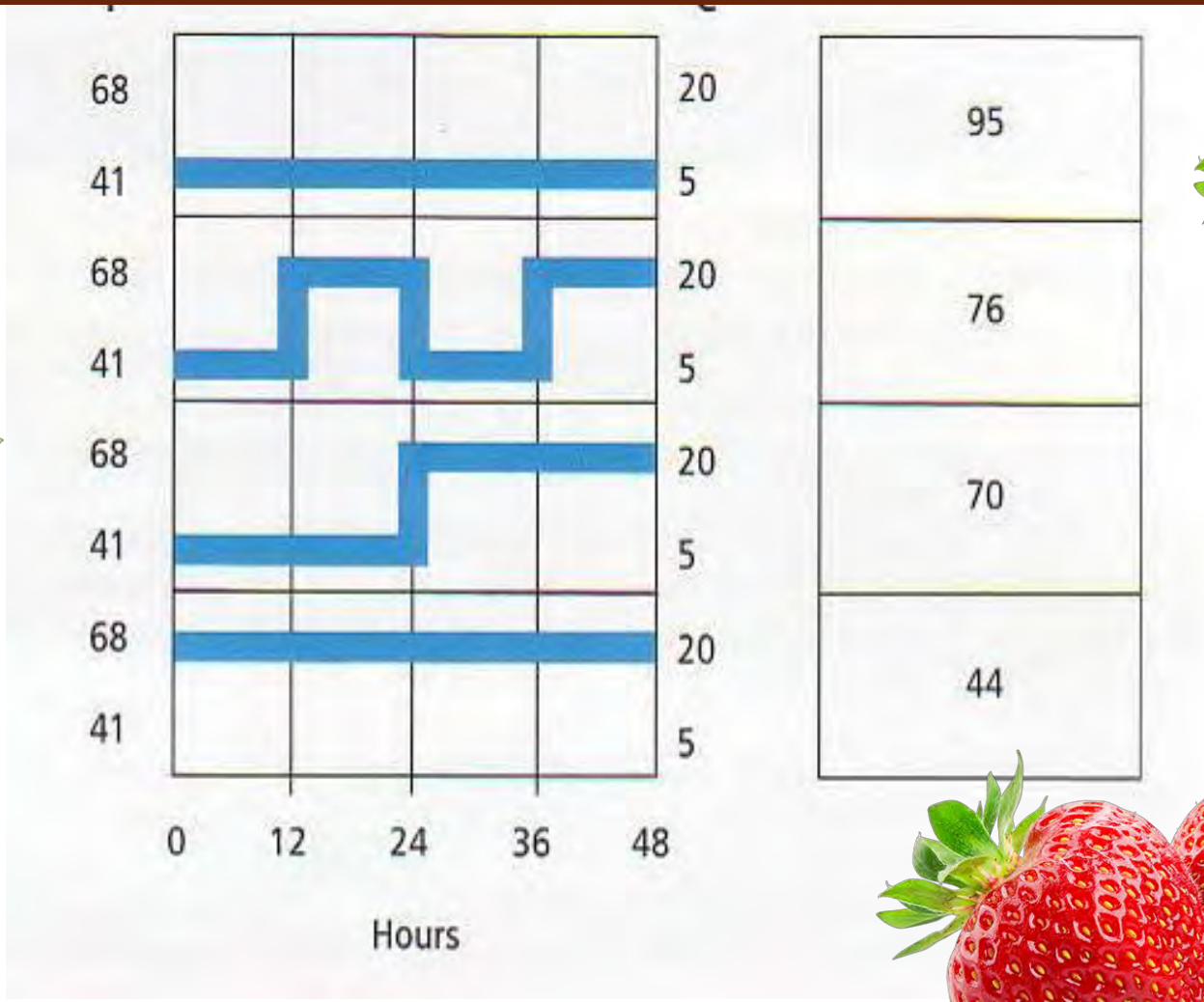

0°
5°
10°
AFTER 7 DAYS IN STORAGE
14°
20°

Caulıflower - 1 week storage

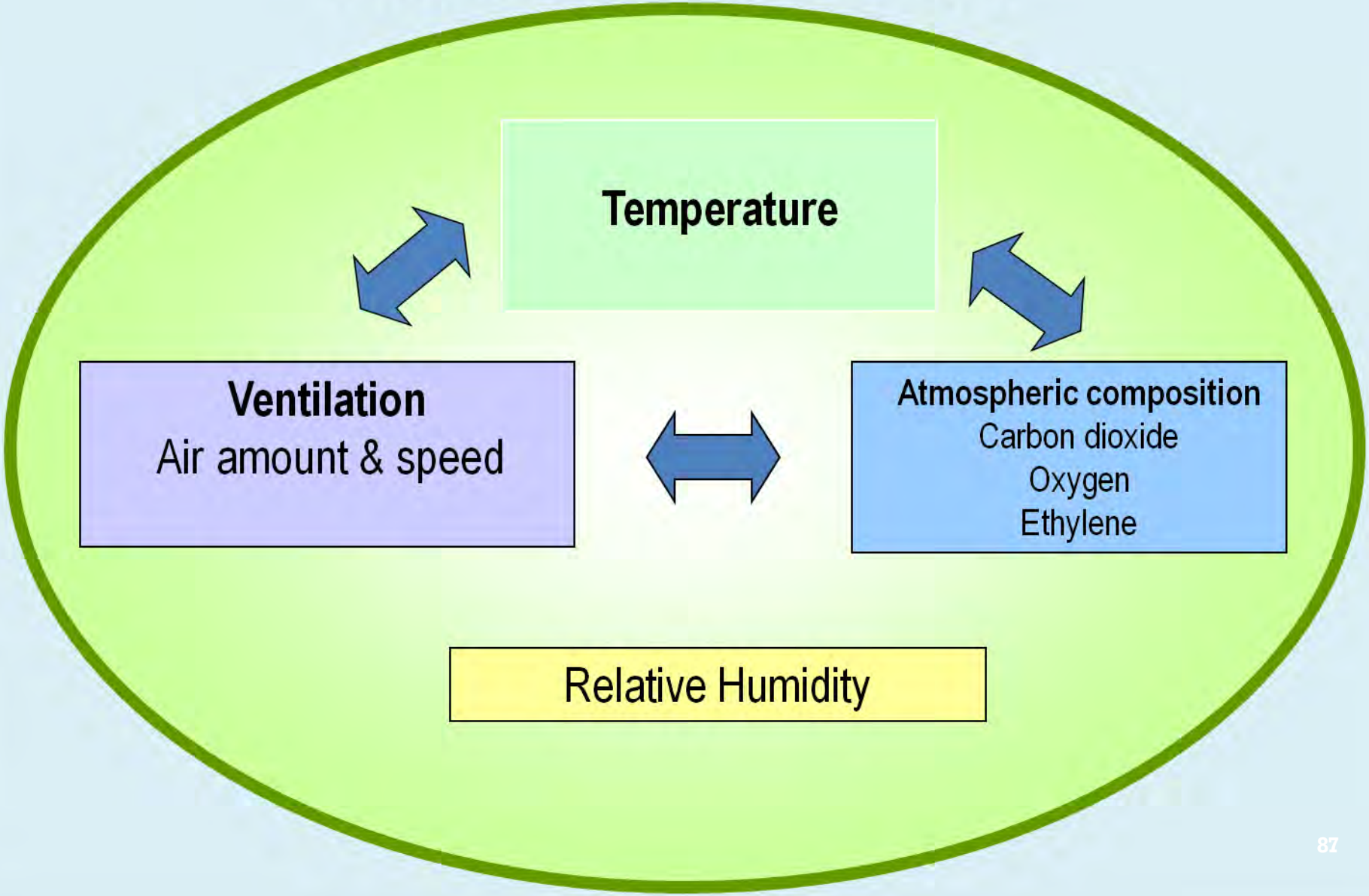


CHILLING INJURY IN PEPPER

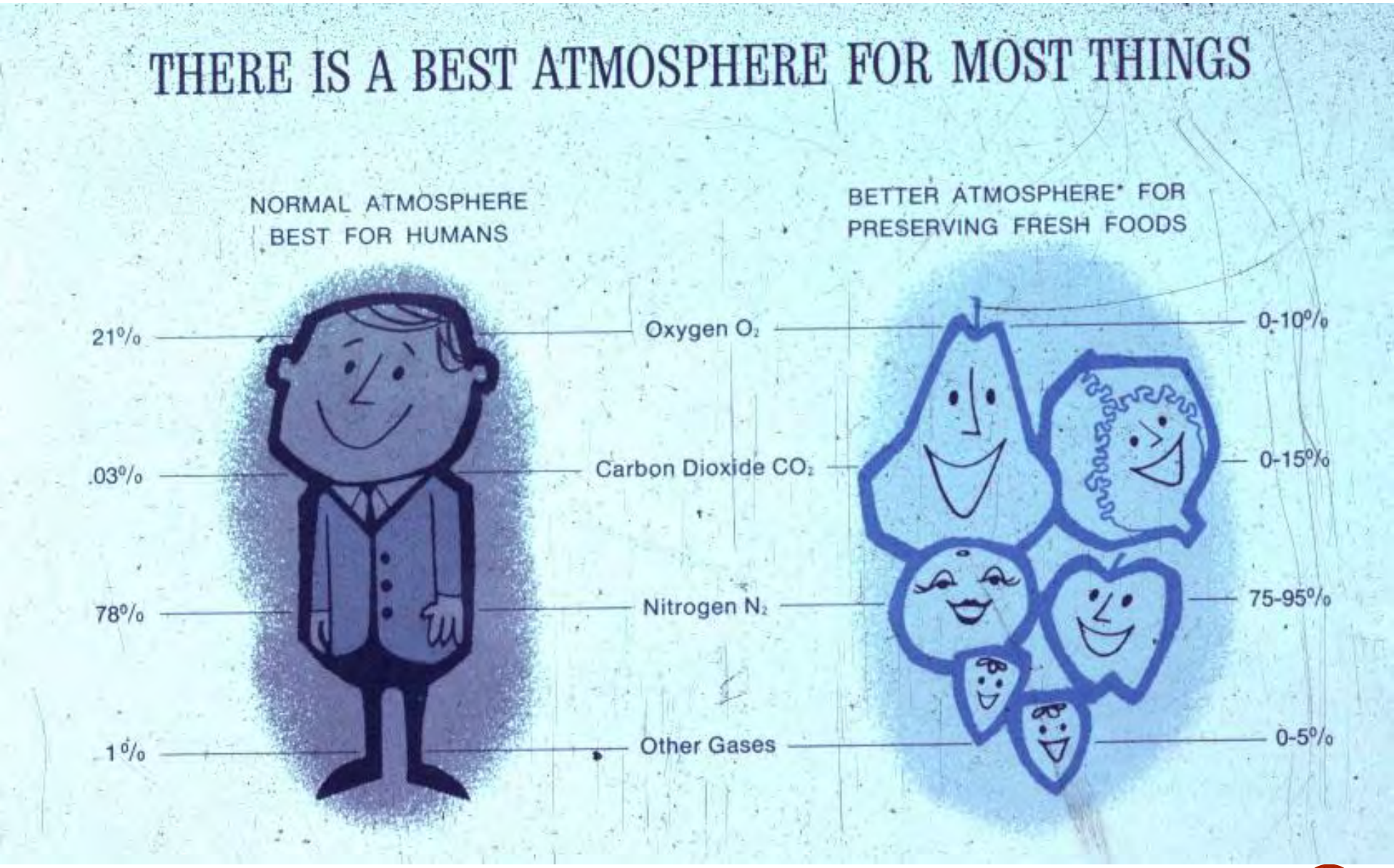
Effect of temperature management for strawberry



Storage parameters AFFECTING fruit QUALITY



THERE IS A BEST ATMOSPHERE FOR MOST THINGS



CONTROLLED ATMOSPHERE STORAGE

Controlled Atmosphere (CA) Storage

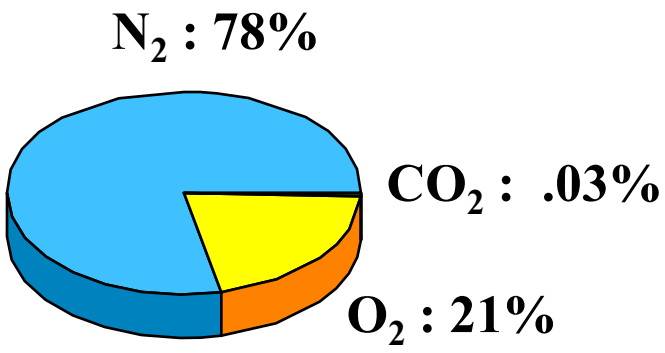
- CA is a system for storing F&V in an atmosphere that differs from normal atmosphere.

  - Reducing O_2 ↓
  - Increasing CO_2 ↑
  - Removing ethylene and other volatiles

