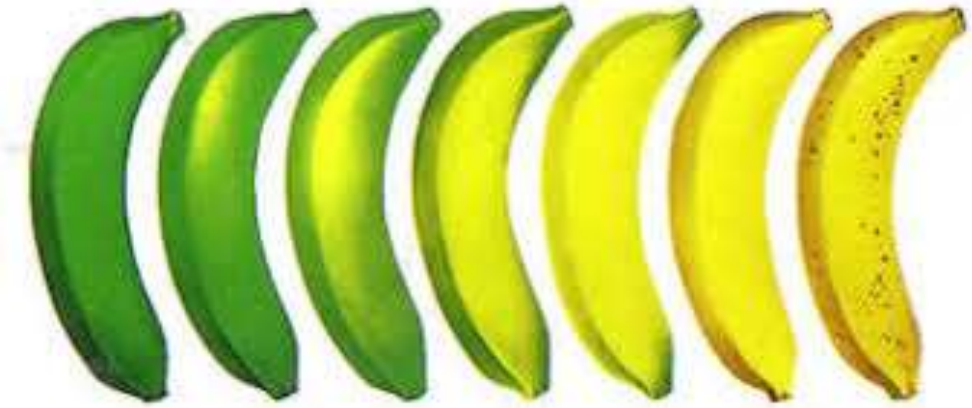
Biological & Environmental Factors Involved in Deterioration

- Fresh fruits, vegetables and ornamentals are living tissues subject to continuous change after harvest.
- Some changes are desirable, most are not.
- Post-harvest changes in fresh produce cannot be stopped.



- Fresh horticultural crops are divers in morphology, composition and physiology.
- Commodity requirements and recommendations for maximum shelf-life vary among the commodities.

Biological factors involved in deterioration

- Respiration
- Ethylene production
- Compositional change
- Growth and development
- Transpiration
- Physiological breakdown
- Physical damage
- Pathological breakdown

Respiration

- The process by which stored organic materials are broken down into simple end products with a release of energy is called respiration.
- O_2 is used and CO_2 is produced.

- The loss of stored food reserves during respiration results in,

✓The hastening of senescence.

✓Reduced food value for the consumer.

✓Loss of flavour quality.

✓Loss of salable dry weight.

- The energy released as heat affects post-harvest technology considerations like refrigeration and ventilation.

- Rate of deterioration of harvested commodity is proportional to the respiration rate.

- Fruits are classified either as climacteric or non-climacteric according to the respiration and ethylene production patterns during maturation and ripening.

Ethylene production

- Ethylene, a plant hormone, is produced by all tissues of higher plants and by some microorganisms.
- It regulates physiological processes of plants like growth, development, abscission of plant organs and senescence.
- Physiologically active in trace amounts.

- Horticultural commodities can be classified according to their ethylene production rates.

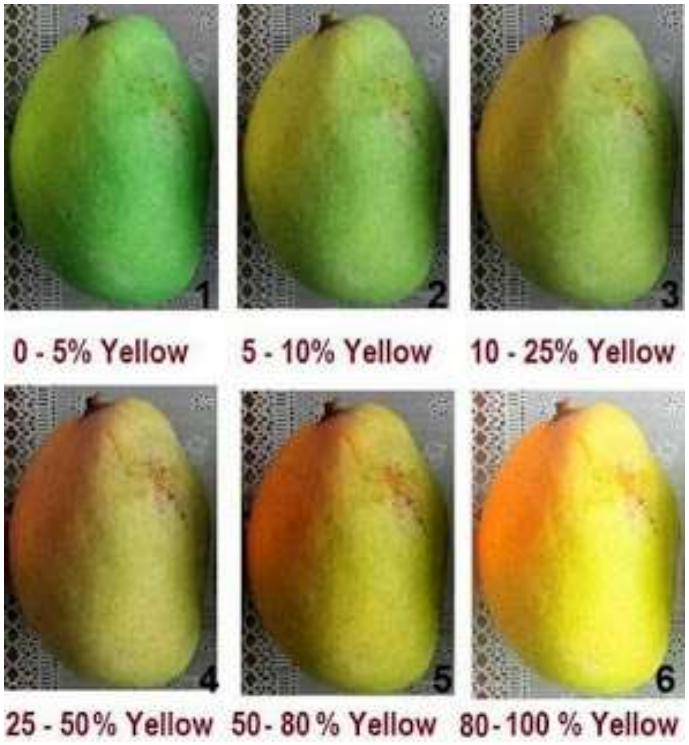
- Ethylene accelerates the senescence of many horticultural commodities.

