Postharvest Handling Update
Cool Season Vegetables

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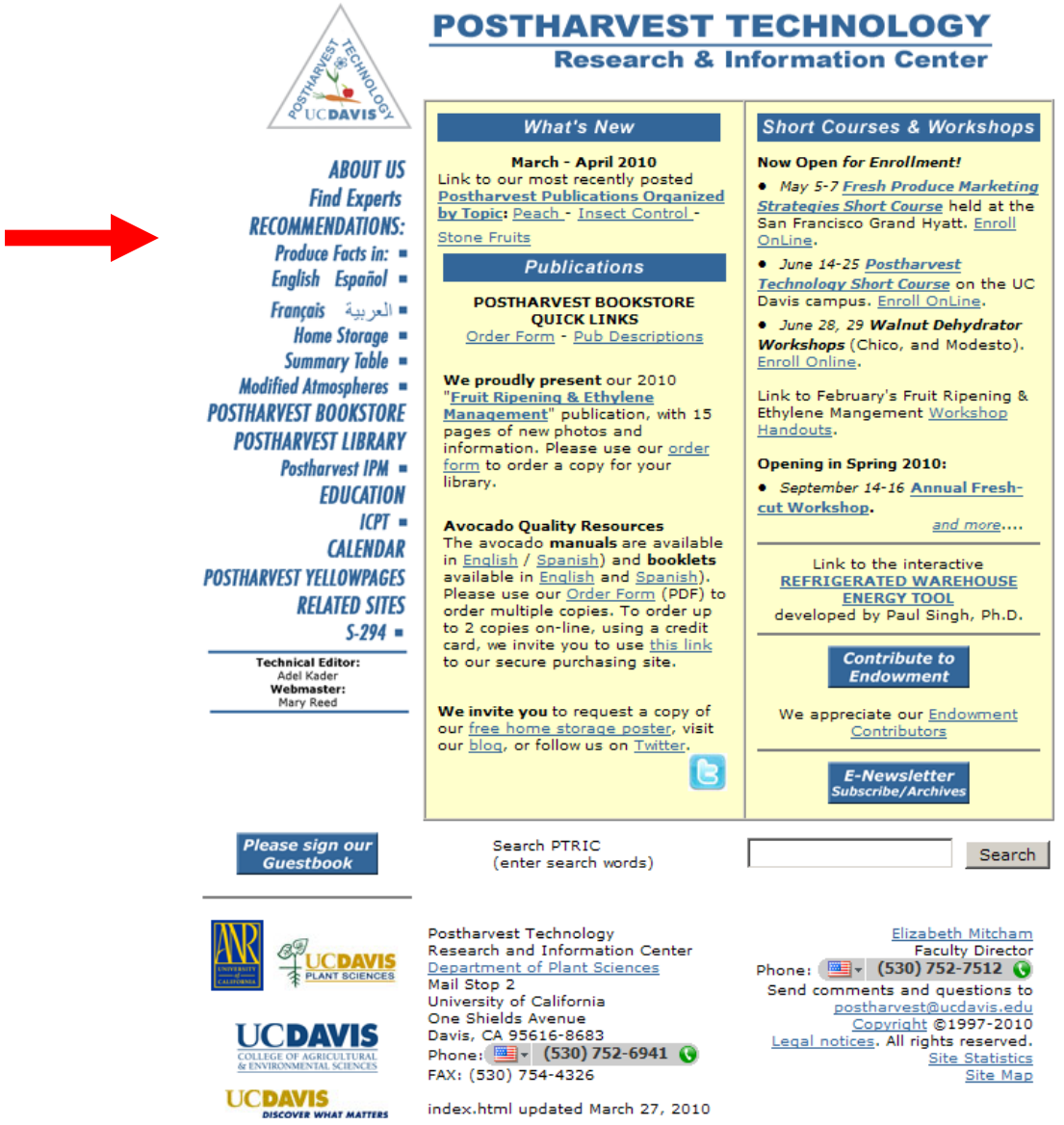
UCCE Vegetable Pest Management and Postharvest Issues
Santa Maria, June 9, 2010

http://postharvest.ucdavis.edu

Produce Facts

- Harvest indices
- Quality indices
- Temperature and RH
- Freezing point/damage
- Respiration rates
- Ethylene production
- Effects of ethylene
- Effects of modified atmospheres
- Physiological disorders
- Postharvest diseases
- Mechanical injury
- PHOTOS

140
Fruits
Vegetables
Flowers



Causes of Quality & Postharvest Losses

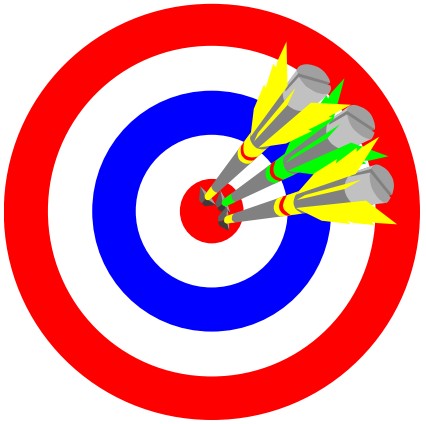
Leafy Vegetables

- Lettuces
- Spinach
- Cabbage
- Chard
- Broccoli
- Celery
- Herbs
- Endives
- Asparagus
- Green Onions

- Water loss
- Mechanical damage
- Loss of chlorophyll and other nutrients
- Respiration rates
- Microbial growth
- Sensitivity to ethylene

Fresh Produce Deterioration

- **Metabolic changes:**
  - **respiration, ethylene,**
  - **texture, aroma, etc.**
- **Growth and development**
- **Transpiration**
- **Mechanical injury**
- **Physiological disorders**
- **Decay; microbial growth**