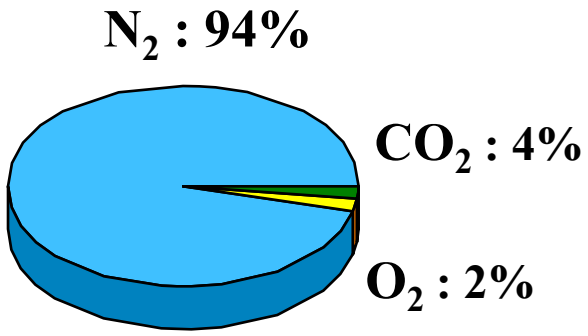
- The three main gases in CA: CO_2, O_2 and N_2.

Composition of Storage Atmosphere

Cold Storage (Normal Air)



CA Storage (Desired Atmosphere)



Desired Atmosphere

$\%CO_2$	: 4
$\%O_2$	: 2
$\%CO_2+O_2$	: 6
$\%N_2$	: 94

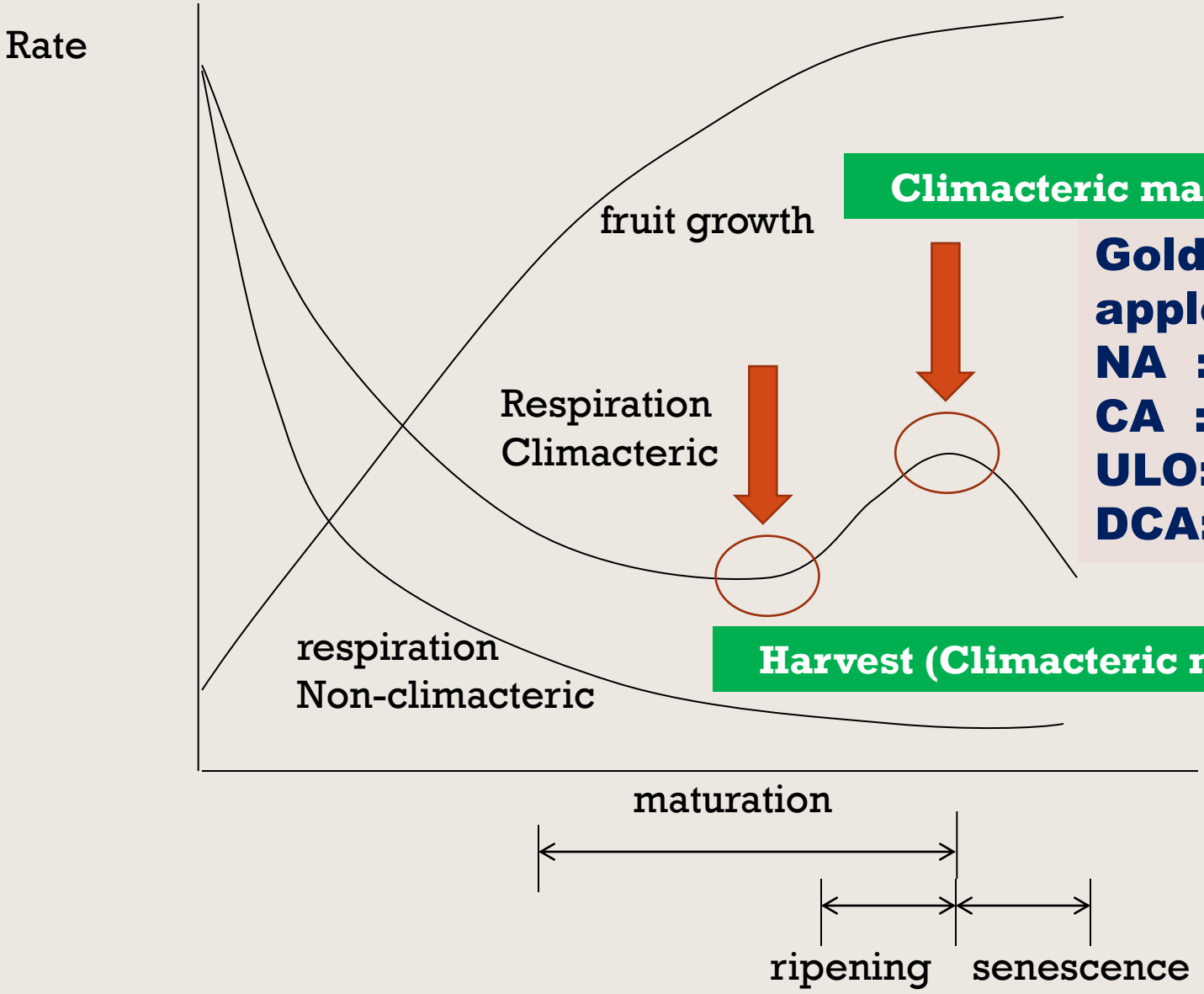
The advantages of CA storage

- **Reduce:** - metabolic activity and oxidation,
  - respiration rate and ethylene production,

- **Control:** - ripening and senescence,
  - loss of acidity, sugars, vitamins, firmness
  - degradation of chlorophyll,
  - physiological disorders,
  - decay and insects,

- Maintain quality and extends storage life,
- Longer shelf life.

