

A Quick Overview of Postharvest Pomology

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Postharvest.tfrec.wsu.edu

Postharvest is Fruit Quality Management

WSU Web site for tree fruit
postharvest information:
postharvest.tfrec.wsu.edu

Chapters in a Postharvest Text

1. Fruit quality
2. Preharvest factors affecting storage
3. Harvest maturity
4. Postharvest drenching
5. Temperature
6. Storage
7. Packing & packaging
8. Disease & disorders
9. Marketing
10. Personnel Mgt.
11. Industry Issues

Academic Disciplines of Postharvest

Horticulture

- Fruit quality
- Disorder control
- Chemistry

Engineering

- Storage construction
- Packing technology
(robotics, NIR)

Business management

- Marketing/Sales
- Personnel
management
- International relations

Pathology

- Disease control

Postharvest Losses

50% loss in some crops!

Biological

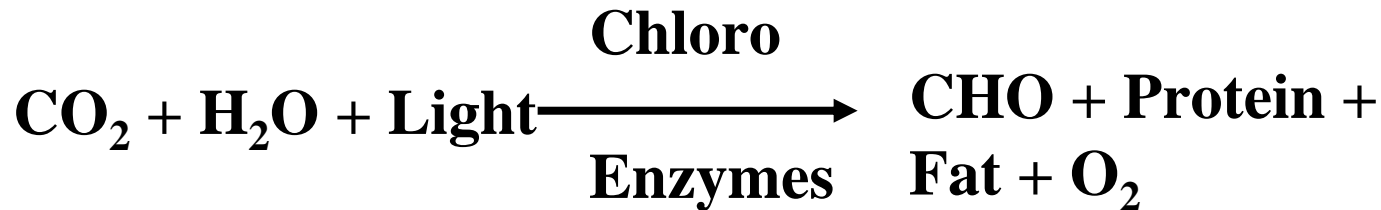
- Respiration
- Ethylene Production
- Compositional Changes
- Growth and Development
- Transpiration