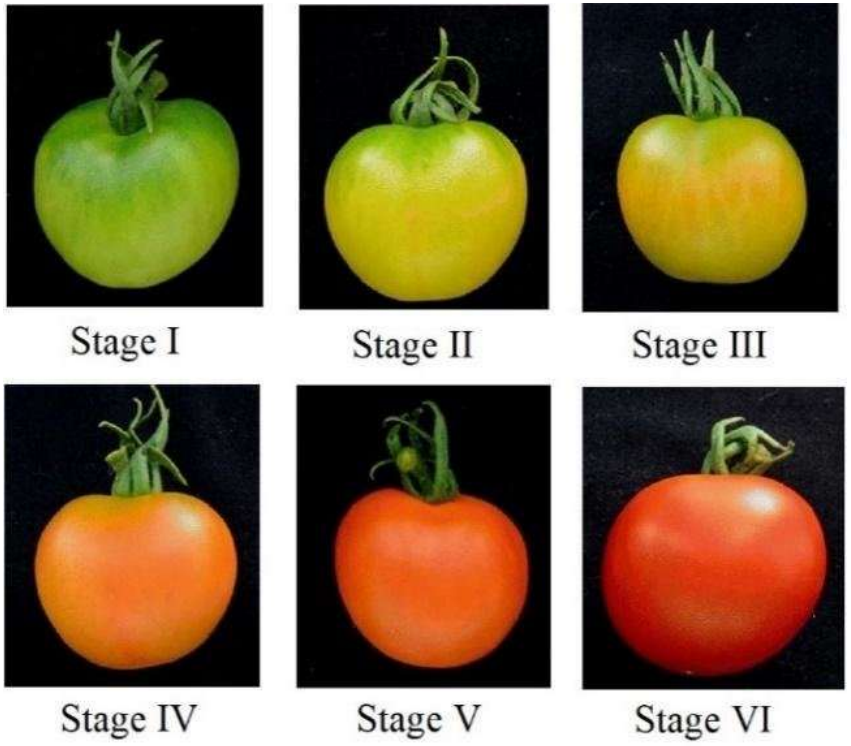
- Ethylene production rate increases with maturity at harvest, physical injuries, disease incidence, increased temperatures up to 30 ^{0}C and water stress.

- Ethylene production rate can be reduced by storage at low temperature, reduced O_2 (<8%) levels and elevated CO_2 (>2% levels).

Compositional change

- Compositional changes that occur in the commodity after harvest can be either desirable or undesirable.





- Changes in pigment content,

✓Loss of chlorophyll is desirable in fruits but not in vegetables.

✓Development of carotenoids is desirable in fruits such as peaches, citrus, tomatoes and grapes.

✓Development of anthocyanins is desirable in fruits such as apples, cherries, red-flesh oranges and strawberries.

✓Changes in anthocyanins and other phenolic compounds result in tissue browning, which is undesirable for appearance quality.

- Changes in carbohydrate content,

✓Starch to sugar conversion is desirable in apple, banana but undesirable in potatoes.

✓Sugar to starch conversion is desirable in potatoes but undesirable in peas and sweet corn.

✓Conversion of starch and sugars to CO_2 and water through respiration is undesirable.

- Breakdown of pectins and other polysaccharides results in softening of fruits and an increased susceptibility to mechanical injuries.

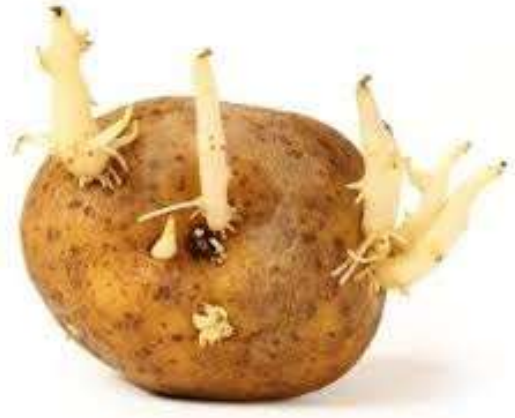
- Increased lignin content results in toughening of root vegetables.

- Changes in organic acids, proteins, amino acids and lipids can influence flavour quality.

- Loss in vitamin content (Vit. C) affects nutritional quality.

- Production of flavour volatiles improves eating quality.