WHY CA STORAGE?

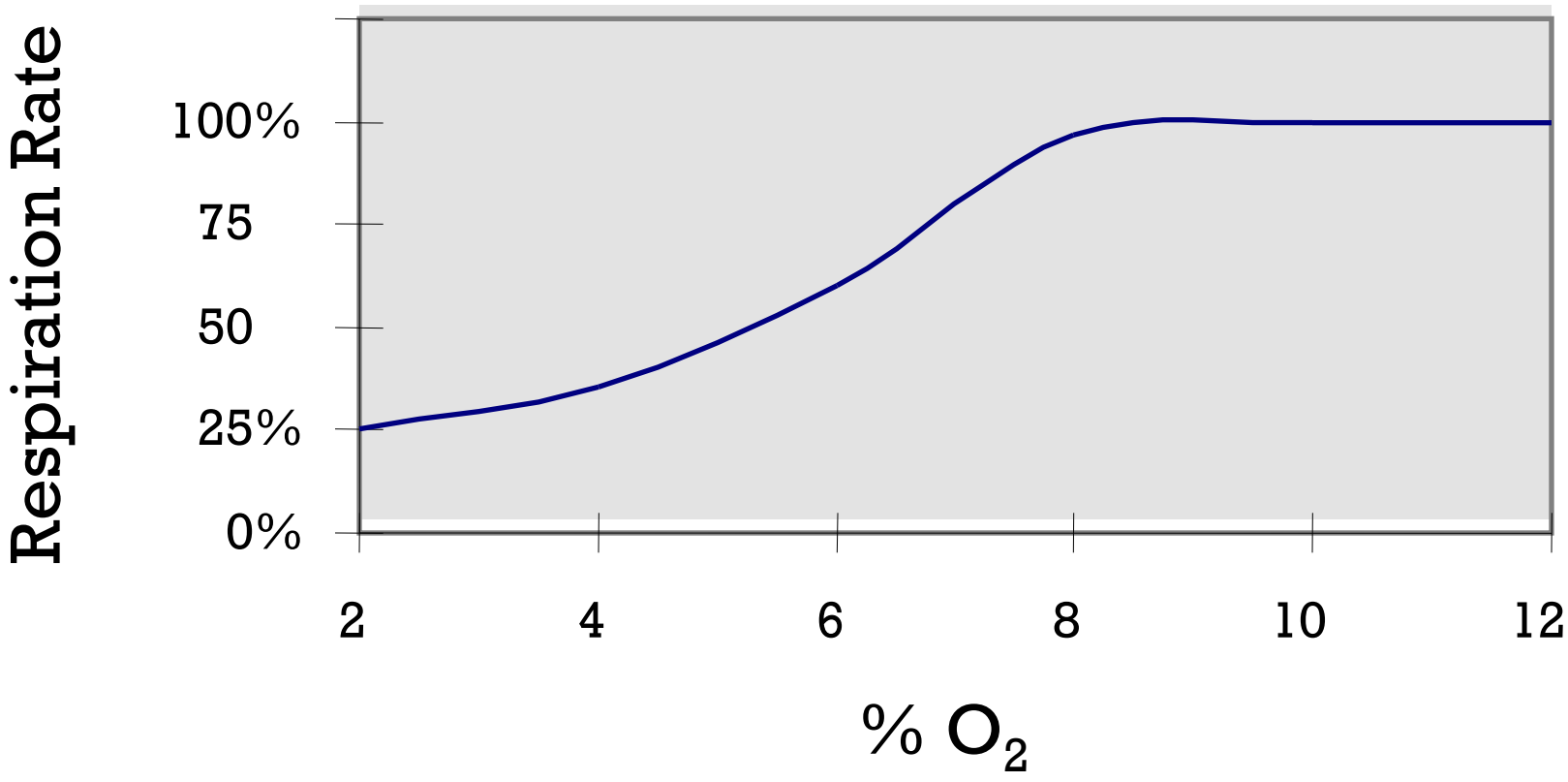


Climacteric maximum

Golden Delicious apples - at 0°C
NA : 150 days
CA : 210 days
ULO: 270 days
DCA: 300 days

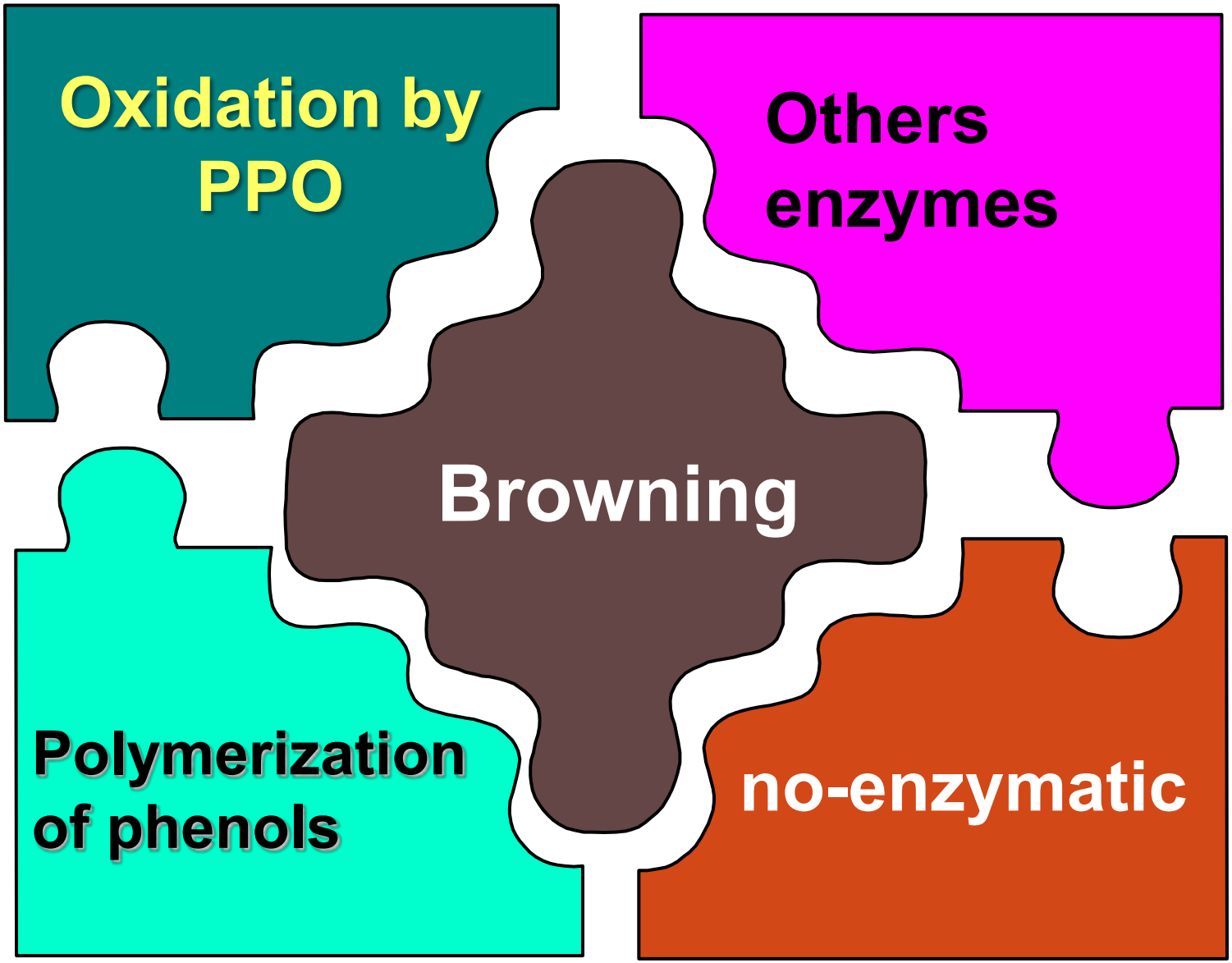
Harvest (Climacteric minimum)