Physiological

- Freezing
- Chilling
- Heat
- Bruising
- Browning

Pathological

Photosynthesis Reaction



Respiration Reaction



Anaerobic respiration

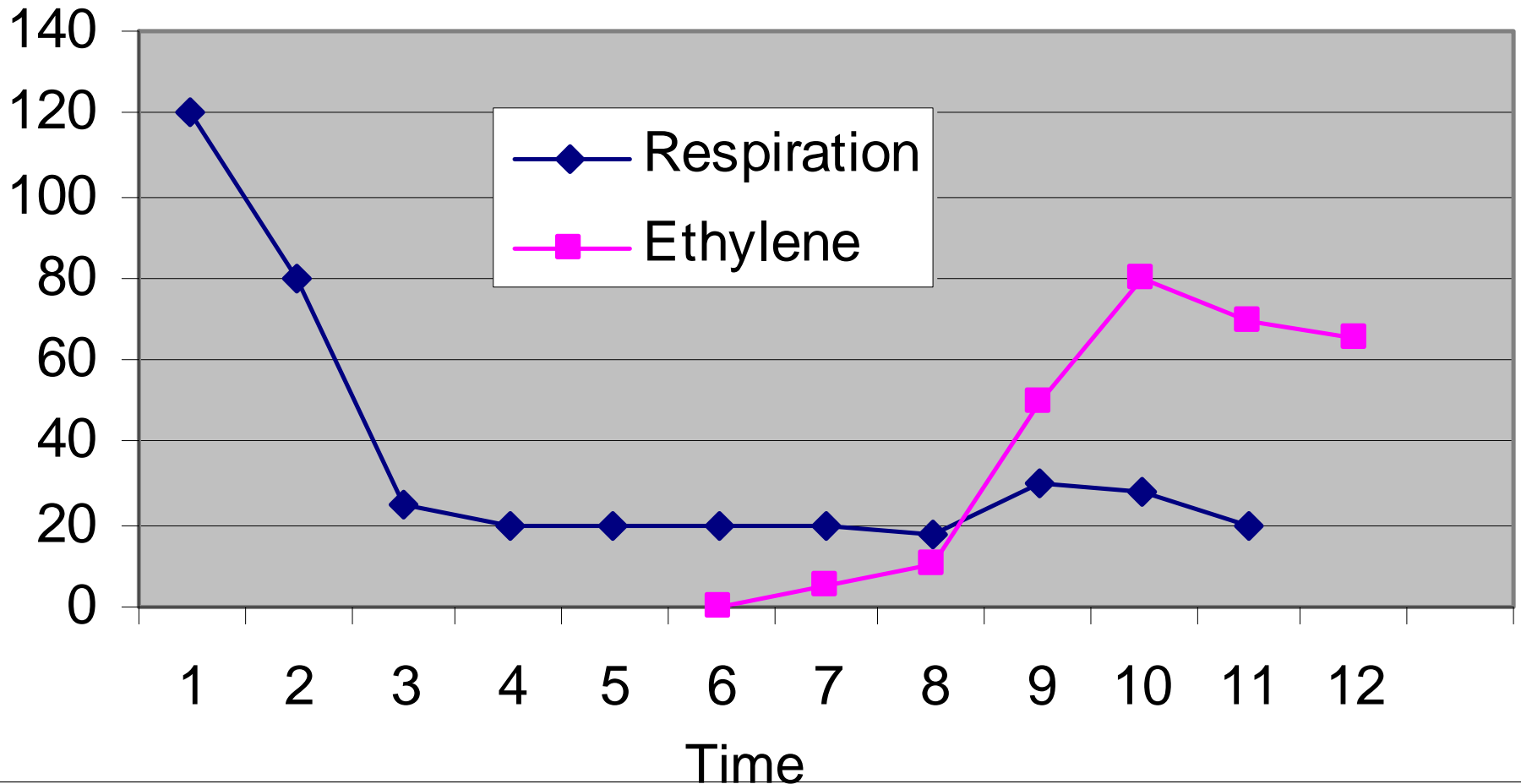


Factors Impacting Respiration Rate and Storage Life

- Temperature – determines the rate of chemical reactions (cooling rate)
- O_2 – low oxygen limits respiration
- CO_2 – high carbon dioxide slows respiration
- C_2H_4 – ethylene speeds respiration

- Variety of fruit – Fuji vs. Gala
- Nutrition – excessive Nitrogen or Boron

The Climacteric



Fruit Senescence*

Exhaustion of 'fuel' (CHO)

or

Inability to conduct life's processes ???

* **“Deterioration ending the functional life of an organ”**

Changes in Apples After Ripening

Constituent	At Maturity	Ripened
Starch	2.0	0.1
Sugar	7.5	7.4
Acid	1.0	0.6
Protein	0.2	0.2
Protopectin	0.7	0.1
Soluble pectin	0.2	0.3
% fresh weight		

Factors Affecting Moisture Loss

- **Apples are 84%+ water**
 - Loss of 4% = shrivel
- **Cuticle and wax coating**
 - Russet and lenticels
- **Air movement**
- **Maturity**
 - Immature apples
- **Fruit size**
 - Surface area/volume
- **Skin characteristics**
 - Epidermis
 - Cuticular wax
- **Temperature**
 - Vapor pressure deficit
 - Most severe during cooling

Preharvest Factors define Postharvest Quality

- Edible Quality
- Appearance
- Seed Count
- Mineral Content
 - Calcium
 - Nitrogen
 - Mg/K
- Maturity
 - Firmness
 - Starch

Effect of Seed Number on Apple Shape and Breakdown

Seed No.	Delicious		Jonathan	
	Shape (%)	Breakdown	Shape (%)	Breakdown
6	100	0	100	3
4	90	5	87	12
2	78	13	60	37

Shape = % of fruit with typical shape

C. Little

Apple's Position on Tree affects Quality

Position	Red Blush	Sugar (%)	Firmness (lbf)	Breakdown (%)
Top	> 50%	13.8	10.4	0.8
Middle	25 to 50%	13.1	10.1	7.3
Lower	< 25%	13.0	10.1	13.9