Growth and development



Growth and development

- Sprouting of potatoes, onion, garlic and root crops reduces utilization value and accelerates deterioration.
- Rooting of onions and root crops is undesirable.
- Asparagus spears continue to grow after harvest and cause increased toughness and decreased palatability.
- Seed germination inside fruits is undesirable.

Transpiration

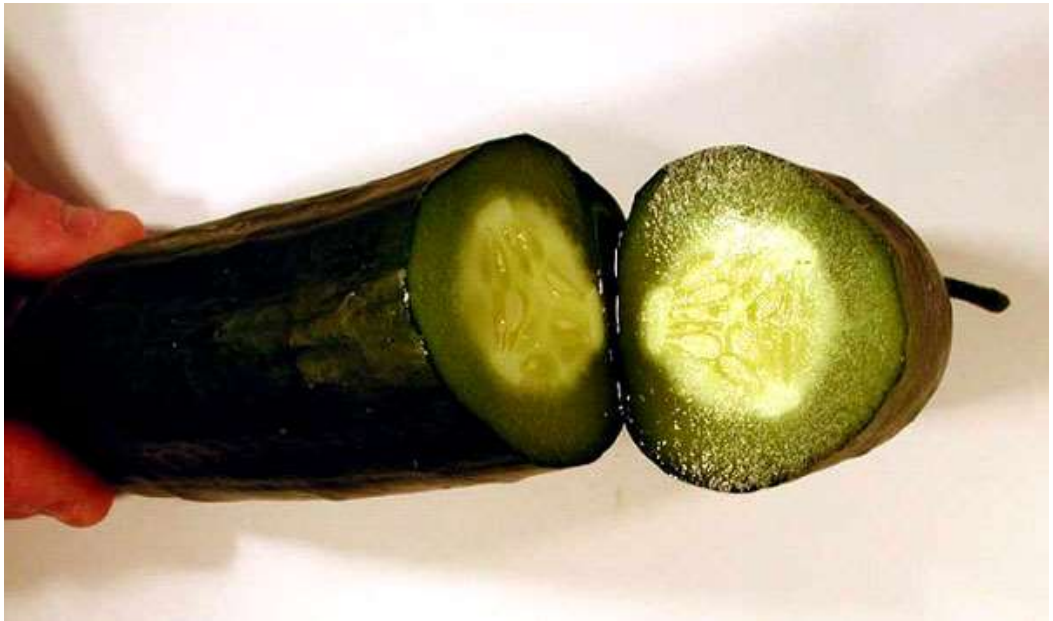
- Transpiration causes loss in quantity, appearance, texture and nutrition.

- The dermal system regulates the loss of water from the commodity.
- Transpiration rate is influenced by internal factors and external factors.
- Transpiration can be controlled by applying treatments to the commodity and by manipulating the environment.