Respiration and O_2 relation

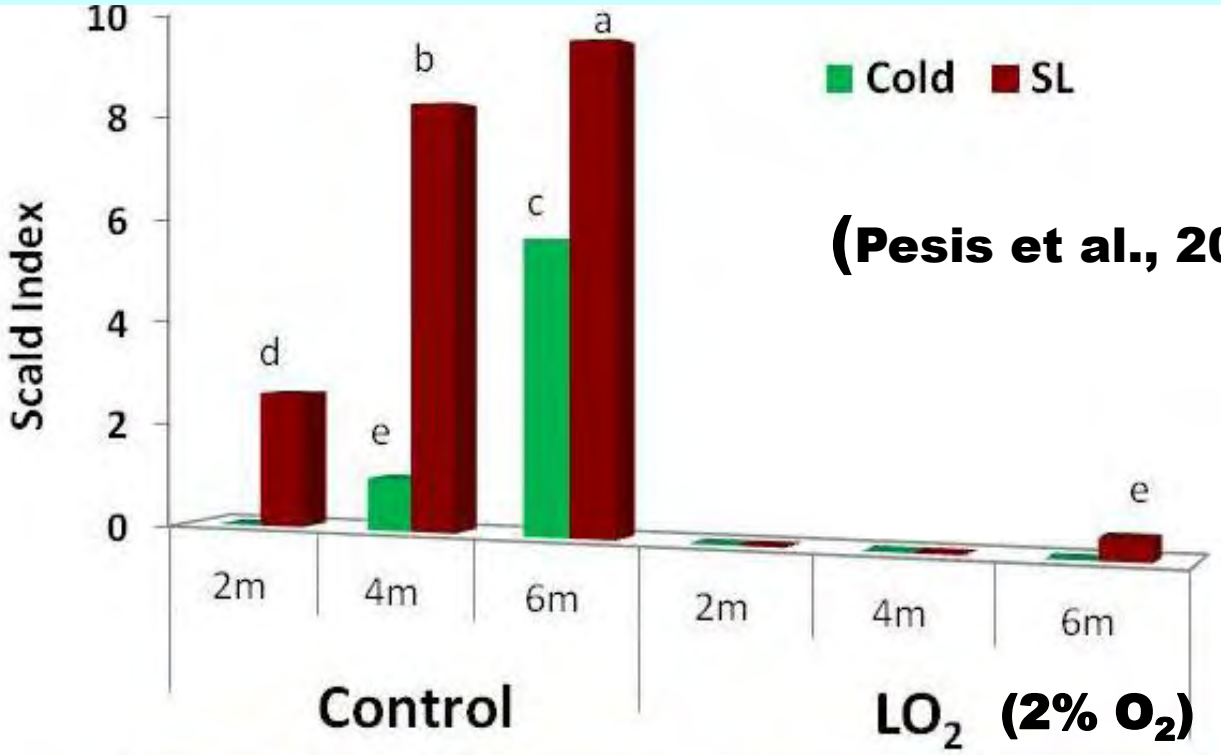


If O_2 level is too low, anaerobic respiration occurs

CONTROLLING BROWNING BY LOW O_2



Superficial Scald Control – Granny Smith apples at 0°C for 6 months + 7 d at 20°C



(Pesis et al., 2014)

DECAY CONTROL

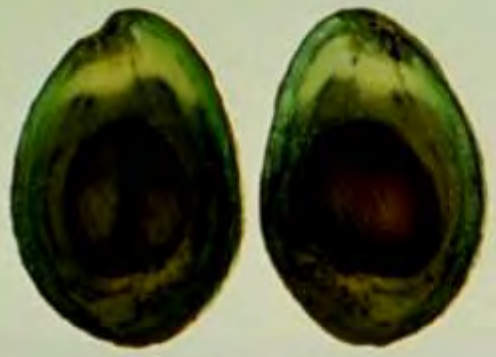
CA stored
(3% O_2 + 15% CO_2)

5 months at 6°C

Air stored

Reducing CI of Avocado with CA

2% O_2 + 2.5% CO_2

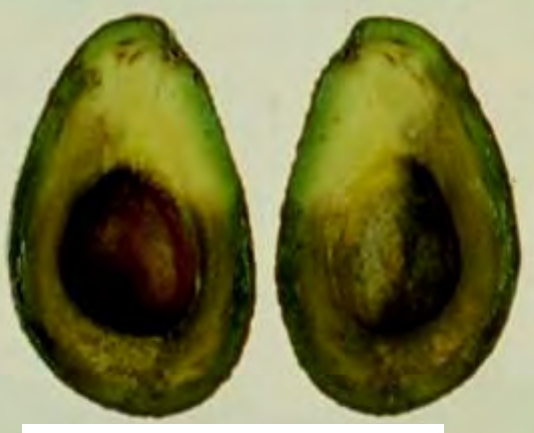


Air (Control)

<0.01ppm Ethylene

+ 0.1ppm Ethylene

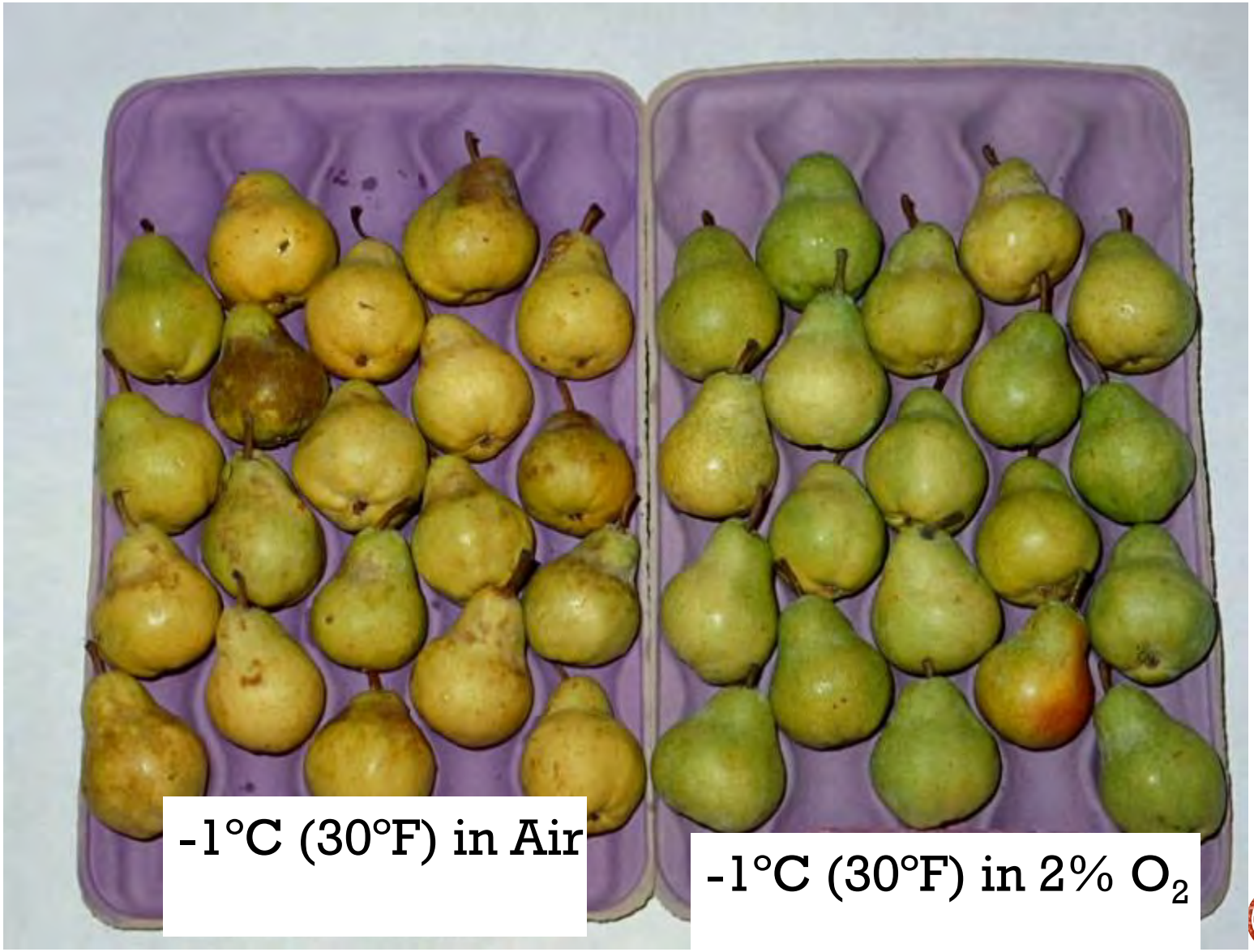
‘Hass’ Avocado
9 weeks at 5°C+
5 days at 20°C