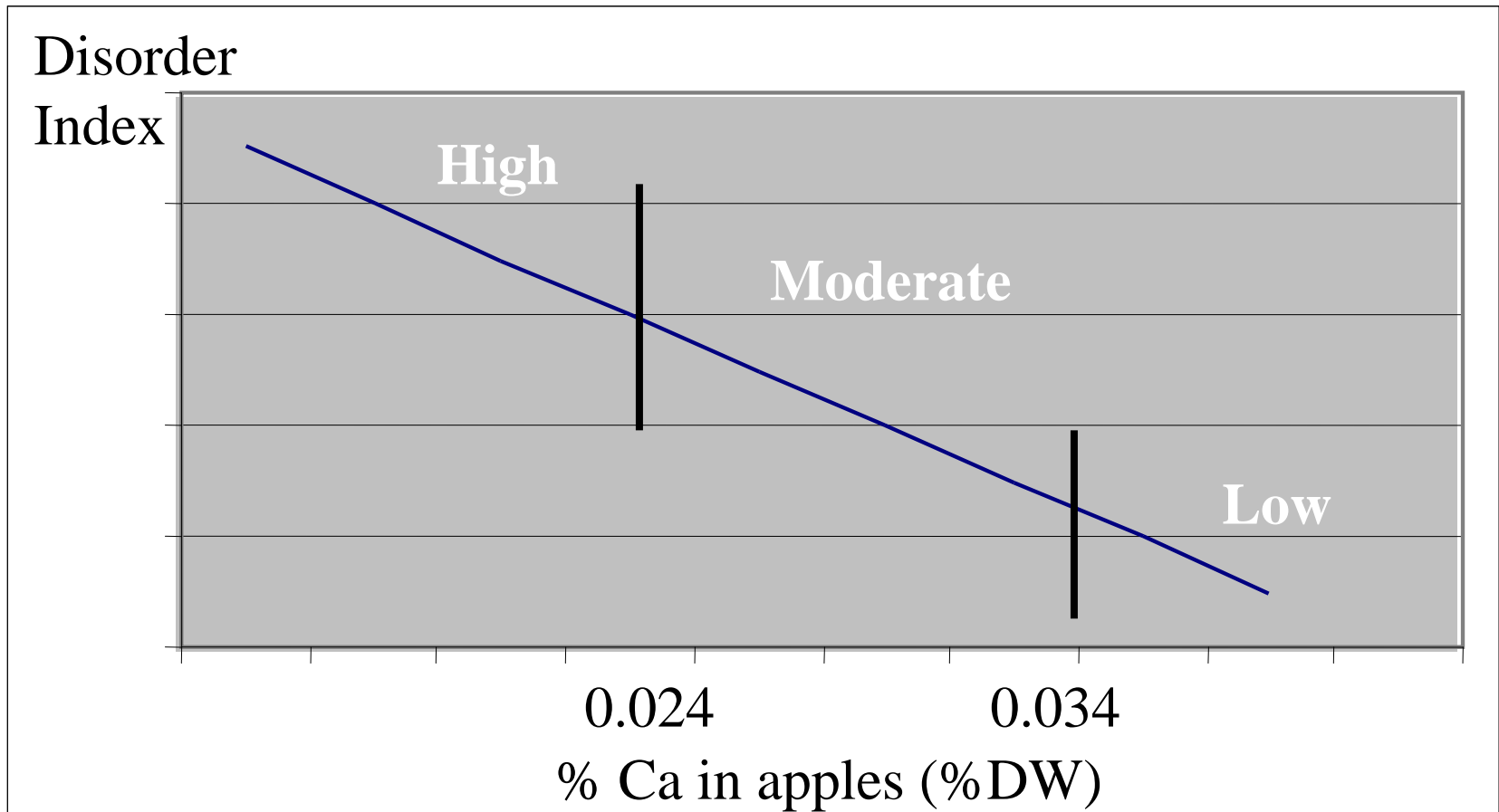
Jonathan after 6 months of storage

C. Little

Mineral Content influences Quality

- **High Calcium**
 - Reduced disorders and decay
 - Improved firmness
- **High Nitrogen**
 - Lack of red skin color
 - Low firmness
 - Rapid deterioration
- **Potassium (moderate)**
 - High acidity
 - High firmness
- **Potassium (high)**
 - Core flush
 - Bitter pit
- **Low Nitrogen**
 - Low sugars
 - Small size
 - Poor shape

