

PRINCIPLES OF POSTHARVEST
HORTICULTURE

Midterm Exam II

100 points possible

Spring 2024

NAME: _____ **Answer Key** _____

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(20 Points) POSTHARVEST PATHOLOGY (Brecht)

(2 points) What term best describes most postharvest pathogens?

- a. Sophisticated saprophytes
- b. Opportunistic saprophytes**
- c. Sophisticated parasites
- d. Unsophisticated parasites

(2 points) Soft rots are “soft” because enzymes produced by a pathogen dissolve:

- a. Cellulose and lignin in the cell wall.
- b. Stored starches, complex sugars, lipids and proteins.
- c. Pectates and pectins in and between cell walls.**

(2 points) Arguably, the most important decay control practice for managing most perishable crops is to:

- a. Refrigerate to the lowest, non-damaging temperature as soon as possible.**
- b. Wash promptly with water containing a surfactant and strong sanitizer.
- c. Dry surfaces of the harvested fruit or vegetable.
- d. Put fruits and vegetables in well-aerated, low-humidity storage.

(3 points) List three ways that breaking the skin (cuticle and epidermis) of a commodity promotes decay. This is **not** asking how the skin might become broken (e.g., scratched, cut, etc.), but why breaking through this barrier promotes decay.

- 1. Rupturing the epidermis provides water to germinate.**
- 2. Rupturing the epidermis releases sugars to “feed” spore germination and development.**
- 3. Rupturing the epidermis allows fungi entry into tissue flesh.**

Credit given for those who said wounding promotes ethylene production, which can also promote decay.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(4 points) List four (4) ways to reduce postharvest decay of fresh fruits and/or vegetables that do not include the use of fungicides.

1. **Avoid injuries to the fruits and vegetables.**
2. **Quickly cool the fruits and vegetables and don't break the cold chain.**
3. **Avoid condensation of liquid water on the fruits and vegetables.**
4. **Cure vegetables as appropriate.**
5. **Choose varieties that are more resistant to decay.**
6. **Use good sanitation practices to reduce pathogen loads.**
7. **Use CA or MA or MAP**

(7 points) Discuss different ways that temperature management may affect pathogen activity, postharvest decay development, and the commodity's ability to prevent/fight pathogen invasion. Include in your answer one example of cold temperature not helping to reduce decay development.

1. Include in your discussion 4 of the following aspects:
2. Pathogens respond to temperature in the same way as fruits and vegetables in that their metabolism (and thus germination and growth) is inhibited at lower temperatures.
3. Low (but not chilling) temperatures delay senescence and tend to maintain fruit and vegetable tissues (especially unripe fruits) in a more resistant condition, which also inhibits decay development.
4. Relatively warmer temperatures can promote wound healing (curing) of some fruits and vegetables.
5. Some heat treatments (*e.g.*, hot water dips) can kill surface pathogens and reduce product decay.
6. Very high temperatures (*e.g.*, sunburn or other heat injury) damages the tissue, allowing entry sites and possible food sources (ruptured or leaky cells).
7. Cold temperature may promote decay if the product is chilling sensitive; or cold temperature may promote decay by inhibiting wound healing.
8. Freezing temperatures cause cellular constituents to be released, providing great conditions for pathogen growth.
9. Temperature fluctuations can promote condensation and the free water can promote pathogen spore germination and growth

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) MATURITY AND QUALITY STANDARDS (Brecht)

(2 points) For each factor listed below, give an example of a fruit or vegetable crop for which that factor is used as a commercial maturity index.

1. Shape – **banana, mango, broccoli etc. (any organ that ‘fills out’ during maturation)**
2. soluble solids content – **citrus fruits, pome fruits, stone fruits, grapes, etc. (anything that accumulates soluble sugars during development)**
3. surface morphology – **watermelon (gloss), cantaloupe (netting)**
4. abscission layer development – **tree fruits (ease of detachment), muskmelons, etc.**

(4 points) Provide a reason why a seller (shipper) might request a USDA inspection to determine the grade of their product; also provide a reason why a buyer (receiver) might request a USDA inspection when receiving the product.

The shipper wants to have proof that their product was in the agreed upon condition at the time it was packed and shipped.

The receiver would request an inspection if they don't think the product is in the agreed upon condition.

(4 points) Explain why each of the following is an important feature of a maturity index for fruits and vegetables.