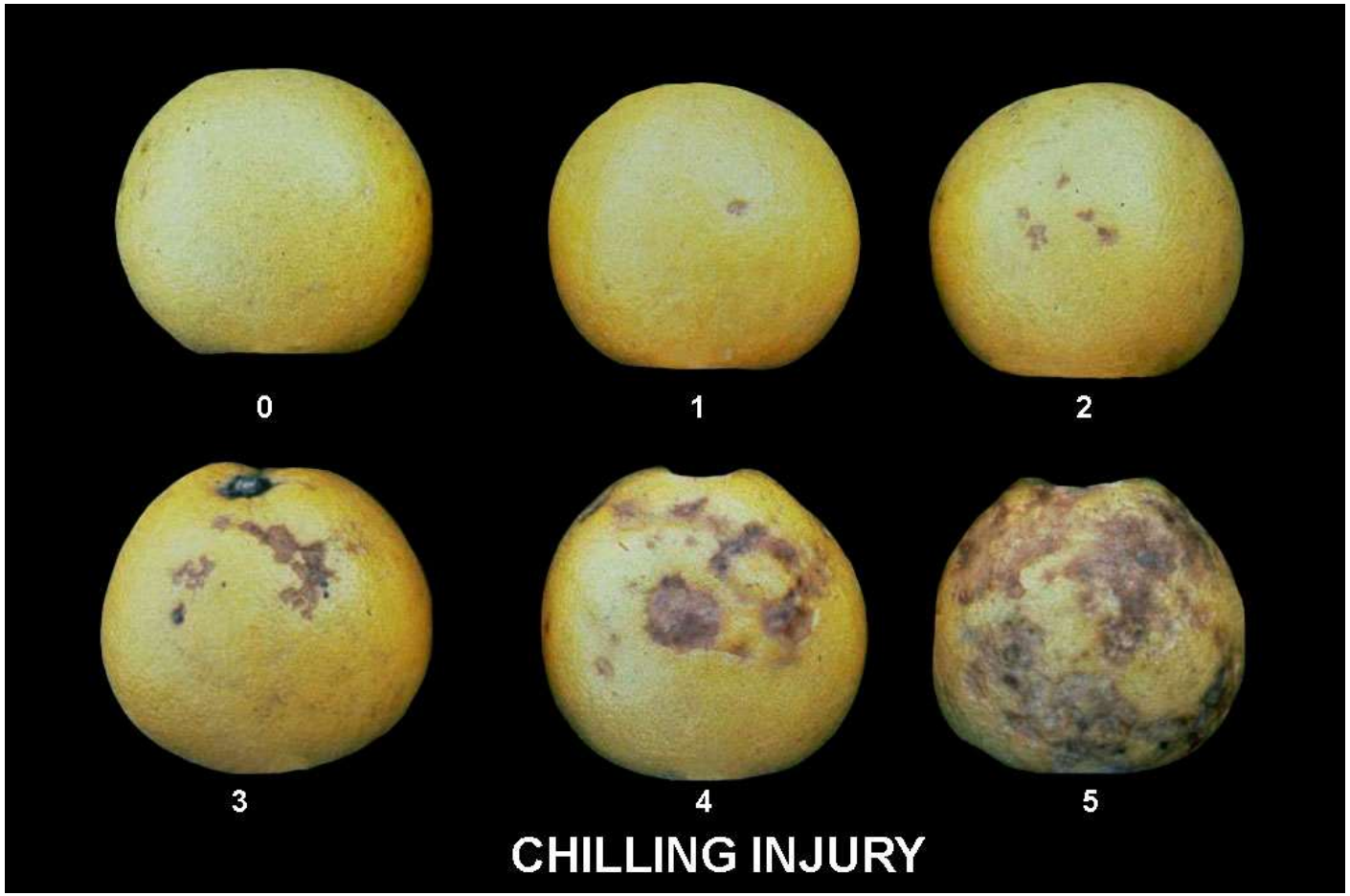
Physiological breakdown

- Exposure of commodities to undesirable temperatures results in physiological breakdown.

✓Freezing injury occurs when commodities are held below their freezing temperatures.



- ✓Chilling injury occurs when commodities are held at temperatures above their freezing point and below 5^0C – 15^0C.



✓Heat injury occurs when commodities are exposed to direct sunlight or to excessive high temperatures.

- Certain physiological disorders occur due to pre-harvest nutritional imbalances.

✓Blossom end rot of tomato and bitter pit of apple occur due to Ca deficiency.

✓Ca influences textural quality and senescence rate of fruits and vegetables.

- Very low O_2 (< 1%) and high CO_2 (> 20%) cause physiological breakdown of most fresh horticultural commodities.

- Ethylene induces physiological disorders in certain commodities.

Physical damage

- Various types of physical damage are major contributors of deterioration.
- Mechanical injuries accelerate water loss, provide sites for fungal infection and stimulate CO_2 and ethylene production.

Pathological breakdown

- Caused by the activity of fungi and bacteria.
- Pathological breakdown follows physiological breakdown and physical damage.

Environmental factors involved in deterioration

- Temperature
- Relative humidity
- Atmospheric composition
- Ethylene
- Light

Temperature

- Influences the deterioration of harvested commodities.
- For each increase of 10 ^{0}C above optimum, the rate of deterioration increases by two to threefold.
- Exposure to undesirable temperatures cause physiological disorders.
- Also influences the effects of ethylene, reduced oxygen and elevated CO_2.
- Spore germination and growth rate of pathogens are influenced by temperature.

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Relative humidity

- The rate of water loss from the commodity depends on the vapour pressure deficit between the commodity and the surrounding environment.
- Influenced by relative humidity and temperature.
- At a given temperature and a rate of air movement, the rate of water loss from the commodity depends on the relative humidity.

Atmospheric composition

- Reduction of O_2 and elevation of CO_2 can either delay or accelerate deterioration of fresh horticultural commodities.
- The magnitude of these effects depends upon commodity, cultivar, physiological age, O_2 and CO_2 level, temperature and duration of holding.

Ethylene

- Effects of ethylene on harvested commodities can be either desirable or undesirable.
- Ethylene is used to promote faster and uniform ripening of fruits.

Light

- Exposure of potatoes to light should be avoided as it causes greening due to formation of chlorophylls and solanine.