Storage Risk Based on Calcium



Climate and Quality

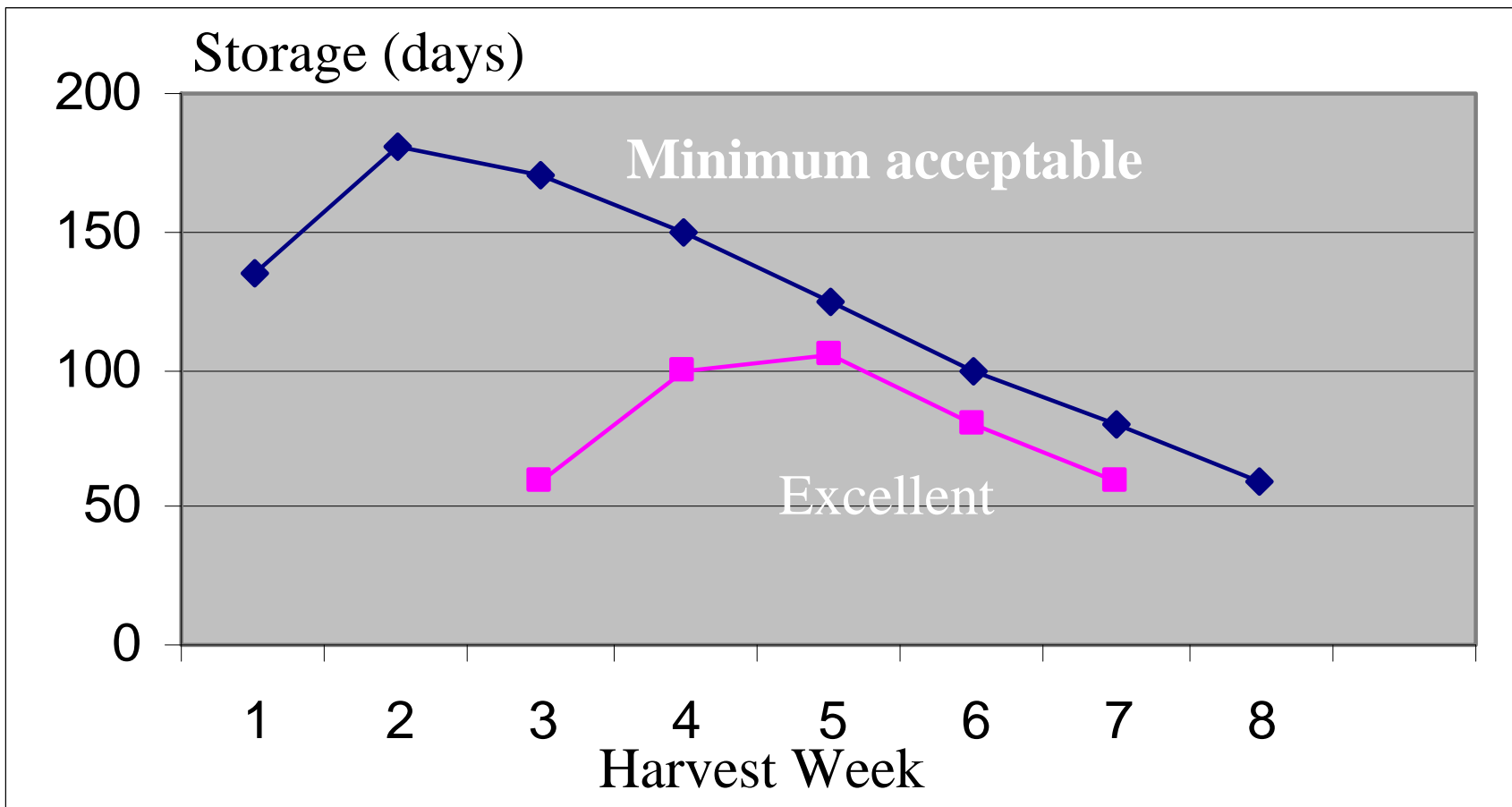
- Year to year variability
- Heat injury (sunburn)
 - Sun + 15°C
 - Shade
- Day/night shift
- Humidity
- Altitude
- Hours of sunshine
- Frost
- Water stress