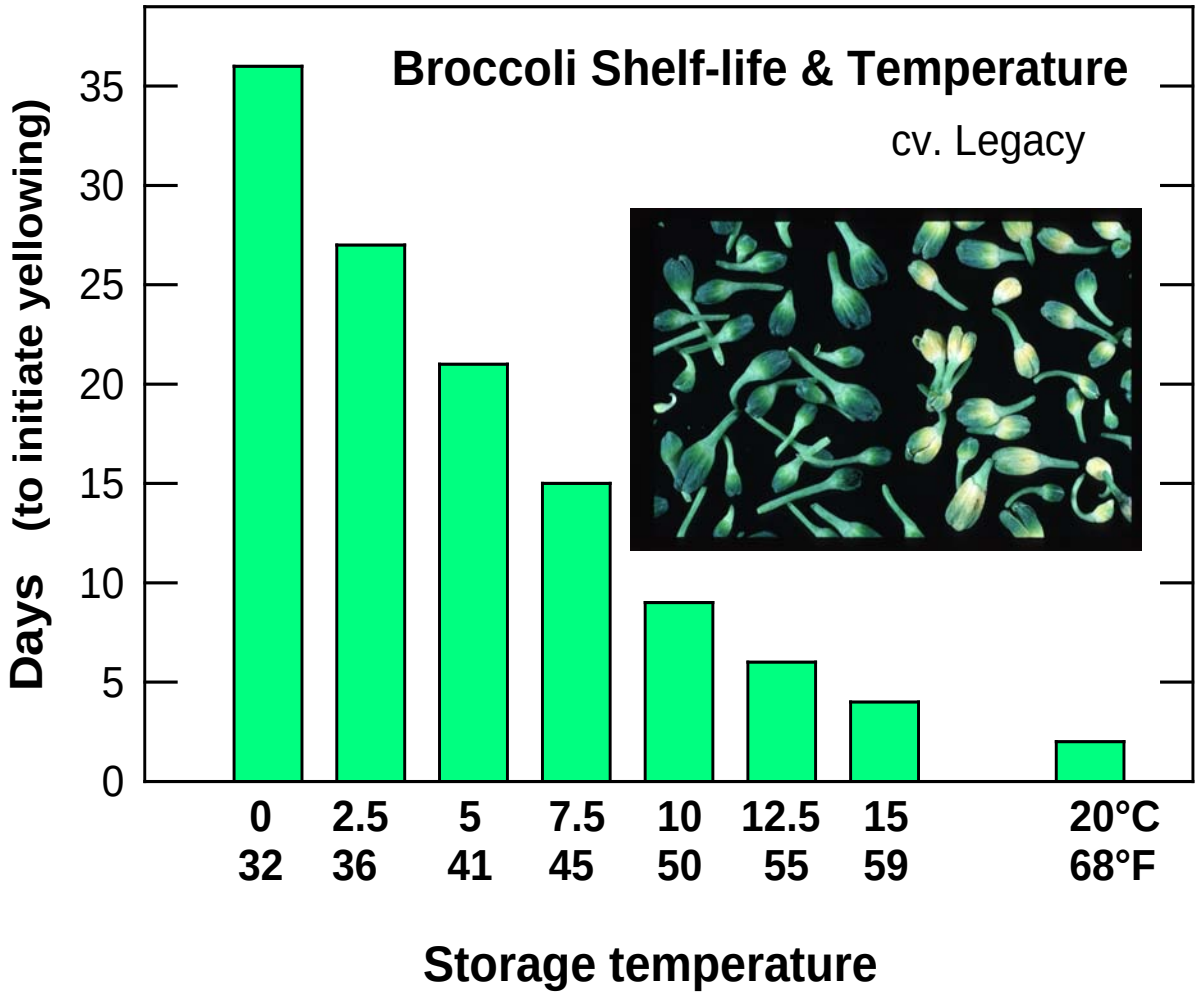


Temperature Affects All Causes of Deterioration

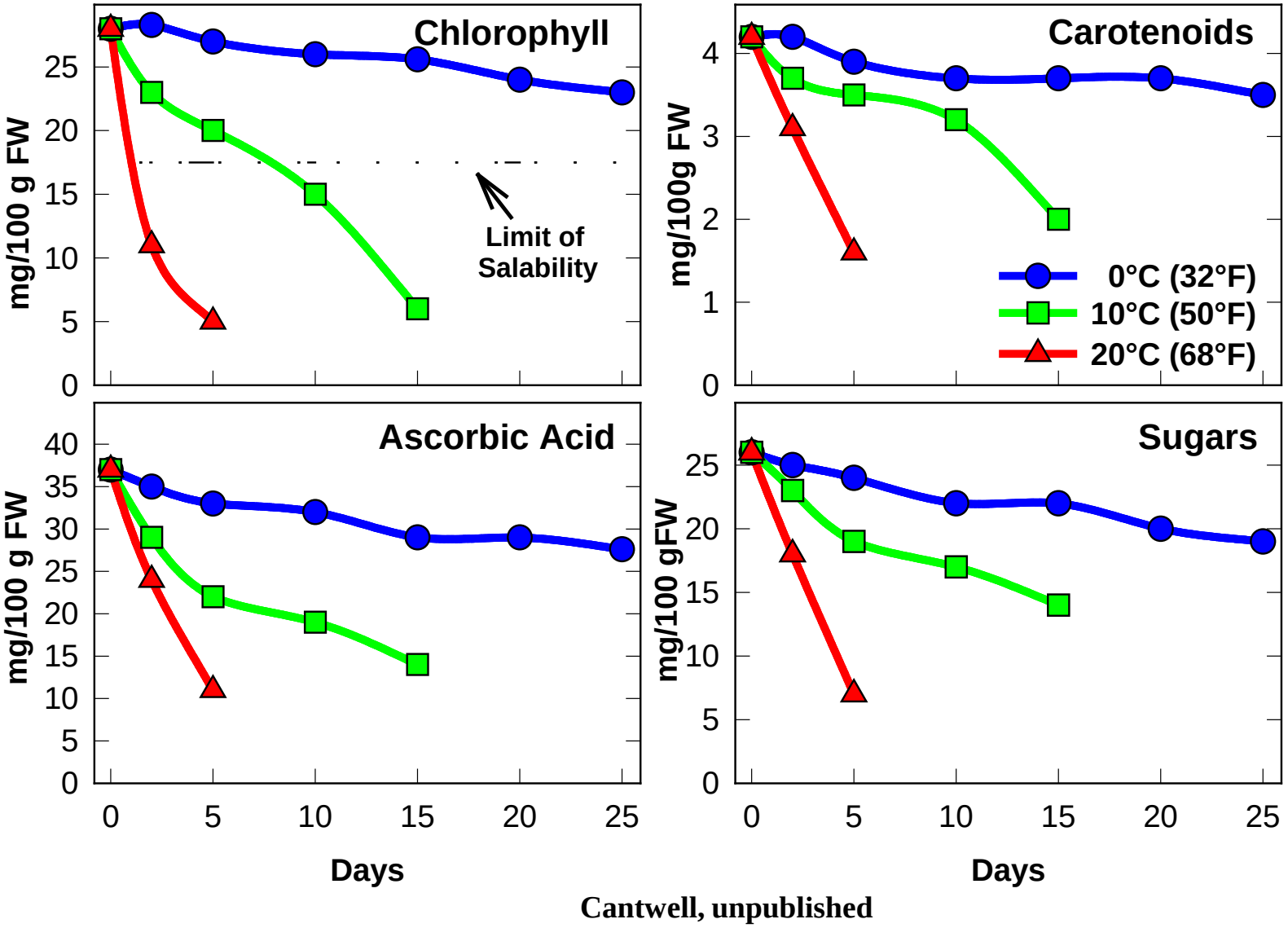
Postharvest Handling Update
Cool Season Vegetables

- Broccoli
  - Iced to iceless product; firmness and water loss
- Specialty Brassicas
  - Compare postharvest performance to broccoli
- Fresh-cut and modified atmospheres
  - Response of broccoli and sugar snap peas
- Cauliflower --needs postharvest work
- Cabbage Quality and Temperature
- Lettuce Varieties
  - Fresh-cut performance

Fresh appearance
Green florets
Tender stem
No discoloration
No breakage
No decay
No off-odors

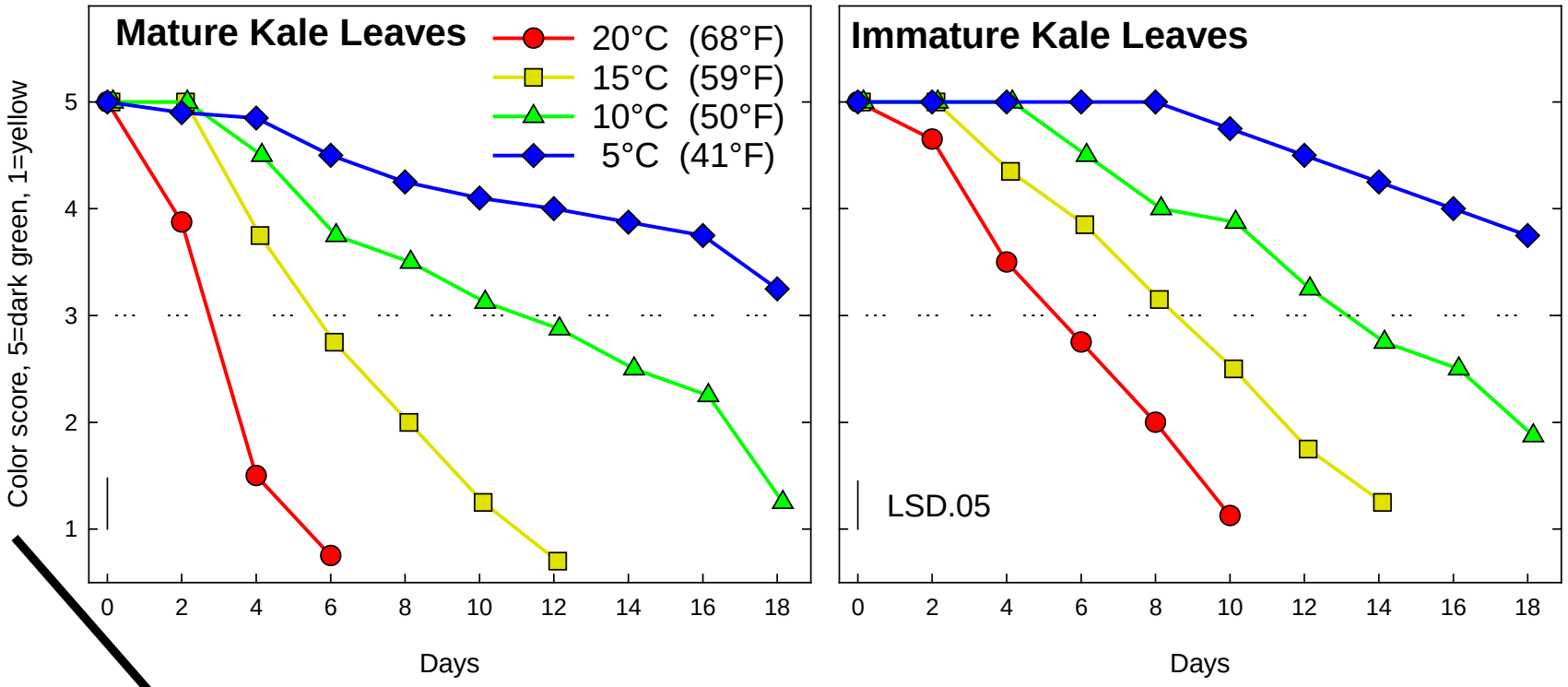


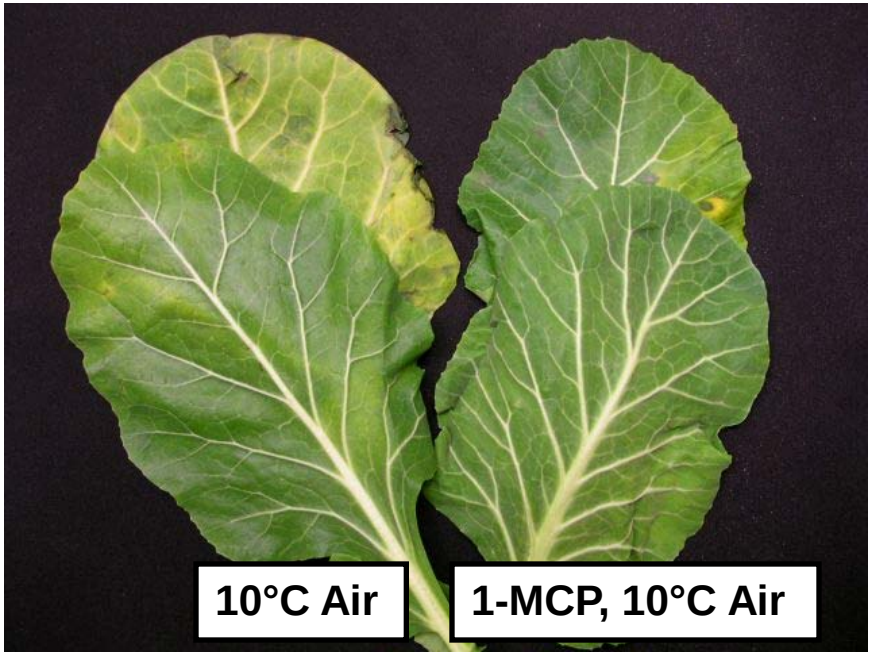
Broccoli Compositional Quality and Storage Temperature