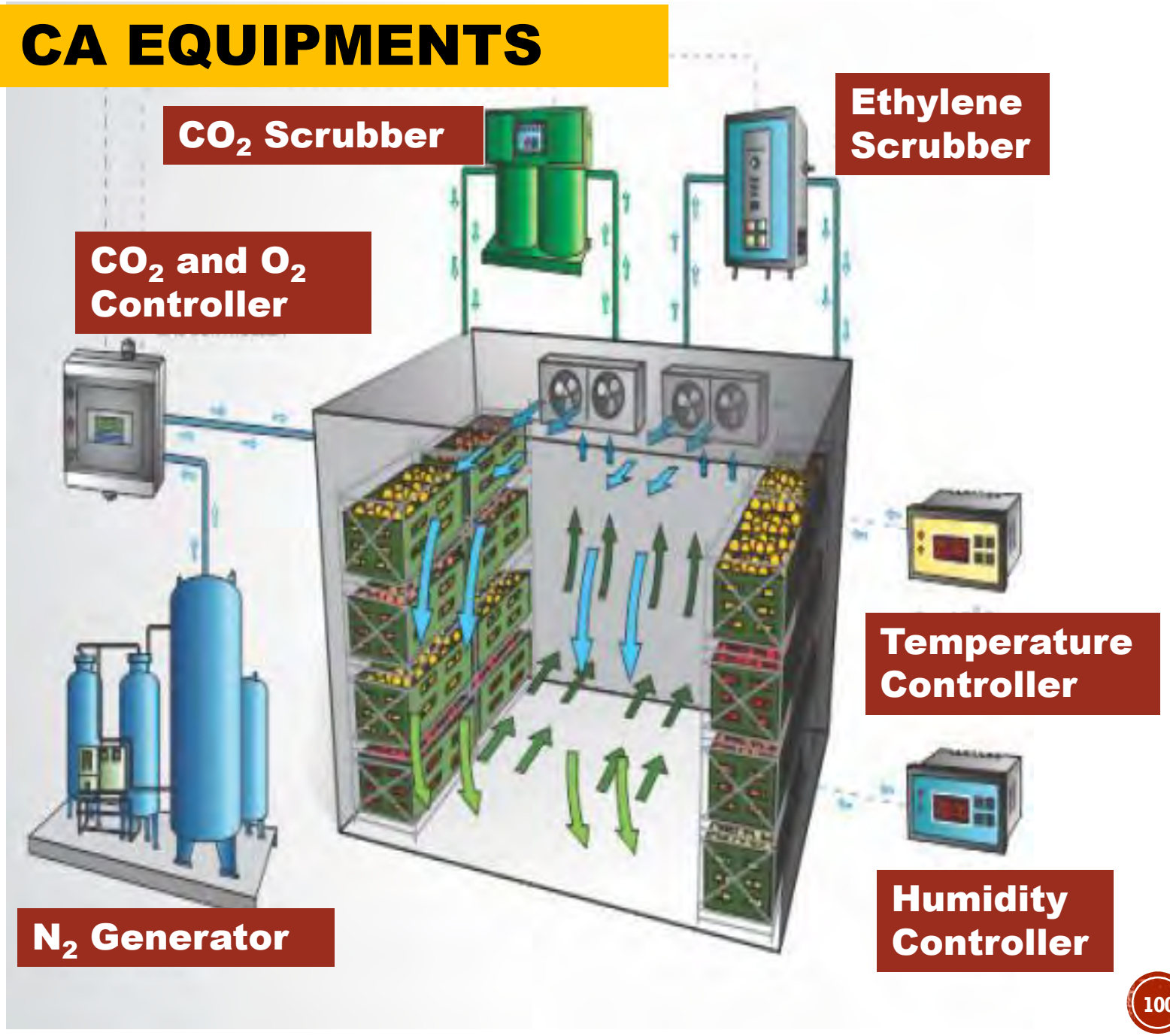
+ 1ppm Ethylene

+ 10ppm Ethylene

Six Months Storage of Bartlett Pears



CA EQUIPMENTS

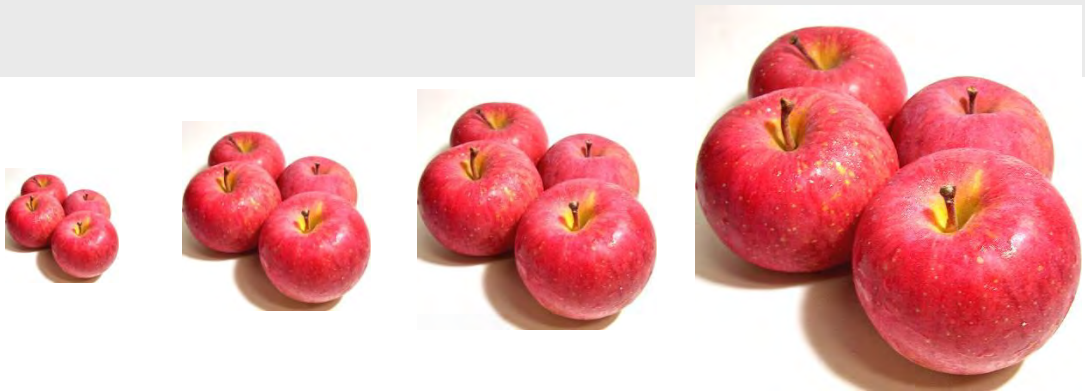


Types of CA Storage

- Conventional CA Storage (2 - 10% O_2)
- Rapid CA (Establish in 1 to 3 days instead of 20-30 days)
- Ultra low O_2 (ULO) (1% O_2)
- Sequential CA (2 weeks 0.5% O_2, then 2% O_2 thereafter)
- High CO_2 Storage (10 - 20% CO_2)
- Dynamic CA (DCA) Storage (0.4 - 1% O_2)
- Low ethylene CA Storage (< 1 µl L^{-1} C_2H_4)

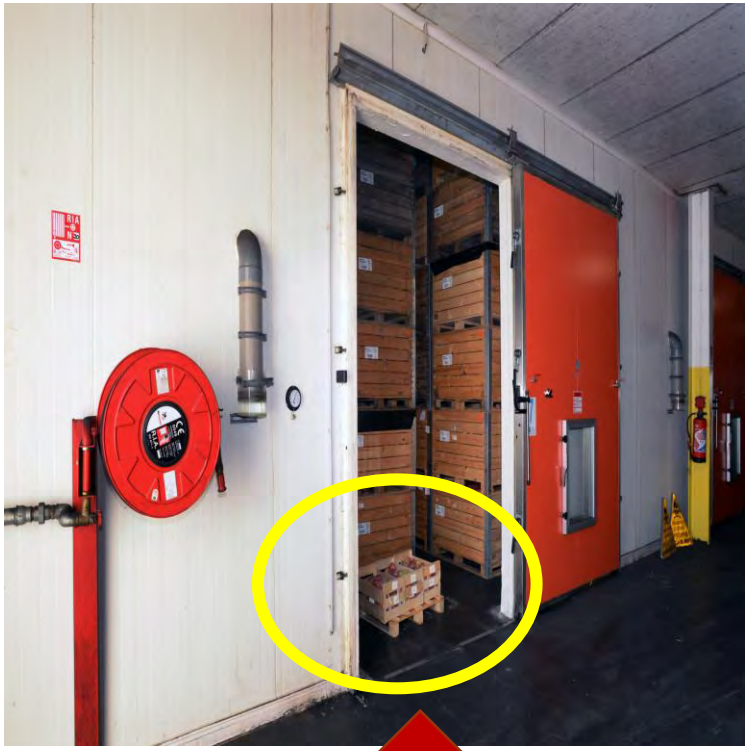
CA STORAGE ROOMS

- Gas tight rooms and doors are prerequisite,
- Made from metal-faced sandwich panels,
- The joints between panels taped with gas tight tape or painted,
- Sealed CA rooms have pressure changes. Thus, pressure relief valve is prerequisite to solve this problem.



GAS TIGHT DOOR FOR CA STORAGE AND CONTROLLING FRUIT

Sample fruit in the boxes must be placed behind the hatch (monitoring window).