- a. Simple - **can be performed in the field with inexpensive equipment**
- b. Objective - **measured, not subjective**
- c. Stable - **relate to quality regardless of grower, district, or year**
- d. Progressive change over time – **can predict when the product will be mature**

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) FOOD SAFETY (Ritenour)

(2 points) A load of apples shipped from the U.S. to Europe arrives and the residue level of one pesticide are found to be slightly above EU tolerances. Europe is notorious for setting low pesticide residue tolerances. In this case, the U.S. shipper can negotiate a lower price with the receiver, but still be able to sell the product in Europe.
(T / F – circle the correct answer)

(2 points) Indicate which of the following food safety requirements must be followed according to U.S. law:

- GLOBALG.A.P. Produce Handling Assurance (PHA)
- **Food Safety Modernization Act (FSMA)**
- Primus Labs GFS
- Safe Quality Foods (SQF)
- British Retail Consortium (BRC)

(2 points) The above required by U.S. law must also be followed by any foreign farm importing fresh produce into the U.S. (T / F – circle the correct answer)

(2 points) The PRIMARY purpose of adding a sanitizer(s) to recirculated water used on packinglines is to decontaminate the fruit surface of potential pathogens.
(T / F – circle the correct answer)

It is to prevent cross contamination

(2 points) Briefly explain why good food safety practices generally result in better arrivals of fresh produce quality and extended shelf life?

Because good sanitation reduces potential contamination from both human and plant pathogens. Less plant pathogen inoculum levels result in less infection with plant pathogens and, thus, less decay and longer shelf life.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) QUARANTINE TREATMENTS (Ritenour)

(2 points) What is the name of the federal agency in the United States that regulates quarantine treatments?

USDA Animal and Plant Health Inspection Service (APHIS)

(2 points) Quarantine treatments for fresh produce are not government approved unless they can be applied without causing injury or reducing quality of the fresh produce.

(T / **F** – circle the correct answer). **The ability of the product to survive the treatment is secondary to making sure the quarantine insect is controlled**

A new fruit called a Thing-a-ma-bob (TAMB) has been discovered in a tropical county that holds great promise for marketing in the United States. Unfortunately, the growing region is also home to a pest not welcome in the U.S.

(1 point) Name what type of quarantine treatment (e.g., of the chemical or physical options) or perhaps even a systems approach you might most want to develop to import this product?

Free point as you can name anything any valid quarantine treatment.

(2 points) Explain why this method would be your first choice.

Answers can vary, just need to be reasonable for this particular product.

(3 points) Why is it not necessary for an irradiation treatment to kill the targeted insects for it to be an effective quarantine treatment?

Because lower irradiation energy than the lethal dose can still sterilize the insects (meaning they are unable to reproduce).

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) HARVESTING, HANDLING AND PACKINGHOUSE OPERATIONS (Ritenour)

(4 points) Consider a cantaloupe grower/shipper harvesting fruit in the middle of summer in California that are then pre-cooled using forced-air cooling. Discuss possible advantages and disadvantages of harvesting the fruit during the night, rather than daylight hours.

Answers can vary, but may include aspects of the following:

Possible Advantages: Fruit come in cooler requiring, with lower respiration rates (less heat production), less time needed for cooling, etc.

Workers may be more comfortable in the cool of night.

The plants are usually under less water stress and so the product may be firmer.

Possible Disadvantages: Adequate lighting is needed for harvesters to adequately see and evaluate the product ripeness and quality.

Insects attracted to the lights may cause problems/annoyances for the harvesters.

Potential for increased decay/dirt if conditions result in dew on the crop during harvest.

Workers may not like working through the night (sleeping during day).

(6 points) What is 'curing'?

Curing is the practice of holding certain products at relatively high temperatures (30-35°C) with either high (90-100%) or low (<40%) relative humidity depending on the product.

What types of crops are cured?

Mainly underground storage organs like roots, tubers and bulbs.

What is the difference between curing potatoes, sweetpotatoes, etc., versus onions and garlic?

The purpose of curing potatoes and sweet potatoes is to promote wound healing (e.g., under warm temperatures with high RH) to protect against pathogen intrusion and water loss, while curing of onions and garlic is intended to dry the neck and outer layers of tissue (e.g., under mid to warm temperatures but low RH) to create a barrier to again protect against pathogen intrusion and water loss.