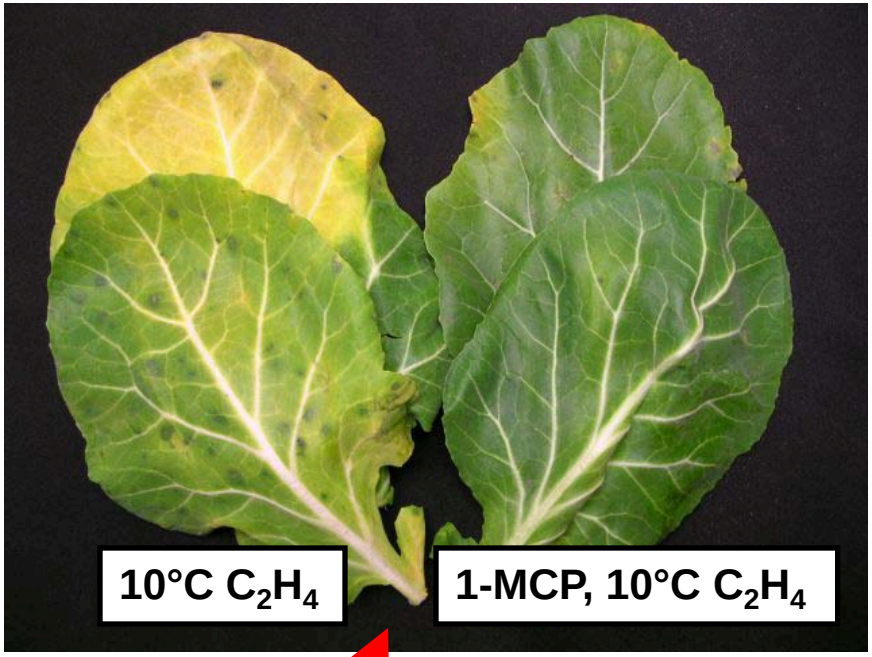


Cantwell, unpublished

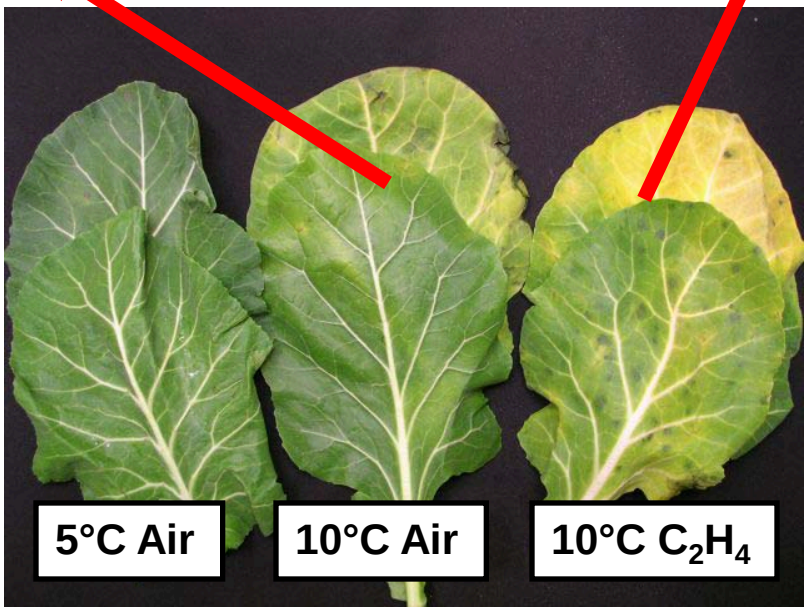
Loss of green color by **mature** and **immature Kale** leaves stored at 4 temperatures for up to 18 days.