Control fruit

Gas tight door and monitoring window

POTENTIAL HAZARDS OF CA STORAGE

- **Cause or aggravate some physiological disorders**

– Low O_2 injury
– High CO_2 injury

- **Cause irregular ripening**

– Appearance, aroma, flavor

- **Induces off-flavors/odors**

– Anaerobic volatiles

- **Increase decay susceptibility in some produce**

Tolerance to high CO_2 levels (Kader, 2003)

Max. CO_2 %	Commodities
2	Most Cvs. apples, apricot, pear, grape, tomato, lettuce, celery, artichoke
5	Peach, plum, orange, avocado, banana, kiwifruit, cauliflower
10	Grapefruit, lemon, lime, persimmon, pineapple, cucumber, asparagus, broccoli
15	Strawberry, cherry, cantaloupe, fig, pomegranate

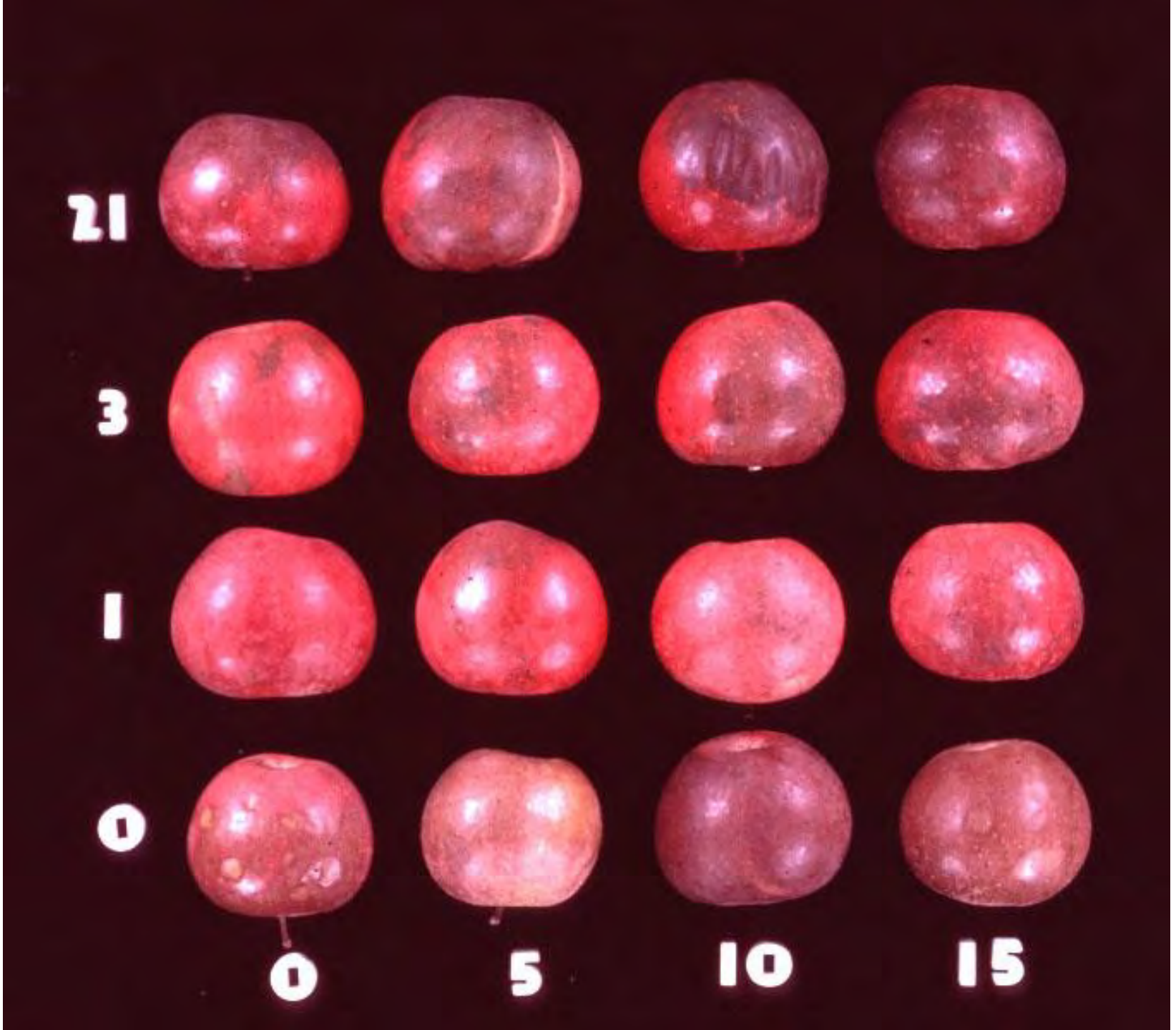
Tolerance to low O_2 levels (Kader, 2003)

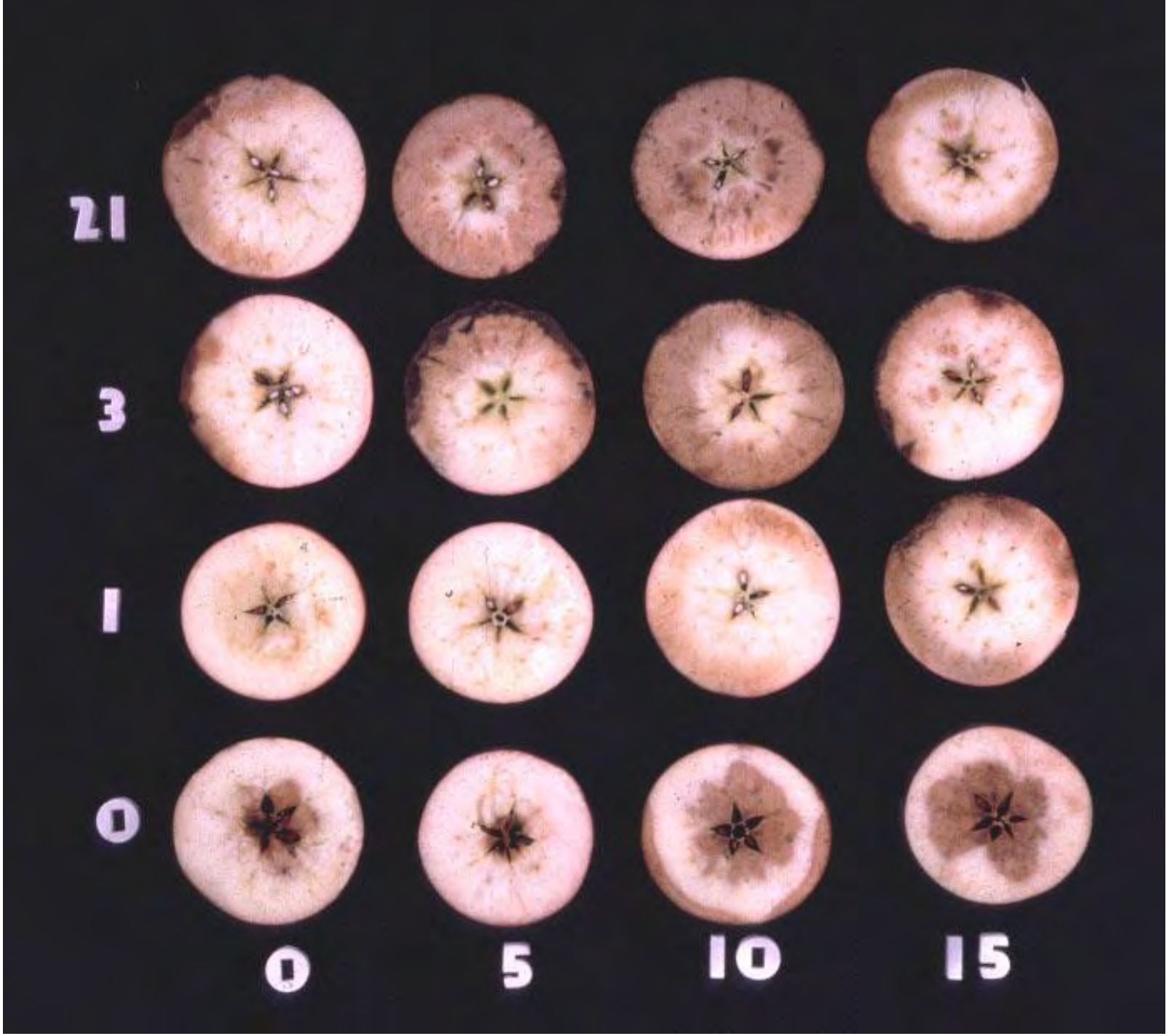
Minimum O_2 %	Commodities
0.5	Nuts, dried fruits & vegetables, Some Cvs. apples
1.0	Most Cvs. apples & pears, broccoli, most min. processed F & V, mushrooms
2.0	Some Cvs. apples & pears, kiwifruit, peach, strawberry, cantaloupe, lettuce, cabbage
3.0	Avocado, persimmon, tomato, pepper, cucumber, pomegranate
5.0	Citrus, asparagus, potato, sweet potato

High CO_2 injury

Golden Delicious apple

Honeycrisp apple


21
3
1
0
0
5
10
15


21
3
1
0
0
5
10
15

Optimum levels for CA storage of apples (Kupferman, 2001)

Cultivar—apples	Country	O_2 (%)	CO_2 (%)	Temp (˚C)	Storage life (month)
McIntosh	USA (MI)	1.5	<3	3.5	4 to 5
Braeburn	New Zealand	3	<1.0	0.5	6
	South Africa	1.5	1.5	-0.5	8
	USA (WA)	1.5	0.5	0 - 1	10
Cortland	Canada (NS)	1.5	1.5	3	8 - 10
Cox's Orange	Netherlands	1.3	0.7	4	6.5
	New Zealand	2	<2.0	3.0	3
Elstar	Netherlands	1 - 1.2	2.5	1.8	7