Maturity at Harvest affects Quality

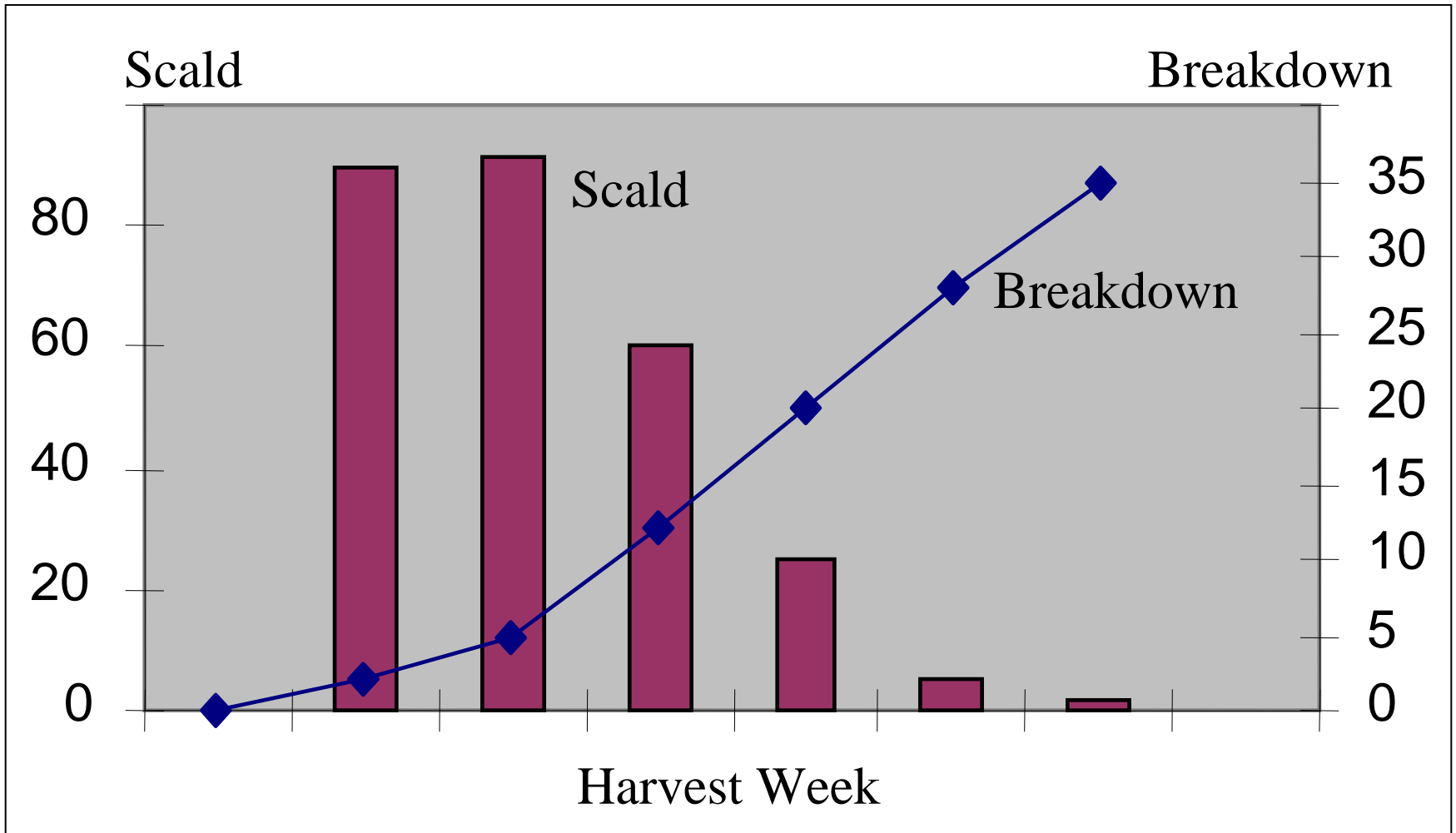
- **Less Mature**
 - Small size
 - Poor skin color
 - High acidity
 - Starchy
 - Low aroma
 - Tough texture
 - Shrivels