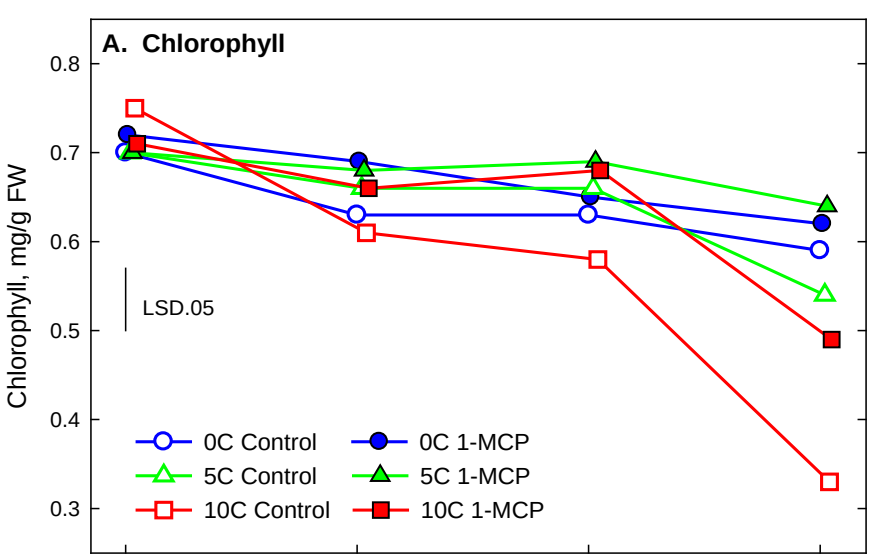
Collards

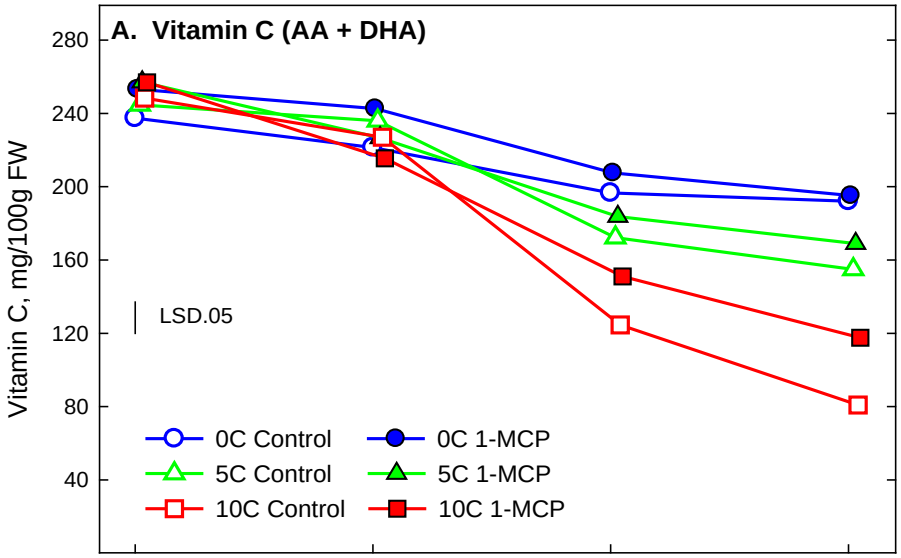


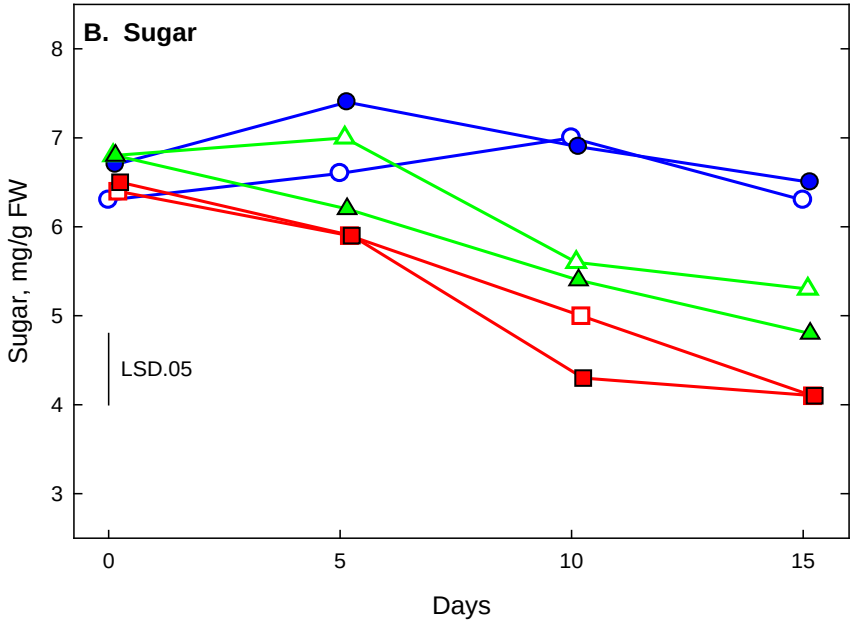
12 days; 8 ppm C2H4;
500 ppb 1-MCP

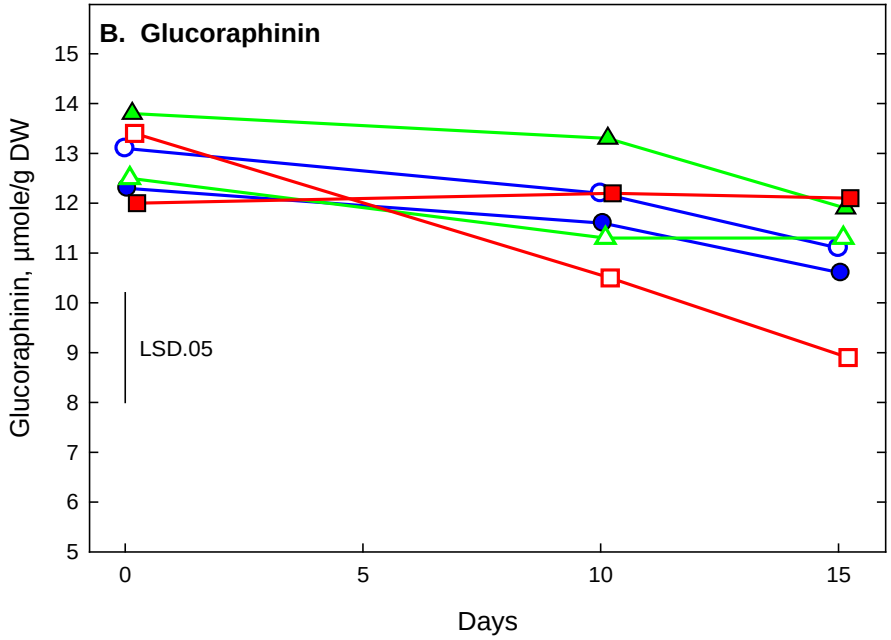
1-MCP=1-methyl-cyclopropene, SmartFresh™, AgroFresh

Broccoli and Temperature and 1-MCP (no ethylene exposure)









Glucoraphin produces Sulforaphane – potent Phase 2 Enzyme Inducer, inhibit cancer

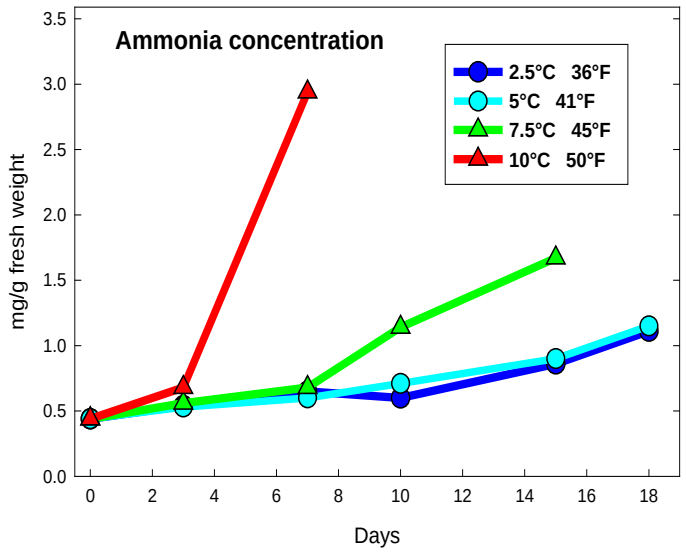
Specialty Brassicas Comparative Study

Gai-lan
Choi-sum
Broccoli raab, rapini
Broccolini

Marketable quality
Compositional quality
Response to Temperature
Response to atmospheres

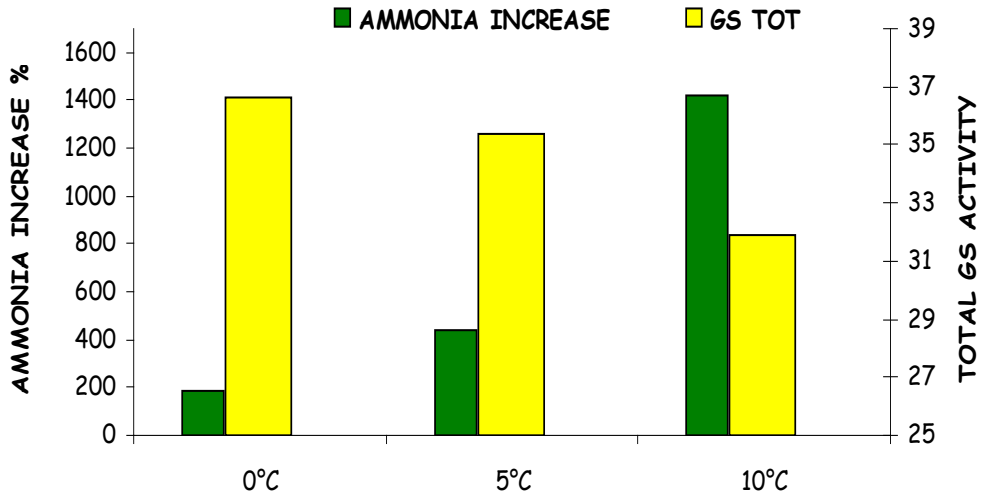
Broccoli raab	**Florets**			**Stem Tissue**		
Component	Initial	5C, 8d	10C 8d	Initial	5C 8d	10C 8d
Total sugars, mg/gFW	5.2	4.5	3.7	17.4	14.4	12.0
Ammonia, µmole/100gFW	1.1	1.4	2.3	0.5	1.0	1.1
Antioxidant activity mg Trolox/100g FW	117	100	92	47	43	32
Vitamin C, mg/100g FW	235	176	112	87	86	88

M. Cefola, G. Hong, M. Cantwell, R. Paiva e G. Colelli. 2009



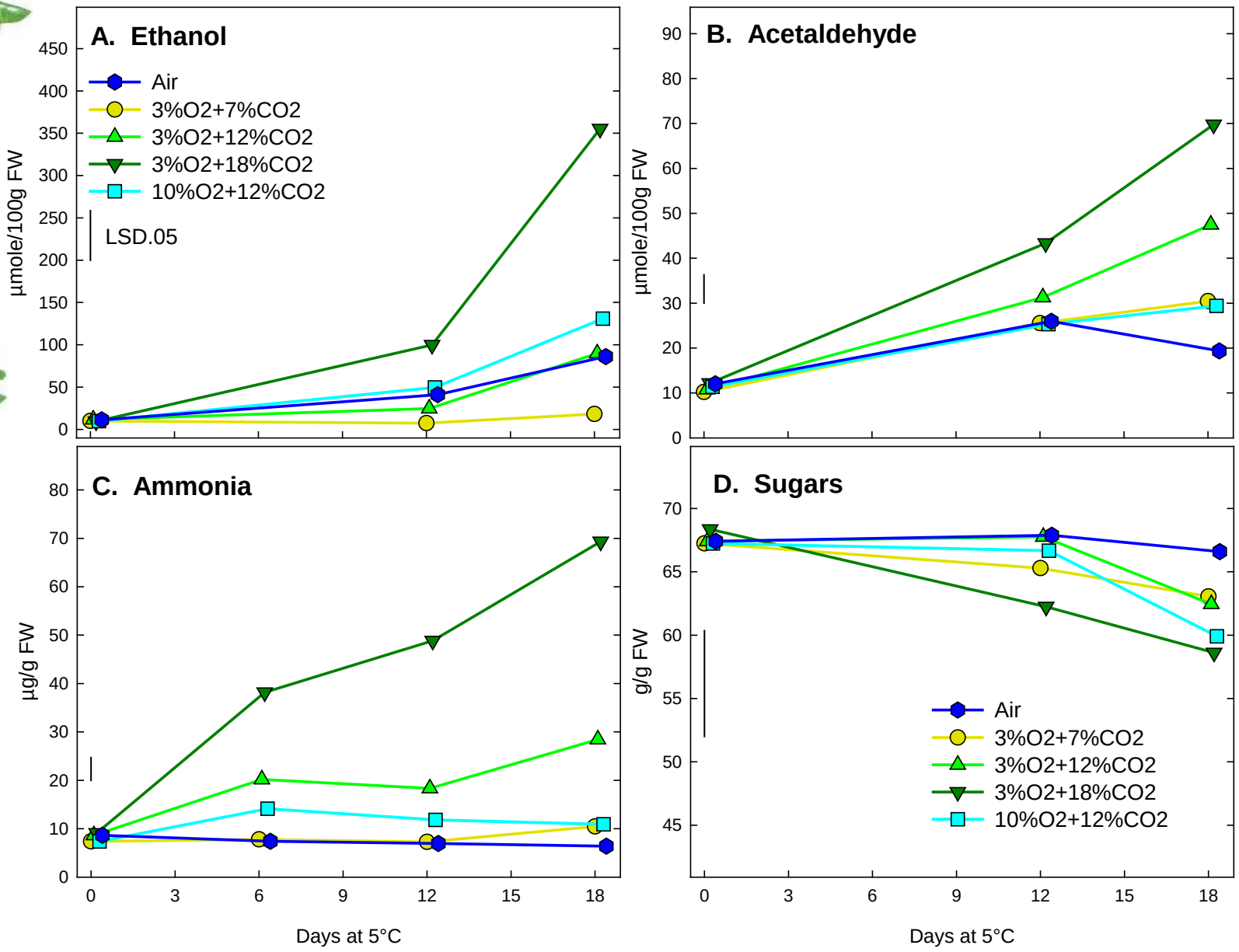
Changes in ammonia in spinach at 4 temperatures over 18 days