Optimum levels for CA storage of apples (Kupferman, 2001)

Cultivar—apples	Country	O_2 (%)	CO_2 (%)	Temp (˚C)	Storage life (month)
Empire	Canada (NS)	2	0.5	2.0 - 2.5	8
	USA (MI)	1.5	<1.0	3.5	5 - 6
	New Zealand	2	<1.0	0.5	6
Fuji	USA (WA)	2.0	0.5	1	12
Gala	Canada (NS)	1.5	1.5	0 - 0.5	8
Gloster	Canada (NS)	1.5	1.5	0 - 0.5	10
Golden Delicious	Italy	1	2	1 - 2	8 - 9
	Netherlands	1 - 1.2	4	1	8
	South Africa	1.5	2.5	-0.5	9
	USA (MI)	1.5	<3	0	6 - 8
	USA (WA)	2	1.5	0 - 1	9

Optimum levels for CA storage of apples (Kupferman, 2001)

Cultivar—apples	Country	O_2 (%)	CO_2 (%)	Temp (°C)	Storage life (month)
Granny Smith	Italy	1	1	0	7 – 8
	New Zealand	2	2	0.5	6
	South Africa	1.5	1.5	-0.5 - +0.5	11
	USA (WA)	1.5	0.5	0 - 1	10
Red Delicious	Canada (NS)	2.5	4.5	0 to 0.5	10
Idared	Canada (NS)	2	0.5 - 1.5	0 - 3.0	10
	USA (MI)	1.5	<3	0	7 – 8
Jonagold	Canada (NS)	1.5	1.5	0 - 0.5	10
Jonathan	USA (MI)	1.5	<3	0	5 - 6

Optimum conditions for CA storage of pears (Kupferman, 2001)

Cultivar—pears	Country	O_2 (%)	CO_2 (%)	Temp (˚C)	Storage life (month)
Anjou	USA (WA)	1.5	0.3	-0.5 - 0	9
Beurre Bosc	South Africa	1.5	1.5	-0.5	4
Conference	Netherlands	2.5	0.7	-1	7.5
Doyenne du Comice	South Africa	1.5	1.5	-0.5	6
	New Zealand	2	<1	-0.5	3
Forelle	South Africa	1.5	0.0	-0.5	7
Packham's Triumph	New Zealand	2	<1.0	-0.5	5
Williams Bon Chretien	South Africa	1	0.0	0.0 - -0.5	4
Josephine	South Africa	1.5	1	-0.5	8

CA conditions for some fruit species other than apple and pear (Kader, 2003)

Species	Tempe r. (°C)	RH (%)	O_2 (%)	CO_2 (%)	Time
Avocado	5-7	90	2-3	3-10	2 - 3 months
Cherry	0	95	3-10	10-12	30 - 45 days
Kiwi	0	98	2	4-5	5 - 7 months
Pomegranate	6	95	3	15	5 months
Peach	0	95	2	4-5	30 - 50 days
Plum	0	95	2	5	2 - 5 months

CA conditions for some vegetables (Kader, 2003)

Species	Temper. (°C)	O_2 (%)	CO_2 (%)	Time
Asparagus	1 - 4	10 - 16	10 - 14	10 - 15 Days
Artichokes	0 - 1	2 - 4	2 - 3	20 - 25 days
Broccoli	0	2 - 3	5 - 10	30-45 days
Cabbage	0	2 - 3	4 - 5	6 months
Cauliflower	0	3 - 4	5 - 7	40-50 days
Cucumber	12	1 - 4	0	20 days
Garlic	-1	3	5	7 months
Green beans	7	3 - 4	4 - 5	10 days
Leeks	0	2 - 4	5 - 10	5 months
Onions	0	1 - 2	0 - 1	9 months
Tomatoes	2	3 - 4	2 - 3	30 - 40 days

Classification of fruits and vegetables according to their CA storage potential (Kader, 2003)

Storage Duration (month)	Commodities
>12	Almond, Brazil nut, cashew, filbert, macadamia, pecan, pistachio, walnut, dried fruits and vegetables
6 -12	Most cultivars of apples and European pears
3 – 6	Cabbage, Chinese cabbage, kiwifruit, persimmon, some plum cvs., pomegranate, some cultivars of Asian pears, pears
1 – 3	Avocado, banana, cherry, grape, mango, olive, onion, some cultivars of nectarine, peach and plum, tomato
<1	Asparagus, broccoli, berries, fig, lettuce, melons, papaya, pineapple, strawberry, fresh-cut produce

ETHYLENE

RIPENING HORMONE

Threshold = 0.1 to 10 ppm

ETHYLENE - AN IMPORTANT FACTOR

- Useful:
  - Accelerates ripening
  - Causes abscission
- A problem:
  - Accelerates ripening
  - Accelerates senescence
  - Causes abscission

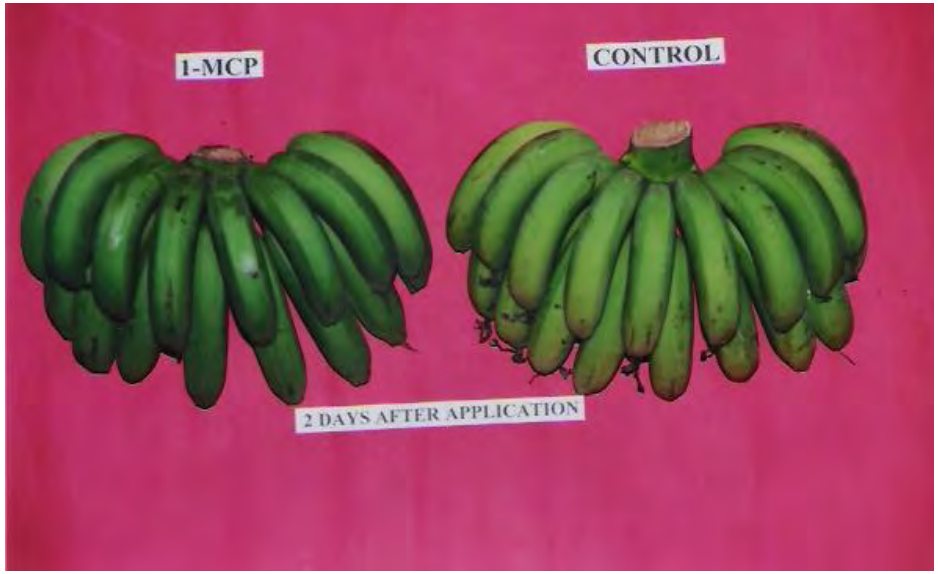
CHARACTERISTICS OF ETHYLENE RESPONSES

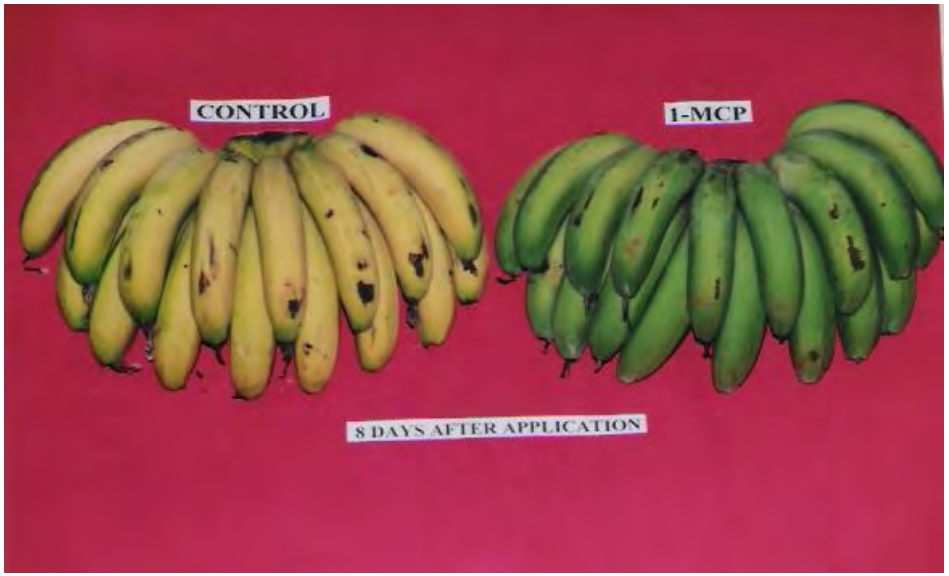
- **Threshold concentration (0.1 ppm)**
- **Plateau concentration (10 ppm)**
- **Associated respiration rise**
- **Temperature optimum (15 – 25°C)**
- **CO_2 (>1%) inhibits**

INHIBITION OF ETHYLENE ACTION

- **Controlled and modified atmospheres**
  - **Low oxygen, high CO_2 inhibit production, action**
- **Silver thiosulfate**
  - **Registered for cut flowers**
- **1-MCP (SmartFresh™)**