What are the benefits of curing?

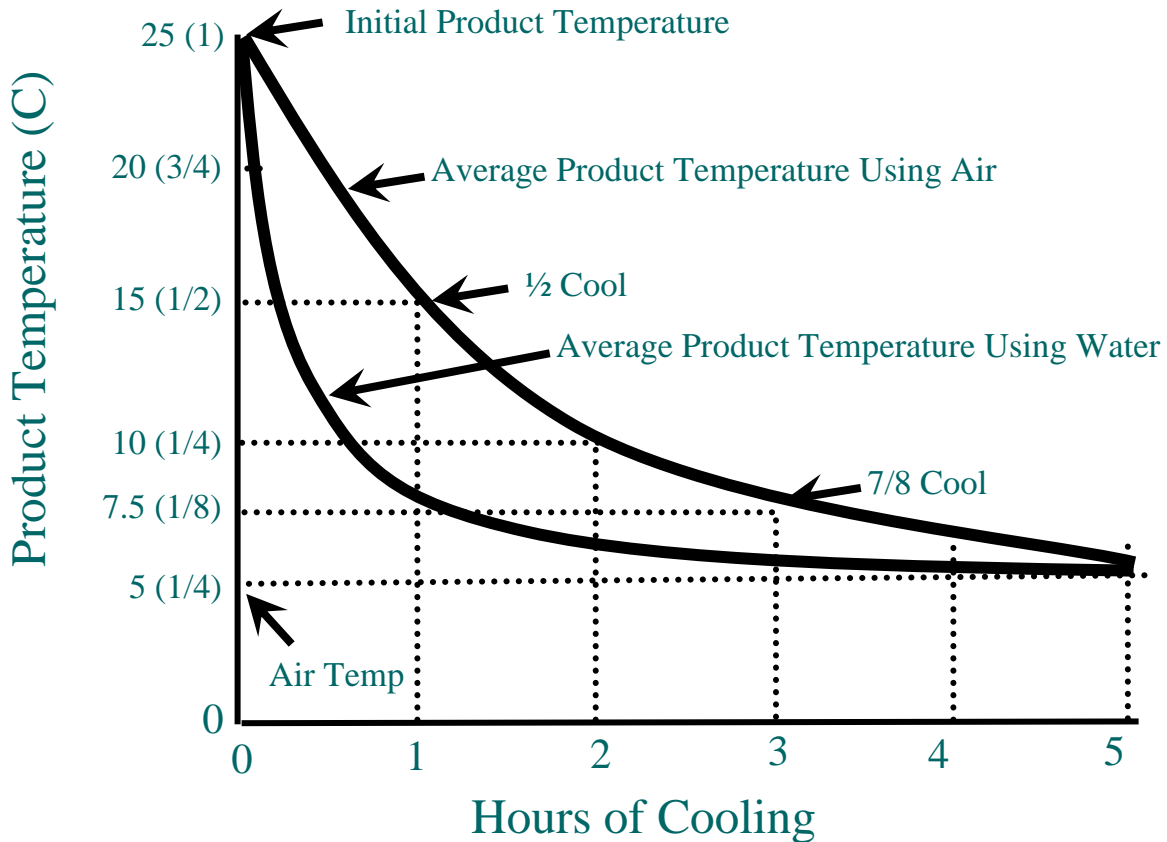
Curing promotes either wound healing (high temperature and high humidity; potatoes, sweetpotatoes, etc.) or creates a barrier of dry tissue (high temperature/low humidity; onions and garlic); the result in both cases is that the product is more resistant to decay development.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) TEMPERATURE MANAGEMENT (Ritenour)

(5 points) For a commodity cooled in air, draw a typical commodity cooling curve with temperature on the “y” (vertical) axis and time on the “x” (horizontal) axis. Assume that the starting temperature is 25°C, and the **air temperature is 5°C**. Identify the initial product temperature, the air temperature, and the $\frac{1}{2}$ and $\frac{7}{8}$ cooling times.



(2 points) Draw in the figure above how you would expect the above cooling curve to be different if the product was cooled using water (hydrocooling)?

See above figure

(3 points) Explain why fruits and vegetables are cooled faster in a well-managed hydrocooler than a forced-air cooling system.