Changes in ammonia and GS activity in Spinach



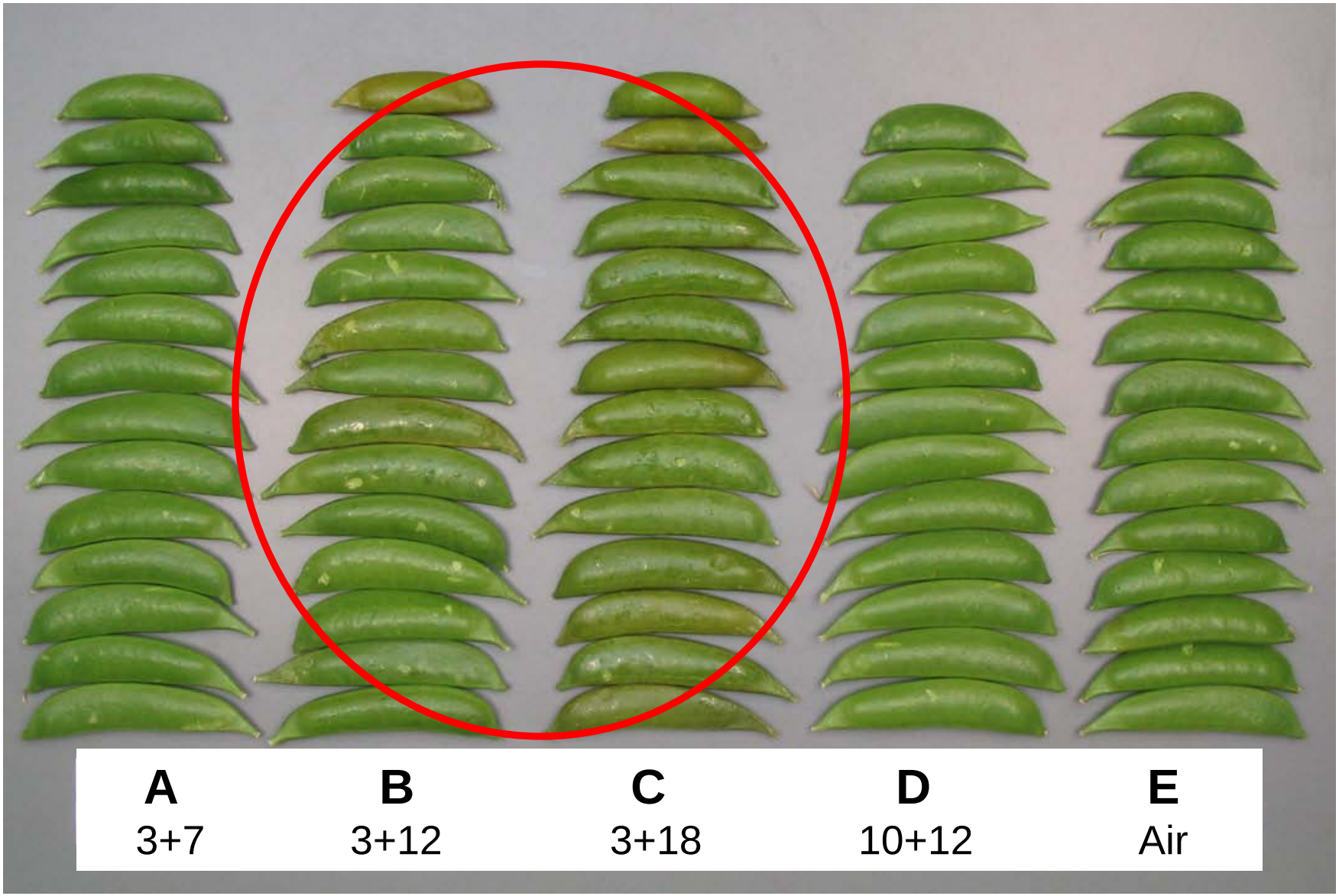
6 days, data of Eghle Catalano, 2007

Test #2


A. Ethanol
Air
3%O2+7%CO2
3%O2+12%CO2
3%O2+18%CO2
10%O2+12%CO2
LSD.05
µmole/100g FW
B. Acetaldehyde
µmole/100g FW
C. Ammonia
µg/g FW
D. Sugars
g/g FW
Air
3%O2+7%CO2
3%O2+12%CO2
3%O2+18%CO2
10%O2+12%CO2
Days at 5°C
Days at 5°C

18 days at 5°C (41°F)