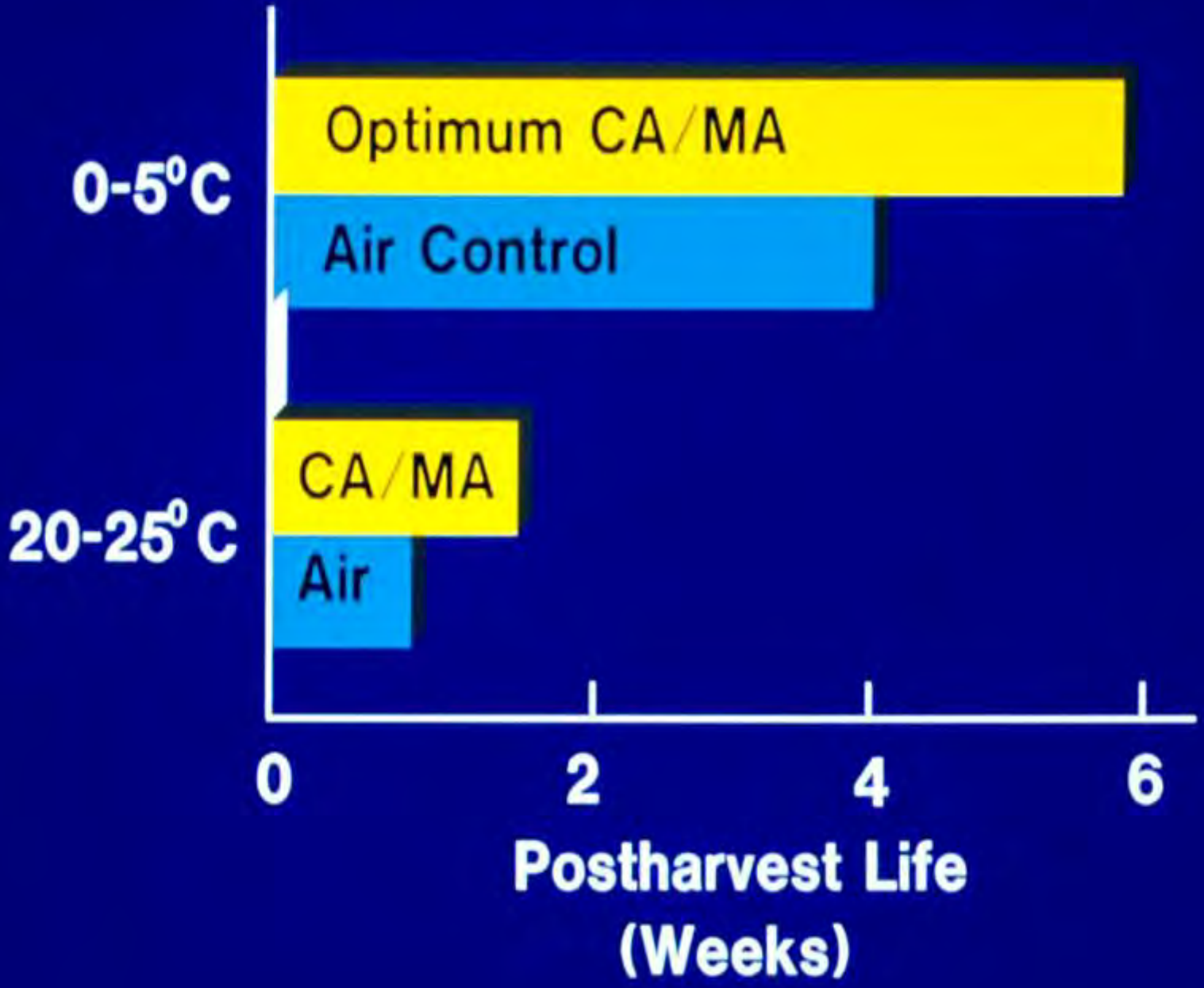
USE OF 1-MCP


1-MCP
CONTROL
2 DAYS AFTER APPLICATION

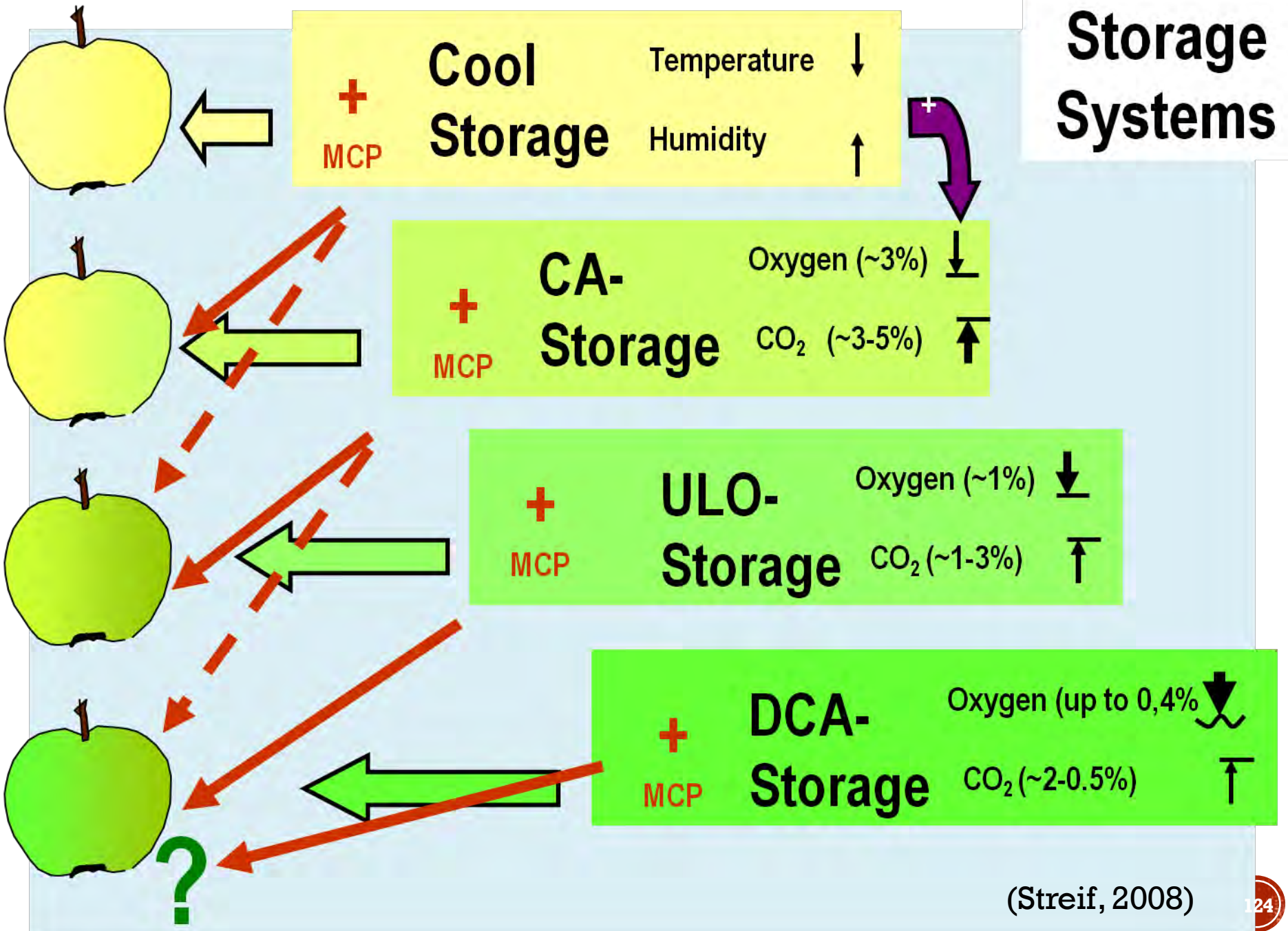

CONTROL
1-MCP
8 DAYS AFTER APPLICATION


CONTROL
1-MCP
18 DAYS AFTER APPLICATION


20°C
8 DAYS AFTER APPLICATION
CONTROL
1-MCP


0-5°C
Optimum CA/MA
Air Control
20-25°C
CA/MA
Air
0
2
4
6
Postharvest Life
(Weeks)

Storage Systems



(Streif, 2008)

10 critical point for quality maintenance

1) Harvesting at optimal maturity,
2) Minimizing mechanical injury at harvest,
3) Do not leave the product under direct sun after harvest,
4) Transportation of products from orchard to packinghouse asap,
5) Immediate cold chain management after harvest ,
6) Using appropriate technology during packaging,
7) Maximum care during handling and packaging,
8) Using appropriate packaging for the product,
9) Using appropriate transportation technology,
10) Teaching employers.

THANK YOU
FOR YOUR ATTENTION