It would cool quicker because of water's higher heat capacity and thermal conductivity compared to air.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) COMMERCIAL STORAGE (Brecht)

(4 points) How does a mechanical refrigeration system remove heat from the storage environment in terms of the physical principle that is involved. What happens to the heat?

Mechanical refrigeration systems work by sequentially compressing and expanding a refrigerant between its liquid and vapor phases. The liquid-to-vapor phase change on the low pressure side requires (absorbs) heat (heat of vaporization); the vapor-to-liquid phase change on the high pressure side releases that heat to the outside of the refrigerated space.

Explain what each of the following components does in a typical mechanical refrigeration system for storing produce.

(2 points) Evaporator coils

Where the refrigerant changes from liquid to gas; provides large surface area for heat absorption from the storage environment.

(2 points) Compressor

Where energy (work) is applied to the system to compress the gaseous refrigerant after it exits the evaporator coils.

(2 points) Condensor

Uses water or outside air to remove heat from the compressed, gaseous refrigerant so that the refrigerant changes back to its liquid phase.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) MA & CA (Brecht)

(2 points) Both modified atmosphere (MA) and controlled atmosphere (CA) storage involve holding a commodity in a reduced O₂ and/or elevated CO₂ atmosphere. So, what's the difference between MA and CA?

Controlled atmosphere (CA) involves active monitoring (measurement) and feedback control of the gas concentrations, which modified atmosphere (MA) does not – MA relies on a design that involves interaction of product respiration and restricted diffusion of gases to maintain the desired atmosphere.

(2 points) What is the difference between active *versus* passive modified atmosphere (MA)?

Passive MA relies on the product respiration to modify the atmosphere while active MA involves an initial flushing operation to immediately establish the desired atmosphere.

(4 points) The $K_m = 0.1\%$ oxygen for the rate-limiting terminal oxidase in the mitochondria in aerobic respiration (meaning the reaction is still running at 1/2-maximal rate with just 0.1% O₂ present inside the mitochondria). So, why is it that most fruits and vegetables can't tolerate exposure to any less than about 2% oxygen in the surrounding atmosphere in a controlled atmosphere storage environment?

A concentration of 2% oxygen surrounding the fruit or vegetable results in a much lower concentration of oxygen within the plant cells, partly because there is physical resistance to diffusion through the plant tissue. Also, the respiratory activity of the plant cells consumes oxygen, adding to the concentration gradient.

(2 points) How is ethylene involved in MA & CA storage??

Ethylene promotes ripening and senescence of fruits and vegetables. Low oxygen, which inhibits ethylene synthesis, and elevated CO₂, which competitively inhibits ethylene action, act to minimize those negative ethylene effects, contributing to extension of storage life in MA & CA.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(10 Points) TRANSPORTATION & THE DISTRIBUTION SYSTEM (Ritenour)

(2 points) List four (4) things wrong with this refrigerated trailer that might make you, as a shipper of high-quality fresh produce, hesitant to allow it to haul your product from Florida to California.



1. It's dirty
2. There is no return air bulkhead
3. There appears to be an open fresh air exchange that possibly can't be closed
4. The air delivery chute is torn so that cold air is not delivered to the rear of the trailer.
5. The walls are smooth rather than corrugated, not allowing air to flow down the sides of product stacked against the walls.
6. There are no T-beams in the floor; in fact, most of the floor is smooth, not facilitating air flow under the product, especially for product stacked directly on the floor.
7. Not able to truly clean and sanitize the wood sections of walls/ceiling.

MIDTERM EXAM II

POSTHARVEST HORTICULTURE

(8 points) List four different types of potential incompatibilities in mixed loads of fruits and vegetables **and** give an example of a pair of incompatible commodities for each type of potential incompatibility.

- 1) Temperature – any temperate *versus* chilling sensitive crop; or two chilling sensitive crops with different chilling threshold temperatures.
- 2) Humidity – onions or garlic *versus* almost anything else.
- 3) Ethylene – any ethylene producer *versus* non-ethylene producer; or ripe *versus* unripe climacteric fruit crop.
- 4) Odor – onions, garlic with most anything else.
- 5) Other gases (O₂, CO₂, SO₂, O₃, etc.) – two MA/CA incompatible crops; grapes fumigated with SO₂ *versus* any other crop; crops with different O₃ tolerances, etc.