Air=Best quality



DAMAGING

Broccoli Storage Conditions

- 0°C with very high humidity
- MA: 5-8% O2 + 7-10% CO2

Iceless Broccoli

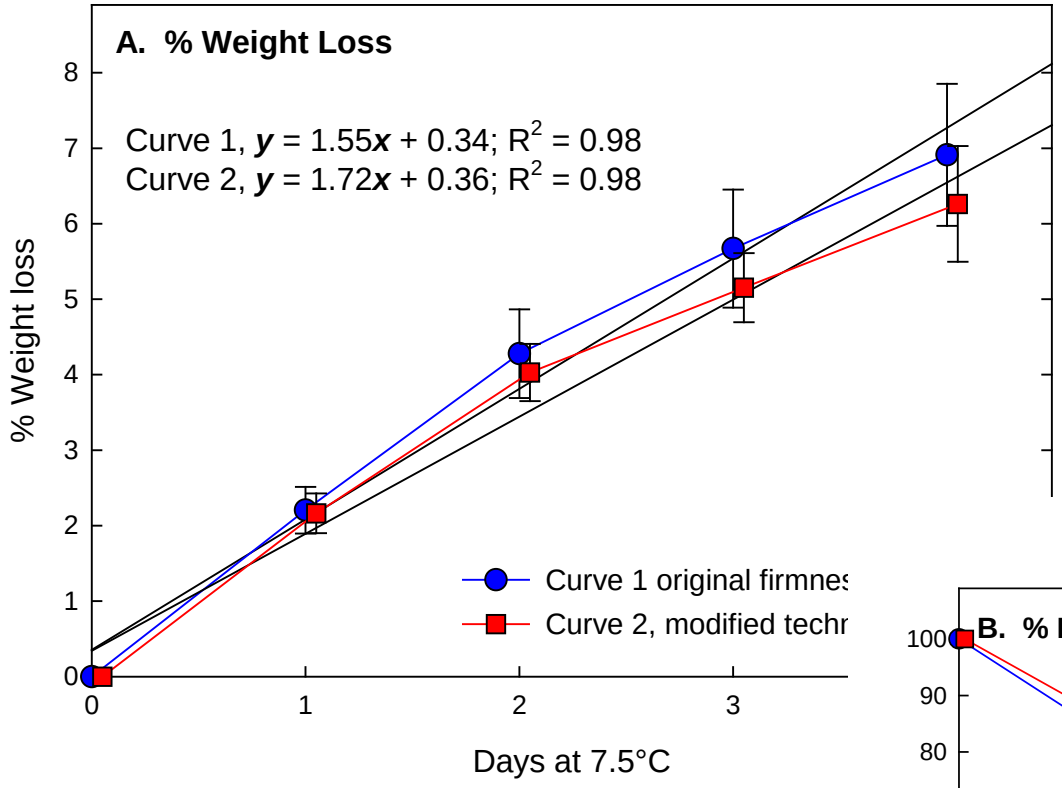
Temperature-yellowing

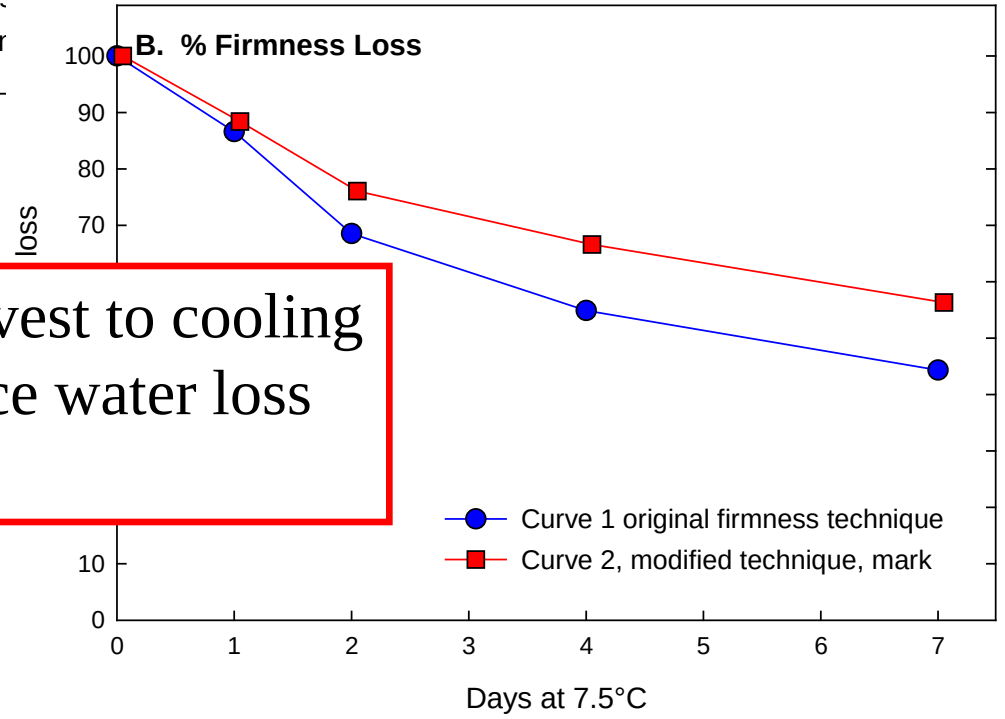
Moisture loss-softening

Table 1. Broccoli head firmness and compactness scoring and the relationship to firmness measurements on texture analyzer. This table based on preliminary 2009 data.

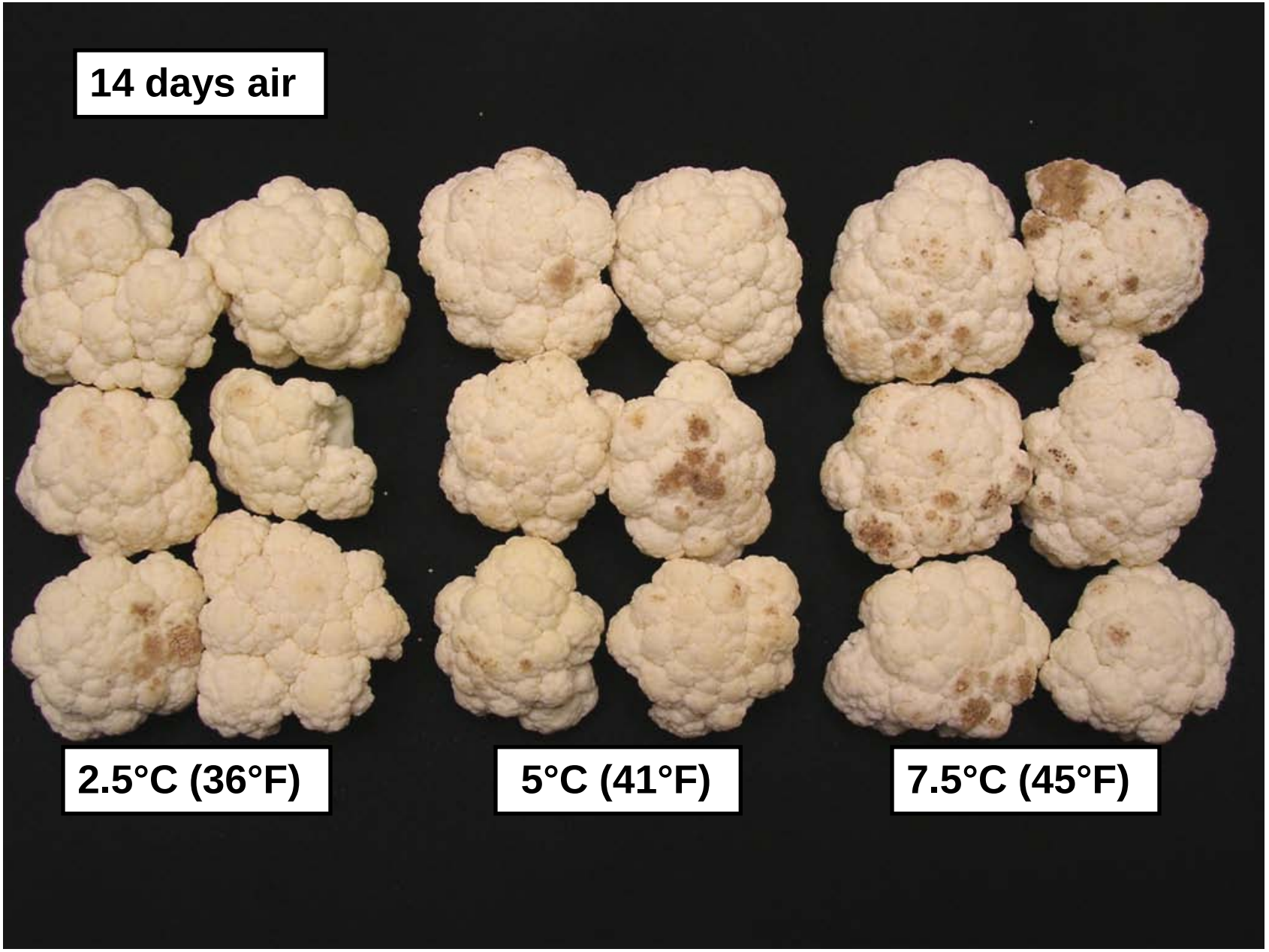
Subjective score	Description	Objective firmness N compression force*
5	Heads hard, very tight and firm	65-100N
4	Heads firm, a few outer florets may be loosened	50-80
3	Heads moderately firm, with some florets loosened**	40-60
2	Heads moderately soft, with most florets loosened	25-40
1	Heads soft, with extensive loosening of florets	10-25

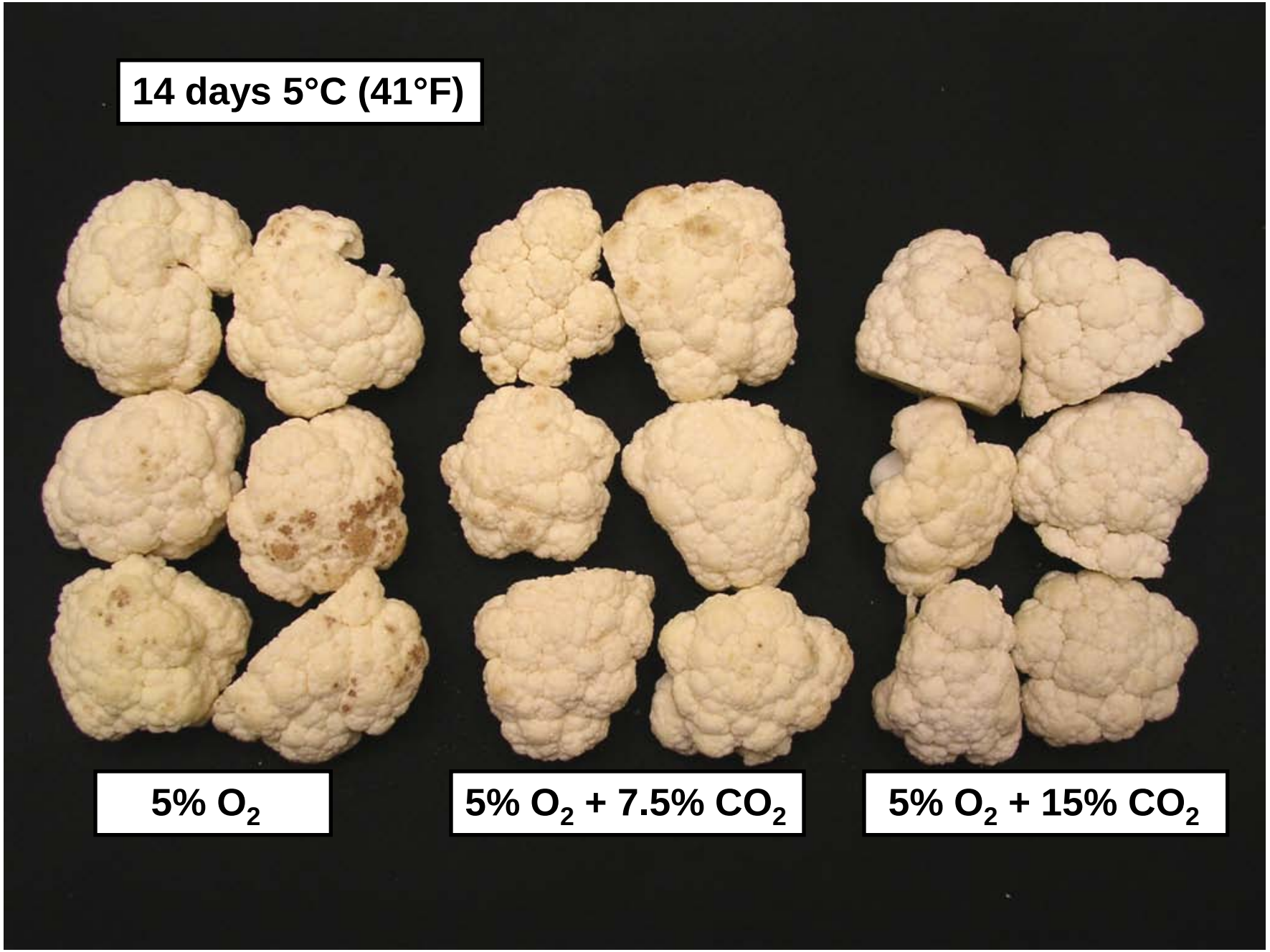
*Heads compressed with a flat disc to a depth of 7.5 mm
**A score of 3 is likely the limit of marketability at retail.