- **Over-Mature**
 - Fruit drop
 - Yellow background
 - Low acidity
 - Poor Flavor
 - Aromatic
 - Soft (mealy?)
 - Greasy

Maturity affects Storage Life and Post-Storage Quality



Maturity affects Scald and Breakdown



Judging Apple Maturity

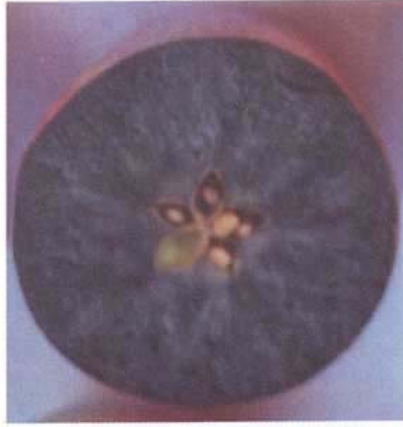
Maturity Measures

- Firmness
- Starch
- Acidity
- DFFB
- Background color
- Watercore
- Soluble solids
- Flesh color
- Ethylene
- Respiration rate
- Cold temperatures
- Fruit size
- Skin color

Measuring Maturity

- **Starch**—Scoring system
- **Firmness**—Penetrometer
- **Acidity**—Titration
- **Skin, background and flesh color**—Color chips
- **Watercore**—Scoring system
- **Soluble solids**—Refractometer
- **Ethylene**—Gas chromatograph
- **Fruit size**—Circumference/weight

Figure 4.10 - Starch Patterns - Radial Type



Score 1. Entire surface stained blue-black.



Score 2. Staining absent from the core.



Score 3. Staining absent from the core and about 10% of the cortex.



Score 4. Staining absent from the core and 50% of the cortex.



Score 4.5. Staining absent from the core and about 70% of the cortex.



Score 5. Staining absent from 90% of the cortex and mainly evident near the skin

Figure 4.11 - Starch Patterns - Concentric Type



Score 1.1 Almost entire surface stained blue-black.



Score 1.7 Staining absent from the core.

The starch-iodine rating scale (concentric type) for use on Red Delicious, Braeburn and Fuji apples.



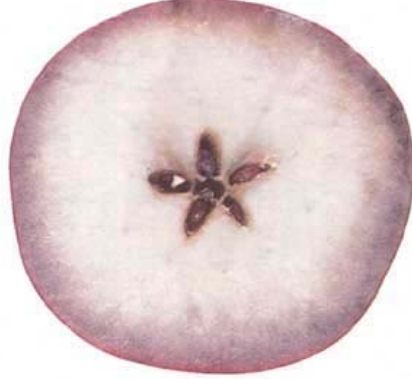
Score 2.0 Staining absent from the core and about 10% of the cortex.



Score 3.0 Staining absent from the core and the cortex to the vascular bundles.



Score 4.0 Staining absent from the core and 50% of the cortex.