- Minimize delay from harvest to cooling
- Use plastic liners to reduce water loss
- Keep it cold


14 days air
2.5°C (36°F)
5°C (41°F)
7.5°C (45°F)


14 days 5°C (41°F)
5% O_2
5% O_2 + 7.5% CO_2
5% O_2 + 15% CO_2

14d 5°C

Air **1%O2 +15% CO2**

Quality Problems

Graying

Loss of fluid

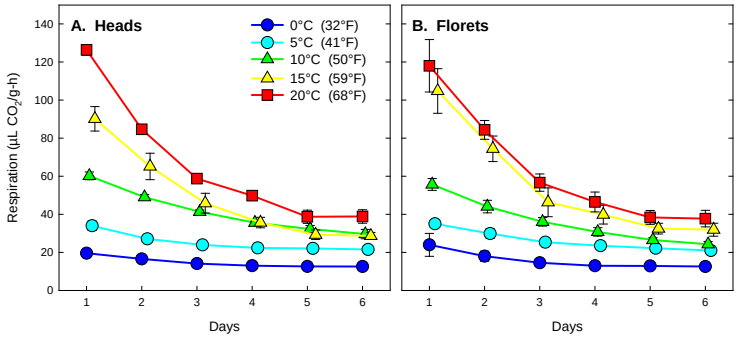
Off-odor

Cauliflower Quality

color is cream white
freedom from mechanical injury
freedom from decay
overall attractive appearance
no discoloration on cut edges
minimal number of small pieces; good integrity of cut florets
good aroma and odor as fresh or microwaved food
retain high content of sugars and Vitamin C

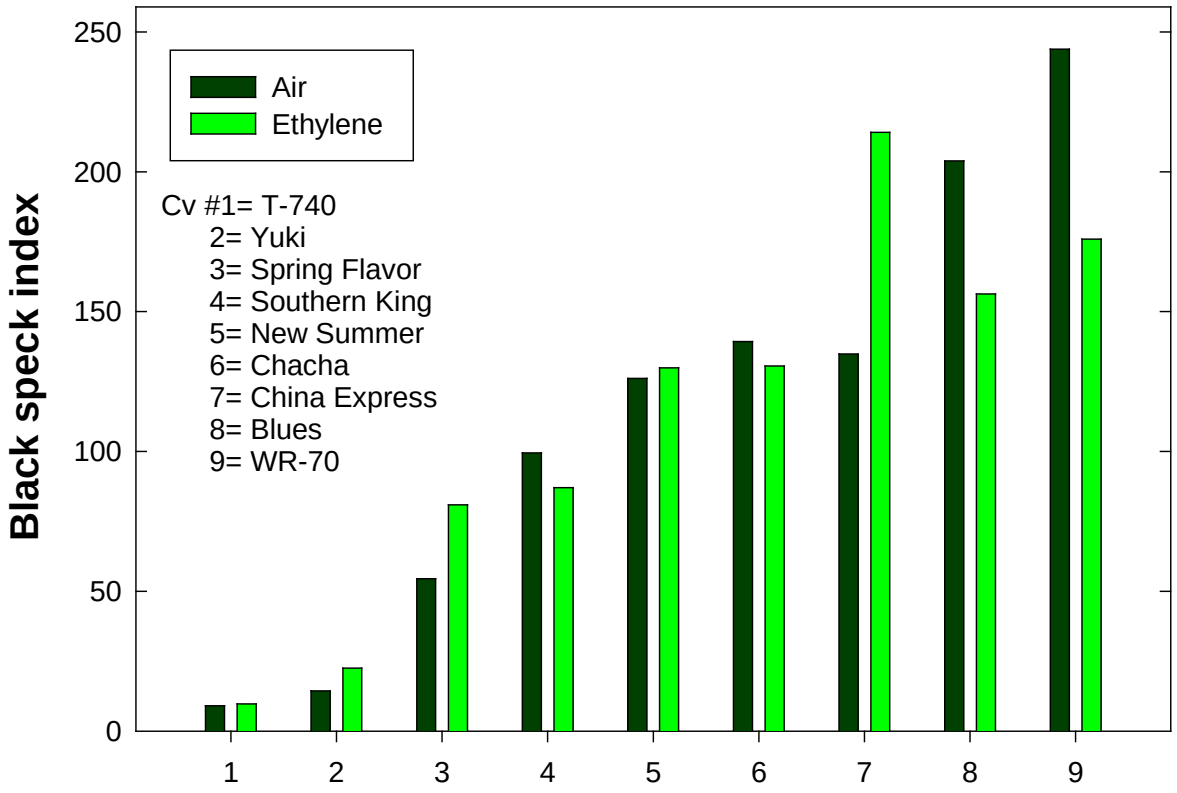
RESEARCH TO DO

- Evaluate the performance of cultivars for quality of fresh market and fresh-cut product
- Evaluate the impact of initial postharvest handling on the shelf-life and quality of fresh-cut cauliflower florets.
- Evaluate the impact of production conditions (seasonablity, fertilization, irrigation) on the quality and shelf-life of cauliflower florets



Napa or Chinese cabbage Black Speck Disorder

Black Speck Disorder on Chinese Cabbage



Black speck index = black speck score multiplied by % extension.

- **Black speck development on Napa cabbage stored in air or in ethylene is the same.**
- **PAL enzyme levels similar; 1-MCP does not reduce black speck.**
- **Cultivars vary greatly in their susceptibility to black speck.**

Cabbage Quality and Temperature

CDFA WIC Stores Small Farm Program Project
Shermain Hardesty, Lucia Kaiser, and Advisors

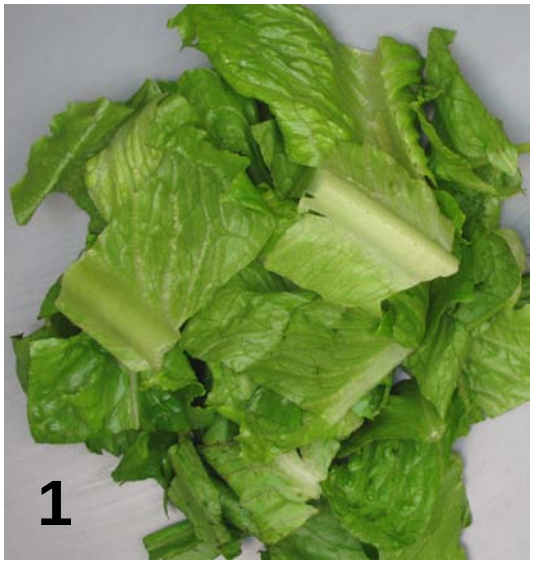
- Retail handling—good to poor conditions
- Impact on marketability and nutritional value—conditions to retain 80% original nutrition
- Vitamin C, Antioxidant Activity, Carotenoids
- Wide range of temperatures (0-29°C; 32-84°F)
- Cabbage performs well over temp range—should be available in all WIC stores

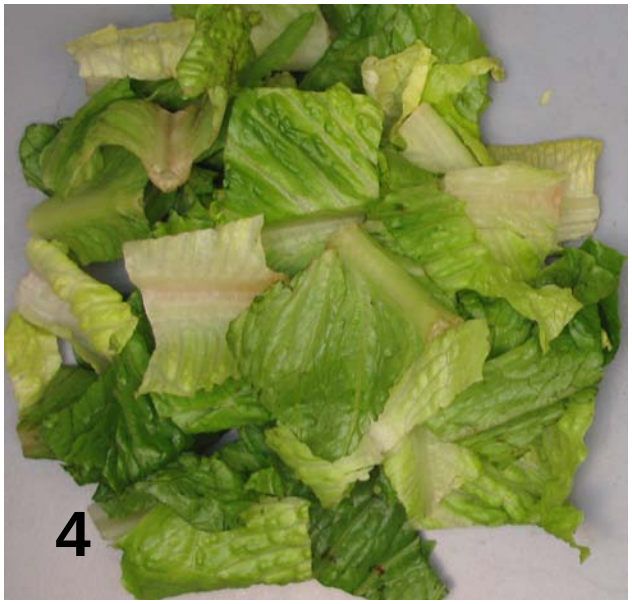
Fresh-cut Lettuces

Varieties of Iceberg, Romaine and Crosses

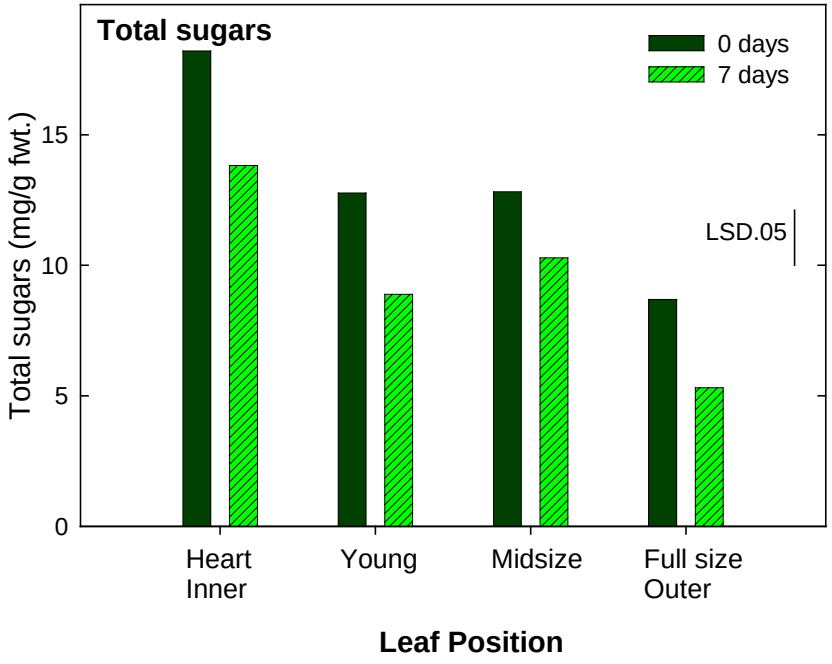
- **Performance as fresh-cut product**
  - Visual quality score
  - Discoloration
  - Decay
- **Respiration rates**
- **Phenolics and phenolic enzymes** (PAL, PPO)
- **Composition**
  - Number leaves per head
  - % dry weight
  - Sugars
  - Chlorophyll and carotenoids
  - Vitamin C
  - Ammonia

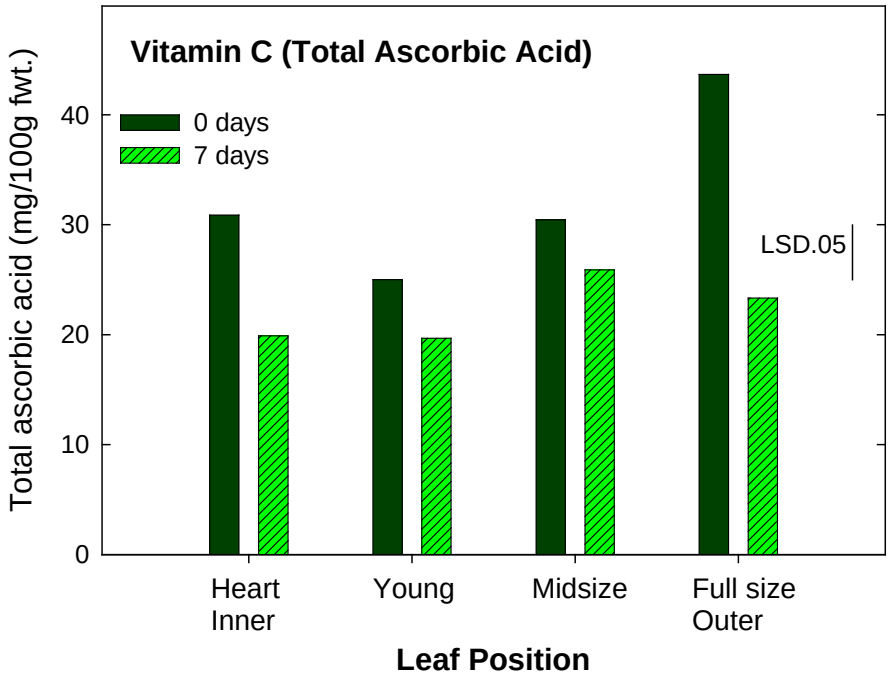
Discoloration Rating Scale for Romaine

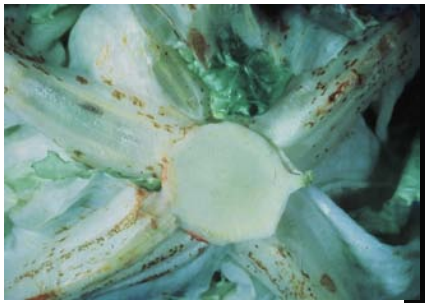


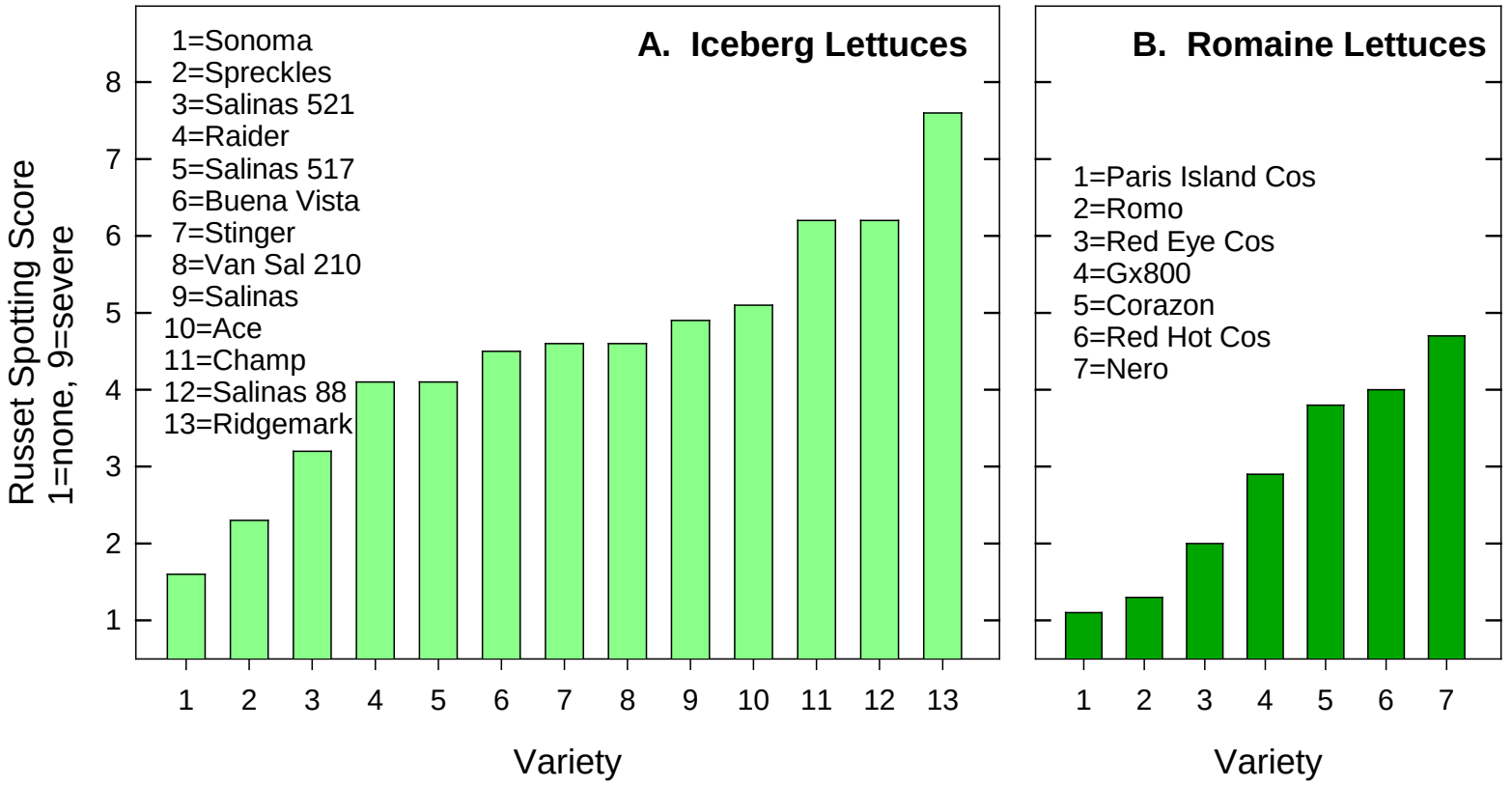


Romaine lettuce









Development of Russet Spot Disorder on Iceberg and Romaine Lettuces. Intact heads were stored in 5ppm ethylene at 5°C (41°F) plus 1 week in air.

Cantwell, UC Davis, unpublished

Is Temperature a Quality Issue or a Food Safety Issue?

- ✓Prevention of Contamination is most important
- ✓ Time and Temperature are Amplifiers of Risk

Slide from Trevor Suslow, UC Davis

10 Basic Postharvest Principles

1) Harvest at correct maturity
2) Reduce physical handling
3) Protect product from sun
4) Keep packingline simple and clean; ensure good worker hygiene
5) Select, classify, and pack carefully
6) Align cartons, strap pallet
7) Cool as soon as possible
8) Know market and product requirements
9) Coordinate efficient & rapid handling
10) Train and compensate workers adequately