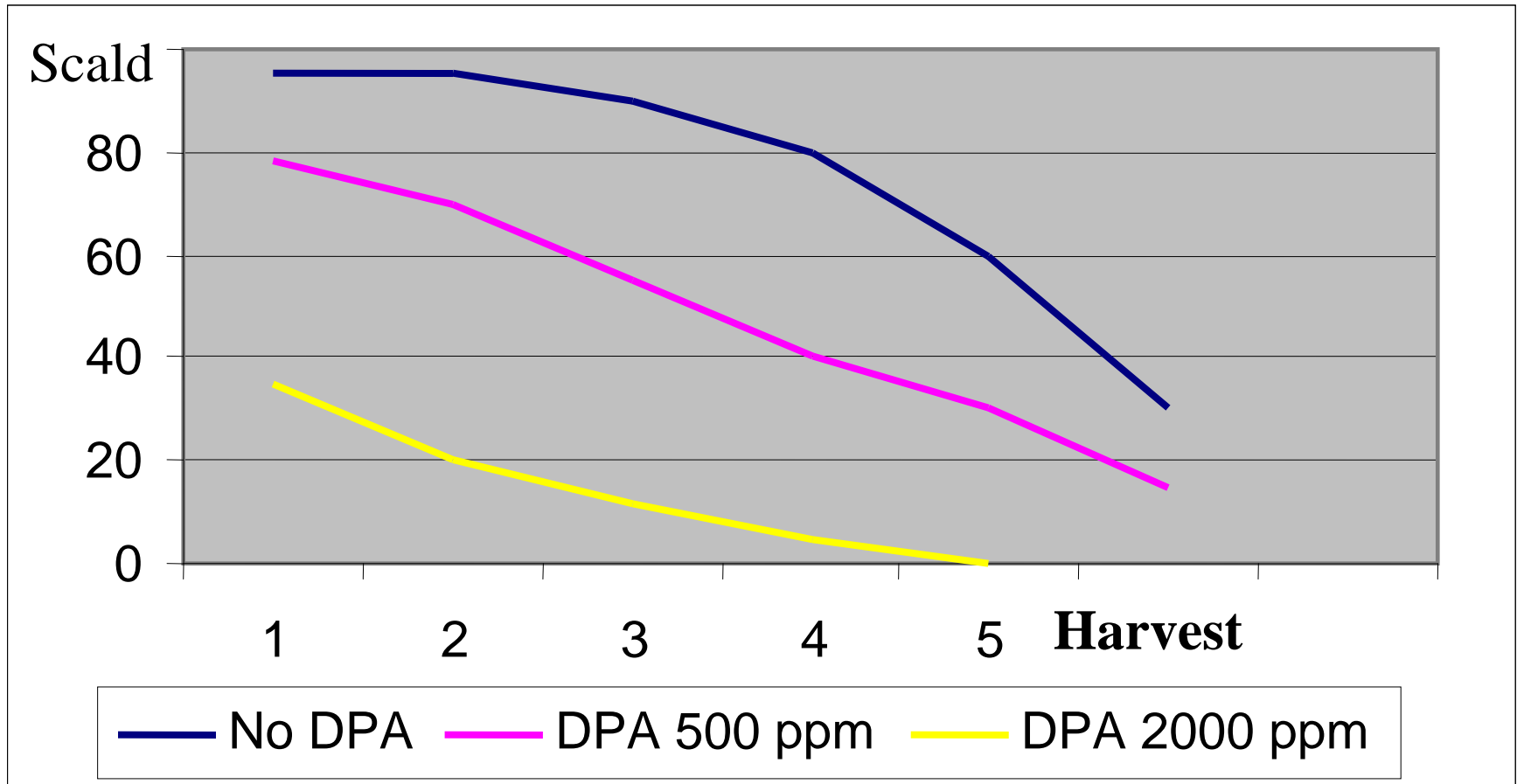
Score 5.0 Staining absent from 90% of the cortex and mainly evident near the skin.

**Some problems...storage scald and
decay**

Storage Scald

- **Variety susceptibility**
- **Risk decreases with maturity**
- **Risk decreases with cold temperatures**
- **Risk decreases with antioxidant use**
 - **Diphenylamine (DPA) on apples**
 - **Ethoxyquin on pears**
 - **Testing: oil, vitamin C and E**
- **Ultra-low oxygen storage**
- **SmartFresh (1-MCP)**

DPA and Maturity on Scald



Granny Smith apples stored 9 months

Postharvest Diseases

- **Blue Mold (*Penicillium spp.*)**
- **Gray Mold (*Botrytis cinerea*)**
- **Mucor Rot (*Mucor spp.*)**

- **Alternaria Rot (*Alternaria spp.*)**

**Drs. Peter Sanderson, Robert Spotts,
David Sugar and Chang-Lin Xiao**

For further information...

- **Web Sites –**

- **WSU: postharvest.tfrec.wsu.edu**
- **UC Davis: <http://postharvest.ucdavis.edu/>**

- **Books –**

- **“Postharvest Technology of Horticultural Crops”**
 - Adel Kader, UC Davis Publication 3311
- **“Fruit Quality and its Biological Basis”**
 - Michael Knee, CRC Press
- **“Storage Technology for Apples and Pears”**
 - Colin Little and Robert Holmes (Australia)

- **To understand globalization**

- **“The World is Flat: A Brief History of the 21st Century”**
 - Thomas Friedman